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WHY CREDENCES CANNOT BE IMPRECISE

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ABSTRACT

Beliefs formed under uncertainty come in different grades, which are called credences or degrees of belief. The most common way of measuring the strength of credences is by ascribing probabilities to them. What kind of probabilities may be used remains an open question and divides the researchers in two camps: the sharpers who claim that credences can be measured by the standard single-valued precise probabilities. The non-sharpers, on the other hand, claim that credences are imprecise and can only be measured by imprecise probabilities. The latter view has recently gained in popularity. According to non-sharpers, credences must be imprecise when the evidence is essentially imprecise (ambiguous, vague, conflicting or scarce).

This view is, however, misleading. Imprecise credences can lead to irrational behaviour and do not make much sense after a closer examination. I provide a coherence-based principle which enables me to demonstrate that there is no need for imprecise credences. This principle is then applied to three special cases, which are prima facie best explained by use of imprecise credences: the jellyfish guy case, Ellsberg paradox and the Sleeping Beauty problem.

The jellyfish guy case deals with a strange situation, where the evidence is very ambiguous. Ellsberg Paradox demonstrates a problem that occurs when comparing precise and imprecise credences. The Sleeping Beauty problem demonstrates that imprecise credences are not useless, but rather misguided. They should be understood as sets of possible precise credences, of which only one can be selected at a given time.

KEY WORDS

beliefs, credences, imprecise probability, uncertainty, epistemology

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INTRODUCTION

The idea that beliefs come in degrees – called degrees of belief or *credences* – is widely accepted among epistemologists and is intuitively easily understood. It is also widely accepted that credences are measured by probabilities and this provides the base for the subjective interpretation of probability. But could these probability measures of credences be imprecise, i.e. could there be imprecise credences? This view has recently gained a lot of attention, but I will claim that it is misleading: credences (degrees of belief) can only be precise.

But let us first get to the underlying notion of credences. The world we live in is full of uncertainties: we cannot know for certain how much the price of gas will rise or drop in the next days, whether it will rain tomorrow, who will win the election and so on. Proponents of the degree-of-belief interpretation of probability, also known as Bayesians (after their founder Thomas Bayes), made an influential claim that uncertainty requires one of the basic epistemological concepts, beliefs, to be reduced into credences, with probabilism being the leading view on how to measure the strenght of credences.

Different analyses of what credences as such are were provided and their exact nature remains an open question. Eriksson and Hájek hold a view that credences are primitive terms, but more importantly, their conclusion that "we can get by well enough without such an analysis" [1; p.212] allows us to focus on probabilities that are successfully used to measure credences.

It has thus become common to ascribe numerical values of probabilities (from 0 to 1) to credences (the higher the probability the stronger the credence). This idea is at the core of Bayesianism, which has demonstrated that an agent can only be rational if her credences follow the laws of probability (Kolmogorov's axioms) [2]. While this interpretation has had a lot of success (and many problems), one specific question has recently caused a lot of debate amongst the researchers, namely, should the probabilities ascribed to credences be precise or imprecise?

The introduction of imprecise probabilities (families of probabilities instead of single probabilities) into analyses of beliefs has divided researchers in two camps: sharpers (proponents of precise credences) and non-sharpers (proponents of the imprecise approach). The main motivation for non-sharpers is that precise credences are not strong enough: if an agent is confronted with imprecise (ambiguous, vague, conflicting or scarce) evidence, she ought to adopt imprecise credences (measured by imprecise probabilities).

Imprecise probabilities *prima facie* look very appealing, but as I will demonstrate, can lead to irrational behaviour and do not make much sense on a closer inspection. This means that the imprecise (non-sharp) evidence does not require imprecise probabilities (which is what motivates many non-sharpers, e.g. [3-6]).

