LegalHalluLens: Typed Hallucination Failure Modes and Calibrated Multi-Agent Debate Mitigation

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Abstract

AI systems deployed for legal workflows hallucinate at rates that aggregate metrics report at ∼52%, but this single number conceals *which* kinds of claim fail and *in which direction* the resulting bias runs. We present **LegalHalluLens**, a typed hallucination diagnostic for LLM contract extraction, paired with a **six-role multi-agent debate pipeline** that uses the diagnosis to calibrate its mitigation. The diagnostic has two parts: **typed hallucination profiles** across four claim categories (numeric, temporal, obligation, factual), and a **Risk Direction Index (RDI)** that decomposes content errors into invention versus omission. Across CUAD (Hendrycks et al., 2021) (510 contracts; 249,252 clause-level instances; four architecturally diverse models) we measure a within-model gap of ∼38–40 pp between obligation/numeric and temporal claims that aggregate reporting hides, and show that two extractors with matched 52% rates can carry opposite RDIs. The calibrated debate pipeline reduces fabricated detections by 45% with per-category gains tracking the diagnosis, allowing a 4B-active open backbone to rank first under 4 of 5 weighting schemes against commercial frontiers.

1. Introduction

Hallucination is the dominant reliability problem in LLM-based legal contract extraction. Aggregate metrics report rates around 52% across architecturally diverse models, but this single number conceals *which* kinds of claim fail and *in which direction* the resulting bias runs. Two extractors with matched 52% rates can fail in opposite directions, leaving a developer building extraction tooling with no signal for where to apply mitigation.

Why aggregate metrics fail. A non-compete scope qualifier silently dropped produces an unenforceable clause that counsel may never flag; a liability cap invented where none exists creates a false risk ceiling that may be relied on for months. These two failures score identically on aggregate hallucination, but the appropriate fix differs by direction and again by which claim type fails most. A mitigation applied uniformly across claim types can leave the dominant failure mode unchanged while reporting an aggregate improvement. We present **LegalHalluLens**, a typed hallucination diagnostic for LLM contract extraction (typed profiles + Risk Direction Index), paired with a six-role multi-agent debate pipeline (Extractor, Skeptic, Supporter, Arbiter, Verifier, Judge) that uses the diagnosis to calibrate its Skeptic challenges and asymmetric structural gates.

Where prior work stops. Prior typological work (Dahl et al., 2024; Hou et al., 2024; Magesh et al., 2025) establishes that legal hallucinations are not uniform but does not address the contract extraction setting or collapse directional character into a deployment-comparable scalar. §2 positions this work against each cluster in detail.

Research questions. This paper addresses three questions.

RQ1: typed failure ordering. Do LLMs exhibit systematically different hallucination rates across legal claim types, and is this pattern consistent enough across architectures to function as a reliable evaluation signal? If numeric and obligation claims fail substantially more than temporal claims across all tested systems, then any evaluation that averages across types is concealing the failure rate on the clauses of greatest legal consequence.

RQ2: error direction. Can the directional character of content errors, whether a model suppresses obligations present in the source or asserts ones that are not, be captured in a single deployment-actionable metric, and does this signal differentiate systems that aggregate rates cannot?

RQ3: typed mitigation. Does a debate pipeline calibrated to both the failure magnitudes from RQ1 and the error direc-

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tions from RQ2 produce gains concentrated on the highest-failure categories, and does this calibrated approach enable a small open model to match or exceed the performance of commercial ?

Experimental scope. We ground the study in structured legal clause extraction using CUAD v1.0 (Hendrycks et al., 2021) as an oracle-bounded evaluation corpus: 510 commercial contracts with 41 expert-annotated clause types, providing a complete ground-truth oracle in which every model output is verifiable against the contract text without external knowledge. We evaluate under full-document context, measuring the performance ceiling for retrieval-augmented variants where retrieval errors compound on top of the content failures we report. *Experiment 1* evaluates four models, two commercial APIs, one 32B open model, one 70B open model, across all 510 contracts and three runs, yielding 249,252 clause-level instances. *Experiment 2* applies a typed debate pipeline to gemma-4-26B-A4B (Mixture-of-Experts, 4B active parameters) on a 120-contract matched subset, testing whether the typed failure profile from Experiment 1 supports a calibrated and cost-efficient mitigation.

Contributions.

1. **Typed hallucination profiles** (§6): a consistent failure ordering {numeric, obligation} $\gg$ factual $\geq$ temporal across four architecturally diverse models, spanning approximately 38–41 pp per model and not observable under aggregate reporting.
2. **Risk Direction Index** (§6.3): a signed scalar metric that decomposes content errors into omission versus invention across typed claim categories, encoding net directional bias as a single deployment-actionable signal.
3. **Typed debate mitigation** (§7): a pipeline calibrated to both failure magnitudes and error directions, reducing fabricated clause detections by 45% on the matched subset and enabling a 4B-active open model to match commercial APIs on composite score (rank 1 under 4 of 5 weighting schemes).

2. Related Work

Legal hallucinations and benchmarks. Dahl et al. (2024) develop a typology of legal hallucinations across federal-judiciary tasks (rates between 58% and 88% depending on model), arguing that "not all modes of hallucination are equally concerning for legal professionals." Hou et al. (2024) construct a fine-grained taxonomy of gap categories for machine-generated legal analysis. Magesh et al. (2025) show that RAG in commercial legal AI tools does not eliminate hallucinations. We take these as starting premises; neither addresses contract extraction, and neither collapses directional character into a deployment-comparable scalar, the gap our four-category taxonomy (§3) and Risk Direction Index (§4.2) fill. Legal benchmarks (Guha et al., 2023; Blair-Stanek et al., 2024; Liu et al., 2025) measure task accuracy without per-claim-type hallucination stratification; CUAD (Hendrycks et al., 2021) provides expert annotations for classification, which we repurpose as a hallucination oracle. Other diagnostics are orthogonal (Enguehard et al., 2025; Demir & Canbaz, 2025; Purushothama et al., 2025).

General hallucination benchmarks and debate-based mitigation. FActScore (Min et al., 2023), HaluBench (Ravi et al., 2024), HalluLens (Bang et al., 2025), and PHANTOM (Ji et al., 2025) measure factual precision without claim-type stratification. Multi-agent debate has been studied as a factuality mechanism (Du et al., 2024; Fang et al., 2025; Li et al., 2025; Hu et al., 2025) with theoretical motivation from inference-time scaling (Snell et al., 2024; Wu et al., 2024). Our contribution is the calibration of Skeptic challenges and asymmetric gates against the per-category and per-direction failure modes from Experiment 1; Huang et al. (2024) contextualises the content-correction limit we observe.

