Is Sortition both Representative and Fair?





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Outline

- Intro. to Sortition
  - Based on *“Democracy and the pursuit of randomness”* by Ariel Procaccia [1]

[1] Link: https://www.youtube.com/watch?v=e7FwWfUcZTg

Outline

- Intro. to Sortition
  - Based on *"Democracy and the pursuit of randomness"* by Ariel Procaccia [1]
- Fairness and Representation in Sortition
  - Definitions
  - Dichotomy
  - (A bit of) Algorithms and Analysis
- Trade-off between Fairness and Representation

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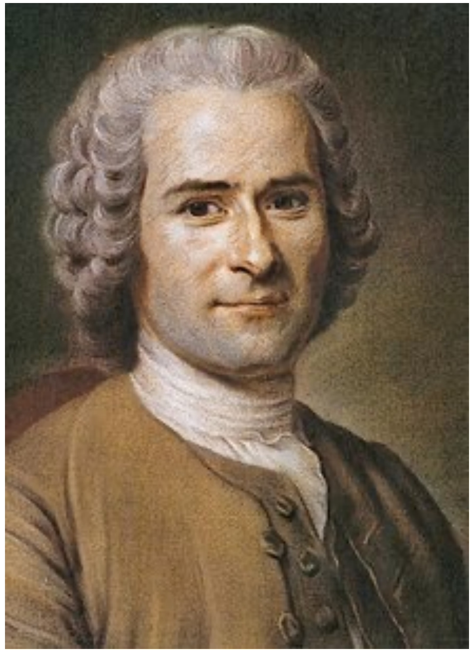
Jean-Jacques Rousseau (1762) *

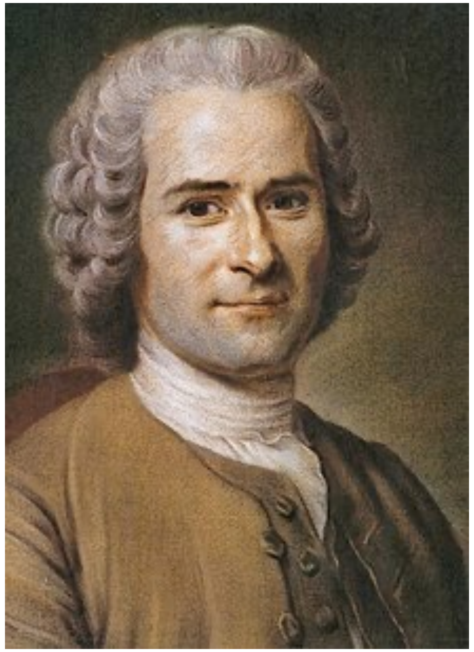
“The people of England deceive themselves when they fancy they are free; they are so, in fact, only during the election of Members of Parliament:



* *“Democracy and the pursuit of randomness”* by Ariel D. Procaccia

Jean-Jacques Rousseau (1762) *

"The people of England deceive themselves when they fancy they are free; they are so, in fact, only during the election of Members of Parliament: for, as soon as a new one is elected, they are again in chains, and are nothing."



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Alternative: *Sortition*

Democracy built on random selection of representatives

Credit: Oivind Hovland/Ikon/Getty

History *

462-322 BC

Ancient Athens:
Council of 500
and magistracies
chosen by lotteries

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21st Century

Worldwide:
Citizen’s assemblies organized by local and national governments

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Recent Examples *

	Ireland (2016, 2019)	France (2019)	Mongolia (2017)	Chile (2020)
Participants:	99	150	669	400
Topic:	Constitution	Climate	Constitution	Pension, Health

