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RESEARCH ARTICLE

Vagueness: Two Myths

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Abstract: Epistemicism about vagueness is the position that bivalence holds for every instance of a vague predicate, even if truth or falsity is unknowable in borderline cases. Epistemicism is accused of rejecting the *tolerance intuition*, and committing itself to *sharp borderlines*. Mainstream Epistemicists, like Williamson and Sorensen, accept these accusations as costs of their view. I argue instead that both are myths. First, I argue our intuitions support only *generic, dense* tolerance principles, which are non-paradoxical. Epistemicists can affirm these principles, without inferring any paradoxical principle, and so can embrace the tolerance intuition. Second, bivalence is perfectly compatible with the denial of sharp borderlines, provided that we model the extension of vague predicates as scattered stochastically and non-monotonically across a gradient, just as we should expect if meaning depends on use. My revisionary form of epistemicism better balances our intuitions about vagueness with the conservation of bivalence.

Keywords: borderline cases; continuous sorites; epistemicism; sorites; tolerance principle; vagueness.

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1. Introduction

Vague predicates give rise to the sorites paradox. The conventional formulation of the sorites paradox arrives at its conclusion either by a large but countable series of *modus ponens* steps, or by mathematical induction. We begin by quantifying over a domain D which is well-ordered by $\leq$, like $\mathbb{N}$, the set of natural numbers. Any monotonic vague relation which can be represented by $\leq$ will do, such as "as short or shorter than," "of an equal or less intense shade of yellow than," or "as rich or less rich than." For instance, our domain might be the set of possible heads, ordered by numbers of hairs on a head. We then offer an instance of the following:

(Well-ordered Sorites) *For predicate F, base case b, and some undetectably small $c > 0$, where $c \in C$ and $|C| \leq |\mathbb{N}|$:*

(P1) Fb
(P2) $(\forall x)(\forall y,|y|\leq c)(\ Fx\ \rightarrow F(x+y))$
(C) $(\forall x)(Fx)$

For example, using "number" to mean "natural number," Fx = "Somebody with x number of hairs is bald," and letting b=0 and c=1:

(P1) Someone with zero hairs is bald
(P2) For any number of hairs, if someone with that number of hairs is bald, then someone with 1 more hair is also bald.
(C) Anyone with any number of hairs is bald. (Even someone with 10 trillion hairs).

We can make the domain as fine-grained as we please, such as including 24.99% of a hair and 25% of a hair, or any other difference so small as to be phenomenologically undetectable through perception or imagination. We can't, however, include all of the rational or real number values *between* 24.99% and 25%, since the rationals and reals are not well-ordered by $\leq$. In the conventional paradox, the domain must consist of well-ordered units of measure, since otherwise the use of mathematical induction or a finite modus ponens series would be invalid.

There are many proposals for avoiding this paradox, usually by motivating some rejection of the *tolerance principle* (P2), despite its appearing

intuitive. First, it's widely agreed that vague predicates are sensitive to conversational context and the purposes of a conversation: what's fast for a marathon is not fast for a fighter jet. So, *contextualists* argue that there are micro-shifts in the conversational context at each step of the sorites, on each application of "fast" (Raffman 1994; 2005a; 2005b), making (P2) equivocal. While I accept that vague predicates are context-sensitive, it seems to me that even if context were kept rigidly fixed for an idealized jury of competent speakers, the jury would struggle to come up with a consensus on Fn & $\sim Fn_{+1}$ for any n. So, for the purpose of this paper, I assume contextualism alone is insufficient to resolve the paradox (Soames 1998; Stanley 2003; Keefe 2007).

Second, the tolerance principle might be rejected by *denying bivalence*. For instance, we might reject (P2) by holding that truth conditions are indeterminate in borderline cases (Machina 1976), denying the law of excluded middle (Field 2003), holding that vague statements can be only *relatively* true (Richard 2008), adopting a three-valued (Halldén 1949) or infinitely valued (Goguen 1969) logic, or holding that it is only true or false *to a degree* whether a vague predicate applies (Smith 2008). The *supervaluationist* tradition (Dummett 1975; Lewis 2001; Fine 1975; Keefe 2000) preserves classical validity even while rejecting classical truth-functional semantics. According to the supervaluationist, a predicate is vague when it admits of many possible *precisifications*, or ways of drawing a sharp borderline between the Fs and the non-Fs. A sentence like "A billionaire is rich" is *supertrue* because it is true on all possible precisifications, while "a person without income or assets is rich" is *superfalse*, but for the grey zone in between the sentence "someone with x net worth is rich" will be true on some precisifications and false on others. Each precisification will make (P2) false somewhere; (P2) seems intuitive because the precisification is entirely arbitrary.

This paper is not concerned with proposals which deny bivalence. I assume denying bivalence and either classical logic or semantics is an unacceptable theoretical cost (Sorensen 1994), and a more conservative approach is preferable. The most conservative way to deny (P2) is *Epistemicism*. The Epistemicist holds that there are in fact cases in which non-bald person and a bald person differ by only one hair, and that vague propositions in the

grey zone are literally true or literally false, but we are simply unable to know whether propositions in this grey zone are true or false (Williamson 1994a; Sorensen 1994).