3. Background

We briefly introduce the domain knowledge needed to follow our contributions: the verification structure of legal text that motivates our four-category claim taxonomy, and the metrics and notation we use throughout.

3.1. Verification Structure of Contract Text

Commercial contracts contain claims of fundamentally different verification character. A claim of the form "the cap on liability is $5,000,000" has a single numeric value whose correctness is decidable by direct comparison against the source. A claim of the form "the agreement terminates on December 31, 2024" similarly reduces to verbatim string comparison. By contrast, a claim such as "the supplier shall, except as provided in Section 4.2, indemnify the buyer against third-party claims arising from products manufactured before the effective date" carries multiple semantic elements that must all be preserved: the modal verb (*shall*), the carve-out (*except as provided*), the scope (*products manufactured before*), and the temporal anchor. Identity claims such as governing law or counterparty name are short and structurally simple but rely on the model resisting its parametric prior of common law jurisdictions.

These four verification regimes correspond to the categories we use throughout the paper: **numeric**, **temporal**, **obligation/entitlement**, and **factual**. The categories are defined by primary verification challenge rather than by document type, so the same categorisation transfers to any legal extraction

task in which model claims can be checked against a source.

3.2. Metrics and Notation

Let D denote a legal document, c_i a claim type from a fixed inventory $\mathcal{C}$, and M an extraction model. For each (D, c_i) pair the model outputs either a clause extraction or a "not present" decision. Per-instance outcomes form a confusion matrix $\{\mathrm{TP}, \mathrm{FP}, \mathrm{FN}, \mathrm{TN}\}$ relative to the CUAD oracle (TP = correctly detected as present; FP = fabricated, asserted present when absent; FN = missed, present but called absent; TN = correctly absent). A judge then labels each TP as *supported* or *contradicted*, together with a categorical `mismatch_type` when an error is identified. We report:

- $\mathbf{FAR} = \mathrm{FP}/(\mathrm{FP} + \mathrm{TN})$ *false-acceptance: invents absent clauses*
- $\mathbf{FRR} = \mathrm{FN}/(\mathrm{FN} + \mathrm{TP})$ *false-rejection: misses present clauses*
- $\mathbf{Acc} = (\mathrm{TP} + \mathrm{TN})/N$ *detection accuracy*
- $\mathbf{Hal_{TP}} = \mathrm{contradicted}/\mathrm{TP}$ *content-quality among detections (Exp. 1)*
- $\mathbf{Hal_{Gen}} = (\mathrm{contradicted} + \mathrm{FP})/(\mathrm{TP} + \mathrm{FP})$ *quality of all generated outputs (Exp. 2)*
- $\mathbf{JEq} = \mathrm{supported}/(\mathrm{TP} + \mathrm{FN})$ *end-to-end correctness*
- **RDI**: see §4.2

The two hallucination metrics differ in scope. $\mathrm{Hal}_{\mathrm{TP}}$ measures content correctness *conditional on detection*: of clauses the model said it found, what fraction had wrong content? It isolates the failure mode where the right clause is located but the extracted text is incorrect, and is the primary signal for typed profiles in Experiment 1. $\mathrm{Hal}_{\mathrm{Gen}}$ is stricter: of *everything the model emitted as a clause*, what fraction was wrong, counting both content contradictions *and* fabrications? Because $\mathrm{Hal}_{\mathrm{Gen}}$ penalises FPs, it is the appropriate metric for evaluating a mitigation pipeline that reduces fabrication, and we use it as the content-quality column in the matched-subset leaderboard (Experiment 2). FAR and FRR are detection-level metrics; the two hallucination metrics measure content quality. All four are complementary and reported together in their respective benchmarks.

4. Method

We describe three components: (i) the typed hallucination profile, (ii) the Risk Direction Index, and (iii) the typed debate pipeline. The first two are evaluation procedures; the third is a mitigation mechanism informed by their output.

4.1. Typed Hallucination Profiles

For a model M evaluated on a corpus $\mathcal{D}$, we partition all clause-level outputs by claim category $c_i \in \{\mathrm{numeric}, \mathrm{temporal}, \mathrm{obligation}, \mathrm{factual}\}$ and report $\mathrm{Hal}_{\mathrm{TP}}(M, c_i)$ stratified per category. The within-model typed gap is defined as

$$\mathrm{Gap}(M) = \max_{c_i} \mathrm{Hal}_{\mathrm{TP}}(M, c_i) - \min_{c_i} \mathrm{Hal}_{\mathrm{TP}}(M, c_i).$$

A model with a large $\mathrm{Gap}(M)$ has hallucination rates that vary substantially across claim categories, which means aggregate $\mathrm{Hal}_{\mathrm{TP}}$ averages claim types whose deployment consequences differ.

4.2. Risk Direction Index (RDI)

The judge returns a `mismatch_type` label from a fixed inventory: `none`, `numeric`, `temporal`, `obligation`, `scope`, `missing_condition`, `extra_condition`, `other`. Two of these labels carry directional meaning: `missing_condition` (the model omits a qualifier present in ground truth) and `extra_condition` (the model asserts a qualifier absent from the source). RDI is defined as

$$\mathrm{RDI}(M) = \frac{\mathrm{p}_{\mathrm{extra}}(M) - \mathrm{p}_{\mathrm{missing}}(M)}{100},$$

where $\mathrm{p}_{\mathrm{extra}}$ and $\mathrm{p}_{\mathrm{missing}}$ are the percentages of contradicted findings carrying each label. Positive values indicate invention-heavy failure (overstates); negative values indicate omission-heavy failure (understates).

The directional concept is recognised qualitatively in prior work (Dahl et al., 2024; Hou et al., 2024); what we add is the operationalisation as a single signed scalar derivable from labels the judge produces already. RDI is intended as a directional signal rather than a cardinal measure of risk magnitude: scope errors account for 62–71% of contradictions in our data and compress the directional component. The empirical claim (§6) is that RDI cleanly separates two systems with matched aggregate $\mathrm{Hal}_{\mathrm{TP}}$.

4.3. Typed Debate Pipeline

The debate pipeline (Figure 3) is a state machine with six agent roles: an *Extractor* that produces the baseline clause extraction (Figure 3, leftmost node); a *Skeptic* that issues typed challenge questions targeting the failure modes measured in §4.1; a *Supporter* that defends the extraction using only verbatim contract quotes; an *Arbiter* that resolves deadlock when agents disagree after all rounds, applying a conservative policy that preserves the baseline unless contrary evidence is strong; a *Verifier* that searches the contract independently and checks definition fit; and a *Judge* that reads the full debate transcript, Verifier report, and Arbiter

assessment to make all binding content decisions, subject to asymmetric structural gates. Routing after each Supporter response: if the Skeptic flagged a structural error in Round 1, the `reextract_node` fires (once only); if both agents agree, the clause proceeds to Verifier; if rounds remain and agents disagree, the debate loops; if rounds are exhausted without consensus, the Arbiter resolves the deadlock before Verifier and Judge. The pipeline runs for at most two rounds. Three design choices distinguish this pipeline from generic multi-agent debate.

