

On Certainty*

Wolfgang Spohn

Certainty is an epistemic quality or, as philosophers are used to say, an epistemic modality. It is not easily accounted for as such; but things get even more complicated due to the fact that certainty is often confused with other epistemic modalities. Since I cannot discuss here the quite sophisticated technical treatments of certainty, I focus on disentangling certainty from and relating it to other epistemic modalities; this is the more important business for getting a hold on certainty. In doing so, I am not presenting any original view or thesis; my view or evaluation implicitly shows just in my selection from material which is familiar in more formally oriented analytic philosophy, but is less known, I think, outside philosophy (and AI).¹

Certainty is most appropriately equated with unrevisability or infallibility. This relation will be one main focus of my talk. But a more important role in the history of philosophy was played by two other modalities, apriority and analyticity, the first of which is clearly epistemic and the second of which may be so taken. Certainty must be strictly distinguished from both which in turn only partly capture the various uses of the notion of necessity. A prominent instance of confusion is Quine's famous attack on the notion of analyticity which ended up with the conclusion, and confusion in my view, that the only feasible sense which can be given to it is centrality, meaning something like "hardly revisable".² So, my other main focus is to address these distinctions.

* Vortrag auf dem 13. Weltkongreß für Soziologie „Contested Boundaries and Shifting Solidarities“ in Bielefeld im Juli 1994.

¹ In Artificial Intelligence as well great efforts are devoted to the modelling of epistemic states; some references are given below. In fact, philosophy has one of its most fruitful interdisciplinary exchanges in this area.

² Cf. Quine (1951), p. 39ff.

Let me start with two basic observations. First, the logical form of the notion of certainty is that it is at least a three-place relation: a is certain of p at t - where a is a subject capable of epistemic attitudes, t is a time, and p is a proposition or whatever you prefer to take as an object of belief; the nature of these objects is utterly problematic and beyond the scope of my talk.³

Secondly, certainty obviously comes in degrees; people are more or less certain and more certain of some things than of others. Thus, certainty is in fact a four-place relation: a is certain of p at t to the degree r . Thus stated, it is tantamount to the most basic epistemological notion, namely: a believes p at t to the degree r . If "certain" behaves like most adjectives, then p is plainly certain for a subject if p is more certain than most other things; compare this with " x is a tall elephant just if x is an elephant taller than most elephants". However, this is not the plain certainty philosophers always talk about; their interest was in absolute certainty, as it was usually emphasized, or in maximal certainty, to express it in terms of degrees.

So, the primary theoretical task is to account for these degrees of certainty and belief. One important theoretical connection is that these degrees manifest themselves in our decisions and actions; we base our actions more firmly on our firmer beliefs and less on our lesser certainties. For our present concern, however, this is the less important connection. One reason for this is that this is, so to speak, an impure manifestation of the degrees of belief; they therein mesh with the degrees of our desires or volitional attitudes in general in a very complicated fashion. The other reason is that the only well-working theoretical model of this complicated meshing is decision theory according to which degrees of belief are probabilities.⁴ Other models of degrees of belief thus drop out of focus because they are not well embedded in the theory of practical reasoning.

But such other models exist, as will become clear when we look at the other theoretical connection: degrees of belief play a crucial role in the dynamics of belief. We continuously revise our beliefs or, more generally, change our epistemic state in the light of new evidence or information; this continuous change is described in the

³ Philosophers have burdened propositions with multiple roles, as truth bearers, as sentence meanings, as objects of propositional attitudes. The clearer it became that no entity can play all these roles, the unclearer it became how to characterize for each role the appropriate entities.

⁴ The most widely used version of decision theory was developed by Savage (1954). Philosophers became acquainted to decision theory by Jeffrey (1965). For a brief comparison of basic decision theoretic models cf. Spohn (1978), ch. 2.

dynamics of belief. However, there is no workable account of this dynamics in terms of ungraded belief⁵; only if one takes belief as graded, one can state reasonable general laws of epistemic change. So, what is changed in the light of evidence is in fact the assignment of degrees of belief or certainty to the various propositions.

The most prominent model of epistemic change, of course, is the probabilistic one. Here, epistemic states are represented as probability measures (in the mathematical sense). The crucial point is that conditional probabilities can be defined relative to a probability measure. The dynamic law then basically takes the form of a rule of conditionalization: my new probability for a given proposition is just my old probability for it conditional on the evidence gathered in between.⁶ Indeed, each account of epistemic change must provide analogous notions of conditional epistemic states and of conditionalization.

