Knowledge in Action[*]

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Abstract

Recent proposals that frame norms of action in terms of knowledge have been challenged by Bayesian decision theorists. The Bayesians object that these knowledge-based norms conflict with the highly successful and established view that rational action is rooted in degrees of belief. I argue that the knowledge-based and Bayesian pictures are not as incompatible as these objectors have made out. Attending to the mechanisms of practical reasoning exposes space for both knowledge and degrees of belief to play their respective roles.

A recent spate of proposals that action should be guided by knowledge has met with opposition from Bayesian decision theorists. On the knowledge-based proposals, practical reasoning should rely on what one knows, but according to Bayesians rational action is about maximizing expected utility with respect to one's credences.[1] Friends of Bayesianism worry that the knowledge-based picture conflicts with their credence-based view. For example, Douven (2008) objects that the knowledge-based picture presumes methods of practical reasoning incompatible with expected utility maximization. And Schiffer (2007) worries that the knowledge-based picture precludes credences from governing action.

But the knowledge-based and credence-based pictures are not as incompatible as one might think, a claim I'll defend by developing three irenic proposals. Very briefly, these proposals will be as follows. First, there are knowledge-based heuristics for practical reasoning which approximate the method of expected utility maximization. Second, credences can constitute knowledge by constituting dispositional flat-out beliefs about probabilities, so that acting on what one knows does not preclude being governed by one's credences. Third and finally, while knowledge-based norms require that one's reasons for acting be known propositions, this does not preclude credences from participating in practical reasoning by acting as weights for those reasons.

The picture to emerge will be one of rational agents striving to maximize expected utility by engaging in a variety of reasoning processes, drawing on a mixture of credal and knowledge states as appropriate. Which reasoning process we use in a

[1] I use 'credence', 'degree of belief', and 'partial belief' interchangeably.

given situation, and what mixture of credence and knowledge we draw upon, will depend on a number of factors: how important it is that an optimal decision be made, what knowledge is available, and the extent to which one's credences help determine the import of one's knowledge for an act's optimality. Detailing the mechanics of these processes and the norms governing them is a major project, and the success of my irenic proposals ultimately hangs on its successful execution. The work done in this paper makes progress towards that end, but does not settle the question just how compatible the Bayesian and knowledge-based pictures ultimately are. Towards the end of the paper, I outline some work that remains.

I will begin by outlining the knowledge-based and credence-based views in §1. I'll then use Douven and Schiffer's objections to the knowledge-based view as foils for my three proposals. Douven's worry will serve as a foil for the first proposal in §2, and Schiffer's as a foil for the second and third proposals in §3.

1 BACKGROUND

A number of authors now endorse knowledge-based norms of action.[2] We will use Hawthorne and Stanley's (2008) proposal as a representative:

The Reason-Knowledge Principle (RKP) Where one's choice is P-dependent,[3] it is appropriate to treat the proposition that P as a reason[4] for acting iff you know that P.

RKP embodies a sufficiency claim and a necessity claim. The sufficiency claim is that it is always appropriate to use relevant knowledge as a reason in practical reasoning. The necessity claim is that it is only appropriate to use what one knows as a reason for acting. Our main focus will be the necessity claim, as it has been the primary target of Bayesian critiques.

Why endorse RKP? Hawthorne (2004) and Hawthorne & Stanley (2008) argue that the necessity half of RKP accounts for the way we assess practical reasoning. If you decline very cheap insurance on the grounds that misfortune will not strike, you are subject to criticism, since you do not know misfortune won't strike. Stanley (2005) also defends an RKP-like claim on the grounds that it accounts for intuitive shifts in what one knows as stakes change. Under ordinary circumstances, Hannah

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2 See (Fantl & McGrath 2002), (Hawthorne 2004), (Stanley 2005), (Fantl & McGrath 2007), (Hawthorne & Stanley 2008), and (Weatherson 2012).

3 A choice is "P-dependent" iff which option is preferable is different given P than given $\neg P$. The restriction to P-dependent choices serves to avoid the absurd consequence that it is appropriate to use what one knows even when it is not relevant.

4 Hawthorne (2004) talks about "using P as a premise", rather than "treating P as a reason". I intend my proposals to accommodate either way of construing RKP.

knows that the bank is open on Saturday since she was there just a few Saturdays ago. But if a lot hangs on whether the bank will be open on Saturday—Hannah must deposit her paycheck to avoid dire financial consequences—she does not know without further evidence. These intuitions line up nicely with the thought that what she knows varies with what it would be appropriate for her to assume in practical reasoning.

On the Bayesian picture of decision making, actions are evaluated in terms of credences rather than knowledge:

The Expected Utility Principle (EUP) It is rational to take an action only if[5] it maximizes expected utility with respect to one's credences and utilities.[6]

Two motivations for EUP have been especially influential. The first is its agreement with common-sense: EUP gives intuitively plausible verdicts in a wide variety of cases.[7] The second argument for EUP is more technical: representation theorems show that violating EUP means having irrational preferences. If one does not maximize expected utility, one will have intransitive preferences, or violate the sure-thing principle, or something similar. (von Neumann & Morgenstern 1944; Savage 1954; Jeffrey 1965; Joyce 1999)

Much more could be said for and against each of RKP and EUP, as well as their respective motivations. But our question here is whether they are compatible. Why think they are not?