Epistemicism is widely believed to carry two burdens which make it unpalatable. First, denying the tolerance principle while maintaining bivalence is believed to conflict with our intuitions about vagueness; the tolerance intuition is thought to be analytic or part of conceptual competence (Eklund 2005; Wright 1976). Second, denying the tolerance principle while preserving classical logic and semantics is believed to entail a commitment to sharp borderlines dividing heaps from non-heaps, white from grey from black, and boys from men (Sorensen 2012; Wright 1995). The most prominent defenders of Epistemicism (Sorensen 2001; Williamson 1994b) take on both burdens.

In this paper, I argue that these are two *myths* about Epistemicism, and Epistemicism bears neither burden. I propose a Revisionary Epistemicism instead. Like other Epistemicists, I maintain that all vague propositions in the borderline region or "grey zone" are unknowable but either entirely true or entirely false. Unlike other Epistemicists, I accept a revised tolerance principle motivated by our intuitions; I simply deny that this principle is paradoxical. Unlike other Epistemicists, I entirely reject the existence of sharp borderlines; I simply deny that this requires sacrificing bivalence.

Since my Revisionary Epistemicism accepts a tolerance principle motivated by our intuitions, and denies the existence of sharp borderlines, while at the same time maintaining bivalence, it should satisfy both the conservativism about ordinary intuition which motivates bivalence-deniers and the conservativism about classical logic and semantics which motivates traditional Epistemicists. The paper will proceed as follows.

In Section 2, I reflect on the tolerance intuition. I argue that the standard *well-ordered* tolerance principle which appears in conventional Sorites arguments is not supported by intuition. What intuitions support is instead a *dense* tolerance principle, which cannot be used to generate the conventional paradox. In Section 3, I further argue that what intuition supports is a *generic* dense tolerance principle. But an Epistemicist can embrace this generic, dense tolerance principle, since it is non-paradoxical.

In Section 4, I present a "gradient" model for the metaphysics of vague predicates which is consistent with the generic dense tolerance principle. On this model, there is a fact of the matter for every vague proposition in the grey zone, yet it entails no commitment to sharp borderlines or cut off points. In Section 5, I argue that the gradient model can be justified as a semantics for vague predicates by reflection on ordinary language use.

There are other challenges which epistemicism still faces which beyond the scope of this paper. My aim is simply to revise epistemicism to appear more plausible as a response to vagueness than it seemed before, by dispelling myths which even its defenders typically accept.

2. Against Well-Ordered Tolerance

Let's begin with some instances of (P2) from our conventional sorites:

(a) Adding 1 grain of sand to a non-heap won't make it a heap.
(b) If you aren't driving fast, then driving 0.01 mph faster still won't be driving fast.
(c) If you take away 1 cent from a rich person, they'll still be rich.
(d) If a person isn't tall, then growing by 1cm won't make them tall.
(e) Subtracting 1 hair won't make a non-bald person bald.

I call these "well-ordered" tolerance principles, because the domain consists of well-ordered units of measure. Conventional sorites paradoxes rely on principles like this, which are often thought to be intuitive. While I accept that our intuitions support another kind of tolerance principle, I reject that our intuitions support tolerance principles involving well-ordered units of measure.

First, consider that well-ordered units of measure *approximate* qualitative real-world properties, which are by nature dense and perhaps continuous. For instance, the *number of years* someone has lived is a well-ordered unit of measure, which will return values like 55 or 2½, but it only approximates the real-world *age* of a person, which is dense, as one smoothly transitions between ages. Real-world *weight* is dense and continuous, but it is measured approximately in well-ordered units like "201.5 lbs." Amounts of hair are dense, but numbers of hairs are well-ordered.

Second, well-ordered units of measure are not part of the *definitions* of vague predicates. Vague predicates are defined in terms of real-world properties, not the discrete, well-ordered units used to measure these properties. Someone is "old" in virtue of their age, not their number of years; something is "heavy" in virtue of its weight, not its number of pounds. The relationship between units of measure and the real-world property is not part of conceptual competence: one can understand "tall" without understanding inches or centimeters. The relationship between units of measure and vague predicates is thus *a posteriori*, not *a priori*. I learn that 85 decibels is loud or 50 degrees Celsius is hot through experience, not conceptual analysis. I know that light years are long and nanometers short only because I know them to be longer and shorter than miles and millimeters respectively, which I can associate with real-world quantities through experience. These are synthetic truths, not analytic truths.

So, any intuitions we have about the extensions of vague predicates must be derived from our phenomenological experiences with real-world properties, not the units of measure which approximate them. Our intuitions must be derived either from memory, perceptual experience, or–most commonly–an "armchair" act of imagination, on which one imagines a number of incremental changes and forms the judgment that no incremental change will make a difference in the application of the predicate (Wright 1976).

Fourth, both perceptual experience and armchair imagination are essentially qualitative and phenomenological, and qualitative experience does not present us with discrete, well-ordered units of measure. Phenomenal qualities present themselves in dense smudges, not well-ordered quantities. There are no phenomenal speedometers to evaluate fast and slow. What happens when I try to imagine a man who is 5 feet tall growing by one centimeter? Do I accurately imagine his particular height then increasing by one centimeter? Suppose that I imagine a measuring tape–would that make my imaginary measurements more accurate? Of course not. Rather, what I imagine is a man who isn't too tall but isn't too short growing by *just-a-little-bit*, some concrete, real, observable height which might or might not be best approximated by "1 centimeter." The same is true in perception. I do not see the sun *as* falling 0.004 degrees on the horizon each second after noon.