In the meantime, there exist various alternatives to the probabilistic model and a vast amount of literature about them. The so-called AGM approach to belief revision is perhaps the most carefully worked out one⁷; there only ordinal degrees of belief are assumed. A bolder and more powerful approach is given by the theory of so-called ranking functions or natural (or ordinal) conditional functions.⁸ In AI two other theories are even more prominent: the Dempster-Shafer theory of belief functions⁹ and fuzzy logic¹⁰ (though the latter is in my view misapplied to the epistemic matters under discussion). And more could be mentioned; the field is, despite the enormous amount of work, still in an experimental state, so to speak.¹¹

⁵ Cf. Spohn (1988), sect. 2.

⁶ More general rules of probabilistic belief change have been developed. The two most prominent ones are Jeffrey's generalized conditionalization (cf. Jeffrey 1965, ch. 11) and the rule of maximizing entropy or of minimizing relative entropy (cf. Hunter 1991).

⁷ Cf. Alchourrón et al. (1985), Gärdenfors (1988), and Gärdenfors and Rott (1994).

⁸ Cf. Spohn (1988) and (1990) and Goldszmidt and Pearl (1992).

⁹ Cf. Shafer (1976), (1990), and (1992).

¹⁰ Cf. Dubois and Prade (1988).

¹¹ There have been predecessors, of course. Dempster (1967), Shackle (1969), Rescher (1976), and Cohen (1977) perhaps deserve most to be mentioned. Shafer (1978) even mentions J. Bernoulli and J.H. Lambert as early predecessors in the 18th century.

Revisability or fallibility¹² are clearly dynamical notions which are explicable precisely by such theories. Certainty, however, is no less a dynamical notion. A belief is the more certain, the harder it is to revise; it is certain in the vague and loose everyday sense if it is hard to revise; and it is certain in the strict philosophical sense if it is not revisable at all. All these explanations adopt a precise meaning only within the theories of epistemic change referred to, and a different meaning, at that, in different theories. The vague notion of hard revisability allows of a spectrum of exactifications; but the strict notion of unrevisability or absolute certainty receives a unique explication in each theory of epistemic change. Consider the most familiar theory, probability theory: there, a proposition is absolutely certain or unrevisable if and only if it has probability 1, because according to each probabilistic rule of epistemic change a proposition keeps probability 1 forever once it has received probability 1. Thus, a theory of certainty can be developed within probability theory; it is in fact quite simple. Analogous assertions hold for the other theories of epistemic change.

So, which propositions are certain? Well, I said that certainty is a subject-relative notion; propositions which are certain for you may be uncertain for me and vice versa; this depends on the subjective epistemic states and their dynamics. So far, the only propositions which turn out to be certain for everyone according to the above-mentioned theories of epistemic change are the logically true ones. Therefore the question arises whether there are more propositions which everyone should or may reasonably take as certain. But note that we are entering a new field with this question. We are no longer explicating certainty, as we have done so far, but we are looking for further rationality constraints on certainty.

A first attempt to answer the question may be to say that the propositions to be taken as certain are the necessary propositions. But this answer is not good enough, since there are many kinds of necessity. There is logical necessity, the strictest kind of necessity, for which the answer is true. There is mathematical necessity the nature of which is much discussed - does it reduce to logical necessity, is it a kind of linguistic necessity or a kind of necessity *sui generis*? - to which the answer applies as well.¹³ But there are also various kinds of material necessity: causal necessity,

¹² Here I would like to mention the markedly different approach by Levi (1980) who strictly distinguishes between fallibility and revisability.

¹³ By thus declaring mathematical propositions as certain or indubitable, I do not want to deny that there is mathematical doubt. But mathematical doubt is not only beyond the scope of the

physical necessity, historical necessity¹⁴, and so on, and the strictest of them, metaphysical necessity¹⁵. For each of them the answer is certainly not true. We may doubt or even disbelieve propositions which are necessary in one of these senses, we may discover them, we may find reasons for rejecting them again, and so on. So, these kinds of necessary propositions should not be taken as certain.

Hence, the first attempt was not yet specific enough. But it headed into the right direction. Certainty itself may be viewed as a kind of epistemic necessity; thus the kind of necessity which is characteristic of propositions reasonably to be held to be certain is presumably an epistemic one as well. Which kinds of epistemic necessity are there?

There are mainly two candidates. Since Kant has made vital use of the analytic/synthetic and of the a priori/a posteriori distinction in his epistemological turn of metaphysics, these distinctions have remained in the center of theoretical philosophy and have caused a lot of concern and confusion.

