Lesson 09 — Voting Systems & DAO Governance

Study Notes

Cryptoeconomics — BSc Level

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Contents

Learning Objectives

By the end of this lesson, students should be able to:

1. **Explain** the design goals of blockchain voting systems and articulate the core tension between Sybil resistance, fairness, and simplicity.
2. **Calculate** voting power under token-weighted, quadratic, conviction, and veToken systems given numerical inputs.
3. **Compare** the trade-offs of on-chain versus off-chain voting platforms (Tally vs. Snapshot).
4. **Describe** the typical structure of a DAO governance process, including proposals, quorum, timelock, and multisig treasury.
5. **Analyse** Sybil resistance mechanisms and explain why identity verification is critical for quadratic voting.
6. **Evaluate** the voter participation problem in DAOs and propose incentive structures to improve turnout.

Voting System Design Goals

Core Design Properties

The Voting Trilemma

No single on-chain voting mechanism fully achieves all three of the following properties simultaneously:

1. **Sybil Resistance**: One person (or entity), one meaningful unit of influence. Fake or duplicate identities must not be able to amplify voting power cheaply.
2. **Fairness**: Equal opportunity to influence outcomes, independent of wealth. Plutocratic systems (1 token = 1 vote) fail this criterion by definition.
3. **Simplicity**: The system must be comprehensible and accessible to ordinary users; complexity depresses participation.

Beyond the core trilemma, practical governance systems must also address:

- **Participation rate**: Typical DAO governance sees 5–15% of eligible token holders voting. A legitimate decision requires a sufficient quorum.
- **Manipulation resistance**: Flash loan attacks (borrow tokens, vote, repay in a single transaction) defeated by snapshot-based voting or time-locks. Vote-buying markets must be economically unattractive.
- **Gas costs**: On-chain voting on Ethereum L1 may cost $10–100 per vote, effectively disenfranchising small holders.

- **Speed**: Decentralised consensus is inherently slower than centralised decision-making. Emergency governance mechanisms are needed for critical security patches.

The Gini Coefficient for Voting Power

A useful tool for measuring plutocracy in a token governance system is the **Gini coefficient**, borrowed from income inequality analysis:

$$G = \frac{2\sum_{i=1}^{n} i \cdot \mathrm{VP}_i}{n\sum_{i=1}^{n} \mathrm{VP}_i} - \frac{n+1}{n}$$

where VP_i denotes the voting power of participant i sorted in ascending order, and n is the total number of voters.

$G = 0$ means perfect equality; $G = 1$ means one entity holds all voting power. Empirical Gini coefficients for major DAOs typically lie in the range 0.85–0.95 under simple token voting, indicating extreme concentration.

Token-Weighted Voting

Mechanics

1 Token

Each token holder receives voting power proportional to their token balance at a specified snapshot block:

$$\mathrm{VotingPower}(\mathrm{user}) = \mathrm{tokenBalance}[\mathrm{user}]$$

Votes are tallied; the option with the majority (or supermajority, depending on the quorum rule) wins.

Implementation is straightforward: most governance frameworks (OpenZeppelin Governor, Compound GovernorBravo) implement token-weighted voting as the default. Snapshot block prevents flashloan manipulation.

Plutocratic Criticism and Whale Concentration Data

Token-weighted voting is inherently plutocratic: wealth directly converts to governance power with no diminishing returns. Empirical data from major DAOs (source: DeepDAO, Tally):

Protocol	Top-10 addresses' share	Gini (approx.)
Uniswap	≈ 50% of delegated votes	0.91
MakerDAO	≈ 60% of MKR votes	0.93
Compound	≈ 45% of COMP votes	0.89

Key implications:

- A small coalition of whales (large token holders) can pass any proposal unilaterally.
- Venture capital firms with early token allocations often hold permanent governance majorities.
- Small holders are rationally apathetic: the marginal impact of their vote approaches zero, but the gas cost is fixed.

Example: MakerDAO Governance Concentration

In multiple critical MakerDAO votes (2020–2022), a single address (a16z's allocation) held sufficient MKR to determine the outcome unilaterally. This prompted ongoing community debate about whether MakerDAO is meaningfully decentralised or effectively controlled by its largest VC investor.

Quadratic Voting

The Cost Function $c(v) = v^2$

Quadratic Voting (QV) was proposed by Posner and Weyl (2018) as a mechanism that reveals preference *intensity* while limiting plutocratic power.

