

Perception and Probability

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1: Introduction

One very popular framework in contemporary epistemology is Bayesian. The central epistemic state is subjective confidence, or *credence*. Traditional epistemic states like belief and knowledge tend to be sidelined, or even dispensed with entirely. (In an attempt to sugar the pill, credences are often called *degrees of belief*.) Instead of believing or knowing that Jones will get the job, the target phenomenon is having a certain *credence* that Jones will get the job. Given this framework, the overarching question is: what credences are the “rational” ones to have?

Credences are often introduced as familiar mental states, merely in need of a special label for the purposes of epistemology. But whether they are implicitly recognized by the folk or posits of a sophisticated scientific psychology, they do not appear to fit well with perception, as is often noted:

A central tenet of the Bayesian program is the representation of beliefs by distributions, which assign probability to each of a set of hypotheses. The prominent theoretical status accorded to such ambiguity seems rather puzzlingly at odds with the all-or-nothing nature of our everyday perceptual lives. For instance, subjects observing ambiguous or rivalrous visual displays famously report experiencing either percept alternately and exclusively; for even the most fervent Bayesian, it seems impossible simultaneously to interpret the Necker cube as potentially facing either direction. (Daw and Courville 2007: 1528)

This paper investigates the tension between probabilistic cognition and non-probabilistic perception. The tension is real, and the solution—to adapt a phrase from Quine and Goodman—is to renounce credences altogether.

2: Belief and credence

Start with belief—also known as *full* belief or *outright* belief.¹ For the purposes of this paper, we can adopt the simple view that believing *p* is a relational state of people and other animals: to believe *p* is to stand in the believing relation to the proposition *p* (cf. Stalnaker 1988: 150).

When one believes *p* one treats *p* as *settled*, and so is inclined to rely on *p* as a premise or assumption. One's inclination might be more or less strong (as a glass might be more or less fragile), which seems to correspond to the strength of belief: one believes *p* more strongly, the greater one's inclination to rely on *p* in reasoning (Williamson 2000: 99).

Beliefs may be more or less strong or firm, but it would be a mistake to conclude from this that beliefs come in degrees, as Moon points out (2017: 767-68). (Mattresses may be more or less firm, but they do not come in degrees.)² More importantly, to believe *p* more or less strongly is to *believe* it. If I know that a coin biased .6 in favor of heads is about to be tossed, I do not believe that it will land heads; a fortiori I do not believe that it will land heads “less strongly” than I believe that it will land either heads or tails.³

In the case of the coin, I neither believe that it will land heads or that it will not land heads. I do believe that the probability of the coin landing heads is .6, but (on the face of it) this is nothing special—it is just a belief like any other. I may hold it more or less strongly, and for good or bad reasons. If in fact the coin is fair then my belief is false. Admittedly, it is not entirely clear what the relevant notion of probability is, but it is usually easy enough to apply in practice.

According to many philosophers, I may also have a certain *credence* in the proposition that the coin will land heads, intuitively thought of as the “amount of confidence” or “level of

¹ For the reasons given in Hawthorne et al. 2016, ‘belief’ may have another weaker interpretation in certain context. The stronger “fully believe” interpretation is in force here (see Williamson forthcoming).

² Thus the terminology of ‘degrees of belief’ (an early occurrence of which is in Ramsey 1926) is not especially apt for belief; for credence, it is not apt at all.

³ ‘Strongly/firmly believe’ is unexceptionable, unlike ‘weakly believe’. Thomas Jefferson wrote to Samuel Kercheval Monticello that we should not “weakly believe that one generation is not as capable as another of taking care of itself, and of ordering its own affairs”; Holton (2014: n. 13, 34-5) notes that Jefferson’s ‘weakly believe’ is vanishingly rare. ‘Partly believe’ is more familiar. (It appears in the King James Bible: “For first of all, when ye come together in the church, I hear that there be divisions among you; and I partly believe it”, *1 Corinthians* 11:18.) But ‘partly’ does not seem to indicate the strength of belief: the most straightforward interpretation of ‘I partly believe the reports’ is ‘I believe (only) some parts of the reports’.

confidence” that I place in that proposition.⁴ The amount of confidence (Cr) is usually scaled from 0 to 1 and—at least in the ideally rational agent—is taken to obey the Kolmogorov axioms of probability. Thus $Cr(p) = 1$ when p is a logical truth, and $Cr(p \vee q) = Cr(p) + Cr(q)$ when p and q are incompatible. So in addition to my belief that the probability of the coin landing heads is .6, I may have credence (or “subjective probability”) .6 in the proposition that the coin will land heads. If Oberon has credence .6 in p and Titania has .5 credence in p , they bear *different* attitudes—different determinates of the same determinable—to the *same* proposition.^{5,6}

It is generally agreed that our credences fall short of the ideal, perhaps by some considerable margin. Although some of our credences are precise (e.g. those pertaining to coin flips), some of our credences may be “imprecise”, as well as not defined on numerous propositions.⁷ And they are sometimes probabilistically inconsistent when defined—to take a famous example, a person’s credence that Linda is a bank teller might be lower than his credence that she is a feminist bank teller (Tversky and Kahneman 1983). But the enterprise of studying the constraints governing the credences of an ideally rational agent would hardly be central to epistemology—and perhaps not even intelligible—unless imperfect agents like ourselves had credences too (cf. Holton 2014: 15).⁸

⁴ E.g. Joyce 2010: 431.

⁵ Thus on the view that replaces probabilistically graded doxastic attitudes with beliefs in propositions about probability, *there are no credences* (here following Hájek and Lin 2017: 210 and Staffel 2013: 3537, not Dogramaci 2018: 10 or Leitgeb 2017: 20).

⁶ This understanding of credence (and, indeed, the very first paragraph of this section) departs from the ambitious have-your-cake-and-eat-it account of credence and knowledge in Moss 2018. Moss argues that the contents of belief are not propositions, but rather “probabilistic contents”, namely “sets of probability spaces” (4), which assign probabilities to possibilities. An ordinary full belief in p has a “nominally probabilistic content”, which only assigns probability to possibilities in which p is true; for her credences are beliefs with “thoroughly probabilistic contents” (14), where the probability spaces are of the more usual kind. Thus, according to Moss, if Oberon has .6 credence in p , the content of his belief is a set of probability spaces all of which assign .6 to p . (Hence if Oberon fully believes p then his credence in p is 1, although Moss rejects the converse.) She also expresses much sympathy with the view that perception has probabilistic content (89-99). Moss’s account is highly relevant to the topic of this paper, but is unexamined here for reasons of space.

⁷ See, e.g., White 2010, Schoenfield 2012.

⁸ See also Hájek and Lin 2017.

