How to Measure Legislative District Compactness If You Only Know it When You See it[1]

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Society for Political Methodology, University of Wisconsin, 7/14/2017

[1] Paper available at j.mp/Compactness

Redistricting Defines Democracy — & Needs Fixing

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  - E.g., Population equality, partisan fairness, racial fairness, respect for municipal boundaries ... compactness

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    - Required in many other jurisdictions

Compactness According to the Law

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A simple single compactness dimension that you know when you see

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More Compact ⟷ Less Compact

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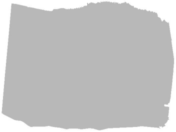

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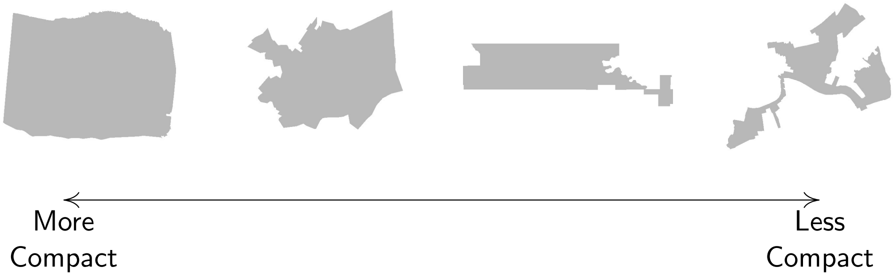

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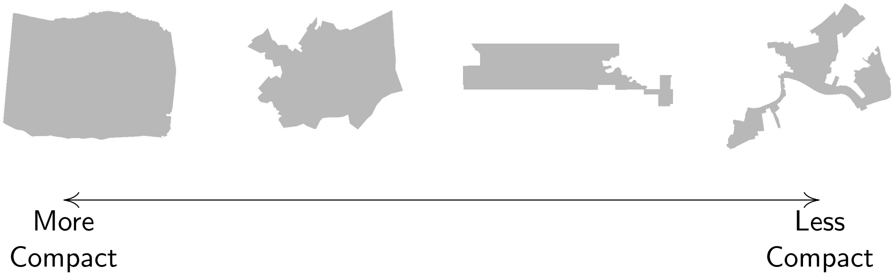

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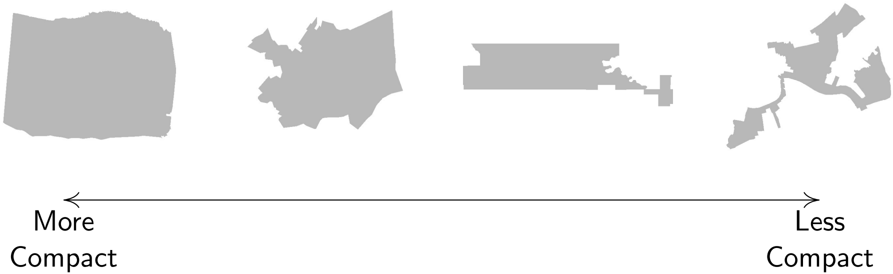

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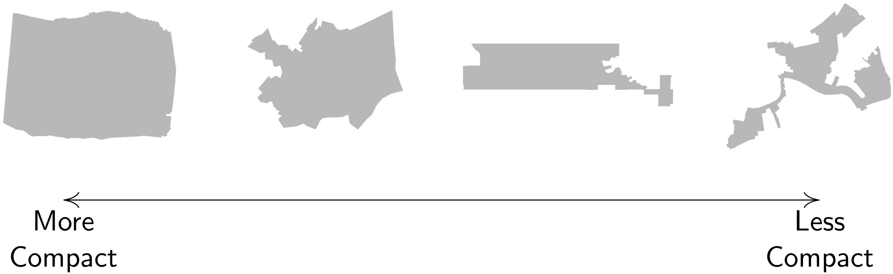

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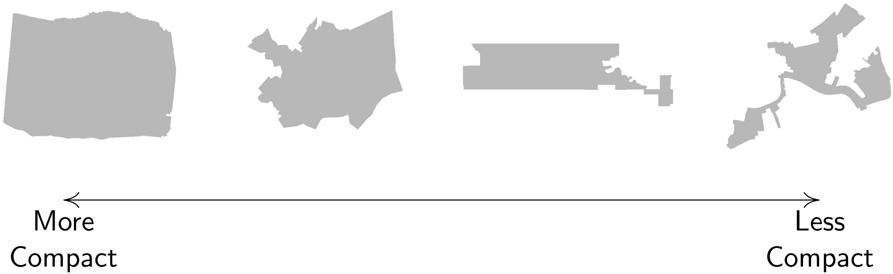