I do not see the sun as falling at all. What I do eventually notice are some qualitative differences between perception and memory of perception, but I do not use a mental protractor to assign the difference some discrete value.

Therefore, tolerance principles about well-ordered units of measure (a)-(e) can't be supported through perceptual experience, memory, or armchair imagination. Without the aid of measuring devices, we can only consider qualitative, dense "amounts" of increase or decrease which we vaguely associate with particular well-ordered units. Imagining a non-fast car driving 0.01mph faster is like imagining a non-loud sound increasing by a micro-decibel: the changes would be barely phenomenologically detectable, if they are detectable at all.

If our intuitions are formed through perception or imagination, then, our intuitions must track these claims instead:

(a*) Adding *just-a-little-bit* of sand to a non-heap won't make it a heap.
(b*) If you aren't driving fast, then driving *just-a-little-bit* faster still won't be driving fast.
(c*) If you take away a *just-a-little-bit* of money from a rich person, they'll still be rich.
(d*) If a person isn't tall, then growing by *just-a-little-bit* won't make them tall.
(e*) Subtracting *just-a-little-bit* of hair won't make a non-bald person bald.

These claims are made along the dense, qualitative domain of observation and experience. When I consider these scenarios in (a*)-(e*), I intuit that a minuscule, *just-a-little-bit* change can't make a genuine difference to the application of a vague predicate. But the scenarios I'm considering are not actually instances of the well-ordered tolerance principle (P2) in the sorites argument, but of some other, dense tolerance principle.

Therefore, our intuitions about vague predicates only support dense tolerance principles, not well-ordered tolerance principles. There is no analytic or experiential link between these intuitions and the claims about well-ordered units of measure in (a)-(e) which appear in the conventional sorites argument. Of course, through practice or inductive reasoning someone might become good at perceptually guessing discrete units of measure, like a seasoned surveyor who can visually estimate distances by the quarter-

meter, but these are at best heuristic and probabilistic, and not sufficient to support an exceptionless universal like (P2).

The conventional sorites is only valid if the domain is well-ordered, given restrictions on mathematical induction. So, the only tolerance principle supported by tolerance intuitions is not a principle which can be used to construct the conventional sorites argument.

3. For Generic Dense Tolerance

This only takes the Epistemicist so far, however. Recently, Weber and Colyvan (2010) have shown it is possible to take our intuitions about dense tolerance (a*)-(e*) and then generate a non-well-ordered, continuous Sorites argument within topology which dispenses with the requirement of well-ordering along a countable domain, as well as a single linear degree of variation. We can formalize a continuous tolerance principle in terms of the topology of a *connected* metric space. A metric space is connected if it cannot be partitioned into non-empty, disjoint, open sets, as is the case for the real numbers. Tolerance can be defined as the principle that, for any element in the space which has a given attribute, everything in its *vicinity* has the attribute, for some sufficiently small "vicinity." The conjunction of tolerance with connectedness leads to the conclusion that every element in the space has (or lacks) the attribute, since no sharp boundary can be applied to the application of the attribute (Dzhafarov 2019; Weber and Colyvan 2010).

Here I will present a slight modification, which I will call the *Dense Sorites*, which rests on slightly more modest assumptions (mere denseness rather than continuity), and which better conforms to the familiar pattern of reasoning in the classic well-ordered Sorites. Define a metric space $M = <\mathrm{M},\mathrm{d}>$ as *chain-connected* if and only if, for any x, y in M and $q > 0$ in $\mathbb{Q}$, there is a finite sequence of "jumps" or "steps" in the space x, z_1, z_2, ... z_n, y connecting x to y such that the distance between each step is less than or equal to q. In other words, even though the space itself may be dense and have infinitely many elements, from any point in the space we can get to any other point in the space through a finite series of jumps of any arbitrary distance q. Quantifying over elements in a metric space $M = <\mathrm{M}, \mathrm{d}>$ for

some distance function d(x,y), and letting $q \in \mathbb{Q}$ be our "sufficiently small" distance, we get:

(PM1) $\exists x\, Fx$
(PM2) $\forall y \forall z((Fy \,\&\, d(y,z) < q) \rightarrow Fz)$
(CM) $\forall x Fx$

For example, letting Fx = "someone with x amount of hair is bald":

(PM1b) Someone with no hair is bald.
(PM2b) For any *amount* of hair a bald person and any *just-a-little-bit* of hair, if that *just-a-little-bit* were added or subtracted, they would still be bald.
(CMb) Anyone with any *amount* of hair is bald.