Quadratic Voting Mechanism

Each voter receives a budget of **voice credits**. To cast v votes on a proposal, a voter must spend v^2 voice credits:

$$c(v) = v^2$$

A voter with 100 voice credits can cast at most 10 votes on a single proposal ($10^2 = 100$), or spread them across multiple proposals.

The marginal cost of the k-th vote is $2k - 1$ credits, which is increasing — each additional vote costs more than the previous. This creates a natural brake on concentrated voting.

Mathematical Properties

- **Optimal spending**: Under QV, a rational voter casts votes until the marginal benefit of one more vote equals its marginal cost of $2v - 1$ credits. This leads voters to reveal true preference

intensity.

- **Comparison with 1-token-1-vote**: In standard token voting, doubling your tokens doubles your votes (linear). In QV, doubling your voice credits increases your maximum votes by $\sqrt{2} \approx 1.41$ (square-root relationship). A voter with $4\times$ the credits has only $2\times$ the votes.
- **Social optimality**: Weyl and Lalley (2018) prove that QV converges to efficient outcomes as the number of voters grows, unlike simple majority voting which ignores preference intensity.

Votes cast (v)	Total cost (v^2)	Marginal cost	Remaining (from 100)
1	1	1	99
3	9	5	91
5	25	9	75
7	49	13	51
9	81	17	19
10	100	19	0

Quadratic Funding

A closely related concept is **Quadratic Funding** (QF), used in Gitcoin Grants:

$$\text{Match for project } p = \left(\sum_i \sqrt{c_{i,p}}\right)^2 - \sum_i c_{i,p}$$

where $c_{i,p}$ is contributor i's direct donation to project p. The matching formula means that *breadth of support* (many small contributors) is rewarded more than a single large donation.

Example: Gitcoin Grants Round 19

A public goods project received 500 small donations averaging \$5 (total \$2,500) vs. a competing project with a single \$50,000 donation. Under QF with a \$1M matching pool, the project with broad community support received a far larger match because $\left(500 \times \sqrt{5}\right)^2 \gg \left(\sqrt{50{,}000}\right)^2$. This directly demonstrates the mechanism's power to surface genuine community preference.

Conviction Voting

Accumulation Formula and Time-Decay

Conviction Voting replaces periodic discrete votes with a *continuous* preference signal that accumulates over time.

Conviction Voting Formula

$$C(t) = C(t-1) \times \alpha + \text{tokens} \times (1 - \alpha)$$

where:

- $C(t)$ = conviction at time t (measured in blocks or days).
- $\alpha \in (0, 1)$ = decay factor (commonly 0.9).
- tokens = tokens allocated to the proposal by all supporters.

A proposal passes when $C(t)$ exceeds a threshold that decreases with the requested amount relative to the total funding pool.

Key dynamics:

- Starting from zero, conviction grows toward $\dfrac{\text{tokens}}{1-\alpha}$ asymptotically. With $\alpha = 0.9$, maximum conviction is $10 \times$ tokens.
- Half-life: the number of periods required for conviction to halve is $t_{1/2} = \ln(2)/\ln(1/\alpha) \approx 6.6$ periods for $\alpha = 0.9$.
- **Flash attack resistance**: Depositing tokens just before a vote does not immediately grant high conviction; sustained support is required.

Aragon Implementation

Conviction Voting was implemented as a Celeste (Aragon) module and deployed by the 1Hive Gardens community (Honey token governance):

- Proposals request funds from a shared treasury.
- Any token holder can allocate tokens to proposals in any proportion; conviction accumulates continuously.
- There is no fixed voting period — proposals pass when conviction is sufficient, making governance *asynchronous*.
- Funds are released automatically by smart contract once the threshold is reached.

veToken Governance

Lock Period and Voting Power

The veToken model (vote-escrowed token) was pioneered by Curve Finance with its veCRV mechanism. Token holders voluntarily lock tokens for a fixed period in exchange for governance power:

veToken Voting Power

$$\text{VotingPower} = \text{tokens} \times \frac{t_{\text{remaining}}}{t_{\max}}$$

where $t_{\text{remaining}}$ is time remaining in the lock, and $t_{\max}$ is the maximum allowed lock period (typically 4 years).

