The rise of prosociality in fiction preceded democratic revolutions in Early Modern Europe

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<th>Ratio</th>
<th>Proxy</th>
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<td>Seed</td>
<td><em>Sympathy, Compassion, Pity</em></td>
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<td></td>
<td></td>
<td>Final</td>
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<td>T-S</td>
<td>Anger</td>
<td>Seed</td>
<td><em>Anger, Fury, Rage, Indignation, Choler</em></td>
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<td></td>
<td>Final</td>
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<td>Seed</td>
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<td></td>
<td></td>
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<td>Strength</td>
<td>Seed</td>
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<td>advice, affect, affection, aid, approbation, assist, assistance, assurance, attachment, benevolence, bounty, care, charity, civility, comfort, compassion, consolation, cordial, counsel, courtesie, courtesy, delicacy, embrace, embracing, encouragement, engagement, esteem, favor, favou, forgiveness, generosity, gentleness, goodnature, goodness, gratitude, help, hint, hug, humanity, humility, imbrace, inclination, incouragement, instruction, kindness, lend, mercy, piety, pittance, pity, pity, protect, protection, quittance, redress, refuge, regard, relief, relieve, remission, request, rescue, sanctuary, save, sensibility, sentime, service, shelter, solici, succour, support, sweetness, tenderness, thankfulness</td>
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<td>Final</td>
<td><em>Obedience, Authority, Strength</em></td>
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<td>Final</td>
<td>accuse, active, allegiance, approv, arder, arders, ardour, authori, bravery, captain, censur, charge, charter, claim, command, condemn, constancy, control, courage, cruelt, demand, determin, disposess, dominion, duty, eminence, empery, energy, enjoin, entreat, entreaty, esquire, extent, fervour, fierceness, firmness, force, fortitude, glory, govern, grandeur, greatness, impulse, infidelit, influence, injunction, judge, judgment, justice,</td>
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<td>-------</td>
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<tr>
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<td>Sympathy</td>
<td>Sympathie, Compassion, Pitié</td>
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<td>affection, antipathie, bonté, compassion, conformité, contraste, convenance, correspondance, harmonie, instinct, nouveauté, pitié, plainte, prière, reconnaissance, regret, remords, ressemblance, soin, souci, sympathie, timidité, égalité</td>
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<td>Colère, Fureur, Rage, Indignation, Courroux</td>
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<td></td>
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<td>barbare, colère, courroux, cruauté, dédain, emportement, frayeur, fureur, furie, haine, indignation, inimitié, rage, ressentiment, rigueur, vengeance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T-S</td>
<td>Sincérité, Confiance</td>
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<td></td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Strength</td>
<td>Force, Puissance</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>adresse, autorité, courage, courroux, dignité, empire, force, forces, suffrage, sévérité, tyrannie, vaillance, valeur, vertu, vigueur, violence</td>
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<td></td>
</tr>
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<td>Prosociality</td>
<td>Consolation, Réconfort, Soin, Aide, Charité, Assistance, Secours</td>
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<td></td>
</tr>
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<td>affection, protecteur, protection, protéger, affliction, aide, aider, allié, amitié, appui, asile, assistance, assister, bienfait, bonté, camarade, charité, civilité, clémence, compliment, concitoyen, confier, conseil, conseiller, consolation, consoler, courtoisie, délivrer, encourager, escorte, favoriser, guérir, générosité, indulgence, inviter, joindre, miséricorde, pardonner, partage, pitié, politesse, prévenir, prêter, reconnaissance, refuge, remerciement, réconfort, salut, sauver, seconder, secourir, secours, sentiment, soigner, soin, souci, soulagement, soulager, soutien, support, supporter, écouter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Authority</td>
<td>Authorité, Obeissance, Force</td>
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</table>
|        | arrêt, autorité, commandement, cruauté, césar, discipline, domination, décret, déférence, déshonneur, empereur, empire, fermeté, fidélité, force, forces, gloire, gouverneur, grandeur, guerrier, honneur, impiété,
Table S1. Search Terms Lists used to calculate the Sympathy-to-Anger (S-A), Trustworthiness-to-Strength (T-S) and Prosociality-to-Authority (P-A) Ratios, based on Proxy terms Anger and Empathy, Strength and Trustworthiness, and Prosociality and Authoritarianism. We depict the Seed words from WordNet and the Final set derived from Word2Vec Similarity analysis.
2. Results
2.1. Time models

