Pragmatism and Inquiry, by Isaac Levi. Oxford: Oxford University Press, 2012. Pp. 256 + viii. H/b £36.

The twin pillars of Levi's epistemology are his *infallibilism* and his *corrigibilism*. According to infallibilism, any agent is committed to being absolutely certain about anything she fully believes. From her own perspective, there is no serious possibility that any proposition she believes is false. She takes her own beliefs to be infallible, in this sense. But this need not make her dogmatic, on Levi's view. According to his corrigibilism, an agent might come to have good reason to change her beliefs, and respond accordingly. And she might recognise this possibility *ex ante*, despite being absolutely certain that her current beliefs are true.

Levi takes the central task of epistemology to be this: provide an account of justified belief change, of the sort countenanced by his corrigibilism. An agent's current beliefs need no justification. Changing them does. Pragmatism provides the framework for such an account. Inquiry, on the pragmatist view — whether it functions to produce changes in belief or some other sort of attitude — is a goal-directed activity. As such, it is governed by means-end, or practical rationality. And the changes it produces are justified just in case they are expected to best promote the aims or goals of that inquiry.

The principal aim of *theoretical* inquiry, the sort of inquiry that trades in belief changes, is to *relieve doubt by acquiring new error-free information*, according to Levi. Put differently, inquiry aims to produce epistemically valuable beliefs, which on Levi's view are beliefs that are both close to the truth (avoid error), and informative. A change in belief is justified just in case it maximises expected epistemic value.

The essays in this volume provide a lucid, insightful development of Levi's epistemology by situating it with respect to the pragmatism of Charles Pierce and John Dewey. Dewey, for example, eschews closeness to the truth (avoidance of error) as a proper aim of inquiry. "Pragmatism and Change of View" illuminates Levi's reasons for departing from Dewey. Without a healthy concern to avoid error, rational inquirers might simply relieve doubt by becoming maximally opinionated, in whatever manner they please. Concern to avoid error checks the tendency to opinionation. Similarly, "Seeking Truth" illuminates Levi's reasons for departing from Pierce. Pierce takes the ultimate aim of inquiry to be settling, in the long run, on the true complete story of the world. But such an aim would promote dogmatism, Levi argues. If rational inquirers were concerned to settle on the true (error-free) complete story of the world *in the long run*, they would never give up any beliefs. After all, according to infallibilism, no rational agent admits the possibility that any proposition she believes is false. So from her current perspective, giving up a belief not only involves abandoning 'valuable information', but also introduces the possibility of error in the long run (coming to believe its negation). No rational inquirer, if she shared Pierce's aims, would make such a move. So rational inquirers — agents who *do*, for various reasons, abandon current beliefs — must not be concerned to settle on the full error-free story of the world in the long run. Instead, Levi thinks, they are only concerned to avoid error in the short run, in their most proximate post-inquiry beliefs.

This volume also responds to a number of interesting challenges set out by Jonathan Adler, Tim Williamson, Peter Unger and others. Levi's scholarship is first rate, his philosophical vision keen, and his epistemological programme impressive. I especially recommend this volume to anyone interested in acquiring a nuanced historical perspective on Levi's epistemology. It will prove illuminating for many more as well: anyone interested in contemporary developments in pragmatism, scientific inquiry and methodology, statistical inference, and the dynamics of rational belief.

The remainder of this brief review will explore whether Levi's infallibilism can be made to sit comfortably with his account of rational belief change, on the one hand, and his account of epistemic value, on the other (or with *any* reasonable account of epistemic value for that matter). I will argue that it cannot.

Levi's work, together with the work of L.J. Savage, Bruno de Finetti, Jim Joyce, Teddy Seidenfeld and others, has given rise to what has come to be known as *epistemic utility theory*. Epistemic utility theorists aim to vindicate epistemic norms by elucidating the ways in which they are a good means to the end of epistemic value. For example, many epistemologists maintain that when an agent learns a new proposition, and nothing more, she ought to use her old conditional degrees of belief, or credences as her new unconditional credences. She ought to update by *conditionalisation*. Greaves and Wallace (2006) and Easwaran (2013) explain why this norm has the force that it does by showing that the plan to update one's old credences by conditionalisation is *precisely* the plan that rational agents will expect to produce the most epistemic value, given some fairly plausible assumptions about the nature of such value.

