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Evidence, Hypothesis, and Grue

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Abstract

Extant literature on Goodman's 'New Riddle of Induction' deals mainly with two versions. I shall consider both of them, starting from the ('epistemic') version of Goodman's classic of 1954. It turns out that it belongs to the realm of applications of inductive logic, and that it can be resolved by admitting only *significant* evidence (as I call it) for confirmations of hypotheses.

Section 1 prepares some ground for the argument. As much of it will depend on the notion of evidential significance, this concept will be defined and its introduction motivated. Further, I shall introduce and explain the distinction between support and confirmation: put in a slogan, 'confirmation is support by significant evidence'.

Section 2 deals with the Riddle itself. It will be shown that, given the provisions of section 1, not 'anything confirms anything': significant *green*-evidence confirms only *green*-hypotheses (and no grue-hypotheses), and significant *grue*-evidence confirms only *grue*-hypotheses (and no green-hypotheses), whichever terms we use for expressing these evidences or hypotheses.

Section 3 rounds off my treatment. First I will show that Frank Jackson's use of his counterfactual condition is unsuccessful. Further, I will argue that no unwanted consequences will result, if one starts from the other, 'objective', definition of 'grue', as it constitutes no more than a mere fact of logic that cannot do any harm. Finally, I present a grue-case involving both kinds of definition, where the exclusive confirmation of either the green- or the grue-hypothesis is shown.

Introducing his useful collection on Nelson Goodman's 'New Riddle of Induction', Douglas Stalker (1994, p. 2) remarks that "[t]here are now something like twenty different approaches to the problem, or kinds of solutions …", and that "[t]here hasn't even been complete agreement on what the problem really amounts to." One may add that there has not been any sufficient agreement either on what Goodman's infamous predicates 'grue' and 'bleen' really amount to,[1] and that approaches have probably multiplied since then, none of them leading to any agreed solution. Given the enormous amount of literature on the problem, it must seem unlikely that anything weighty could be added to the topic. Nevertheless, I think there is an aspect that may be of interest.

In a nutshell, my point will be that the difficulty posed by the 'New Riddle of Induction' (henceforth 'the Riddle') is neither one of the *logic of confirmation*, nor of *'ill-behaved' predicates*, but one of *application*,[2] in particular of *evidential significance,* as I call it. Accordingly, my discussion will not turn on details of some *logic* of confirmation[3] because my point applies to *any one* of them. They all deal in their own ways with the relation between evidence and hypothesis, but my primary interest will not focus on this relation itself but on the *evidence* related.

Extant literature deals mainly with two versions of the Riddle, based on different definitions of Goodman's predicates. I shall deal with both of them, starting from the ('epistemic') version of Goodman's classic of 1954. It turns out that it belongs to the realm of applications of inductive logic, and that it can be resolved by admitting only significant evidence for the confirmation of hypotheses.

My main argument, dealing with the first, epistemic, version of defining 'grue' and 'bleen', will run (in essence and not necessarily in this order) along the following line:

1. For terminological convenience, I distinguish '*support'*, understood as the *logic* of confirmation (defined on suitably chosen sets of propositions), from *'confirmation'*, which is support of some hypothesis *h* by '*significant*' evidence *e*. Thus, any proposition *h* will be called (logically) *supported* by any proposition *e* iff *h* and *e* are appropriately related as afforded by some presupposed support relation $s(h,e)$; a hypothesis *h* will be called *confirmed* by evidence *e* iff *h* is (logically) *supported* by *e* and *e* is (evidentially) significant.
2. By *'green-evidence'*, $\mathcal{E}_1$, I refer to a set of propositions, each stating that objects of some kind examined up to time *T* are green, and by *'grue-evidence'*, $\mathcal{E}_2$, to a set of propositions, each stating that objects of some kind examined up to time *T* are grue. Accordingly with *'green-hypothesis'*, h_1, as the general proposition that all objects of some kind are green; *'grue-hypothesis'*, h_2; and so on.

[1] See, for instance, Jackson (1975, p. 80ff), who distinguishes "Three ways of defining 'Grue'". For a recent exchange on what to take as the 'correct' or 'important' definition see Israel (2004) and Kowalenko (2012).

[2] This is Carnap's term; cp. his (1971) pp. 70-76, in particular section B.

[3] Goodman himself seems to have designed his Riddle chiefly in criticism of Hempelian, that is qualitative, instantial confirmation.

The *terms* used for expressing the respective propositions are merely a matter of definition and are, thus, not of any particular importance. For instance, we may as well express the green-hypothesis h_1 in terms of 'grue' and 'bleen', or the *grue-evidence* $\mathcal{E}_2$ in terms of 'green' and 'blue'.

3. *Evidential significance* of a proposition is determined by a counterfactual condition. This condition shows that $\mathcal{E}_1$ and $\mathcal{E}_2$ are mutually exclusive with respect to significance: at most one, but not both of them, can constitute *significant* evidence.
4. This entails that, even though $\mathcal{E}_1$ and $\mathcal{E}_2$ may respectively *support* h_1 and h_2 (in terms of the *logic* of confirmation), only one of the hypotheses, h_1 or h_2, can receive *confirmation*, depending on which evidence is accepted as significant. Thus, Goodman's claim to the effect that 'anything confirms anything' cannot be upheld.
5. There are examples for both, significant green-evidence confirming green-hypotheses, and significant grue-evidence confirming grue-hypotheses, but all such cases exclude confirmation of the respective other hypothesis due to the exclusiveness of evidential significance.

In *section 1* I shall prepare some ground for my argument. As much of it will depend on the notion of evidential significance, this concept will be defined and its introduction motivated. Further, I shall introduce and explain the distinction between support and confirmation: put in a slogan, 'confirmation is support by significant evidence'. Most of the tenets presented in this section might as well be discussed in abstract terms, but for later convenience I develop them as a discussion of the exposition given by Goodman himself before introducing the Riddle.

Section 2 deals with the Riddle itself. As already mentioned, it will be shown that, given the provisions of section 1, not 'anything confirms anything': significant *green*-evidence confirms only *green*-hypotheses (and no grue-hypotheses), and significant *grue*-evidence confirms only *grue*-hypotheses (and no green-hypotheses), whichever terms we use for expressing these evidences or hypotheses. As green- and grue-evidences exclude each other with respect to significance, only one of the hypotheses can receive confirmation. *Which* evidence we accept as significant is therefore of minor importance for my argument.

Section 3 rounds off my treatment of the Riddle. First I will show that Frank Jackson introduced in his account a counterfactual condition that is nearly identical with mine, but that he makes a different, in my view unsuccessful use of it.
Another point is that, as already mentioned, there are two different kinds of definition of Goodman's predicates, each of them prominently discussed in the literature. As I deal in the main part of my treatment just with the 'epistemic' one, I will show that no

unwanted consequences will result either, if one starts from the other, 'objective', definition. Taken by itself, it constitutes no more than a mere fact of pure logic and cannot do any harm. Finally, I present a grue-case involving both kinds of definition, where the role of evidential significance for the exclusive confirmation of either the green- or the grue-hypothesis is shown. Thus, as already argued in section 2, Goodman's Riddle is not a problem of the *logic* of confirmation (in my terms: of support), but one belonging to the theory of *evidence*.