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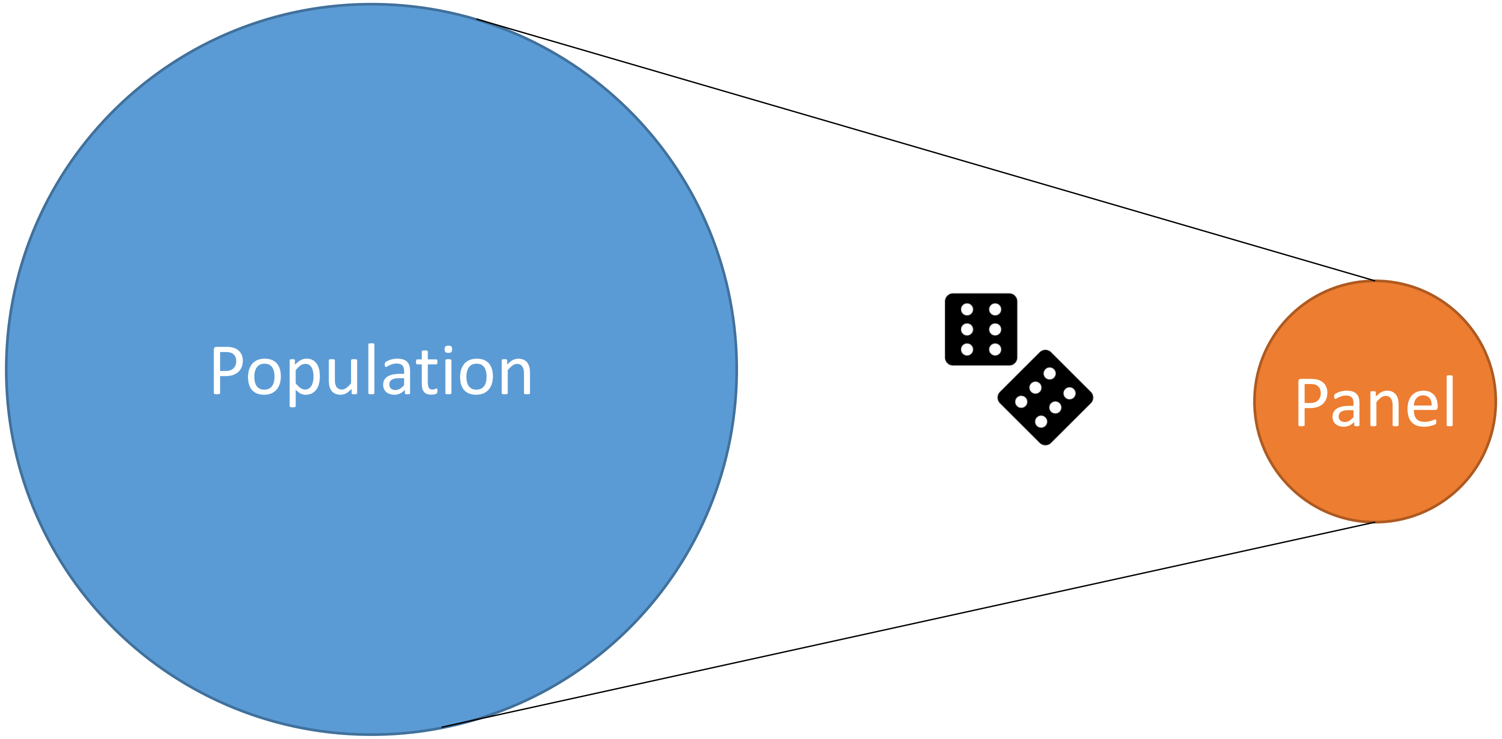
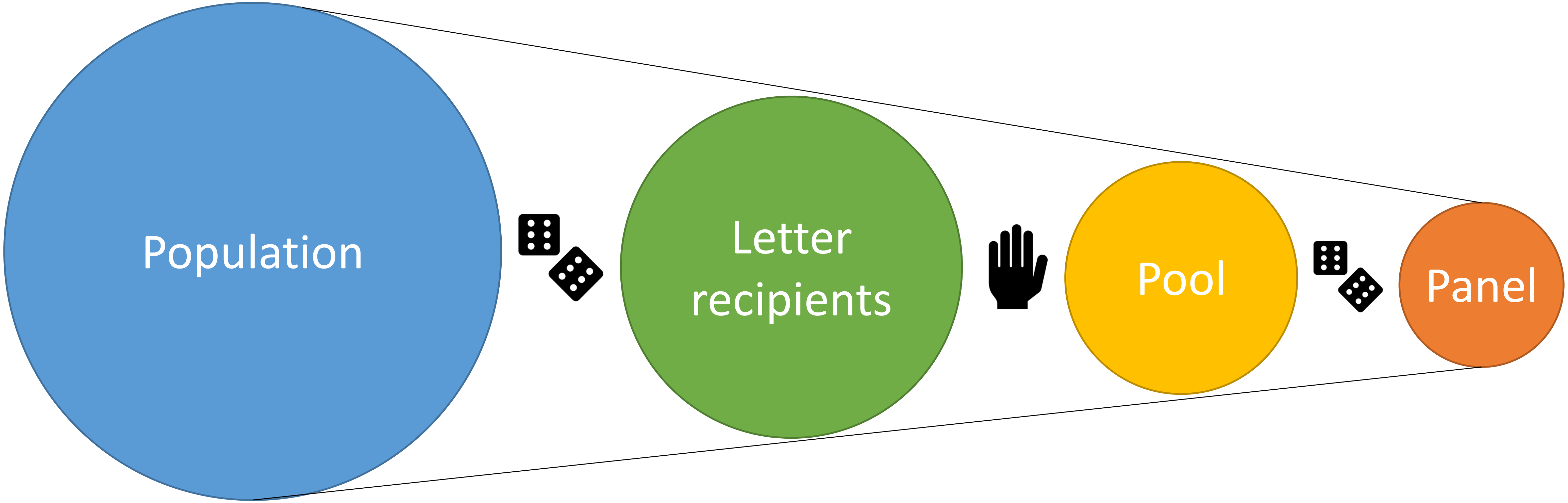
Uniformly Random Selection



