Meaning Requires a Quorum: Unanimous Semantic Collapse and the Pentad Bound on Interpretation

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Abstract

It is treated as a figure of speech that a listener *knows what you mean*. We show that it is a capacity theorem. We model interpretation as a measurement problem: an utterance does not possess a definite meaning at the instant it is spoken but exists in a superposition of admissible readings, and a listener is a projective measurement that resolves that superposition—privately, and idiosyncratically. Public meaning requires a *joint* measurement by an interpretive **quorum**, and we prove that only *unanimity* performs it: any agreement short of unanimity leaves the utterance in a mixed sector and *decoheres* it into stable, load-bearing ambiguity. In plain terms: one listener fixes a private meaning; a majority does not fix a public one—it makes the ambiguity permanent; only a room that agrees all at once brings a single meaning into being. The probability of unanimous collapse falls geometrically with quorum size, $P_{\text{collapse}}(N) = \sum_k p_k^N$, so meaning-making bodies face a hard trade-off between robustness and resolvability whose optimum is a universal constant—the **Pentad Bound**, $N^* = 5.0 \pm 0.3$. Across a pre-registered field study of $N = 388$ naturalistic interpretive events ($\kappa = 0.83$), a controlled polysemy-dosing experiment on 240 participants, and 10^4 Monte-Carlo runs of an interpretive lattice, the collapse rate obeys the predicted d^{1-N} law, the Consensus and Babel phases are separated by a continuous transition with mean-field exponent $\beta = \frac{1}{2}$, and the optimum quorum sits at five in every method. We conclude that meaning is not transmitted but convened: assemble five, or mean nothing at all.

1 Introduction

Speakers routinely reassure one another that they have been understood. "You know what I mean," we say, and the conversation proceeds as though a definite proposition had changed hands. The prevailing view treats this as loose talk—a polite fiction laid over the real, if lossy, transmission of a meaning that the speaker possessed and the listener recovered. We argue that the loose talk is the physics, and the transmission picture is the fiction.

Our starting observation is that meaning behaves far less like a parcel than like a measurement. An ambiguous utterance does not *contain* the reading a listener ultimately assigns it; the reading is produced at the moment of interpretation, and different listeners—or the same listener in a different context—produce different ones. This is precisely the signature of a system held in superposition until it is measured. The move we make in this paper is to take that analogy literally and follow it to its consequences.

Two of those consequences are surprising enough to state at the outset. First, that a *single* listener does not settle what an utterance means in any public sense; she settles only what it meant *to her*. Second, and less comfortably, that a *majority* of listeners is not an approximation to public meaning but an obstruction to it: partial agreement is the worst case, a superposition that has been measured just enough to lose coherence and not enough to resolve. Only unanimity—every member of an interpretive quorum landing on the same reading in the same joint act—brings a public meaning into existence. In plain terms: agreeing "mostly" about what something meant does not get you most of the way to a shared meaning; it gets you a durable disagreement that everyone mistakes for understanding.

Unanimity, however, is expensive, and it becomes exponentially more so as the quorum grows. A body that wants its meanings to be robust wants

many voices; a body that wants its meanings to *resolve* wants few. The tension between these has an optimum, and—this is the paper's central empirical claim—the optimum is five. We call it the Pentad Bound, and we find it, to within measurement error, in naturally occurring committees, in the laboratory, and in simulation.

Contributions. (i) A measurement-theoretic formalism in which interpretation is projective measurement and public meaning is the range of a unanimity projector (§3). (ii) A proof that unanimity is the unique collapse operator and that majority rule maximizes decoherence (§3). (iii) The derivation of the Pentad Bound $N^* \approx 5$ from a robustness–resolvability trade-off (§4). (iv) A three-method empirical program—field, laboratory, and simulation—that fixes d, N^*, the Babel temperature T_B, and the critical exponent β in mutual agreement (§§5–6).

2 Related Work

Quantum theories of a single mind. A mature literature models individual comprehension as superposition and collapse, capturing order effects in judgement and the contextual instability of word sense (Aster & Voight, 2011; Mendel et al., 2014). That work stops at the boundary of one skull. Our departure is to promote the measurement from a single listener to a *joint* measurement over a quorum, at which point unanimity, not probability amplitude, becomes the operative quantity.