Does this mean I should pretend I am perfect (as the title question of Julia Staffel's draft [7] asks) and pretend all I ever deal with are risks and not uncertainties (in Knight's sense, [8])? My answer is short: No. While there certainly are special cases, which raise philosophical interest, precise probabilities remain the most powerful way to deal with them. I will argue that imprecise credences are based on a wrong assumption that imprecise evidence requires them. Exactly the opposite: imprecise evidence allows multiple possible precise credences, but not all at once (as imprecise credences suggest). I will develop my defence of the precise credences on three special cases, which seem to call for imprecision, and show why and how imprecise approach leads in wrong directions. These three cases are the jellyfish guy case, the Ellsberg paradox and the Sleeping Beauty problem.

THEORETICAL FRAMEWORK

Let me first introduce a few theoretical considerations on the nature of imprecise probabilities, imprecise credences and associated theoretical questions. Imprecise probabilities are a generalisation of precise probabilities, more particularly, they are sets of probability functions. They may be represented with intervals of probabilities, even though this is not the only possibility. It suffices to limit myself to interval-based imprecise probabilities in this paper as my defence depends on the fundamental idea that a single credence cannot have multiple values. My objections could also be applied to other representations of imprecise credences.

The interval-based imprecise credences are represented by intervals of precise probabilities with lower and upper probabilities as its endpoints. Formally: "A family $\mathcal{P}$ of probabilities on X induces lower and upper probabilities on sets A. Namely

$$\underline{P}(\mathrm{A}) = \inf_{P \in \mathrm{P}} P(\mathrm{A}), \quad \overline{P}(\mathrm{A}) = \sup_{P \in \mathrm{P}} P(\mathrm{A}).$$

We have [9; p.250]:

$$P_{\underline{P}-\overline{P}}(\mathrm{A}) = \left\{ P \middle|_{\forall} \mathrm{A} < \mathrm{X}\ \text{measurable}, \underline{P}(\mathrm{A}) < P(\mathrm{A}) < \overline{P}(\mathrm{A}) \right\}.$$

The idea to represent probabilities with intervals rather than singular numerical values is relatively old (one of the earlier proponents was the famous economist J. Keynes in 1920's [10]), but only gained wider recognition in the last decades. Imprecise probabilities were introduced for a variety of reasons. It seems very hard to pinpoint the exact probability of most events, so it is, according to the non-sharpers, more accurate if an interval-based estimate is given. Pinpointing a precise probability (based on, e.g. maximum entropy principle) could in some situations also mean that more information was introduced than evidence provides and this would lead to disastrous consequences (cf. van Fraassen's cube factory paradox [11]).

Another motivation for imprecise probabilities lies in their apparent similarity to psychological reality. Ascribing precise numerical values to credences strikes us as psychologically unconvincing. What does it mean to have, say, 0,563 credence that it will rain tomorrow? Even more, how could this particular number be more appropriate than 0,564? While historical accounts show that this was not the main motivation for early introductions of imprecise probabilities (the before-mentioned Keynes, for example, used the imprecise approach in his work on logical probabilities), it is exactly this subjective interpretation of probability that gained the strongest momentum when applying imprecise probabilities to imprecise credences[1].

An important theoretical difference between precise and imprecise credences lies in their conditionalization, i.e. updating prior credences when confronted with new evidence, one of the pillars of Bayesianism (according to [2]). Conditionalization is, at least theoretically, quite straight-forward for precise credences. The most basic proceeding is as follows: a rational agent has some prior credence $P_{\text{prior}}(\mathrm{H})$ and some conditional credence $P(\mathrm{H}|\mathrm{E})$ (credence in H *given* E). When she learns *E*, her posterior credence changes to $P_{\text{posterior}}(\mathrm{H}) = P(\mathrm{H}|\mathrm{E})$. When confronted with imprecise credences, conditionalization basically works in the same way, but the whole process requires much more computation as every value in the interval (or, more generally, in the set of credences) is updated, conditional on the new evidence.