These results generalise to full beliefs as well, in a way that spells trouble for Levi's infallibilism. If infallibilism is true, an agent's plans for updating her full beliefs must be *spineless*, I will argue. She cannot plan to believe any proposition unless her new evidence *rules its negation out entirely*, regardless of how strongly her new evidence confirms that proposition. Rational belief change, however, is not spineless. So infallibilism must be false. Or so I will argue.

Start with an example. You are going to visit a colleague. You are unsure whether she is at her desk, and accordingly suspend judgment on the matter (neither believe nor disbelieve it). Your credences before walking into her office are:

	S: *See your colleague at her desk*	$\neg S$: *Do not see her at her desk*
D: *Colleague is at her desk*	$c(S\&D) = 0.499$	$c(\neg S\&D) = 0.001$
$\neg D$: *Colleague is not at her desk*	$c(S\&\neg D) = 0.001$	$c(\neg S\&\neg D) = 0.499$

So you take S (seeing your colleague at her desk) to be strong, but not quite conclusive evidence for D (she is in fact at her desk). Likewise for $\neg S$ and $\neg D$.

When you walk in, you will either see her at her desk or not. And if rational, you will update both your credences and full beliefs. You *could* conceivably update those beliefs in accordance with any number of plans, or in Levi's terms, 'programs for routine expansion'. Plans or programs are just rules that specify, for each possible learning experience, an updated credal state or full belief state to adopt (*cf.* Levi 1991, p. 77). But your response is *justified*, on Levi's view, just in case it is the product of a plan that maximises expected epistemic value.

For precision, assume that your credences $c : \Omega \rightarrow \mathbb{R}$ are defined over a Boolean algebra of propositions Ω. And for each atom ω of Ω, let w_ω be 'the' possible world that makes ω true. (Differences between worlds that agree on the truth-value of ω do not matter for our purposes. Ignore them.) Let $\mathcal{W}$ be the set of all such worlds. Then a plan for updating one's credences is a function $\mathcal{P} : \mathcal{C} \times \mathcal{W} \rightarrow \mathcal{C}$ that maps prior (pre-learning) credal states c in $\mathcal{C}$ (the set of possible credal states), and worlds w in which you have some learning experience or other E in $\mathcal{E}$ (the set of possible learning experiences), to updated credal states $c' \in \mathcal{C}$. *Mutatis mutandis* for full beliefs. (We assume that $\mathcal{E}$ partitions $\mathcal{W}$. We also assume that updating plans are *available*, as in Greaves and Wallace (2006), *i.e.*, $\mathcal{P}$ recommends the same updated credences in any two worlds in which you have the same learning experience: $\mathcal{P}(c, w) = \mathcal{P}(c, w')$ for any $w, w' \in E$.)

Your response to your learning experience is justified, then, just in case it is the product of a plan $\mathcal{P}$ that maximises expected epistemic value: for any plan $\mathcal{P}' \neq \mathcal{P}$,

$$\mathbf{Exp}_c(\mathcal{U}(\mathcal{P})) = \sum_{w \in \mathcal{W}} c(w) \cdot \mathcal{U}(\mathcal{P}(c, w), w) > \sum_{w \in \mathcal{W}} c(w) \cdot \mathcal{U}(\mathcal{P}'(c, w), w) = \mathbf{Exp}_c(\mathcal{U}(\mathcal{P}')).$$

$\mathcal{U}$ is an *epistemic utility function*, which measures the all-things-considered epistemic value of a belief state (full or partial) at a world. $\mathcal{U}$ maps credal states c and worlds w to non-negative real numbers, $\mathcal{U}(c, w)$, which measure how well c does if w is actual, in terms of striking an optimal balance between epistemic good-making features. *Mutatis mutandis* for full belief states.

Greaves and Wallace (2006) and Easwaran (2013) show that rational agents must plan to update their credences by conditionalisation: $\mathcal{P}(c, w) = c_E$ for any world w in which you have learning experience E (any $w \in E$), at least when $c(E) > 0$. (As usual, $c_E(X) = c(X \& E)/c(E)$ for all $X \in \Omega$). Their results depend only on the assumption that plausible epistemic utility measures $\mathcal{U}$ are *strictly proper*: every coherent credence function c uniquely maximises expected epistemic utility from its own perspective.