1 *Preliminaries: evidence, support, and confirmation*

A good share of the trouble with the Riddle (and with the diversity of accounts of it) is due to Goodman's own formulations.[4] Difficulties start already with the preparatory *exposition*, even before introducing the Riddle itself:

> "Suppose that all emeralds examined before a certain time *t* are green. At time *t*, then, our observations support the hypothesis that all emeralds are green ... Our evidence statements assert that emerald *a* is green, that emerald *b* is green, and so on; and each confirms the general hypothesis that all emeralds are green." (Goodman (1954), p. 73-74.)

As a first point we note that the statement "… that all emeralds examined before a certain time *t* are green …" does not exclude that the emeralds *are* examined before *t* and that they *are* green, without anyone even noticing *that* they are green (they might as well have been examined for their taste). Thus, the mere (objective) facts *that* the emeralds have been examined and *that* they are green wouldn't amount to *evidence* that they are green. The very point of explicitly *mentioning* that they have been examined is here obviously meant to indicate that being examined and being green must be related in some way, namely, that the greenness of the emeralds has been found out by examining them *with respect to* their color (and not, say, with respect to their taste or inflammability).[5] We can secure this connection by calling the *acceptance* of an

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[4] One may read and re-read the whole book, or spend hours pondering over just the famous two paragraphs in Goodman's (1954, pp. 73-75) without coming to a conclusion on what *exactly* Goodman is defining and/or presupposing there in order to arrive finally at his "intolerable result that anything confirms anything" (p. 75).

[5] In a previous version I explained this by distinguishing two kinds of *uses* we make of terms like 'examined', 'observed', and the like: in 'predicating use' we ascribe some individual the property of being examined just like any other property, say, being round. In 'evidence-assuring use' we express by

evidential proposition *e* '*experientially based*', if it was gained from examination *with respect to a particular property*, by defining:

EB The *acceptance* of an evidential proposition *e* that some examined object a_i has the property *P* (respectively lacks the property *P*) is *experientially based* iff a_i has been examined *with respect to P* and, on account of this, has been attributed (respectively denied) the property *P*.

To be experientially based in this sense does, of course, not exclude fallibility of our examinations.

That something like this is what Goodman *intends* (though he doesn't say so), seems plausible from the rest of the quoted exposition.

Another point is that from "… each confirms the general hypothesis that all emeralds are green …", we learn that Goodman takes the evidence *statements*,[6] not the observations themselves (as stated one sentence before), to confirm the hypothesis.

Already these two points indicate that it may be worthwhile to rephrase Goodman's exposition somewhat less ambiguously.

We presuppose the predicates ***emerald*** [*E*] and ***green*** [*G*] as unproblematic. For later use we introduce also the predicate ***blue*** [*B*], and, in particular, that green and blue (both of them *'all over'* at the same time) exclude each other, i.e., $\neg\exists x(Gx \wedge Bx)$.

The *'green-hypothesis'* h_1 to be confirmed here is that "… all emeralds are green":

$$h_1 : \quad \forall x(Ex \rightarrow Gx).$$

Furthermore, we define

$\boldsymbol{D_1}$ $O_T x =_{df}$ *x has been examined before T*,[7]

them the *credentials* for *why* we attribute some other property *P* to an individual *a*: "Individual *a* has been *examined with respect to* property *P* (and found to be so) – that's why I accept that *Pa*." Furthermore, I would insist that an *unnoticed* matter of fact that *Pa* doesn't constitute *evidence* that *Pa*.

6 I'd rather prefer the evidential *propositions* expressed by the evidence statements, but it is also fine this way. Throughout this paper we shall take a *sentence* as expressing a *proposition*, and a *statement* as a proposition *asserted* by means of a sentence. Having declared that much, we may follow a liberal policy in our formulations as long as we keep in mind their interpretation in this sense.

7 The predicate letter *E* is reserved for 'being an emerald', so we may read Goodman's 'examined' and my 'observed' (thus '*O*'), or any other terms of this family like 'inspected', 'sampled', and so on, as synonymous and use them interchangeably in the text.

where the index T indicates the time-point at which h_1 is to be assessed (or a prediction to be made) on the basis of the evidence gained so far, that is, up to T. (Another time-index will be discussed below, in *3.2*.)

Having found the emeralds $Ea_1,\dots,Ea_n$ examined before T to be *green*, we gain evidence statements $e_1: Ea_1 \wedge Ga_1,\dots, e_n: Ea_n \wedge Ga_n$, and as "... *all* emeralds examined before T are green", we may summarize this as *'green-evidence'* $\mathcal{E}_1$,

$$\mathcal{E}_1: \quad \forall x((Ex \wedge O_T x) \rightarrow Gx))$$

or, equivalently,

$$\mathcal{E}_1': \quad \forall x(Ex \rightarrow (O_T x \rightarrow Gx)).$$

This latter form indicates how the evidence is supposed to support h_1: Transforming h_1 into its equivalent,

$$h_1': \quad \forall x(Ex \rightarrow ((O_T x \rightarrow Gx) \wedge (\neg O_T x \rightarrow Gx))),$$

makes obvious that the evidence $\mathcal{E}_1$, referring exclusively to emeralds *examined* up to T, is supposed to confirm the hypothesis h_1 which refers to *all* emeralds, *whether examined or not*.[8]

Plausible as this seems to be, there is a catch:

On the one hand, we have found out *by examination* of an emerald Ea_i that it *is green*; therefore we may not only be justified to accept as evidence that it is green, Ga_i, we must also accept that it is examined, $O_T a_i$, and, thus, accept $O_T a_i \wedge Ga_i$. On the other hand, what we mean by accepting *that* Ga_i, is certainly not that the emerald were merely green *as far as it is examined*, or *just in case it is examined*. The latter would even entail that the emerald would *not* be green if it were not examined, *contrary to our evidential claim* that it is *objectively* green, that is, *green whether examined or not*.

The catch lies in this: we have *gained* our evidence that the individual Ea_i is green *by examining* it. What we *accept* as evidence is, that Ea_i is green *whether examined or not*. But to put this as $(O_T a_i \rightarrow Ga_i) \wedge (\neg O_T a_i \rightarrow Ga_i)$ would be of no use because, as a matter of

'*O*' may be read here in either the 'predicating' or the 'evidence-assuring' sense (see note 5); eventual exclusive involvement of the 'evidence-assuring' sense is secured via *acceptance*-conditions (see above, definition ***EB***).

[8] I presuppose here and in the following that if some evidence $\mathcal{E}$ supports a hypothesis h, then $\mathcal{E}$ supports any h' that is logically equivalent to h.

fact, our emerald *has been* examined, and this leaves the second conjunct merely *vacuously* true. Thus, from $O_T a_i$ and $O_T a_i \rightarrow G a_i$ we are back at $G a_i$ and, therefore, at $O_T a_i \wedge G a_i$. But this, as just explained, fails to secure what we accept as our evidence, namely, that our observed emerald is *objectively* green (i.e., once more, that it is green *whether examined or not*, irrespectively of our having *gained* this as evidence from examination).