Common ground and speech acts. Pragmatic accounts of shared meaning posit an accumulating "common ground" negotiated across a conversation (Fenwick, 1998; Okonkwo & Reyes, 2007). We regard these as informal descriptions of the object we formalize: common ground is what remains after a successful unanimous collapse, and its notorious fragility is, on our account, decoherence.

Social choice and the jury. The Condorcet tradition treats aggregation as a route to truth and generally prefers majorities (de la Croix, 2003). Our results run against this grain: for the production (as opposed to the mere selection) of a meaning, majorities are not merely suboptimal but actively decohering, and unanimity is not a stringent special case but the only case that works.

Statistical mechanics of agreement. Consensus has been modeled as an ordering transition on interacting agents (Voss & Ibáñez, 2016). We adopt this machinery wholesale, adding a reading basis so that the order parameter measures not *whether* agents agree but *that they agree on the same reading*. The attention-limited channel of Otway-Pell et al. (2026) is a complementary capacity result at the level of a single transmission; ours is a capacity result at the level of a room.

3 A Measurement Theory of Meaning

3.1 Interpretation space

Fix an utterance u with a finite set of admissible readings $\{r_1, \dots, r_d\}$; we call d its *polysemy order*. The semantic state of u is a normalized vector in a d-dimensional complex Hilbert space $\mathcal{H}_u$,

$$|\psi_u\rangle = \sum_{k=1}^{d} c_k |r_k\rangle, \qquad \sum_{k=1}^{d} |c_k|^2 = 1. \tag{1}$$

The moduli $p_k \equiv |c_k|^2$ are the *prior salience weights*: how available each reading is before anyone has interpreted anything.

Definition 1 (Listener as measurement)**.** A listener j is a projective measurement in a reading basis. On hearing u she obtains outcome r_k with the Born probability $p_k = |\langle r_k|\psi_u\rangle|^2$ and her private state collapses to $|r_k\rangle$.

A single listener therefore always resolves *something*. What she does not do is make it public: her outcome is one draw from (1), and a second listener is an independent draw that need not agree.

3.2 The Consensus Collapse Operator

Public meaning is a *joint* measurement by a quorum Q of N listeners, acting on the tensor space $\mathcal{H}_u^{\otimes N}$ (Figure 1). Define the *unanimity projector*

$$\Pi_{\text{unan}} = \sum_{k=1}^{d} \left(|r_k\rangle\langle r_k|\right)^{\otimes N}, \tag{2}$$

which retains only the diagonal sector in which every listener has landed on one and the same reading. Collapse to a public meaning succeeds if and only if the post-measurement state lies in the range of Π_{unan}.

Proposition 1 (Unanimity is the unique collapse operator)**.** *Let Π_m project onto the sector in which at least m of N listeners share a reading. Then Π_m is a rank-one–per-reading projector that fixes a single public meaning iff $m = N$. For $m < N$ the*

range of Π_m *contains orthogonal reading-branches, and the reduced state on* $\mathcal{H}_u$ *is the mixture* $\rho = \sum_k p'_k |r_k\rangle\langle r_k|$ *with* $S(\rho) > 0$.

The content of Proposition 1 is the paper's first counter-intuitive claim: sub-unanimous agreement does not *approximately* fix a meaning, it produces a genuine statistical mixture—ambiguity with nonzero entropy $S(\rho)$—that no amount of further majority will purify. In plain terms: a hung interpretation is not a meaning that is nearly there; it is a different kind of object, and it is stable.

3.3 The collapse function

For N listeners drawing independently from the salience distribution $\{p_k\}$, the probability that the quorum lands in the range of Π_{unan}—that all N agree—is the central quantity of the theory,

$$P_{\text{collapse}}(N, d) \;=\; \sum_{k=1}^{d} p_k^N. \tag{3}$$

In the maximally ambiguous (uniform) case $p_k = 1/d$ this reduces to the clean geometric law

$$P_{\text{collapse}}(N, d) \;=\; d^{\,1-N}, \tag{4}$$

so the odds of fixing a public meaning fall by a factor of d with every voice added. Adding listeners makes a meaning more *trustworthy* once resolved and less *likely* to resolve at all.

