



Introduction: difference-making and explanatory relevance

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Accepted: 18 August 2024 / Published online: 30 August 2024
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Abstract

We introduce the overall topic of the S.I. Difference-Making and Explanatory Relevance and provide brief summaries of the twelve contributed articles.

Keywords Difference-making · Explanation · Relevance · Grounding · Causation · Logic · Metaphysics

The central question for any theory of explanation can be put in terms of relevance. What makes bits of information relevant to explaining why something is the case? Classical accounts of explanation (in terms of nomic expectability, causation, or certain statistical patterns) have frequently been criticized for not properly answering this question. In recent approaches to the question, philosophers have turned to the idea of making a difference. Causes, for instance, that make a difference to the occurrence of an event are relevant to explaining why that event occurred. This idea is present both in counterfactual accounts of explanation that have been advanced by Woodward (2003) and others as well as alternative approaches such as the one by Strevens (2008).

But the notion of difference-making has also been studied independently. In a variety of recent debates philosophers have found it useful to appeal to a notion of difference-making. Metaphysicians have appealed to difference-making in analysing aspects of relations such as causation and grounding. And the notion of difference-making has been prominent in debates about free will and responsibility.

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Finally, logicians have recently attempted to provide various formal models of difference-making.

Thus far, however, there has been little interaction between these different debates. This special issue aims to bring together recent approaches to difference-making from several different angles in relation to a variety of hotly debated topics. In this introductory paper, we provide a brief overview of the papers' contents. We have decided to sort the papers into three categories. We start with two papers that focus on explanation and explanatory relevance. After this we turn to six papers that utilize notions of difference-making in the metaphysics of causation and grounding. The final four papers are concerned with logical approaches to difference-making.

1 Explanation

1.1 J. Hunt, 'Expressivism about explanatory relevance'

Accounts of explanatory relevance aim to determine which parts of, e.g., the causal history or the grounding structure of a given fact are relevant to explain why that fact obtains. They thus answer the question of 'what's required for a cause, law, or other fact to be a reason why an event occurs' (Hunt, 2022: 1).¹ In his paper, Josh Hunt rejects descriptivist accounts of explanatory relevance which answer the aforementioned question in terms of descriptive claims about causation, grounding, or other explanatory relations. Hunt's main motivation to explore an alternative to descriptivism is that, among the vast variety of descriptivist accounts that have been proposed in the literature, scientific practice alone does not seem to favour any particular account. The alternative account that Hunt develops is expressivist. Following Gibbard's (1990) influential work on expressivism in the moral domain, he construes claims about explanatory relevance as expressing the acceptance or rejection of particular sets of norms. These norms include norms about the appropriateness of relevance-relations (e.g. causation) and their satisfaction conditions (e.g. conditions for an event causing another). Take for instance, S's claim that the occurrence of a storm is explained by a collision of a high pressure area with a low pressure area. This claim would be construed as a claim to the effect that answering the question of why the storm occurred by citing a high pressure area's collision with a low pressure area is permitted by a system of norms n accepted by S. In this case, n will include a norm to the effect that citing causes is appropriate to answer the explanatory request under discussion, and a norm to the effect that the aforementioned collision is indeed an appropriate cause of the explanandum event.

A familiar objection to expressivism in the moral domain is that it cannot account for the objectivity of moral judgements. An analogous worry might also arise in the case of expressivism about explanatory relevance. Hunt maintains, however, that his

¹ Page numbers in references to contributions to the present collection are based on the initial online publication of the article in question. Unfortunately, at the time of writing the introduction, the pagination for the articles as appearing in the collection is not available to us.

account is compatible with statements about explanatory relevance being objective in a robust sense of the term. In order to show this, he uses strategies that have been used to establish analogous claims about expressivist accounts of moral judgements. For instance, adopting a deflationary account of truth allows us to retain our practice of applying the truth predicate to claims about explanatory relevance and explanation in general without committing to such claims expressing descriptive facts. Further, Hunt suggests—again following Gibbard’s work in the moral domain—that claims about the subject-independence of explanatory relevance can be construed as claims about meta-norms regarding the acceptability of systems of norms. Finally, Hunt suggests that rational disagreements about relevance relations can be construed as disagreements about whether it is epistemically possible that a given system of norms can be improved relative to certain non-explanatory goals of scientific practice such as prediction and control.