Although belief and credence appear to be quite different, appearances can be misleading: knowledge-how and knowledge-that appear different, but arguably the former is a species of the latter (Stanley and Williamson 2001). Could belief be a species of credence? Equating believing p with having credence 1 in p sets the bar for belief too high, since credence 1 is supposed to correspond to maximal certainty, admitting of no further gradations.⁹ But equating believing p with having credence $> x$ (the “Lockean view”) is also problematic, because—it is generally agreed—rational belief agglomerates: if one rationally believes p and believes q one may rationally believe $p \& q$. But rational credence $> x$ does not: if one has rational credence $> x$ in p and rational credence $> x$ in q , the rational credence to have in $p \& q$ might be $< x$. (See, e.g., Holton 2008: 34; Sturgeon 2008.) A reduction in the other direction, of credence to belief, seems hopeless from the start: as was pointed out, to have credence .6 in p is not to believe anything. Here we will make the widely (although not universally) accepted assumption that appearances are not misleading: beliefs do not tag along for free once credences are in place.¹⁰

Granted that neither credence nor belief can be reduced to the other, there is an immediate problem, which Weisberg (2020: 2) calls the *dualist dilemma*. Credences are supposed to be information-encoding action-guiding states: Titania opened the fridge because she had high credence that it contained beer. But belief and knowledge are supposed to be information-encoding action-guiding states too: Titania opened the fridge because she believed (or knew) it contained beer. Since neither explanation requires the other, we appear to have pointless redundancy. Perhaps worse, we might have conflicting norms. Suppose that opening the fridge would maximize Titania’s expected utility, but she doesn’t know that it contains beer. According to the recommendations of decision theory, she should open the fridge; according to the maxim ‘Act only on what you know’ (Hawthorne and Stanley 2008), she shouldn’t.¹¹

⁹ It also appears to set the bar too low, since having credence 1 that a ticket in an infinite lottery will lose is not to be *wrong* if it wins (see Williamson forthcoming; cf. Moss 2018: 56). For defenses of belief = credence 1 see Clarke 2013 and Greco 2015; Wedgwood 2012 argues for a more complicated kind of reduction.

¹⁰ See also Sturgeon 2008, Sturgeon 2015, Dietrich and List 2021.

¹¹ Weisberg’s version of the “dilemma”, unlike the one in the text, makes the terminology appropriate: either beliefs and credences “dictate the same inferences, actions, and assertions...or they do not” (2020: 2). He also notes *the parsimony problem*: “How are full and partial beliefs stored and maintained without duplicating cognitive burdens

Despite this tension, many theorists (Weisberg included) are dualists: we have both credences and beliefs. Weisberg himself tries to resolve the dilemma by arguing (in part) that although we “simultaneously have full and partial beliefs [i.e. credences] about one and the same propositions *dispositionally*...only one of these dispositional states will be active at any given moment” (2020: 21-2).

Historically, *credence monism* was more favored by Bayesians. We have credences, and either don't have beliefs or else the folk notion of belief is too confused to bear much theoretical weight. As Jeffrey puts in in an often-quoted remark: “our ordinary notion of belief is only vestigially present in the notion of degree of belief. I am inclined to think Ramsey sucked the marrow out of the ordinary notion and used it to nourish a more adequate view.” (1970: 171–172).¹² Since there is little motivation to sweep away belief while sparing knowledge (and obviously impossible if knowledge entails belief), credence monism is extremely revisionary. Learning has to go too, since that involves the acquisition of knowledge, although in practice Bayesians like Jeffrey treat it as unproblematic.

That leaves *belief monism*, the thesis of this paper: “there are no such things as credences” (Holton 2014: 20). Belief monism is not widely defended, although it has some prominent adherents.¹³

Two final assumptions. First, credences are not reducible to dispositions to bet, or any other uncontroversial items.¹⁴ Second, we know and believe various things. The contest is between dualism and belief monism.¹⁵

like storage and maintenance?” (3). (For related discussion see Staffel 2013, Buchak 2014, Hájek and Lin 2017, Jackson 2019.)

¹² See also Jeffrey 1992: 1-2, Maher 1993: 130. A nice summary of Jeffrey's view is in Leitgeb 2017: 19.

¹³ For varying degrees of sympathy, see Harman 1986, Easwaran 2016, Horgan 2017, Dogramaci 2018, Mandelbaum 2018 and Williamson forthcoming.

¹⁴ The classic reduction to betting prices is in de Finetti 2017: 64. For some convincing arguments in favor of non-reducibility, see Eriksson and Hájek 2007.

¹⁵ Disparaging belief and knowledge as outdated relics of folk psychology would be more convincing if scientists didn't traffic heavily in them (for helpful discussion see Nagel 2013).

3: Perception as a propositional attitude

So far we have discussed two familiar propositional attitudes: belief and credence. They are at least somewhat similar, which is why reductive programs are worth pursuing. We now need to introduce a *third* belief-like propositional attitude.

Philosophers of perception frequently invoke tomatoes and J. L. Austin's piece of soap that looks just like a lemon, so imagine seeing a tomato and soap bar on a tabletop, in good light. (The soap is a white bar of Ivory, not a lemon lookalike.) You are not just visually presented with *this* (the red tomato) and *that* (the white soap), but with the *fact* that this is red and ovoid and that that is white and cuboid, and that *this* is to the left of *that*. In a situation of this kind, in which you have no reason to think anything amiss, you will believe (and, moreover, know) that a red ovoid is next to a white cuboid. And if you are familiar with basic household items, you will believe (and know) this red tomato is next to that white bar of soap. Here is McDowell making essentially the same point:

In a particular experience in which one is not misled, what one takes in is *that things are thus and so*. *That things are thus and so* is the content of the experience, and it can also be the content of a judgement: it becomes the content of a judgement if the subject decides to take the experience at face value. (McDowell 1994: 26)¹⁶

Vision is in the business of delivering information (“that things are thus and so”) about the perceiver's environment, information that specialized subsystems glean from the environment's interaction with light. Treated with appropriate caution, Thomas Reid's metaphor is useful here: information (or misinformation) delivered by perception is the *testimony* of the senses. Vision is testifying that *this* is red and ovoid and that *that* is white and cuboid—and of course it is testifying to much else besides. Put in contemporary jargon, the testimony of the senses is the “content of perception”.

It is a short step from this to the introduction of a third propositional attitude, *exing*. (‘Exing’ is meant to suggest ‘experiencing’, although it should not be taken to be equivalent to any ordinary English expression.) When one “takes in that things are thus and so”, one *exes* that things are thus and so. If one's senses testify to *p* (in the intended interpretation of Reid's metaphor), one *exes p*. If one *exes p* and the operative sense is vision, then we can think of vision

¹⁶ McDowell later amended his view, but not in ways relevant to this paper (McDowell 2008).

scientists as trying to explain how the visual system derives p from retinal stimulation, “how to get from optical images of scenes back to knowledge of the objects that gave rise to them” (Palmer 1999: 23).¹⁷

All this granted, there must be a point at which exing falls silent and judging and believing take over. If I see the bar and soap and immediately form the belief that Titania has been shopping, I am not simply taking “the experience at face value”. I did not ex that Titania has been shopping because I didn’t even see Titania, and anyway *having been shopping* has no characteristic visual signature. My belief, rather, is the result of some kind of inference from propositions I did ex. If Titania has not been shopping and I claim that my senses were deceiving me, then, in Reid’s words, this “lays the blame where it ought not to be laid” (quoted in Van Cleve 2015: 139). There was nothing wrong with the testimony of perception, the fault is in what I did with it.