Figure S1. Variation of Trust, Strength, Sympathy, Anger, Prosociality and Authoritarianism across time for England. The bottom panel also depicts the Positive to Negative ratio.
## Trust – England

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Estimates</th>
<th>CI</th>
<th>p</th>
<th>Estimates</th>
<th>CI</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.01</td>
<td>-0.07 – 0.08</td>
<td>0.874</td>
<td>-2.76</td>
<td>-3.28 – -2.23</td>
<td>&lt;0.001</td>
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<tr>
<td>year</td>
<td>0.34</td>
<td>0.26 – 0.41</td>
<td>&lt;0.001</td>
<td>0.38</td>
<td>0.30 – 0.45</td>
<td>&lt;0.001</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>2.73</td>
<td>2.22 – 3.25</td>
<td>&lt;0.001</td>
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**Random Effects**

<table>
<thead>
<tr>
<th></th>
<th>σ²</th>
<th></th>
<th>τ₀₀</th>
<th></th>
<th>ICC</th>
<th></th>
<th>N</th>
<th></th>
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<tr>
<td></td>
<td>0.77</td>
<td>0.70</td>
<td>0.11 author</td>
<td>0.08 author</td>
<td>0.12</td>
<td>0.10</td>
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<td>282 author</td>
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<td>Observations</td>
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<td></td>
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<td>904</td>
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<tr>
<td>Marginal R² / Conditional R²</td>
<td>0.111 / 0.220</td>
<td></td>
<td>0.211 / 0.288</td>
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<td></td>
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</table>

**Table S2.** GLMM results for the Trustworthiness-to-Strength ratio (Trust) in England as predicted by time (year) and positivity. Type II Sum of Squares (top), and Type III (below).
Sympathy – England

<table>
<thead>
<tr>
<th>Predictors</th>
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<th></th>
<th>Sympathy</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Estimates</td>
<td>CI</td>
<td>p</td>
<td>Estimates</td>
<td>CI</td>
<td>p</td>
</tr>
<tr>
<td>(Intercept)</td>
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<td>-0.12 – 0.04</td>
<td>0.361</td>
<td>-3.09</td>
<td>-3.62 – -2.56</td>
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<td>year</td>
<td>0.32</td>
<td>0.23 – 0.40</td>
<td>&lt;0.001</td>
<td>0.36</td>
<td>0.29 – 0.44</td>
<td>&lt;0.001</td>
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<tr>
<td>positivity</td>
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<td></td>
<td></td>
<td>3.03</td>
<td>2.51 – 3.54</td>
<td>&lt;0.001</td>
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Random Effects

<p>| | | |</p>
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<tbody>
<tr>
<td>σ²</td>
<td>0.78</td>
<td>0.71</td>
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<tr>
<td>τ₀₀</td>
<td>0.15 author</td>
<td>0.08 author</td>
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<tr>
<td>ICC</td>
<td>0.16</td>
<td>0.11</td>
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<tr>
<td>N</td>
<td>280 author</td>
<td>280 author</td>
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</table>

Observations | 908 | 908

Marginal R² / Conditional R² | 0.097 / 0.241 | 0.216 / 0.300

Table S3. GLMM results for the Sympathy-to-Anger ratio (Sympathy) in England as predicted by time (year) and positivity. Type II Sum of Squares (top), and Type III (below).
## Prosociality – England

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Estimates</th>
<th>CI</th>
<th>p</th>
<th>Estimates</th>
<th>CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.00</td>
<td>-</td>
<td>0.977</td>
<td>-0.53</td>
<td>-</td>
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<tr>
<td></td>
<td>0.08 – 0.08</td>
<td>1.08 – 0.02</td>
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<tr>
<td>year</td>
<td>0.28</td>
<td>0.20 – 0.36</td>
<td>&lt;0.001</td>
<td>0.29</td>
<td>0.20 – 0.37</td>
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<tr>
<td>positivity</td>
<td>0.53</td>
<td>-</td>
<td>0.055</td>
<td>0.01 – 1.07</td>
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### Random Effects