Pipeline in Practice *



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Pipeline in Practice *

Fair Algorithms for Selecting Citizens' Assemblies (Nature, 2021)
Bailey Flanigan, Paul Gölz, Anupam Gupta, Brett Hennig, and Ariel D. Procaccia

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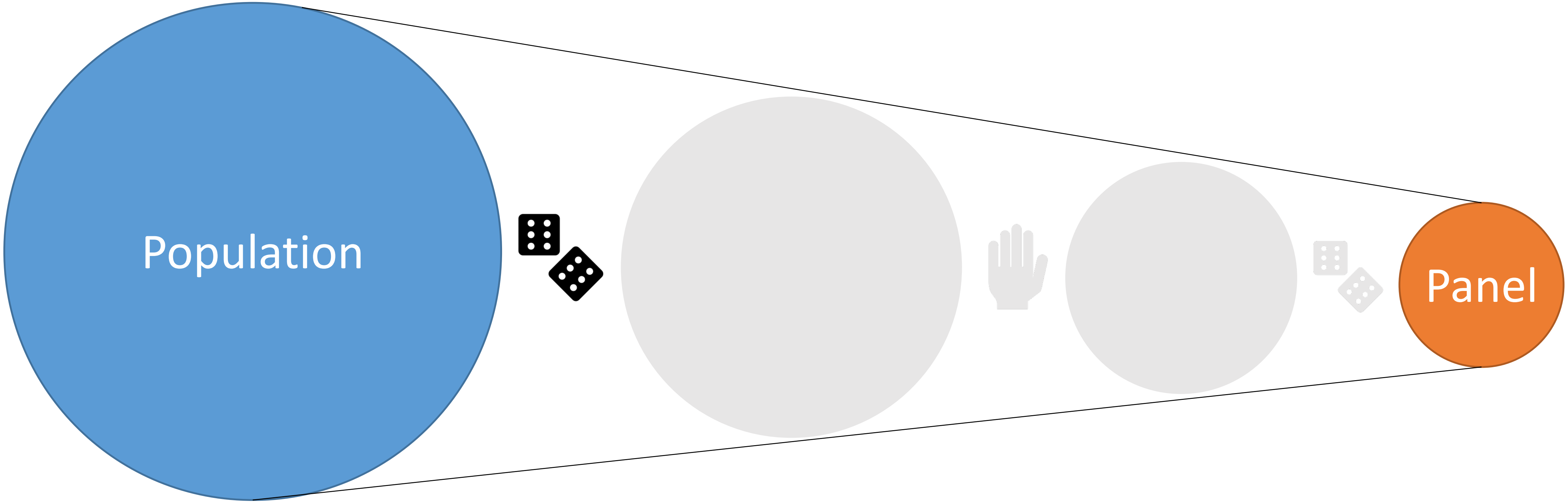