There are two broad kinds of concerns. The first are what we might call "B vs. K" issues. These arise from the fact that RKP appeals to knowledge while EUP appeals to beliefs (albeit partial ones). Many Bayesians would agree that a belief must be justified or rational in order to guide action, but must it be more than that? Must it have the extra, external features that separate knowledge from (justified) belief? Brown (2008a; 2008b) puts a point on this concern by comparing two subjects who both believe their train comes at 12:20 P.M., though only one actually knows this fact, while the other is in a Gettier (1963) scenario. Intuitively, these subjects are equally entitled to assume that the train comes at 12:20 P.M. in deciding when to leave the

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5 I state EUP as a necessary but not sufficient condition because it is possible to choose an expected utility maximizing option for the wrong reasons. And if one does, the action is not rational in an important sense; rational action, like rational belief, must be well-founded (but cf. (Maher 1993: 148–9)). This point will be important in §2.

6 The expected utility of act A is defined $\sum_i p(O_i|A)u(O_i \wedge A)$, where $\{O_i\}$ is a partition of possible outcomes of the act, p is the subject's credence function, and u her utility function.

7 Potential counterexamples have been discussed (Allais 1953; Ellsberg 1961; Nozick 1969). Proponents of EUP respond that these are cases where common sense goes astray, or the principle has been misinterpreted (Savage 1954; Jeffrey 1965; Maher 1993; Joyce 1999). But even if the alleged counterexamples are genuine, they leave mundane applications of the principle unaffected, and mundane applications are the cases of interest in discussions of RKP.

office, though RKP says that only the knower truly is.

The B vs. K difference is an important one, and points like Brown's pose a serious challenge for RKP. But these B vs. K issues will not be the focus here. For present purposes, I will assume that RKP's proponents have adequate answers to worries like Brown's. Maybe, as Hawthorne and Stanley (2008: 586) suggest, Brown's Gettiered subject is blameless because she makes an excusable mistake, with the need for an excuse betraying the fact that she has violated a norm, namely RKP. Or maybe some other response is correct. I won't pursue the matter here.

The second class of concerns are what we might call "partial vs. full" issues, arising from the fact that EUP appeals to partial beliefs while RKP appeals to knowledge and hence, presumably, full beliefs.[8] For example, one worry is that RKP and EUP presuppose incompatible views about how practical reasoning works. A theory based on full beliefs invites a natural deduction type picture, where premises are used to infer lemmas which are in turn used to infer conclusions about how to act. Whereas a theory based on partial beliefs suggests a very different sort of procedure, calculating values of actions by applying the expected utility formula.

This paper is concerned with these partial vs. full issues. My aim is to develop a picture of practical reasoning that integrates the partial and full belief perspectives, one where credences and knowledge (hence full beliefs) both have significant roles to play. The picture I will develop sees practical reasoning as drawing on a mixture of reasoning processes, some more classically Bayesian in their operation than others. These processes draw on a mixture of epistemic states, combining non-probabilistic knowledge with credences to settle on an appropriate action. In fact in some cases, I will argue, those states are one and the same (or at least very intimately metaphysically related), so that acting on a piece of knowledge amounts to acting on a credence. The resulting picture will not make RKP and EUP perfectly compatible, nor will it answer every concern about their compatibility. But it will bring the two closer together, and suggest ways for further work to close the gap.

2 METHODS OF PRACTICAL REASONING

RKP is supposed to be motivated in part by its ability to explain the impropriety of certain episodes of practical reasoning, like declining very cheap insurance on the grounds that misfortune will not strike, when you do not know it won't. One Bayesian worry is that such examples presuppose a step-by-step, premise-lemma-conclusion form of practical reasoning that is at odds with the Bayesian method of expected utility calculation.

Douven (2008) gives voice to this worry, focusing on an example of Hawthorne's

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8 This presumption has been challenged (Moss forthcoming), and will be challenged below (§3).

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([2004](#)). Suppose you have the opportunity to sell your lottery ticket for a penny and you reason as follows:

(i) My lottery ticket is a loser.
   So, if I keep the ticket, I will get nothing.
   But if I sell it, I will get a cent.
   So, I should sell the ticket.

RKP garners support from such examples by agreeing with common sense that the reasoning is faulty; the RKP diagnosis locates the fault in the fact that your reasoning is based on something you don't know, namely that your ticket is a loser. But, Douven counters, Bayesianism tells us the reasoning in (i) is bad for a different reason, namely that "it deploys the wrong kind of reasoning for the purpose at hand: a decision about whether to sell a lottery ticket (or any other decision, for that matter) is not to be taken on the basis of a deductive argument like (i), but on the basis of expected utility calculations." ([2008](#): 107) If the highly successful and widely endorsed Bayesian theory of decision is right, then isn't RKP on the wrong diagnostic track altogether?

There is an obvious reply to this initial Bayesian challenge, but a more serious challenge is waiting in the wings. The obvious reply is that Bayesianism does not require us to calculate expected utilities, neither consciously nor even unconsciously. Bayesian decision theory says that one should choose an option that maximizes expected utility, but it says nothing about how one must arrive at that choice. EUP, for example, does not say anything about what steps or reasoning process one must follow in coming to a decision, so long as one ends up at a decision that maximizes expected utility. Indeed, many Bayesians explicitly acknowledge that one needn't make one's choice on the basis of expected utility calculations, since they allow that dominance reasoning is rational when applicable. I might buy fire insurance because the resulting peace of mind will far outweigh the minor financial cost, leading to a better outcome whether there is a fire or not. In this case I do not calculate expected utilities, but instead use a form of reasoning that has the same effect.[9]

Reasoning that doesn't involve actually calculating expected utilities isn't just compatible with the letter of Bayesianism, it is also compatible with its spirit. The main arguments supporting EUP are silent on the question of how one arrives at an