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<td>$\sigma^2$</td>
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<td>$\tau_{00}$</td>
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<td>author</td>
<td>0.16</td>
<td>0.16</td>
<td>author</td>
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<tr>
<td>ICC</td>
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<td>308</td>
<td>308</td>
<td>author</td>
<td>308</td>
<td>308</td>
<td>author</td>
</tr>
</tbody>
</table>

| Observations | 919 | 919 |       |     |         |       |
| Marginal R$^2$ / Conditional R$^2$ | 0.078 / 0.242 | 0.081 / 0.243 |       |     |         |       |
| log-Likelihood | -1245.737 | -1244.269 |       |     |         |       |

**Table S4.** GLMM results for the Prosociality-to-Authoritarianism ratio (Prosociality) in England as predicted by time (year) and positivity. Type II Sum of Squares (top), and Type III (below).
Figure S2. Variation of Trust, Strength, Sympathy, Anger, Prosociality and Authority across time for France. The bottom panel also depicts the Positive to Negative ratio.
<table>
<thead>
<tr>
<th>Predictors</th>
<th>Trust Estimates</th>
<th>CI</th>
<th>p</th>
<th>Trust Estimates</th>
<th>CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>-0.06</td>
<td>-0.15 – 0.04</td>
<td>0.231</td>
<td>-0.05</td>
<td>-0.14 – 0.03</td>
<td>0.234</td>
</tr>
<tr>
<td>year</td>
<td>0.33</td>
<td>0.25 – 0.41</td>
<td>&lt;0.001</td>
<td>0.28</td>
<td>0.21 – 0.36</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>positivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.25</td>
<td>0.19 – 0.31</td>
</tr>
</tbody>
</table>

**Random Effects**

- $\sigma^2$ 0.62
- $\tau_{00}$ 0.25 author 0.20 author
- ICC 0.29
- N 280 author 280 author

<table>
<thead>
<tr>
<th>Observations</th>
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<th>932</th>
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</table>

Marginal $R^2$ / Conditional $R^2$ 0.105 / 0.366 0.163 / 0.371

**Table S5.** GLMM results for the Trustworthiness-to-Strength ratio (Trust) in France as predicted by time (year) and positivity. Type II Sum of Squares (top), and Type III (below).
### Sympathy – France

<table>
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<tr>
<th>Predictors</th>
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<th>p</th>
<th>Estimates</th>
<th>CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
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<td>-0.10 – 0.09</td>
<td>0.895</td>
<td>0.01</td>
<td>-0.07 – 0.09</td>
<td>0.814</td>
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<tr>
<td>year</td>
<td>0.23</td>
<td>0.14 – 0.31</td>
<td>&lt;0.001</td>
<td>0.17</td>
<td>0.09 – 0.24</td>
<td>&lt;0.001</td>
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<tr>
<td>positivity</td>
<td></td>
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<td></td>
<td>0.39</td>
<td>0.32 – 0.45</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**Random Effects**

- $\sigma^2$: 0.74
- $\tau_{00}$: 0.23 \text{ author}
- ICC: 0.24
- N: 276 \text{ author}

<table>
<thead>
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<th>934</th>
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<td>Marginal $R^2$ / Conditional $R^2$</td>
<td>0.045 / 0.272</td>
<td>0.176 / 0.325</td>
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</table>

**Table S6.** GLMM results for the Sympathy-to-Anger ratio (Sympathy) in France as predicted by time (year) and positivity. Type II Sum of Squares (top), and Type III (below).
# Prosociality — France

## Prosociality

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Estimates</th>
<th>CI</th>
<th>p</th>
<th>Estimates</th>
<th>CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>-0.06</td>
<td>-</td>
<td>0.136</td>
<td>-0.60</td>
<td>-1.16 – -0.03</td>
<td>0.040</td>
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<tr>
<td>year</td>
<td>0.31</td>
<td>0.23 – 0.38</td>
<td>&lt;0.001</td>
<td>0.30</td>
<td>0.23 – 0.38</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>positivity</td>
<td></td>
<td></td>
<td>0.58</td>
<td>-0.03 – 1.19</td>
<td>0.063</td>
<td></td>
</tr>
</tbody>
</table>