Lock Duration	$t_r/t_{\max}$	**VP (100 tokens)**	**Annual yield boost**
4 years (max)	$4/4 = 1.00$	100	Up to 2.5×
3 years	$3/4 = 0.75$	75	$\sim 1.9\times$
2 years	$2/4 = 0.50$	50	$\sim 1.5\times$
1 year	$1/4 = 0.25$	25	$\sim 1.2\times$
3 months	$0.25/4 \approx 0.06$	6	Minimal

Decay Curve

Voting power *decays linearly* as the lock expiry approaches. A holder who locks for 4 years and does not renew will see their veCRV decay to zero by expiry. This is intentional: it ensures governance power remains with *currently committed* participants, not long-past lockers.

Curve Finance Case Study

Curve Finance (DEX for stablecoin swaps, launched 2020) is the canonical veToken governance example:

- CRV token holders lock for up to 4 years to receive veCRV.
- veCRV holders direct CRV emissions (gauge weights) to specific liquidity pools — controlling which pools receive the most protocol rewards.
- This created the **Curve Wars**: protocols such as Convex Finance, Stake DAO, and others accumulated veCRV to direct emissions toward their own pools, creating a meta-governance layer.
- Convex Finance aggregates veCRV from many users and votes on their behalf, effectively becoming the largest single veCRV holder ($> 50\%$ of veCRV as of 2024).

Example: The Curve Wars in Practice

Protocol A wants to attract stablecoin liquidity. It buys CRV, locks it for veCRV, and votes to direct emissions to Pool A. Liquidity providers (LPs) in Pool A earn more CRV rewards. More LPs join. TVL increases. This positive feedback loop made gauge-weight control extremely valuable — bribes on Votium/Hidden Hand to veCRV holders reached tens of millions of dollars per epoch, demonstrating that governance rights can themselves be traded commodities.

Reputation-Based Systems

Non-Transferable Reputation

Reputation-based governance decouples voting power from token wealth, granting influence based on *contribution history*:

- Voting power is typically **soulbound**: it cannot be transferred, sold, or delegated. It is tied to a specific Ethereum address (or off-chain identity).
- Reputation is earned through protocol-specific actions: attending governance calls, submitting code, writing proposals, providing verified expertise.
- The square-root formula $\text{VP} = \sqrt{\text{Reputation}}$ is often applied to prevent runaway inequality among long-term contributors.

Earned Governance and Optimism Citizens' House

Optimism (OP Mainnet) pioneered a **bicameral governance** model:

- **Token House**: Standard token-weighted voting for protocol changes (OP token holders).
- **Citizens' House**: Reputation-based body responsible for *Retroactive Public Goods Funding (RPGF)* — allocating grants to projects that have already created value for the ecosystem.
- Citizens hold non-transferable "Citizen Attestations" (EAS-based) granted by the Optimism Foundation and community.
- RPGF Round 3 (2023) allocated $30M+ across 501 projects, decided entirely by Citizens' House vote.

The rationale: existing impact is easier to evaluate than promised future impact. Retroactive funding creates incentive compatibility — builders invest in genuine value creation because they can be rewarded after the fact.

On-Chain vs Off-Chain Voting

Snapshot: Gasless Off-Chain Voting

Snapshot.org

Snapshot is an off-chain, gasless voting platform used by >33,000 DAO spaces. Votes are **cryptographically signed messages** stored on IPFS, not Ethereum transactions. Token balances are verified at a specified snapshot block but no gas is consumed to vote.

Key features:

- Supports 50+ voting strategies (token balance, delegated balance, quadratic, NFT gating, multi-token weighted).

- Results are verifiable by anyone (IPFS-stored vote data) but *not automatically binding* — execution requires manual or automated on-chain follow-up.
- Free to vote; cost to create a space is minimal (requires ENS name).
- Used by Uniswap, Aave, ENS, Gitcoin, Yearn, and the vast majority of major DAOs for signalling and non-critical votes.

Limitation: Off-chain votes can be ignored. There is no trustless mechanism forcing the core team or multisig to implement the result of a Snapshot vote.

Tally: On-Chain Execution

Tally is a governance front-end for fully on-chain governance contracts (OpenZeppelin Governor, Compound GovernorBravo):

- Votes are Ethereum transactions; every vote costs gas.
- Approved proposals are automatically executed by the Governor contract after the timelock period, requiring no manual action from any party.
- On-chain voting is *binding*: the protocol executes exactly what was approved.
- Used for critical decisions: treasury transfers, protocol parameter changes, smart contract upgrades.