A trickier case is my belief that this red tomato is next to that white bar of soap. Is vision testifying to the presence of a tomato, and soap, as such? There is near-universal agreement that “low-level” features like color, texture, shape, motion and so on are part of the deliverances of vision, but whether the list extends to botanical or artifact kinds is disputed (see, e.g., Siegel and Byrne 2016). For present purposes this dispute won’t matter; for convenience we will assume the “rich view”, on which one can ex that this tomato is next to that bar of soap.

4: Exing and perceptual epistemology

An epistemically rational person is not simply a *coherent* one, or so we may fairly assume. To believe a consistent fairy tale is not to believe as one should. Similarly with having credences that confirm to the probability calculus: “subjective Bayesianism” is not the correct theory of rationality.¹⁸ Further constraints come from the world itself, and in particular from perception.

¹⁷ Information from the various senses is pooled (this is particularly clear for smell and taste), hence a single attitude of exing is arguably all that is needed; a single attitude is useful but not crucial for the purposes of this paper. Exing appears in Morrison 2016 as “perceptually entertaining” (37). There are plenty of exing sympathizers; some recent ones include Siegel 2010, 2017, Speaks 2015, Schellenberg 2018, Brogaard 2018. Other views of perception are even less hospitable to the credence picture. See, e.g., Campbell 2002, Travis 2004, Martin 2004, Brewer 2006, Johnston 2006. Some views hostile to exing could be adapted to accommodate credences, e.g. Gupta 2006.

¹⁸ See, e.g. Fitelson et al. 2006: 606.

Setting credences aside for the moment, perception “justifies” belief, or “provides reasons” for belief, or (more plainly put) induces knowledge. Exactly how this works is controversial. On one view, if one exes p , one has “prima facie justification” for believing p , whether p is true or not.¹⁹ On another view, exing is a determinable of a factive propositional attitude, which we can call *sensing*, which does all the epistemological heavy lifting. In the good case, when everything is working well, one senses (and exes) p ; if one takes one’s experience at face value, then one ends up knowing p . In the illusory bad case, one merely exes p and the corresponding belief is excusable but unjustified. This is closer to McDowell’s account.²⁰ In a variant, there is no step between sensing (or exing) p and believing p —experience is automatically “taken at face value”. On this view, exing (and so sensing) entails believing, and sensing (but not exing) entails knowing (Byrne 2016).²¹

When you see the tomato and soap, it is natural to think that vision testifies that the tomato is red and the soap is white, with no qualification needed. Vision is not testifying that the hypothesis that the soap is white is likely correct; neither is there anything palpably probabilistic in the *attitude*, the exing relation of ostensible perceptual awareness that you bear to the content. There is nothing hesitant or tentative in the presentation of the scene before your eyes: the tomato and soap are just *there*.

Here is McDowell saying much the same thing. Consider a good case of seeing a medium-sized green object in daylight. One is in a position in which:

the greenness of things is visibly *there* for one, present to one’s rationally self-conscious awareness...One’s perceptual state leaves *no possibility* that it is not green (McDowell 2011: 38, last emphasis added).

Now it is true that Bayesian models are very popular in perceptual psychology, and for good reason. Recovery of the layout of the environment from the retinal stimulus is a notoriously ill-posed problem: many hypotheses are compatible with the data. A promising approach is to employ Bayesian methods. In a Bayesian perceptual model, the end result of the strictly Bayesian part is a posterior probability distribution over various possibilities—for instance,

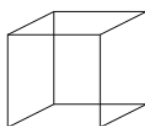
¹⁹ See, e.g., Pryor 2000, Huemer 2001, and Siegel and Silins 2015.

²⁰ See Byrne 2014.

²¹ For related views, see Gluer 2009, Quilty-Dunn 2015, and Lewis 1980b: 239.

different orientations of lines, or different shapes. Leaving it there would plainly be inadequate: as an overview of such models explains, “Perception normally yields a determinate percept. For instance, one sees an object as having a determinate shape, not a spectrum of more or less probable shapes” (Rescorla 2015: 697). To accommodate the phenomenology, the Bayesian theorist adds a *decision rule* to determine one possibility as the “best” hypothesis. One such decision rule selects the environmental possibility that has the maximum posterior probability (the MAP, or Maximum A Posteriori Rule) (Mamassian et al. 2002; see also Bennett et al. 2014, Rescorla 2015). The proposition corresponding to the selected possibility is then the one that the subject sees.

As illustrated by the quotation at the beginning, bistable figures like the Necker cube (below) vividly show the need for a decision rule.



The stimulus suggests two plausible real world hypotheses (ironically, neither is correct when viewing the usual 2D illustration). On both hypotheses a wire cube is before the perceiver, but the hypotheses disagree about its orientation. Any reasonable Bayesian prior will not favor one over the other. As Denison says, “If there is any situation in which we might expect perception to give us a probabilistic experience, it is when viewing a bistable figure...But this is not what happens” (2017: 67). Instead, we oscillate from seeing the Necker figure as a wire cube with one orientation, to seeing it with another.

Exing, then, is no more probabilistic than believing—even less so, if one can’t express propositions about probabilities. It is thus quite ill-suited to interface with credences. If one sees p , what should one’s credence in p be, all else equal? If p is always a fact about some inner realm of self-disclosing sensations or appearances, credence 1 is arguably appropriate (and then updating could proceed in the usual manner, by ordinary conditionalization). But Cartesianism about perception has had its day, and on the contemporary and much better motivated view, p is a proposition about various aspects of one’s physical environment. Even in the good case, maximal certainty about the presence of tomatoes and soap is too dogmatic: if updating can only proceed by conditionalization (including Jeffrey conditionalization), it would never be rational to

change one's mind.²² But any lower credence than 1 is entirely arbitrary. The rational response to an ordinary case of testimony (perhaps just *knowledgeable* testimony) is *belief* in the content of the testimony. On the standard picture of exing, the edges of our “web of belief”, where it “impinges on experience” (Quine 1951: 39), are not “degrees of belief” or credences—they are full beliefs.

As Munton insightfully puts it:

It is natural to understand the contents of belief states and perceptual states as structurally analogous to each other. This is motivated in part by the way in which the two seem capable of interacting with each other. But if belief comes in degrees, while perceptual states stand in a binary relation to their contents, how do they interface with each other? What facts about an experience fix the credence a subject is entitled to have in its contents? ... what determines the probability that visual evidence receives? How does that evidence take a graded form, if the experiential state itself is binary? There is a mismatch between the form of the visual state and that of the belief-state that responds to it.

(Munton 2016: 310)

If the propositional attitude distinctive of perceiving is exing, credences are not found at the edges of the web of belief. They must lie in the interior.