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9 Interestingly, (i) seems to set out precisely this sort of argument for selling one's ticket, trying to establish that selling dominates. The natural Bayesian diagnosis of the flaw in this dominance reasoning is that it uses the wrong space of possibilities or the wrong distribution of probabilities over that space. But this Bayesian diagnosis actually looks to be compatible with RKP. Why can't you exclude the possibility that your ticket will win from your decision table? Because you do not know that it won't obtain. See Weatherson ([2012](#)) for more on the general proposal that RKP complements Bayesian reasoning by shaping decision tables.

expected utility maximizing decision. For example, the argument that EUP agrees with common sense frequently relies on dominance reasoning and other heuristics to elicit common sense judgments about cases. And the representation theorem argument for EUP doesn't speak to one's method of reasoning either, but instead to the coherence within one's beliefs and preferences. According to that argument, failing to choose an expected utility maximizing option means having intransitive preferences, or preferences that violate the sure-thing principle, or something similarly unpalatable. The idea is that choosing a maximal option is necessary for one's preferences and beliefs to cohere with one another. But any method of forming one's preferences that maximizes expected utility will avoid incoherence equally well.

The broad point here is that we must distinguish between what psychologists call theories of *substantive* rationality and theories of *procedural* rationality (Simon 1982). EUP is not a theory of *procedural* rationality, a theory that says which ways of reasoning towards optimal actions are good or bad. It is a theory of *substantive* rationality, a theory that says what choice is rational given one's epistemic state and values. Given one's beliefs, knowledge, epistemic probabilities, desires, utilities, and so on, which action is optimal? Bayesian decision theory says it is any action that maximizes expected utility. But it does not say anything about what reasoning or argumentation one may use to arrive at that choice (except that it must be reasoning that takes one to a substantively rational choice).

So why worry that expected utility maximization might be incompatible with the examples of practical reasoning RKP's proponents appeal to? Here we come to the more serious Bayesian challenge. What procedural theory could RKP's proponents have in mind such that:

(a) practical reasoning is representable in the step-by-step, premise-lemmas-conclusion format of (i), and

(b) it results in expected utility maximizing choices?

One might well be skeptical that any method of practical reasoning could satisfy both (a) and (b).[10]

Here again Douven gives voice to the worry, motivating skepticism about the joint satisfiability of (a) and (b) by focusing on another of Hawthorne's examples of practical reasoning, this time an example of allegedly good reasoning. Suppose you are a person of modest means shopping in a bookstore, and you are contemplating whether to buy the local destination guide or the more expensive worldwide guide. You reason as follows:

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10 I take this to be the challenge Douven ultimately means to raise for RKP, since he acknowledges the rationality of dominance reasoning (2008: fn. 21), and goes on to consider the possibility that RKP's proponents might prefer a procedural theory that does not involve calculating expected utilities.

(ii) I won't be able to afford a trip to an exotic destination.
      Thus, I won't have any use for the worldwide guide.
      Thus, I should buy the local destination guide.

RKP allows that (ii) is good reasoning, since you presumably know what you can afford, and this premise supports the subsequent lemma and conclusion. But, Douven contends, (ii) is only good if it is supplemented with a number of additional assumptions. For example, we must take you to know, or at least presuppose, that the worldwide guide is not of outstanding quality and the last copy to be found anywhere. We must also assume that the you do not expect to be in a much better financial position in a couple years. Further still, we must assume that your niece is not planning a trip to an exotic destination, so that she would have use for the guide. And so on. Douven's point seems to be that for (ii) to represent a good episode of reasoning, it must be an enthymematic representation of a much more involved argument:

(ii′) I won't be able to afford a trip to an exotic destination, *ever*.
       Thus, I won't have any use for the worldwide guide, *ever*.
       No one else I know will have any use for the worldwide guide, *ever*.
       I couldn't resell the worldwide guide for a profit.
       ⋮
       Thus, buying the local guide is the best[11] option.
       Thus, I should buy the local destination guide.

But if (ii′) correctly represents the reasoning in question, then RKP should deem it unacceptable on the grounds that some of the premises are not known. What seems true is not that the myriad possibilities highlighted by (ii′) are ruled out by one's knowledge, but that they will carry little weight in an expected utility calculation, since one gives them little credence. In short, we are being pressed to grant that (ii) is really just a crude summary of a much more involved reasoning process, one that is more accurately represented by a thorough Bayesian decision table. The challenge is to explain how one could reason one's way to buying the local guide from the scant knowledge given in the premises of (ii), when the myriad possibilities acknowledged by (ii′) cannot be ruled out.

My central proposal in this section is an attempt to answer that challenge. But first let me resist the pressure to replace (ii) with (ii′). Douven presses for (ii′) as the more faithful representation of your reasoning by pointing out possibilities that would make the worldwide guide the more optimal choice, insisting that you must

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11 Douven uses 'best' here, instead of 'expected utility maximizing', in case RKP's proponents choose to challenge the Bayesian conception of bestness. I won't pursue that option here, so I will continue to talk in terms of expected utility maximization.

in some sense rule them out. But consider the analogous attack on a commonplace piece of non-practical reasoning:

> I remember locking my door when I left the house this morning.
> So my home and belongings are as I left them.

Maybe I need, in some sense, to rule out possibilities that would undermine the support the premise lends to the conclusion here. For my reasoning to be good, I may need to know that my memory is working well, that forceful break-ins are rare in my neighbourhood, that my landlord is unlikely to use his key to steal my things, and so on. But these factors needn't enter my reasoning, consciously *or unconsciously*, for my reasoning to be good. My reasoning can be as simple as noting the premise and combining it with my (perhaps tacit) knowledge that the premise makes the conclusion probable. It may be that I need to know many other things in order to know (perhaps tacitly) that this premise renders this conclusion probable. But possessing that knowledge needn't complicate my actual reasoning process.