Strict Propriety. $\mathbf{Exp}_c(\mathcal{U}(c)) > \mathbf{Exp}_c(\mathcal{U}(b))$ for any coherent c and $b \neq c$.

To see why strict propriety is a reasonable property to demand of $\mathcal{U}$, consider an argument adapted from Gibbard (2007, pp. 7-10) and Joyce (2009, pp. 277-9). Any coherent credal state c is uniquely rationally permissible in certain evidential circumstances. Imagine, for example, that you know that the chance of X is $c(X)$ for all X, and no more. According to the Principal Principle, then, c is the uniquely permissible credal state for you to adopt. Any other credal state b is impermissible in your evidential circumstances.

But now suppose that you have credences c, and $\mathbf{Exp}_c(\mathcal{U}(c)) \leq \mathbf{Exp}_c(\mathcal{U}(b))$. Then you expect that you could do just as well or better, epistemically speaking, by having different credences b. $\mathbf{Exp}_c(\mathcal{U}(b))$ and $\mathbf{Exp}_c(\mathcal{U}(c))$ encode your best estimates of the all-things-considered epistemic value of b and c, respectively. And these best estimates act as 'summary statistics' that reflect how much epistemic reason you have to be in those states. So you see yourself as having no epistemic reason to avoid the impermissible credal state b. Plausible epistemic utility measures $\mathcal{U}$ give agents reasons to avoid being in impermissible states. Hence, $\mathcal{U}$ must be strictly proper.

With strict propriety in hand, Greaves and Wallace argue as follows:

$$\begin{aligned}
\mathbf{Exp}_c(\mathcal{U}(\mathcal{P})) &= \textstyle\sum_{w\in\mathcal{W}} c(w)\cdot\mathcal{U}(\mathcal{P}(c,w),w) && (i)\\
&= \textstyle\sum_{E\in\mathcal{E}}\sum_{w\in E} c(w)\cdot\mathcal{U}(\mathcal{P}(c,w),w) && (ii)\\
&= \textstyle\sum_{E\in\mathcal{E}}\sum_{w\in E} c(E)\cdot c_E(w)\cdot\mathcal{U}(\mathcal{P}(c,w),w) && (iii)\\
&= \textstyle\sum_{E\in\mathcal{E}} c(E)\cdot\sum_{w\in E} c_E(w)\cdot\mathcal{U}(\mathcal{P}(c,w),w) && (iv)\\
&= \textstyle\sum_{E\in\mathcal{E}} c(E)\cdot\sum_{w\in\mathcal{W}} c_E(w)\cdot\mathcal{U}(\mathcal{P}(c,w),w) && (v)
\end{aligned}$$

From here, it is easy to see why rational agents must plan to update by conditionalisation. Since $\mathcal{U}$ is strictly proper, $\mathbf{Exp}_{c_E}(\mathcal{U}(\mathcal{P})) = \sum_{w\in\mathcal{W}} c_E(w)\cdot\mathcal{U}(\mathcal{P}(c,w),w)$ takes a unique maximum when $\mathcal{P}(c,w)$ is equal to c_E (for all $w \in E$), rather than some other $b \neq c_E$. So whatever values the $c(E)$'s take, $\mathbf{Exp}_c(\mathcal{U}(\mathcal{P}))$ will take a unique maximum when $\mathcal{P}$ is the plan to update by conditionalisation.

This result generalises to the full belief case in a way that spells trouble for Levi's infallibilism. Measures of all-things-considered epistemic value for full belief should satisfy a condition similar to strict propriety: *manifestness*. Strict propriety requires that certain important deontic facts — *viz.*, the fact that for any coherent credence function c there are circumstances in which c is uniquely permissible — be manifest in c's own estimates of all-things-considered epistemic value. Manifestness requires something similar: if it is rationally impermissible to have both coherent credences c and full beliefs k — because the two do not 'hang together' in the right way — then k should not maximise expected epistemic utility relative to c.

Manifestness. If it is rationally impermissible to have both coherent credences c and full beliefs k, then it is not the case that $\mathbf{Exp}_c(\mathcal{U}(k)) \geq \mathbf{Exp}_c(\mathcal{U}(k'))$ for all $k' \neq k$.