The *Strict Dense Tolerance Principle* (PM2) tells us that for some sufficiently small distance q, everything which is within q or less distance to something to which F applies is also something to which F applies. Given the chain-connectedness of our space, everything is within a finite number n of steps of distance q from everything else. So, if some element is F, then by a finite number of steps, we can prove for any given element of the space that it is also F. While the number of points in the space might be infinite, for any given point in the space there is some finite method of proving that either both are F or neither are, given (PM2). The property of chain-connectedness effectively replaces the role played in the conventional Sorites by well-ordering and the Archimedean axiom $(\forall x)(\forall y)(\forall z)(\exists n \in D)(x < y + (n \times z))$. This allows a Sorites argument for vague predicates which have multiple dimensions of variation of dense degrees. [1]

In Section 2, I argued that our intuitions support a dense tolerance principle. The question is now whether the principle our intuitions support is nonetheless *paradoxical*, like the *strict* dense tolerance principle (PM2). I do not know of any philosopher who defends the claim that our intuitions actually support strict dense tolerance (PM2), since most discussion focuses on well-ordered tolerance. In fact, the dense sorites has been called "a degenerate form of sorites, in which the puzzling behaviour of the classical

[1] Thanks to Roy Cook for the lesson in topology (Cook 2017).

sorites is lost precisely because the local and global level are collapsed together" (Rizza 2013). Discussions of a tolerance principle in the literature typically presuppose well-ordered tolerance. So, there is no *prima facie* reason to think strict dense tolerance is supported by intuition.

Furthermore, Susanne Bobzien has persuasively argued that people mistakenly infer strict, paradoxical tolerance principles from a weaker, modal, non-paradoxical principle (Bobzien 2025, 2597), i.e.,

> (SC2) *Weak Tolerance*, interpreting □ as "it is clear that" or "it is definite that"
> $\forall i\ \neg\Box\neg(\mathrm{F}a_i \leftrightarrow \mathrm{F}a_{i+1})$
> e.g. "for any fast speed, it is not definitely not the case that the next speed is fast"

That is, we reflect on weak tolerance whenever we form intuitions, but then invalidly *infer* strict tolerance from it. I agree with Bobzien in spirit, though I think there are a number of other non-strict tolerance principles which our intuitions and experiences could also be said to support. These principles share in common with Bobzien's (SC2) that they do not lead to a sorites paradox, and that one cannot validly infer from them the paradoxical (PM2):

> (PG2) *Generic Tolerance*, letting ↄx be the implicit Generic quantifier in "Dogs bark"
> $\text{ↄy}\text{ↄz}((\mathrm{Fy}\ \&\ \mathrm{d(y,z)} < q) \rightarrow \mathrm{Fz}))$
> e.g., "Speeds a tiny bit different than a fast one are still fast."
>
> (PC2) *Counterfactual Tolerance*
> $\forall\mathrm{y}\forall\mathrm{z}((\mathrm{Fy}\ \&\ \mathrm{d(y,z)} < q)\ \Box\!\!\rightarrow \mathrm{Fz}))$
> e.g., "Were a speed just a tiny bit different, it would still be fast."
>
> (PS2) *Subjective Tolerance,* letting S(p) indicate thinking about p:
> $\forall\mathrm{y}\forall\mathrm{z}((\mathrm{Fy}\ \&\ \mathrm{d(y,z)} < q) \rightarrow (\mathrm{S}(\mathrm{Fy}\ \&\ \mathrm{Fz}) \rightarrow \mathrm{Fz}))$
> e.g., "Any speed you'll think of as a tiny bit different than a fast one is still fast"
>
> (PJ2) *Doxastic Tolerance*, letting J(p) indicate justified belief in p:
> $\forall\mathrm{y}\forall\mathrm{z}(\mathrm{J}(\mathrm{Fy}\ \&\ \mathrm{d(y,z)} < q) \rightarrow \mathrm{J}(\mathrm{Fz}))$
> e.g., "For any speed you're justified in believing is just a tiny bit different than a fast speed, you're justified in believing it's fast too."

These four non-strict principles have in common with Bobzien's (SC2) that they could be readily justified inductively by random samplings of particular cases of vague predicates without the need to consider every possible case in an infinite, dense domain. By contrast, random sampling can't support *analytically necessary* claims about the infinite set of possible collections of wealth and possible distributions of hair, and hence does not justify an exceptionless dense tolerance principle.

These four principles also fit our intuitions about vagueness. Generic tolerance fits the phenomenology of expectation: encountering something indistinguishable from an F gives you a good reason to expect an F. Generics permit exceptions. Counterfactual tolerance fits the intuition-grabbing language of thought experiments about vagueness: *were a bald person to grow a hair, he'd still be bald.* Counterfactuals only require the truth of the *nearest* case, not every case. Neither is paradoxical.

Subjective tolerance fits the phenomenology of the *forced march*: the act of consciously considering any two qualitatively indistinguishable cases compels me to categorize neighboring cases as *F* or both as non-*F* (Horgan 1994). Since the domain is dense, this process will never force me to affirm that clear *F*s are non-*F*s, or clear non-*F*s are *F*s. Perhaps we cannot consciously consider, without falling into a kind of Blindspot, a particular case in which an F and a non-F are within close vicinity of one another (Sorensen 1988).