The pressure to acknowledge (ii′) as a more faithful representation seems to rest on a mistaken presupposition that (ii) is intended to be deductive.[12] The suggestion seems to be that all possibilities of error must be ruled out before the conclusion is warranted. But this supposition is one that Douven imposes on proponents of RKP, not one they have any reason accept. It is uncontroversial that knowledge-based reasoning in theoretical domains is frequently non-deductive, and I see no reason that the practical domain should be different.

Returning to our central question then: how might one's reasoning proceed in (ii)? What process could take you from such sparse information to the conclusion that the local guide is the better option, if not by taking account of the myriad possibilities acknowledged by (ii′) and then calculating expected utilities? Research in the last 40 years strongly supports the view that we do not make decisions (just) by calculating expected utilities. Instead we use a mixture of more economical heuristics, heuristics specifically designed to make effective use of sparse information. There is a massive research program in psychology dedicated to determining what heuristics are available, which ones we use, when we use them, and how effective they are at generating expected utility maximizing choices. This program is far from complete, but it has come far enough to offer a preliminary answer to Douven's challenge. It has uncovered fairly effective ways of determining which option maximizes expected utility, not by calculating expected utilities, but instead using reasoning that looks much like that represented in (ii).[13]

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12 Indeed, Douven frequently accuses RKP's proponents of presupposing a "deductive" conception of practical reasoning. But he does not say why he thinks it must be deductive, as opposed to merely being representable in premise-lemma-conclusion format.

13 For some early work in this program, see (Simon 1956; Tversky 1972; Kahneman & Tversky 1973).

One such method is the lexicographic heuristic, or LEX.[14] When deciding between two options, LEX considers various desirable attributes each option might have or lack, searching through them in descending order of importance[15] until a "tie-breaker" is found. If we are deciding between restaurants A and B, and we value in descending order price, taste, service, proximity, and ambience, LEX will run through these factors in that order until it hits on an attribute that one option has and the other lacks. If A and B are comparable in price, it will go on to consider taste; if they are comparable in taste, it will go on to consider service; if B has better service, LEX will stop and settle on option B. (Payne et al. 1993)

LEX is crude, going with the first tie-breaker it finds. Searching for a tie-breaker by order of importance is better than searching randomly, but there is still plenty of room for error. It is possible that the option not chosen is actually the one that maximizes expected utility, possessing many desirable attributes that weren't considered because they were too far down in the search queue. One way of reducing such errors is to keep the search going until it becomes unlikely that further searching will make a difference. For example, we might keep track of how many desirable features each option has, and to what degree it has them, searching until one option passes some pre-determined threshold. When greater assurance of arriving at the expected utility maximizing option is needed, we can set the threshold high; when optimality is not so essential, it can be set lower. These enhancements of LEX yield another prominent heuristic, the evidence accumulation model, or EAM. (Lee & Cummins 2004)

Many heuristics besides LEX and EAM have been proposed and continue to be studied,[16] but these two will serve as examples. They show that there are simple methods for determining which option maximizes expected utility without calculating expected utilities. Moreover, they look to be the sorts of methods we plausibly

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For more contemporary surveys, see (Payne et al. 1993; Gigerenzer et al. 1999; Baron 2007). For an opposing paradigm, see (Oaksford & Chater 1998, 2007, 2009). For a critical review of recent work on heuristics, see (Hilbig 2010).

14 LEX is closely related to, but distinct from, the "take the best" heuristic popularized by Gigerenzer and his colleagues (Gigerenzer & Goldstein 1996; Gigerenzer et al. 1999; Gigerenzer & Selten 2001).

15 How should we understand 'importance' here? Different authors presuppose different interpretions, yielding different versions of the heuristic. One common interpretation takes importance to be the probability with which the attribute in question predicts the expected utility maximizing choice. So, for example, the importance of fair prices when choosing between restaurants A and B is $P(A > B|F(A) \wedge \neg F(B))$, where $F(A)$ means that A is fairly priced, and $A > B$ means that A is a better choice than B. Alternatively, one could interpret importance as the degree to which a factor's presence or absence contributes to an option's utility. For more on interpreting the LEX heuristic, see (Payne et al. 1993).

16 Payne, Bettman, and Johnson (1993: ch. 2) survey other prominent proposals. For recent work on LEX, see (Gigerenzer et al. 1999; Bröder 2000; Newell et al. 2003; Newell 2005; Bröder & Newell 2008), and for recent work on EAM see (Lee & Cummins 2004; Newell 2005; Newell & Lee forthcoming).

use when reasoning in ways like that represented in (ii). Consider two competing stories about how a rational subject actually reasons when we describe her as using the reasoning in (ii). The first story, Douven's, says that (ii) is a badly enthymematic representation of an expected utility calculation that draws on the expanded space of possibilities acknowledged in (ii′). The second story, mine, says that the subject compares her two options on a couple of the most important attributes, favouring the one that does better on both. She considers of each guide how much it costs and whether she is likely to have use of it in the near future, opting for the local guide since it does better in both respects. If more were at stake or if she were pressed to justify her choice, she might consider further attributes or even calculate expected utilities. But in the circumstances, a restricted set of considerations suffices to settle the matter. I submit that the second story is more plausible. At the very least, it would be hasty to dismiss it out of hand and the supposed support for RKP along with it.