Trade-offs Summary

Property	**Snapshot (Off-Chain)**	**Tally (On-Chain)**
Cost to vote	Free	$5–100 in gas
Binding execution	Manual/optional	Automatic (trustless)
Censorship resistance	Moderate (IPFS)	High (Ethereum)
Sybil resistance	As good as token	As good as token
Speed	Instant	Delayed (timelock)
Typical use	Signal/temperature	Protocol changes

Best practice: Use Snapshot for community signalling and non-critical governance; use on-chain Governor for binding protocol actions.

DAO Organisational Structure

Proposals

A governance proposal typically passes through the following stages:

1. **Temperature Check / Forum Discussion**: Posted on Discourse or Commonwealth; informal discussion to gauge community sentiment. No token commitment required.

2. **Snapshot Signal Vote**: Gasless off-chain vote to confirm community support before on-chain submission. Often required to pass a simple majority threshold.
3. **On-Chain Proposal**: Author submits calldata specifying exact contract calls to be executed if the proposal passes. Proposal is live for the voting period.
4. **Voting Period**: Token holders vote For / Against / Abstain. Typically 3–7 days.
5. **Quorum Check**: Minimum participation threshold must be met (e.g., 4% of total supply must vote For in Uniswap governance).
6. **Timelock**: If passed, the execution is delayed by a fixed period (often 24–72 hours) allowing users to exit before a potentially harmful change takes effect.
7. **Execution**: The Governor or multisig executes the approved calldata.

Quorum Requirements

Quorum prevents governance capture by a tiny minority when most holders are inactive:

- **Absolute quorum**: A fixed number of tokens must vote (e.g., 400,000 UNI for Uniswap). Disadvantage: inflation or token lockups can make quorum permanently unachievable.
- **Relative quorum**: A percentage of *circulating* supply must participate. More robust to token supply changes.
- **Adaptive quorum**: Threshold adjusts based on historical participation (used by some Optimism proposals).

Timelock

Timelock Contract

A timelock contract delays execution of governance-approved actions by a fixed period (the *delay*, typically 24 hours to 7 days). During this window, users can:

- Review the pending action.
- Exit positions or withdraw funds if they disagree.
- Trigger a guardian veto if the action is clearly malicious.

A 48-hour timelock is the minimum generally considered sufficient for users to react to a governance attack. Compound's 2-day timelock became the de facto industry standard after it was deployed in 2020.

Multisig Treasury

Most DAOs hold treasury funds in a **Gnosis Safe multisig** (now called Safe) — an m-of-n multi-signature wallet:

- Requires m signers from a set of n trusted addresses to execute any transaction.
- Common configurations: 4-of-7 or 5-of-9 for large treasuries.
- Signers are typically elected via governance or appointed by the founding team during early stages.
- The multisig sits *beneath* the timelock in the execution stack, adding a human checkpoint before funds move.

Delegation and Liquid Democracy

Representative Selection

Liquid Democracy

Liquid democracy is a hybrid between direct democracy (every person votes on every issue) and representative democracy (elected representatives vote on your behalf). In the liquid variant:

- You may **vote directly** on any proposal.
- You may **delegate** your votes to a representative.
- Delegation is **transitive**: your delegate can re-delegate.
- Delegation is **revocable** at any time.

In blockchain governance, delegation is implemented via the `delegate(address)` function in ERC-20-compatible governance tokens (ERC-20Votes in OpenZeppelin). Delegated tokens are counted at the representative's address in voting power calculations.

Gitcoin and ENS Delegation

Two prominent examples of delegation ecosystems:

Gitcoin DAO (GTC):

- Launched a *Steward programme*: elected contributors who accept delegation, publish voting rationales, and engage with the community.
- Steward performance tracked by a Health Card (participation rate, communication score, on-chain activity).
- Delegation encourages participation without requiring every token holder to follow governance actively.

ENS DAO:

- ENS launched an explicit *delegate application* process: potential delegates published platforms on the ENS forum.
- Top 100 delegates control a substantial majority of delegated votes.

- ENS governance has maintained unusually high participation relative to peer DAOs, partly attributed to active delegate culture.