1.1 Evidential significance

But the catch can be defused. In order to express the *full* content of what we accept as evidence (and, by this, make the claim of objectivity explicit), we must use a *counterfactual condition*: for any one of our examined green emeralds $E a_i$ we must accept (*in addition* to accepting that it is examined and green) that it *would* also be green if, *counterfactually, it had not been examined*, i.e., $\neg O_T a_i \Box\!\!\rightarrow G a_i$.[9] And this, I suppose, is in accordance with how most people would take it: "I can *see* [I have *observed*] this emerald to be green, so, of course it *would be* green as well if I *would not* see it [if I had not observed it]."

To *deny* this counterfactual of an examined and (found to be) green emerald would come to claiming that it were merely green *just in case* it were examined, contrary to our evidential claim of it being *objectively* green.

Let us then call this counterfactual the *objectifying condition of an evidential proposition e*. As this should not be restricted to propositions involving 'basic', or 'primitive', or (possibly) 'observational' predicates, we can define it more generally:

OC Let '$O_T x$' be defined as above, let any predicate P be called '*primitive*'[10] iff no proposition expressed by any state-description formed of O_T and P is self-contradictory (i.e., P and O_T are *conceptually independent* of each other), and let any predicate D be called '*dependent*' iff $Dx \equiv ((O_T x \rightarrow Px) \wedge (\neg O_T x \rightarrow Qx))$ [where P and Q are primitive and mutually exclusive]; then for any evidential proposition e:

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9 In order to remain neutral vis-à-vis extant theories of counterfactual conditionals, I shall write *'If counterfactually* α*, then* β*' as* '$\alpha \Box\!\!\rightarrow \beta$'; any such formula may then be read according to the respective theory.

10 As defined here, the term 'primitive' need not be restricted to an *observational* language in Carnap's sense. Cp. Carnap (1971), p. 70.

(i) if e states of some individual a_i that $O_T a_i \wedge P a_i$ [where P is primitive], then its *objectifying condition* is that $\neg O_T a_i \Box\!\!\rightarrow P a_i$; and

(ii) if e states of some individual a_i that $O_T a_i \wedge D a_i$ [where D is dependent as above], then its *objectifying condition* is that $\neg O_T a_i \Box\!\!\rightarrow Q a_i$.

By conjoining the evidential propositions of our green-evidence $\mathcal{E}_1$ with their objectifying conditions, and understanding 'green' to be primitive, we arrive at a *complete* statement of what must be accepted as '*evidentially significant*' (to be defined promptly):

$\mathcal{E}_1$*: $\forall x((Ex \wedge O_T x) \rightarrow (Gx \wedge (\neg O_T x \Box\!\!\rightarrow Gx)))$.

Comparing this with h_1' indicates even better than before how a proposition becomes evidentially significant for the confirmation of a hypothesis: the *counterfactual* content provided by the objectifying condition (that an observed emerald *would* also be green, if, counterfactually, it were an unobserved one) 'accords', as it were, with that *indicative* content of the hypothesis that reaches beyond the evidence: that any unobserved emerald *is* green as well.

For completion, we integrate the defined concept of an objectifying condition into the following *principle of evidential significance*:

PES Given any evidential proposition e, stating of some individual a_i that $Oa_i \wedge Ua_i$ [where U may be primitive or dependent], then e is *evidentially significant* just in case

(i) e and its *objectifying condition* are both *accepted* as true;

(ii) the acceptance of e is *experientially based*. (Cp. definition ***EB***)

If a proposition e is evidentially significant in this sense, then we may also use formulations like 'e is significant evidence', or similar ones. We might as well take 'e*' as the conjunction of e and its objectifying condition and rephrase condition *(i)* by 'e* is accepted as true'.

Both conditions introduced for evidential significance demand *acceptance* as true and not just truth. The reason is that not any singular proposition *taken by itself* constitutes *evidence*, even if it happens to be (objectively) true. By requiring that an evidential proposition including its objectifying condition must at least be *accepted as* (taken for, believed to be) true, we bring in that *minimum of epistemic import* that must be required for evidence. An account of confirmation without *any* such import reduces to the purely logical questions of support.[11] But the requirement can be kept minimal for our present purpose. If one demands more of evidence than acceptance, for instance, to be *known*, or to be believed (accepted) *with justification*, then such demands would entail this weaker requirement anyway. Note also that conditions *(i)* and *(ii)* do not even demand of an evidential proposition e_i to *be* true, but merely to be *accepted as* true.[12] Furthermore, acceptance need not entail acceptance with *certainty*, but may also allow of eventual degrees of assent.

How we come to accept evidential propositions as true is, arguably, a subject of empirical science (in essence of psychology and physiology). *Whether* such acceptance is *justified*, is a standard topic of epistemology and need not be discussed here either.

Finally, condition *(ii)* needs not much arguing: it asks merely for evidence being experientially based as defined above, such that convictions out of whim or caprice, or on no grounds at all, are not admitted as significant.[13] (But, of course, we may *feign* experiential basing and significance in discussions of fictional examples.)

Although conditions *(i)* and *(ii)* impose weak (I think, trivial) conditions on a proposition for representing significant evidence, they lead to a strong consequence: for evidential significance, a proposition must in a relevant sense *reach beyond* a merely 'experiential' claim. Let an examination of some object a_i lead to the judgment that it is P; then accepting the resulting proposition 'Pa_i' (if made *evidentially significant* by Pa_i*) means *more* than merely accepting 'a_i is or has been *experienced as P*'. Rather, the *acceptance* of such an evidential proposition entails the acceptance that it is an *objective* truth that Pa_i. There is, thus, a 'leap' (from *experiencing* an object *as P* to *acceptance* of the object *being*

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11 For the distinction between confirmation and support see below, section *1.2*.

12 For the present purpose this requirement is kept as weak as possible, even though my personal preference would be to have *justified belief* of a proposition e_i for its evidential significance. Of course, what we *want to have* is truth, but (arguably) all we *can certify for ourselves to have* is justified belief of truth. If, in addition, e_i happens to be true so much the better. In any case, my weak postulates are compatible with, and could easily be strengthened to, such extremes like Williamson's "E = K" (see his 2000, p. 185). For a discussion of this see for instance Littlejohn (2011) and the literature referred there.

13 Condition *(ii)* should not (yet) be understood as a requirement of justification. Rather, I propose it as a raw version of some weak principle of empiricism which, I guess, might also be acceptable for non-empiricists who wish in *some* way to 'anchor' evidential credentials in experience. A suitable modification of condition *(ii)* may as well extend to a kind of 'indirect' or 'inferential anchoring', but the present version will suffice for concerns of this paper.

P) which affords the 'objectifying' hypothetical component (as defined by ***OC***): although we *base* our acceptance that Pa_i on experiential procedures like observation, the acceptance of it *as an objective* truth affords also the acceptance of the according counterfactual, as argued above. *How* this leap from (personal) experience to acceptance as an (objective) truth may be justified, or whether it needs any justification at all, is, though an important topic of its own, not our present concern.

All this may as well be put (somewhat paradoxically) as follows: at least significant evidence statements are *hypothetical* insofar, as their *full* content (viz. their counterfactual aspect) 'transcends' any merely experiential content, although (arguably) they stem from no more than from experience. But they are *treated* as objective truths in virtue of the credentials they receive from how they are acquired.

