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Credences, Truth, and Educated Guesses

Belief, supposedly, "aims at the truth". Whatever else this might mean, it's at least clear that a belief has succeeded in this aim when it is true, and failed when it is false. That is, it's obvious what a belief has to be like to get things right. But what about credences, or degrees of belief? Arguably, they aim at truth as well, in some sense. They can be accurate or inaccurate, just like beliefs. But credences can't be true or false. So what makes credences more or less accurate? One of the central challenges to epistemologists who would like to think in degreed-belief terms is to provide an answer to this question. My goal here is to take up this challenge.

A number of answers to this question have been discussed in the literature. Some conclude that accuracy, for credences, is not a matter of credences' relation to what's true and false, but in virtue of how they relate to frequencies or objective chances.[1] Others are skeptical that there is any notion of accuracy can be usefully applied to credences, and that we should instead assess credences according to their practical efficacy.[2] Another approach assesses accuracy using "scoring rules" – functions of the distance between credences and truth. According to this class of views, the closer your credence is to the truth (1 if the proposition is true, and 0 if it is false), the better it is.[3]

This last approach – epistemic utility theory – has gained a significant amount of support in recent years. Part of its appeal is that it looks like a natural extension of some common-sense thoughts about accuracy: that it's better for our doxastic states to be right than wrong, and that for credences, it's better to be close to the truth than far away.[4] But the approach faces problems as well. Just saying that close is better than far does not do much to narrow down the possible ways of measuring accuracy. And when we do try to

[1] For discussion these views, see Hájek [ms]. (Van Fraassen and Lange are among the defenders of
[2] See Gibbard [2008].
[3] Practitioners of this approach, known as "epistemic utility theory", include Joyce, Greaves and Wallace, and Pettigrew.
[4] cite Joyce here and maybe Gibbard

narrow things down, defending the use of one scoring rule over another, we move farther and farther from the common-sense understanding of accuracy that we started with.

I won't enter this debate in depth here. Instead, I will propose a new way to understand accuracy. That is: we can evaluate credences' accuracy by looking at the "educated guesses" that they license. This framework is motivated by the optimistic thought that accuracy, for credences, is a matter of their relation to the truth – and by the common-sense understanding of accuracy, according to which credences are more accurate as they get closer to the truth. But the framework also has an advantage over epistemic utility theory: it does not require us to choose any particular scoring rule, or way of measuring how accuracy increases with closeness to truth. Instead, it leaves us free to adopt whatever scoring rule we'd like, or to reject epistemic utility theory altogether.

Here is the plan for the rest of the paper. In section 1, I will introduce a new way of assessing accuracy, which rates credences in terms of the educated guesses that they license. In sections 2 and 3, I will look at two more applications of this framework. First, I will argue that educated guesses can be used to provide a justification for *probabilism*: the thesis that rational credences should be probabilistically coherent. Second, I will show how the view can help us make sense of the phenomenon David Lewis calls "immodesty": the sense in which a rational agent's own doxastic states should come out looking best, by the lights of her way of evaluating those doxastic states' truth-conduciveness or accuracy. (I will say much more about immodesty in section 3.) In section 4 I will (very) briefly survey two other popular views, and compare them to my proposal. I will conclude by mentioning some further advantages of educated guesses, and suggesting some possible ways in which the framework might be useful in future work.

1. Educated guesses

In gathering evidence and forming opinions about the world, we aim to get things right. We might aim at other things, too, but there's an important sense in which we've been successful if we get to the truth, and unsuccessful if we haven't.

If we're lucky, the evidence is clear, and we can be sure of what's true and false. More often, the evidence is not so clear. In less-clear cases, the best we can do is to adopt intermediate degrees of belief in the relevant propositions. Rather than being sure, we can just be more or less confident about what's true and false. And when we have to act under less-clear circumstances, we give it our best shot.

I want to look at a special kind of action: educated guessing. This is a kind of action with correctness conditions that are the same as those of all-out belief: a guess is correct if it's true, and incorrect if it's false. But guessing is something we might be called upon to do even when we're quite unsure whether the proposition we're guessing about is true or false. When we're guessing under uncertainty, and we want to guess correctly, the right thing to do is to give it our best shot, given the limited information we have. We should guess on the basis of our credences.

I'd like to propose that we think about educated guesses as a way of assessing how credences get things right and wrong. Specifically, my proposal is:

Your credences are *more* accurate insofar as they license true educated guesses. They are *less* accurate insofar as they license false educated guesses.

We might think of credences as "aiming" to license true guesses, much as beliefs "aim" at being true themselves.

What are educated guesses? I hope that the intuitive idea is clear enough, but in this context it will help to be more precise. We can think of an educated guess as a potential forced choice between two (or more) propositions, made on the basis of your credences. If you are given some options – say, P and ~P – and asked to choose between them, your educated guess should correspond to the option you take to have the best shot at being true. A couple of notes on the notion of educated guessing: I want to think about "guesses", rather than "judgments" or "beliefs", because I want to explicitly leave open the possibility that you guess that P while refraining from judging or believing P. You might be licensed to guess that P while also rationally holding neutral degree of credence in P, suspending judgment, or even perhaps believing ~P. (Q2, below, is an example where this last possibility might come about.) I am calling them "educated" guesses to emphasize that they are governed by rational norms and depend on your credences. Your educated guesses are the guesses that it would be rational for you to make, given your credences, if your only aim were to guess truly.

The norms for guessing are as follows. I'll treat these as definitional, though they also seem plausible to me on independent grounds.[5]

> **Simple questions:** When faced with a forced choice between two propositions, your educated guess should be the proposition in which your credence is highest.
>
> **Suppositional questions:** When faced with a forced choice between two propositions given some supposition, your educated guess should be the proposition in which your conditional credence (conditional on the supposition being true) is the highest.
>
> **Equal credence:** With both suppositional and non-suppositional questions, if you have equal credence in both options, you are licensed to guess in favor of either one.

I'll be interested in the guesses that are licensed by a rational agent's credences, according to the norms above.

To get a handle on how these norms are meant to work, consider a couple of sample questions. Simple, non-suppositional questions are easy enough:

Q1: Is it raining?

In this case, if your credence in Rain is more than .5, you should guess "yes". Your credence in ~Rain is > .5, you should guess "no". If you have exactly .5 credence in each of Rain and ~Rain, you may guess either way.

Suppositional questions are just slightly more complicated:

Q2: Supposing that it's not sunny, which is it: rain or snow?

Suppose your credences in these three (disjoint[6]) possibilities are as follows, where Cr is your credence function:

Cr(Sun) = .75
Cr(Rain) = .2
Cr(Snow) = .05

[5] At the moment I'll keep things simple and just look at two-option cases, but there is no reason I can see why the framework couldn't be extended to choices between three or more options.
[6] Pretend they are disjoint. As I'm writing this, it's sunny and raining at the same time.

By your lights, then, it's most likely sunny. But Q2 asks you to suppose that it's *not* sunny. In this case, your credences license guessing Rain: given that it's not sunny, you regard it as more likely to be raining than snowing.

Your guesses can then be assessed straightforwardly for truth and falsity. Suppositional guesses won't be assessed at all in cases where the supposition is false.

A good account of the relationship between credences and truth should fit together nicely with other parts of our overall epistemological theory. One of the main goals of existing accounts, such as epistemic utility theory, is to do just this – help us explain certain formal rational requirements, for example. In the next two sections I will look at two ways in which the guessing picture can be put to work to this end. First, in section 2, I will argue that the guessing framework can help us vindicate probabilistic coherence as a requirement on rational credence. In section 3, I will look at immodesty.

The guess framework does justice to our common-sense understanding of accuracy: it vindicates the intuitive thought that degrees of belief are more accurate as they get closer to the truth. The basic idea here is that, as credences get closer to truth, they will license more and more true guesses, and fewer and fewer false ones. I will come back to this last point in section 5.

