

# Degrees of Belief — I

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Website: [users.ox.ac.uk/~mert2060/2017/Degrees-of-belief](http://users.ox.ac.uk/~mert2060/2017/Degrees-of-belief)

## Schedule of Lectures

1. Introduction: degrees of belief and their structure.
2. Learning and confirmation
3. Decision theory
4. Subjective and objective probability

(Lectures 2 and 3 are switched relative to the Lecture Prospectus.)

## 1 Degrees of Belief

### 1.1 Credences

**Terminology:** Degrees of Belief = levels of **confidence** or (the usual jargon:) **credence**.

$$\text{Clara} \left\{ \begin{array}{l} \text{does not believe } \textit{but} \\ \text{has some level of confidence } \textit{or} \\ \text{has some credence } \textit{or} \\ \text{'believes to some degree'} \end{array} \right\} \underline{\text{that it will rain.}}$$
$$\text{Clara} \left\{ \begin{array}{l} \text{is more confident } \textit{or} \\ \text{has higher credence} \end{array} \right\} \underline{\text{that it will rain}} \text{ than } \underline{\text{that it will stay dry.}}$$

'Clara's credences' are her levels of confidence in various propositions.

**Bayesian Epistemology:** The leading philosophical theory, or family of theories, of credences, and particularly of the norms that govern them. (Contrast 'traditional' epistemology, which focuses on belief, especially justified belief and knowledge.)

### 1.2 Why Study Credences?

In many cases credences seem to be *more important* than ordinary belief:

(1) Responding to evidence. Clara sees a forecast for good weather on TV. She remains agnostic (the forecast was for London, not Oxford), but she becomes more confident that it will stay dry. [Lecture 2]

(2) Action guidance. Having become more confident that it will stay dry, Clara leaves her umbrella at home. Before she saw the forecast, she had intended to bring it with her. [Lecture 3]

**Question.** Do beliefs rather than credences play any important role in these examples?

(3) Philosophy of Probability. [Lecture 4] Contrast:

(A) Clara is fairly confident that it will rain.

(B) Clara believes that it will probably rain.

These say similar things, but on the surface they are quite different. Bayesian epistemology is often associated with 'subjectivist' views of probability that explain (B) in terms of (A).

## 2 The Standard View: Probabilism

### 2.1 The View

Suppose that Clara has some confidence that  $P$  is true. Then, *insofar as Clara is rational*:

1. We can quantify credences: we can represent Clara's credence in  $P$  by a number,  $\text{Cr}(P)$ . The higher the number, the more confident Clara is that  $P$  is true.
2. More precisely, we can choose these numbers to fit together in a certain way: they satisfy the *probability axioms*, that is, they behave like probabilities do:<sup>1</sup>
  - (a)  $\text{Cr}(P)$  is always between 0 and 1.<sup>2</sup>
  - (b)  $\text{Cr}(\text{not } P) = 1 - \text{Cr}(P)$
  - (c)  $\text{Cr}(P \text{ or } Q) = \text{Cr}(P) + \text{Cr}(Q) - \text{Cr}(P \text{ and } Q)$ .

HEURISTIC: Credences are *like* beliefs about probability. In standard probabilistic cases (flipping coins, rolling dice) your credences should match the ordinary probabilities. (This is *not* part of Probabilism, though – it's an extra claim – more in week 4.)

EXAMPLE OF AXIOM (c): You roll a fair die.

$$\text{Cr}(\text{Roll } 1, 2, \text{ or } 3) = \text{Cr}(\text{Roll } 1 \text{ or } 2) + \text{Cr}(\text{Roll } 2 \text{ or } 3) - \text{Cr}(\text{Roll } 2)$$

$$\frac{3}{6} = \frac{2}{6} + \frac{2}{6} - \frac{1}{6}.$$

### 2.2 Arguments for Probabilism: Dutch Books

A traditional but unsatisfactory argument (de Finetti); some alternatives are available.

#### Step 1: Explain How to Quantify Credences

**Main idea:** I offer Clara a deal: she gives me money up front, and I promise that *if it rains* I'll pay her back £1. How much money should she be willing to give me? The more confident she is that it will rain (so I will pay her back), the more she should be willing to give me.

**In general:** Clara's *fair price* for  $P$  is the most she is willing to pay for a promise of £1 if  $P$  is true. (The resulting agreement is called a **unit bet** on  $P$ .) Intuitively, the larger Clara's fair price for  $P$ , the more confident Clara is that  $P$  is true.

**The Betting Principle.**  $\text{Cr}(P)$  equals Clara's fair price for  $P$ .

**Basic issue:** what is the status of this 'principle'? It is not always true that Clara's fair price represents her level of confidence.

EXAMPLE. Suppose  $P$  is the proposition that the world will end in 10 years. Clara's fair price for  $P$  may be 0, no matter how confident she is that  $P$  is true.

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<sup>1</sup>The axioms of probability theory' often called the Kolmogorov axioms, usually also include countable additivity, a generalisation of (c). But countable additivity is less well supported than the other axioms.

<sup>2</sup>As a student pointed out, a further axiom is that  $\text{Cr}(\top) = 1$ , where  $\top$  is a tautology.