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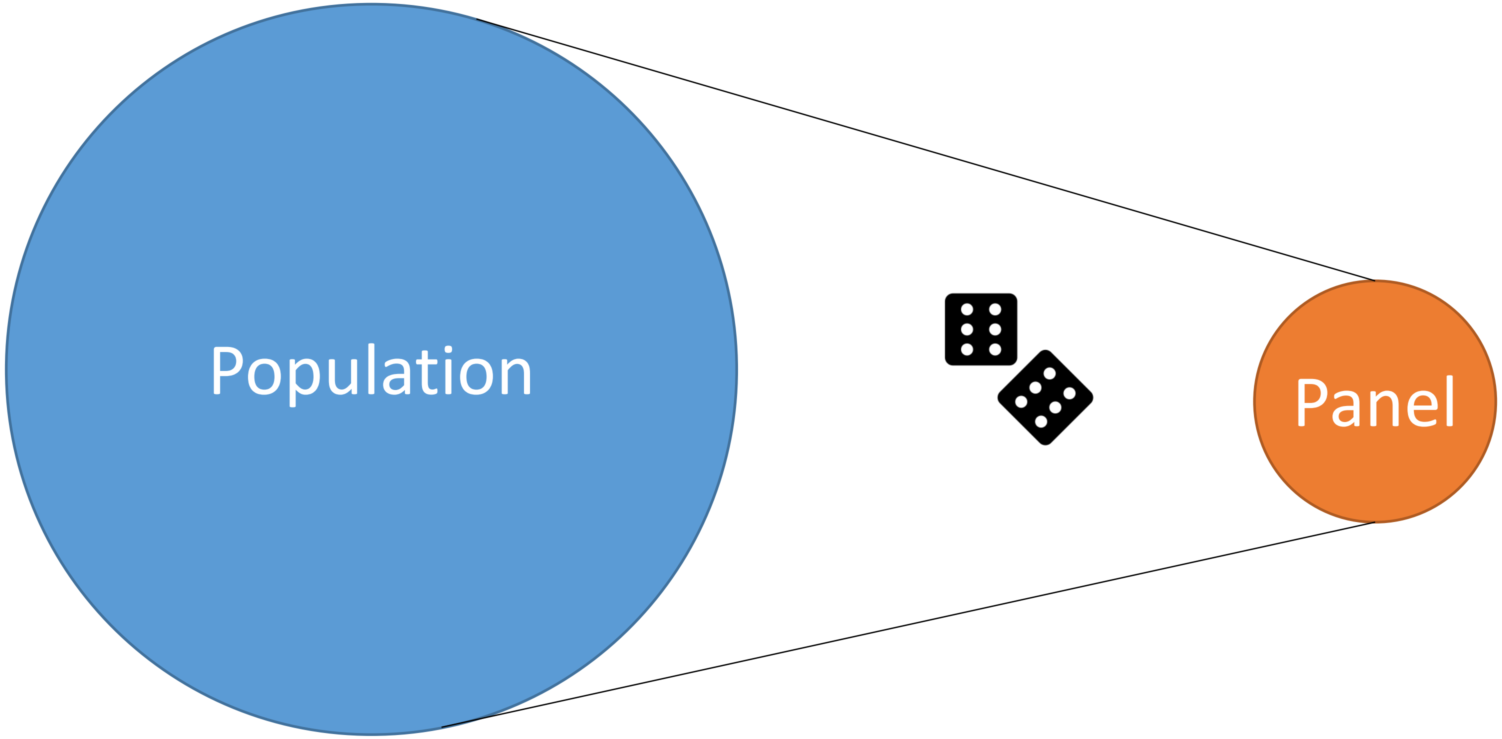

Two Appealing Qualities

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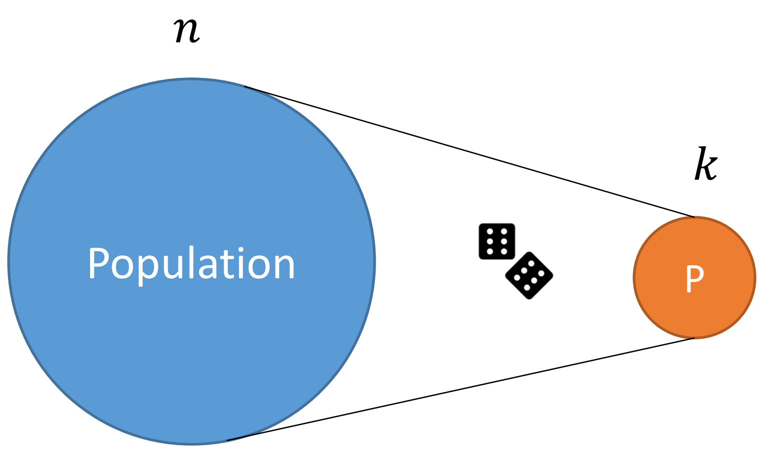
- Fairness
  Equal chance of participation