One of the main reasons that a rational agent should still prefer imprecise credences despite their computational complexity is, according to the non-sharpers, that imprecise credences provide higher accuracy. An imprecise credence of [0,3, 0,4] (between 0,3 and 0,4) in some proposition *P* is more accurate than a credence 0,34 in the same proposition given that its objective chance is not 0,34 but rather 0,341. This strikes as unnatural as we are more inclined to accept non-accurate but precise estimates than wider intervals, as Yaniv and Foster [12] have demonstrated in their psychological experiments. The higher accuracy is not hard to understand if the rain example is exaggerated: it is much more likely that the actual objective chance[2] of tomorrow's rain is included in my credence if my credence is [0,1, 0,9] instead of 0,34. But even though this wider interval is more accurate, it is a lot less informative and almost useless. Non-sharpers are not unprepared for such objections and wouldn't agree with such a definition of accuracy at all. They constrain arbitrary widening (or narrowing) of the intervals with an important rule: lower credence should be exactly as low as the evidence minimally allows, while the upper should be as high as it allows. If a rational agent is faced with completely ambiguous evidence, her credence should be [0, 1]. The credence of tomorrow's rain of [0,1, 0,9] would be wrong as the evidence does not allow it (given that we are not in England). This restriction makes imprecise credences much more attractive, but still leaves an important open question: how exactly to determine the correct (and, after all, precise) lower and upper boundaries? How could the credence of [0,3, 0,4] be acceptable, given some evidence, while [0,29, 0,41] would be wrong? This is a major problem for the standard interval-based credences as the upper and lower boundaries remain sharp (and thus subject to the same criticism as sharp probabilities). It is possible to envision a response to this problem – boundaries could be non-sharp (a similar idea was suggested in [13]) so that the credence would look somewhat like this: $P(\mathrm{A}) = {}_{a}[^{b}\, x, y\, {}_{c}]^{d}$; $0 \leq a \leq b \leq x \leq y \leq c \leq d \leq 1$ with boundaries $[a, b]$ and $[c, d]$ defined as intervals. But it is obvious that we could repeat this process infinitely as boundaries of any interval are essentially sharp. This flaw could be generalised from interval-based credences to most non-sharp probabilities: how to allow some singular credences and exclude some? One could argue that imprecise credences could be represented by a fuzzy set (where each member has a specific grade of membership) or by a statistical distribution, which would supposedly save the attack that imprecise credences essentially remain sharp. As I will argue, even this would still be suspect to the basic problem – a credence may only be singular (and, hence, precise).

But let us first look into the primary theoretical role of (prior) credences. Konek [14], discussing the related problem of the priors (i.e. prior probabilities/credences), listed a few of the most influential accounts:

1. Informational account: To accurately reflect the informational content of the agent's evidence.
2. Subjectivist account: To accurately represent the agent's opinions about the plausibility of hypotheses (or, more generally, propositions).
3. Practical account: To yield the most sensible decision-making policy under conditions of ignorance.
4. Instrumental account: To put us in a position to secure accurate, minimally luck-dependent posterior credences by updating on new data.

The practical account is problematic as the most sensible decision-making policy "depends on which epistemic perspective you evaluate it from" ([14; p.9). Most non-sharpers adhere to informational and subjectivist accounts and both accounts depend on accuracy, which is in conflict with informativeness (the less precise credences are the less informative they are). The instrumental account (Konek's position) remains the most promising of those listed. It directly suggests that credences are theoretical constructs and that their role should be defined by their relationship between prior and posterior credences. It remains problematic, though, as it aims at accuracy (alethic correctness), which is sufficient, but not necessary for rational agents. I argue that the necessary principle should rather be coherence.

The problem with accuracy is that many researchers who aimed at it implicitly "derived deductive consistency as a coherence norm for full belief" [15]. Coherence, on the other hand, is a weaker principle than consistency. It still requires the credences to respect the laws of probability, but they do not need to be completely deductively consistent.

The preface paradox, a problem related to the difference between consistency and coherence, has recently been raised and it roughly goes as follows:

Imagine that you wrote a book and have re-read every sentence many times checking for mistakes. Yet it is highly plausible that there may be some mistakes left, so you point out in your preface that you are aware of this and that all mistakes are unintended. The paradox arises because of two inconsistent claims, both supported by your evidence:

1. Your evidence (thorough reading) suggests that every sentence of the book is free of mistakes.
2. Your evidence (past experience) suggests that human mind is prone to error, so there must be at least one mistake in the book.