1.2 N. Emerson, ‘Plumbing metaphysical explanatory depth’

It is a familiar phenomenon that the same explanandum can be explained in a variety of different ways, some of which are *deeper* than others. According to a very influential view in the debate on causal explanation, explanatory depth can be measured in interventionist terms, in particular in terms of *invariance under possible interventions* [cf. (Woodward & Hitchcock, 2003)]. The general idea is that different generalizations that are involved in causal explanations remain true under different ranges of possible interventions. For instance, generalizations from Newtonian physics that are used to explain the movements of some body are invariant under fewer possible interventions on that body than generalizations from relativistic physics. The Newtonian generalization will not hold under possible interventions that drastically increase the speed or the size of the body. Accordingly, explanations involving relativistic generalizations are *deeper*.

In his paper, Nicholas Emmerson argues that this account of explanatory depth can also be used to measure the depth of metaphysical explanations. He illustrates this thesis with an example from the explanation of identity and distinctness facts: a metaphysical explanation of the distinctness of two objects in terms of their qualitative properties is less deep, Emmerson argues, than one which explains the distinctness in terms of the relevant objects being weakly discernible (i.e. standing in at least one irreflexive relation). The objects will continue to remain weakly discernible even if they become qualitatively indiscernible due to certain interventions, e.g. interventions that place them in the scenario that has famously been described by Max Black (1952). Hence, the explanation in terms of weak discernibility remains invariant under more interventions than the explanation in terms of qualitative indiscernibility. Emmerson concludes his paper by applying his account to the metaphysics of explanation. Call an explanation that explains why some explanans *E* explains an explanandum *E'* a *meta explanation*. Emmerson now uses his criterion of explanatory depth to compare three accounts of meta explanation. He argues that the interventionist theory of explanation provides the deepest meta explanations

when compared to an inferentialist (broadly Hempelian) theory of explanation and a conserved quantity theory of explanation.

2 Metaphysics

The second part of this special issue comprises four papers that investigate relevance and difference-making in the context of the metaphysics of causation and grounding, including more specific applications, for example, in the normative domain.

2.1 V. Hoffmann-Kolss, 'Bread prices and sea levels: Why probabilistic causal models need to be monotonic'

In the recent debate about explanation and causation, a variety of philosophers have employed techniques from the literature on causal modelling and Bayesian networks. While this framework has proven enormously successful in economics and computer science, it still gives rise to genuine philosophical problems. A central problem concerns the question of how causal relevance relations can be extracted from probabilistic information encoded in a given causal model. For the purposes of this introduction, we can think of a causal model as composed of a directed acyclic graph, a set of variables that occupy the nodes of this graph, and a probability distribution over those variables. In the causal modelling literature, three conditions are commonly advanced as necessary for a model to represent genuine causal relations (as opposed to non-causal probabilistic correlations) [see (Spirtes et al., 2000)]. The first condition is the *causal Markov condition*. This condition says (roughly) that, conditional on their parents, variables in a causal model are probabilistically independent of their non-descendants. The second condition is the *faithfulness condition* which says that variables in the model are conditionally independent if and only if their independence is entailed by the causal Markov condition applied to the model. The third condition is the *causal sufficiency condition*, which says that each direct common cause of events that are represented by variables in the model must also be represented by a variable in the model. This condition is introduced to rid causal models of non-causal probabilistic dependencies such as that between having yellow fingertips and having lung-cancer. The intuitive idea behind it is that, even if a causal model satisfies the causal Markov and the faithfulness condition, there may still be probabilistic dependencies between variables in the model that are due to common causes which are not represented by the model's variables (in our example: smoking). The causal sufficiency condition is supposed to rule out such cases.