The point of the discussion so far is that only significant evidence can be admissible as confirming evidence. My own words added, this should sufficiently specify the first part of Goodman's claim (as quoted above) that "… our evidence statements assert [the evidentially significant propositions] … that emerald *a* is [objectively] green, that emerald *b* is [objectively] green, and so on …".

The ensuing half-sentence of the exposition, that "… each confirms the general hypothesis that all emeralds are green" affords a few further remarks.

1.2 Support and confirmation

By using the terms '*support*' and '*confirmation*' in different senses, I want to accentuate terminologically the following distinction: '*support*' is meant to refer to the *logic* of confirmation, while '*confirmation*' refers to the support that a hypothesis *h* receives from *significant* evidence *e*. This is akin to Carnap's distinction of *logical* from *methodological* problems (Carnap (1962), in particular § 43, sect. B, and § 44), or of *pure* from *applied* inductive logic (Carnap (1971), sect. 4, pp. 69-76). But I draw a slightly different dividing line, and, foremost, I generalize the distinction as mandatory for *any* theory or version of confirmation.

We can represent *support* schematically by '$s(p,q)$' for any qualitative, or by '$s(p,q)=r$' for any quantitative functions that are appropriately defined on (sets of) propositions *p* and *q*. Then, what support (and, thus, *a logic* of confirmation) amounts to, is a matter of how such a function is defined. A statement of support with arguments *p* and *q* assigned is then, given the respective definition, *analytic*. This is what a logic should amount to: it declares for *any* chosen arguments *p* and *q* whether or not *q* (logically) supports *p*, respectively determines a degree *r* of support. In other words, support, as the logic of confirmation, must be *generally* defined for any (sets of) propositions expressible by means of the respectively preconceived language.

But not any singular proposition *q* is evidential, let alone significant (and not any proposition *p* is a hypothesis). So, for *applying* a support function (whichever one thinks to be adequate) to real or fictional cases of projection, we must reduce the domain of the second argument place of the support function to *significant evidence* (and the first to hypotheses) in order to gain according statements of *confirmation*: a hypothesis *h* is then *confirmed*, respectively *confirmed with degree r*, by evidence *e*, iff *e is significant evidence* and *s(h,e)*, respectively *s(h,e)=r*.

Some (indeed, many) authors use the terms 'support' and 'confirmation' more or less synonymously, possibly because they deem a detailed discussion of the epistemic import of evidence not to be essential in this connection.[14] But most, if not all, confirmation theorists *presuppose* (as a matter of course, but more or less silently) some such distinction of *logical* questions of confirmation (my 'support') from questions of the *application* of these logical relations (my 'confirmation'). But then this distinction tends often to get ignored in general discussions of confirmation theory (maybe just *because* it is trivial).

Goodman is obviously aware of the distinction, and remarks in a footnote

> "… if we have determined that statements E, E', etc. stand to hypothesis H in the relationship specified by an adequate definition of confirmation, still the question whether H is a confirmed hypothesis will depend on whether E, E' etc. are actually evidence statements." (Goodman (1954), p. 89).

This is exactly the point of my terminological distinction: Goodman's "relationship specified by an adequate definition of confirmation" refers to the *logical* relation that I call *support* in order to keep it more clearly apart from confirmation. Then the question

[14] Hempel's *main focus* was certainly on the *logic* of confirmation (thus, the title of his (1945)), but he was of course aware of the distinction, cp. Hempel (1965), sect. 6. Other authors, who draw distinctions similar to my proposal, use the terms differently. Fitelson (2008, p. 617f), for instance, has the terms nearly exactly converse to the present proposal: his 'confirmation', as a '*logical*' relation, is my 'support', and his 'evidential support', as an '*epistemic*' relation, is my 'confirmation'.

whether some proposition *h* can be counted as a *confirmed* hypothesis depends indeed on "whether E, E' etc. are actually evidence statements". All I would add to this is that, in order to be 'actual' evidence statements, they must be significant.

Returning now to the last half-sentence of the exposition quoted above that "… each [evidence statement] confirms the general hypothesis that all emeralds are green", my point can be illustrated by utilizing a version of the Nicod condition:[15]

We define 'Nicod-support', $s_N(h,e)$, as:

$Supp_N$ For any predicates *P* and *Q*, and any proposition *h*, stating that $\forall x(Px \rightarrow Qx)$,
h is *N-supported* by any proposition *e* stating that $Pa \wedge Qa$, and
h is *N-countersupported* by any proposition *e* stating that $Pa \wedge \neg Qa$.

Then we say:

$Conf_N$ For any hypothesis *h*
(i) *h* is *N-confirmed* just in case *h* is N-supported by evidence *e*, and *e* is evidentially significant;
(ii) *h* is *N-disconfirmed* just in case *h* is N-countersupported by evidence *e*, and *e* is evidentially significant.

If there is no evidentially significant evidence, then the confirmation of *h* is undetermined (though there may exist *N*-supporting or *N*-countersupporting propositions). But in our case of green emeralds we find that $\mathcal{E}_1$ *N-supports* h_1, and, if we accept $\mathcal{E}_1$* such that $\mathcal{E}_1$ is evidentially significant, we conclude that $\mathcal{E}_1$ *N-confirms* h_1.

Now we are prepared to consider the Riddle.

2 *The Riddle and an answer*

Goodman defines:

> "... the predicate 'grue' … applies to all things examined before *t* just in case they are green but to other things just in case they are blue". (Goodman (1954), p. 74.)

and

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15 This is really but an example, and I take it because it is suggestive for illustrating my more general point. Although Nicod himself seems to have intended a *probabilistic* criterion, Hempel's *qualitative* theory of confirmation pursued among others an improved and more guarded version of Nicod's basic idea. Cp. Hempel (1945), sect. 3, and the painstaking analysis in Fittelson (2008).
As the net effect of my proposal is to restrict admissibility (of propositions into the respective argument places in applications of inductive logic) to significant evidence for *any* support functions, an analogous procedure should also work with quantitative support and/or confirmation, for instance Carnap-style or Bayesian probabilistic confirmation.

> "... the predicate 'bleen' ... applies to ... [all things] ... examined before time *t* just in case they are blue and to other ... [things] ... just in case they are green." (Goodman (1954), p. 79.)

By means of ***D₁***, we formalize this as ***grue*** [*GR*] and ***bleen*** [*BL*]:

D₂ $GRx \equiv ((O_Tx \rightarrow Gx) \wedge (\neg O_Tx \rightarrow Bx))$,[16]

D₃ $BLx \equiv ((O_Tx \rightarrow Bx) \wedge (\neg O_Tx \rightarrow Gx))$.