The deontic status (impermissibility) of the credal state/full belief state pair $\langle c, k\rangle$ should be manifest in c's estimates of all-things-considered epistemic value. The rationale is not wholly unfamiliar. If k maximises expected epistemic utility relative to c, then in our agent's own best estimate, she could do no better, epistemically speaking, than to adopt k. Our agent sees herself as having no epistemic reason to avoid k. Plausible epistemic utility measures $\mathcal{U}$ give agents reasons to avoid being in impermissible states.

To illustrate why this spells trouble for infallibilism, consider Levi's preferred epistemic utility function, which takes the form:

$$\mathcal{U}(k,w) = \alpha \cdot w(k) + (1-\alpha)\cdot(1-m(k)) \text{ (cf. Rott (2006)).}$$

The first quantity, $w(k)$, is the truth-value of your belief state k at w (0 if false, 1 if true), *i.e.*, the truth-value of the conjunction of all your beliefs according to k. The second quantity, $1-m(k)$, is k's degree of informativeness, which measures how virtuous k is, in terms of "simplicity, explanatory and predictive power," etc. (Levi 1991, p. 83; Levi 2012, p. 179).

These two quantities — truth-value and degree of informativeness — are the two principal good-making features of belief states k, on Levi's view. They determine the extent to which k lives up to what William James called our two 'great commandments as would-be knowers', *viz.*, Shun error! Believe truth! α represents the degree of priority that you give to these competing commandments. The closer α is to 1, the more you prioritise avoidance of error over the pursuit of truth (acquiring valuable information).

Return now to our initial example. You are going to visit a colleague, and are unsure whether she is at her desk. Your current credences c are as follows:

	S: *See your colleague at her desk*	$\neg S$: *Do not see her at her desk*
D: *Colleague is at her desk*	$c(S\&D) = 0.499$	$c(\neg S\&D) = 0.001$
$\neg D$: *Colleague is not at her desk*	$c(S\&\neg D) = 0.001$	$c(\neg S\&\neg D) = 0.499$

And suppose infallibilism is true:

INFALLIBILISM. It is rationally permissible to have both coherent credences c and full beliefs k only if the following is true: if X is believed according to k ($\neg X$ is inconsistent with k), then $c(X) = 1$.

The *only* way to satisfy this constraint, in the case at hand, is to suspend judgment across the board, so that all of $S\&D$, $S\&\neg D$, $\neg S\&D$ and $\neg S\&\neg D$ are consistent with your belief state k (*i.e.*, none are disbelieved according to k). *Every* other potential full belief state k' is impermissible, in light of your credences c, according to Infallibilism. So *every* other k' must fail to maximise expected epistemic utility, relative to c, according to Manifestness. That is, k must uniquely maximise expected epistemic utility, relative to c.

Suppose further, for illustrative purposes, that you treat each of the above hypotheses as equally informative; $m(S\&D) = m(S\&\neg D) = m(\neg S\&D) = m(\neg S\&\neg D) = 1/4$. Then, if $\mathcal{U}$ takes Levi's preferred form — $\mathcal{U}(k,w) = \alpha \cdot w(k) + (1-\alpha)\cdot(1-m(k))$ — and satisfies Infallibilism and Manifestness, α must be greater than 750/751. This means that you have a near-overriding concern for the avoidance of error over the pursuit of truth.

And this has a drastic effect on how you plan to update your beliefs. Consider, for example, the *spineless* updating plan $\mathcal{Q}$. It says: if you learn S (that you see your colleague at her desk), add only that proposition (and its logical consequences) to your stock of full beliefs. Do not add any auxiliary hypothesis H, regardless of how strongly it is confirmed by your new evidence (unless its negation, despite not being a logical consequence of S, is nevertheless ruled out entirely by your new evidence, *i.e.*, $c(\neg H|S) = 0$). Do not, in particular, come to believe that she is *actually* at her desk.

Compare this with the plan $\mathcal{Q}'$ to update by believing the testimony of your senses. If you learn that you see your colleague at her desk, come to believe not only this fact about you, but also that she is *in fact* at her desk.