To take up analyticity first: The common explanation is that analytic sentences are sentences which are true only by virtue of the meaning of the expressions and the syntactic constructions from which they are built. Analytic truths are thus known by fully competent speakers simply in virtue of their knowledge of language. And come what may, they cannot turn out false. The meanings may change, of course, and the syntactic forms when associated with the new meanings may yield falsehoods. But then you have, in a way, different sentences in a new language; it is not the old analyticities which would thereby turn false. In this sense, analytic sentences are epistemically necessary.

The explanation given is so common because it is vague. What is truth in virtue of meaning alone? In order to render this precise, nothing less than a full

theories I am referring to; I know of no theory at all which would be able to adequately cope with it.

¹⁴ The simplest account for these necessities is this: Something is causally (physically, historically) necessary just if it is logically entailed by the causal (physical, historic) laws. Thus, insofar there are no historic laws, there are no historical necessities (except the logical ones). Whether this simple account is adequate in each case is doubtful. It may be better, for instance, to proceed conversely and explain causal laws in terms of causal necessity; cf., e.g., von Fraassen (1989) and Spohn (1993).

¹⁵ Which has been forcefully reintroduced into the current philosophical discussion by Kripke (1972), among others.

meaning theory is required. Indeed, the search for an explication of analyticity was an important motive in developing various and ever more sophisticated meaning theories. Thus, in a way, there are today as many concepts of analyticity as there are theories of meaning.¹⁶

The state of the notion of apriority is still worse. The common explanation is that a proposition is a priori known by a subject if the subject knows it prior to any experience. From this cautious, subject-relative explanation it needs a substantive step to argue that the same propositions are a priori known by all subjects; these propositions may then be called a priori by themselves. If propositions a priori are known prior to any experience, then no experience can prove them to be false; they are to be believed come what may. In this sense, propositions a priori are again epistemically necessary.

This explanation of apriority is still vaguer than that of analyticity. Certainly, the philosophical community was also misled by the logical empiricists' forcefully doing away with apriority by simply identifying it, contra Kant, with analyticity. This misunderstanding has been cleared up cleared up for over 20 years¹⁷, and since the notion of apriority is widely and freely used again. However, its use is, to my knowledge, hardly backed up by any theory and stays on a rather insecure informal level.¹⁸ This is why I said it would be worse off than the notion of analyticity.

There is, however, a theoretical framework which in my view improves upon the situation. The part of the theory of meaning which is relevant to an account of analyticity is referential semantics, i.e. that part which is concerned with reference and truth. It has received its most powerful and up-to-date format in the so-called character theory of David Kaplan.¹⁹ Kaplan wanted it to keep separate from epistemology, but Robert Stalnaker has given it an explicitly epistemological

¹⁶ Quine (1960) tries to satisfy us with ersatz concepts like stimulus meaning and stimulus analyticity. Putnam had influential, though changing views on the matter; see Putnam (1975), ch. 2 and 12. Lewis (1969) is ultimately an attempt to reestablish the notion of analyticity. And so on; the list could be continued almost indefinitely.

¹⁷ Due to Kripke (1972) who made very clear that analyticity, metaphysical necessity, and apriority are three different notions and that the latter two are in fact independent, since there are clear cases of necessities a posteriori and of contingencies a priori.

¹⁸ Cf., e.g., Putnam (1983), ch. 6 and 7, Kitcher (1980) or Casullo (1988).

¹⁹ Cf. Kaplan (1977) and (1989) and Lewis (1980).

reinterpretation.²⁰ Given this reinterpretation, the theory is capable not only of explicating metaphysical necessity and analyticity, but also of analyzing apriority.²¹ It thus provides a framework for studying not only apriority, but also its relation to other central modal notions. In this it is unrivaled, as far as I know, and that is why I am mentioning it here.

According to these explications, analyticity is a stronger notion than apriority.²² There is, however, a further difference. Analyticity is a communal notion applying to a given language as spoken by a given linguistic community, whereas apriority is rather a subjective notion applying to the propositions or thought contents entertained by a given epistemic subject.²³ This difference is relevant here because the truths which are analytic on the communal level need not be a priori known on the subjective level. This is so because knowledge of analytic truths requires full semantic competence in a strong sense which we may well fail to satisfy without ceasing to count as members of our linguistic community.²⁴ Thus, analytic truths are not necessarily subjectively certain; only a priori truths taken at the subjective level are certain.