Granted that the web starts out with some “a priori” prior credences in the interior, how can credences rationally change? If perceptual experience doesn't directly induce a rational change in credence, then the only other candidate is belief, or knowledge. For instance, knowledge that the coin has a probability of .5 of landing heads might rationally induce a credence of .5 that the coin will land heads (cf. the “Principal Principle” of Lewis 1980a: 266²³). The relevant kind of probability could be “objective chance” as found in quantum mechanics, some other kind of

²² Conditionalizing on p amounts to replacing one's probability function $P_{\text{OLD}}(\alpha)$ with $P_{\text{NEW}}(\alpha) = P_{\text{OLD}}(\alpha|p)$; thus $P_{\text{NEW}}(p) = 1$, and so one becomes 100% certain in p . Jeffrey conditionalizing on p , in the simplest case where one becomes $x\%$ confident in p and $1-x\%$ confident in $\sim p$, amounts to replacing $P_{\text{OLD}}(\alpha)$ with $P_{\text{NEW}}(\alpha) = P_{\text{OLD}}(\alpha|p).x\% + P_{\text{OLD}}(\alpha|\sim p).1-x\%$. In both cases if $P_{\text{OLD}}(q) = 1$ then $P_{\text{NEW}}(q) = 1$. (See Jeffrey 1965: ch. 11.)

²³ As Lewis formulates the Principal Principle, it is not stated in terms of knowledge (or belief) at all, but rather credence. Roughly: given that you have credence 1 that the objective chance of p is x , your credence in p should also be x .

physical probability, or probability relative to evidence (evidential probability). Knowledge of the symmetry of the coin, the tossing process, or the frequency of previous tosses, may have a similar effect without passing through explicit knowledge of probabilities. Thus, a dynamic system of credences may be restored by supposing that exing produces knowledge right at the perception-cognition interface, which in turn is leveraged to produce more knowledge, which at some point induces rational credences.²⁴

Dogramaci has recently defended a proposal along these lines:

you have a rational credence, n , in a proposition p —if and only if, and *because*—you reasoned that the chance²⁵ of p is n , and your reasoning followed the correct rules for reasoning about chances. (2018: 11)

Dogramaci’s proposal is far from the usual Bayesian vision: knowledge and belief are in the driving seat, with credences coming along for the ride. This is more of a vindication of traditional epistemology than anything else.

Worse, on this kind of proposal credences seem otiose. Either credences change in response to explicit knowledge of probabilities or else from knowledge that itself can easily yield knowledge of probabilities. So why bother with credences at all? Why not reason directly about probabilities? Indeed, Dogramaci himself is “inclined to accept” the view that “credences *just are* ordinary full beliefs with probabilistic contents” (10). (In the more standard terminology adopted in this paper, this is the view that *there are no credences*.)

The upshot is that credences are dubious entities if perception is not probabilistic. Munton, however, raises this problem for the Bayesian only to propose a solution. Along with Morrison (2016), she argues that perception is probabilistic after all. Can Munton and Morrison pull the Bayesian’s chestnuts out of the fire? The next section examines that question.²⁶

²⁴ Cf. Williamson 2010: 4-7.

²⁵ “When I talk of chance here, I mean a specific sense of this ambiguous term, one that has been called *evidential* or *epistemic probability*” (Dogramaci 2018: 10).

²⁶ For more discussion of Morrison and Munton see Block 2018 (Morrison), Beck 2020 and Siegel 2020 (Morrison and Munton).

5: Is perception probabilistic?

Morrison and Munton's views are similar; it will be convenient to start with Morrison. He defends *PERCEPTUAL CONFIDENCE*, "the view that our perceptual experiences assign degrees of confidence" (2016: 15), where "degrees of confidence", at least in the "ideal" case, can be formally represented as obeying the probability calculus (21).²⁷ After noting that philosophers of perception "became convinced that experiences are belief-like in many ways", he says that "[a]ccording to *PERCEPTUAL CONFIDENCE*, experiences are belief-like in yet another way: they can assign more or less confidence" (16).

Now here Morrison is following many other philosophers and casually talking of *beliefs* when in all strictness he means *credences*. (At one point he mentions a "ten percent" "confidence at the level of belief" (15), clearly having credence .1 in mind.) If *PERCEPTUAL CONFIDENCE* is correct, then experiences are more *credence*-like than belief-like. As Munton puts the view, "visual states include something like the perceptual analogue of credence" (2016: 316).²⁸ And that is exactly what we want. If seeing is graded like credence, then perceptual input has a probabilistic structure. The web of belief is really a web of *credence*, at least at the edges. Beliefs must lie further from the periphery.

The previous section suggested that perception simply presents the world—the red tomato next to the white soap, for instance. However, philosophers are notoriously fond of restricted diets of examples, and the philosophy of perception is no exception. Staring glassily at some nearby medium-sized objects is a rather unusual kind of perceptual situation. More often we are actively scanning a scene to try to identify something—one's keys, a familiar face in a crowd. And of course mundane actions are governed by perception—a glimpse of a patch of ice, or uneven pavement, prompts a step to the side. Often these sorts of cases are freighted with uncertainty—probably that is Titania (although it could be Oberon), probably the pavement is uneven (although there could be a misleading shadow), and so on.

Uncontroversially, sometimes uncertainty is on the side of cognition, rather than perception. Gazing at the tomato and the soap, and wondering how they got there, I suspect that Titania

²⁷ Morrison's considered view is actually more qualified—see below.

²⁸ The full quotation from Munton is: "...perceptual analogue of credence *for belief*" (emphasis added), which elides the crucial difference between credence and belief.

came home early: ‘Perhaps she came home early’, I might say. But there is no temptation to think that *perception* is testifying that Titania came home early, hesitantly or not; neither is perception testifying that there’s a decent chance that Titania came home early. Rather, perception tells me something about the tomato and the soap, and it is this strictly perceptual evidence that supports my suspicion that Titania came home early. All “perceptual” uncertainty might be like that—a view that Morrison labels *POST-PERCEPTUAL CONFIDENCE*.²⁹

According to *PERCEPTUAL CONFIDENCE*, uncertainty is also sometimes on the side of perception; specifically, a kind of uncertainty that is analogous to credences. That is, probability is not in the content of perception, but rather in the attitude. Just as a hardcore Bayesian like Jeffrey replaces ‘believing p ’ with ‘having credence x in p ’, the proponent of *PERCEPTUAL CONFIDENCE* replaces ‘*exing* p ’ with ‘*exing* p to degree x ’—*exing_x p*, for short. Morrison and Munton provide a number of motivating examples. Here are two representative ones.

Vision in fog: Elmer looks through a window and sees a tree being slowly enveloped by fog; “as the fog becomes thicker, ... the *degree* of justification Elmer’s experience provides for a tree belief [e.g., that there is a tree outside] begins to wane” (Munton 2016: 304).

Peripheral vision: fixating on a cross, with five closely spaced vertical black bars displaced some distance to the right, “It looks as though there could be three bars, four bars, five bars, six bars, seven bars, or eight bars, but most likely five or six bars” (Morrison 2016: 18).

The second example shows that uncertainty even attends the tomato and soap example. Visual acuity drops off quite dramatically outside foveal vision, a fact not immediately apparent because our eyes are typically jittering from one point to another. But if you try to read the inscription *Ivory* on the soap while fixating on the tomato, it will be obvious.

Now one could take these examples to support what we can call *PERCEPTUAL PROBABILITY*: the content of perception is, at least sometimes, probabilistic. Munton does not pursue this possibility (2016: 316); Morrison, on the other hand, expresses some sympathy with it. (In fact, Morrison understands *PERCEPTUAL CONFIDENCE* as a broad thesis that has *PERCEPTUAL*

²⁹ In the psychological literature ‘visual confidence’ is used for “an observer’s ability to judge the accuracy of her perceptual decisions” (Mamassian 2016: 459)—metacognitive “post-perceptual” confidence, not a view like Morrison and Munton’s.