Typed Skeptic challenges. For numeric claims, the Skeptic asks whether the value is verbatim in the source or substituted by a common prior. For obligation claims, it asks whether the modal verb is preserved and whether all carve-outs are captured. For temporal claims, it asks whether the value is stated explicitly or inferred. For factual claims, it asks whether the information comes from the document or from external knowledge. Full challenge sets appear in Appendix C.

The `reextract_node`. When the Skeptic identifies that the wrong clause was extracted (rather than imprecise content within the right clause), the pipeline re-runs extraction from the source rather than debating an answer that cannot be repaired. This targets structural extraction errors, which are distinct from the within-clause scope errors that account for 62–71% of content contradictions.

Asymmetric structural gates. The Addition Gate (absent $\rightarrow$ present) requires both Verifier confirmation and debate consensus before accepting a new detection. The Deletion Gate (present $\rightarrow$ absent) is blocked when the Verifier confirms presence, preventing over-conservative removal of real findings. The asymmetry encodes the FAR $>$ FRR risk profile measured in Experiment 1 for high-error claim types.

5. Experiments

5.1. Dataset and Oracle

We use CUAD v1.0 (Hendrycks et al., 2021): 510 commercial contracts with 41 expert-annotated clause types. CUAD is chosen because it provides a complete ground-truth oracle against which every model output is verifiable from the contract text alone, no external knowledge is used at any stage. We map the 41 clause types to four categories by primary verification challenge (Appendix D):

Category	n	Primary verification challenge
Numeric	5	Threshold fabrication, unit mismatch
Temporal	6	Implied deadline inference
Obligation/Ent.	27	Modal drift, condition loss
Factual	3	Outside-knowledge injection

The Factual and Numeric categories have small n; results for these categories are reported as supporting evidence, with our central typed-gap claim resting on the Obligation (n=27) versus Temporal (n=6) contrast.

5.2. Models

Experiment 1 (typed profiles benchmark). Four models at temperature $= 0$: gemini-3-flash and gpt-5.2 (commercial APIs); qwen3-32b (open, 32.8B parameters); llama-3.3-70b (open, 70B). All extract clauses with identical structured-JSON prompts (Appendix B).

Experiment 2 (typed debate mitigation). Backbone: gemma-4-26B-A4B (Mixture-of-Experts; 4B active parameters)[1] This model is held out from Experiment 1 to keep the mitigation study separate from the benchmark, and is selected as the worst baseline composite score on the matched subset, any improvement is therefore attributable to the intervention rather than to a stronger starting point.

5.3. External Evaluation Judge

A single external evaluation judge (gemini-2.5-flash, temperature $= 0$) scores each extracted clause against CUAD ground truth under a strict five-criterion rubric: exact numeric precision, temporal precision, modality match, polarity match, and exception/carve-out preservation. The judge returns a *supported / contradicted* verdict and a `mismatch_type` label. The full judge prompt appears in Appendix A. The same evaluation judge is used for both experiments and produces every reported $\mathrm{Hal}_{\mathrm{TP}}$, $\mathrm{Hal}_{\mathrm{Gen}}$, and RDI value in the paper. This is distinct from the in-debate Judge node (§4.3, Figure 3), which shares the extraction backbone (gemma-4-26B-A4B in Experiment 2) and adjudicates the Add/Del gates internally to the pipeline; the in-debate Judge does not score outputs against ground truth and does not contribute to the reported metrics.

5.4. Protocol and Scale

Experiment 1. Three independent runs per model on all 510 contracts. Nominal opportunities are $510 \times 41 \times 3 = 62{,}730$ per model. Actual exported totals are 62,580 (gemini-3-flash), 62,689 (gpt-5.2), 61,536 (qwen3-32b), and 62,447 (llama-3.3-70b), yielding **249,252** clause-level instances total. The 0.2–1.9% shortfall is contract-correlated rather than random: only 5 contracts fail across all three qwen3-32b runs (8.6% of affected contracts), indicating a set of consistently challenging inputs rather than stochastic dropout (App. E).

Experiment 2. A 120-contract matched subset (run_id $= 1$, nominal 4,920 opportunities) for direct baseline-vs-debate

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comparison.

6. Results: Typed Hallucination Profiles (Experiment 1)

6.1. Aggregate Rates Cannot Support Legal Deployment Decisions

Table 1. Aggregate metrics on the full 510-contract benchmark (three runs). $\mathrm{Hal}_{\mathrm{TP}}$ measures content errors among detected clauses; $\mathrm{Hal}_{\mathrm{Gen}}$ adds fabrications into the denominator and reorders the models.

Model	FAR	FRR	Acc	$\mathrm{Hal}_{\mathrm{TP}}$	$\mathrm{Hal}_{\mathrm{Gen}}$	JEq
gemini-3-flash	19.1	4.5	85.6	50.9	65.5	46.9
gpt-5.2	11.8	11.6	88.3	51.8	62.4	42.6
qwen3-32b	13.4	10.8	87.5	52.1	63.6	42.7
llama-3.3-70b	7.7	18.0	89.0	56.5	63.7	35.7

Table 1 illustrates the evaluation problem. Four architecturally distinct models, two commercial APIs, a 32B open model, and a 70B open model, fall within a 6 pp $\mathrm{Hal}_{\mathrm{TP}}$ band (50.9–56.5%). This range is too narrow to support deployment decisions. A compliance officer comparing these systems on aggregate $\mathrm{Hal}_{\mathrm{TP}}$ would have no actionable signal.

6.2. The Typed Failure Ordering Is Consistent and Large

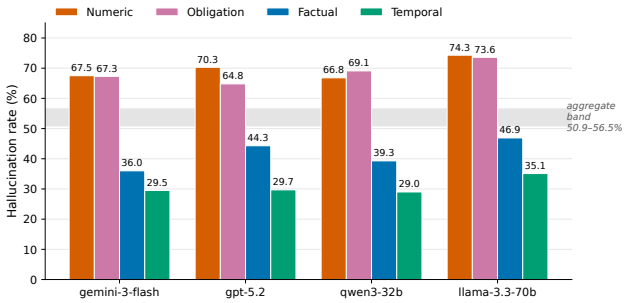

Figure 1. Typed hallucination rates on the 510-contract benchmark. The grey band marks the aggregate $\mathrm{Hal}_{\mathrm{TP}}$ cluster (50.9–56.5%). Numeric and obligation claims hallucinate at 64.8–74.3% across every tested model; temporal claims remain at 29.0–35.1%. The resulting within-model gap (approximately 38–41 pp) is not observable under aggregate reporting.