The paradox basically arises because of the demand for consistency, which is a classical way to reach accuracy. One suggested solution is to withhold both claims, but as Easwaran and Fitelson [15] have demonstrated this is not the correct solution for rational agents. Rather than withhold both beliefs, one should withhold the demand for full accuracy or as Fitelson and Easwaran have shown, one should aim for beliefs that avoid accuracy-dominance. It is fully rational to hold both of the claims (1) and (2), even though this might be inaccurate (and inconsistent). This occurs because accuracy is a too strong constraining requirement for perfectly rational agents, so one is not only able to, but also required to be perfectly rational with weaker constraints. To put it in simpler terms (departing from Easwaran and Fitelson's formally more detailed account, dealing with full beliefs): one should avoid accuracy-dominated credences for weaker, coherent (with regards to evidence) beliefs. This brings us to the coherence principle (CP): a set of credences is coherent, in the most simplified form, if there are no other sets of credences that are better supported by evidence, regardless of the situation we are in**.**

It is exactly this tension between consistency (accuracy) and coherence (best evidential support), which theoretically furthers the defence of precise credences. CP lets us recognize that the requirements of accuracy, one of the motivations behind imprecise credences, are too strong and that a weaker principle (CP), satisfiable by precise credences, is sufficient for a perfectly rational agent. Imprecise credences are also compatible with CP but unnecessary. What is more: a perfectly rational agent should avoid them as they unjustifiably lower the informative value of credences. This leads us to a novel account of the theoretical role of credences, the so-called coherence-based instrumental (C-B I) account.

C-B I account: The role of credences is to be defined by their prior-posterior relationship in regards to credence-updating. The role of prior credences is, thus, to put us in a position to secure coherent posterior credences that are best supported by evidence by updating on new evidence.

And this role of credences may only be rationally fulfilled if credences are precise.

THE JELLYFISH GUY CASE

Still, there are some special cases that supposedly justify the use of imprecise credences. I refer to one of the more bizarre mental experiments, pointing in this direction, as the jellyfish guy case. It was introduced by Adam Elga [16] and goes as follows:

"A stranger approaches you on the street and starts pulling out objects from a bag. The first three objects he pulls out are a regular-sized tube of toothpaste, a live jellyfish, and a travel-sized tube of toothpaste. To what degree should you believe that the next object he pulls out will be another tube of toothpaste?"

A natural response is that I cannot have a precise credence. The whole situation is clearly bizarre and very unique. I have no past experience with strangers, who walk around with a jellyfish in their bag, so any precise credence (e.g. 0,2, 0,94 or 0,53) could only be arbitrary. The only way out of it with precise credences seems to be to apply the maximum entropy principle and say that I should have 0,5 credence that the next object he pulls out will be a tube of toothpaste, but this answer is unacceptable – there are no reasons to justify one (maximum entropy) or another principle. It is not that I do not have enough computational skills to determine the correct credence. The problem is that the evidence on hand does not allow me to determine which principle could be applied in this situation. As Elga [16] pointed out, this case is clearly artificial, but realistic scenarios have also been proposed. E.g. what is your credence that "the price of copper and the rate of interest twenty years hence, or the obsolescence of a new invention, or the position of private wealth owners in the social system in [40 years]" [16]? Such scenarios seem to call for non-sharp answers: if your evidence is essentially non-sharp, so should be your credences and it seems perfectly rational to do so.

Let me now show, why and where such claims go into the wrong direction. Imagine that my credence about the next item the stranger takes out of his bag is non-sharp, for example [0,3, 0,9]. Such credence is consistent with the strange evidence and very wide (non-sharpers claim that in cases of complete ambiguity, the rational credence is spread out over the whole interval [0, 1]). The problem with such non-sharp credence is that it does not conform to the requirements of the C-B I account as I have listed it.

Exactly how could holding such prior credence secure coherent posterior credence, best represented by evidence, if we were to update it? It doesn't. If I were introduced to some new evidence (it would be on the news that there is a guy who walks around the town with a jellyfish, two tubes of toothpaste and a sock in his bag), my posterior credence would drop to [0, 0,3] (as I can still only be partially sure with such a bizarre guy). But this is not best supported by evidence: there is nothing in the evidence that demands a wide credence after all – it allows multiple (precise) possibilities, but not a single multiple-valued credence. It is only rational to have such multiple-valued credence in some rare cases like quantum physics scenarios.