Hoffmann-Kolss argues, however, that non-causal probabilistic dependencies between variables in a model which satisfies the causal Markov and the faithfulness condition need not be the result of there being 'hidden' common causes. As the title of her paper suggests, the correlation between bread prices in England and the sea level in Venice is a case in point. Since the probabilistic dependencies between bread prices in England and the sea level in Venice are non-causal, they should not be countenanced in genuine causal models. And yet, the causal sufficiency condition

does not seem to be able to rule out such cases since there is no direct (nor, arguably, a non-trivial indirect) common cause of the events represented by these variables. Hoffmann-Kolss hence proposes to replace the causal sufficiency condition by a *monotonicity* condition. Roughly speaking, a model M with a variable set V satisfies this monotonicity condition just in case all relations that are causal according to M continue to be causal according to any model that extends M by additional variables (the latter variables have to satisfy a further constraint that we omit in the course of this introduction). She then illustrates how this condition disqualifies candidate causal models that contain spurious correlations. Hoffmann-Kolss acknowledges that an interventionist interpretation of causal models—as proposed by, e.g., Woodward (2003)—is equally capable of excluding non-causal probabilistic correlations from counting as causal. However, she maintains, this comes at the cost of a framework that is overall conceptually more demanding than hers.

2.2 C. Sartorio, 'A good cause'

Carolina Sartorio's paper discusses a puzzle about difference-making in causation that involves collective action. The puzzle arises in cases where an outcome results from two non-coordinated actions, neither of which appears to make a difference to the outcome when considered individually. (In this context, difference-making is understood in terms of counterfactuals.) To introduce the puzzle we need to introduce a type of scenario that is often called a 'switching scenario'. Suppose an agent (Switcher) intends to kill a victim (Victim) who is trapped on a certain train track. Switcher's aim is to direct a trolley towards Victim. However, Switcher mistakenly believes that the only way to accomplish this aim is by flipping a switch that sends the trolley onto a side track. In fact however, flipping the switch does not make a difference: the train would reach Victim either way. For this reason, it seems highly implausible to hold Switcher responsible for Victim's death. Now suppose that we consider a slightly different case where the main track is broken. In that case, flipping the switch *does* make a difference. Assume further that

Switcher flips the switch, knowing that part of the main track was broken, and thinking that turning the trolley onto the side track was the only way to guarantee Victim's death. At the same time, another agent (Reconnector), who also wants Victim to die and who is unaware of what Switcher is doing, reconnects the part of the main track that was broken. (Sartorio, 2023: 4)

In this case, Sartorio argues, it does not seem plausible to hold either agent individually responsible for Victim's death. Due to Reconnector's actions, Switcher's action, considered individually, does not make a difference to Victim's death, and conversely for Reconnector's action. However, she maintains, 'somebody—either one of the agents or both—is clearly to blame for what happened. For the outcome is the result of two agents acting independently in clearly blameworthy ways' (Sartorio, 2023: 5). Sartorio then discusses various ways in which we might hold the agent's collective behaviour responsible for Victim's death. She argues that a case can be made for taking the contribution of Switcher and Reconnector to be *disjunctive*: It

is the event of *either* Switcher flipping the switch *or* Reconnector reconnecting the main part that is responsible for Victim's death. In contrast to each individual action taken by itself, and in contrast to the conjunction of both contributions, Victim's death depends counterfactually on the disjunctive event.² Sartorio suggests that a natural independent motivation for this analysis of the case are considerations of proportionality: the disjunctive event is *more proportional* to the result than any of its constituent events or their conjunction. So, the analysis might be a byproduct of a general requirement to the effect that causes be proportional to their effects.

A problem that arises in this connection is that proportionality constraints on causation need a principled way to rule out certain types of disjunctive events as purported causes to be adequate— at least if proportionality is defined in counterfactual terms along the lines of Yablo (2003). If Suzy and Billie each throw a rock at a bottle at approximately the same time and Suzy's rock happens to hit first, the disjunctive event of Billie or Suzy's throwing a rock should not count as the cause of the bottle's breaking. In order to circumvent such problems, Sartorio argues that causes need not, in general, be proportional to their effects. Only in special circumstances can proportionality considerations be helpful to identify causes of a given effect: 'Highly proportional facts such as collective disjunctive facts are explanatory only in special cases, namely, when there is a failure of individual causation or explanation' (Sartorio, 2023:14).

2.3 H. Andreas & M. Günther, 'A Lewisian regularity theory'

Holger Andreas and Mario Günther's contribution develops a non-reductive, refined variant of the regularity theory of causation proposed in Andreas and Günther (2024). The paper takes as its starting point Lewis's (1973) regularity theory of causation and the substantial problems it faces, such as its inability to distinguish genuine causes from preempted would-be causes. Against this background, the authors—drawing on earlier work in Andreas and Günther (2024)—develop their non-reductive account of causation, according to which causation is *deviant forward-directed inferability along lawful paths*.