And here, then, is the famous Riddle:

> "… at time *t* we have, for each evidence statement asserting that a given emerald is green, *a parallel evidence statement* asserting that that emerald is grue. And the statements that emerald *a* is grue, that emerald *b* is grue, and so on, will each confirm the general hypothesis that all emeralds are grue. Thus ... the prediction that all emeralds subsequently examined will be green and the prediction that all will be grue *are alike confirmed by evidence statements describing the same observations*. But if an emerald subsequently examined is grue, it is blue and hence not green. ... [I]t is clear that if we simply choose an appropriate predicate, then *on the basis of these same observations* we shall have equal confirmation, by our definition, for any predicate whatever about other emeralds - or indeed about anything else. ... We are left ... with the intolerable result that anything confirms anything." (Goodman (1954), p. 74f; my emphases.)

Given definitions ***D₁*** to ***D₃***, one may well call the statements about the grue emeralds *"parallel"* to the statements about the green ones. But I submit that these statements *don't express the same significant evidence* as based on "the same observations". Which one of them (or of any further ones) is significant, remains a contingent matter depending on *which evidence* we happen to establish by observation.

In response to Carnap's repeated objection (already in his (1947), but most detailed in Carnap (1971), pp. 70-76) that 'green' and 'blue' were 'qualitative' (thus admissible as primitive attributes), while 'grue' and 'bleen' were 'positional' (thus inadmissible as primitives), Goodman answered that this is merely a relative matter – we might as well define green and blue in terms of grue and bleen.[17]

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16 Presupposing that 'being green' and 'being blue' (both 'all over') exclude each other, that is, $\neg\exists x(Gx \wedge Bx)$, the following definitions of grue are equivalent: $((O_Tx \wedge Gx) \vee (\neg O_Tx \wedge Bx))$; $((O_Tx \leftrightarrow Gx) \wedge (\neg O_Tx \leftrightarrow Bx))$; $((O_Tx \rightarrow Gx) \wedge (\neg O_Tx \rightarrow Bx))$; *mutatis mutandis*, the same with bleen.

17 "True enough, if we start with 'blue' and 'green', then 'grue' and 'bleen' will be explained in terms of 'blue' and 'green' and a temporal term. But equally truly, if we start with 'grue' and 'bleen', then 'blue'

So, let us accept this relativity of primitive terms and see what we get after according transformations. It may be ‘natural’ to take Gx and Bx as *primitive* in the sense of ***OC***, such that no proposition expressed by any of the state-descriptions $O_Ta \wedge Ga, \ldots, \neg O_Ta \wedge \neg Ga$; $O_Ta \wedge Ba, \ldots, \neg O_Ta \wedge \neg Ba$ is self-contradictory. In this case GRx and BLx, as defined by $\boldsymbol{D_2}$ and $\boldsymbol{D_3}$, would count as *dependent*. But we may as well have it the other way round by taking GRx and BLx as primitive, such that no proposition $O_Ta \wedge GRa, \ldots, \neg O_Ta \wedge \neg GRa$; $O_Ta \wedge BLa, \ldots, \neg O_Ta \wedge \neg BLa$ is self-contradictory, and define ***green*** [G] and ***blue*** [B] as *dependent* predicates:

$\boldsymbol{D_4}$ $\quad Gx \equiv ((O_Tx \rightarrow GRx) \wedge (\neg O_Tx \rightarrow BLx)),$

$\boldsymbol{D_5}$ $\quad Bx \equiv ((O_Tx \rightarrow BLx) \wedge (\neg O_Tx \rightarrow GRx)).$

As it seems not *logically* impossible that there are beings with the ability of ascertaining the properties referred to by ‘grue’ and ‘bleen’ (or that we ourselves might develop such an ability), we shall not exclude this as a possibility.

Our *green-hypothesis* h_1, $\forall x(Ex \rightarrow Gx)$, as expanded in the equivalent

$$h_1': \quad \forall x(Ex \rightarrow ((O_Tx \rightarrow Gx) \wedge (\neg O_Tx \rightarrow Gx))),$$

must then read in terms of GR/BL

$$h_1'': \quad \forall x(Ex \rightarrow ((O_Tx \rightarrow GRx) \wedge (\neg O_Tx \rightarrow BLx))).$$

Above, we have stated the full significant evidence needed for confirming h_1 as

$$\mathcal{E}_1^*: \quad \forall x((Ex \wedge O_Tx) \rightarrow (Gx \wedge (\neg O_Tx \Box\!\!\rightarrow Gx))),$$

which reads equivalently, now in terms of GR/BL,

$$\mathcal{E}_1^{*\prime}: \quad \forall x((Ex \wedge O_Tx) \rightarrow ((GRx \wedge (\neg O_Tx \Box\!\!\rightarrow BLx))).$$

Thus, by the same kind of reasoning as before, the green-hypothesis h_1, *whether stated in G/B or in GR/BL*, is confirmed by green-evidence $\mathcal{E}_1$, *whether stated in G/B or in GR/BL*: as $\mathcal{E}_1^{*\prime}$ is equivalent with $\mathcal{E}_1^*$, it confirms h_1'' iff $\mathcal{E}_1^*$ confirms h_1'.

On the other hand, “… the general hypothesis that all emeralds are grue …”, call this *grue-hypothesis* h_2, would be

and ‘green’ will be explained in terms of ‘grue’ and ‘bleen’ and a temporal term; *‘green’, for example, applies to emeralds examined before time t just in case they are grue, and to other emeralds just in case they are bleen*. Thus qualitativeness is an entirely relative matter and does not by itself establish any dichotomy of predicates.” Goodman (1954, p. 80f.), my emphases.

h_2: $\forall x(Ex \rightarrow GRx)$,

and, in expanded form,

h_2': $\forall x(Ex \rightarrow ((O_T x \rightarrow GRx) \wedge (\neg O_T x \rightarrow GRx)))$.

This reads in terms of *G/B*

h_2'': $\forall x(Ex \rightarrow ((O_T x \rightarrow Gx) \wedge (\neg O_T x \rightarrow Bx)))$.

But in order to confirm *this*, we would need significant evidence quite *different* from any version of $\mathcal{E}_1$, call it *grue-evidence* $\mathcal{E}_2$:

$\mathcal{E}_2$: $\forall x((Ex \wedge O_T x) \rightarrow GRx))$

which, conjoined with its objectifying condition, becomes

$\mathcal{E}_2$*: $\forall x((Ex \wedge O_T x) \rightarrow (GRx \wedge (\neg O_T x \square\!\!\rightarrow GRx)))$.

And this reads in terms of *G/B*

$\mathcal{E}_2$*': $\forall x((Ex \wedge O_T x) \rightarrow (Gx \wedge (\neg O_T x \square\!\!\rightarrow Bx)))$.

In short, the overall situation is not merely "parallel" but, indeed, perfectly *symmetric*, *depending on which evidence we accept as significant*: $\mathcal{E}_1$, if significant, confirms h_1 but doesn't confirm h_2 , and $\mathcal{E}_2$, if significant, confirms h_2 , but doesn't confirm h_1 . This, however, isn't surprising at all.