Sybil Resistance Mechanisms

The Sybil Problem in Governance

A **Sybil attack** in governance occurs when an adversary creates multiple pseudonymous identities (wallets) to amplify voting power beyond their true stake. This is the central vulnerability of any identity-sensitive voting scheme like quadratic voting.

- In token-weighted voting, Sybil attacks are economically pointless: splitting 1,000 tokens across 10 wallets yields the same total votes.
- In quadratic voting with voice credits distributed per wallet, splitting yields $10 \times \sqrt{100} = 100$ votes vs. $\sqrt{1000} \approx 31.6$ votes from a single wallet — a 3.2× amplification.
- Strong Sybil resistance therefore requires binding one governance identity to one real-world person.

Proof of Humanity

Proof of Humanity (PoH) is an on-chain registry of verified humans:

- Submitters record a video and deposit ETH.
- Existing registered humans vouch for new entrants.
- Disputes resolved by Kleros decentralised court.
- Registered profiles are *non-transferable* and *unique per person* (enforced socially, not cryptographically).
- Used as a Sybil-resistance primitive in some QV deployments and Universal Basic Income experiments (UBI token).

Social Graphs

Graph-based Sybil resistance analyses the *connection structure* between wallet addresses to infer human uniqueness:

- **Gitcoin Passport**: Aggregates identity signals (Twitter, GitHub, ENS, Proof of Humanity attestations, Google sign-in) into a passport score. Higher scores receive higher trust weighting in quadratic funding rounds.
- **BrightID**: A social graph application where real human connections are made in video calls; a trust graph is used to detect and exclude Sybil clusters.
- **Worldcoin**: Iris-scan biometric registration to produce a "World ID"; the most aggressive Sybil resistance approach, raising significant privacy concerns.

Quadratic Costs as Sybil Deterrence

Even without identity verification, QV makes Sybil attacks *more expensive*:

- An attacker with N tokens allocated to k wallets maximises votes by splitting evenly. Total votes: $k \times \sqrt{N/k} = \sqrt{Nk}$.
- The attacker therefore benefits from creating more identities, but each additional identity requires additional on-chain setup costs (gas, time, wallet management).
- With sufficiently high per-identity costs (e.g., requiring staked collateral), the marginal benefit of more Sybil accounts approaches zero.

Voter Participation Problem

Typical 5–15% Turnout

DAO governance suffers from a severe participation problem:

Protocol	Eligible holders	Typical turnout	Active delegates
Uniswap	∼300,000 addresses	5–10%	∼200
Compound	∼180,000 addresses	8–15%	∼150
ENS DAO	∼50,000 addresses	10–20%	∼100
MakerDAO	∼80,000 addresses	5–12%	∼50

Causes of low participation:

- **Rational apathy**: Individual impact is negligible in token systems dominated by large holders.
- **Information cost**: Understanding complex protocol proposals requires deep technical knowledge.
- **Gas cost**: On Ethereum L1, a vote costs real money; small holders skip non-critical votes.
- **Voter fatigue**: Active DAOs run multiple proposals per week; sustained engagement is cognitively demanding.

Incentive Structures to Improve Turnout

Several mechanisms have been proposed or deployed:

- **Voting rewards**: Direct token or points rewards for participation (Synthetix, some Optimism programs). Risk: incentivises empty "Yes" votes rather than informed participation.
- **Delegation programs**: Reducing the burden on individual holders by routing votes through informed delegates (Gitcoin Stewards, ENS Delegates).

- **Off-chain gas-free voting**: Snapshot removes the gas barrier, significantly improving retail participation.
- **Adaptive quorum**: Lowering quorum thresholds for lower-stakes proposals reduces the chance of quorum failure.
- **Gamification**: Governance participation NFTs, on-chain attestations, and leaderboards create social incentives.
- **Conviction Voting**: Removes the need for active periodic participation by using continuous, asynchronous preference signals.

Common Pitfall

Misconception: "Higher participation always means better governance."
Correction: Uninformed participation (voting based on superficial signals or token rewards) can be worse than low participation by informed holders. The goal is *informed participation*, not maximum headcount. Delegation is generally superior to indiscriminate participation incentives because it routes influence toward those willing to invest in understanding the issues.