2. Probabilism

Probabilism is traditionally expressed in three axioms. There are different formulations; I'll use the ones listed below. Assuming that Pr is any rational credence function, T is a tautology, and Q and R are disjoint propositions, the axioms are:

Non-Triviality:	$Pr(\sim T) < Pr(T)$
Boundedness:	$Pr(\sim T) \leq Pr(Q) \leq Pr(T)$
Finite Additivity:	$Pr(Q \vee R) = Pr(Q) + Pr(R)$

My strategy here will be to show that if you violate Non-Triviality or Boundedness, you will be guaranteed to guess falsely in situations where guessing falsely is not necessary. It is irrational to guarantee unnecessary false guesses. Therefore it is irrational to violate these axioms. I will then give a different kind of argument for Finite Additivity.

By "*unnecessary* guaranteed false guesses", I mean guaranteed false guesses in situations where you could avoid a guaranteed false guess by adopting different credences. For example, if your credence in a necessary falsehood is greater than zero, there may be situations in which, when making an educated guess between the necessary falsehood and some contingent alternative (to which you also assign nonzero credence), you are licensed to guess that the necessary falsehood is true. This is an unnecessary guaranteed false guess: if your credence in the necessary falsehood were zero, you would be licensed to guess that the contingent proposition was true, and your guess would *not* be guaranteed false. (This is similar to part of the argument for Boundedness, below.)

Compare this to a situation where you are choosing between two necessary falsehoods. Even if your credence in each necessary falsehood is zero, you are licensed to guess that one or the other is true (because you have no other choice). This is a bad outcome – it's a guaranteed-false guess – but it shouldn't be held against you. There is nothing you could do to avoid it: no matter what credences you adopt in the two necessary falsehoods, you would not be able to avoid making a guaranteed-false guess. Therefore, in the next two sections, I will show that violating Non-Triviality or Boundedness guarantees *unnecessary* false guesses.

In this section and the next, I will use "Pr" to designate a rational credence function, and "Cr" to designate your current credence function without presupposing that your credences are rational.

2.1 Non-Triviality

Non-Triviality:	$Pr(\sim T) < Pr(T)$

Non-Triviality says that your credence in a tautology, T, must be greater than your credence in its negation, ~T. We can prove this axiom into two parts. First suppose that $Cr(\sim T) > Cr(T)$. This immediately leads to problems: if you were asked to guess whether T is true or false, you would be licensed to guess that T is false. But T is a tautology, and therefore guaranteed to be true. So your guess is guaranteed to be false. And it is *unnecessarily* guaranteed to be false: if your credence in T were greater than your credence in ~T, your guess would not be guaranteed to be false. (Even stronger, in fact: it would be guaranteed to be true.)

Second, suppose that Cr(T) = Cr(~T). If you were asked to guess whether T or ~T, you would be licensed to answer either way. This means that you would be licensed to guess ~T, which is guaranteed to be false. This guess is also *unnecessarily* guaranteed false: if your credence in T were greater than your credence in ~T, you would not be licensed to guess ~T in this situation, so you would not be licensed to make a guaranteed-false guess.

In both cases, violating Non-Triviality licenses you to make an unnecessary, guaranteed-to-be-false guess. The only way to avoid unnecessary, guaranteed-false guesses is if Cr(~T) < Cr(T). So it is irrational to violate Non-Triviality.

2.2 Boundedness

Boundedness:	Pr(~T) ≤ Pr(Q) ≤ Pr(T)

Boundedness says that it is irrational for you to be *more* confident of any proposition than you are of a necessary truth, and it is irrational for you to be *less* confident of any proposition than you are of the negation of a necessary falsehood. One way to read this axiom is as saying that, of all of the possible credences you could have, your credence in necessary truths must be highest and your credence in necessary falsehoods must be lowest. If we add in a plausible assumption about what this means, we can prove Boundedness within the educated guess framework.

The assumption is this: there is a maximal (highest possible) degree of credence, and a minimal (lowest possible) degree of credence.[7] I'll also assume a plausible

[7] Note that, in adding this as an assumption, I am departing from a more general Boundedness principle that some other approaches aim to justify. The more general principle says that there *should be* an upper bound to your credences, rather than assuming from the outset that there is one. This stronger Boundedness principle can't be defended on the guessing picture. This is because the guessing picture does not differentiate between maximal and "more than maximal" credence. If you (somehow) had more-than-maximal credence in some proposition A on the guessing picture, you would always be licensed to guess A

consequence of this assumption in the guessing framework. First: if you have the maximal degree of credence in some proposition, A, you are *always* licensed to guess that A when A is one of your choices. That is, if you are asked to guess between A and A*, your credences always license guessing A. (If Cr(A) = Cr(A*), of course, you are licensed to guess either A or A*.) Second: if you have the minimal degree of credence in some proposition, B, you are *never* licensed to guess B, unless you are asked to choose between B and some other proposition in which you have minimal credence. That is, if you are asked to guess between B and B*, you are *not* licensed to guess B, except in cases where Cr(B) = Cr(B*).

For simplicity, let's assume that your credences satisfy Non-Triviality, which we have already argued for. So, Cr(~T) < Cr(T). Assuming that there is a maximal credence and a minimal credence, we can normalize any agent's credences, assigning the value 1 to the maximal credence and the value 0 to the minimal credence. So, if Cr(T) is maximal, Cr(T) = 1. If Cr(~T) is minimal, Cr(~T) = 0.

First, let's prove that your credence in T should be maximal – that is, Pr(T) = 1. My strategy will be to show that there is at least one question such that, with non-maximal credence in T, you are guaranteed to give an unnecessary, guaranteed-false answer.

Here is an example of a question that illustrates this point. I'll go through this example in detail; subsequent examples will have a similar form. Suppose Cr(T) = .8, and Cr(~T) = .2 Now consider the following question:

Q3: A weighted coin has T on one side, and ~T on the other. It is weighted .9:.1 in favor of whichever of T or ~T is true.
Now suppose:
(a) the coin is flipped, out of sight;
(b) you guess whether T; and
(c) you and the coin disagree about T.

– just as you would be if you had maximal credence in A. This would not lead to special problems over and above the problems (if there are any) associated with having maximal credence in A. Other proposals, however, do differentiate between maximal and more-than-maximal credence. On the Dutch Book picture, more-than-maximal credence licenses different betting behavior from maximal credence, and therefore can lead to special problems.

Though this does mean that the guessing argument for Boundedness is weaker than, for example, the Dutch Book Argument, I don't think this is obviously a cause for worry. Whereas the Dutch Book Argument sees more-than-maximal credence as possible but irrational, the guessing picture leaves us free to say that more-than-maximal credence is just impossible (and hence, no argument for its irrationality is needed).

Who is right?

Since Cr(T) > Cr(~T), you are licensed to guess T. You can work out, then, that the only situation in which you and the coin might disagree is one in which you answer T and the coin answers ~T. So Q3 is asking you to compare two conditional credences: your credence that the coin is *right*, given that it says ~T, and your credence that the coin is *wrong*, given that it says ~T. Before we get into the details, here is what I'll show: in this case, you are licensed to guess that, given that the supposition holds, the coin is right. But since ~T is a necessary falsehood, your guess is guaranteed to be false (if it's evaluated at all). So by violating Boundedness in this case, you are licensed to make a guaranteed-false guess.

Let's work out the values to see why you will guess this way. To find your relevant conditional credences, we will need to know your credence that the coin will say ~T. That will be given by the following sum:

(The coin says ~T and it's weighted in favor of ~T) +
(The coin says ~T and it's weighted in favor of T)

You know that the coin is .9 likely to answer one way or the other; so, if it's weighted in favor of ~T it's .9 likely to come up ~T. If it's weighted in favor of T, it's only .1 likely to come up ~T. You also know that the coin is weighted in favor of whichever of T or ~T is true. Your credence in T is .8, and your credence in ~T is .2. So, plugging in the numbers, your credence that the coin will say ~T is:

(.9 * .2) + (.1 * .8) = **.26**

Now let's find your conditional credence that the coin is right, given that it says ~T. If the coin is right, that means that ~T is true, which means that the coin was weighted in favor of ~T. So your credence that the coin says ~T and it's right should be:

$$\frac{\text{Cr(The coin's answer is right) * Cr(The coin was weighted in favor of \textasciitilde T)}}{\text{Cr(The coin says \textasciitilde T)}}$$

Again, you know that the first term in the numerator is .9 because you were told that the coin is weighted .9:.1 in favor of the truth. The second term in the numerator is your credence in ~T, which is .2. The denominator is .26. So your conditional credence that the coin is right, given that it says ~T, is (.9 * .2) / .26 = **.69**.