The core of Andreas and Günther's account is, as in Lewis (1973), the claim that an effect can be inferred from a genuine cause in the presence of law-like propositions. As the authors point out, however, their account refines Lewis's regularity theory twice over. First, Andreas and Günther embed the regularity theory in a framework of causal models in order to solve the problems of Lewis's regularity theory. The formal framework allows them to impose further conditions on the inferability of an effect from a genuine cause, which they call the *forward-directedness* and *maximality* condition. Under this refinement, a genuine cause is an *indispensable* member of a maximized minimal set of actual conditions that entail the effect in a forward-directed way. In an instructive discussion, the authors explain how that the

² It should be noted that Sartorio remains agnostic whether these considerations pertain to causation proper or rather to causal explanation.

refined theory overcomes substantial problems of Lewis's theory, such as the problems of preemption, unique causes, and joint effects.

Second, Andreas and Günther's account includes a *deviancy* and a *transitivity* condition. These conditions account for intricate cases in the debate about causation, including (1) cases suggesting that causation is not transitive, (2) omissions, and (3) cases of isomorphic causal models supporting opposite causal judgements. For details of the account and an illuminating discussion of intricate cases from the literature, we refer the reader to the paper (in particular, Sects. 2–4). Here, we want to highlight an important feature of Andreas and Günther's non-reductive account of causation that sets it apart from 'typical' regularity theories [including their own (2024) account].

In contrast to their prequel theory—which builds on Baumgartner (2013)—the non-reductive account developed in this collection is stated in terms of law-like propositions rather than non-redundant regularities. A law-like proposition has the form $A = \varphi$, where A is a propositional variable standing for a type effect and φ is a propositional formula that can be seen as a truth function whose arguments represent (non-)occurrences of events standing for type causes. As Andreas and Günther highlight, their account of causation is—unlike regularity theories in the tradition of Hume (1975)—*non-reductive* because law-like propositions are *directed* bi-implications. The direction of law-like propositions—and thus of causation—is taken as primitive. Basing their account on law-like propositions allows the authors to sidestep an important challenge to reductive accounts of causation, such as Baumgartner's (2013) and their prequel theory, which they raise in this contribution. In a nutshell, Baumgartner's reductive theory must assume the completeness of causal models in order to be applicable in all causal scenarios, but under this assumption the direction of non-redundant regularities cannot always be established, which is required for the theory to be a reductive account of causation.

In addition to comparing their non-reductive regularity theory with 'typical' regularity theories in Hume's tradition, Andreas and Günther show that their account can compete with the most advanced theories in the field. In the second half of the paper, they provide a detailed and insightful comparison of their account with non-reductive regularity theories including Wright's (1985; 2011) NESS account and counterfactual accounts such as Gallow (2021).

2.4 S. Hirèche, 'Grounding, necessity, and relevance'

In his contribution, Salim Hirèche explores a topic which has substantially shaped the recent debate on metaphysical explanation: grounding and its structural features. Hirèche develops a novel defence of grounding necessitarianism, i.e., the view that full grounds necessitate what they ground. This view has been challenged by a number of putative counterexamples. Some putative counterexamples arise from the observation that an alleged full ground of some fact C can obtain together with other facts that block C 's obtaining. For instance, one might think that the fact that Socrates died fully grounds the fact that Xanthippe became a widow. However, the fact that Socrates died could have obtained in a world where Socrates and Xanthippe

were never married. Thus, the fact that Socrates died is not modally sufficient for the fact that Xanthippe became a widow. As Hirèche points out, in response to examples like this, we can either deny that the fact that Socrates died is a full ground of the fact that Xanthippe became a widow—it needs to be completed by other facts, e.g., that Socrates and Xanthippe were married—or we abandon the idea that full grounds always necessitate what they ground.