PROBABILITY as a special case. But for our purposes it is better to take PERCEPTUAL CONFIDENCE as the narrow thesis that ex should be replaced by $ex_{g,x}$.)

PERCEPTUAL PROBABILITY does not force a credence-based epistemology. If perception is testifying that an object is “likely to be a tree” (Munton 2016: 316), then since that could rationally induce a probabilistic belief with the same content, why is there any need for credences? On the other hand, PERCEPTUAL PROBABILITY is not *uncongenial* to credence-based epistemology. There may be advantages to using credences rather than beliefs, and PERCEPTUAL PROBABILITY allows that they too could be rationally induced at the web’s edges.

PERCEPTUAL PROBABILITY cannot be ignored, then. We can use Munton’s fog example as the main proving ground for both PERCEPTUAL PROBABILITY and PERCEPTUAL CONFIDENCE.

Elaborating on the example, Munton writes:

If [Elmer] goes to the window soon, he will be able to see the tree outside clearly. That experience entitles him to have a high credence in the proposition that there’s a tree outside. If he waits a little longer, his foggier experience will entitle him to have only a moderate credence in that same content. Why? Both experiences have tree content. But that content is presented with different degrees of confidence. When it is presented with a high degree of confidence, that entitles Elmer to have a correspondingly high credence in the corresponding proposition. When it is presented with a moderate confidence, that entitles him to have the same middling degree of belief in its contents. (2016: 322)

Let p_{TREE} be the proposition that *this* (the tree outside Elmer’s window) is a tree. Munton describes Elmer’s situation in accord with PERCEPTUAL CONFIDENCE: picking some numbers for illustration, if Elmer looks out of the window early, he will $ex_{.9} p_{TREE}$; and if he looks out of the window late, he will $ex_{.6} p_{TREE}$. (We can ignore qualifications about time and tense.) On the alternative view, PERCEPTUAL PROBABILITY, the propositions that Elmer $exes$ will be about probability, specifically the probability of p_{TREE} . If Elmer looks out of the window early, then his experience will testify that the probability of p_{TREE} is .9.

Take PERCEPTUAL PROBABILITY first. What kind of probability could experience be testifying to? One possibility Morrison mentions is subjective confidence. On that view:

your experience is like a weatherman who tells you how much subjective probability he assigns to the possibility that it will rain tomorrow. (2017: 75)

One proposition that Elmer exes when he looks out of the window early, then, can be more explicitly expressed as: this experience is confident to degree .9 in p_{TREE} (cf. Morrison 2016: 38).

This is not a very appealing view, if only for the reason that it loses the idea of a perceptual presentation *as of a tree* entirely. This object is not presented *as a tree*, or even as *likely* to be a tree. Rather, it is presented as *something this experience is 90% confident is a tree*. Like Morrison's weatherman, perceptual experience is simply telling Elmer about itself, specifically about its own degrees of confidence. Not only is the content of Elmer's perceptual state compatible with this object *not* being a tree, it is also compatible with this object being *not at all likely* to be a tree.³⁰

The other possibility is that the relevant probability is "objective"—a physical probability of some kind, or (more plausibly) an evidential one. And this is more attractive: perceptual experience is not entirely self-absorbed, and the object is presented as (likely to be) a tree.

If Elmer looks out the window early, and watches the tree as the fog slowly gathers, his visual system first testifies that $\text{prob}(p_{\text{TREE}})=.9$, and continues to revise this number downwards. Now imagine a different case: Elmer is watching a tree *shrinking in size* (on a clear day). Elmer's visual system first testifies that the height of the tree= h , and continues to revise this number downwards. If the tree is shrinking sufficiently quickly, Elmer's visual system will be able to detect the change, and Elmer will have the visual impression that *the tree is changing*—specifically, that it is becoming smaller. Similarly, if the probability that *that* is a tree is changing sufficiently quickly, Elmer's visual system will be able to detect the change, and Elmer will have the visual impression that *the tree is changing*: specifically, that it is becoming *less likely to be a tree*. But that is not how a tree being rapidly swathed in fog looks: the only apparent change in the scene is the increasing fog.

Putting confidence or probability in the content is not particularly promising, then. That leaves PERCEPTUAL CONFIDENCE, on which the perceptual propositional attitude is the credence-like attitude of exing_x .

³⁰ Morrison mentions the similarity of his proposal to Searle's, on which the content of Elmer's perceptual state is: there is a tree there which is causing *this* visual experience (cf. Searle 1983: 48-9). But Searle's view at least has the advantage that it does not eliminate the perceptual presentation *as of a tree*. This problem applies to two other suggestions of Morrison's, that your experience is "telling you how much confidence you should have", or is ordering you to have a certain confidence level ("Assign fifty percent confidence!") (2016: 38).

Return again to Elmer, looking at the befogged tree. He may ex various propositions, including p_{TREE} , but his experience is not fragmented, waiting for cognition to combine it into one detailed story about scene before his eyes. He plausibly exes a proposition that specifies the scene in much more detail than any tractable linguistic representation of it, and that entails any other proposition that he exes. Let that proposition, the *total content* of Elmer's experience at that time, be p_{MAX} ; p_{MAX} entails p_{TREE} . If PERCEPTUAL CONFIDENCE is right, Elmer exes p_{MAX} to a certain degree, say .7. Presumably that proposition could be exed to a different degree, say .9. There should be a pair of cases, then, where one subject exes p_{MAX} to degree .7 and the other exes p_{MAX} to degree .9. And the difficulty is that there seem to be no such cases. Given the *total content*, there is no wiggle room for the hypothesized perceptual confidence in this proposition to vary.

Let us examine this objection in more detail. As Morrison notes, if the motivating examples support PERCEPTUAL CONFIDENCE, they also “support CONFIDENTIALISM, the view that if two experiences have the same phenomenology, they assign confidence in the same way” (2016: 21), and along similar lines Munton says that “[d]ifferences in confidence are phenomenally detectable” (2016: 317). A widely held (albeit disputed) thesis is INTENTIONALISM, the view that (necessarily) if two experiences have the same content, the experiences have the same phenomenal character (Harman 1990 is an early classic defense³¹). PERCEPTUAL CONFIDENCE, CONFIDENTIALISM, and INTENTIONALISM are jointly inconsistent. By PERCEPTUAL CONFIDENCE, the perceiving propositional attitude is $exing_x$. By INTENTIONALISM, $exing_x p$ and $exing_y p$ have the same phenomenal character, even if $x \neq y$, which implies that CONFIDENTIALISM is false.