If the coin is wrong, that means T is true, which means that the coin was weighted in favor of T. So your credence that the coin says ~T and it's wrong should be:

$$\frac{\text{Cr(The coin's answer is wrong) * Cr(The coin was weighted in favor of T)}}{\text{Cr(The coin says \textasciitilde T)}}$$

You know that the first term is .1, again because you know that the coin is weighted in favor of the truth. The second term is your credence in T, which is .8. The denominator is .26. So your conditional credence that the coin is wrong, given that it says ~T, is (.1 * .8) / .26 = **.31**.

In this situation, then, your credence that the coin will be *right* is greater than your credence that the coin will be *wrong*. So you are licensed to guess that, if you disagree with the coin, the coin will be right. But since you will guess T, if you disagree with the coin, the coin is *guaranteed to be wrong*: T is a necessary truth, and ~T is a necessary falsehood. So your guessing in favor of the coin, in this case, is a guaranteed-false guess.[8] Your non-maximal credence in T is the cause of the problem here: if it had been maximal, we would not have been able to find a coin that you would take to be right in the case of disagreement. So your credence in T should be maximal.

Now, for the second part of Boundedness, let's prove that your credence in ~T should be minimal.

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[8] More precisely, your guess is guaranteed to be false if it's evaluable at all (that is, if the supposition in Q3 holds).

Here is the general formula for creating examples of this type. Suppose that your Cr(T) is not maximal: it is 1-y, where 0 < y < 1. Now consider the following question:

> **Q3*:** A weighted coin has T on one side, and ~T on the other. It is weighted 1-x:x in favor of whichever of T or ~T is true, where 0 < x < y. Now suppose:
> (a) the coin is flipped, out of sight;
> (b) you guess whether T; and
> (c) you and the coin disagree about T.
>
> Who is right?

Suppose again that your credence in ~T is .2, and your credence in T is .8. Consider the following question:

> **Q4:** A weighted coin has some contingent proposition R on one side, and ~R on the other. It is weighted .9:.1 *against* whichever of R or ~R is true. Now suppose that the coin is flipped out of sight.
>
> Which is right? The coin (however it landed), or ~T?

Again, we want to show that you will guess ~T, which is guaranteed false.

In Q4, the coin is weighted heavily *against* the truth about R. You aren't told what R is; without any more information, your credence that the coin will be right should be .1. Your credence in ~T is .2. Although your credences in both propositions are quite low, your credence in ~T is still higher – so, you are licensed to guess ~T. But ~T is guaranteed to be false. Your non-minimal credence in ~T is causing the problem here: if your credence in ~T was minimal, you would have been licensed to guess in favor of the coin, which is not guaranteed to come up false. So you should have minimal credence in ~T.[9]

Violating Boundedness licenses unnecessary, guaranteed-false guesses. You could avoid these problems by adhering to Boundedness: your credence in T should be maximal, and your credence in ~T should be minimal.

2.3 Finite Additivity

While Non-Triviality and Boundedness provide constraints on our credences in necessary truths and falsehoods, Additivity says that our credences in contingent propositions should fit together with one another as follows:

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[9] Again, here is the general recipe for creating examples like this. Suppose your credence in ~T is z, where $0 < z < 1$, so z is not the minimal credence. Consider the following question:

> **Q4*:** A weighted coin has some contingent proposition R on one side, and ~R on the other. It is weighted 1-x:x *against* whichever of R or ~R is true, where $0 < x < z$. Now suppose that the coin is flipped out of sight. Your question is: which is right? The coin (however it landed), or ~T?

If you have minimal credence in ~T, you will be licensed to guess in favor of the coin, no matter how it is weighted. You will only be licensed to guess ~T if the coin is weighted 1:0 against the truth about R – which is a *necessary* guaranteed-false guess, so not a mark of irrationality.

Finite Additivity:	P(Q v R) = P(Q) + P(R)

Contingent propositions are not themselves guaranteed to be true or false. So violating Additivity – while it will lead to some *irrational* guesses – may not lead to any *guaranteed false* guesses. That means that we need a different sort of argument for accepting Additivity as a rational constraint. I will provide such an argument, and then address a potential objection.

Suppose you have the following credences in these two independent propositions, Q and R:

Cr(Q) = .3

Cr(R) = .4

Additivity says that, if you are rational, Cr(Q v R) = .7. My argument will bring out the fact that, if you violate Additivity, the way you guess regarding Q and R will differ depending on how the options are presented to you.[10] I'll discuss the significance of this after going through the example.

As before, the argument for Additivity is broken into two cases. First, suppose that Cr(Q v R) = .9 (so, higher than the credence recommended by Additivity). Now consider the following question:

Q5a: Coin A has "yes" on one side, and "no" on the other. It is weighted .8:.2, in favor of "yes" if (Q v R) is true and in favor of "no" if (Q v R) is false. Now suppose:

(a) the coin is flipped out of sight, and
(b) you guess whether (Q v R). Say "yes" if you guess (Q v R), and "no" if you guess ~(Q v R).

Interpret the coin's "yes" or "no" as answering whether (Q v R).

If you and the coin disagree, which is right?

This question is very similar to Q3. You and the coin are both answering whether (Q v R) is true, and your credence in (Q v R) is more opinionated than the coin's weighting. (Intuitively: from your perspective, the probability that you're right about (Q v R) is .9,

[10] **Skyrms citation**

but the probability that the coin is right is only .8. So your conditional credence that you are right, given that you disagree, should be higher than your conditional credence that the coin is right, given that you disagree.) You should guess that, if you and Coin A disagree, you are right and the coin is wrong.[11]

Compare Q5a to the following question, again supposing that Cr(Q) = .3, Cr(R) = .4, and Cr(Q v R) = .9:

> **Q5b:** Coin A has "yes" on one side, and "no" on the other. It is weighted .8:.2 in favor of "yes" (Q v R) is true and in favor of "no" (Q v R) is false. Coin B has "Q" on both sides. Coin C has "R" on both sides. Now suppose:
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> (a) all three coins are flipped out of sight,
> (b) you guess "yes" or "no" in response to this question: *Did at least one of Coin B and Coin C land true-side-up?* and
> (c) You and Coin A disagree: either you said "yes" and the coin said "no", or you said "no" and the coin said "yes".
>
> Interpret the coin's "yes" or "no" as answering whether at least one of Coin B and Coin C landed true-side-up.
>
> Between you and Coin A, who is right?

Your credence that at least one of Coin B and Coin C landed true-side-up should be .7: after all, your credence that Coin B landed true-side-up is .3, your credence that Coin C landed true-side-up is .4, and Q and R are independent. So from your perspective, the probability that you will be right is .7. The probability that the coin is right, however, is .8. So your conditional probability that you will be right, given that you disagree, is *less* than your conditional probability that the coin will be right, given that you disagree. You should guess that if you disagree, the coin will be right.[12]

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[11] Plugging in the numbers: since your credence in (Q v R) is .9, you will guess "yes". So if you disagree, that means the coin must have landed "no". We are therefore comparing the following two conditional probabilities: Cr(Coin A is right | Coin A says "no") and Cr(Coin A is wrong | Coin 1 says "no").

Your credence that Coin A says "no" is given by this sum:

Cr(Coin A says "no" and it's right) + Cr(Coin A says "no" and it's wrong)

Plugging in the numbers, we get (.8 * .1) + (.2 * .9) = .26.

Your credence that Coin A says "no" and it's right is (.8 * .1). So your conditional credence that Coin A is right, given that it says "no", is **.31**. Your credence that Coin A says "no" and it's wrong is (.2 * .9). So your conditional credence that Coin A is wrong, given that it says "no", is **.69**.

So you should guess that, if you disagree, you are right and Coin A is wrong.