Figure 1 and Table 2 reveal what the aggregate band conceals. The failure ordering {numeric, obligation} $\gg$ factual $\geq$ temporal holds for every model without exception. A system appearing "51% unreliable" in aggregate is in fact **65–74% unreliable** on numeric and obligation claims, the categories that determine liability thresholds, obligation scope, and contract enforceability, while being only 29–35% unreliable on temporal claims.

Table 2. Typed hallucination profiles ($\mathrm{Hal}_{\mathrm{TP}}$ %, content hallucination among detected clauses). Gap = max − min across types per model.

Model	Num.	Obl.	Fact.	Temp.	Gap
gemini-3-flash	67.5	67.3	**36.0**	29.5	38.0
gpt-5.2	70.3	**64.8**	44.3	29.7	40.6
qwen3-32b	**66.8**	69.1	39.3	**29.0**	40.1
llama-3.3-70b	74.3	73.6	46.9	35.1	39.2
Range	66.8–74.3	64.8–73.6	36.0–46.9	29.0–35.1	38.0–40.6

Two factors explain the disparity. First, obligation clauses genuinely carry more that can go wrong: modal verbs, trigger conditions, carve-outs, and scope qualifiers, while a temporal claim is typically a single verbatim value. Second, our extraction prompt includes explicit NOTE blocks specifying what does *not* qualify as each numeric clause type, yet numeric ranks among the two highest-failure types in every model, never displaced despite explicit prompt guidance: pretraining priors about common threshold values ("liability caps are usually $5M or $10M") override explicit instructions, a finding that bears directly on how far prompt engineering can compensate for parametric bias.

No single model dominates: qwen3-32b leads on numeric (66.8%) and temporal (29.0%); gpt-5.2 leads on obligation (64.8%); gemini-3-flash leads on factual (36.0%) and end-to-end JEq (46.9%). The best choice depends on which claim type is central to the deployment. Aggregate-based selection can yield the wrong answer whenever the most consequential claim type for a given deployment differs from the average. Conservative abstention is not a safe fallback either: llama-3.3-70b records the lowest FAR (7.7%) and highest Acc (89.0%), but on numeric clauses its FRR reaches **52.8%** and its numeric JEq is only **12.1%**, fewer than 1 in 8 numeric clauses correctly extracted with correct content. A model silent on liability caps is not safe for a compliance workflow.

6.3. The Compliance Direction Problem

qwen3-32b ($\mathrm{Hal}_{\mathrm{TP}}$ = 52.1%) and gpt-5.2 ($\mathrm{Hal}_{\mathrm{TP}}$ = 51.8%) are essentially indistinguishable under aggregate evaluation. Figure 2 shows that they fail in opposite directions.

The underlying distinction is one that compliance practitioners already reason about and that prior typological work (Dahl et al., 2024; Hou et al., 2024) has discussed qualitatively: *do a model's errors tend to suppress obligations present in the document, or to assert ones that are not?* These two failure modes have different legal consequences. A model that drops the "within 50 miles" scope qualifier from a non-compete clause leaves the employer with an unenforceable overreach that counsel may not flag. A model that invents a liability cap where none exists creates a false

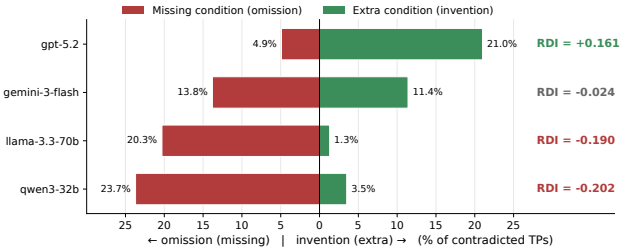

Figure 2. Error direction across benchmark models (percentage of contradicted TP findings). Scope errors dominate universally (62–71%), but the residual signal reveals a deployment-critical distinction: qwen3-32b predominantly omits conditions (23.7% missing-condition errors), whereas gpt-5.2 predominantly invents them (21.0% extra-condition errors). Both systems report 52% aggregate $\mathrm{Hal}_{\mathrm{TP}}$. Only the directional decomposition separates their compliance risk profiles.

risk ceiling that materially alters a client's assessment. Both kinds of error score identically on aggregate $\mathrm{Hal}_{\mathrm{TP}}$, but the appropriate remediation and the exposure carried differ.

The RDI operationalises this distinction using the `missing_condition` and `extra_condition` labels already returned by the judge, it requires no additional annotation or model calls. The warrant for naming it is not that the directional concept is novel (it is not, see Dahl et al., 2024; Hou et al., 2024) but that reducing direction to a single signed scalar lets practitioners compare systems directly on the question that aggregate $\mathrm{Hal}_{\mathrm{TP}}$ cannot answer.

Table 3. RDI and 95% bootstrap CIs (2,000 resamples) for all four models. gpt-5.2 and qwen3-32b intervals do not overlap, confirming the directional separation is stable, not run noise.

Model	RDI [95% CI]	Direction
gpt-5.2	$+0.161$ $[+0.151, +0.170]$	invents (overstates)
gemini-3-flash	-0.024 $[-0.035, -0.015]$	near-balanced
llama-3.3-70b	-0.190 $[-0.198, -0.180]$	omits (understates)
qwen3-32b	-0.202 $[-0.212, -0.193]$	omits most

RDI should be read as a directional signal rather than a cardinal measure of risk. Scope errors (62–71% of contradictions) compress the directional variance: many errors are neither clearly omission nor invention but reflect a wrong semantic aspect. RDI captures only the portion of errors with a clear directional character. Despite this compression, the signal cleanly separates qwen3-32b from gpt-5.2, which is the distinction aggregate $\mathrm{Hal}_{\mathrm{TP}}$ cannot make.

In legal workflows where a missed obligation creates liability (regulatory compliance, covenant monitoring, employment agreements), gpt-5.2's positive RDI is the safer profile: its errors are visible additions that reviewers can identify and reject. In legal operations workflows where false positives consume review capacity and erode trust in the system, the ordering reverses. No single model is universally correct; the appropriate choice depends on the asymmetry of the legal task. RDI makes that choice tractable.