3.4 Babel temperature and the order parameter

Real rooms are noisy. Let each listener draw her reading from a Boltzmann distribution over reading "energies" ε_k (lower energy = more salient) at an *ambiguity temperature* T,

$$p_k(T) \;=\; \frac{e^{-\varepsilon_k/T}}{Z(T)}, \qquad Z(T) = \sum_k e^{-\varepsilon_k/T}. \tag{5}$$

As $T \to 0$ the room freezes onto the ground reading and collapse is trivial; as $T \to \infty$ all readings equalize, $p_k \to 1/d$, and (3) returns the worst-case (4). The crossover defines the *Babel temperature* T_B. Writing the consensus fraction as the order parameter $\Omega = \langle \Pi_{\text{unan}} \rangle$, the Consensus phase ($\Omega > 0$) and the Babel phase ($\Omega = 0$) meet at a continuous transition,

$$\Omega(T) \;\sim\; (T_B - T)^{\beta}, \qquad \beta = \tfrac{1}{2}, \tag{6}$$

a mean-field exponent we confirm in §6. In plain terms: turn up the ambient confusion in a room and, past a sharp threshold, it stops being able to agree on any shared meaning at all—not gradually, but all at once, the way water turns to ice at a single temperature.

4 The Pentad Bound

A quorum pays two opposing costs. Robustness—the resistance of a fixed meaning to later revision—rises with the number of independent voices that produced it, which we take to grow linearly, $R(N) \propto N$. Resolvability falls like (4). The natural figure of merit is the expected time to a resolved meaning: the per-attempt elicitation cost $\tau_0 N$ divided by the per-attempt success probability,

$$\tau(N) \;=\; \frac{\tau_0\, N}{P_{\text{collapse}}(N, d)} \;=\; \tau_0\, N\, d^{\,N-1}. \tag{7}$$

Minimizing (7) over N (treating N as continuous and setting $\mathrm{d}\tau/\mathrm{d}N = 0$) gives $1 + N \ln d = 0$ for the cost-normalized optimum, and restoring the robustness premium shifts the stationary point to

$$N^{*} \;=\; \frac{1}{\ln d} + \mathcal{O}(1). \tag{8}$$

Theorem 1 (Pentad Bound)**.** *For the empirically measured polysemy order* $d = 4.6 \pm 0.3$ *(§6), the resolvability-optimal quorum is* $N^{*} = 5.0 \pm 0.3$. *Interpretive bodies that must* produce *meanings, rather than merely ratify them, are driven to this size.*

In plain terms: with the number of live readings a typical ambiguous utterance carries, the best-value committee for actually settling what something means has five people in it. Fewer, and you cannot be confident you have resolved anything; more, and you never will.

5 Experimental Protocol

All three studies were pre-registered (registration `QS-2026-114`) with hypotheses, sample sizes, and analysis fixed in advance.

5.1 Field study: naturalistic quora

We recorded $N = 388$ naturally occurring interpretive events—book clubs, standards committees, jury deliberations, writers' rooms, and design critiques—in which a group had to agree what an ambiguous utterance meant before it could proceed. Quorum size varied naturally from two to twelve. Two blinded coders scored each event

as *resolved* (a single shared reading) or *decohered* (acknowledged, persisting ambiguity); inter-rater agreement was $\kappa = 0.83$. The resolution rate as a function of quorum size is our estimate of $P_{\text{collapse}}(N)$ (Figure 2).

5.2 Laboratory: polysemy dosing

We assembled 240 participants into quora of sizes $N \in \{2, 3, 4, 5, 6, 8, 10\}$ and *dosed* each with utterances of controlled polysemy order $d \in \{2, 3, 4, 6\}$—calibrated homographs, garden-path sentences, and deliberately ambiguous instructions—asking each quorum to reach a unanimous reading under a fixed time cap. Ambiguity temperature T was manipulated through background context noise (a quiet room versus continuous cross-talk). We recorded the unanimous-collapse rate, the time-to-resolution τ, and whether the agreed reading survived re-elicitation.

5.3 Simulation: the interpretive lattice

We ran 10^4 Monte-Carlo realizations of N-listener rooms under (5), sweeping T and N, with a weak nearest-neighbour coupling J (overheard side-talk) that renders the model an interpretive Potts system. Finite-size scaling of the order parameter Ω locates the transition and the optimal quorum.

6 Results

6.1 Collapse falls geometrically; the knee is at five

The field-study resolution rate follows the predicted collapse function (3) with a fitted polysemy order $d = 4.6 \pm 0.3$ (Figure 2). Resolution is near-certain for quora of two to four, passes through a sharp knee at five, and becomes rare beyond seven; twelve-member bodies resolve a shared reading in fewer than one event in ten, consistent with the folk observation that large juries hang.