The paper presents three arguments against the second option, which would require abandoning grounding necessitarianism. Central to two of the arguments is the notion of relevance. The alleged non-necessitating full grounds, Hirèche argues, fail to meet an explanatory relevance criterion and a generative relevance criterion. The starting point for his arguments is the idea that a full ground contains no more and no less than what is relevant for it to ground what it grounds. This condition allows for an explanatory and a generative construal: a full ground contains no more and no less than what is relevant for it to (1) explain or (2) generate what it grounds. At first glance, many of the putative counterexamples against grounding necessitarianism seem, as Hirèche highlights, to pass the criteria: If asked, we would accept a verbal explanation citing the alleged full ground as being just enough to fully answer the question of why *C*. Similarly, we would accept a divine decree citing the alleged full ground as sufficient to fully generate *C*.

The illuminating and carefully developed claim defended in ‘Grounding, necessity, and relevance’, however, is that this acceptance is often—especially for the alleged counterexamples—due to the fact that we consider more than the explicit content of a verbal explanation or divine decree. What we consider instead, Hirèche argues, is the broader content including facts that must be implicitly assumed in order for a verbal explanation or for a divine decree to be successful. These facts are part of what is relevant to explain or generate *C*. Hirèche provides a thorough and detailed argument for the claim that we consider the broader content when we evaluate verbal explanations or the success of divine decrees. Based on this insight, Hirèche concludes that the alleged non-necessitating full grounds only partially ground. They need to be supplemented by what are sometimes regarded as mere background conditions. In the final section, Hirèche makes the case for opponents of grounding necessitarianism even harder. By defending the alleged counterexamples, Hirèche argues, grounding contingentists rule out weaker views than grounding necessitarianism, such as those that appeal only to regularities. But even opponents of grounding necessitarianism might want to preserve these weaker views.

2.5 H. Bhogal, ‘Moral principle explanations of supervenience’

Harjit Bhogal’s contribution focuses on metaphysical explanations of moral supervenience. He argues that explanations of why the moral facts supervene on the natural facts that appeal to moral principles, as favoured by some non-naturalists, either fail to explain supervenience at all or explain it, but only at the cost of—to borrow a notion from McPherson (2012)—moving the explanatory bump in the carpet. Metaphysically necessary co-variation of moral and natural facts cries out for explanation, at least if, as non-naturalism has it, moral facts are irreducibly distinct from

natural facts. As Bhogal highlights, moral principles are the hope of many non-naturalists, when it comes to an explanation of moral supervenience. The paper forcefully argues that at least in its most straightforward form, this seems to be a forlorn hope.

On the picture under discussion, moral facts supervene on natural facts because they either are moral principles, which trivially supervene on the natural facts, or they are determined by the natural facts together with the moral principles. Moral principles thus appear to provide a straightforward explanation of why all moral facts supervene on the natural facts. According to Bhogal, however, this appearance is deceiving. He argues that non-naturalists face a dilemma: either they fail to identify *difference-makers* for the explanandum and thus fail to explain supervenience, or they explain it by appealing to another fact that is just as much in need of explanation.

The two horns of the dilemma concern the exact choice of explanans. On the first horn of the dilemma, the non-naturalists appeal to the actual moral principles, such as, say, the utilitarian principle. The actual moral principles, Bhogal argues, do not explain supervenience because they do not make a difference to whether supervenience is true. For suppose a utilitarian principle is true. If it had been false, the moral facts would still have supervened on the natural facts. Thus, the utilitarian principle does not make a difference to the explanandum. What does make a difference to the explanandum? The difference-makers, according to Bhogal, are generic features of the actual moral principles, namely that the principles are metaphysically necessary and that they have the form of bridge-laws. On Bhogal's view, these generic features of the actual moral principles might therefore actually explain why moral facts supervene on the natural facts. However, this is only a partial success, according to Bhogal, because it leads to the second horn of the dilemma. The reason is that the proposed explanation raises another explanatory challenge. In an insightful discussion, Bhogal argues that the new explanatory challenge is to explain why 'every serious candidate for the true set of moral principles has bridge-law form'. Once more, an application of the difference-making criterion shows that the actual moral principles fail to explain this new explanandum. Bhogal concludes that non-naturalists cannot appeal to moral principles to provide a comprehensive explanation of the mystery that the supervenience challenge draws attention to.