Of course, heuristic methods are not perfectly reliable: it is possible to apply LEX or EAM correctly and still settle on an option that does not maximize expected utility. The current proposal thus implies that an episode of practical reasoning need not follow a perfectly reliable method in order to be good reasoning. And it is important to appreciate that the imperfection of heuristic reasoning goes beyond the familiar imperfection of inductive reasoning. All parties are agreed that, in practical and non-practical reasoning alike, one can reason perfectly and still arrive at the wrong conclusion—a false belief or an action that does not maximize *actual* utility (as opposed to *expected* utility). But when we allow that using heuristics like LEX and EAM can be rational, we go a step further. Methods like LEX and EAM can be executed perfectly and lead to the "wrong" conclusion in a more internalist sense: an action that does not even maximize *expected* epistemic utility, much less actual utility.

Some Bayesians will feel uncomfortable allowing the use of such imperfect heuristics. But many Bayesians have long held that the Bayesian canons of rationality are idealizations, useful because they illuminate philosophical problems and serve as heights to strive for (Horwich 1982, 1993; Garber 1983; Christensen 1992, 2004, 2007; Hawthorne 2005; Hájek & Hartmann 2010). A number of authors even advocate using heuristics to approximate Bayesian ideals in the domain of theoretical reasoning; Okasha (2000), McGrew (2003), and Lipton (2004) suggest that Inference to the Best Explanation is a heuristic for approximating Bayesian updating. There is even evidence that human decision makers actually perform better when they use heuristics than when they try to calculate expected utilities (Hogarth & Karelaia 2007).

The upshot is that Douven may be right that there is no way to always and perfectly meet the demands of EUP, except to calculate expected utilities. But most psychologists, and many philosophers, have come to suspect that doing so is far beyond

our cognitive abilities. They interpret EUP as an ideal to strive for rather than as a minimal standard of rationality. And on this view, Douven's challenge can be answered. There are rational alternatives to the Bayesian, expected utility calculating procedure, and these alternatives can underwrite the conception of practical reasoning presupposed in examples like (i) and (ii).

3   REASONS AND CREDENCES

A different Bayesian objection to RKP is that a reasons-based picture of practical reasoning leaves credences no role to play in the governance of action. The worry begins to emerge when RKP's proponents are confronted with cases where it seems rational to act on a credence. For example, Schiffer (2007) worries about the case of Jane, who has 0.4 credence that it will rain and consequently carries an umbrella. Her reason for carrying an umbrella is not that it will rain, for she does not believe it will. She acts instead on her middling credence, and yet she seems rational.[17]

Hawthorne & Stanley (2008) reply that Jane's reason for carrying an umbrella is that there's a decent chance of rain, which is something she knows. Schiffer worries that Jane may not be in a position to know this fact, since it is a fact about her epistemic probabilities, rather than about objective physical or meteorological chance, and Jane may not possess the sophistication to distinguish epistemic and objective chance. But Hawthorne & Stanley caution against overintellectualizing beliefs about epistemic probabilities. Folk discourse makes frequent use of expressions for epistemic probability, as in "it's likely to rain" and "there's a decent chance of rain." So it seems that having beliefs about epistemic probabilities does not require philosophical sophistication. Thus Jane can believe, and know, that there is a decent chance of rain. And it is this knowledge that is her reason for carrying an umbrella, consistent with RKP.

Beliefs about epistemic probabilities thus replace credences in the governance of action on the RKP view, and the real tension between the credence- and knowledge-based pictures emerges with this replacement. To accommodate cases like Jane's, Hawthorne & Stanley re-describe them as cases of acting on a belief about epistemic probability. But then what becomes of credences? Must we abandon them in favour of beliefs about epistemic probabilities, jettisoning the psychological picture traditionally at the core of Bayesianism? Or can traditional Bayesian psychology be integrated with a picture where action is based on known reasons?

I opt for integration, and will offer two proposals to that end. The first pro-

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17 Strictly speaking, there might be no conflict with RKP here, since there could be *no* proposition whatsoever that is Jane's reason, and thus no unknown proposition she acts on. But this attempt at reconciliation runs counter to common sense, since Jane would include amongst her reasons that there's a chance of rain, that it may rain, or something similar.

posal is more extreme: credences often *constitute* beliefs about epistemic probability, and hence sometimes constitute knowledge about epistemic probability. Thus acting on one's knowledge of epistemic probabilities sometimes just *is* acting on one's credences. The second proposal is less extreme: in many cases where one's reason is a known proposition, one still needs to determine how much weight to give that reason, and credences serve to determine that weight. The first proposal is ambitious, taking a strong stand on the metaphysical connection between credences and full beliefs about probabilities. The second is less risky, but does less to preserve the role of credences in the knowledge-based view. The two proposals are consistent and one can accept both, though accepting either one may reduce the incentive to accept the other. I will hedge my bets and defend each of them independently. Whether one ought to accept the first, the second, or both, I leave open.

3.1   First Proposal: Credences Can Constitute Beliefs About Probabilities

According to RKP, one's belief that a storm is coming warrants staying home when that belief constitutes knowledge.[18] Similarly, Jane's belief that there is a 0.4 chance of rain warrants carrying an umbrella if that belief constitutes knowledge. Now suppose we say that Jane's 0.4 credence that it will rain constitutes her belief that there is 0.4 chance of rain. Then her 0.4 credence warrants carrying an umbrella, consistent with RKP. In general, if credences can constitute beliefs about probabilities, and those beliefs can constitute knowledge, then RKP permits acting on some credences. For those credences constitute knowledge.