## Random Effects

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>$\sigma^2$</td>
<td>0.71</td>
<td>0.72</td>
</tr>
<tr>
<td>$\tau_{00}$</td>
<td>0.18 _author</td>
<td>0.16 _author</td>
</tr>
<tr>
<td>ICC</td>
<td>0.20</td>
<td>0.19</td>
</tr>
<tr>
<td>N</td>
<td>308 _author</td>
<td>308 _author</td>
</tr>
</tbody>
</table>

| Observations | 1043 | 1043 |
| Marginal $R^2$ / Conditional $R^2$ | 0.096 / 0.274 | 0.100 / 0.267 |
| log-Likelihood | -1378.897 | -1377.459 |

**Table S7.** GLMM results for the Prosociality-to-Authoritarianism ratio (Prosociality) in France as predicted by time (year) and positivity. Type II Sum of Squares (top), and Type III (below).
2.2. Genre analysis

Figure S3. Temporal dynamics of cooperation-to-dominance ratios in both England (top) and France (bottom) across different theatre genres.
## 2.3. Historical analysis

### England

<table>
<thead>
<tr>
<th></th>
<th>1. Pre-Civil War</th>
<th>2. Restoration</th>
<th>3. Post-Glorious Revolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust</td>
<td>mean (±SD)</td>
<td>-0.54±0.24</td>
<td>-0.36±0.29</td>
</tr>
<tr>
<td></td>
<td>growth rate (±SE)</td>
<td>0.75±0.25</td>
<td>-1.24±0.68</td>
</tr>
<tr>
<td>Sympathy</td>
<td>mean (±SD)</td>
<td>0.04±0.31</td>
<td>0.00±0.32</td>
</tr>
<tr>
<td></td>
<td>growth rate (±SE)</td>
<td>0.64±0.26</td>
<td>-0.37±0.70</td>
</tr>
<tr>
<td>Prosociality</td>
<td>mean (±SD)</td>
<td>-0.28±0.17</td>
<td>-0.23±0.18</td>
</tr>
<tr>
<td></td>
<td>growth rate (±SE)</td>
<td>0.58±0.27</td>
<td>-0.59±0.70</td>
</tr>
</tbody>
</table>

Table S8. Trustworthiness-to-Strength (Trust), Sympathy-to-Anger (Sympathy) and Prosociality-to-Authoritarianism (Prosociality) ratios, means and growth rates during different historical periods for England.
### Table S9. LMM results for Trust, Sympathy and Prosociality in England as predicted by time (year) and historical period (reference period: Restoration).

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Trust</th>
<th>Sympathy</th>
<th>Prosociality</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.04</td>
<td>-0.41</td>
<td>-0.07</td>
</tr>
<tr>
<td></td>
<td>-0.20 – 0.28</td>
<td>-0.65 – 0.16</td>
<td>-0.32 – 0.18</td>
</tr>
<tr>
<td>year</td>
<td>-1.24</td>
<td>-0.37</td>
<td>0.595</td>
</tr>
<tr>
<td></td>
<td>-2.57 – 0.09</td>
<td>-1.74 – 1.00</td>
<td>-1.98 – 0.79</td>
</tr>
<tr>
<td>period [post glorious revolution]</td>
<td>-0.14</td>
<td>0.18</td>
<td>0.24</td>
</tr>
<tr>
<td></td>
<td>-0.44 – 0.15</td>
<td>-0.13 – 0.48</td>
<td>-0.06 – 0.54</td>
</tr>
<tr>
<td>period [pre_civil_war]</td>
<td>0.34</td>
<td>0.86</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td>-0.22 – 0.90</td>
<td>0.28 – 1.45</td>
<td>-0.26 – 0.95</td>
</tr>
<tr>
<td>year * period [post glorious revolution]</td>
<td>1.63</td>
<td>0.90</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>0.28 – 2.98</td>
<td>-0.48 – 2.29</td>
<td>-0.69 – 2.12</td>
</tr>
<tr>
<td>year * period [pre_civil_war]</td>
<td>1.99</td>
<td>0.99</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>0.57 – 3.41</td>
<td>-0.46 – 2.45</td>
<td>-0.30 – 2.65</td>
</tr>
</tbody>
</table>