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- $\rightsquigarrow$ Let's start with existing measures by social scientists

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Squarish districts more compact than long thin ones

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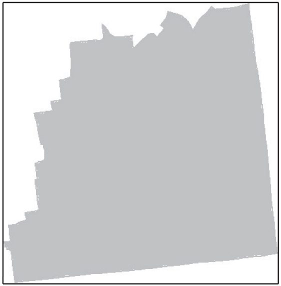

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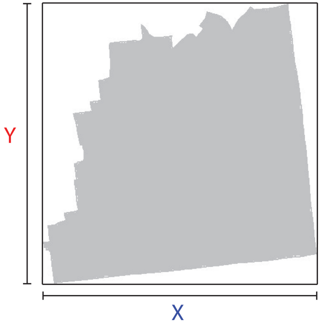

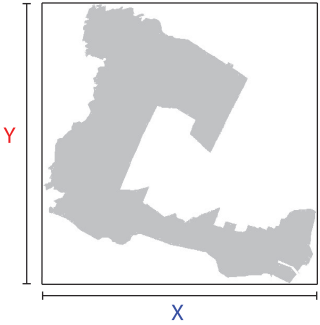

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In both districts: X/Y ≈ 1.30

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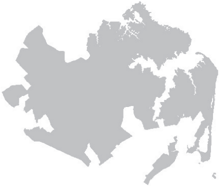

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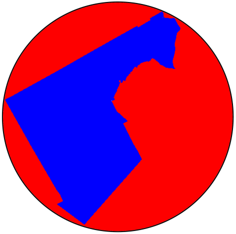

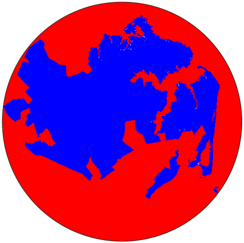

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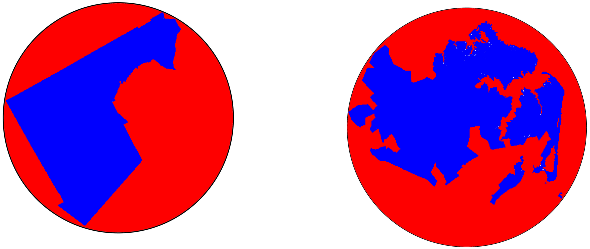

In both cases, $X/(Y+X) \approx 0.37$

Measure 3: Boyce-Clark, Variation in Centroid Deviations

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All travel distances from center should be similar

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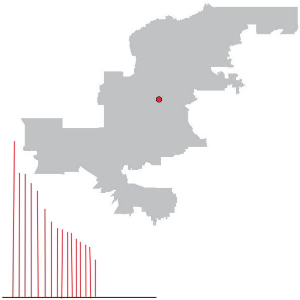

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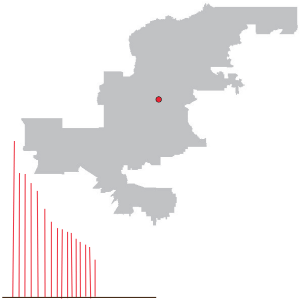

In both cases, $\mathrm{MAD}(r)/\bar{r} \approx 0.31$

A Brief Interlude: Can you Name this Celebrity?

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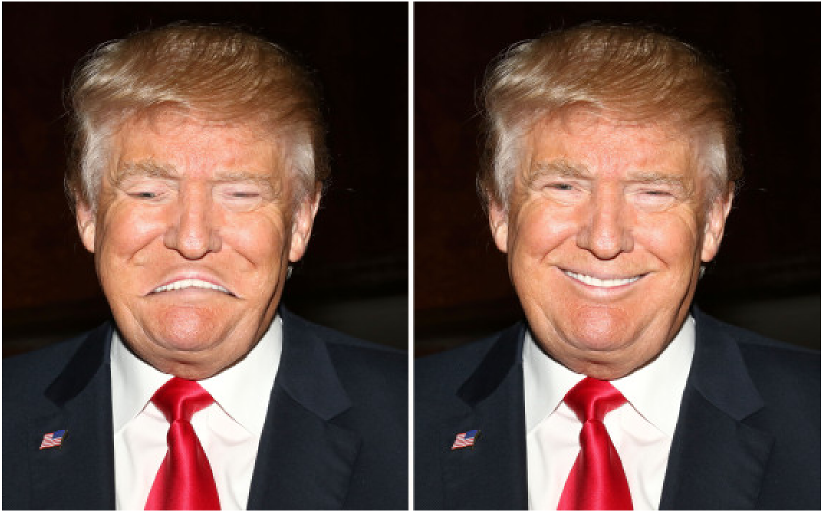