Doxastic tolerance best fits the phenomenology of epistemic indiscriminability. Égré (2015) proposes that, if vague predicates were not tolerant, we would expect to encounter cases in which known Fs and known non-Fs are in close vicinity to one another, but we do not. Thus, "there are no close cases in which it is known that a sentence takes a certain truth-state in one case and known that this sentence takes the complementary truth-state in the other close case" (Greenough 2003). There is no need to invoke strict dense tolerance.

Yet none of these four alternative principles are paradoxical, because each is compatible with the existence of some exceptional non-F in the vicinity of an F which disrupts the ability to form a chain of inferences throughout the space. Both individually and in conjunction with one another they are consistent with the denial of both well-ordered tolerance and of the strict dense tolerance principle, namely:

(~PM2) $\exists y\ \exists z(Fy\ \&\ d(y, z) < q\ \&\ \sim Fz)$

So, we can put to rest the first myth of vagueness. The myth is that our intuitions support a paradoxical tolerance principle. In fact, our intuitions do support a number of tolerance principles, but these principles cannot be used to generate a conventional sorites paradox–because their domain is not well-ordered–and they cannot be used to generate a continuous sorites or dense sorites paradox, because they admit of exceptions. Therefore, one can maintain bivalence and avoid paradox without having to deny an intuitive tolerance principle.

4. Epistemicism without Borders

The denial of well-ordered tolerance is this claim:

(~P2) $\forall c\exists x\exists y(Fx\ \&\ \sim F(x+y)\ \&\ |y|\leq c)$

The denial of strict dense tolerance is this claim:

(~PM2) $\forall q\ \exists y\ \exists z(Fy\ \&\ \sim Fz\ \&\ d(y, z) < q)$

As discussed, to avoid a Sorites, the Epistemicist must affirm both, even while they may accept other, non-strict tolerance principles. So, an Epistemicist must hold for each vague predicate that there is some point along the line where small differences impact whether or not a vague predicate applies. There is a possible bald man who differs from some possible non-bald man by only a single hair, or an even tinier amount of hair. There is a possible rich man who differs from some possible non-rich man only in owning a single penny, or some even tinier amount of wealth. This is generally interpreted to suggest that there is some sharp borderline between the bald and the non-bald, or some fixed threshold for being rich, that is:

(Borderline) $\exists x((\forall y\ (y\geq x \rightarrow Fy)\ \&\ (\forall z\ (x>z \rightarrow \sim Fz))$

If (Borderline) holds for richness, then there is some *poorest rich* person such that everyone richer than that person is also rich, and anyone poorer than that person isn't rich. If it holds for baldness, then there is some hairiest bald man such that everyone hairier than that bald man is non-bald and no one with less hair is bald. Of course, baldness and wealth are likely

determined by some multi-dimensional dense parameter–the arrangement of the hair matters for baldness and the liquidity of the assets matters for richness–rather than a well-ordered number of hairs or dollar value in cash (Graff 2000). Still, the Epistemicist's denial of strict tolerance suggests the existence of sharp borderlines.

It does not logically *entail* the existence of borderlines, however. While it is standard to conflate the Epistemicist's claim that *there are unknowable facts in borderline cases* with the *there are unknowable borderline*s, the claim that there are sharp borderlines or thresholds is a much stronger claim. Unlike (Borderline), (~P2) and (~PM2) are consistent with the existence of a possible bald man who is hairier than some possible non-bald man, or some possible rich woman who has less wealth than some possible non-rich woman. Unlike (~P2) and (~PM2), (Borderline) requires that all possible persons who fall "between" any two possible bald persons in their degree of hairlessness must also be bald, and all possible persons who fall "between" any two possible rich persons in their degree of wealth must also be rich. Suppose that 80.492mph is the threshold for driving "fast," the least fast speed, in a given context. According to (Borderline), it follows that 80.491mph and 80.4919mph are not fast, including all of the irrational speeds between them, and that 80.49200001mph and 80.493mph are fast, as well as all the irrational speeds between them.

One could deny (Borderline), while also denying strict dense tolerance, by holding that there are some speeds less than 80.492mph which are fast, and some speeds greater than 80.492mph which are not fast; that is, 80.492 is not truly the least fast speed. Within the borderline zone, the "fast" and "non-fast" speeds might not be organized at all, but between any two speeds there may in fact be infinitely many "fast" speeds and infinitely many "non-fast" speeds.

This is a denial of a certain kind of *Monotonicity* for vague predicates. Just as we noted earlier that there are strict and non-strict forms of the tolerance principle, there are also both strict and non-strict forms of the tolerance principle, as Bobzien compares:

$\text{Monotonicity}_{\Box}$: $\forall i\ ((\Box Fa_i \rightarrow \Box Fa_{i-1}) \wedge (\Box \neg Fa_i \rightarrow \Box \neg Fa_{i+1}))$
Monotonicity_{F}: $\forall i\ ((Fa_i \rightarrow Fa_{i-1}) \wedge (\neg Fa_i \rightarrow \neg Fa_{i+1}))$
(Bobzien 2025, 2597, 2601).