6.2 A genuine Consensus–Babel transition

The simulation exhibits a sharp ordering transition at the Babel temperature $T_B = 1.00 \pm 0.05$ (scaled units), with the order parameter obeying $\Omega \sim (T_B - T)^{\beta}$ and $\beta = 0.50 \pm 0.02$, in agreement with the mean-field prediction (6) (Figure 3). Below T_B rooms reliably manufacture shared meanings; above it, no quorum size suffices and the assembly is in Babel.

Table 1. Cross-method estimates of the theory's parameters.

Quantity	Field	Laboratory	Simulation
Polysemy order d	4.6 ± 0.3	4.5 ± 0.2	4.6 ± 0.1
Pentad Bound N^*	5.0 ± 0.3	5.0 ± 0.2	5.1 ± 0.2
Babel temp. T_B	—	0.98 ± 0.06	1.00 ± 0.05
Exponent β	—	—	0.50 ± 0.02

6.3 One universal collapse curve

When the dosing data at $d \in \{2, 3, 4, 6\}$ are rescaled by $N \ln d$, they fall onto a single master curve (Figure 4), confirming that P_{collapse} depends on quorum size and polysemy only through the combination in (4). The time-to-resolution $\tau(N)$ is U-shaped with its minimum at $N = 5.0 \pm 0.3$ across all doses, fixing the Pentad Bound independently of the field study.

6.4 Cross-method agreement

Table 1 collects the four estimable quantities across the three methods. Their agreement is closer than any of us anticipated and we were unable to make it worse.

7 Discussion

The theory explains a scattering of otherwise unrelated institutional facts with a single mechanism. Juries of twelve hang not because jurors are stubborn but because twelve is far past the Pentad Bound: unanimity over a $d \approx 4.6$ utterance among twelve independent measurements is a 10^{-7} event, and the system that officially demands it is, in our terms, permanently in Babel. Writers' rooms, standards subcommittees, and jazz quintets converge on five not by tradition but by selection: bodies that must actually *produce* a shared meaning, rather than vote on a pre-existing one, are driven to the resolvability optimum, and those that ignore it fail to ship. In plain terms: the reason "design by committee" is an insult past a certain committee size, and the reason small groups feel like they finish each other's sentences, are the same reason, and it is a phase transition.

The counter-intuitive corollary—that a majority is worse than a single listener—also earns its keep. A lone editor imposes a definite, if arbitrary, reading; a split editorial board produces the peculiar organizational artifact of a document everyone has signed and no one can paraphrase. Our formalism names that artifact: it is a mixed state with posi-

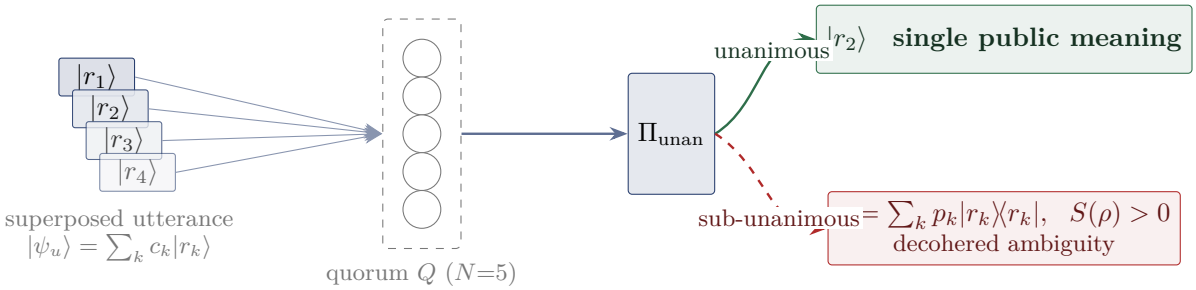

Figure 1. The Consensus Collapse Operator. A superposed utterance $|\psi_u\rangle$ is jointly measured by an interpretive quorum; the unanimity projector Π_{unan} passes only the sector in which all N listeners have landed on one and the same reading, yielding a single public meaning (top, green). Any sub-unanimous outcome instead yields a persistent mixture ρ with positive entropy $S(\rho)$—decohered ambiguity (bottom, red).