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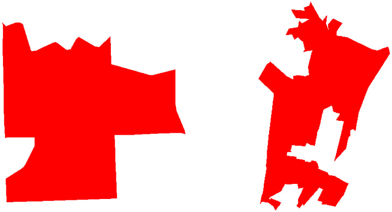

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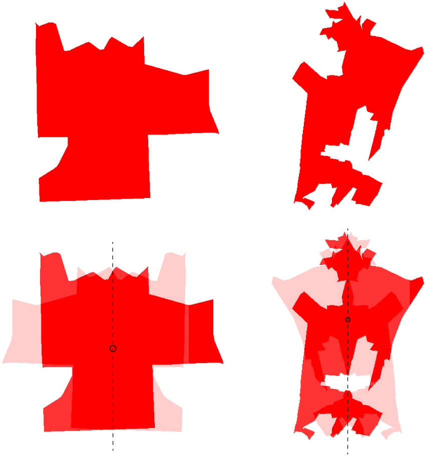

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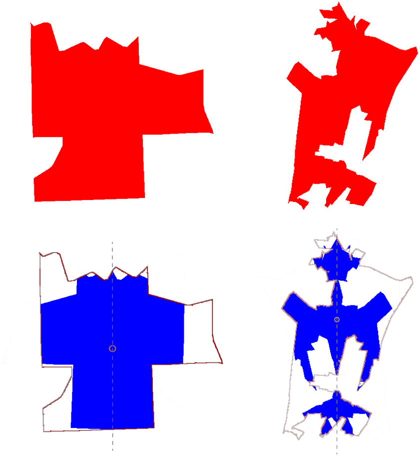

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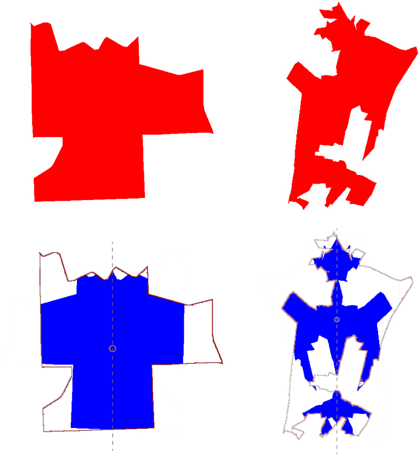

In both cases, Overlap/Original Area ≈ 0.34

New Measure 2: Number of Visually Significant Corners

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Computer vision algorithm identifies "objects" in photos

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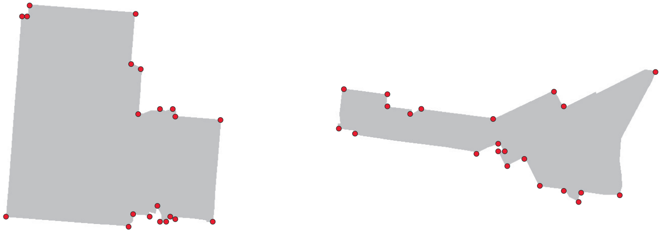

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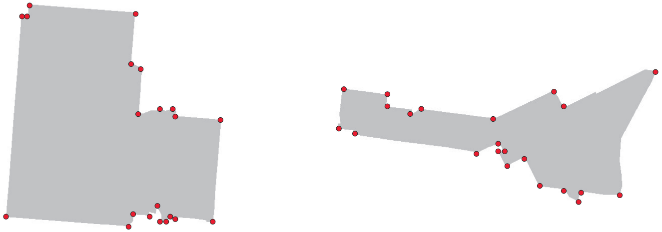
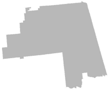


Both districts have 21 significant corners

Which is more compact?

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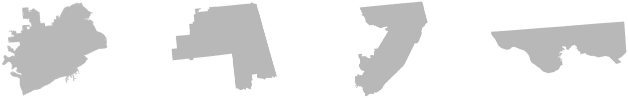

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		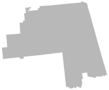		
Convex Hull	4	3	2	1

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		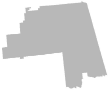		
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		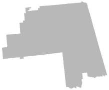		
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		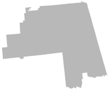		
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		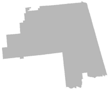		
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		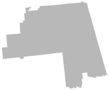		
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		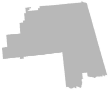		
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		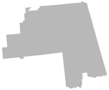		
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		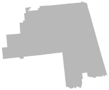		
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		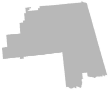		
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		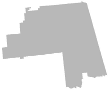		
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		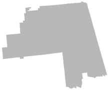		
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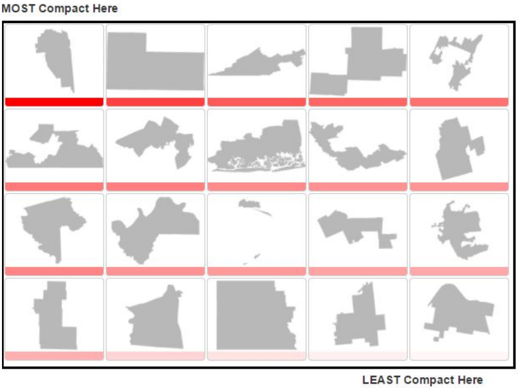