[12] Plugging in the numbers again: Your credence in Q is .3, and your credence in R is .4. You know that Coin B will say "Q" and Coin C will say "R". So your credence that at least one of Coin B and Coin C will

This combination of guesses illustrates the inconsistency in your credences. In Q5a, you are licensed to guess that if you disagree with Coin A, *you* will be right. In Q5b, you are licensed to guess that if you disagree with Coin A, *the coin* will be right. But the only difference between Q5a and Q5b was in how your guess about Q and R was presented: as a disjunction in Q5a, and as separate guesses on Q and R in Q5b. So if you are rational, you should not answer differently in Q5a and Q5b.[13]

We can create a parallel setup for the case where your credence in (Q v R) is *lower* than the credence recommended by Additivity. All we need is a Coin A*, whose weight is between your credence in (Q v R) and the sum of your credence in Q and your credence in R. (For example, if your credence in (Q v R) is .51, we could weight the coin

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land true-side-up should be .7. You should guess "yes". If you disagree with Coin A, then, that means that Coin A must have said "no".

Your credence that Coin A says "no" is given by this sum:

Cr(Coin A says "no" and it's right) + Cr(Coin A says "no" and it's wrong)

Plugging in the numbers, we get ((.8 * .1) + (.2 * .9) = .26.

In this question, when you disagree with Coin A, you are each answering the question of whether at least one of Coin B and Coin C landed true-side-up. Your credence that Coin A says "no" and is right about that question is (.8 * .3). So your conditional credence that Coin A is right, given that it says "no", is **.92**. Your credence that Coin A says "no" and it's wrong about that question (.2 * .7). So your conditional credence that Coin A is wrong, given that it says "no", is **.53**.

So you should guess that, if you disagree, the coin is right and you are wrong.

[13] Here is the general recipe for examples of this form. Suppose that Cr(Q) = x, Cr(R) = y, and Cr(Q v R) = z. Now, suppose z > x + y. Compare the following two questions:

> **Q5a*:** Coin A has "yes" on one side, and "no" on the other. It is weighted v:1-v, where x + y < v < z, in favor of "yes" if (Q v R) is true and in favor of "no" if (Q v R) is false. Now suppose:
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> (a) the coin is flipped out of sight, and
> (b) you guess whether (Q v R). Say "yes" if you guess (Q v R), and "no" if you guess ~(Q v R).
>
> Interpret the coin's "yes" or "no" as answering whether (Q v R).
>
> If you and the coin disagree, which is right?

> **Q5b*:** Coin A has "yes" on one side, and "no" on the other. It is weighted v:1-v, where x + y < v < z, in favor of "yes" if (Q v R) is true and in favor of "no" if (Q v R) is false. Coin B has Q on both sides. Coin C has R on both sides. Now suppose:
>
> (a) all three coins are flipped out of sight,
> (b) you guess "yes" or "no" in response to this question: *Did at least one of Coin B and Coin C land true-side-up?* and
> (c) You and Coin A disagree.
>
> Between you and Coin A, which is right?

You will guess in favor of yourself in Q5a*, and in favor of the coin in Q5b*.

.6:.2 in favor of “yes” if (Q v R) is true, and in favor of “no” if (Q v R) is false.) Again, you will guess inconsistently: you will guess in favor of the coin when you consider (Q v R) presented as a disjunction, and you will guess in favor of yourself when you consider Q and R separately.

This is irrational. You have no basis for treating Q5a and Q5b (or their twins, with coin A*) differently from one another. But if you violate Additivity, your credences require you to treat the two cases differently.

Here is another way we could put the point. Your guesses in questions Q5a and Q5b reflect how you regard the strength of your evidence about Q and R. In Q5a, guessing in favor of yourself, over the coin, makes sense because you consider your evidence to be a stronger indicator of whether Q or R is true than the coin is. From the perspective of your evidence, trusting the coin over your own guess is a positively bad idea; it gives you a *worse* shot at being right. Compare this to your guess in Q6b. From the perspective of your evidence, as characterized in Q6b, trusting your own guess over the coin is a positively bad idea. But if the relevant evidence – the evidence bearing on Q, and the evidence bearing on R – is the same, and you are judging its strength in comparison to the very same coin, it doesn’t make sense to guess differently in the two cases. Your credences should not license both guesses simultaneously. The only rational option is to obey Additivity.

I’d like to close by addressing a worry you might have about this argument. That is: you might think that providing a different kind of argument for Additivity from the kind we had for Boundedness and Non-Triviality is a weakness of the guessing picture. (After all, popular defenses of probabilism – Dutch Book arguments and epistemic utility theory – argue for all three axioms in a unified way. The Dutch Book argument says that agents with incoherent credences will be licensed to take bets that guarantee a net loss of money (or utility, or whatever you’re betting on). Epistemic utility theorists argue that incoherent credences are accuracy-dominated by coherent credences, or else that incoherent credences fail to maximize expected epistemic utility.) The argument for Additivity is, in a way, weaker than the arguments for the other two: it gives us an illustration of tension in your credences, rather than pointing to something positively bad that will result from that tension. Is this a problem?

I'd like to propose that we think of Additivity differently from the other axioms. The argument I gave was meant to show how, if your credences violate Additivity, you will fail to make sense by your own lights. How reliable you take yourself to be regarding Q and R depends on how you are asked about Q and R – how the very same guessing situation is presented to you. This is the same sort of argument we might make to show that it is irrational to consider John a bachelor but deny that he is unmarried. You're not guaranteed to have any *particular* false belief about John by virtue of believing both that he's a bachelor and that he's married. But you will have beliefs that don't make sense by your own lights (at least if you know what bachelors and marriage are). We could also make this kind of argument in favor of other informal coherence constraints: for example, to show that it is irrational to believe both *P* and *my evidence supports ~P*. There is a kind of incoherence involved in holding both beliefs, even if doing so does not lead to a straight-out contradiction. In both cases, we might not have the security of a formal dominance-style argument on our side. But that doesn't show that the rational requirements in question don't hold.

Of course, my argument for Additivity depends on some controversial assumptions. Most obviously, I relied on the thought that if you have evidence bearing on (Q v R) as a disjunction, that very same evidence bears on both Q and R, separately. Some would deny this: for example, they might argue that it's possible to have evidence bearing on (Q v R) as a disjunction that has no bearing on either Q or R individually. Some alternative formal systems, like Dempster-Schafer theory, deny Additivity as a rational requirement, and are supported by these kinds of motivations. Advocates of Dempster-Schafer argue that you might, for example, have evidence for skepticism without having evidence for any particular skeptical hypothesis – even though skepticism is the disjunction of several possible skeptical hypotheses. My argument would do little to persuade a fan of Dempster-Schafer to be a Bayesian if she was moved by these kinds of concerns. So you might think this shows that the guessing account can't really provide a strong justification of probabilism.

I take this to count in favor of the guessing account. It can be used to make sense of, and argue for, the axioms of probability for those who are sympathetic to certain background assumptions. But I think it is also flexible enough that, were we to deny these assumptions, we might still be able to make use of the general framework. The guessing picture leaves room for some of the substantive debates in formal epistemology. And the particular argument I proposed for Additivity makes clear where the substantive assumptions come in. A more ambitious project might attempt to give a stronger justification for particular proposed rational requirements, working within the guessing framework. I won't attempt to take that project on here, but will instead leave this as a first step in the direction of what such a project might look like.

3. Immodesty

In the last section I showed how we can use the educated guess framework to argue for probabilistic coherence as a constraint on rational credence. In this section I will argue that educated guesses can also be used to vindicate "immodesty": the thesis that an epistemically rational agent should regard her own credences as giving her the best shot at the truth (compared to other credences she could adopt). The argument here will again rely on the rules set out in section 1 for educated guesses. As a reminder:

> **Simple questions**: when faced with a forced choice between two or more propositions, your educated guess should be the proposition in which your credence is highest.
>
> **Suppositional questions**: when faced with a forced choice between two or more propositions given some supposition, your educated guess should be the proposition in which your conditional credence (conditional on the supposition being true) is the highest.
>
> **Equal credence**: with both suppositional and non-suppositional questions, if you have equal credence in both options, you are licensed to guess in favor of either one.