It is not enough to reject INTENTIONALISM. Imagine seeing a red spot in good light: your visual system can detect both the color of the spot and the intensity of the illuminant, among other things. For simplicity, pretend that the total content of your experience is the proposition that that the spot is red and brightly illuminated. Your experience has a distinctive “phenomenal character” (PC_R), quite different from the phenomenal character associated with seeing a green spot (PC_G). Perhaps some kind of “inverted spectrum” scenario shows that someone could ex that the spot is red and brightly illuminated, just as you do, but with the accompanying phenomenal character being PC_G (Block 2003). If that is right then INTENTIONALISM is false. But

³¹ See also Tye 2000, Chalmers 2004, and Speaks 2015.

in order to defend PERCEPTUAL CONFIDENCE, we need to argue that the exed proposition—that the spot is red and brightly illuminated—can be (in Munton’s phrase) “presented with different degrees of confidence”. And it is quite unclear how to do that. Cases of seeing the spot under *dim* light are irrelevant, since that is to change the content.³²

The upshot is that the total content of experience does not appear to be something that can be exed to differing degrees. In fact, there seems little reason to suppose that the total content is exed to any degree at all. The propositions that Morrison and Munton isolate as “assigned degrees of confidence” are never the total contents of the relevant experiences.

Couldn’t the traditional attitude of exing and the new-fangled attitude of exing_x be combined? When p is the *total* content, one exes p . But for various weaker propositions q (that this is a tree, for instance), one may ex_x q . The problem with this suggestion is that the senses come out as incoherent: they testify to p without qualification, but also *hesitantly* testify to some propositions entailed by p . Taking one’s experience “at face value” would then require full belief in p and, say, .5 credence in q —not a rational combination by anyone’s lights.

Finally, a second objection. Elmer, suppose, has different “amounts of confidence” in propositions, represented by a function Cf_{ELMER} from propositions to the interval $[0, 1]$. Assuming Elmer is a mere mortal, Cf_{ELMER} not a probability function: perhaps $Cf_{\text{ELMER}}(p) = .7$, but $Cf_{\text{ELMER}}(\sim p)$ is undefined, or is set at .4. So why is Cf_{ELMER} a *credence* function? In other words, why are Elmer’s states of confidence *credences*, as opposed to graded but *non-probabilistic* mental states? Because Elmer’s states of confidence *aim at probabilities*, in the sense that there something *defective* about them if Cf_{ELMER} isn’t a probability function. Elmer’s amount of confidence in p and his amount of confidence in $\sim p$ should sum to 1: his confidence function Cf should be like the credence function Cr of an ideally rational agent. Without this normative story, there is no reason to think that ‘ x ’ in ‘is confident in p to degree x ’ stands for a probability at all.

Likewise for ‘exing p to degree x ’: a normative story is required if “degrees of perceptual confidence” are going to be probabilities, and so are suitable to interface with credences. That is, we need to establish that, “like degree of doxastic confidence, degrees of [perceptual confidence]

³² The original case is Jeffrey’s “observation by candlelight” (1965: 165-6), mentioned by both Morrison and Munton.

are more or less ideal to the extent they preserve the axioms of probability theory” (Morrison 2016: 34). But is that plausible?

Block has remarked on the apparent “lack of logical structure” in perception, vision in particular (Block 2019: 507).³³ Put in terms of exing, Block’s point is that if p is a proposition that can be exed, then $\sim p$ isn’t; similarly, if exing can predicate feature F , then it can’t predicate $\sim F$.³⁴ That seems right: returning to the tomato and soap, vision presents the tomato *as red*, but does not present the soap as *not-red*—rather, it simply presents the soap as white. (Red is a feature that can produce perceptual “pop-out”; not-red is not.) A similar point goes for Morrison and Munton’s examples. To the extent that it is plausible to think of vision as presenting incompatible alternatives, these do not include p and $\sim p$, or an object’s either having F or $\sim F$. As Morrison describes his example of peripheral vision, “there could be three bars, four bars, five bars...”.³⁵ Block attributes the lack of negation to the representational format of perception (which Block thinks is iconic), but we need not investigate this further. It is sufficient to note that the absence of negation is not credibly a *deficit*, something corrected by an “ideal” visual system to which primate visual systems aspire. Yet without the claim that an ideal visual system would constrain the perceiver to $\text{ex}_{\sim x} \sim p$ if she $\text{exes}_x p$, “visual confidences” are not probabilities. And if they are not probabilities, we are back to Munton’s “mismatch between the form of the visual state” and the probabilistic credences that allegedly respond to it.

6: Against credences

The (provisional) conclusion is that perception is not probabilistic: both PERCEPTUAL PROBABILITY and PERCEPTUAL CONFIDENCE are false. If there are credences, their point of entry is cognitive, not perceptual. But a cognitive point of entry threatens to render credences redundant. The easiest way out is to deny that we have credences, but this option is frequently not considered. This last section takes it seriously.

³³ See also Pautz 2020.

³⁴ Disjunction is another example; Block himself doesn’t think perception has propositional content (2019: 507).

³⁵ Morrison suggests that “In simple cases, our experiences assign confidence to a possibility and its negation, like that [a person in the distance is] Isaac and that it’s not Isaac” (2016: 20); but by the usual tests *not being Isaac* is not a feature that figures in perceptual content.

One—perhaps the main—reason why belief-monism is usually off the table is that credence is taken to be “an intuitive notion in folk psychology, familiar from everyday speech and thought” (Eriksson and Hájek 2007: 209³⁶). Elaborating, Eriksson and Hájek write:

After all, we have various ways in English (and, we hazard to guess, every natural language) for conveying our degrees of belief. Think of the spectrum of phrases that we have at our disposal: “I’m certain that p”, “I’m almost certain that p”, “I’m extremely confident that p”, “I’m moderately confident that p”, “I’m fairly confident that p”, ... all the way down to their duals at the other end: “I’m certain that not-p”, and so on. (Eriksson and Hájek 2007: 209)

However, this list of phrases is not exactly the promised “spectrum” from ‘I’m certain that p’ to ‘I’m certain that not-p’. First, the phrases are very limited in number. Second, and more significantly, confidence vanishes around Eriksson and Hájek’s ellipsis, which is why ‘I’m certain that’ reappears at the other end. A poll asked Americans how confident they were that the Mueller investigation into President Trump’s ties to Russia were fair and impartial. They were given three possible responses: “extremely/very”, “moderately”, and “not very/not at all”.³⁷ Someone who thought that it was pretty much a tossup—that the investigation was about as likely to be partial as to be impartial—should choose the *last* option, not the second one. To be “moderately confident” (or, indeed, “fairly confident”) that the investigation was impartial is, if not actually to believe that it is impartial, then to be teetering on the edge.³⁸ One should be *not at all* confident that a fair coin will land heads; likewise, one should be not at all confident that it will land tails (cf. Wright and Ayton 1994: 4). As Williamson puts it, “‘No confidence’ is quite different from ‘no chance’” (Williamson forthcoming). Only by appeal to the charity of the hearer can one force ‘no confidence’ to be ‘no chance’. The question ‘How confident are you on a scale of 0% to 100% that this coin will land heads?’ is best interpreted as asking for an estimate of probability: thus, if the coin is fair, ‘50% confident’ is the right answer.

What about the extremes? Doesn’t “everyday speech and thought” at least give us a handle on credence 1 and credence zero? We do say, after all, that we are extremely/completely/very

³⁶ See also Christensen 2004, Sturgeon 2015, Pettigrew 2016, and Leitgeb 2017, among others.

³⁷ The poll was by the Associated Press-NORC Center for Public Affairs Research, March 2019.