Practice Problems

1. **(Quadratic Voting Calculation)** A voter receives 144 voice credits for a Gitcoin Grants round. They want to vote on three projects: Project A (strong preference), Project B (moderate), Project C (weak).
   (a) If they spend all credits on Project A, how many votes do they cast?
   (b) If they split: 100 credits on A, 36 on B, and 8 on C, how many votes does each project receive from this voter?
   (c) Another voter has 9× more credits (1,296). If they spend all on Project A, how many more votes does that voter cast compared to the first voter's all-in option? Compare with what simple 1-credit-1-vote would give.
2. **(veToken Calculation)** A holder has 1,000 CRV tokens and is choosing between two lock strategies before a critical gauge weight vote: (a) lock all for 4 years, or (b) lock 500 tokens for 4 years and keep 500 unlocked.
   (a) Calculate veCRV for each strategy.
   (b) After 1 year elapses without renewal, what is the remaining veCRV in strategy (a)?
   (c) What is the breakeven lock duration at which both strategies yield equal veCRV?
3. **(Conviction Voting)** A proposal is submitted to 1Hive Gardens. The conviction threshold is 1,000 conviction units. 500 tokens are staked on the proposal. Using $\alpha = 0.9$, starting from $C(0) = 0$:

(a) Calculate $C(1)$, $C(2)$, $C(5)$, and $C(10)$.

(b) What is the maximum conviction this proposal can ever reach?

(c) After how many periods will conviction first exceed 500 (the halfway point to threshold)?

4. **(Governance Scenario)** A DAO is deciding whether to redirect 10% of its treasury to fund community development grants. Token supply: 1 billion tokens. Quorum requirement: 4% of total supply must vote "For". Current on-chain proposal has the following votes after 48 hours: For: 38 million, Against: 4 million, Abstain: 2 million.

   (a) Does the proposal currently meet quorum?

   (b) If there are 36 hours left in the voting period, what is the minimum additional "For" votes needed to reach quorum?

   (c) The treasury contains \$50M. The proposal passes. Describe the governance execution steps from proposal approval to funds being available (assume a 48-hour timelock and 4-of-7 multisig).

5. **(Sybil Attack Analysis)** A quadratic voting system distributes 100 voice credits to each registered wallet. An attacker controls \$10,000 worth of assets and can create new Sybil wallets at a cost of \$50 each (gas + setup time). Each wallet receives 100 credits.

   (a) With 1 wallet, how many votes can the attacker cast if they spend all credits on one proposal?

   (b) With 100 wallets (\$5,000 total cost), how many total votes on a single proposal?

   (c) What does this reveal about the importance of per-identity costs in QV systems?

Key Takeaways

1. **No perfect voting system**: Every mechanism trades off Sybil resistance, fairness, and simplicity. Matching the mechanism to the governance context is more important than searching for a universal optimum.

2. **Token-weighted voting** is simple and plutocratic. Gini coefficients of 0.9+ are typical in major DAOs, meaning a handful of addresses dominate decisions.

3. **Quadratic voting** ($c(v) = v^2$) reduces plutocracy by making concentrated voting expensive. Its effectiveness depends entirely on Sybil resistance — without identity, it degrades to token voting.

4. **Conviction voting** uses continuous time-weighted accumulation ($C(t) = \alpha C(t-1) + \text{tokens}(1-\alpha)$) to reward sustained support and resist flash attacks, at the cost of slower decisions.

5. **veToken governance** ties voting power to lock duration ($\text{VP} = \text{tokens} \times t_r/t_{\max}$), aligning governance power with long-term commitment. Curve Finance and the "Curve Wars" demonstrate how this creates valuable, tradeable governance rights.

6. **Reputation-based systems** (Optimism Citizens' House) decouple influence from wealth by granting non-transferable soulbound governance power to verified contributors. Best suited for grant allocation and public goods decisions.
7. **On-chain voting** (Tally/Governor) is binding and trustless but costs gas. **Off-chain voting** (Snapshot) is free and accessible but not automatically enforceable. Best practice combines both.
8. **DAO structure**: Proposals flow through forum discussion, Snapshot signal, on-chain vote, quorum check, timelock delay, and multisig execution — each stage adding security at the cost of speed.
9. **Delegation** (Gitcoin, ENS) allows passive holders to route voting power to informed representatives, improving governance quality without demanding active participation from all token holders.
10. **Voter participation** typically ranges from 5–15% in major DAOs. Root causes include rational apathy, information costs, gas costs, and voter fatigue. Informed participation via delegation is generally superior to uninformed mass participation.

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