$$\forall i\colon \Pr(i \in P) = \frac{k}{n}$$



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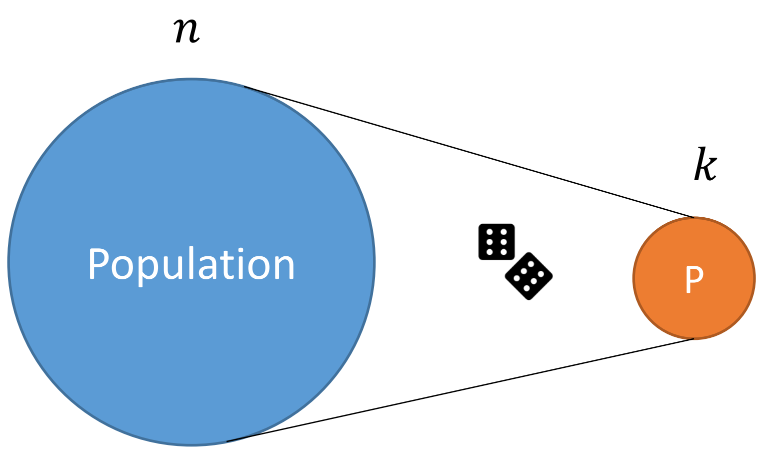

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  Likely to reflect the composition of the population

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✓ Perfectly fair

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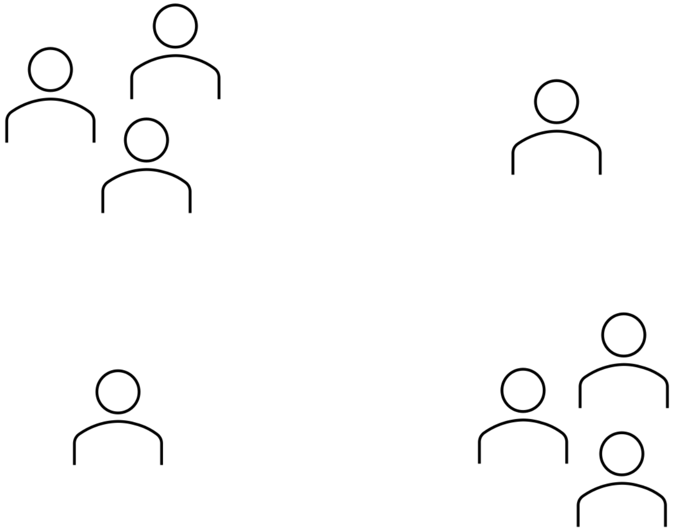
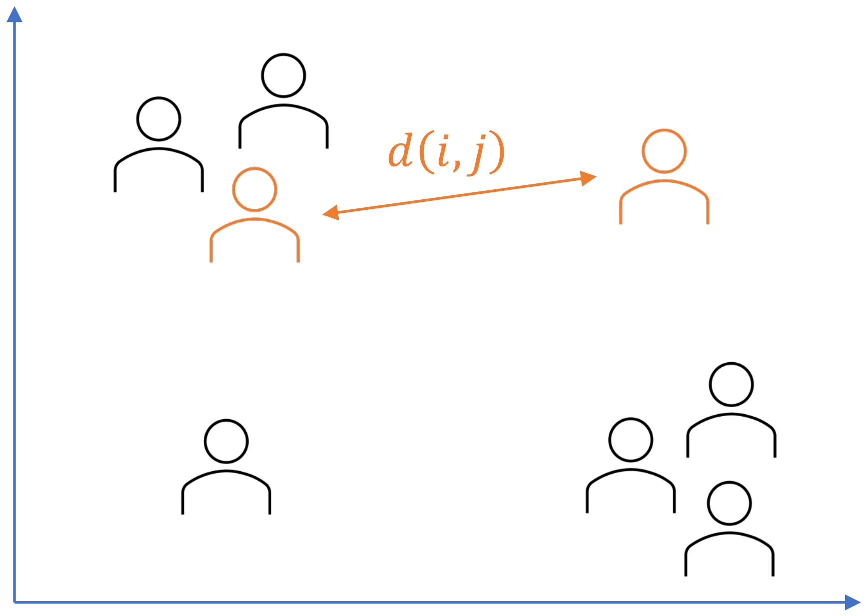
? *Is it representative in a rigorous sense?*

[This work]