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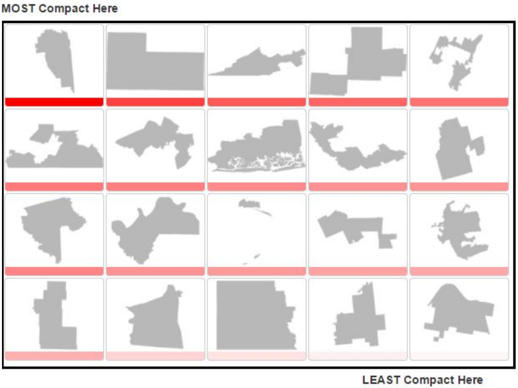

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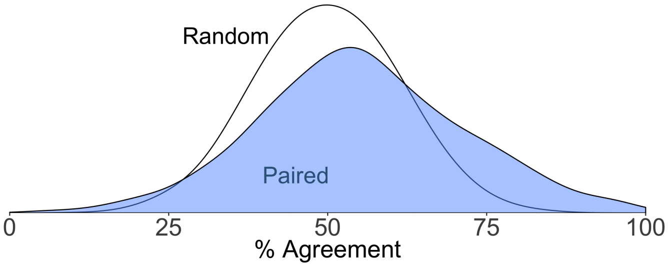

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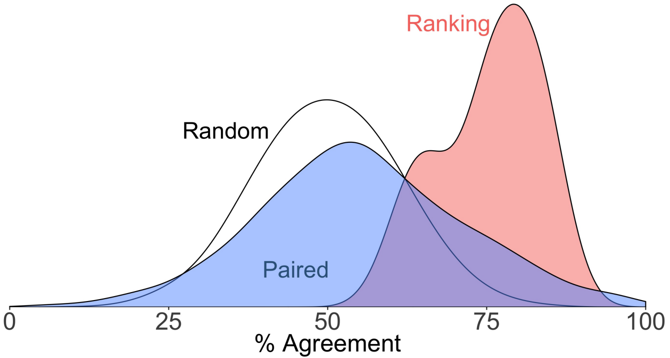

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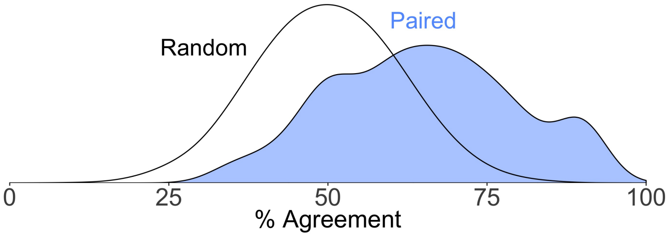

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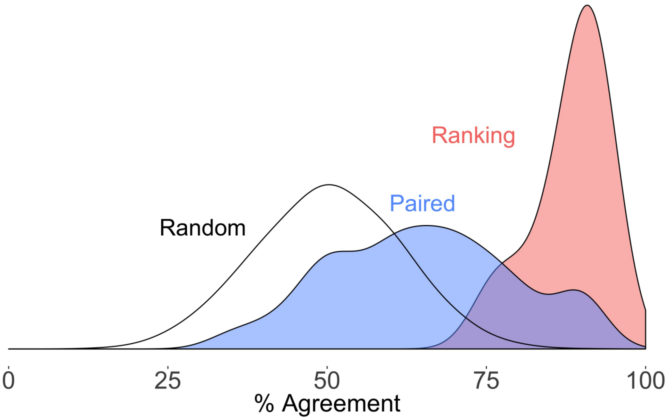

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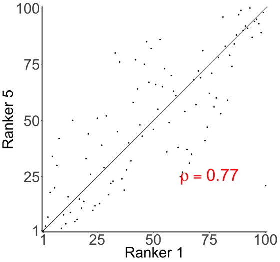

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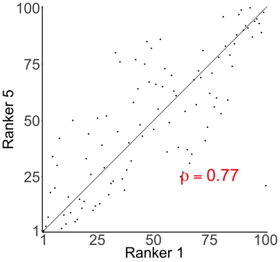