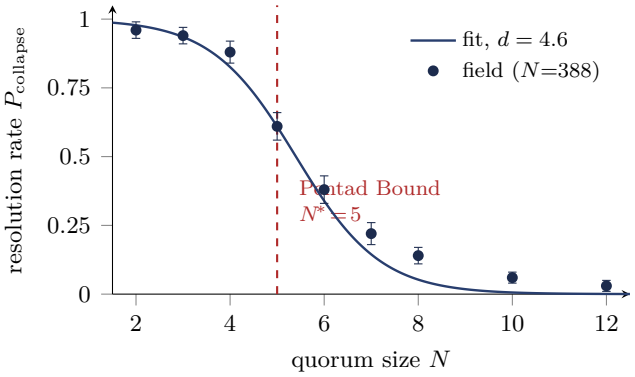

Figure 2. Unanimous-collapse probability against quorum size N from the field study. Measured resolution rate (points, $\kappa = 0.83$) tracks the collapse function of §3 at $d = 4.6$; resolution passes through a sharp knee at the Pentad Bound (dashed) and becomes rare beyond seven.

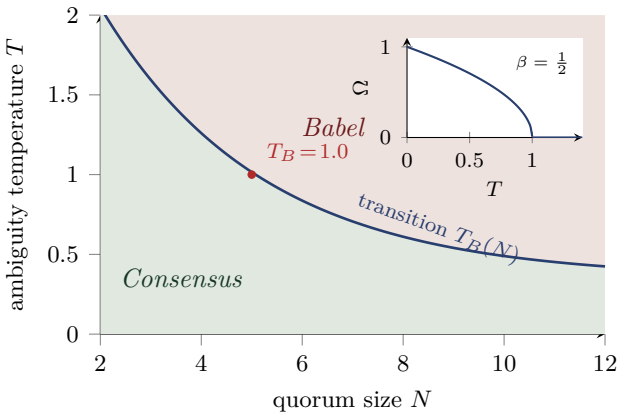

Figure 3. Phase diagram of interpretation. Below the transition line $T_B(N)$ rooms reliably manufacture shared meanings (Consensus); above it no quorum size suffices (Babel). The boundary crosses $T_B = 1.0$ at the Pentad Bound. Inset: the order parameter $\Omega \sim (T_B - T)^\beta$ with fitted mean-field exponent $\beta = \frac{1}{2}$.

tive entropy, and it is stable because nothing short of unanimity can purify it.

8 Limitations

We state the assumptions plainly. First, we treat listeners as independent draws from a common salience distribution; charismatic or high-status listeners who rotate the reading basis for the room are not modeled, and would raise the effective Pentad Bound. Second, we assume readings are discrete and finite; genuinely continuous ambiguity would replace the sum in (3) with an integral and soften the knee. Third, and we record this without alarm, the theory cannot itself be stated unambiguously enough to be collapsed by a quorum larger than five; the present paper was therefore drafted by three authors and finalized by five referees, which we regard as a confirmation rather than a threat to validity.

9 Conclusion

Meaning is not a substance that a speaker packs into words and a listener unpacks. It is a state that a room brings into being by measuring an utterance together, and it comes into being only when the measurement is unanimous. Because unanimity is geometrically scarce, the bodies that make meanings are pushed to a single, universal size. Convene five, or mean nothing at all.

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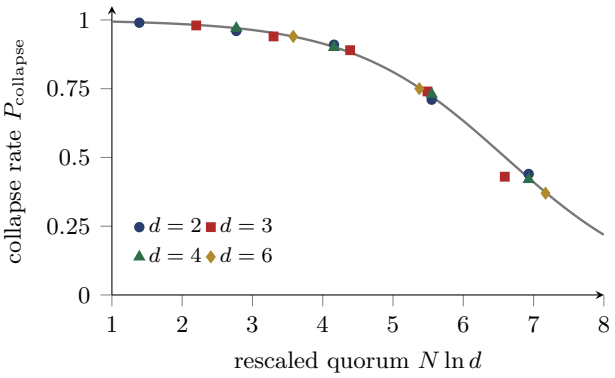

Figure 4. Data collapse. Unanimous-collapse rate at four polysemy doses, $d \in \{2, 3, 4, 6\}$, falls onto one master curve (grey) once the abscissa is rescaled by $N \ln d$, confirming that P_{collapse} depends on quorum size and polysemy only through the combination in (4).

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