A perfectly rational epistemological agent, confronted with the jellyfish guy case, should consider multiple possible credences (as the evidence is very vague) with all of them being precise as there are no evidential reasons for the opposite. Even more, how could one hold a multiple-valued credence in the next object the stranger pulls out? There is nothing in the evidence that demands a multiple-valued credence. But even if we pretend that it may make sense to hold multiple credences at the same time (what imprecise credences are in a nutshell), C-B I completely rules out imprecise credences when updating is called for. This may be more clear in our next case.

ELLSBERG PARADOX

The jellyfish guy case is very unrealistic and does not require updating in the standard version, so we should consider another more famous example that non-sharpers often refer to, the Ellsberg paradox (so named after Daniel Ellsberg, who first introduced it in [17]). The paradox can be presented in the following way:

There is a vase about which you know the following: there are 90 balls of three different colours inside. One third (30) of the balls are black and the other two thirds are either red or yellow. You are offered two exclusive choices:

1.A) You get 10€ if you draw a black ball, or
1.B) You get 10€ if you draw a red ball.

And another two choices:

2.A) You get 10€ if you draw either black or yellow ball, or
2.B) You get 10€ if you draw either yellow or red ball.

The paradox arises because most people choose answers 1.A and 2.B, which are inconsistent. If you choose answer 1.A, this would mean that you believe there are more black balls than red. This implies that you believe there are less or equal than 30 red balls ($B = 30 \geq R$), for example 29. Because you know that there are 60 yellow or red balls, this would also imply that you believe there are at least 30 yellow balls. In our case this would mean that if there are 29 red balls, then there are exactly 31 yellow balls. If you evaluate answers 2.A and 2.B on this basis, you conclude that the option 2.A can be fulfilled by at least 60 balls (61 in our example), and the option 2.B by at most 60 (59).

If you choose answer 1.A, it would only be rational to choose the answer 2.A. The same holds if you initially choose 1.B (you think there are more than 30 red balls). It would then only be rational to choose 2.B. The paradox arises because, as said, most people choose two inconsistent answers 1.A and 2.B. This is usually explained by ambiguity aversion. Both options 1.A and 2.B are clear; the first may be winning if one of 30 balls is picked and the other if one out of 60. Although the results may be explained (away) as a psychological bias, the use of imprecise credences also leads to irrational behaviour in this example.

Let us see why imprecise credences look appealing from the normative point of view and why they ultimately fail in comparison to precise credences. It is tempting to apply imprecise credences to cases like Ellsberg paradox. A rational credence about option 1.A would thus be 1/3, while it would be [0, 2/3] about 1.B. 2.A would be assigned a credence of [1/3, 1] and 2.B a sharp 2/3.

While such imprecise credences (1.B and 2.A) are accurate, they do not provide any rational guidance on selection. How may a perfectly rational make the first choice between 1.A and 1.B? She cannot, because there is no rational way of comparing which choice is better as one is precise and the other is imprecise. A correct set of choices (1.A, 2.A or 1.B, 2.B) would follow if this first choice was made, but there is no rational ground to make it. Our perfectly rational agent withholds her choice and gives up the possible prize, which is clearly irrational. This demonstrates another aspect of the possible violations of the C-B I principle. If the main argument against imprecise credences in the jellyfish guy case was based on the nature of evidence, Ellsberg paradox shows they may lead to irrational withholding of choices (and the updating from prior to posterior credences doesn't take place at all, which is a clear violation of C-B I).

This problem perishes if precise credences are used. Let's take a look at one of many evidentially possible sets of precise credences a perfectly rational agent may have:

1.A: 1/3, 1.B: 1/6; 2.A: 5/6, 2.B: 2/3. The rational choice would then directly follow: 1.A and 2.A. A formal proof that precise credences always lead to a set of coherent choices could be provided, but is not necessary for our means. It is more important to note that the imprecise approach is not useless - the intervals, provided as imprecise credences in Ellsberg paradox cases, could be understood as sets of possible precise credences. But to be able to update our credences, they should remain precise and only a single credence may be selected from the interval of possibilities. The main problem is then that imprecise credences should not be understood as credences, but rather as sets of evidentially possible precise credences.