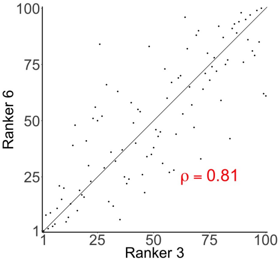

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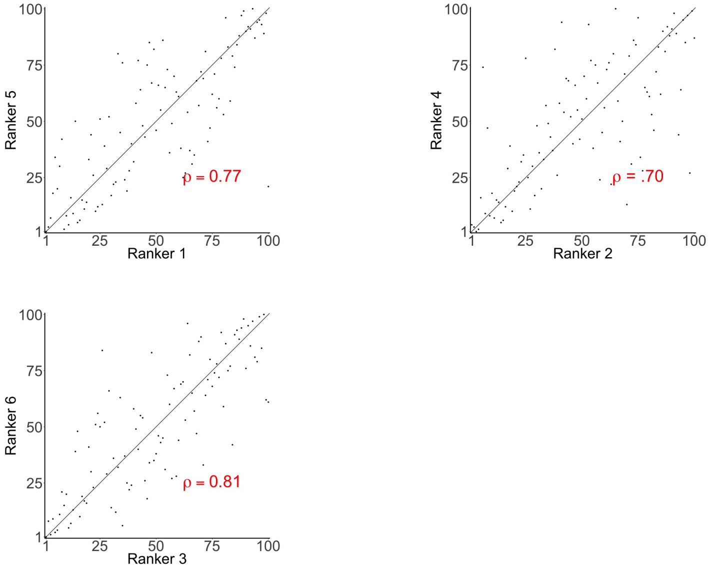

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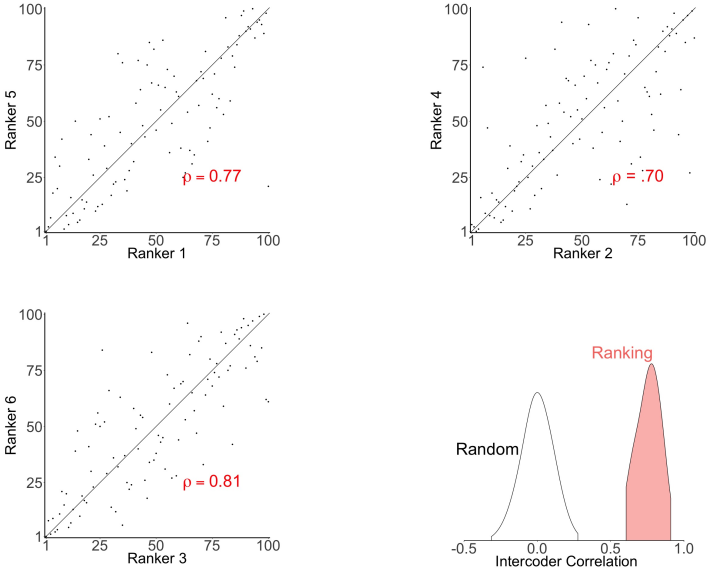

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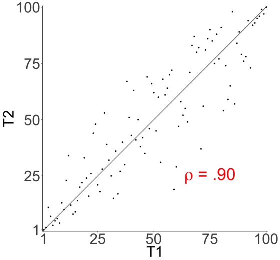

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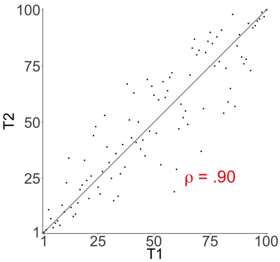

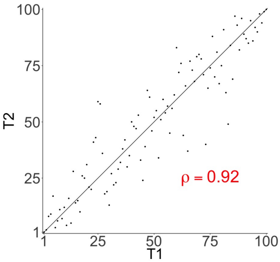

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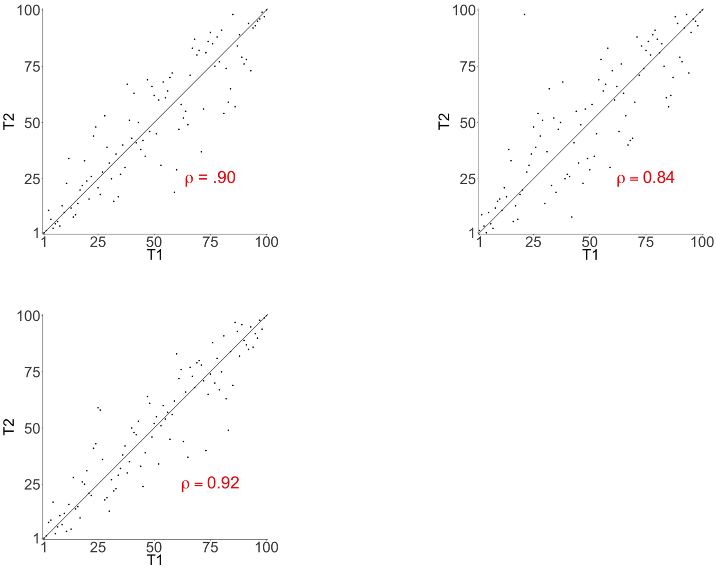