I should first say something about what immodesty is, and why we should accept it as a constraint on rational credence. The term comes from David Lewis.[14] Lewis

[14] This example comes from Lewis's [1971] paper, "Immodest Inductive Methods". Lewis defines "immodesty" slightly differently – in his terms an "inductive method", rather than the person who follows

introduces the idea with the following example: think about a magazine like *Consumer Reports*, which ranks consumer products. After gathering information about different products' various features, the magazine makes a recommendation about which product (vacuum cleaner, toaster, etc.) to trust. What if a consumer magazine ranked consumer magazines? If it's to be trusted, Lewis argues, it must at least recommend itself over other magazines with different product-ranking methods. If *Consumer Reports* recommended trusting *Consumer Bulletin*, for example, its methods would be self-undermining in a problematic way. For example, it might tell you that Toasty Plus is the best toaster, far better than the Crispy Supreme – while at the same time recommending that you trust *Consumer Bulletin*'s toaster ratings, which recommend the Crispy Supreme over the Toasty Plus. Recommending *Consumer Bulletin* would therefore lead to incoherence, and undermine *Consumer Reports*'s recommendation of the *Toasty Plus.* So if *Consumer Reports* is to be trusted, it must at least stand behind its own methods of ranking products.

Lewis's example needs a few qualifications. Without saying more about the situation, it's not clear that *Consumer Reports* really should rank itself *best*. There are some situations in which it seems appropriate to take a more modest attitude. What if, for example, *Consumer Bulletin* has a higher budget and access to more information about toasters? It might then make perfect sense for *Consumer Reports* to recommend *Consumer Bulletin*, and let consumers decide for themselves whether the extra information is worth the increase in newsstand price. Or, what if the two magazines don't always rate the same products? It might be perfectly coherent for *Consumer Reports* to recommend trusting *Consumer Bulletin* for at least those products that *Consumer Reports* can't rank. Finally, it seems perfectly sensible for *Consumer Reports* to admit that there is *some* possible magazine whose rankings are more accurate: for example, *God's Product Review Monthly*. In all of these situations, it doesn't seem at all problematic for *Consumer Reports* to display a more modest attitude toward its own trustworthiness.

We have to control for these factors to get clear on how to formulate a true principle that respects the intuition behind immodesty. First of all, *Consumer Reports* need only rank itself better than other magazines that rank the same products, and base

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it, is immodest. (An "inductive method" can be understood as a function from evidence to doxastic states.) I'll follow Gibbard [2008] here in applying the idea of immodesty to an agent who follows an immodest method.

their rankings on the same information. Among those magazines, *Consumer Reports* should recommend itself over other magazines with different ranking algorithms – for example, magazines that use a different weighting of crispiness versus speed. Second, *Consumer Reports* need not consider its own rankings to be the absolute best possible. After all, there might be some undiscovered flaw in the Toasty Plus, not inferable from what we know of it now, that only time and more evidence will reveal. *Consumer Reports* need only consider its rankings better than other specific rankings, picked out by the particularities of the ranking method – i.e. its weighting of crispiness versus speed – rather than some description like "God's Omniscient Toaster-Ranking Method".

The idea, carried over to epistemology, is that a rational agent should regard her own epistemic methods as optimal in the same sense as *Consumer Reports* should regard its ranking methods as optimal. Compared to other ways in which she might respond to her evidence – other *particular* ways, specified in terms of the credences they assign to different propositions – a rational agent should regard her own credences as giving her the best shot at the truth.

There are two more important things to note about immodesty before moving on. One is that it is meant to be a *necessary* condition on rational credence, but it may not be sufficient. (There may be all kinds of self-recommending epistemic methods or doxastic states that are not rational.) So I will not assume that merely being immodest is enough to make you rational.

The other is that immodesty can be thought of as a kind of coherence requirement, holding between your way of responding to evidence on the one hand, and your way of assessing credences for truth on the other. Using your method of assessment to rate your own credences should yield the result that your own credences are best, or have the best shot at being right. (The contrast here is a different kind of rational requirement, which mandates having some particular attitude. On my more neutral understanding, an agent might be immodest even if she hasn't bothered to form any explicit opinions about her own beliefs.)

What I will be doing in this section is outlining how the educated guess picture vindicates immodesty for coherent credences. This will involve proposing a cleaned-up principle that expresses the idea behind immodesty in terms of educated guesses, and then showing why this principle is true. In this section I will also assume that rational agents have probabilistically coherent credences. But I won't rely on any of the particular arguments I gave in the last section. So I hope that the discussion here holds interest for any reader who accepts probabilism as a rational constraint – regardless of how convincing you may have found the arguments given above.

Here is the cleaned up principle:

> **Immodesty**: A rational agent should take her own credences to be best, by her current lights, for the purposes of *making true educated guesses*.

I will argue that the guesses warranted by your own credence function have the best expected success. So, you should regard your own credences as best – compared to other particular credences you could adopt – for the purpose of making true guesses.

The guessing picture asks us to see epistemically rational agents as analogous to students preparing to take a multiple choice test. Even if you aren't sure of the right answers – after all, you don't know everything – you should take your best shot. Of course, we aren't *actually* preparing for a test like this, just as we aren't (usually) preparing to meet Dutch bookies or other potential money-pumpers. The test setup is meant to be an illustration of a more basic underlying idea: that your own credences should come out looking best, compared with other particular credences you might adopt, according to your method of assessing credences for truth. To show that this is true on guessing picture, it will be helpful to pretend that you are preparing for a test, and that you are able to choose which credences you will use for the purpose of making educated guesses. I'll argue that if you were to do that, you would be rationally required to choose your own credences. This will illustrate why Immodesty is a rational requirement.[15]

To see how Immodesty follows from the guessing picture, consider the following hypothetical scenario. You will take an exam. The exam will consist of just one question regarding a proposition (you don't know which one, beforehand) in which you have some degree of credence. You will have to give a categorical answer – for example, "It's

[15] My strategy here owes a lot to Gibbard's, in his [2008], discussed below. Gibbard argues that we should assess our credences for their "guidance value", or their ability to make us money given a hypothetical series of bets. Gibbard points out that of course we aren't really preparing for any such bets, and nor are we choosing our credences for that purpose – but it is "as if" we are. It might be helpful to think of my general line of argument as a "depragmatized" version of Gibbard's.

raining" – as opposed to expressing some intermediate degree of confidence. You will not have the option of refusing to answer. For the purposes of this exam, you only care about answering truly. Now suppose that you are choosing a credence function to take with you into the exam. You will use this credence function, together with the norms for guessing, to give answers on the exam. Which credence function should you choose? What we are interested in is which credence function does well by your current lights. So we will be considering various different candidate credence functions and evaluating their expected success according to your *current* credence function. My claim is that if you are rational, then the prospectively best credence function, by your current lights, is your own.

For concreteness, let's once again call your *current* credence function "Cr", and the credence function you *should* pick for the purposes of guessing "Pr".[16] So more precisely, my claim is that Pr = Cr. You should pick your own credences as the best credences to use for guessing.

To see how the argument works, we can start off by looking back at Q1 and Q2. Suppose the exam question is Q1:

Q1: Is it raining?

Whatever credence function you choose for Pr will license guessing "yes" if Pr(Rain) ≥ .5, and "no" if Pr(Rain) ≤ .5. Suppose your credence in Rain is .8. Then, by your current lights, a "yes" answer has the (uniquely) best shot at being right. So you should pick a Pr such that Pr(Rain) > .5.

Simple questions like Q1 impose some constraints on Pr. In particular, Pr needs to have the same "valences" as Cr. That is, Pr needs to assign values that, for every

[16] Some might object to the thought that there is just one credence function that you should pick, given your evidence. After all, if permissivism is true, many different credences are *rational* given your evidence. I won't get into this issue in depth here. However, I don't think that the current line of argument begs any questions against permissivism, at least if permissivism is understood *interpersonally*. If interpersonal (but not intrapersonal) permissivism is true, we still need to explain for why rational agents should not switch from one rational credence function to another without new evidence. One explanation for this might be Immodesty: a rational agent should regard her own credences as the uniquely most truth-conducive credences, even if she does not regard them as the uniquely most rational credences. See Kelly [2013] for discussion of interpersonal versus intrapersonal permissivism; Kelly is more sympathetic to the interpersonal version. See Schoenfield [2014] for an explicit appeal to immodesty in defense of (interpersonal) permissivism.

proposition it ranges over, are on the same side of .5 as the values that Cr assigns. But questions like Q1 are not enough to fully prove Immodesty. To do well on Q1 and questions like it, you don't need to pick Pr such that Pr = Cr. In this example, Pr could assign .8 to Rain, like Cr does, or it could assign .7 or .9. In fact, to do well on questions like Q1, you might as well round all of your credences to 0 or 1, and guess based on this maximally-opinionated counterpart of Cr.