Metric Representation



Metric Representation

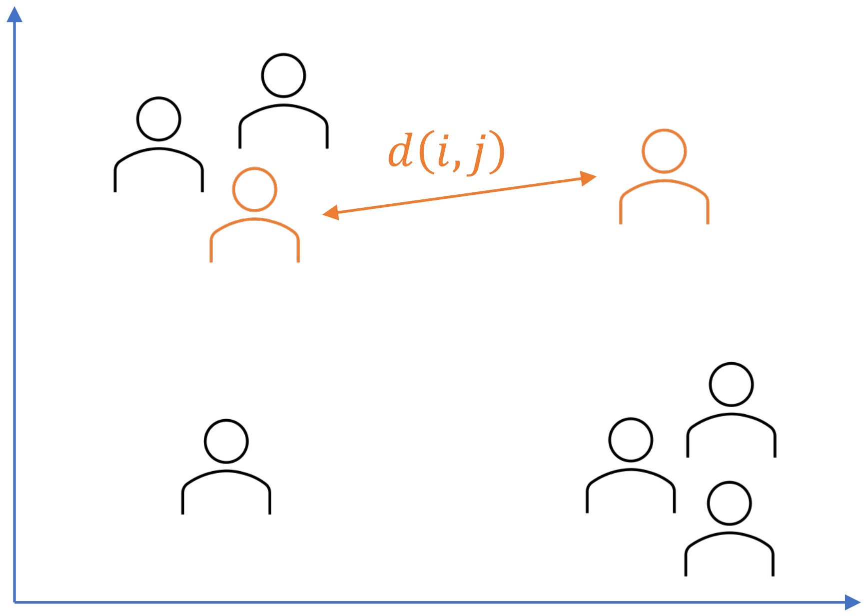


Smaller Distance ⟷ Better Representation

Metric Representation

How to determine the metric?

- Demographic features
- Domain specific features
- Tricky: Legal interpretations



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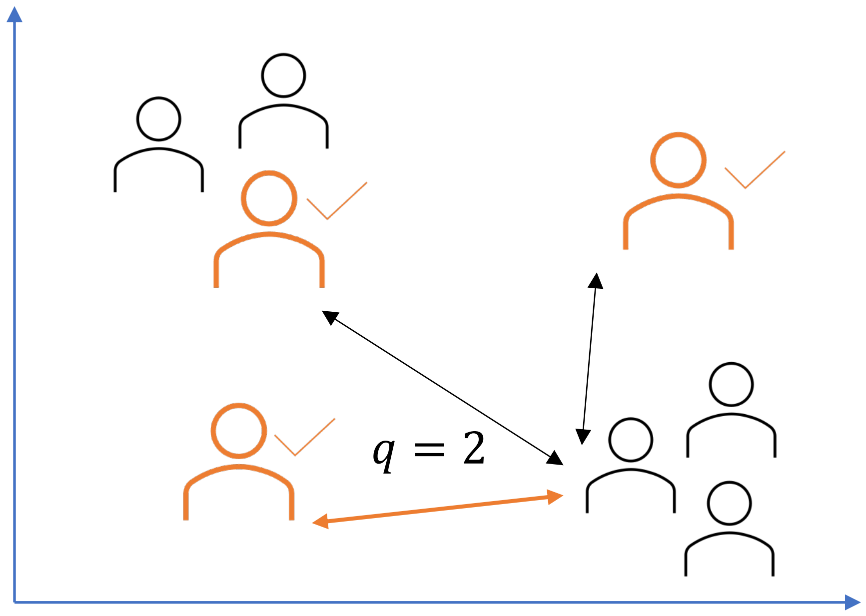
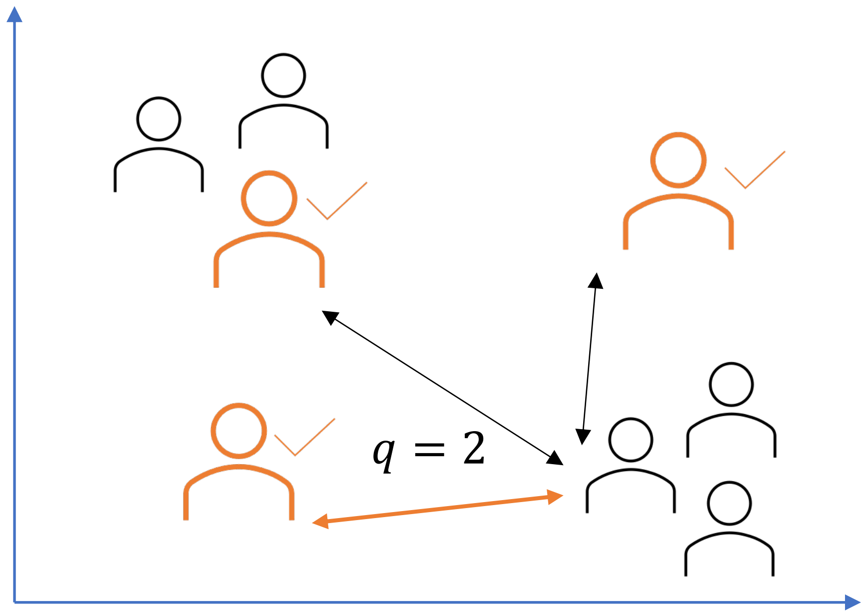
Cost of Panel