THE SLEEPING BEAUTY PROBLEM

D.J. Singer titled his recently published paper *Sleeping beauty should be imprecise* [18]. He does not discuss how Sleeping Beauty should be imprecise to get the handsome prince's kiss quicker. What Singer is really discussing is another paradoxical problem introduced by Adam Elga (the creator of the jellyfish guy thought experiment) with Sleeping Beauty in the main role. It was introduced in [19] and is paradoxical because it allows two distinct answers. The problem is: "Some researchers are going to put you to sleep. During the two days that your sleep will last, they will briefly wake you up either once or twice, depending on the toss of a fair coin (Heads: once; Tails: twice). After each waking, they will put you to back to sleep with a drug that makes you forget that waking. When you are first awakened, to what degree ought you believe that the outcome of the coin toss is Heads?" [19; p.143].

The two distinct answers are:

1.) 1/2 - that is the answer put forward by David Lewis [20]. Sleeping Beauty knows that the coin is fair and when she is awaken it is only possible for her to keep the 1/2 credence of heads. Coin is fair after all.

2.) 1/3 - this is Elga's position. He gets to this answer by imagining a series of repeated tosses. There are three possibilities:

a.) Heads is tossed - Sleeping beauty wakes up on Tuesday.

b.) Tails is tossed - she wakes up on Monday.

c.) Tails is tossed - she wakes up on Tuesday.

All three possibilities are equally likely as they depend on a toss of a fair coin. Beauty's credence that heads was tossed should thus be 1/3.

Many solutions were proposed, but none of them is able to reconcile the two distinct intuitions. Singer [18] claims that a solution could be provided if Sleeping Beauty was imprecise (i.e. her credences were imprecise). His detailed investigation leads him to the claim that Beauty's credence should be imprecise and represented on a set of probability functions that assign for $x \in [0, 1/2]$ the credences as in Table 1.

Table 1. Singer's analysis of the Sleeping Beauty problem.

	Monday	Tuesday
Heads	x	0
Tails	x	$1 - 2x$

Singer's imprecise approach allows him to cover both traditional responses (1/2 and 1/3) and even takes updating into consideration – but still fails at C-B I, because there is nothing in the evidence Sleeping Beauty that would demand a multiple-valued credence over precise responses. Does this mean that Singer's finding are useless? This is not the case. If the range of possibilities (wrongly understood as imprecise credences) in Ellsberg paradox was easily determined, it takes a lot of effort to plot all possibilities Sleeping Beauty has on hand and Singer succeeded in providing them. His only problem is that he understands the sets of possibilities he provided as imprecise credences and concludes that Sleeping Beauty should be imprecise. His response to Elga's original question would be: we cannot say precisely what credence is the most rational for Sleeping Beauty, but her credence can be represented with such and such interval.

The correct response would be to say that there are multiple possible precise credences (represented by Singer's sets), but our Sleeping Beauty can only choose a single one of them – either 1/2, 1/3 or anything in his intervals. Singer's intervals turn out to be very useful, but wrongly understood as credences instead of sets of precise credences. And this provides another answer why credences cannot be imprecise - what they call imprecise credences are rather sets of possibilities in which one can find the correct precise credences.

CONCLUSION

More cases could be provided to show how imprecise probabilities may lead to disastrous consequences, but these three special cases should provide sufficient support for my defence of precise credences against imprecise ones. It should be clear by now that what is usually understood as imprecise credences are actually just sets of precise credences available given some (ambigous, conflicting, scarce or vague) evidence.

After all, the existence of imprecise credences would mean that precise credences are just their special cases – like beliefs turn out to be special cases of credences above a certain threshold. But as Hájek and Erikssen [1] have shown, credences may be understood as primary concepts which cannot be further analysed. This does not prove that imprecise credences do not exist, but is in line with my defense of precise credences.