More complicated questions impose stricter constraints on Pr. For example, recall this suppositional question:

Q2: Supposing that it's not sunny, which is it: rain or snow?

Suppose again that your credences in Sun, Rain, and Snow are as follows:

Cr(Sun) = .75
Cr(Rain) = .2
Cr(Snow) = .05

For this question, you need to be more picky about which Pr you choose. You will not do well, by your current lights, if you guess based on the maximally-opinionated counterpart of Cr. That credence function assigns 1 to Sun, and 0 to both Rain and Snow. So that credence function will recommend answering Q2 by flipping a coin or guessing arbitrarily. But, but your current lights, guessing arbitrarily on Q2 does not give you the best shot at guessing truly; it's better to guess Rain. So you need to pick Pr such that it licenses guessing Rain, and does not license guessing anything else, on Q2.

To answer questions like Q2, then, you need to not only choose credences with the same valences as yours, but credences that also differentiate among unlikely possibilities in the same way that Cr does. But this still does not show that Pr = Cr. You could do well on Q2, for example, by choosing a credence function that is uniformly just a bit more or less opinionated than Cr. This credence function is not Cr, but it will do just as well as Cr on questions like Q2.

Now consider another, more complicated question. (It is similar to Q3, which we used to argue for Boundedness, above.) For this example, suppose Cr(Rain) = .8.

Q6: A weighted coin has "Rain" written on one side, and "~Rain" on the other. It is weighted .7:.3 in favor of whichever of Rain or ~Rain is true. Now suppose:

(a) the coin is flipped, out of sight;
(b) you answer whether Rain; and
(c) you and the coin disagree about Rain.

Who is right?

In this case, the best answer by the lights of Cr is that you are right. So you should choose a Pr that will also answer that you are right. I'll first go through the example to show why this is, and then argue that questions like Q6 show that Immodesty is true.

We can work out why you should guess that you are right, in Q6, in much the same way we did for Q3, Q4, and Q5a and b. Since your credence in Rain is .8, you can work out that you will answer "Rain". The only situation in which you will disagree with the coin, then, is one in which the coin lands "~Rain". So we are comparing these two conditional credences: Cr(The coin is right | The coin says "~Rain") and Cr(The coin is wrong | The coin says "~Rain").

First, your credence that the coin will say "~Rain" is given by the following sum:

Cr(The coin says ~Rain and it's right) + Cr(The coin says ~Rain and it's wrong)

Plugging in the numbers, using the weighting of the coin and the values that Cr assigns to Rain and ~Rain, we get: (.7 * .2) + (.3 * .8) = .38.

Your conditional credence that the coin is right, given that it says ~Rain, is (.7 * .2) / .38 = **.37**. Your conditional credence that the coin is wrong, given that it says ~Rain, is (.3 * .8) / .38 = **.63**. Since the second value is higher, the best answer by the lights of Cr is that, given that you disagree, you are right and the coin is wrong.

Questions like Q6 could be constructed with any proposition, and any weighting of the coin. To do well on the exam, when you don't know what question you will encounter, you need to be prepared for any question of this form. So you need to pick Pr such that it will give the best answers (by the lights of Cr) given any question like Q6 – involving any proposition and any possible coin.

The guesses that any credence function licenses on questions like Q6 depend on the relationship between the value that credence function assigns to the proposition (in this case, Rain) and the weighting of the coin. If the credence function is more opinionated than the coin (in this case, if Pr(Rain) > .7), it will license guessing in favor of yourself. If the credence function is less opinionated the coin (in this case, if Pr(Rain) < .7) it will license guessing in favor of the coin.

This is what we need to show that Immodesty is true. Suppose you choose a Pr that is different from Cr, so it assigns a different value to at least one proposition. Then, there would be at least one question for which Pr will license the "wrong" answer, by the lights of Cr. For example, suppose that Cr(Rain) = .8, but Pr(Rain) = .6. Then Pr will license the wrong answer in Q6: it will license guessing that the coin is right and you are wrong. This is because while Cr's value for Rain is *more* opinionated than the weighting of the coin, Pr's value for Rain is *less* opinionated. And it's easy to see how the point generalizes. To create an example like this for any proposition, P, to which Pr and Cr assign different values, just find a coin whose weighting falls between Cr(P) and Pr(P). Then, in a setup like Q6, Cr and Pr will recommend different answers. And by the lights of Cr, Pr's answer will look bad; it won't give you the best shot at getting the truth.

To guarantee that Pr will license good guesses in every situation, Pr must not differ from Cr. So Immodesty is true: you should choose your own credence function, Cr, for the purpose of making educated guesses. Pr = Cr. [17]

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[17] Here is the more general form of Q6, and a more general explanation for why it shows that Immodesty is true:

> **Q6*:** A weighted coin has P written on one side, and ~P on the other. It is weighted x:1-x in favor of whichever of P or ~P is true, where 0 < x < 1. Now suppose:
>
> (a) the coin is flipped, out of sight;
> (b) you answer whether Rain; and
> (c) you and the coin disagree about Rain.
>
> Who is right?

Suppose Cr(P) > Cr(~P); turn the example around if the opposite is true for you. You should guess in favor of yourself if Cr(P) > x, and in favor of the coin if Cr(P) < x.

The probability that the coin says ~P will be the sum

Cr(The coin is right | The coin says ~P) + Cr(The coin is wrong) | The coin says ~P)

Or:

$$(1-y)(x) + (y)(1-x)$$

4. Alternative approaches

So far I have introduced my new framework and explained how it can be used to account for two kinds of rational requirements: probabilism and immodesty. In this section I will look very briefly at two alternatives to my proposal, each of which also offers an account of these two requirements. Epistemic utility theory evaluates credences for "accuracy", or closeness to truth. Another approach, which I'll call "the practical approach", does away with truth and looks instead at which actions are rationalized by an agent's credences. This section is not meant to be anything like a comprehensive overview of all possible approaches, or even of these two. I mention these only to bring out some salient features of the educated guess picture in comparison to its competitors.

4.1 Epistemic utility theory

A popular strand of formal epistemology, "epistemic utility theory", starts off with what I referred to earlier as the common-sense notion of accuracy. Although credences can't be true or false, they can be closer or farther from the truth.[18] Your credence in P is better if it's closer to P's truth-value (close to 1 if P is true, and close to 0 if P is false), and worse if it's farther from P's truth-value. The way someone measures accuracy, weighing tradeoffs between being *close to truth* and *far from error*, is represented by a special kind of utility function, or "scoring rule". According to epistemic utility theory, epistemically rational agents should adopt the credences that maximize expected epistemic utility from

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The following therefore gives you your conditional credences:

$$\begin{aligned}
\text{Cr(Coin is right|Coin says} \sim\text{P)} &= (1\text{-}y)(x)) \,/\, ((1\text{-}y)(x) + (y)(1\text{-}x)) \\
&= \mathbf{(x - xy) \,/\, ((1\text{-}y)(x) + (y)(1\text{-}x))} \\
\text{Cr(Coin is wrong|Coin says} \sim\text{P)} &= (y)(1\text{-}x) \,/\, ((1\text{-}y)(x) + (y)(1\text{-}x)) \\
&= \mathbf{(y - xy) \,/\, ((1\text{-}y)(x) + (y)(1\text{-}x))}
\end{aligned}$$

To see which of the conditional credences will be higher, just look at the numerators (the denominators are of course the same). It's easy to see that if $x > y$, the first conditional credence will be higher than the second; if $y > x$, the second will be higher than the first. So you should guess that *the coin is right*, conditional on your disagreeing, if your credence in P is greater than the weighting of the coin. You should guess that *you are right*, conditional on your disagreeing, if your credence in P is less than the weighting of the coin.