Cost of panel for an individual: Distance to its q-th closest panel member

Smaller q-Cost ⟷ Better Representation

Cost of Panel



Cost of panel for an individual: Distance to its q-th closest panel member

Optimal Panel: Minimizes the sum of costs (i.e., min social cost)

Representation: $$\frac{\min_{P^*} \text{social-cost}(P^*)}{\mathrm{E}_{P\sim \mathrm{Alg}}[\text{social-cost}(P)]}$$ → Between 0 and 1

Dichotomy of Results

$$q > \frac{k}{2}$$

Uniform Selection achieves constant representation when $\frac{k}{2} < q < k - \Omega(k)$.

$$q \leq \frac{k}{2}$$

- Uniform Selection incurs zero representation in the worst case

Regime of $q > \frac{k}{2}$

- Interpretation: one wants the majority of the panel to be representative of themselves.

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Theorem 1.

Any *perfectly fair* selection algorithm achieves a representation of at least $\frac{1}{2} \cdot \frac{k - q + 1}{k}$.

Theorem 2.

Any *perfectly fair* selection algorithm incurs a representation of at most $2 \cdot \frac{k - q + 1}{k}$.

- Constant representation (near optimal) when $\frac{k}{2} < q < k - \Omega(k)$.

Zero Representation when $q \leq \frac{k}{2}$

Optimal social cost: 0 (e.g., $\frac{k}{2}$ from left and $\frac{k}{2}$ from right)

Uniform selection: prone to picking less than q from one side

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Fix: Always pick $\frac{k}{2}$ panel members randomly from left and $\frac{k}{2}$ randomly from right

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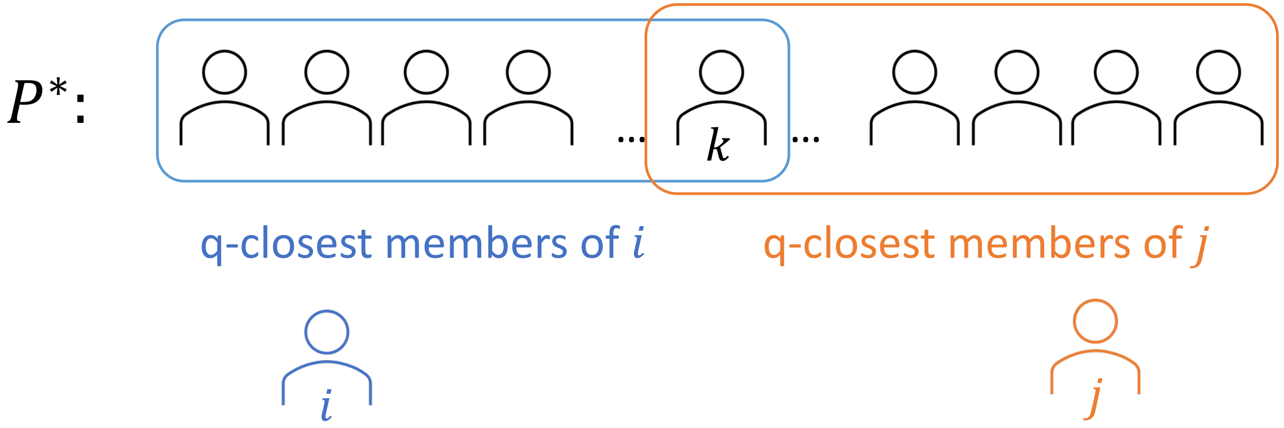
Theorem 3 (weaker version).