Bobzien and I both affirm Monotonicity$_{\Box}$ with the $\Box$ operator interpreted as "it is clear that" or "it is definite that," or perhaps also "it is justifiable to believe that" or "I actively consider that" or "it is accepted in conversation that." But Bobzien raises doubts about Monotonicity$_{F}$:

> There is some empirical evidence that even qualified speakers seem inconstant and capricious in their assessment of such objects with regard to F. They may judge ak+n to be F but ak+(n−1) not to be F, and even may judge the same object first F and shortly after ¬F, if they are unaware that it is the same—or even if they are cognizant of this fact (e.g. (Raffman 1994) (Bobzien 2025, 2601).

Similar concerns about Monotonicity$_{F}$ given the multi-dimensionality of vague predicates are raised by Sagid Salles:

> Not just the number of hairs, but also how they are distributed on someone's head is relevant to the application of this predicate. Because of this, it is arguable that a person who has n hairs on her head is bald, while a person who has fewer than n hairs is not bald. We could handle this problem by saying that, all other things being equal, $\forall n\ (Ba_n \rightarrow Ba_{n-1})$ will hold. (Salles 2021, 133)

An Epistemicist can maintain bivalence while rejecting (Borderline) by accepting the weaker Monotonicity$_{\Box}$ while rejecting the stricter Monotonicity$_{F}$. I hope an illustration will help show why this is actually a very good picture of what the extension of vague predicates looks like.

Imagine that you are in a room facing a large wall. The wallpaper on the wall creates a black-to-white gradient. On the left side, the wall is completely black, and on the right side, the wall is completely white. The wall smoothly transitions from black to white with every shade of grey in between.

Figure 1

Clearly, there is no "borderline" or "threshold" point along the wall t such that everything to the left of t is black and everything to the right of t is not black.

Suppose, though, that the wall-paper was printed using a dot-matrix printer from the 1980s. For those too young to recall, a dot-matrix printer would print only tiny black dots and white dots, although when viewed at the level of an ordinary human eye the aggregate of individual black and white dots appeared gray. Then it *will* be true that there exist points p which are black, but that points immediately to their right (and their left!) are white. Such points will be scattered all over the "grey" region at the center of the wall. This doesn't make p a borderline or threshold, but does make well-ordered tolerance false.

Suppose now that this is a futuristic dot-matrix printer, which prints using infinitesimally small points. The result is a *perfect* gradient along a continuum. No matter how powerful a magnifying glass one takes to the wallpaper, one will never see the individual dots. There will be nothing remotely resembling a borderline. It will be true, however, that for any well-ordered distance to the right n, there is some point on the wall p such that p is black, but $p+n$ is not black – and it will be false that there is a sufficiently small well-ordered distance to the right n such that for all p, if p is black, then $p+n$ is black. Both strict dense tolerance and (Borderline) will be false.

In some regions of the wall, the relative distribution of white points to black points will be 99-100% or 0-1%. Suppose I were to throw an infinitesimally small-tipped dart at one of those regions of the wall. Then "I will hit a black spot" or "I will hit a white spot" will both be highly probable and assertable. In the middle of the wall, the distribution will be 50/50, and "I will hit a black spot" will be unknowable and unassertable. In other regions the distribution may be 95% or 90% or 85%–at some point "I will hit a black spot" will pass from assertable to unassertable, from knowable to unknowable. But this does not mean that it becomes indeterminate whether I will hit a black spot or a white spot, nor does it mean that it is 95%, 90%, or 85% *true* that I will hit a black spot. It is not 90% true that the region is black, but rather it is 100% true that 90% of the region is black.

On this picture, the facts in borderline cases are stochastic, random, chaotic, erratic, and unpredictable, just like throwing a dart at the grey zone of the gradient on the wall. They are stochastic because meaning is grounded in actual use, and the actual use of vague predicates is stochastic in the borderline range of cases. There will be an objective probability that the dart will hit a white spot instead of a black spot–a probability which will increase to the right and decrease to the left–but *only* a probability. We can never know. Similarly, in borderline cases of *heap* or *bald*, a speaker will have some probability of speaking the truth, but cannot *know* that what she is about to say is true, since every borderline case of baldness is surrounded on all sides by possible borderline cases of non-baldness. The appropriate thing to do, given the knowledge norm of assertion and Gricean principles, is to say something hedged in the way ordinary speakers do.

Notice that this model of vagueness allows our four non-strict tolerance principles to still come out true. *Generic Tolerance* will still be true, because in general it is true that Fs will be generally surrounded by other Fs. Even the stray Fs which are in the region of the borderline zone closer to the non-Fs will have other Fs nearby them. *Doxastic Tolerance* will be true for the same reason, given that the probability of running into an F in the vicinity of another F is going to remain high. These principles require only something like Monotonicity$_{\Box}$, not Monotonicity$_{\mathrm{F}}$.