³⁸ It’s also worth noting that ‘I am moderately confident that...’ is quite a rare construction.

confident in various propositions. Kellyanne Conway, counsellor to President Trump, once told reporters that “I’m very confident he’s not breaking any laws”. Even if she had sincerely said she was “100% confident”, it is safe to say that she would not have bet her life for a dollar on the proposition that Trump is no law breaker. If betting behavior is good test of credence, then Conway did not have credence 1 in that proposition. By the betting test, no ordinary person has credence 1 in anything; if it occurs at all, credence 1 appears to be a sign of insanity rather than the ideal of rationality.

Do comparative judgments point towards credences? According to Staffel, “degrees of belief are the kinds of attitudes we mean when we [say]...that S is more confident in p than in q ” (Staffel 2013: 3536-7). To take a morbid example from John Venn, “Do I not feel more certain that some one will die this week in the whole town, than in the particular street in which I live?” (Venn 1888: 149). The at-least-as-confident-in- x -than- y relation at best only generates a partial order over propositions, since for many pairs of propositions p , q (including some I have entertained), I will not be at least as confident in p than I am in q , and neither be at least as confident in q than I am in p . (For example, take p to be the proposition that there is life elsewhere in our galaxy, and q to be the proposition that my young son will be an accountant.) And although one can make sense of numerically qualified comparisons, like ‘I am twice as confident in p that I am in q ’, the natural interpretive strategy is to understand these unusual locutions as covert probability talk: ‘I think p is twice as likely to be true than q ’. (More typical numerically qualified uses of ‘confidence’ are used to speak about self-assurance, not credence: ‘I am twice as confident as I used to be’.) Ordinary comparative judgments of confidence by themselves do not give us anything like the rich structure of a probability space.³⁹

Credences are not worn on the sleeve of our talk about confidence. They may yet be implicated in some unobvious way, as a number of sophisticated semantic proposals have it (e.g. Yalcin 2012). But to use the virtues of these proposals to argue for credences is to put the semantic cart before the psychological horse. An independent case for credences needs to be given first.

³⁹ Given certain assumptions, a comparative probability relation can be represented by a (non-unique) probability function; see Stefánsson 2017. Stefánsson uses this formal result to argue that only comparative credences are psychologically real (see Stefánsson 2018 for some qualifications). This position is also vulnerable to the main arguments in this paper.

Perhaps credences are evident by the light of introspection? (Introspection is understood here as a method of knowing about one's own mental states that has no application to the mental states of others.⁴⁰) Indeed, it is invariably assumed that one has at least some knowledge of one's credences, presumably by a first-person method.⁴¹

One can easily learn to speak the lingo of credences, and to report one's ostensible degrees of confidence in various propositions. That might seem to be evidence for credences—why else would the reporting come so easily? However, there are plausible alternative explanations that render the postulation of credences idle. One is given a simple coin-tossing problem. What is one's credence that the coin will land heads twice? The only apparent way to answer is to calculate the probability that the coin will land heads twice. Once one has worked that out (rightly or wrongly), the probability simply gets transferred to one's supposed credence: 'I have credence .25 that the coin will land heads'. And a mere recipe for converting known statements about Xs to corresponding statements about Ys does not suggest that the latter are true, otherwise astrology would be on a much surer footing.

Another kind of case where probability judgments seem to be in the driving seat are non-numerical comparisons like Venn's example: "Do I not feel more certain that some one will die this week in the whole town, than in the particular street in which I live?" There is no need to suppose that an affirmative answer is given by comparing one's credences in the two propositions: one can simply note that deaths in Venn's street are deaths in his town, but not conversely. So (given a background assumption about mortality) deaths in his town must be more probable than deaths in his street, which one can express in terms of "feeling more certain". Alternatively, as in the fable of Linda the feminist bank teller, one might answer by using Kahneman and Tversky's representative heuristic. A representative bank teller is not, like Linda, a philosophy major passionate about social justice; hence Linda is more likely to be a feminist bank teller than a bank teller—which again one can express in terms of feeling more certain. If one is familiar with the ideology of credences, one can further report that one has greater credence that Linda is a feminist bank teller, but we have not yet seen any reason to think that this report is correct.

⁴⁰ On introspection of credences, see Dogramaci 2016; on introspection of the strength of belief, see Byrne 2018: 119-20.

⁴¹ Or, if not knowledge, then a Bayesian surrogate.

One can answer Venn's question without being able to discern one's credence in either proposition. If we have direct introspective access to credences, an explanation is needed of how one can compare them without having the foggiest idea of their actual values. That is not to say that one can't be provided, but the most parsimonious hypothesis is that answering Venn's question does not involve comparing credences at all.

So far we have gone some way to undermining the positive case for credences; let us now consider the positive case against.

6.1 The difficulty of probabilistic reasoning

In 2012 97 members of the UK Parliament were asked for the probability of getting heads twice in two coin tosses. 60 gave the wrong answer (Spiegelhalter 2019: 209). Admittedly they were not told that the coin could land either heads or tails with equal probability, or that the probability of a second head given a first head is the same as the probability of a second head given a first tail, but this would only have confused them further.

It is not just MPs. People in general are not very good at reasoning with explicitly probabilistic premises (say, the probability of positive test result given cancer = .8); we do much better if presented with natural frequencies (of 10 people with a positive test result, 8 will have cancer). Given data in the form of conditional probabilities, we find it difficult to work out, say, the probability that a person has cancer given a positive test result. Given similar data in the form of natural frequencies, the problem is much more tractable.⁴² Holton uses this fact to argue against credences:

[I]f the probabilities were really in the attitudes [as opposed to being in the content], then to do the calculation the subjects would need to have credences of the correct degree before they could apply Bayes' rule. But the relevant degrees of credence are exactly what they are given when the problems are presented as conditional probabilities. In contrast, in the natural frequency presentation, the conditional probabilities are merely implicit in the data. The subjects would first have to calculate the relevant conditional probabilities and then go on to apply Bayes' rule. So you would expect the natural

⁴² Simplifying Holton's example (2014: 22): 10 in 1000 people have cancer; of those 10, 8 will have a positive test result. Of the remaining 990, 99 will have a positive test result. Assuming these frequencies reflect the probabilities, the probability of cancer conditional on a positive test = $8/107 = 7\%$.

frequency presentation, requiring a further step, to be more difficult than the conditional probability presentation. (Holton 2014: 24)⁴³

Holton is assuming that if we have credences, they are used to reason with probabilities. That is, if one has a probabilistic problem to solve (‘What is the probability that someone with a positive test result has cancer?’) one first forms the appropriate credences, given the description of the problem. Next, one’s Bayesian psychological machinery starts whirring and grinding, and one forms a new credence—more exactly, a *conditional* credence, one’s credence in a person having cancer, conditional on having a positive test result. One then, in effect, converts this conditional credence into a belief about conditional probability, and the content of that belief is the answer: ‘The probability that someone with a positive test result has cancer = 10%’. Explicitly stating the conditional probabilities, rather than leaving them implicit in the natural frequencies, would then presumably make the problem easier.