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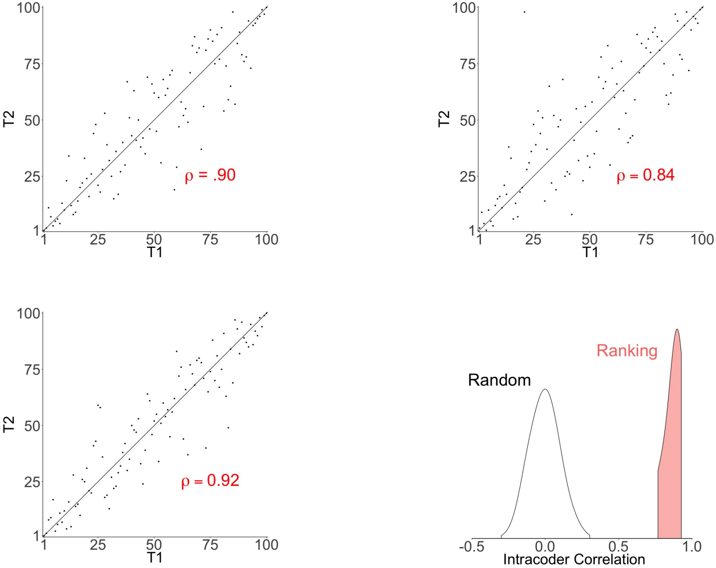

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Goal: Compactness score $= f(\text{shape})$

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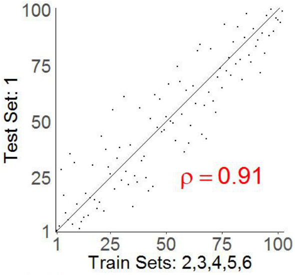

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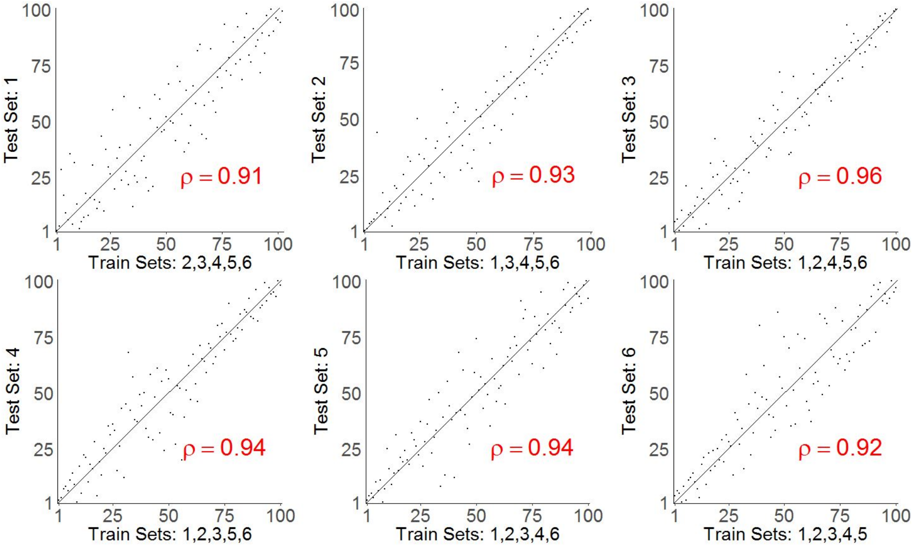

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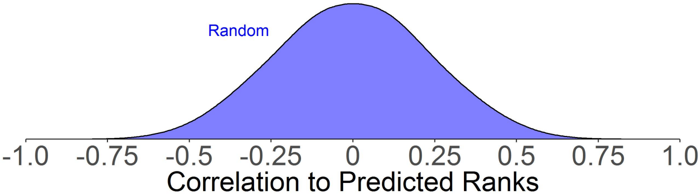