It is by now also clear why imprecise credences are so appealing at the first sight: they look like a good representation of our actual credences – human agents are often dealing with fuzzy evidence and the instinct is that our credences should also be fuzzy (imprecise). The main problem is in the misunderstanding of the precise credences, which allow multiple possibilities, but not all at once as imprecise credences call for. Imprecise evidence under uncertainty allows multiple rational responses, but it is irrational (and impossible except for the quantum physics scenarios) to have multiple responses at the same time.

Problems mainly arise because the theoretical role of credences is not discussed often enough and the interpretation one uses is often implicit or naive. We must be aware, though, that credences are either theoretical constructs and so they should play a role most suitable for our fundamental epistemological principles, or they are primary concepts which cannot be further reduced. It should be noted, though, that there are no real reasons credences couldn’t also take part in the empirical reasoning of common people [21] and my conceptual clarification could well serve as a basis for further empirical research of credences.

I only pointed out problems that arise after using imprecise credences if they are confronted with my C-B I principle, but there are more problems for non-sharpers, which I have not discussed. One of the most frequent attacks says that imprecise probabilities (which is how imprecise credences are measured) lead to probabilistic dilations which, roughly speaking, occur when a more precise estimate E changes to a less precise estimate E when new evidence F is learned (for a non-sharper’s counterargument, c.f. [22]).

To conclude on a more positive note: imprecise probabilities are not defeated by my arguments. There are some great uses for them, for example in statistics, quantum physics, bioinformatic. But there is really no place for imprecise probabilities in analyses of credences. Imprecise credences just cannot exist.

REMARKS

[1]It must be noted that imprecise probabilities are successfully used in some scientific fields, like statistics and quantum physics.

[2]The notion of objective chance is introduced as a measure of credence’s accuracy, i.e. a credence is accurate if it is equal to the objective chance. It is unimportant for my point what, if anything at all, an objective chance could be.

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ZAŠTO UVJERENJA NE MOGU BITI NEPRECIZNA

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SAŽETAK

Vjerovanja formirana uz nesigurnost dolaze u različitim stupnjevima koje nazivamo uvjerenja ili stupnjevi vjerovanja. Najčešći način mjerenja snage uvjerenja je tako da im pripišemo vjerojatnosti. Koje vrste vjerojatnosti možemo koristiti ostaje otvoreno pitanje koje dijeli istraživače u dva tabora. Tabor oštrijih tvrdi kako se uvjerenja mjere uobičajenim preciznim vjerojatnostima jedinstvenog iznosa. S druge strane, tabor neoštrijih smatra kako su uvjerenja neprecizna te ih se mjeri nepreciznim vjerojatnostima. Ovaj zadnji pristup u novije je vrijeme dobio na popularnosti. Prema neoštrijima, uvjerenja moraju biti neprecizna kad su dokazi u biti neprecizni (višeznačni, magloviti, suprotstavljajući ili rijetki).

Ovaj pogled je, međutim, stranputica. Neprecizna uvjerenja mogu dovesti do iracionalnog ponašanja i nakon detaljnijeg propitivanja ne pokazuju puno smisla. U radu predstavljam princip temeljen na koherentnsoti koji mi omogućuje demonstriranje kako nema potrebe za nepreciznim uvjerenjima. Princip je zatim primijenjen na tri posebna slučaja, koje je *prima facie* najbolje objasniti primjenom nepreciznih uvjerenja: slučaj čovjeka s meduzom, Ellsbergov paradoks i problem uspavane ljepotice.

Slučaj čovjeka s meduzom razmatra neuobičajenu situaciju u kojoj su dokazi višeznačni. Ellsbergov paradoks demonstrira problem koji se javlja pri usporedbi preciznih i nepreciznih uvjerenja. Problem uspavane ljepotice demonstrira kako uvjerenja nisu beskorisna nego više vode na stranputicu. Mora ih se razumjeri kao skup mogućih preciznih uvjerenja od kojih se samo neka može odabrati u određenom trenutku.

KLJUČNE RIJEČI

vjerovanja, uvjerenja, neprecizna vjerojatnost, nesigurnost, epistemiologija