The view that credences can constitute knowledge comes from Moss (forthcoming). I am defending the same claim, though on different grounds. The argument here turns on a metaphysical thesis about the relationship between credences and beliefs about probabilities. The claim is that, while a 0.4 credence in P may not constitute a belief that P, it can constitute a belief that there's a decent chance that P, or even a belief that P is 0.4 probable.[19] My argument for this claim rests on two complementary supports.

First, we are generally prepared to attribute beliefs about what may well happen, what is likely to happen, or how probable a certain happening is, to subjects who have the corresponding credences. When someone gives something low credence we say that they believe it is improbable; when they give it middling credence we say that they believe it is somewhat probable; and when they give it high credence we

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18 In what sense do beliefs "constitute" knowledge? I won't try to answer that question here. I will assume what all parties to the debate presumably accept: there is some sense in which beliefs sometimes constitute knowledge. Our question is whether the same relation can hold between credal states and knowledge. I will defend the current proposal by responding to reasons for thinking it could not hold.
19 Moss (personal communication) abstains from endorsing this claim.

say they think it highly probable. Similarly, when someone gives higher credence to *P* than to *Q*, we say they believe *P* is more probable than *Q*.[20] One might object that this tendency just reflects a strong psychological correlation between having a certain credence in *P* and also having formed an outright belief about *P*'s probability. Maybe, when we have a credence in *P*, we often also form an outright belief about *P*'s probability. This would explain the pattern just described without going so far as to say that the credences in question *constitute* the beliefs reported. But the best candidates for cases where a subject has a credence without a corresponding belief about probabilities do not support this conjecture. Take someone who has never considered whether *P* is probable, but still has some level of confidence about *P*, and acts on that confidence-level. It will typically[21] be acceptable to explain their action by saying that they thought or believed *P* was so-and-so probable.

Second, there is a very plausible explanation for the above connection, namely that credences often constitute dispositions to form occurrent beliefs about probabilities. While one may have a credence in *P* without having formed any overt belief about how probable *P* is, one's credence can still constitute a *non-occurrent*, or *dispositional*, belief about probabilities. After all, when someone has credence *x* in *P*, they are very close, cognitively speaking, to forming an outright judgment that *P* is *x* probable. Suppose, for example, that you are fairly confident your horse will lose the race. If asked whether your horse will probably lose, you can formulate your answer by consulting your credence that your horse will lose, and then translating it into an overt judgment that he will probably lose. In general, when one has credence *x* in *P*, one is disposed to judge that *P* is *x* probable.[22] This close cognitive connection between credence and occurrent probabilistic belief makes it plausible that credences constitute dispositional beliefs about probabilities.

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20 I'm borrowing from Moss here: she discusses (but does not endorse) a semantics for probabilistic discourse which predicts that credal states will line up with belief attributions in the manner just outlined. See also (Yalcin 2007, unpublished).

21 Exceptions may arise when the agent is seriously incoherent. E.g., if she is disposed to judge that *P* is highly probable even though she gives it low credence, it may not be appropriate to say that she believes/thinks *P* improbable. But these exceptions are compatible with the current proposal, since we can allow that such subject's credences do not constitute the corresponding beliefs about probabilities, in virtue of her incoherence on relevant matters.

22 This disposition is likely imperfect. Indeed, empirical work suggests that people's dispositions to convert credences into overt probability judgments are subject to well-known biases like overestimating low values and underestimating high ones (Hurley 2005). Fortunately, the current proposal can accommodate imperfection. People who are very imperfect, e.g. those disposed to judge that *P* is highly probable when they give it low credence, may be too cognitively incoherent to count as knowing that *P* is improbable (perhaps because they can't be said to believe that *P* is improbable; see fn. 21). But people disposed to judge that *P* is $x + \varepsilon$ probable when they give it credence *x* may still believe/know that *P* is *approximately x* probable. And such knowledge will generally be sufficient to guide action in cases like Jane's.

One might nevertheless be skeptical that these dispositional beliefs about probabilities can constitute knowledge. Knowledge is a relation to a true proposition, but what proposition could a subject know/believe when we ascribe these sorts of beliefs about probabilities? Like Hawthorne & Stanley, I think the relevant propositions are about epistemic probabilities.[23] Someone cannot know that P is probable unless their epistemic probability for P is high, so it is natural to say that their (dispositional) belief is a belief about their epistemic probability. But we can stay agnostic on the matter. Moss (forthcoming: §4) argues that the factivity of knowledge, and other truth-directed requirements like safety and sensitivity, can be understood without requiring that knowledge be a relation to truth-apt propositions. Factivity, safety, and sensitivity can be captured on a view where knowledge is instead a relation to a constraint on credences. For the purposes of the current proposal, either approach will do, since either one allows a credal state to constitute a doxastic state with all the properties one might demanded of knowledge: factivity, safety, sensitivity, etc.

The present proposal has the nice feature of integrating Hawthorne & Stanley's view with the traditional Bayesian view. By saying that credences constitute beliefs about epistemic probabilities, we can allow credences to guide action while requiring that only knowledge guide action. Hawthorne & Stanley's view—that knowledge of epistemic probabilities guides action in cases like Jane's—was compatible with this possibility all along. But by spelling out the metaphysics of the connection between credences and beliefs about probabilities, we see that the irenic possibility is actually quite plausible. We thereby allay the worry that acting on knowledge about the probability of P precludes acting on one's credence in P. Because one's belief about P's probability can be constituted by one's credence in P, one can act on one's credence in virtue of acting on one's knowledge.