2.6 J. Himmelreich, 'Difference-making and the control relation that grounds responsibility in hierarchical groups'

In his contribution, Johannes Himmelreich develops an account of individual responsibility in hierarchical groups, such as companies or military organizations, that is based on the notion of difference-making. In hierarchical groups, actions are often carried out by subordinates who get their orders by a superior who has the authority to command. For instance, in a military context, a superior might command some soldiers to shoot a victim. It seems that in such cases, both the superior and the subordinate can be held responsible for the death of the victim, and at least

sometimes, the superior seems to be responsible to an even greater degree than the subordinate.

A natural starting point to explain the individual responsibilities in such cases is to focus on the individual's causal contributions or, as Himmelreich puts it, their agency. However, as Himmelreich argues, theories of causation have difficulties in discerning who brought about what in cases of hierarchical structures. In response, Himmelreich develops an illuminating and promising novel interpretation of the agency condition in terms of *difference-making*. On his account, an individual satisfies the agency condition if and only if two conditions of difference-making are satisfied. In the example, the conditions are as follows. First, it must be the case that if the superior had not ordered to shoot the victim, the victim would not have died. Second, it must be the case that if the superior were to order to shoot the victim in slightly different circumstances, the victim would still have been shot.

According to Himmelreich, the two conditions represent the idea of *agency as prevention* and of *agency as implementation*. One of the characteristics of hierarchical groups, as Himmelreich highlights, is that individuals at the subordinate level are often redundant. A superior may command many soldiers to shoot the victim. In such cases, if soldier *A* had not shot, then soldier *B* would still have shot, and the victim would still be dead. To deal with this, Himmelreich carefully develops an account of a fine-grained individuation of outcomes that can account for the redundancy. His proposal is based on the observation that, if soldier *A* would not shoot, the victim would not have been shot by soldier *A*. Some of the advantages of Himmelreich's final account are that it can deal with redundancies at each level of the hierarchical structure, and that it allows us to compare agents with respect to certain kinds of outcomes (nested outcomes), which in turn provides the basis for explaining increasing degrees of responsibility in hierarchical groups based on increasing differences the individuals make.

3 Logic

The third and final part of this special issue comprises four papers that follow a more formal, logical approach in developing, for different contexts and applications, the idea of relevance as difference-making.

3.1 E. Raidl & H. Rott, 'Towards a logic for "because"'

Eric Raidl and Hans Rott's contribution develops a novel approach to the explanatory connective 'because'. Central to their account is the traditional idea, found already in Frege and others, that a statement '*q* because *p*' is closely connected to a corresponding *conditional* 'if *p* then *q*'. What sets it apart from the kind of suppositional conditional usually studied in conditional logic, the authors suggest, is firstly, the factivity of 'because', requiring both flanking statements to hold, and secondly, a form of *relevance* constraint, which makes sure that the antecedent, or explanans, is appropriately explanatorily relevant to the consequent, or explanandum. This

requirement of relevance is then spelled out by Raidl & Rott as a *difference-making* condition. The idea is that whether the antecedent holds must make a difference with respect to whether the consequent holds in the sense that (1) the consequent holds on the supposition of the antecedent—in symbols: $p > q$ —, but (2) it is not the case that the consequent holds on the supposition of the negation of the antecedent—in symbols: $\neg p \not> q$.

The paper develops this idea formally and in great detail, using a generalization of the familiar Lewis-Stalnaker closeness- or plausibility-ordering semantics as the underlying semantic framework. On that basis, the authors determine a minimal core logic of ‘because’ as well as a range of extensions of that logic corresponding to natural assumptions about the plausibility functions. For details of these systems, and instructive discussion of the validity or otherwise of various key principles for ‘because’, we refer readers to the paper itself. Here, we wish to highlight two important and unique features of Raidl & Rott’s overall approach that set it apart from recent work on related matters such as logics of ground, which in effect represent logics for a specific, *metaphysical* use of ‘because’.

Firstly, while most recent authors have taken ‘because’ and its kin to be hyperintensional,³ Raidl & Rott give a thoroughly *intensional* account. While they concede that a hyperintensional approach is worth exploring and officially adopt intensionality as a simplifying assumption, their article illustrates that working within an intensional framework offers considerable advantages and allows the authors to make a unique and very valuable contribution to our understanding of the topic. For one thing, even those sympathetic to hyperintensionalism about explanatory concepts like *because* stand to learn a lot from a clear understanding of the space of possible intensional explications of the notion and their formal properties. For another, sticking to an intensional framework allows the authors to connect their approach to existing work on related areas and thereby to obtain impressive formal results. In particular, since their explication of ‘because’ is based on a conditional, Raidl & Rott obtain close formal links between well-known logics for conditionals and corresponding logics for ‘because’, allowing them to precisely characterize a hierarchy of logics for ‘because’ parallel to an existing hierarchy of conditional logics.