**Random Effects**

- $\sigma^2$: 0.76
- $\tau_{00}$: 0.09\_author
- ICC: 0.11
- N: 302\_author

**Observations**: 897
**Marginal R² / Conditional R²**: 0.148 / 0.241
**log-Likelihood**: -1196.395

- $\sigma^2$: 0.77
- $\tau_{00}$: 0.12\_author
- ICC: 0.14
- N: 299\_author

**Observations**: 901
**Marginal R² / Conditional R²**: 0.122 / 0.244
**log-Likelihood**: -1216.168

- $\sigma^2$: 0.76
- $\tau_{00}$: 0.16\_author
- ICC: 0.17
- N: 306\_author

**Observations**: 912
**Marginal R² / Conditional R²**: 0.086 / 0.243
**log-Likelihood**: -1234.794
<table>
<thead>
<tr>
<th>contrast</th>
<th>B</th>
<th>SE</th>
<th>df</th>
<th>T</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model: Trust</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>restoration - post glorious revolution</td>
<td>-1.627</td>
<td>0.691</td>
<td>686</td>
<td>-2.356</td>
<td><strong>0.049</strong></td>
</tr>
<tr>
<td>restoration – pre civil war</td>
<td>-1.992</td>
<td>0.726</td>
<td>659</td>
<td>-2.745</td>
<td><strong>0.017</strong></td>
</tr>
<tr>
<td>post glorious revolution – pre civil war</td>
<td>-0.365</td>
<td>0.266</td>
<td>296</td>
<td>-1.372</td>
<td>0.356</td>
</tr>
<tr>
<td>Model: Sympathy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>restoration - post glorious revolution</td>
<td>-0.86</td>
<td>0.711</td>
<td>703</td>
<td>-1.21</td>
<td>0.447</td>
</tr>
<tr>
<td>restoration – pre civil war</td>
<td>-0.988</td>
<td>0.747</td>
<td>682</td>
<td>-1.322</td>
<td>0.383</td>
</tr>
<tr>
<td>post glorious revolution – pre civil war</td>
<td>-0.127</td>
<td>0.276</td>
<td>336</td>
<td>-0.461</td>
<td>0.889</td>
</tr>
<tr>
<td>Model: Prosociality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>restoration - post glorious revolution</td>
<td>-0.71</td>
<td>0.719</td>
<td>745</td>
<td>-0.992</td>
<td>0.582</td>
</tr>
<tr>
<td>restoration – pre civil war</td>
<td>-1.173</td>
<td>0.755</td>
<td>729</td>
<td>-1.553</td>
<td>0.266</td>
</tr>
<tr>
<td>post glorious revolution – pre civil war</td>
<td>-0.460</td>
<td>0.280</td>
<td>389</td>
<td>-1.637</td>
<td>0.230</td>
</tr>
</tbody>
</table>

Degrees-of-freedom method: kenward-roger
P value adjustment: tukey method for comparing a family of 3 estimates

**Table S10.** Slope pairwise contrasts between historical periods of the models in Table S9.
### France

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trust</td>
<td>mean (±SD)</td>
<td>-0.26±0.36</td>
<td>-0.09±0.37</td>
<td>-0.15±0.42</td>
</tr>
<tr>
<td></td>
<td>growth rate (±SE)</td>
<td>0.50±0.06</td>
<td>3.33±2.5</td>
<td>-0.94±0.54</td>
</tr>
<tr>
<td>Sympathy</td>
<td>mean (±SD)</td>
<td>0.02±0.34</td>
<td>0.07±0.35</td>
<td>0.23±0.36</td>
</tr>
<tr>
<td></td>
<td>growth rate (±SE)</td>
<td>0.18±0.06</td>
<td>0.88±2.6</td>
<td>0.23±0.57</td>
</tr>
<tr>
<td>Prosociality</td>
<td>mean (±SD)</td>
<td>-0.08±0.30</td>
<td>0.07±0.38</td>
<td>0.10±0.33</td>
</tr>
<tr>
<td></td>
<td>growth rate (±SE)</td>
<td>0.36±0.06</td>
<td>4.5±2.4</td>
<td>-0.36±0.49</td>
</tr>
</tbody>
</table>