The proposal faces a serious limitation though. It only permits acting on credences that constitute knowledge, and these credences may not always be sufficient for answering the practical question at hand. One's credal state may not constitute enough knowledge to settle the question. For example, suppose my decision about whether to cancel a trip doesn't just depend on whether there's a decent chance of snow, but on the more precise question whether snow is at least 0.7 probable. In such a case, despite having a credence in snow greater than 0.7, I may not know that snow is at least 0.7 probable. This might happen, for example, because my credence is not sufficiently safe or sensitive—maybe if the true epistemic probability were just below 0.7, I would still have credence greater than 0.7. I might be sensitive enough to the truth to know that snow is probable, yet not sensitive enough to know that it is at least

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23 Epistemic probabilities are not to be confused with degrees of belief. One's epistemic probability for P measures the degree to which one's evidence supports P, not the degree to which one is confident in P, or takes P to be supported. To a first approximation, one's epistemic probability for P is the degree of belief one ought to have in P (but see (Williamson 2000: §10.1)).

0.7 probable. How then am I to decide whether to cancel my trip? Bayesianism has the advantage that, as long as I have the relevant (rational) credences, there is a fact about which actions maximize expected utility and thus what courses of action are rational. But if, as the current proposal implies, only those of my credences that constitute knowledge may influence my decision, I may not have sufficient information to settle whether a course of action is rational or not.

The present proposal thus goes some way towards reconciling the knowledge- and credence-based pictures, but not all the way. The next proposal offers another way of narrowing the gap. It may be seen either as an alternative or as a supplement to the present one.

3.2   *Second Proposal: Credences As Reason-Weights*

A natural thing for Jane to say is that she brings an umbrella because it *may* rain. But the fact that it may rain does not always carry enough weight to warrant carrying an umbrella; two subjects might each reasonably treat the fact that it may rain as a reason for carrying an umbrella, while only one of them should, on a balance of reasons, opt to carry one. A subject with 0.4 credence in rain and another with 0.1 credence might share a reason for bringing an umbrella, namely that it may rain. But only the first, we may suppose, should end up brining one. What cuts the difference is the weight each subject should give to that reason. For the first subject, the possibility of rain carries enough weight to overcome the reasons against carrying an umbrella. But not so for the 0.1 subject. So one role for credences, I propose, is to determine how much *weight* we should give to certain reasons. Thus proponents of RKP and EUP can both be right: one's reasons must be known, but one's decisions should still weigh one's credences in various possibilities.

It's natural to ask what rules and formulae reason-weights will obey on this proposal. When one knows that *P* might happen, how does one's credence in *P* combine with this knowledge, and with other knowledge and credal states, to settle what action is warranted? What about when one knows that *P* will happen, or that *P* will probably happen—what role does credence play then? And what about mixed cases, where one knows some things, knows that other things are probable, and knows of other things merely that they are possible? In general, what rules govern the weighing of various pieces of knowledge when determining a course of action? I will offer some concrete answers in a moment, but first a word about dialectical burden.

These questions are pressing because they are pressing for the knowledge-based program in general. A proposal like RKP is extremely difficult to evaluate without any accompanying specifics about the rules of practical reasoning. Which actions are and aren't warranted according to RKP, and to what extent do RKP's predictions agree or disagree with Bayesianism's? It's difficult to say: we are told where the game

pieces start (with knowledge), but not how they move. I suspect much dissatisfaction in the Bayesian camp stems from frustration with RKP's proponents on this front. Bayesian decision theorists make very precise predictions about what actions are warranted. RKP's proponents then propose norms of action based in knowledge rather than in credences, yet stay largely silent about when a piece of knowledge counts as a reason for taking a certain course of action, or how much weight that reason carries. In my view, the real challenge Bayesianism poses for the knowledge-based approach emerges here: to get traction, proposals like RKP have to be supplemented with a decision theory with enough content to make concrete predictions on a par with Bayesianism's.

But, while Bayesians have a right to demand more details from RKP's proponents, RKP's proponents should be allowed time to work out those details. Until they do, the right stance to take is not that the knowledge-based picture should be dismissed because the credence-based picture is right, but that the compatibility of principles like RKP and EUP remains an open question. Those of us interested in the extent of RKP and EUP's compatibility thus do best to work on those details. I'll now offer two suggestions on that score.

How might credal weights interact with knowledge when deciding what to do? One natural proposal is that one's knowledge of what may and will happen determines a decision table, which credal weights are then distributed over, determining the optimal action via expected utility maximization. If one knows that P is true, one excludes $\neg P$-possibilities from the table. If one knows that Q may happen, one includes Q-possibilities in the table. One then calculates an act's expected utility by weighting the possibilities in the resulting table according to one's credences and utilities. (Weatherson 2012)

What if one knows that P isn't just possible, but probable? To the extent that one knows probabilities, that knowledge should constrain how credal weights are distributed over the table. If one knows that P is probable, one should not give it less than (say) 0.5 weight. Of course, if one knows all the relevant probabilities, then credences may have no role to play in determining what to do. But this case will be the exception rather than the rule, so Bayesians shouldn't worry that knowledge-based reasoning will muscle credences out of our decision-theoretic picture.[24]

A second way for credences to act as reason-weights emerges from the discussion in §2, where we looked at less overtly Bayesian forms of knowledge-based reasoning, like the evidence accumulation model (EAM). Recall the example of deciding between two restaurants. EAM runs through a list of attributes each restaurant may have or lack, looking for respects in which one restaurant is superior, and stopping when one option emerges as superior with sufficient clarity. Importantly, the search

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24 If our epistemic position were so strong that we did always know the correct epistemic probabilities, credences might then be muscled out, but deservedly so.

runs through attributes in order of their importance. What makes an attribute important? One standard interpretation identifies importance with the probability that an option with that attribute will be the better option all-things-considered. Thus importance can be measured by credence—one's credence that having the attribute predicts its all-things-considered superiority. Thus, when ordering her search queue, an agent might appeal to her credences that various attributes are indicative of bestness. The decision that results will then be knowledge-based, yet weighted by her credences: her knowledge that one restaurant has cheaper prices is weighted according to her credence that price predicts all-things-considered superiority.