We must agree that, with respect to *any examined* item a_i, the proposition 'Emerald a_i is grue' (therefore $O_T a_i \wedge GRa_i$) must be true *by definition* if the proposition 'Emerald a_i is green' (therefore $O_T a_i \wedge Ga_i$) is true, and *vice versa*. But as their *objectifying conditions* are incompatible, only one of them can (as evidentially significant) serve for *confirmation*:

Either

the green resp. grue emerald a_i (having been observed up to *T*) is, if it - counterfactually - had not been observed, green: $Ea_i \wedge Ga_i \wedge (\neg O_T a_i \square\!\!\rightarrow Ga_i)$, that is bleen: $Ea_i \wedge GRa_i \wedge (\neg O_T a_i \square\!\!\rightarrow BLa_i)$, in which case the according evidence statement e_i belongs to $\mathcal{E}_1$ and confirms h_1,

or

the grue resp. green emerald a_i (having been observed up to *T*) is, if it - counterfactually - had not been observed, grue: $Ea_i \wedge GRa_i \wedge (\neg O_T a_i \square\!\!\rightarrow GRa_i)$, that is blue:

$Ea_i \wedge Ga_i \wedge (\neg O_T a_i \,\Box\!\!\rightarrow Ba_i)$, in which case the according evidence statement e_i belongs to $\mathcal{E}_2$ and confirms h_2.

Which one of $\mathcal{E}_1$ or $\mathcal{E}_2$ can legitimately be taken for significant evidence depends entirely on what is accepted as a result of examining the respective items. The counterfactual contents of $\mathcal{E}_1$ and $\mathcal{E}_2$ are incompatible, whichever terms we use for expressing them. Thus, on pain of inconsistency, accepting $\mathcal{E}_1$ as significant forbids accepting $\mathcal{E}_2$ as significant, and *vice versa*. Accordingly, only *one* of the hypotheses, either h_1 or h_2, will get confirmed. And so it is *not* the case that "… anything confirms anything."

In order to show what I have called the objectifying conditions of all significant evidence, it was necessary to resort to counterfactual conditionals. Goodman started off his classic (1954) with a treatment of counterfactual conditionals, passing on to dispositions, lawlikeness, confirmation, and finally to introducing his 'New Riddle' and his theory of projection. There may be a slight irony here in that now, so it seems, we have come full circle, back to counterfactuals.

3 *Other treatments of the Riddle, and the umpteenth Grue-example*

The primary purpose of this section is to round off the proposed argument by contrasting some aspects of it with other treatments of the Riddle. I acknowledge that all the mentioned (as well as many other) authors would deserve a much more detailed discussion. But this would exceed all limits for a paper.

3.1 Jackson's counterfactuals

Besides presenting a thorough discussion of various ways of defining grue and many interesting grue-like examples, Jackson (1975) offers an analysis of the Riddle by utilizing a surprisingly similar looking counterfactual condition. So, it will be interesting to enquire the differences between his and the present account.

His central idea is to contrast two cases of projections

> "… where certain *F*s being *G* supports … other *F*s being *G*, but certain *F*s which are *H* being *G* does not support other *F*s which are not *H* being *G*; in each case the reason being that *it is known* that the *F*s that form the evidence class *would not have been G if they had not been H*. The condition: that certain *F*s which are *H* being *G* does not support

> other *F*s which are not *H* being *G if they had not been H*, will be referred to as *the counterfactual condition*." (Jackson (1975), p. 88; my emphases except the last one.)

An advantage of this proposal is that Jackson can apply it on a multitude of examples, where predicates like 'observed up to *T*' (or 'sampled', 'examined', etc.) do not explicitly occur. For instance, evidence of diamonds (*F*) glinting in the light (*G*) may be projected to other diamonds glinting in the light. But if we add 'being polished' (*H*) to the evidence, then we can (should?) not project to other, possibly unpolished, diamonds glinting.

But this advantage is only a seeming one. For *applying* his counterfactual condition, Jackson must refer (as quoted) to "that it is *known*" which counterfactual is 'the true one' and which one is not. In the grue-case

> "… the counterfactual condition is that the emeralds $a_1,\ldots,a_n$ would still have been green even if they had not been examined; and, in the world *as we know it*, this condition is satisfied. … Precisely the opposite is the case with 'grue.' We *know* that an emerald that is grue and examined would *not* have been grue if it had not been examined; for if it is grue and examined, it is green and examined, and … if it had not been examined would still have been green; but then it would have been green and unexamined, and so, not grue. In other words, a green, examined emerald would have been a green, unexamined emerald if it had not been examined, and so $a_1,\ldots,a_n$ would not have been grue if they had not been examined. Therefore, to use the SR to yield the prediction that a_{n+1} is grue (and unexamined) is to violate the counterfactual condition. … If we bring in the fact that a_{n+1} is unexamined, we … must take note of the counterfactual condition. But if we take note of this condition, we do not get an inconsistency because - although $a_1,\ldots,a_n$ would still have been green if they had not been examined - they would not have been grue if they had not been examined." (Jackson (1975), p. 89; my emphases; 'SR' refers here to the 'Straight Rule'.)

As much as I agree (like presumably anybody else does) that in the present case the green-counterfactual is 'the true one', and not the grue-counterfactual, this is not really the problem. Jackson *uses* the counterfactual condition here quite correctly, but the question *why* it should be imposed is not answered by referring to that it is *known* to be true (in whichever sense of 'known'). Maybe, that we are right and know it – but why should this be of any relevance? He reduces the force of the counterfactual condition to cases where evidence of 'certain *F*s which are *H* being *G*' does or does not support hypotheses that 'other *F*s which are not *H* are *G*', and decides from case to case whether an according counterfactual condition (and which one) is known to be the true one.

My explanation, in contrast, is that *any* evidence, *including* cases where evidence of ‘certain *F*s being *G*’ supports hypotheses that ‘other *F*s are *G*’, must stand the counterfactuality-test (in my terms: must be significant) in order to be admissible for confirming a hypothesis. The counterfactual condition is, as explained above, an ‘objectifying’ condition that any singular proposition must meet in order to be admissible as evidence at all.

Nevertheless, even though I think that Jackson fails to explain the force of the counterfactual condition, I take his overall account as an encouraging sign to be on the right track with my own analysis.

3.2 Time-indexes and an alternative definition of ‘grue’

So far, the discussion of the Riddle presupposed definitions of grue and bleen involving the time-indexed predicate O_T, where the index (capital) T indicates the time-point at which a hypothesis is to be assessed on the basis of evidence gained ‘so far’ (up to T). Put this way, T refers always to a respective ‘now’, up to which the evidence referred to must already have been gained and accepted as a presupposition for venturing a prediction, or assessing a general hypothesis with respect to its confirmation. This has a distinctively *epistemic* sense: the evidence *gained* up to T must at least be *accepted* in order to receive evidential significance and, by this, become effective as *confirming* the respective hypothesis.

But the Riddle had also several (more or less clear) readings involving other time-indexes. A (clear) classic of the most prominent alternative reading is Skyrms (1966, chapter III), who defines: “A certain thing *X* is said to be *grue* at a certain time *t* if and only if: *X* is green at *t and t* is before the year [2060], *or X* is blue at *t and t* is during or after the year [2060]”.[18] So, let us analyze this version and see how to deal with that.