However, Holton’s argument does not quite work as stated. As Holton himself emphasizes, putting the problem in terms of natural frequencies makes it easy to solve through a simple calculation. Given that a simple calculation is available, why take the trouble of converting frequencies to probabilities, then to credences, and back again to probabilities? And if subjects stick with the simple calculation, then the natural frequency presentation does *not* involve a “further step”—the method is entirely different. So there is no reason to expect it to be more difficult.

Still, that does not explain why we do so badly with the conditional probability presentation. We clearly do not form the appropriate credences and let the Bayesian machinery do its work: the vast majority of us become confused and give the wrong answer. And there is no evidence that the unconfused minority are manipulating credences, rather than explicitly reasoning with beliefs about probabilities.

This is puzzling. If we have credences, then there must be at least a rough match between them and our statements of probability and confidence. For if these come drastically apart, and credences explain behavior, then one would predict peculiar dissociations—I claim to feel very

⁴³ Holton has another argument, which starts from the premise that the two presentations are “logically equivalent” “descriptions of the same situation” (25). But the two presentations are not logically equivalent, since natural frequencies are compatible with numerous different assignments of probability.

confident that Zippy will win the 2.30, but put all my money on The Sluggard. Given that we have *both* beliefs and credences, one would expect the credences to provide some added value, otherwise they would be an evolutionary extravagance.

Perhaps the fact that the problem is stated linguistically somehow biases us to reason with beliefs about probabilities rather than credences. So let us leave language behind altogether, and examine how chimpanzees, our closest relatives, cope with elementary probability problems. Chimpanzees are similar to us in so many ways: they have the same basic perceptual apparatus; they know about the mental lives of their fellows and have complex social relations; they can count, anticipate the future, and reason using disjunctive syllogism. It would be extraordinary if credences arose in the human lineage, leaving chimpanzees to muddle through with old-fashioned belief and knowledge. Credences are of no more help with distinctively human problems than they are with problems faced by all great apes. If we have credences, chimpanzees surely do as well.

Here is one relevant experiment (Hanus and Call 2014).⁴⁴ A chimpanzee watches treats being put into closed cans, resulting in (say) two of six cans on the right, and one of two cans on the left, containing a treat. The chimpanzee does not know which individual cans have treats, and has the option of picking one can from the right or one can from the left. Choosing left will maximize the expected gain: 50% chance of a treat as opposed to 33%. Chimpanzees do better than chance, and seem to be sensitive to the ratio of the two probabilities—the higher it is, the more likely they are to make the right choice. Interestingly, they show no appreciation of the significance of probability 1, treating the certainty of a treat on one side like any other probability, to be compared to the probability of a treat on the other. If chimpanzees have credences, one would expect the advantages of the Bayesian machinery to be on display here. Instead, the chimpanzees' performance suggests that they are merely capable of rudimentary probability judgments.

Chimpanzees, like many other animals, have a variety of ways of coping with uncertainty. For example, they can monitor how well they have performed on a rewarded task where the reward is dispensed some distance away. The chimpanzees can either wait for a cue that tells them they will be rewarded, or else move to the reward site before the cue (making it easier to

⁴⁴ See also Tecwyn et al. 2017. On probabilistic reasoning in infants, see Denison and Xu 2014.

get the reward). They are more likely to move early when they successfully complete the task (Beran et al. 2015). But this sophisticated ability does not require credences.⁴⁵

6.2 *Credences and memory*

On the Bayesian picture, credences are supposed to be retained, just like beliefs, and updated when necessary. Without retention, there would be no learning (more precisely, no Bayesian surrogate of learning). And if credences are retained, they can surely be recalled, brought to mind when the occasion requires. What would recalling a credence be like? If one has credence x in p one can note that psychological fact and commit it to memory, later recollecting that one has credence x in p . However, this is ordinary belief-memory, not credence-memory in the pertinent sense. If one can bring to mind one's stored credence x in p , the content of this episode of recollection should be p , the content of the credence. How could the probabilistic index x manifest itself? The obvious suggestion is: through a feeling of confidence. That is, one will recall p , but one's recollection will more or less confident, depending on the value of x .

Sometimes confidence is an entirely intellectual affair, as with Venn's example of being more certain of a death next week in one's town than a death in one's street. Venn uses '*feel more certain*' which, although perfectly appropriate, blurs the distinction between his example and ones where there really is some kind of "feeling" or sensation. ("Feeling confident in p " is therefore improbably a natural psychological kind.) The classic illustrations of phenomenological confidence are "tip of the tongue" states, poetically described by William James:

Suppose we try to recall a forgotten name. The state of our consciousness is peculiar. There is a gap therein; but no mere gap. It is a gap that is intensely active. A sort of wraith of the name is in it, beckoning us in a given direction, making us at moments tingle with the sense of our closeness and then letting it sink back without the longed-for term. (James 1893: 251)

Consider an example discussed by Weisberg (2020). If asked for the capital of Iceland, one might answer 'Reykjavik', but in some palpable way "feel uncertain" that the answer is correct. (And similarly for comparatives: one might palpably "feel more certain" that Reykjavik is the

⁴⁵ On "uncertainty monitoring" in animals, see Smith et al. 2003, Smith and Washburn 2005.

capital than that Bergen is.) And this seems to be exactly the desired phenomenon: if there is such a thing as recalling a credence, this is an example. Weisberg sees a problem here, noting that there is much evidence suggesting that these sorts of “feelings of confidence” (or “feelings of knowing”) are due to cues like ease of processing (“fluency”) and whether related information can be brought to mind.⁴⁶ As he puts it, “confidence in memory-based beliefs appears to be constructed at the time of recall, rather than stored” (18). Weisberg directly draws the conclusion that *credence* is “constructed at the time of recall” (19), but this seems to be because he identifies credence and confidence (in the ordinary sense⁴⁷).

However, confidence—whether of the intellectual or phenomenological variety—is not credence. The fact that feelings of confidence derive from the process of recollection does not immediately show that credences are not stored in memory. But we can reach that conclusion by slightly expanding and amending Weisberg’s line of thought. If we can recall credences, their strength is manifest (at least sometimes) in feelings of confidence. Feelings of confidence are based on cues like fluency. Yet it is very implausible that fluency and related cues are an indication of the strength of remembered credence. A storage system for credences needs to keep track of two items, propositions and their probabilistic indices. There is no reason to think that retrieving $\langle p, .5 \rangle$ is going to be *harder* than retrieving $\langle p, .9 \rangle$. And what on earth would be the point of making middling or low credences a struggle to retrieve?

If we can store credences, we should be able to recollect them. Since the best candidate for doing that is not sensitive to the strength of credence, but is rather driven by unrelated factors, credences are not remembered.

* * *

Orthodoxy about credences and orthodoxy about perception conflict. Attempts to resolve the conflict by amending orthodoxy about perception instructively fail. This paper has recommended heterodoxy about credences instead. As Weisberg emphasizes, the empirical issues are subtle and

⁴⁶ See, e.g., Oppenheimer 2008.

⁴⁷ E.g., “how do dualists explain the tight connection between full belief and *high credence*? Typically, we believe P only when we are *highly confident* in P” (Weisberg 2020: 3, emphasis added).

complicated, and any conclusion should be stated circumspectly. There are no credences. Probably.⁴⁸

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