7. Results: Calibrated Mitigation (Experiment 2)

7.1. From Typed Diagnosis to Calibrated Intervention

Experiment 1 produces an actionable failure profile. Numeric and obligation claims fail most. Parametric priors from pretraining override explicit extraction instructions on threshold values. Models that score equivalently on aggregate $\mathrm{Hal}_{\mathrm{TP}}$ may nonetheless fail in opposite compliance directions. This characterisation doubles as a specification: a mitigation should reduce the FAR on numeric and obligation clauses; it should compensate for prior-substitution rather than ignoring it; and its effect on error direction should be measurable.

The specific question for Experiment 2 is therefore narrow: can a debate pipeline calibrated to the measured failure profile reduce fabrication on a low-cost open model, and do the gains concentrate on the highest-failure categories as the calibration predicts?

Figure 3 shows the pipeline; §4.3 describes its components in full. Skeptic challenges are calibrated against the Experiment 1 per-type failure profile; asymmetric gates encode the measured FAR $>$ FRR risk asymmetry.

7.2. Results: Fabrication Filtered, Direction Corrected

Table 4. Matched-subset comparison (120 contracts, run_id=1). $\mathrm{Hal}_{\mathrm{Gen}}$ is the stricter generation-side metric $(\text{contradicted} + \mathrm{FP})/(\mathrm{TP} + \mathrm{FP})$, penalising fabrications in addition to content errors. Score = mean rank across FAR, FRR, Acc, $\mathrm{Hal}_{\mathrm{Gen}}$, JEq (lower = better). qwen3-32b: 4,817 rows vs 4,920 nominal due to export variation. Comparisons involving qwen3-32b on this subset should be interpreted with this row-count caveat.

#	Model	FAR	FRR	Acc	$\mathrm{Hal}_{\mathrm{Gen}}$	JEq	Sc.
1	gemma-debate	8.4	14.4	89.7	58.6	43.3	**2.4**
2	gpt-5.2	10.7	12.0	88.9	61.0	43.7	2.6
3	qwen3-32b	14.9	10.6	86.5	64.6	43.4	3.4
4	llama-3.3-70b	7.6	17.9	89.2	63.4	36.3	3.6
5	gemini-3-flash	19.1	4.5	85.4	66.2	46.8	3.8
6	gemma-base	15.4	15.8	84.5	64.8	41.8	5.2

The typed debate moves gemma-4-26B-A4B from last place (Score 5.2) to first (Score 2.4) on the matched subset (rank 1 under 4 of 5 weighting schemes; gpt-5.2 leads under recall-heavy weighting, App. E). The mechanism is fabrication filtering rather than content correction: false-positive extractions drop from 524 to 287 (-45%) while content contradictions move only 642 to 641 (-0.2%). The Skeptic can verify clause *existence* through absence-of-evidence reasoning, but is less effective at correcting *content* errors within genuinely

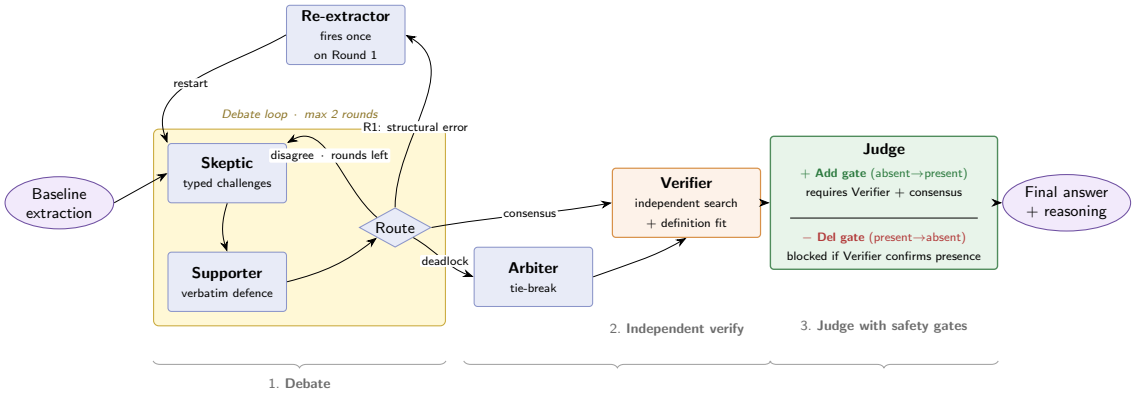

Figure 3. Typed debate pipeline, organised into three phases. **(1) Debate**: a Skeptic issues claim-type-specific challenges (Appendix C); a Supporter defends with verbatim contract quotes; a Route node directs traffic. If the Skeptic flags a structural error in Round 1, the Re-extractor fires once and the loop restarts. If agents disagree with rounds remaining, the loop continues; on deadlock, the Arbiter tie-breaks conservatively. **(2) Independent verify**: the Verifier searches the contract independently and checks definition fit. **(3) Judge with safety gates**: the Add gate (absent → present) requires both Verifier confirmation and debate consensus, blocking fabricated additions; the Del gate (present → absent) is blocked when the Verifier confirms presence, preventing erasure of correct findings. The asymmetry encodes the measured FAR > FRR profile from Experiment 1.

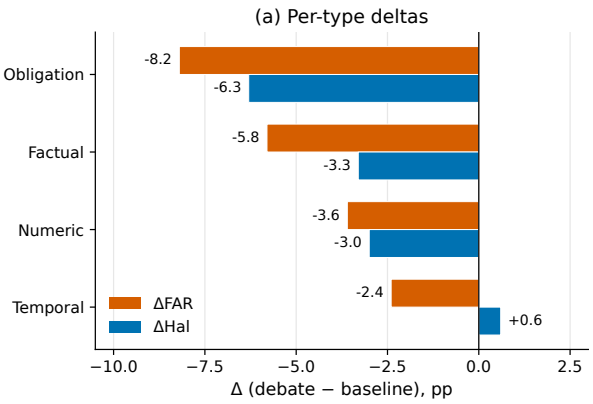

Figure 4. Per-type deltas from Experiment 2. Gains concentrate on obligation (ΔFAR $= -8.2$, $\Delta\text{Hal}_{\text{Gen}} = -6.3$) and factual ($\Delta$FAR $= -5.8$). Temporal Hal_{Gen} is essentially unchanged ($+0.6$ pp), consistent with temporal being the lowest-hallucination type at baseline. The calibrated intervention produces the per-type pattern predicted by Experiment 1. ΔHal in the legend denotes $\Delta\text{Hal}_{\text{Gen}}$