Any *perfectly fair* selection algorithm incurs 0 representation when $q \leq \frac{k}{2}$.

What is the Difference when $q > \frac{k}{2}$?

- Optimal cost is bounded away from zero

- For two individuals i, j and optimal panel P^*



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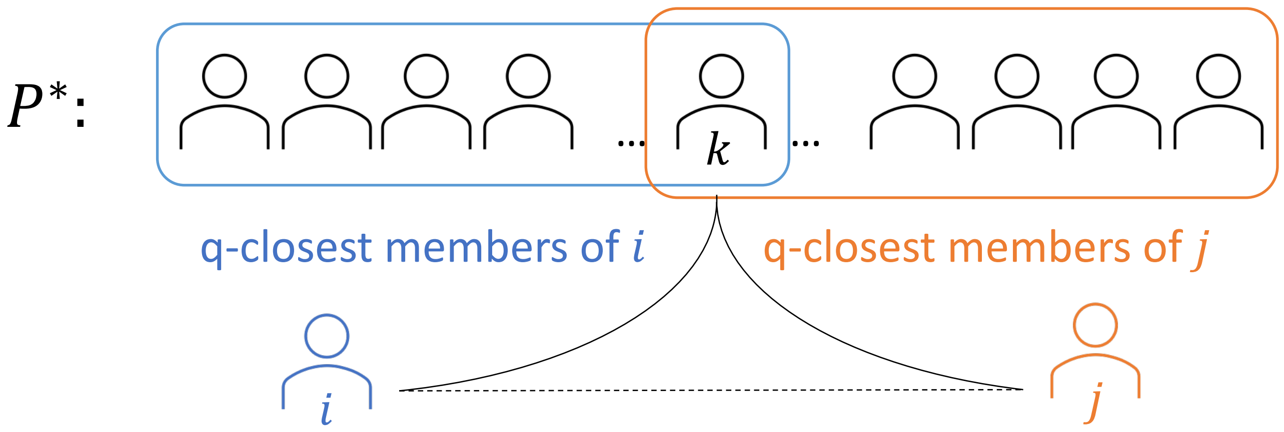

$$d(i,j) \leq d(i,k) + d(k,j) \leq c_q(i,P^*) + c_q(j,P^*)$$

What is the Difference when $q > \frac{k}{2}$?

- Optimal cost is bounded away from zero

$$\forall\, i \neq j : \quad d(i,j) \leq c_q(i,P^*) + c_q(j,P^*)$$

$$\Rightarrow \sum_{i \neq j} d(i,j) \leq \sum_{i \neq j} c_q(i,P^*) + c_q(j,P^*)$$

$$\Rightarrow \sum_{i \neq j} d(i,j) \leq 2(n-1) \cdot \text{social-cost}(P^*)$$

Proof of Theorem 2

Theorem 2.
Any *perfectly fair* selection algorithm achieves a representation of at least $\frac{1}{2} \cdot \frac{k - q + 1}{k}$.

- On Blackboard!

Positive news for $q \leq \frac{k}{2}$?

Trade-off between Fairness and Representation

Positive news for $q \leq \frac{k}{2}$

Theorem 4.

RandomReplace achieves $\frac{1}{q+1}$ representation while selecting each individual w.p. $\frac{q}{n}$.

RandomReplace Algorithm

- Find P^*
- Randomly pick a group S of size q
- For each $i \in S$:
    - Replace i with one of its (remaining) closest q neighbors in P^*

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RandomReplace Algorithm

- Find P^* ← Hard to find. Use approximately optimal.
- Randomly pick a group S of size q
- For each $i \in S$:
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Conclusion

- Sortition and Metric Representation
  - Dichotomy
    - $\frac{k}{2} < q < k - \Omega(k)$: Uniform selection is almost optimal in *expectation*
    - $q \leq \frac{k}{2}$: No representation if fairness is sought
- Trade-off between Fairness and Representation
  - RandomReplace: Scratched the surface
  - What level of fairness can be achieved if we seek *constant* representation?

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    - $q \leq \frac{k}{2}$: No representation if fairness is sought
- Trade-off between Fairness and Representation
  - RandomReplace: Scratched the surface
  - What level of fairness can be achieved if we seek *constant* representation?
- Other cost functions
  - Some results for average distance to all members of the panel
  - Several other options

Thank you!