Table S11. Trustworthiness-to-strength (Trust), sympathy-to-anger (Sympathy) and Prosociality-to-Authoritarianism (Prosociality) ratios, means and growth rates during different historical periods for France.
<table>
<thead>
<tr>
<th>Predictors</th>
<th>Trust Estimates</th>
<th>trust CI</th>
<th>p</th>
<th>Sympathy Estimates</th>
<th>Sympathy CI</th>
<th>p</th>
<th>Prosociality Estimates</th>
<th>Prosociality CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(intercept)</td>
<td>1.73</td>
<td>-0.00 – 3.46</td>
<td>0.051</td>
<td>0.09</td>
<td>-1.77 – 1.95</td>
<td>0.923</td>
<td>0.97</td>
<td>-0.63 – 2.57</td>
<td>0.234</td>
</tr>
<tr>
<td>period [rep III]</td>
<td>1.18</td>
<td>-7.96 – 10.32</td>
<td>0.801</td>
<td>5.98</td>
<td>-5.92 – 17.89</td>
<td>0.325</td>
<td>8.28</td>
<td>0.77 – 15.79</td>
<td>0.031</td>
</tr>
<tr>
<td>period [revolution]</td>
<td>-4.54</td>
<td>-9.67 – 0.59</td>
<td>0.083</td>
<td>-0.82</td>
<td>-6.31 – 4.67</td>
<td>0.769</td>
<td>5.10</td>
<td>-10.07 – -0.13</td>
<td>0.044</td>
</tr>
<tr>
<td>year</td>
<td>-0.94</td>
<td>-1.99 – 0.11</td>
<td>0.078</td>
<td>0.23</td>
<td>-0.90 – 1.35</td>
<td>0.695</td>
<td>-0.36</td>
<td>-1.33 – 0.61</td>
<td>0.464</td>
</tr>
<tr>
<td>period [pre revolution]</td>
<td>-1.69</td>
<td>-3.42 – 0.04</td>
<td>0.056</td>
<td>-0.10</td>
<td>-1.96 – 1.76</td>
<td>0.916</td>
<td>1.01</td>
<td>-2.61 – 0.59</td>
<td>0.215</td>
</tr>
<tr>
<td>year * period [pre revolution]</td>
<td>1.45</td>
<td>0.39 – 2.51</td>
<td>0.007</td>
<td>0.03</td>
<td>-1.17 – 1.10</td>
<td>0.953</td>
<td>0.73</td>
<td>-0.25 – 1.71</td>
<td>0.145</td>
</tr>
<tr>
<td>year * period [rep III]</td>
<td>-0.17</td>
<td>-4.18 – 3.83</td>
<td>0.932</td>
<td>-2.53</td>
<td>-7.72 – 2.66</td>
<td>0.339</td>
<td>-3.36</td>
<td>-6.64 – -0.07</td>
<td>0.045</td>
</tr>
<tr>
<td>year * period [revolution]</td>
<td>4.27</td>
<td>-0.72 – 9.27</td>
<td>0.094</td>
<td>0.62</td>
<td>-4.66 – 5.89</td>
<td>0.819</td>
<td>4.86</td>
<td>0.04 – 9.69</td>
<td>0.048</td>
</tr>
</tbody>
</table>

**Random Effects**

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma^2$</td>
<td>0.62</td>
<td>0.73</td>
<td>0.72</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\tau_{00}$</td>
<td>0.20</td>
<td>author</td>
<td>0.25</td>
<td>author</td>
<td>0.16</td>
<td>author</td>
</tr>
<tr>
<td>ICC</td>
<td>0.24</td>
<td>0.25</td>
<td>0.18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>285</td>
<td>author</td>
<td>283</td>
<td>author</td>
<td>304</td>
<td>author</td>
</tr>
</tbody>
</table>

| Observations | 925 | 927 | 1036 |
| Marginal R² / Conditional R² | 0.157 / 0.360 | 0.045 / 0.289 | 0.114 / 0.277 |
| log-Likelihood | -1169.262 | -1250.526 | -1363.873 |