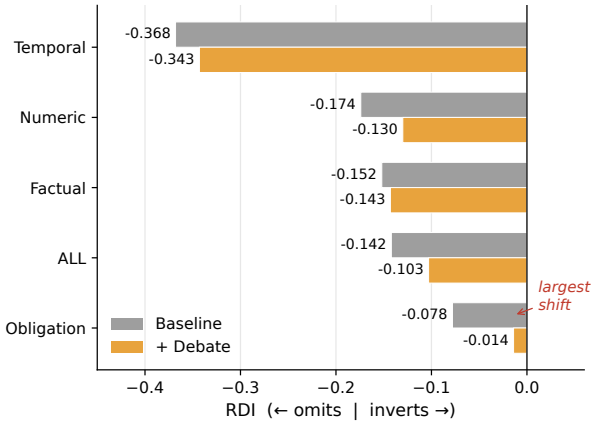

Figure 5. RDI shift for gemma-4-26B-A4B after applying the typed debate pipeline. The obligation category shows the largest correction ($-0.078 \rightarrow -0.014$, near-balanced). Skeptic challenges target missing conditions and carve-outs, addressing the omission bias Experiment 1 identified as the dominant obligation error direction.

present clauses because Extractor and Skeptic share the same parametric priors. This is consistent with (Huang et al., 2024) and calibrates deployment expectations: typed debate reduces fabrications but does not reliably repair what a present clause says.

Figure 4 validates the diagnostic predictions from Experiment 1. The typed intervention predicts that obligation and factual claims will show the largest gains (highest baseline FAR, with Skeptic challenges most directly targeted to their failure modes) and that temporal will show the smallest (lowest baseline FAR, and values that are difficult to fabricate verbatim). The observed deltas match this ordering: obligation ΔFAR $= -8.2$, factual ΔFAR $= -5.8$, numeric ΔFAR $= -3.6$, and temporal ΔFAR $= -2.4$. We specified this ordering before running the mitigation rather than reading it off the results, so the match provides evidence that the typed diagnosis is informative beyond the summary it supplies.

Two facts in Table 4 are decisive: gemma-debate clears the commercial frontier on composite score (2.4 vs gpt-5.2 at 2.6), and the gap between gemma-base (5.2) and gemma-debate (2.4) is the intervention's effect, holding the underlying model fixed.

The corresponding direction correction appears in the obligation RDI (Figure 5): typed Skeptic challenges targeting missing conditions, dropped carve-outs, and scope loss move gemma-4-26B-A4B from omission-heavy (-0.078) to near-balanced (-0.014) on obligation claims. The challenge questions were written to counteract omission bias before running Experiment 2, because Experiment 1 identified omission as the dominant obligation error direction; the observed shift is therefore the intended consequence of the calibration rather than an incidental effect.

8. Discussion

Deployment and governance implications. The $\sim$40 pp typed gap means any legal AI evaluation reporting only aggregate $\mathrm{Hal}_{\mathrm{TP}}$ averages a 29–35% failure rate on temporal claims alongside a 65–74% rate on claims determining liability thresholds and obligation scope. Two systems scoring identically on $\mathrm{Hal}_{\mathrm{TP}}$ can carry opposite risk profiles, a distinction RDI surfaces as a single comparable number. For compliance workflows where missed obligations create liability, a positive or near-zero RDI is the safer profile; for legal-operations settings where false positives consume review capacity, the ordering reverses. Typed profiles and RDI are derivable from any oracle-bounded legal corpus, supporting typed audits before deployment rather than relying on vendor-reported aggregate accuracy.

Scope. The typed profiles and RDI values reported here apply to CUAD-style English US commercial contracts. Whether the failure ordering transfers to other document types is an empirical question this paper does not resolve. What transfers is the auditing method: any legal task with a verifiable oracle can instantiate typed profiles and RDI, but resulting numbers will differ. Practitioners should commission task-specific audits rather than applying CUAD-derived thresholds to new contexts.

9. Conclusion

LegalHalluLens measures, on 249,252 clause-level instances across four models, a consistent $\sim$40 pp hallucination gap (range 38.0–40.6 pp across models) between obligation/numeric and temporal claims that aggregate evaluation conceals. Two models with matched $\mathrm{Hal}_{\mathrm{TP}}$ carry opposite risk profiles, operationalised by the Risk Direction Index. A typed debate pipeline reduces fabricated detections by 45%, with per-category gains tracking the prior diagnosis. The useful question for trustworthy legal AI deployment is not the model's aggregate accuracy but which claim types it fails on and, when it fails, in which direction.

Limitations

Numerical results apply to 510 English-US commercial contracts from CUAD; the typed failure ordering is consistent across four architectures, but generalisation across jurisdictions and document types remains to be verified. All experiments assume full-document context; for contracts exceeding model context windows, retrieval-augmented variants introduce additional failure modes orthogonal to those measured here. Experiment 2 uses one run with one backbone (gemma-4-26B-A4B) on a 120-contract subset; the composite ranking is evidence for that comparison only. Minimal-prompt and generic-debate ablations are direct extensions. Code, prompts, and analysis scripts will be released upon acceptance.

Judge dependence. All reported $\mathrm{Hal}_{\mathrm{TP}}$, $\mathrm{Hal}_{\mathrm{Gen}}$, and RDI numbers flow through a single LLM evaluation judge (gemini-2.5-flash) applying the rubric in Appendix A. The judge is held fixed and independent of every extractor evaluated, and we have framed RDI as a directional signal (§4.2) precisely because the absence of human-validated judge labels means small RDI differences should not be over-interpreted; large bootstrap-stable separations such as gpt-5.2 ($+0.161$) versus qwen3-32b (-0.202) lie well outside any plausible judge-noise band, but per-category RDI values close to zero warrant additional caution. Validating judge labels against expert annotation on a stratified sample is a direct extension that would tighten the cardinal interpretation of RDI without changing the directional ordering.

Impact Statement

Diagnostic, not clearance. Typed profiles provide finer resolution than aggregate rates, supporting model comparison, risk-aware deployment, and mitigation design. Even our best configuration contradicted the source in 58.6% of detected clause contents, so typed evaluation should inform, not replace, qualified human review in high-stakes legal workflows.

Direction-aware deployment. The RDI surfaces a systematic bias that aggregate metrics conceal. Compliance workflows (where missed obligations create liability) benefit from systems with a positive or near-zero RDI; legal-operations settings (where false positives consume review capacity) may prefer the opposite profile. The framework makes this trade-off legible.