Let (lower case) t refer to any point of time where an object a_i has a certain property, say ‘G’. We put this as ‘$G_t a_i$’ for expressing the proposition that a_i is green at t. Furthermore, by fixing a reference point t^* (usually in the future), we can express propositions of an object a_i *being green at a time-point t before* t^* by ‘$G_{t<t^*} a_i$’, and *being green at a time-point*

[18] Skyrms (1966, p. 57); his ‘switching year’ 2000 is meanwhile outdated and had to be shifted to 2060. This kind of defining ‘grue’ has also become quite popular. Hacking (1994, p.221) identifies Barker and Achinstein (1960) as originators.

*t at or after t** by '$G_{t^*\leq t}a_i$'; likewise we deal with '*B*' for blue (and, again, demand mutual exclusiveness by $\neg\exists x(G_tx\wedge B_tx)$).

Then we can define Goodmanesque predicates as

D₆ $GR_tx \equiv G_{t<t^*}x \vee B_{t^*\leq t}x$,

and

D₇ $BL_tx \equiv B_{t<t^*}x \vee G_{t^*\leq t}x$

This version has no epistemic ties at all. A problem connected with it could then only be one of *support* and not of *confirmation* (in the sense of the distinction drawn above) and, consequently, concern exclusively the question of how certain propositions are logically related for support. Just for convenience we keep on using the letters *e*, ***E***, and *h*, but implicating by this nothing beyond that these letters stand for propositions (or sets of propositions) and, in particular, that they indicate no epistemic import at all.

The question is then, whether we can create any paradoxical results with respect to eventual support for incompatible propositions ('hypotheses') h_1 and h_2 from given ('evidential') propositions.

There are two basic cases of how one *might* argue for eventual 'riddles'. The first one, call it '*individual projection*', is that, if it is true of a particular individual a_i that $G_{t<t^*}a_i$, then, if it doesn't change its color at *t**, it must be also true that $G_{t^*\leq t}a_i$. However, *by definition* ***D₆*** it is then also true of a_i that $GR_{t<t^*}a_i$. Thus, if it doesn't change its color at *t**, it must also be true that $GR_{t^*\leq t}a_i$, hence $B_{t^*\leq t}a_i$. But $G_{t^*\leq t}a_i$ and $B_{t^*\leq t}a_i$ are incompatible, nor is it possible that a_i has and has not changed its color at *t**.

The mistake in this argument is two-fold. First, it takes advantage of an ambiguity in what 'changing colors'[19] amounts to, and, secondly, it mistakes (as it were) '*transfer of truth-value*' (via definitions of predicates) for '*transfer of support*'. In a sense, our individual a_i must *always* 'change its color'. If it is indeed the case (e_1) that $G_{t<t^*}a_i$ (hence $GR_{t<t^*}a_i$ by definition) and a_i doesn't change color, then this supports (h_1) that $G_{t^*\leq t}a_i$, *hence* $BL_{t^*\leq t}a_i$ *by definition*! On the other hand, if it is indeed the case (e_2) that $GR_{t<t^*}a_i$ (hence $G_{t<t^*}a_i$ by definition) and a_i doesn't change color, then this supports (h_2) that

[19] As usual, we presuppose here that 'grue' and 'bleen' are understood as ordinary color words like 'green' and 'blue'; cp. Skyrms (1966, p. 57) and the more detailed treatment in Jackson (1976, pp. 80-83).

$GR_{t^*\leq t}a_i$, *hence* $B_{t^*\leq t}a_i$ *by definition*! Thus, our individual will always 'change and not change its color': it *keeps* the color of what we take for the evidence supporting the hypothesis, and it *changes* the color in terms of the respectively presupposed definitions. But this conforms to all we can demand of any support function: *logic* must not tell us what to take for evidence, this is a matter of the *application* of logic, and we shall turn to this promptly. Before doing so, we have a look at the other case of a possible 'riddle', call it '*general projection*':

Let it be true for all a_i of $a_1,\dots,a_n$ emeralds that $G_{t<t^*}a_i$, such that we get for all the according ('evidential') propositions $e_i \in \mathcal{E}$ that $Ea_i \wedge G_{t<t^*}a_i$. This supports the ('predictive') proposition h_1 that $Ea_{n+1} \wedge G_{t^*\leq t}a_{n+1}$. However, by $\boldsymbol{D_6}$ it is also true of all a_i of $a_1,\dots,a_n$ that $GR_{t<t^*}a_i$, and this supports the ('predictive') proposition h_2 that $Ea_{n+1} \wedge GR_{t^*\leq t}a_{n+1}$, hence $Ea_{n+1} \wedge B_{t^*\leq t}a_{n+1}$. But $G_{t^*\leq t}a_{n+1}$ and $B_{t^*\leq t}a_{n+1}$ are incompatible. In short, if there are true ('evidential') propositions $e_1,\dots,e_n$ in terms of 'well-behaved' predicates like 'green' supporting a ('predictive') proposition h_1, then there are always equally true (indeed, indefinitely many sets of) Goodmanesque propositions $q_1,\dots,q_n$ supporting alternative propositions h_2 ($\dots,h_i,\dots$) such that any h_i, h_j of them are incompatible with h_1 and among each other.

After the discussion of individual projection above, we can easily detect the mistake here: it is, again, mistaking '*transfer of truth-value*' (via definitions of predicates) for '*transfer of support*':

If we take for all the a_i of evidence $\mathcal{E}_1$ that $Ea_i \wedge G_{t<t^*}a_i$ (hence $GR_{t<t^*}a_i$ by definition), then this supports the hypothesis (h_1) that $Ea_{n+1} \wedge G_{t^*\leq t}a_{n+1}$ (hence $Ea_{n+1} \wedge BL_{t^*\leq t}a_{n+1}$ by definition). But if we take for all the a_i of evidence $\mathcal{E}_2$ that $Ea_i \wedge GR_{t<t^*}a_i$ (hence $G_{t<t^*}a_i$ by definition), then this supports the hypothesis (h_2) that $Ea_{n+1} \wedge GR_{t^*\leq t}a_{n+1}$ (hence $Ea_{n+1} \wedge B_{t^*\leq t}a_{n+1}$ by definition). But *what* to accept as our evidence is not a matter of logic, it is a matter of the *application* of (inductive) logic, and we have dealt with that in section *2*.

Nevertheless, it will be useful to have a closer look at the example of an application given by Skyrms:

> "Imagine a tribe of people speaking a language that had 'grue' and 'bleen' as basic color words ... Suppose we describe a situation in our language – for example, [a] piece of glass being green before the year [2060] and remaining green afterward – in which we would say

> that there is no change of color. But if they *correctly describe the same situation* in their language, then, in their terms, there is a change." (Skyrms (1966), p. 58; my emphasis).

What could it possibly mean to "*correctly describe the same situation*"? I think that we, in our language $\mathcal{L}_1$, 'describe correctly the situation' that it is true of the piece of glass *a* that $G_{t<t^*}a \wedge G_{t^*\leq t}a$, while they, in their language $\mathcal{L}_2$, 'describe correctly the situation' that it is true of *a* that $GR_{t<t^*}a \wedge BL_{t^*\leq t}a$. If it is *the same situation*, the respective *sentences* must express *the same proposition*, though in different terms (which is to be expected of sentences of different languages expressing identical propositions). It's only hard to accept that there seems to be no conspicuous change expressed in $\mathcal{L}_1$ at the time-transition from $G_{t<t^*}a$ to $G_{t^*\leq t}a$, while there occurs to be a change expressed in $\mathcal{L}_2$ at the time-transition from $GR_{t<t^*}a$ to $BL_{t^*\leq t}a$.