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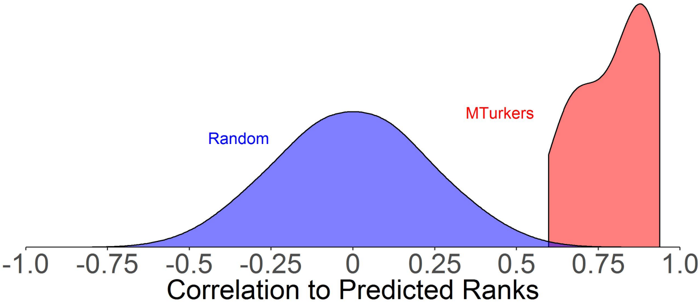

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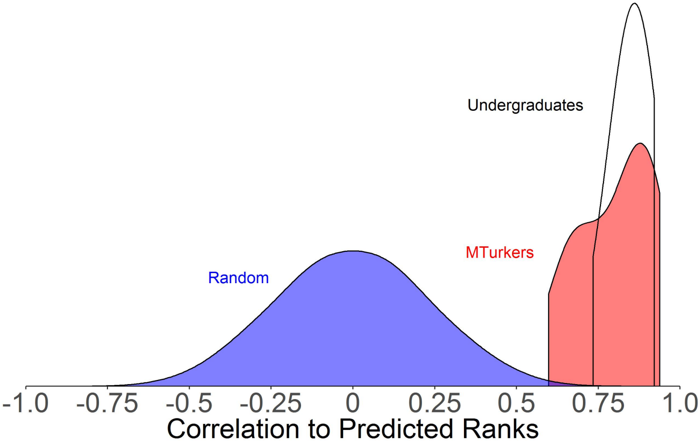

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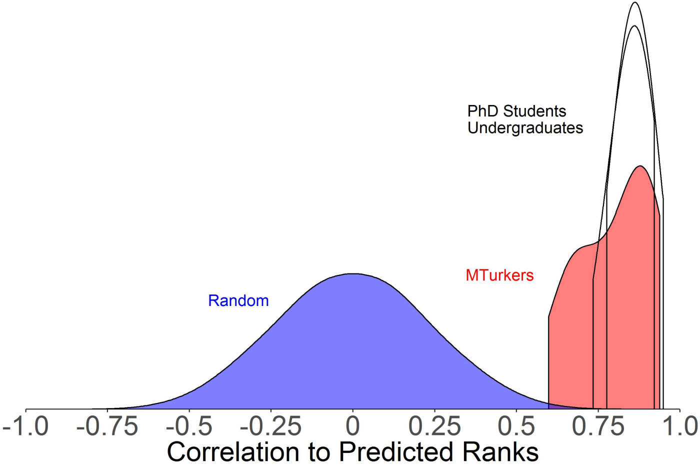

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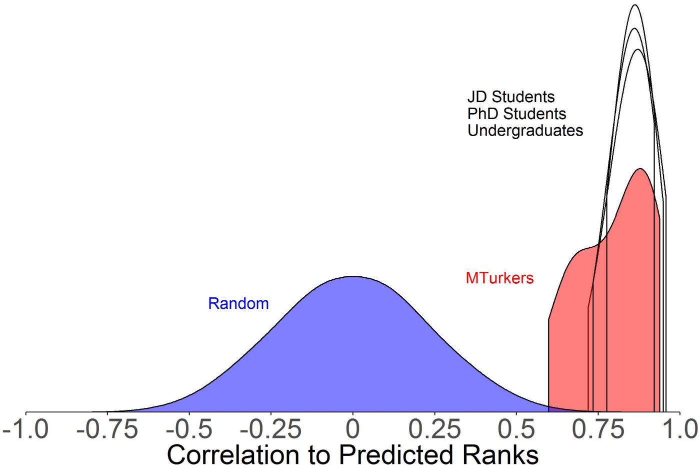

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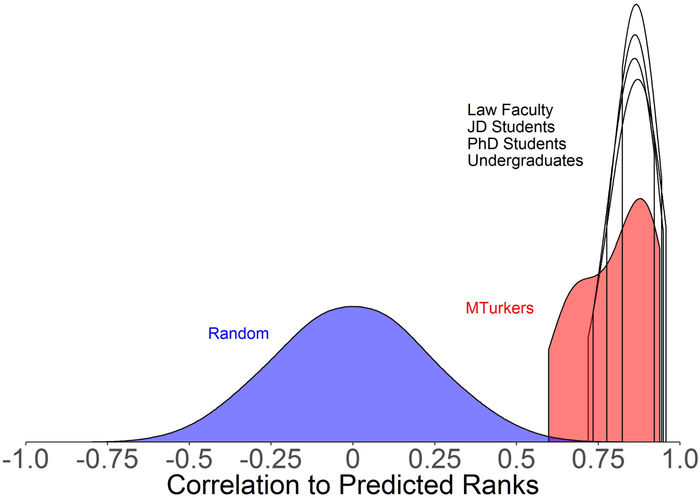