## Step 2: Argue for the Probability Axioms

*Assume the Betting Principle is true.*

**Sample Argument:** If Clara is rational, then  $Cr(P)$  cannot be more than 1.

Indeed, suppose  $Cr(P)$  is more than 1. Then, by the Betting Principle, Clara is willing to pay more than £1 for a unit bet on  $P$ . But she will only get £1 back, at most! She is willing to give away money!! She must be irrational!!! The general strategy:

**Dutch Book:** a set of bets which, if all accepted, would logically guarantee a loss.

**The argument** (still assuming the Betting Principle):

- (P1) If Clara violates Probabilism, then there is some set of bets, each of which Clara is willing to accept, which together form a Dutch Book.
- (P2) If Clara is willing to accept each of several bets, and she is rational, then she is willing to accept all of the bets together. ('The Package Principle')
- (P3) If Clara is willing to accept a Dutch Book, then she is not rational!!!
- (C) Therefore, if Clara is rational, she must not violate Probabilism.

**Objections?** Here (P1) is more or less a theorem. But (P2) and (P3) are dubious (as is the Betting Principle).

**General vague worry:** Beliefs should aim at truth, not at usefulness. Cf. Pascal's Wager.

**Question.** What is the best way to understand Dutch Book arguments? In general, can pragmatic arguments tell us anything about epistemology?

- See Ramsey, Joyce for alternatives to Dutch Book arguments. See Kyburg and Eriksson-Hájek for critical commentaries.

## 3 Ordinary Belief Revisited

Can we characterise belief in terms of credences? The simplest views:

**Belief as Certainty.** To believe that  $P$  is true is just to be completely certain that  $P$  is true.

'**The Lockean Thesis**'. To believe that  $P$  is true is just to be sufficiently confident (but maybe not completely certain) that  $P$  is true.

**THE LOTTERY.** Clara buys a raffle ticket – one out of 1000. She is very confident that her ticket will lose, but she doesn't especially *believe* it will lose. The more tickets, the more confident she would be; she could be very confident indeed; but she would still withhold belief. Therefore nothing short of complete certainty is sufficient for belief.

On the other hand, complete confidence seems to be a very high standard.

**THE PREFACE.** Clara writes a non-fiction book. She's an honest and careful scholar: she doesn't write anything she doesn't believe. But she is also modest: she is pretty certain that at least one of the claims is mistaken. She apologises for this in the book's preface.

Clara is the epitome of rationality. But if she were *completely certain* of each claim, she would have to be certain of their conjunction. (E.g. this follows from Probabilism.) She is not confident of the conjunction; therefore she is not completely certain of every claim. Therefore complete certainty is not necessary for belief. (But the Lockean Thesis works pretty well!)

**Question.** What attitudes should Clara have in THE PREFACE and THE LOTTERY? What, if anything, does that tell us about the relationship between belief and credence?

- See Hawthorne and Weatherson for Belief as Certainty; see Foley for the Lockean Thesis; see Easwaran (2015) for an attempt to reduce credence to belief.

## Further Reading

### Surveys

Eagle, A. (2011) *Philosophy of Probability*, Routledge.

[A collection of classic papers, including some of those below, with introductions by Eagle. It includes a 'Probability Primer', giving a brief but thorough introduction to the maths of probability, aimed at philosophers.]

Easwaran, K. (2011). 'Bayesianism I' and 'Bayesianism II', *Philosophy Compass* 6/5, 312–332.

[A concise two-part survey with useful references.]

As usual, a variety of useful articles can be found in the *Stanford Encyclopedia of Philosophy*, online.

### Probabilism

Ramsey, F. P. (1926) 'Truth and Probability', reprinted in Eagle above.

[In many ways the beginning of Bayesianism. The source (along with de Finetti) of 'Dutch Book' and (more especially) 'Representation Theorem' arguments for Probabilism.]

Kyburg, H. (1978) 'Subjective Probability: Criticisms, Reflections, and Problems', *Journal of Philosophical Logic* 7, 157–180. Reprinted in Eagle.

[Critical analysis of arguments for probabilism, concluding that 'the theory of subjective probability is psychologically false ... and philosophically bankrupt'.]

Eriksson, L. and Hájek, A (2007). 'What are Degrees of Belief?' *Studia Logica* (2007) 86: 183–213.

[Similarly critical, but maintains over all that probabilism is 'our best theory of rational belief and decision'.]

Joyce, J. M. (1998) 'A Non-Pragmatic Vindication of Probabilism', *Philosophy of Science* 65, 575–603. Reprinted in Eagle.

[Defends probabilism on overtly epistemic rather than pragmatic grounds. ]

### Outright Belief

Foley, R. (1992) 'The Epistemology of Belief and the Epistemology of Degrees of Belief', *American Philosophical Quarterly* 29 (2), 111–124.

[Defends the 'Lockean' view that belief corresponds to sufficient credence.]

Hawthorne, J. and Weatherson, B. (2000) 'Beliefs Old and New', unpublished manuscript, <http://brian.weatherson.org/belief.pdf>

[Defends a contextualist version of the view that belief corresponds to certainty.]

Easwaran, K. (2015) 'Dr. Truthlove or: How I Learned to Stop Worrying and Love Bayesian Probabilities', *Noûs* 50 (4), 816–53.

[A recent attempt to reduce credence to belief.]