The principles of *Subjective Tolerance* and *Counterfactual Tolerance* will come out true if we specify some further rules about context-shifting and reference. Let's specify that an accepted utterance of "n is an F" impacts every subsequent utterance of "$n+m$ is an F" by "magnetically" pulling uses of "$n+m$" to refer to a particular point the region of our M-space which is an F as opposed to one which is not an F, *ceteris paribus*. For instance, suppose that it is accepted in a conversation that "56mph is fast," and then I utter "55mph is fast." There are infinitely many particular speeds within the range of 54.5 - 55.5mph to which "55mph" could refer. Suppose that 55mph is towards the "non-fast" end of the gradient in the borderline zone for "fast," such that 20% of the points are "fast" and 80% of the points are "non-fast." While it would be more probable that we'd land on a "non-fast" point were we to jump to a random point within the 55mph range, the pull from the acceptance of "56mph is fast" will lead "55mph" to refer

to one of the 20% of the particular speeds which *are* fast, rather than one of the 80% of particular speeds which are not fast. So, "55mph is fast" will come out as true. If we grant that this context-sensitive reference magnetism impacts which cases I am able to think about–given that my mind cannot phenomenologically distinguish small differences between speed, which particular speed my thought "55mph" refers to is partly fixed by "56mph is fast" – then *Subjective Tolerance* will be true. If our analysis of counterfactual nearness includes such context sensitivity, then it will also come out true that "Were you to drive 1mph slower, you'd still be driving fast."

My revisionary Epistemicism can affirm a number of other related "anti-borderline" claims which a traditional Epistemicist would have to deny:

(No Carvings) It isn't possible to carve up the extension of F into two disjoint non-empty open subsets such that everything in one is F and nothing in the other is F, or such that everything connected to one side is F and everything connected to the other side is not F.

(No Crossings) Take any point in the extension, and head in any direction from it along a path. There's no point such that prior to that point there are Fs and only Fs, and after that point there are non-Fs and only non-Fs.

(No Zooming) There will be regions R such that every sub-region of R will have the same distribution of Fs and non-Fs as R. In other words, one can zoom in far enough that zooming in on the grey further will no longer change the proportion of black and white, but it will be a consistent shade of grey.

(Infinite Buffers) For anything which is F, there's something else which is F and which is *closer than* the nearest thing which is not F, and vice-versa.

(No Least Greatests) For anything which is F, there may be something else which is F and which is *closer to* the nearest thing which is not F. Hence, there is no shortest possible tall person, because for any tall person, however short, there could be a shorter tall person.

(Borderline-Borderline Zones) Between any two non-empty regions R_m and R_n where the distributions of Fs are n% and m% respectively, there will be regions in between them where the distribution of Fs is between n and m. Further, it is not possible to divide any region R into two disjoint non-empty open subsets such that for one the distribution is 0% and for the other the distribution is >0%. In other words, there will always be borderline zones as to whether a region is a borderline zone.

(Lotteries) In the grey zone, while I rationally must believe that Fx and ~Fy for some neighboring x and y, yet for each particular neighboring x and y I rationally must believe that both are F or both are not F. The sorites is thus analogous to the lottery paradox (Lissia 2022)

I take these to be characteristics of genuine, *robust* vagueness. My theory is thus not a "wimpy" theory, to use Terry Horgan's term, as it invokes no arbitrary borderlines or precisifications. I escape the "problem of precisification" (Horgan 1994), the problem of the arbitrariness imposing constraints that sharpen the extension, because I entirely deny anything associated with sharpenings. Yet, unlike Horgan, I do not have to reject bivalence or the determinate truth of vague propositions. I simply have to make the domain dense instead of well-ordered, and to scatter the extension and antiextension across a gradient.

I might appear to face, however, something analogous to what Horgan calls the "foundational problem of precisification" faced by supervaluationists. That is, *what grounds* the fact that x is F for some borderline case of F-ness? On my account, why is one borderline case of baldness truly bald, even though two other possible men with indistinguishable amounts of hair aren't bald? What kind of strange truthmaker could make "n kmph is fast" true, and "$n + \pi^{-3}$ kmph is fast" false?

5. Grounding the Scattered Model

Meaning is grounded in use. In practical, everyday life, the use of vague predicates is stochastic and chaotic. Given this, there are only three possible attitudes to take towards vague predicates:

(a) Use *underdetermines* meaning
(b) Use *determines* meaning *in an orderly, precise way*
(c) Use *determines* meaning *in a stochastic, chaotic way*

The bivalence-deniers take attitude (a). For instance, they might say that vague predicates suffer from an incompleteness of meaning (Fine 1975). Perhaps they are akin to indexicals in having character but not content until assigned a boundary in a local context and situation: the meaning of "heavy" is only fixed when we have to divide up the actual wrestlers evenly into "heavyweights," "middleweights," and "lightweights" (Salles 2021, 151). Perhaps this is akin to grading papers, where the meaning of a "B+" shifts based on who is in the class and where one feels like drawing the cut off (Maudlin 2008). Perhaps use determines meaning in clear cases, but for borderline cases use fails to determine a truth value (Tye 1994). Alternatively, perhaps use determines a meaning which is genuinely inconsistent and paradoxical (Eklund 2005).

Traditional Epistemicists take attitude (b). They hold that precise meanings can emerge from patterns of use, even though these boundaries of these precise meanings are unknowable. Tolerance is an illusion produced by the persistence heuristic (Williamson 2024, 1.3). Sharp thresholds arise from collective behavior, though their location is as unpredictable and ever-shifting as a weather forecast (Williamson 1994b).

My revisionary epistemicism takes attitude (c). Given that meaning is grounded in use, and the use of vague predicates is chaotic and stochastic, then – even controlling for local context–we should expect the extension of a vague predicate to be fully determined in an equally stochastic and chaotic way. This position is more conservative than (a), while avoiding the implausible commitments of (b).