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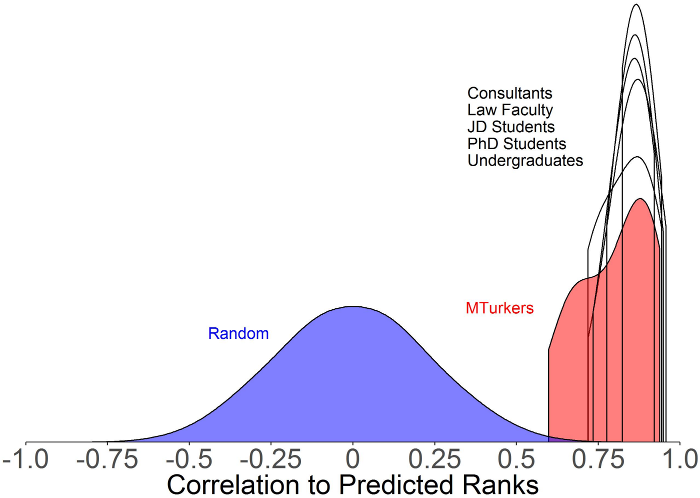

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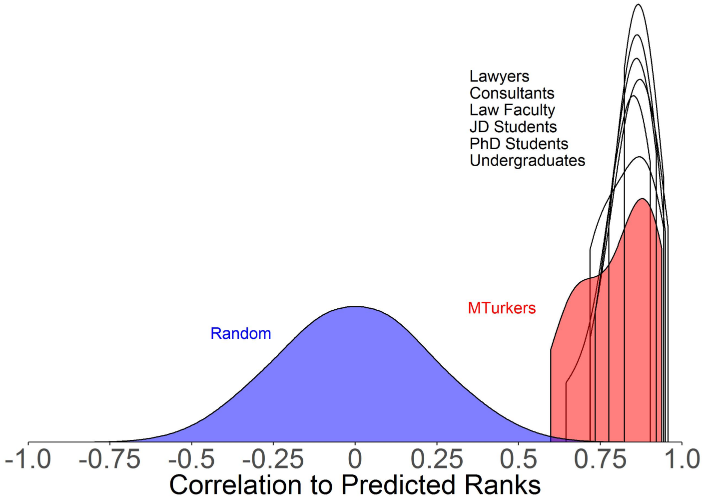

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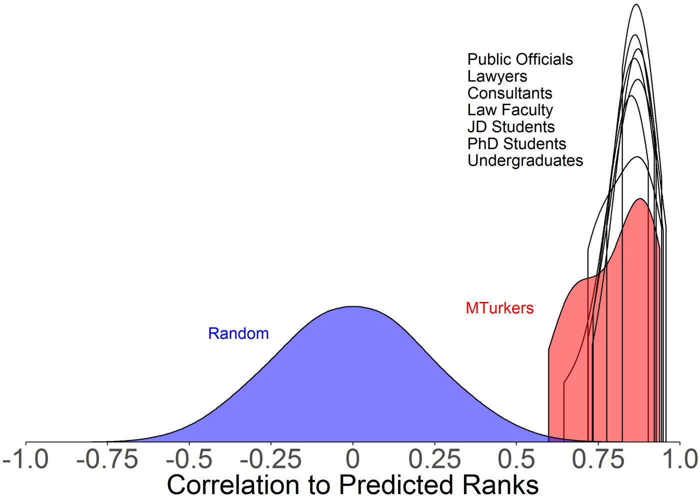

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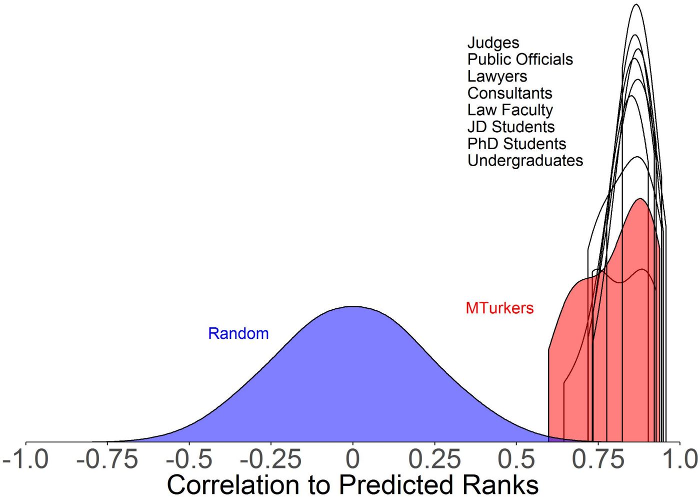

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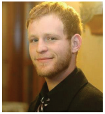
For more information



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