[18] For instance, see Joyce [1998] and [2009], Greaves and Wallace [2006], and Leitgeb and Pettigrew [2010].

their own point of view, much as decision theory understands practically rational agents as taking actions that maximize expected utility.

Much of the work in epistemic utility theory focuses on providing a justification for probabilism. Joyce (in his [1998] and [2009]) does so by introducing several axioms, which provide constraints on acceptable scoring rules. Legitimate measures of epistemic utility are those that obey the axioms. He then gives an accuracy-dominance argument for probabilism: credences that violate probabilistic coherence are always dominated by probabilistic credences. That is, for any incoherent credence function, there is a coherent credence function that is guaranteed to have higher epistemic utility no matter how the world turns out to be. But probabilistic credences are not accuracy-dominated. Therefore, Joyce argues, it is irrational to have incoherent credences: doing so guarantees that your credences will be defective in a certain way that you could avoid by being coherent.

Along the way, epistemic utility theorists often also endorse an immodesty principle. Immodesty (which I discussed in detail in the last section) is the sense in which a rational agent should take her own beliefs or credences to give her the best shot at getting at the truth. According to epistemic utility theory, the right way to cash out this thought is in terms of expected epistemic utility: insofar as you are rational, you will adopt the credences that maximize expected epistemic utility, as assessed by the lights of your credences and your scoring rule. This consonance between an agent's credences and her method for assessing accuracy accounts for the fact that rational credences are stable: a rational agent should stick with the credences she's got, unless she receives new evidence. Immodesty, understood this way, also imposes some restrictions on which scoring rules are legitimate or acceptable for rational agents to use. (In fact, when we adopt immodesty as a requirement, several initially plausible ways of measuring accuracy are positively ruled out.[19])

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[19] For example: the "Absolute Distance" rule, which equates a credence's degree of inaccuracy with its absolute distance from the truth, is ruled out because it is incompatible with immodesty. Here's a quick illustration of why. Suppose you have .6 credence in P, and .4 credence in ~P (so, your credences are coherent). You are wondering whether .6 credence in P maximizes expected accuracy – or, equivalently, minimizes expected inaccuracy. The inaccuracy of credence .6 is just the absolute distance between .6 and 1 if P is true, and the absolute distance between .6 and 0 if P is false. So to find the *expected* inaccuracy, take the average of these values, weighted by the likelihood that each of these possibilities is the actual case: $(.6)(|1-.6|) + (.4)(|0-.6|) = .48$. Is .6 the best – i.e., most expectedly-accurate – credence in P to have, from your point of view? No: any credence *higher* than .6 is better. To take the extreme case, consider credence 1 in P. The expected inaccuracy of credence 1 is $(.6)(|1-1|) + (.4)(|0-1|)$, or .4. In fact, using the

Epistemic utility theory therefore gives us a unified story about credences, truth, and certain rational requirements, including probabilism and immodesty. This is a mark in its favor. But there are also reasons to worry about the approach.

First, epistemic utility theory asks us to adopt quite substantive restrictions on our notion of accuracy and concern from the truth. Though it starts off with the common-sense idea that closer to the truth is better, choosing a particular scoring rule requires us to go far beyond that initial thought. For example, Joyce's "Normality" axiom says roughly that equal distance from the truth must be evaluated equally for accuracy – so, .4 credence in a false proposition is just as accurate as .6 credence in a true proposition. Allan Gibbard objects to this rule, claiming that it is far more committal than is warranted by our ordinary notions of "accuracy" or "concern for the truth". He argues that someone should count as purely concerned with the truth, or purely concerned with accuracy, even if she values closeness to truth much more highly than distance from error. Patrick Maher gives a similar objection to Joyce's "Symmetry" axiom.[20] If Gibbard is right, and Joyce's axioms aren't motivated by our pre-theoretic understanding of accuracy, where do they come from? We might worry that their only support comes in after the fact, when we discover that they are necessary for defending probabilism. Rather than uncovering surprising discoveries about accuracy, epistemic utility theory may be assuming what it's trying to prove, or simply changing the subject.

The second potential problem has to do with adopting a decision-theoretic understanding of epistemic rationality. Is epistemic rationality really about trying to maximize some quantity? Those who are worried about consequentialism, in epistemology as well as other normative domains, might be suspicious of its use here. Since epistemic utility theory involves aggregating the value of your credences in different propositions (to find the overall accuracy of your total doxastic state), it's hard to see how it could avoid sanctioning illegitimate trade-offs between beliefs, much in the way that consequentialist moral theories sanction moral trade-offs. Worries along these

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Absolute Distance measure, only credences of 1, 0, and .5 will ever maximize expected accuracy from their own point of view. So unless your credences have only those values, if your scoring rule is Absolute Distance, you will never maximize expected accuracy by your own lights.

[20] See Maher [2003] and Gibbard [2008].

lines have been raised recently by Jennifer Carr (in the specific context of epistemic utility theory) and Selim Berker (more generally).[21]

4.2 The practical approach

An alternative family of arguments tries to justify rational requirements such as probabilism and immodesty by looking at *practical* value. These arguments don't appeal directly to any particular understanding of accuracy, or any other way of evaluating credences directly in relation to truth.

The Dutch Book argument is a well-known example of this approach, used to argue for probabilism.[22] This argument works by using the connection between credences and rational action, as understood by decision theory. The argument goes like this: if you have incoherent credences, your credences will license accepting a series of bets that, together, guarantee a sure loss (of money, utility, or whatever you are betting on). But it is not practically rational to take actions that are guaranteed to leave you practically worse off. If you had coherent credences, however, you would not be licensed to take sure-loss bets. So it is not epistemically rational to have incoherent credences.

Gibbard (in his [2008]) uses a similar approach to argue for an immodesty principle. His proposal is that a rational agent should regard her credences as best, not for the purposes of getting at the truth, but for the purposes of maximizing practical value. Gibbard's argument goes roughly as follows: holding your utilities fixed, suppose that you are choosing some credences to act on. Insofar as you're rational, you will take the action that maximizes expected utility, as assessed by those credences and utilities. Now imagine a continuum of bets that you could be offered. In order to guarantee that you will accept bets only when doing so looks good by your *current* lights (that is, when accepting the bet maximizes expected utility according to your current credence function), you must bet on the basis of *your current* credences. If you bet on the basis of any other credences than your own, you will take bets that look bad by your current lights, and reject bets that look good.[23]

[21] See Carr [ms], and Berker [2013a] and [2013b].

[22] **Citations here**

[23] Gibbard's proof, adapted from Schervish, looks like this. Imagine a continuum of bets on a proposition, S, at odds 1-x:x, where 0<x<1 (so, all possible odds at which you could bet on S are represented). You will

Practical arguments provide an economical way of accounting for these requirements of epistemic rationality. They don't require us to posit a special kind of epistemic utility; instead, they piggyback on practical utility, which has independent uses in the theory of practical rationality. But there is reason to think that we should try to do better. Most obviously, the phenomena that these practical arguments attempt to explain are, at face value, purely epistemic. Why should *epistemic* rationality be held hostage to practical concerns, such as how much money you're likely to make? (We don't generally think that you should adopt one belief over another because of monetary gain – so how are these arguments different?) For those who want to maintain that the practical and the epistemic as distinct normative realms, practical arguments for epistemic requirements miss the mark.

There is much more to be said here. For instance, we could reject the flat, simplistic interpretation of the Dutch Book argument, and take it as an illustration of an epistemic phenomenon, rather than focusing on the practical aspects at face value.[24] I will come back to this in the last section. (It's worth noting, though, that not all defenders of the practical approach want to adopt this sort of understanding. Gibbard explicitly advocates rejecting the notion of "pure concern for truth", and giving up on the hope of a purely epistemic argument for immodesty.) But at least at first glance, the practical strategy seems to be giving up too soon.

We should not throw in the towel just yet. We should hold out for a purely epistemic account of probabilism and immodesty. A rational agent should be coherent and immodest, not because this will make her happy or rich, but because she takes her credences to give her the best shot at representing the world as it is.