**Table S12.** LMM results for Trust, Sympathy and Prosociality in France as predicted by time (year) and historical period (reference period: Restoration).
<table>
<thead>
<tr>
<th>contrast</th>
<th>$B$</th>
<th>$SE$</th>
<th>$df$</th>
<th>$T$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model: Trust</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>restoration - pre revolution</td>
<td>-1.451</td>
<td>0.541</td>
<td>658</td>
<td>-2.685</td>
<td>0.0373</td>
</tr>
<tr>
<td>restoration - rep III</td>
<td>0.173</td>
<td>2.045</td>
<td>719</td>
<td>0.084</td>
<td>0.9998</td>
</tr>
<tr>
<td>restoration - revolution</td>
<td>-4.277</td>
<td>2.556</td>
<td>826</td>
<td>-1.674</td>
<td>0.3383</td>
</tr>
<tr>
<td>pre revolution - rep III</td>
<td>1.624</td>
<td>1.977</td>
<td>716</td>
<td>0.821</td>
<td>0.8443</td>
</tr>
<tr>
<td>pre revolution - revolution</td>
<td>-2.826</td>
<td>2.5</td>
<td>830</td>
<td>-1.13</td>
<td>0.6708</td>
</tr>
<tr>
<td>rep III - revolution</td>
<td>-4.45</td>
<td>3.197</td>
<td>779</td>
<td>-1.392</td>
<td>0.5048</td>
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<tr>
<td>Model: Sympathy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>restoration - pre revolution</td>
<td>0.0534</td>
<td>0.58</td>
<td>648</td>
<td>0.092</td>
<td>0.9997</td>
</tr>
<tr>
<td>restoration - rep III</td>
<td>2.5091</td>
<td>2.64</td>
<td>674</td>
<td>0.95</td>
<td>0.7779</td>
</tr>
<tr>
<td>restoration - revolution</td>
<td>-0.6506</td>
<td>2.69</td>
<td>847</td>
<td>-0.242</td>
<td>0.995</td>
</tr>
<tr>
<td>pre revolution - rep III</td>
<td>2.4557</td>
<td>2.58</td>
<td>667</td>
<td>0.951</td>
<td>0.7774</td>
</tr>
<tr>
<td>pre revolution - revolution</td>
<td>-0.704</td>
<td>2.63</td>
<td>852</td>
<td>-0.267</td>
<td>0.9933</td>
</tr>
<tr>
<td>rep III - revolution</td>
<td>-3.1597</td>
<td>3.7</td>
<td>757</td>
<td>-0.854</td>
<td>0.8285</td>
</tr>
<tr>
<td>Model: Prosociality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>restoration - pre revolution</td>
<td>-0.726</td>
<td>0.50</td>
<td>751</td>
<td>-1.452</td>
<td>0.4669</td>
</tr>
<tr>
<td>restoration - rep III</td>
<td>3.355</td>
<td>1.67</td>
<td>787</td>
<td>1.999</td>
<td>0.1889</td>
</tr>
<tr>
<td>restoration - revolution</td>
<td>-4.862</td>
<td>2.46</td>
<td>935</td>
<td>-1.973</td>
<td>0.1988</td>
</tr>
<tr>
<td>pre revolution - rep III</td>
<td>4.082</td>
<td>1.60</td>
<td>789</td>
<td>2.547</td>
<td>0.0537</td>
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<tr>
<td>pre revolution - revolution</td>
<td>-4.135</td>
<td>2.41</td>
<td>939</td>
<td>-1.712</td>
<td>0.3177</td>
</tr>
<tr>
<td>rep III - revolution</td>
<td>-8.217</td>
<td>2.90</td>
<td>889</td>
<td>-2.829</td>
<td>0.0245</td>
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</table>

Degrees-of-freedom method: kenward-roger
P value adjustment: tukey method for comparing a family of 3 estimates

**Table S13.** Slope pairwise contrasts between historical periods in the models in S8. Rep III: Third Republic.
2.4. Affluence and Cooperation

2.4.1. Affluence and Cooperation (England)

Trust – England

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Estimates</th>
<th>CI</th>
<th>Statistic</th>
<th>p</th>
<th>Estimates</th>
<th>CI</th>
<th>Statistic</th>
<th>p</th>
<th>Estimates</th>
<th>CI</th>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>-0.00</td>
<td>-0.08 - 0.08</td>
<td>-0.05</td>
<td>0.963</td>
<td>-0.00</td>
<td>-0.08 - 0.07</td>
<td>-0.12</td>
<td>0.905</td>
<td>0.07</td>
<td>-0.16 - 0.31</td>
<td>0.59</td>
<td>0.554</td>
</tr>
<tr>
<td>GDPpc</td>
<td>0.29</td>
<td>0.21 - 0.37</td>
<td>7.33</td>
<td>&lt;0.001</td>
<td>-0.17</td>
<td>-0.37 - 0.03</td>
<td>-1.65</td>
<td>0.100</td>
<td>-0.54</td>
<td>-1.02 - -0.06</td>
<td>-2.21</td>
<td>0.027</td>
</tr>
<tr>
<td>year</td>
<td>0.51</td>
<td>0.30 - 0.72</td>
<td>4.84</td>
<td>&lt;0.001</td>
<td>0.49</td>
<td>0.18 - 0.81</td>
<td>3.12</td>
<td>0.002</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>GDPpc * period [post glorious revolution]</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>period [pre_civil_war]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDPpc * period [pre_civil_war]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>period [post glorious revolution]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Random Effects