Scope of evidence. Numerical results apply to CUAD-style English US commercial contracts. The methodology extends to any legal task with a verifiable source, but specific failure rates should be re-measured for each new deployment context. **LLM usage.** The authors used Claude Opus 4.6 and Claude Sonnet 4.6 (Anthropic) for writing assistance (drafting, polishing, grammar, literature reading)

and code assistance (scaffolding, debugging). Research design, methodology, and conclusions are the authors' own work; the authors take full responsibility for all content.

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A. Judge Prompt

The following is the verbatim prompt used by the external evaluation judge (gemini-2.5-flash, temperature = 0). It is applied identically across all four extraction backbones in Experiment 1 and across all six configurations in Experiment 2.

```
You are an expert legal contract verifier.

TASK:
Determine whether ANSWER 1 (AI) is semantically equivalent to
ANSWER 2 (Ground Truth) for the SAME clause and contract.

CLAUSE: {clause_name}

ANSWER 1 (AI Generated):
{ai_answer}

ANSWER 2 (Ground Truth):
{gt_answer}

DECISION CRITERIA (BE STRICT ON PRECISION):
Return "equivalent": true ONLY IF all of the following hold:
1) CORE FACTS MATCH: The same parties/actors,
   rights/obligations, and conditions are stated.
2) NUMERIC PRECISION MATCHES: Any amounts, percentages,
   thresholds, caps, quantities, and units (including time basis
   like per month/per year) are the same. Any mismatch
   => equivalent=false.
3) TEMPORAL PRECISION MATCHES: Any dates, durations, notice
   periods, renewal terms, survival periods, and timelines are
   the same. Any mismatch => equivalent=false.
4) MODALITY/POLARITY MATCHES: must/shall vs may, prohibited vs
   permitted, and any negation (not/unless/except) must match.
   Any mismatch => equivalent=false.
5) EXCEPTIONS/CARVE-OUTS: If either answer includes an exception,
   carve-out, or condition, the other must include the same
   exception/condition in substance.
   Otherwise => equivalent=false.

ALLOWABLE DIFFERENCES:
- Formatting, whitespace, and punctuation.
- Reordering of equivalent statements.
- Minor paraphrases that do not change any of the precise facts
  above.

OUTPUT (JSON ONLY):
Return ONLY a valid JSON object:
{
  "equivalent": true/false,
  "reason": "one short sentence",
  "mismatch_type": "none|numeric|temporal|obligation|scope|
                    missing_condition|extra_condition|other"
}

RULES:
- If either answer is empty or says "Not present" while the
```

```
  other contains content, equivalent=false.
- If the AI answer is a subset of the ground truth but misses a
  required condition/exception, equivalent=false.
- Do not add any extra text outside the JSON.
```

`missing_condition`: AI omits a carve-out or condition present in ground truth. `extra_condition`: AI asserts an obligation, condition, or qualifier absent from the source.

B. Extraction Prompt (abbreviated)

```
You are a legal AI assistant analyzing a commercial contract.
Use ONLY the provided contract text. No outside knowledge.

For EACH of the 41 CUAD clause types:
- If present: return ALL spans capturing the operative meaning,
  including exceptions, carve-outs, conditions, notice periods,
  and cross-references ("subject to","except","provided that").
- If not present: mark is_impossible=true, answer=[].

SELF-CHECK: Re-scan for additional conditions, numeric thresholds,
and cross-references before finalising output.

OUTPUT: JSON array of 41 items:
{ "clause_name": str, "is_impossible": bool, "answer": [str] }
Complete ALL 41. Temperature = 0.
```

B.1 Numeric Clause Definitions (verbatim)

The five numeric clause types are defined to the model with the following NOTE blocks specifying exclusions. These are referenced in §6 as evidence that pretraining priors override explicit prompt guidance.

```
"Cap On Liability": Does the contract include a cap on
liability upon the breach of a party's obligation? This
includes time limitation for the counterparty to bring claims
or maximum amount for recovery. NOTE: This requires an
explicit maximum amount or formula capping liability. A clause
that ONLY excludes certain types of damages (e.g. no
consequential damages) without stating a maximum liability
amount is typically not a Cap On Liability.

"Liquidated Damages": Does the contract contain a clause that
would award either party liquidated damages for breach or a
fee upon the termination of a contract? NOTE: The clause must
AWARD or SPECIFY a liquidated damages amount. A clause
EXCLUDING or DENYING liability for liquidated damages (e.g.
"no liability for liquidated damages") is the OPPOSITE - it is
NOT a Liquidated Damages clause.

"Minimum Commitment": Is there a minimum order size or minimum
amount or units per-time period that one party must buy from
the counterparty? NOTE: This includes purchase minimums, order
minimums, AND performance minimums. A recurring fixed service
fee where no minimum quantity is specified is less likely to
qualify.
```

```
"Volume Restriction": Is there a fee increase or consent
requirement if one party's use exceeds certain threshold?
NOTE: This is an explicit MAXIMUM CAP or threshold on
usage/quantity that triggers a fee or consent requirement.
Minimum purchase quotas are NOT Volume Restrictions.

"Price Restrictions": Is there a restriction on the ability
of a party to raise or reduce prices? NOTE: This restricts the
PRICING DISCRETION of a party - their ability to SET or CHANGE
prices. A payment cap or maximum payment amount is a PAYMENT
LIMIT, not a Price Restriction.
```

The remaining 36 clause definitions follow the same pattern.

C. Typed Skeptic Challenge Questions

Challenge questions are derived from the dominant failure mode per type identified in Experiment 1, not from general-purpose verification heuristics.

Numeric (5 types). Is this exact value stated verbatim in the contract, or is it a plausible prior assumption about common threshold values for this clause type? Is the unit of measurement explicit and correct (per month vs per year; USD vs percentage)? Is any cap, floor, or qualifier ("up to", "at least", "not to exceed") present in the contract but absent from the extraction?

Obligation/Entitlement (27 types). What is the exact modal verb in the contract (shall/must/may/should/will), does the extraction preserve it, or has it been upgraded or downgraded? Are ALL trigger conditions and antecedents that must occur before this obligation activates captured? Are there exceptions, carve-outs, or "provided that / except / unless" clauses in the text that the extraction omits? Is any geographic, temporal, or subject-matter scope limitation dropped?

Temporal (6 types). Is the date or duration stated explicitly and verbatim, or inferred from surrounding context? Is the notice period unit exact (30 days is not equivalent to one month)? Could this be a common boilerplate value assumed from prior rather than read from this specific contract?

Factual (3 types). Is this fact explicitly stated in the contract text, or is the model drawing on outside knowledge? Is the exact legal entity name used as it appears in the contract?

D. CUAD Clause-to-Category Mapping

Numeric (5): Cap on Liability; Minimum Commitment; Volume Restriction; Price Restrictions; Liquidated Damages.