These two suggestions serve only to illustrate some ways that credences might act as reason-weights. The details of these proposals need development, and other questions are still open. When is it appropriate to use each of these methods, and what other methods are there? These are important questions, but it is important to realize that they aren't just questions for the present proposal. RKP's proponents— or proponents of any reasons-based view of practical reasoning—face the massive project of elaborating on the mechanisms and rules of proper practical reasoning. What I've done here is show that, on some ways of pursuing that project, the notion that knowledge-based reasoning can be guided by credal weights is viable. Whether it will ultimately succeed, it is too early to say.

We should pause to consider how the present proposal compares with Hawthorne & Stanley's own view. Their view is that in cases like Jane's one acts on knowledge about epistemic probability. The current proposal differs in that it needn't posit such pervasive knowledge of probabilities. It allows that one can be appropriately guided by a credence without having knowledge of (or even a belief about) the corresponding epistemic probability. All one needs to believe and know is that rain is a possibility.

This might seem a small difference, but the current proposal is significantly more permissive. For one thing, it requires us to know less: even when one has no idea what the relevant probabilities are, one can still be guided by expected utility maximization. If all I tell you is that there are 100 marbles in the urn, some black and some white, you might well be very unsure what the epistemic probability of the next draw being black is. At the very least, it is contentious to say that you know the epistemic probability is 0.5. But it is much less contentious to say that your credence might nevertheless reasonably be 0.5, thereby explaining why it is reasonable for you to bet on black at 1:1 odds. The current proposal also avoids any commitment to the ubiquity of full beliefs about epistemic probabilities, which is likely to turn off those who think it implausible that we habitually form/have such beliefs.[25] The current proposal will also be more amenable to "subjectivist"-leaning Bayesians, who will be

25 Hawthorne & Stanley dismiss such worries as overintellectualization, and I am sympathetic; still, the current proposal offers an alternative.

skeptical of the objectivism presupposed by knowledge of epistemic probabilities.[26]

Let me close our discussion of this proposal by anticipating an objection. One might worry that the spirit of RKP forbids being swayed by any doxastic state that fails to constitute knowledge. Even if one does not treat P as a reason in Jane's case, treating one's credence in P as a reason-weight does employ a doxastic attitude other than knowledge to guide one's reasoning. And isn't that against the spirit of RKP?

Not if one endorses RKP for the reasons prominent in the literature. Stanley's (2005) reason for embracing RKP is that it matches intuitions about how people's knowledge varies with stakes. On this view, there is no reason to think the above proposals violate the spirit of RKP: increased stakes will still block knowledge in the high-stakes cases that motivated RKP. We can continue to say that, when much hangs on whether the bank is open tomorrow, Hannah does not know that it will be open tomorrow, so it is inappropriate for her to treat that proposition as a reason for waiting until tomorrow to visit. It is appropriate for her to treat the fact that it *might* be open as a reason for delaying her visit, but if she is reasonable, her credence will not be high enough to give that reason enough weight to warrant postponing her visit until tomorrow.

Hawthorne (2004) and Hawthorne & Stanley (2008) support RKP on the grounds that it explains folk appraisals of practical reasoning. A doctor who uses a needle without knowing it is safe is blameworthy. Here again, there is no reason to shy away from the above proposal: the doctor still does not know that the needle is safe. She does know that it *might* be safe, but if she does not know it is safe, then she cannot have a the very high credence it would it would take to outweigh the costs of error in an expected utility calculation.

A third motivation for RKP comes from Williamson's (2000) arguments that knowledge is central to our normative theorizing, and especially his arguments that evidence and knowledge are coextensive. If knowledge is the fundamental ground of theoretical reasoning, it is natural to suppose that it plays the same role in practical reasoning (Hawthorne & Stanley 2008: 577). Yet here again, there is no tension. Knowledge may be the fundamental ground of theoretical reasoning, with credence guiding its use and impact in ways parallel to the above suggestions for practical reasoning.

4 CONCLUSION

I developed three irenic proposals, using Schiffer and Douven's objections to RKP as foils. Schiffer worried that RKP precludes middling credences from governing action, since it requires that one's reasons be known propositions. Our first pro-

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26 Again, epistemic probabilities are not to be confused with degrees of belief. See fn. 23.

posal was that credences act as reason-weights. One's reasons may need to be known propositions, but that is compatible with saying that the weight one gives those reasons is determined by one's credences. The second proposal was that these credal weights might themselves constitute knowledge. Because credences embody dispositions to form outright probabilistic beliefs, they can constitute dispositional full beliefs about probabilities, which can in turn constitute knowledge.

Douven worried that the reasoning processes envisioned by RKP's proponents were in tension with EUP. How could reasoning as in Hawthorne's (ii) lead to expected utility maximizing choices? Our third proposal was that such reasoning might employ the sorts of decision heuristics being studied by psychologists. In particular, I suggested that (ii) looks like the sort of reasoning that results from using heuristics like LEX and EAM. On the assumption that it is rational to use such heuristics to maximize expected utility, using examples like (i) and (ii) to motivate RKP is not in tension with the theory of substantive rationality embodied in EUP.

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