But we know already that this need not be due to the involvement of two different languages. After all, we have learned of, *and understood*, this 'same situation' by extending our own language $\mathcal{L}_1$ into $\mathcal{L}'_1$ by adding just the two definitions for 'grue' and 'bleen' and leaving everything else unchanged. And we have already seen before, that the same thing can be done with $\mathcal{L}_2$ by extending it into $\mathcal{L}'_2$ via the definitions

D₈ $G_t x \equiv GR_{t<t^*}x \vee BL_{t^*\leq t}x$,

and

D₉ $B_t x \equiv BL_{t<t^*}x \vee GR_{t^*\leq t}x$.

As the only difference left between $\mathcal{L}'_1$ and $\mathcal{L}'_2$ is just that the one has 'green' and 'blue' as primitives, while the other one has 'grue' and 'bleen' (the respective other pairs of predicates added by definition), the result must be that we can express the 'same situation', that is *the identical propositions*, within *either* language in *either terms*. Indeed, $\mathcal{L}'_1$ and $\mathcal{L}'_2$ must now be *one-one* such that for any *sentence* $\mathbf{s}_1$ of one language expressing a certain *proposition p* with truth-value *V* there must exist a *sentence* $\mathbf{s}_2$ of the other language expressing *the same proposition p* with *the same truth-value V*, and, furthermore, the respective definitions provide, for any such sentence **s** of one language, a precise rule of transformation (or translation) preserving propositional content and truth-value of the respective counterpart sentence of the other language. What remains of all the difference is merely a matter of convenience whether to express some proposition in terms of *G/B* or of *GR/BL* (irrespective of whether in $\mathcal{L}'_1$ or in $\mathcal{L}'_2$).

So, what should we and Skyrms' tribe of people project at *T* [20] to be the case beyond *t**, given we both describe correctly the same situation, that is, *agree on the evidence and the respective counterfactual condition* (whether expressed in $\mathcal{L}'_1$ or $\mathcal{L}'_2$)? Well, we take our primitive *green* or our defined *grue*, they take their primitive *grue* or their defined *green* and we all will predict in full harmony that, after *t**, it will be *green* (in our primitive and their defined sense) or that it will be *bleen* (in our defined and their primitive sense).

But, even at the risk of boring readers, I must tell yet another grue-example for demonstrating how the 'epistemic' and the 'logical' sides of the Riddle interact.

3.3 The umpteenth Grue-example

> It happened in 2010 in a paint factory that, by some irreproducible mixture of blunder and coincidence, the production line for moss green got chemically polluted, such that the paint produced there (still seemingly beautiful moss) is bound to turn after a time-span of ten years (therefore in 2020) into sky blue rather rapidly (estimates are within one to three days). As it seems, they happened to create a new kind. (See Quine (1969) for this kind of treatment.) Because chemical tests need their time, the production line had already produced 10,000 gallons of the stuff before the quality manager could detect the problem and stop it. What should they do with the expensive waste? The sales manager had the brilliant idea to sell it as 'guaranteed grue paint'. As it happened, the campaign was a resounding success, and all the 'Grue' was sold within weeks. My neighbor thinks he was lucky to get a canister of it on the black market. (He paid a horrendous price, but did a nice job at varnishing his fence with it, though.) I think he was cheated, and that the stuff referred to on the canister as 'guaranteed Grue' is not really grue, but is just ordinary green paint that won't change into blue.

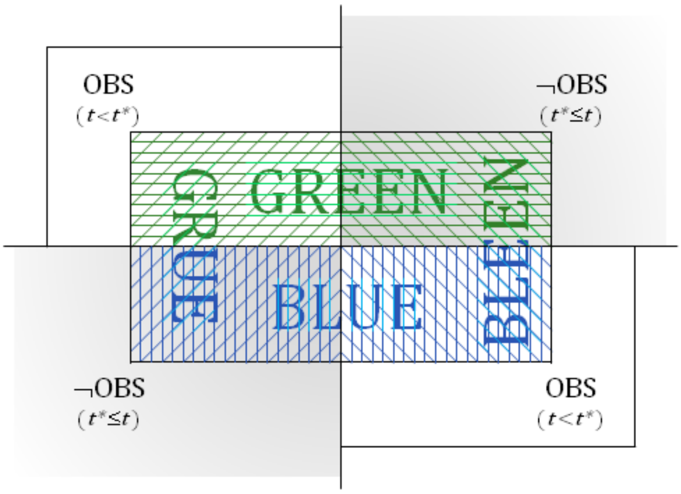
So, our opinions differ. But the difference is neither about *language*, nor about our *understanding* of 'the situation', and not even about the *logic* of confirmation, that is, how to *support* our diverging predictions from the evidence we take as premises: it is about the *evidence itself*. We both know that *if he is right* about the evidence and the stuff is grue, then *his* prediction will turn out right, and his fence will remain grue during and after 2020 (that is, it will change from green to blue); and *if I am right* about the evidence and the stuff is green, then *my* prediction will turn out right, and his fence will

[20] Remember that as soon as we project, we have a case of *application* and an according time *T* at which we venture our prediction.

remain green during and after 2020 (that is, it will change from grue to bleen). But we know already now that our disagreement is *about the evidence* (i.e., what we accept as the true property of the paint), and that we will find out who was right with that in 2020.[21]

4 Upshot

Put together, the logical situation can be visualized by this intuitive diagram:



By either definitions discussed here, the set of *green-or-blue* things is co-extensive with the set of *grue-or-bleen* things. However, the *observed* things of them (respectively all of them before *t**) are either green and grue [*G&GR*], or they are blue and bleen [*B&BL*], while the *unobserved* ones (respectively all of them from *t** on) are either green and bleen [*G&BL*], or they are blue and grue [*B&GR*]. Thus, for any projection from the observed ones (that is, from evidence), respectively from the ones before *t**, to unobserved ones, respectively to ones from *t** on, no (logical) support relation can provide the means for deciding *what* to project. If, for instance, we want to project from *G&GR* (that is, from *NW*), then we may choose either *G* for projection, leading eastward to *G&BL*, and therefore not-*GR*. Or we chose *GR* for projection, leading southward to *GR&B*, and therefore not-*G*. No *logical* condition of support can tell which projection to

[21] Let $2010 < T = t < t^* = 2020$, when we review our evidences at *T* in order to project our hypotheses. Then *my* significant evidence that the paint is green, *and would be green* if not inspected, supports the hypothesis that it is green at any other time $t \lessgtr t^*$. My *neighbor's* significant evidence that the paint is grue, *and would be grue* if not inspected, supports the hypothesis that it is grue at any other time $t \lessgtr t^*$. Thus, our diverging predictions depend entirely on the divergence of what we respectively accept as significant evidence.

prefer over the other. What *can* decide between these two options and provide preference for one of them, is what we accept as evidentially significant.

There are still many problems left open for research in the *logic* of confirmation, whether qualitative or metric. But Goodman's Riddle does not belong to them. It is a problem of evidence.

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