- We assume our agent has a *probabilistic* credence function $b(\cdot)$ [11, 21, 20]. This allows us to use $b(\cdot)$ to explicate notions of (subjective) *expected epistemic utility* (EEU).
- We assume that our agent takes exactly one of three qualitative attitudes (B, D, S) toward each member of a finite agenda $\mathcal{A}$ of (classical, possible worlds) propositions.
- We do *not* assume that these qualitative judgments can be *reduced* to $b(\cdot)$. But, we will use $b(\cdot)$ to derive a *rational coherence constraint* for qualitative judgment sets $\mathbf{B}$ (on $\mathcal{A}$).
- This derivation requires both the agent's credence function $b(\cdot)$ and an *epistemic utility function* $u(\cdot)$ [10, 15, 17].

  ☞ Following Easwaran [3], we assume $u(\cdot)$ depends *only* on whether the agent's judgments are *accurate* (*viz.*, *veritism*).
- Specifically, our agent attaches some *positive* utility ($\mathfrak{r}$) with making an *accurate* judgment, and some *negative* utility ($-\mathfrak{w}$) with making an *inaccurate* judgment (where $\mathfrak{w} \geq \mathfrak{r} > 0$).

- Because suspensions are neither accurate nor inaccurate (*per se*), our agent will attach *zero* epistemic utility to suspensions $S(p)$, independently of the truth-value of p.
- Thus, we have the following piecewise definition of $u(\cdot, w)$.

$$u(B(p), w) \stackrel{\text{def}}{=} \begin{cases} -\mathfrak{w} & \text{if } p \text{ is false at } w \\ \mathfrak{r} & \text{if } p \text{ is true at } w \end{cases}$$

$$u(D(p), w) \stackrel{\text{def}}{=} \begin{cases} \mathfrak{r} & \text{if } p \text{ is false at } w \\ -\mathfrak{w} & \text{if } p \text{ is true at } w \end{cases}$$

$$u(S(p), w) \stackrel{\text{def}}{=} \begin{cases} 0 & \text{if } p \text{ is false at } w \\ 0 & \text{if } p \text{ is true at } w \end{cases}$$

- With this *veritistic* epistemic utility function in hand, we can derive a naïve (and simple) EUT coherence requirement.

- To do so, we'll also need a *decision-theoretic principle*.
- Our principle is based on the idea that epistemic *rationality* requires the minimization of *expected* inaccuracy — *i.e.*, the maximization of expected epistemic utility [10, 19, 9, 4, 14].

  Coherence. An agent's belief set $\mathbf{B}$ over an agenda $\mathcal{A}$ is said to *cohere* their credences $b(\cdot)$ just in case $\mathbf{B}$ *maximizes* *b-expected epistemic utility*, *i.e.*, iff $\mathbf{B}$ maximizes:

$$EEU(\mathbf{B}, b) \stackrel{\text{def}}{=} \sum_{p \in \mathcal{A}} \sum_{w \in W} b(w) \cdot u(\mathbf{B}(p), w)$$

  where $\mathbf{B}(p)$ is the agent's attitude toward p, and $W \stackrel{\text{def}}{=} \bigcup \mathcal{A}$.[1]
- The consequences of **Coherence** are rather simple and intuitive. It is straightforward to prove the following result.

[1]We assume "*act-state independence*" (ASI): $\mathbf{B}(p)$ and p are *b-independent*. Violations of ASI lead to troublesome cases (see, *e.g.*, [8, 1, 2, 12] for discussion), but these cases are beyond the scope of today's presentation.

Theorem ([3]). An agent with credence function $b(\cdot)$ and qualitative judgment set $\mathbf{B}$ over agenda $\mathcal{A}$ satisfies **Coherence** *if and only if* for all $p \in \mathcal{A}$

$$B(p) \in \mathbf{B} \textit{ iff } b(p) > \tfrac{\mathfrak{w}}{\mathfrak{r}+\mathfrak{w}},$$

$$D(p) \in \mathbf{B} \textit{ iff } b(p) < \tfrac{\mathfrak{r}}{\mathfrak{r}+\mathfrak{w}},$$

$$S(p) \in \mathbf{B} \textit{ iff } b(p) \in \left[\tfrac{\mathfrak{r}}{\mathfrak{r}+\mathfrak{w}}, \tfrac{\mathfrak{w}}{\mathfrak{r}+\mathfrak{w}}\right].$$

☞ In other words, **Coherence** *entails Lockean representability*, where the Lockean thresholds are determined by the way the agent (relatively) values accuracy *vs.* inaccuracy.

- This provides an elegant, EUT-based explanation of why Lockean representability is a rational requirement [7] for agents with *both* credences *and* qualitative attitudes.
- Leitgeb [13] accepts **Coherence** as a *necessary* requirement of epistemic rationality. But, he adds a *stability* requirement for (full) belief. Leitgeb's stability requirement is (essentially) a *resilient* form of (normative) Lockeanism.

- On Leitgeb's approach, a rational agent with credence function b (over a Boolean algebra $\mathcal{B}_W$) *stably* believes a proposition p, *viz.*, $B(p)$ iff p is entailed by some proposition B_W that is p*-stable*, where this is defined as:

  p-stability. Given a probability model $\langle \mathcal{B}_W, b(\cdot) \rangle$, a proposition $x \in \mathcal{B}_W$ is **p-stable** iff $b(x \mid y) > 1/2$, for all $y \in \mathcal{B}_W$ such that $x \,\&\, y \neq \bot$ and $b(y) > 0$.

☞ Leitgeb requires that an agent's beliefs satisfy a *resilient* [24] Lockean threshold — they must be b-probable, and they must *remain so*, under possible conditionalizations.

- Leitgeb's theory has some odd consequences [16, 18].
  - Any (non-trivial) stable belief can be undermined, merely by introducing b*-irrelevant possibilities* (*e.g.*, that some fair coin toss landed heads) into an agent's epistemic space [23, 6].
  - Small perturbations to $b(\cdot)$ that *lower* $b(p)$ can *make* $B(p)$ *rational*, where $B(p)$ was previously *ir*rational [6].

- From the point of view of naïve epistemic utility theory (*i.e.*, Easwaran's framework), Leitgeb's *stability* can be seen as a kind of *resilient EEU-maximization*. That is, we have:

  Bridge ([6]). Let $\mathcal{Y}$ be any set of W-propositions (with nonzero b-credence). If a belief set $\mathbf{B}$ (on $\mathcal{A}$) maximizes

  $$EEU_y(\mathbf{B}, b) \stackrel{\text{def}}{=} \sum_{p \in \mathcal{A}} \sum_{w \in W} b(w \mid y) \cdot u(\mathbf{B}(p), w)$$

  for all $y \in \mathcal{Y}$, then $\mathbf{B}$ is *resiliently* Lockean representable by $b(\cdot \mid y)$, *for each* $y \in \mathcal{Y}$, with threshold $t = \frac{\mathfrak{w}}{\mathfrak{r}+\mathfrak{w}}$.

- When viewed from this perspective, it is not too surprising that Leitgeb-style stability is such a strong (and peculiar) requirement. Think about the *practical* analogue.

☞ If we required preferences (in general) to have *resilient* EU-representations, then most preference structures we now take to be coherent [22] would become incoherent (and, they would become *sensitive to irrelevant possibilities*, *etc.*).

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