This brings us back to our topic. I said which propositions a subject takes as certain is up to her or him and depends on her or his dynamics of epistemic states. But it is certainly a rationality postulate on this dynamics that all and only propositions a priori are taken to be certain, i.e. unrevisable. On the one hand, there will never arise a need to revise the belief in an a priori proposition because it is

²⁰ Cf. Stalnaker (1978) and (1987). However, Stalnaker did not conceive of himself as reinterpreting Kaplan; he intended just different things with a formal apparatus similar to Kaplan's. The relation between Kaplan and Stalnaker is reconstructed in Haas-Spohn (1994).

²¹ Technically speaking, metaphysical necessity is truth at the actual context and all indices, apriority is truth at all contexts, and analyticity is truth at all contexts and indices. Thus, analyticity is the strongest notion and comes to a priori necessity, as Kripke (1972), p. 264, has already claimed. The significance of these explications is, however, revealed only by studying the whole framework. Cf. Haas-Spohn (1994), sect. 1.2.

²² The standard example for a sentence which is a priori, but not analytic is "I exist now". Whether any of Kant's arguments for his synthetic truths a priori can be made good is questionable.

²³ One may also make sense of a linguistic or communal a priori, but the subjective one is certainly the primary notion. For a way to account for the communal as well as for the subjective level within the framework of Kaplan and Stalnaker see Haas-Spohn (1994), section 3.9. Of course, my earlier claim about the relative strength of analyticity and apriority holds only when both notions are taken at the same level.

²⁴ This is forcefully argued by Burge (1979) who builds his far-reaching doctrine of anti-individualism on this fact.

independent from any information, evidence, or experience. On the other hand, there may always arise the need to revise the belief in an a posteriori proposition because it is dependent on information and adopted only after some experience which may have been misleading, which may be amended or superseded by further evidence; it may therefore be disadvantageous to stick to it come what may. Indeed, this postulate is just a generalized version of the regularity axiom of Carnap's inductive logic²⁵ which is widely held to be reasonable. But note that it is only this rationality postulate which positively connects the two parts of my talk. As far as the analysis of certainty is concerned, the second part was only negatively connected with the first part, namely by the warning that the notions discussed in the second part be not confused with certainty.

Much more could be said about certainty, but hardly more in 20 minutes. I hope what I said was not already too dense for this brief time. Thank you for your attention!

References

- Alchourrón, C.E., P. Gärdenfors, D. Makinson (1985), "On the Logic of Theory Change: Partial Meet Functions for Contraction and Revision", *Journal of Symbolic Logic* 50, 510-530
- Burge, T. (1979), "Individualism and the Mental", in: P.A. French, T.E. Uehling jr., H.K. Wettstein (eds.), *Midwest Studies in Philosophy IV, Metaphysics*, University of Minnesota Press, Minneapolis, pp. 73-121
- Carnap, R. (1971), "A Basic System of Inductive Logic, Part I", in: R. Carnap, R.C. Jeffrey (eds.), *Studies in Inductive Logic and Probability*, Vol. I, University of California Press, Berkeley, pp. 33-165
- Casullo, A. (1988), "Revisability, Reliabilism, and A Priori Knowledge", *Philosophy and Phenomenological Research* 49, 187-213
- Cohen, L.J., (1977), *The Probable and the Provable*, Clarendon Press, Oxford
- Dempster, A.P. (1967), "Upper and Lower Probabilities Induced by a Multivalued Mapping", *Annals of Mathematical Statistics* 38, 325-339

²⁵ Cf. Carnap (1971), sect. 7. Since Carnap's axiom referred to logically true or analytic propositions, whereas my postulate refers only to a priori propositions, I have slightly generalized Carnap's axiom, in a way Carnap would have agreed to if he had had an independent notion of apriority.