If it helps to get a grip on the truthmakers for vague propositions on my view, imagine that in some Platonic heaven a zealous prosecutor refers every possible thought with a vague concept and every possible utterance with a vague term before a jury of ideally competent speakers, along with a detailed review of the context and a description of the various basal properties, both those known to the conceiver or speaker and those unknown, and a review of the precedents of accepted and rejected past uses of the predicate. The jury will then deliberate. If it comes to a consensus that the

proposition is false, then the proposition is false. If it fails to achieve a consensus that it is false, then the proposition is true. The truthmakers will thus include the multi-dimensional basal properties, the context, and the social facts about use, but also something like *how the idealized judgments happen to fall*.

We should expect judgments in these cases to fall predictably and reliably in clear cases, and chaotically and randomly in the grey zone. Some possible borderline old men will be just slightly older than possible borderline non-old men, and some just slightly older, and some possible men of the same age will be old while others are not. Monotonicity$_F$ will fail. Nonetheless, the consensus or non-consensus of the jurors will settle the matter.

Although I have spoken of a jury, the relevant point is not *subjectivity* but arbitrariness. Consider Crispin Wright's "tachometer paradox." A tachometer measures the rotational speed of the motor, and produces a well-ordered numerical output in RPMs given the constantly varying and dense real-world state of the motor. There are inevitably borderline cases in which a miniscule change in the motor's rotation leads to a shift up or down in the tachometer in one case, and not in another case. The shifts will be arbitrary, but no human subjective judgment will be involved. Stochasticity is no reason to doubt there is a fact of the matter (Wright 1987).

When we consider the multi-dimensional, context-sensitive properties which ground baldness, along with the stochasticity of ordinary use of "bald," it becomes very hard to believe the extension of "baldness" will be better behaved than the reading of the tachometer. Even *purely hypothetical* sharp borderlines, or the idealized possible "precisifications" or "sharpenings" proposed by the supervaluationists, seem at odds with the meanings of vague terms. Instead, we should expect true uses of any vague term–say, "is brave"–to cluster stochastically and non-monotonically around a nucleus, not unlike an electron cloud:

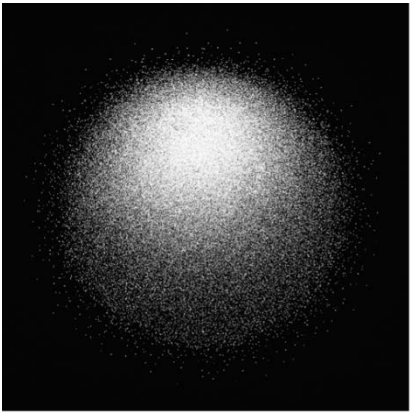

Figure 2

This model of the extension of a vague predicate affirms that "vagueness, if taken at face value, cannot be reconciled with *any* precise dividing lines." (Tye 1994, 193) Surprisingly, it shows that it is consistent to hold that there are no sharp borderlines between the extension and antiextension for P, and yet every object is either in the extension or antiextension of P. This in itself is sufficient to dispel the second myth of vagueness, and to lift the second burden from epistemicism. The revisionary Epistemicist can accept that it is analytic that there are no shortest possible tall people or first noonish moments without any denial of bivalence.

6. Conclusion

I have presented a revisionary form of epistemicism which affirms its essential doctrine: every vague proposition is either true or false, even if it is unknowable in the borderline region. In comparison to supervaluationism and degree of truth views, my model remains conservative by preserving the bivalence of classical logic and semantics. On the other hand, unlike traditional epistemicism, my model allows us to affirm that there are no strict borderlines, thresholds, or cut off points between the bald and the non-bald, because the extensions of vague predicates are scattered stochastically and non-monotonically in the borderline region, akin to the readings of Wright's tachometer–just like we should expect, given the dependence of meaning on use.

My model also allows us to affirm a number of serious tolerance principles, supported by ordinary intuitions, by distinguishing these from two paradox-generating tolerance principles which I have argued are not backed by intuition. Our intuitions must be formed through experience, but our experiences are too qualitative and *dense* to support the well-ordered tolerance principle historically used to generate sorites paradoxes. While a dense sorites may be generated by a strict dense tolerance principle, intuitions do not extend so infinitesimally as to support such a principle. It is more plausible to hold, like Bobzien (2025), that we form intuitions that support a weak or non-strict principle, and then make mistaken inferences to stricter principles.

I have only discussed the semantics of vagueness. I admit my revisionary epistemicism needs still to offer an account in pragmatics for why speakers accept "he didn't plant the petunias, but he didn't *not* plant them" (Machina 1976), or why social pressure in a forced march can stretch what speakers are willing to accept as the extension of a vague predicate. I have not argued explicitly against supervaluationist or degree of truth proposals; sacrificing bivalence may be rational if one thinks epistemicism is committed to affirming sharp borderlines and rejecting the tolerance intuition, much as Williamson and Sorensen present it. Insofar as I have offered a way in which bivalence can be preserved along with the denial of sharp borderlines and a charitable interpretation of the tolerance intuition, however, I take my project of demythologizing to have reduced the appeal of these views.

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