5. Some more advantages for educated guesses

We've seen how the guessing account can be used to argue for probabilism, and how it gives us a true immodesty principle. I take both of these to count in favor of the educated

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win \$(1-x) if S is true, and lose \$x if S is false. Your action policy will recommend accepting bets that have positive expected value, and rejecting bets that have negative expected value. In other words, if "Pr" is the credence function you will use for acting, your action policy will recommend accepting bets where $Pr(S) < x$. You will reject bets where $Pr(S) > x$. If you act on some credences other than your own, you will end up accepting bets that, by your own lights, should be rejected, and vice versa.

[24] **Christensen, Skryms**

guess picture as a good way to understand the relationship between credences and truth. In this last section I'll mention some more advantages of the account, both as an alternative to epistemic utility theory and to the practical approach, and as a project that is independently useful and worth pursuing. I'll also point to some avenues for further applications of educated guesses.

Now that we have seen how the guess account works, it should be easier to see how it does justice to the common-sense notion of accuracy. True guesses are better than false ones; that's built into the norms for rational guessing. The guess account also vindicates the thought that it's better to be close to the truth than far away – e.g., it's better to have .8 credence in a true proposition than .7. One way to think about it is that, the closer your credence is to P's truth-value, the more likely you are to guess correctly about P. We could also think about the point by looking back at the continuum of weighted coins we imagined in the argument for Immodesty. You should expect to "beat" a given coin if you're more opinionated than the coin. So as you get closer to a proposition's truth-value – that is, more opinionated – you should expect to beat more and more possible coins. Your credence gets better and better as you get closer to the truth because the space of coins that are better than you gets smaller and smaller. Understanding the coins as representatives for all of the possible questions you might need to answer, we can say that in general, the space of possible questions you can expect to answer correctly gets larger and larger as your credence gets closer to the truth. Greater accuracy, on the guessing account, amounts to getting more and more things right.

Compared epistemic utility theory, the guessing account of accuracy has an important advantage in the way it lets us make this last point. We can say that closer to the truth is better, but we don't have to say anything more about the rate at which your credence gets better. We don't have to adopt any particular scoring rule, which frees us from the task of defending some of the more controversial axioms. And unlike epistemic utility theory, we don't need to say anything about how to trade off the value of true beliefs in different propositions, or how to weight the value of closeness to truth versus distance from error. We don't need to commit ourselves to a special kind of epistemic value, or take a consequentialist approach to epistemology. All we need to say is that for any proposition, a rational agent should have the credence that gives her the best shot, given her evidence, at guessing truly on questions regarding that proposition.

The guessing account therefore leaves us free to compare or aggregate value as we wish – or to refuse to compare. We could adopt the view that believing truly about P and believing truly about Q are incommensurable, or that we are rationally required to care about each, but that "value" talk is the wrong way to characterize the way in which we care about them. As Selim Berker puts it, we can "respect the separateness of propositions."[25] Our notion of accuracy, on the guessing picture, is therefore compatible with a wider range of positions about epistemic rationality and normativity.

The guessing account of accuracy also has advantages over the practical picture. It is decidedly less pragmatic than Gibbard's (explicitly pragmatic) "guidance" account. Unlike Gibbard's story, the guessing account essentially involves the connection between credences and truth. It is also less pragmatic than the simple, straightforward interpretation of the Dutch Book account: it appeals to the desire for truth, rather than utility or money.

Is the guessing picture really free from pragmatic concerns? Guessing is, after all, an action. And in any real exam, whether it's rational to guess one way or another is going to be subject to all kinds of practical concerns. This raises the worry that the guessing account isn't "purely epistemic".

I think we can respond to this worry by adopting the strategy of "depragmatized" Dutch Book arguments. Defenders of this approach suggest that we think of Dutch Books as illustrations of epistemic incoherence, rather than taking the badness of losing money at face value.[26] We can think of educated guesses in the same way. What we're interested in isn't the practical badness of guessing falsely (in some situations, guessing falsely might be practically advantageous), but the way in which that action illustrates an underlying epistemic flaw.

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[25]This means that we can accept a non-consequentialist account of epistemic rationality – something that is harder to justify using epistemic utility theory. A non-consequentialist guessing picture could also provide an argument for why trade-offs between our beliefs are not rational: remember that if you adopt credences other than your own for your guessing policy, your guessing policy will recommend particular guesses that are likely to be false by your current lights. On a non-consequentialist interpretation, we might say that adopting this policy is irrational because it fails to respect the truth of that particular proposition. See Berker [2013a] and [2013b], as well as Carr [ms] for discussion of epistemic tradeoffs.

[26] **Citation: Christensen, skryms**

In fact, the depragmatization strategy seems to me to work better for the guessing account than for Dutch Book arguments. For the guessing account, we need only look at one particular kind of action (answering whether propositions are true or false), and one desire (to answer truly), to illustrate the epistemic phenomena we are interested in. This action and this desire are much more directly connected to epistemic concerns than betting behavior is. As I mentioned before, guessing is already an action with familiar correctness conditions, which are the same as those of full belief. It is natural to think, therefore, that credences that license true guesses are better, epistemically speaking, than credences that license false ones. And if your credences unnecessarily license guaranteed-false guesses – or if your credences are more likely, by your own lights, to license false guesses than other credences you could have – it is irrational to hold those credences. It is also natural to think of this flaw as an epistemic one; more natural, I think, than it is in the case of depragmatized Dutch Books.

Alongside these advantages, taking on the guessing account also raises a challenge: we need to accept educated guesses as a new piece of theoretical machinery. Why should we think such things exist, let alone think that they are something that epistemology should care about?

One thing we can do is point to examples of educated guesses "in the wild". Multiple choice tests are one way to elicit educated guesses in the sense I'm interested in here. Assertion under time constraints might be another way to elicit them, as well as unconstrained assertion. Statements like "if I had to guess, [P]… but I'm not sure…" plausibly express educated guesses in the same sense.

We also have an alternative strategy at our disposal – to argue for the existence of educated guesses by putting them to theoretical use. The arguments here, which use educated guesses to account for probabilism and immodesty as rational requirements, are two examples of that kind of project. Could we use educated guesses for other theoretical purposes, too?

I think we can. Just as it is important to draw a connection between credences and *truth*, it is also important to connect credences to other all-out epistemic notions. Educated guesses could give us a natural way to draw this connection. For example:

many traditional epistemological questions have to do with *reliability*. Reliability is normally thought of in all-out terms, as a matter of one's propensity to get things right and wrong. If we want to talk about the reliability of someone's credences, we might begin by looking at the guesses that those credences license.

One place this might come in handy is in thinking about "higher-order" evidence: evidence about your own rationality, what your evidence is, or what it supports. Many epistemologists find it plausible that this kind of evidence should influence what credences are rational for you to adopt; a natural explanation of this is that impairments in rationality often go along with impairments in reliability as well.[27] I have also argued elsewhere for an explicit connection between credences and educated guesses, in the interest of spelling out how higher-order evidence works.[28] If this strategy is successful, it will be another mark in favor of including educated guesses as a legitimate part of our epistemological theory.

Educated guesses might also fit naturally with certain accounts of all-out belief.[29] On many of these accounts, we might see belief as a special case of guessing. For example, we might think there is an important difference between guesses that are rational to act on, and guesses that are not. You *believe* P if guessing that P is licensed by your credences, and it is also rational for you to act on P.

Educated guesses provide a natural way to think about how credences get things right or wrong. This picture is compatible with at least two kinds of coherence requirements on rational credence: probabilism and immodesty. And more generally, educated guesses give us a promising way to understand questions in traditional epistemology – which often deal with all-out notions – for those of us who like to think of belief in degreed terms.

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[27] The temptation to speak in all-out terms is clear in much of the literature on higher-order evidence. For example, see White [2009]'s "Calibration Rule", which states: "If I draw the conclusion that P on the basis of any evidence E, my credence in P should equal my prior expected reliability with respect to P." See also Elga [2007]'s (similar) formulation of the Equal Weight View: "Upon finding out that an advisor disagrees, your probability that you are right should equal your prior conditional probability that you would be right…" Though both White and Elga work in a degreed-belief framework, they often slip into all-or-nothing terms to describe how higher-order evidence should work. The guessing picture could help to make this connection more precise.

[28] See Horowitz and Sliwa [ms].

[29] **citation – fantl & mcgrath, weatherson. more here**

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