- Dubois, D., H. Prade (1988), *Possibility Theory. An Approach to the Computerized Processing of Uncertainty*, Plenum Press, New York
- van Fraassen, B.C. (1989), *Laws and Symmetry*, Oxford University Press, Oxford
- Gärdenfors, P. (1988), *Knowledge in Flux*, MIT Press, Cambridge, Mass.
- Gärdenfors, P., H. Rott (1994), "Belief Revision", in: D.M. Gabbay, C.J. Hogger, J.A. Robinson (eds.), *Handbook of Logic in AI and Logic Programming. Vol. IV: Epistemic and Temporal Reasoning*, Oxford University Press, forthcoming
- Goldszmidt, M., J. Pearl (1992), "Rank-Based Systems: A Simple Approach to Belief Revision, Belief Update, and Reasoning About Evidence and Actions", *Proceedings of the Third International Conference on Principles of Knowledge Representation and Reasoning*, Cambridge, Mass.
- Haas-Spohn, U. (1994), *Versteckte Indexikalität und subjektive Bedeutung*, Dissertation, Tübingen
- Hunter, D. (1991), "Maximum Entropy Updating and Conditionalization", in: W. Spohn, B.C. van Fraassen, B. Skyrms (eds.), *Existence and Explanation. Essays in Honor of Karel Lambert*, Kluwer, Dordrecht, pp. 45-57
- Jeffrey, R.C. (1965), *The Logic of Decision*, University of Chicago Press, Chicago, 2. Aufl. 1983
- Kaplan, D. (1977), "Demonstratives", in: J. Almog, J. Perry, H. Wettstein (eds.), *Themes from Kaplan*, Oxford University Press, Oxford 1989, pp. 481-563
- Kaplan, D. (1989), "Afterthoughts", in: J. Almog, J. Perry, H. Wettstein (eds.), *Themes from Kaplan*, Oxford University Press, Oxford, pp. 565-614
- Kitcher, P. (1980), "A Priori Knowledge", *The Philosophical Review* 89, 3-23
- Kripke, S.A. (1972), "Naming and Necessity", in: D. Davidson, G. Harman (eds.), *Semantics of Natural Language*, Reidel, Dordrecht, pp. 253-355, 763-769
- Levi, I. (1980), *The Enterprise of Knowledge. An Essay on Knowledge, Credal Probability, and Chance*, MIT Press, Cambridge, Mass.
- Lewis, D. (1969), *Convention: A Philosophical Study*, Harvard University Press, Cambridge, Mass.
- Lewis, D. (1980), "A Subjectivist's Guide to Objective Chance", in R.C. Jeffrey (ed.), *Studies in Inductive Logic and Probability, Vol. II*, University of California Press, Los Angeles, pp. 263-293
- Putnam, H. (1975), *Mind, Language, and Reality. Philosophical Papers, Vol. 2*, Cambridge University Press, Cambridge
- Putnam, H. (1983), *Realism and Reason. Philosophical Papers, Vol. 3*, Cambridge University Press, Cambridge
- Quine, W.V.O. (1951), "Two Dogmas of Empiricism", *Philosophical Review* 60, 20-43
- Quine, W.V.O. (1960), *Word and Object*, MIT Press, Cambridge, Mass.
- Rescher, N. (1976), *Plausible Reasoning*, Van Gorcum, Assen
- Savage, L.J. (1954), *The Foundations of Statistics*, Wiley, New York

- Shackle, G.L.S. (1969), *Decision, Order, and Time in Human Affairs*, Cambridge University Press, Cambridge
- Shafer, G. (1976), *A Mathematical Theory of Evidence*, Princeton University Press, Princeton:
- Shafer, G. (1978), "Non-Additive Probabilities in the Work of Bernoulli and Lambert", *Archive for the History of Exact Sciences* 19, 309-370
- Shafer, G. (1990), "Perspectives on the Theory and Practice of Belief Functions", *International Journal of Approximate Reasoning* 4, 323-362
- Shafer, G. (1992), "Rejoinders to Comments on 'Perspectives on the Theory and Practice of Belief Functions'", *International Journal of Approximate Reasoning* 6, 445-480
- Spohn, W. (1978), *Grundlagen der Entscheidungstheorie*, Scriptor, Kronberg/Ts.
- Spohn, W. (1988), "Ordinal Conditional Functions. A Dynamic Theory of Epistemic States", in: W.L. Harper, B. Skyrms (eds.), *Causation in Decision, Belief Change, and Statistics*, Vol. II, Kluwer, Dordrecht, pp. 105-134
- Spohn, W. (1990), "A General Non-Probabilistic Theory of Inductive Reasoning", in: R.D. Shachter, T.S. Levitt, J. Lemmer, L.N. Kanal (eds.), *Uncertainty in Artificial Intelligence* 4, Elsevier, Amsterdam, pp. 149-158
- Spohn, W. (1993), "Causal Laws are Objectifications of Inductive Schemes", in: J. Dubucs (Hg.), *Philosophy of Probability*, Kluwer, Dordrecht 1993, pp. 223-252
- Stalnaker, R.C. (1978), "Assertion", in: P. Cole (ed.), *Syntax and Semantics Vol. 9: Pragmatics*, Academic Press, New York, pp. 315-332
- Stalnaker, Robert C. (1987), "Belief Attribution and Context", in: R. Grimm, D. Merrill (eds.), *Contents of Thought*, Tucson, pp. 140-156