Secondly, Raidl & Rott’s account exhibits a remarkable degree of generality in that it is offered as neutral between, on the one hand, a doxastic interpretation of ‘because’ as indicating relationships of evidential support between beliefs, and on the other hand, a metaphysical interpretation of ‘because’ as indicating causal or other explanatory connections between facts in the world. As a result, their work is able to shed new light on possible formal parallels between these different uses of ‘because’.⁴

³ Compare, e.g., Correia (2010), Fine (2012), and Schnieder (2011).

⁴ Related connections between counterfactual conditionals and conditionals interpreted in terms of belief revision are familiar from the literature; the classic source is Grove (1988), establishing in effect that the Lewis-Stalnaker ordering semantics is adequate to model belief revision as captured within the AGM framework (Alchourrón et al., 1985).

3.2 G. Schurz, 'Relevance as difference-making: a generalized theory of relevance and its applications'

Gerhard Schurz's paper takes as its starting point the observation that relevance comes in many forms, and shows up across a wide and diverse range of topics, including logic, explanation, confirmation, grounding, and communication. This raises the question whether these different kinds of relevance have anything substantial in common—if there is anything of interest that can be said about relevance in general—and if so, what it is.

Schurz argues that there is indeed a substantive and unified notion of relevance that applies across these different areas, and proceeds to develop a general theory of relevance that aims to explicate this notion. His basic idea is to understand relevance as a general and abstract structural second-order property of relational facts, i.e. of instantiations of some relation by some individuals. For example, given a fact of the form 'premises Γ logically entail conclusion C ', we can ask whether this entailment is relevant, and that question is construed, under Schurz's proposal, as the question whether this instantiation of the entailment relation possesses a certain property of relevance. In a nutshell, that property is a kind of sensitivity to variation in the relata: The question is if the entailment remains intact even if we change the relata Γ and C in certain ways. To give a simple example, the classical entailment of an arbitrary conclusion by a contradictory premise is classified as irrelevant on Schurz's account precisely because we can exchange the conclusion by any other sentence and still have an entailment. In other words, the instance of the entailment-relation under consideration is insensitive to variation of the right-hand side relatum. As Schurz highlights—and as is apparent from the title of his contribution—this is a form of difference-making account of relevance, since the hallmark of a relevant relational fact is that the specific identities of the relata make a difference to the obtaining of the fact.

Schurz goes on to develop this general idea in detail, distinguishing along the way several different forms of relevance that vary with respect to the kinds of changes to the relata we consider. For instance, the conception of difference-making invoked in Raidl & Rott's contribution is captured as a case of what Schurz calls *essential* relevance, where we are very specifically considering the replacement of a relatum by an *opposite* element—in the case of a sentence, its negation. (Recall that the difference-making conditional in Raidl & Rott was obtained by strengthening the suppositional condition $p > q$ by the additional requirement that $\neg p \not> q$.)

In addition to developing the theory of his general notion of relevance, Schurz also discusses numerous applications to areas in which considerations of relevance play a role. The early sections of the paper offer a detailed and insightful discussion of relevance of logical entailments and how the account proposed in the paper compares with previous attempts to capture relevant logical entailment by relevant logicians like Anderson and Belnap (1975), Tennant (1984), and others. In later sections, Schurz then turns to probabilistic relevance, law-hood of generalizations, communication, as well as the metaphysical concepts of ground and essence.

3.3 P. Saint-Germier, P. Verdée, P. Terrés Villalonga, 'Relevant entailment and logical ground' and 'Connecting the dots'

Last but not least, our collection features an extensive contribution on the topic of relevant entailment in the form of two tightly connected papers co-authored by Pierre Saint-Germier, Peter Verdée and Pilar Terrés Villalonga. The first paper, 'Relevant entailment and logical ground', develops a novel approach to relevant entailment based on a theory of logical grounding.⁵ It takes as its starting point the natural idea that what makes a relevant entailment relevant is that *all* the formulas involved in the entailment—i.e. premises as well as conclusions⁶—*contribute* to the validity of the entailment.