Temporal (6): Agreement Date; Effective Date; Expiration Date; Renewal Term; Notice Period to Terminate Renewal; Warranty Duration.

Obligation/Entitlement (27): Non-Compete; Exclusivity; No-Solicit of Customers; No-Solicit of Employees; License Grant; IP Ownership Assignment; Joint IP Ownership; Non-Transferable License; Audit Rights; Insurance; Termination for Convenience; Post-Termination Services; Most Favored Nation; Competitive Restriction Exception; Non-Disparagement; Rofr/Rofo/Rofn; Change of Control; Anti-Assignment; Revenue/Profit Sharing; Affiliate License-Licensor; Affiliate License-Licensee; Unlimited/All-You-Can-Eat-License; Irrevocable or Perpetual License; Source Code Escrow; Uncapped Liability; Covenant Not to Sue; Third Party Beneficiary.

Factual (3): Document Name; Parties; Governing Law.

E. Robustness Analyses

This appendix reports robustness checks supporting claims in the main text. All analyses use the same data as Experiments 1 and 2.

E.1 Per-Run Variance (Experiment 1)

Standard deviations across the three independent runs are small relative to the within-model typed gap (38.0–40.6 pp), confirming that the typed ordering is a stable property rather than run noise.

Model	FAR	FRR	Acc	$\mathrm{Hal}_{\mathrm{TP}}$	JEq
gemini-3-flash	19.1 (0.1)	4.5 (0.0)	85.6 (0.0)	50.9 (0.0)	46.9 (0.0)
gpt-5.2	11.8 (0.2)	11.6 (0.1)	88.3 (0.1)	51.9 (0.4)	42.6 (0.3)
qwen3-32b	13.4 (0.4)	10.8 (0.3)	87.5 (0.2)	52.1 (0.6)	42.7 (0.7)
llama-3.3-70b	7.7 (0.1)	18.0 (0.1)	89.0 (0.1)	56.5 (0.2)	35.7 (0.2)

Mean (SD) across 3 runs. Largest SD on $\mathrm{Hal}_{\mathrm{TP}}$ is 0.6 pp. Per-category $\mathrm{Hal}_{\mathrm{TP}}$ SDs are ≤ 2.4 pp (largest: gpt-5.2 numeric). All within-model typed gaps remain ≥ 36 pp at the 1-SD bound.

E.2 RDI Bootstrap CIs by Category

95% bootstrap confidence intervals (2,000 resamples) over all runs pooled. Aggregate (ALL) intervals appear in §6.3; the typed breakdown shows the directional separation holds within the dominant Obligation category, where the ordering is deployment-relevant.

Model	RDI [95% CI]	Category
gpt-5.2	$+0.220$ $[+0.207, +0.234]$	obligation
gemini-3-flash	$+0.018$ $[+0.004, +0.031]$	obligation
llama-3.3-70b	-0.198 $[-0.210, -0.186]$	obligation
qwen3-32b	-0.181 $[-0.194, -0.168]$	obligation

E.3 Composite Rank Sensitivity

Composite Score (§7) uses equal weights across FAR, FRR, Acc, $\mathrm{Hal}_{\mathrm{Gen}}$, JEq. Robustness across alternative weightings:

Scheme	gemma-debate	gpt-5.2	gemma-base
Equal (1:1:1:1:1)	**1**	2	6
FP-heavy (2:1:1:2:1)	**1**	2	6
Recall-heavy (1:2:1:1:2)	2	**1**	6
Halluc-only (0:0:0:1:0)	**1**	2	5
Detection-only (1:1:1:0:0)	**1**	2	6

gemma-debate ranks first under 4 of 5 schemes; gpt-5.2 leads under recall-heavy weighting. The intervention's improvement over gemma-base (rank 5–6 in every scheme) is robust to weighting.

E.4 Missing-Row Attribution

Per-run row counts vs. the nominal 20,910 per run:

Model	Run 1	Run 2	Run 3
gemini-3-flash	20860	20860	20860
gpt-5.2	20910	20910	20869
qwen3-32b	20417	20771	20348
llama-3.3-70b	20843	20802	20802

For qwen3-32b (the largest variation): 5 contracts are incomplete in all 3 runs; 58 contracts are incomplete in any run; persistent fraction 8.6%. Variation is contract-correlated, not random, a small set of inputs the model consistently fails to process under temperature $= 0$ API calls.

E.5 Obligation Subtype Profiles

The Obligation/Entitlement category aggregates 27 CUAD types. Mean $\mathrm{Hal}_{\mathrm{TP}}$ across all four models, by subtype:

Subtype	$\mathrm{Hal}_{\mathrm{TP}}$	Subtype	$\mathrm{Hal}_{\mathrm{TP}}$
Post-Termination Services	88.6	Change of Control	68.3
Affiliate License-Licensor	85.1	Uncapped Liability	66.1
Source Code Escrow	84.1	Joint IP Ownership	63.6
IP Ownership Assignment	80.5	Non-Compete	62.2
Revenue/Profit Sharing	79.3	Covenant Not to Sue	61.1
Exclusivity	79.1	Irrev./Perpetual License	60.5
Affiliate License-Licensee	79.0	No-Solicit of Customers	57.4
Audit Rights	77.2	Anti-Assignment	56.5
Competitive Rest. Except.	76.9	No-Solicit of Employees	54.1
Non-Transferable License	74.2	Most Favored Nation	48.3
Unlimited/All-You-Can-Eat	73.0	Third Party Beneficiary	42.9
License Grant	71.6	Termination for Conv.	42.7
Non-Disparagement	69.1		
Rofr/Rofo/Rofn	69.0		
Insurance	68.8		

Range 42.7–88.6%; within-bucket SD 12.4 pp. Even the lowest obligation subtype (42.7%) lies above the temporal category mean (29.0–35.1%), confirming the typed gap survives intra-bucket heterogeneity.

E.6 Debate Pipeline Overhead

Cost proxy for the typed debate pipeline (Experiment 2, gemma-4-26B-A4B, 4,920 clause-level decisions):

Statistic	Value	Note
Mean rounds	1.12	max = 2
Median rounds	1	87.9% finish in R1
% detections changed	12.8	flips at gates
Skeptic–Supporter consensus	99.94%	
Stability (1.0)	90.6%	remaining 9.4% partial

Per-type flip rates: factual 4.2%, temporal 9.9%, numeric 13.8%, obligation 14.2% , consistent with the per-category ΔFAR ordering in Figure 4. Mean rounds-per-type span only 1.10–1.20, indicating that the calibrated benefit comes from *which* clauses are flipped rather than from extended deliberation.