However sensible $\mathcal{Q}'$ might seem, in light of the fact that you take S (you see your colleague at her desk) to be near-conclusive evidence for D (she is actually at her desk), you cannot adopt this updating plan, given Infallibilism and Manifestness. Together they force $\mathcal{U}$ to reflect such a severe concern for avoiding error that $\mathcal{Q}$ *uniquely* maximises expected epistemic value.

This phenomenon is entirely general.

> **Theorem**. Suppose epistemic value is measured by a utility function $\mathcal{U}$ that satisfies Manifestness (whether or not it takes Levi's preferred form). Suppose further that your credences and full beliefs satisfy Infallibilism. Then you must plan to update *spinelessly*, *i.e.*, by only ever coming to believe propositions that you learn directly (or propositions whose negations are entirely ruled out by what you learn directly), regardless of how well auxiliary hypotheses might be supported by that evidence.

The proof is simple. First observe:

$$\begin{aligned}
\mathbf{Exp}_c(\mathcal{U}(\mathcal{Q})) &= \textstyle\sum_{w\in\mathcal{W}} c(w)\cdot\mathcal{U}(\mathcal{Q}(k,w),w) && (i')\\
&= \textstyle\sum_{E\in\mathcal{E}}\sum_{w\in E} c(w)\cdot\mathcal{U}(\mathcal{Q}(k,w),w) && (ii')\\
&= \textstyle\sum_{E\in\mathcal{E}}\sum_{w\in E} c(E)\cdot c_E(w)\cdot\mathcal{U}(\mathcal{Q}(k,w),w) && (iii')\\
&= \textstyle\sum_{E\in\mathcal{E}} c(E)\cdot\sum_{w\in E} c_E(w)\cdot\mathcal{U}(\mathcal{Q}(k,w),w) && (iv')\\
&= \textstyle\sum_{E\in\mathcal{E}} c(E)\cdot\sum_{w\in\mathcal{W}} c_E(w)\cdot\mathcal{U}(\mathcal{Q}(k,w),w) && (v')
\end{aligned}$$

Now suppose that $\mathbf{Exp}_{c_E}(\mathcal{U}(\mathcal{Q})) = \sum_{w\in\mathcal{W}} c_E(w)\cdot\mathcal{U}(\mathcal{Q}(k,w),w)$ takes a maximum at $\mathcal{Q}(k,E) = k'$. Then, by Manifestness, it is rationally permissible to have both coherent credences c_E and full beliefs k'. In turn, by Infallibilism, X is believed according to k ($\neg X$ is inconsistent with k) only if $c_E(X) = 1$. That is, X is believed according to k only if your new evidence E rules out $\neg X$ entirely ($c_E(\neg X) = 0$). So, whatever values the $c(E)$'s take, $\mathbf{Exp}_c(\mathcal{U}(\mathcal{Q}))$ will only ever take a maximum when $\mathcal{Q}$ is the plan to update spinelessly, *i.e.*, the plan to only believe propositions that you learn directly (or propositions whose negations are entirely ruled out by what you learn).

Manifestness seems to be a non-negotiable constraint on plausible epistemic utility measures $\mathcal{U}$. And rational belief change is clearly not spineless. You are sometimes justified in coming to believe that your colleague is in her office when you walk in and see her there. Given our little theorem, then, infallibilism must be false.

This is not such a bad result, I think. Levi's principal reason for insisting on it is this: If infallibilism is false, then...

> ...it becomes unclear to me why anyone should undertake inquiries to improve the current doctrine as apologists for progressive science do. Accepting some conjecture in the current doctrine does not relieve doubt. The inquirer, after all, acknowledges that the conjecture is but a conjecture and, hence, might be false. Even if it is judged highly probable, doubt has not been removed and will not be removed unless information is added to the standard for serious possibility. Those who insist that agent X should allow for the serious possibility that X's current doctrine is false... ought to explain why anyone should wish to inquire. (Levi, 2012, p. 48)

But we need not give up on the idea that the aim of theoretical inquiry is to relieve doubt, if, as I have argued, infallibilism turns out to be false. We need only realise that doubt, like belief, comes in degrees. Suppose, as seems plausible, that an agent is less in doubt about a hypothesis the more extreme (high or low) her credence in it is. Then the rational pursuit of accuracy — the pursuit of credences that are close to the truth, and so, *inter alia*, extreme — dovetails quite naturally with the aim of relieving doubt.

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