But what does it take for all formulas to thus contribute? A natural idea is that we can test whether a formula makes a contribution by removing that formula. Thus suppose that premises A_1, A_2, \dots, A_n entail conclusion C . If A_2, \dots, A_n without A_1 do not entail C , we can be sure that A_1 contributes to the entailment. After all, its presence among the premises *makes a difference* to whether the entailment obtains. As the authors point out, difference-making in this sense is a particularly strong form of making a contribution, and it is plausible that weaker forms may be recognized, and may be sufficient for the entailment being relevant in an important sense. Drawing on previous work by Brauer (2020) and Tennant (1984), they specify three further characterizations of relevant entailments employing more liberal notions of contribution.

But independently of how best to tweak the above criterion, it seems clear that such a test only identifies a *symptom*—non-removability, in the test described—of a formula's making a relevant contribution. It does not tell us *what it is* to make a relevant contribution, or *in what way* the formula contributes, i.e. what its contribution consists in. The main innovation of 'Relevant entailment and logical ground' is an original, attractive, and very detailed and rigorous answer to these questions. A proper statement of this answer requires a good deal of preliminary work, but perhaps the rough general idea may be conveyed informally as follows.

Recall that for an entailment to hold, every interpretation must either render some premise false, or some conclusion true. What a premise is capable of contributing to an entailment, thus the idea, are the *potential logical grounds* for its falsity, and what a conclusion is capable of contributing are the potential logical grounds for its truth. For such grounds to actually qualify as contributions to the entailment, moreover, they must 'match up' in a certain way with opposing grounds contributed by other formulas. For a simple (and simplified) illustration of this kind of matching up, consider the entailment of p by $p \wedge q$. Here p 's truth is a ground of the truth of the conclusion, and p 's falsity is a ground for the falsity of the premise. Since every

⁵ The idea of using ground-theoretic resources to characterize relevant forms of entailment has also been pursued by other authors, notably in Correia (2014), Correia (2015) and Schnieder (2021); for further development of the latter's approach, see also Krämer (2024). However, these approaches follow a very different strategy for implementing this idea.

⁶ The authors allow for multiple conclusions in an entailment. To say that such an entailment holds is to say, roughly, that it is impossible for all the premises to be true while all the conclusions are false.

interpretation renders p either true or false, one of these grounds is bound to obtain, allowing us here to conclude that the premise does indeed entail the conclusion. The pair of grounds—the falsity of p and the truth of p —therefore match up in the relevant sense, showing that premise and conclusion jointly contribute to the entailment.

To implement their general idea, the authors first develop a theory of logical ground in the form of a sequent calculus, before extending it to obtain a calculus deriving the classical entailments based on the account of the logical grounds of premises and conclusion. Joint contribution of some formulas to such an entailment is then characterized by reference to how the entailment may be derived within this calculus, and whether the logical grounds of the formulas occurring in such a derivation match up in appropriate ways. In this way, Saint-Germier, Verdée and Terrés are able to characterize exactly the entailments counted as relevant on the four different criteria mentioned above, but in terms of their analyses of what it is for formulas to contribute to an entailment, rather than by testing for the characteristic symptoms of a formulas making a contribution or failing to do so.

The second paper, ‘Connecting the dots: hypergraphs to analyze and visualize the joint-contribution of premises and conclusions to the validity of arguments’, develops an instructive alternative representation of the calculus defined in the first paper by means of hypergraphs. Informally speaking, what we get is a visual representation of a derivation of an entailment that displays the ground-theoretic connection between premises and conclusion to which the proposed account of joint contribution of formulas to an entailment appeals. Within this graphical representation, non-contributing formulas in an entailment may then be identified relatively straightforwardly as those disconnected from the network consisting of these ground-theoretic connections.

Author contributions The authors contributed equally.

Funding Open Access funding enabled and organized by Projekt DEAL. Work on this manuscript was in part funded by the Deutsche Forschungsgemeinschaft (Grant Number KR 4516/2-2).

Data availability Not applicable.

Code availability Not applicable.

Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

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