<p>| | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>σ²</td>
<td>0.78</td>
<td>0.77</td>
<td>0.76</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>τoo</td>
<td>0.13 author</td>
<td>0.10 author</td>
<td>0.10 author</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICC</td>
<td>0.14</td>
<td>0.12</td>
<td>0.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>304 author</td>
<td>304 author</td>
<td>302 author</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Observations | 904 | 904 | 897 |
Marginal R² / Conditional R² | 0.083 / 0.214 | 0.123 / 0.225 | 0.145 / 0.249 |
log-Likelihood | -1224.671 | -1214.715 | -1199.036 |

Table S14. LMM results for Trust in England as predicted by time (year), GDP per capita (GDP) and historical period (reference period: Restoration).
Figure S4. Residuals autocorrelation (ACF), partial ACF, and distribution of the in Table S10.
### Sympathy – England

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Sympathy</th>
<th></th>
<th></th>
<th></th>
<th>Sympathy</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimates</td>
<td>CI</td>
<td>Statistic</td>
<td>p</td>
<td>Estimates</td>
<td>CI</td>
<td>Statistic</td>
<td>p</td>
</tr>
<tr>
<td>(Intercept)</td>
<td>-0.04</td>
<td>-0.12 – 0.05</td>
<td>-0.85</td>
<td>0.393</td>
<td>-0.04</td>
<td>-0.12 – 0.05</td>
<td>-0.87</td>
<td>0.386</td>
</tr>
<tr>
<td>GDPpc</td>
<td>0.31</td>
<td>0.23 – 0.39</td>
<td>7.57</td>
<td>&lt;0.001</td>
<td>0.20</td>
<td>-0.00 – 0.41</td>
<td>1.94</td>
<td>0.053</td>
</tr>
<tr>
<td>year</td>
<td>0.12</td>
<td>-0.09 – 0.33</td>
<td>1.10</td>
<td>0.271</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Random Effects**

- $\sigma^2$: 0.77
- $\tau_{00}$: 0.16
- ICC: 0.17
- N: 301

| Observations | 908 | 908 |
| Marginal $R^2$ / Conditional $R^2$ | 0.092 / 0.249 | 0.097 / 0.250 |
| log-Likelihood | -1232.716 | -1233.418 |

**Table S15.** LMM results for Sympathy in England as predicted by time (year) and GDP per capita (GDP).
Figure S5. Residuals autocorrelation (ACF), partial ACF, and distribution of Model 2 in Table S15.
## Prosociality – England

| Predictors                      | Estimates | CI          | Statistic | p    | Estimates | CI          | Statistic | p    | Estimates | CI          | Statistic | p    |
|--------------------------------|-----------|-------------|-----------|------|-----------|-------------|-----------|------|-----------|-------------|-----------|------|------|
| (Intercept)                    | 0.00      | -0.08 - 0.09 | 0.08      | 0.932| 0.00      | -0.08 - 0.08 | 0.03      | 0.977| -0.15     | -0.39 - 0.10 | -1.16     | 0.246|
| GDPpc                          | 0.24      | 0.16 - 0.32 | 5.90      | <0.001| -0.05     | -0.25 - 0.16 | -0.47     | 0.639| -0.46     | -0.95 - 0.03 | -1.86     | 0.063|
| year                           | 0.33      | 0.11 - 0.54 | 3.01      | 0.003| 0.15      | -0.17 - 0.48 | 0.92      | 0.357|
| GDPpc * period [post glorious revolution] |          |             |           |      | 0.50      | -0.08 - 1.08 | 1.69      | 0.091|
| period [pre_civil_war]         |           |             |           |      | -0.14     | -0.72 - 0.44 | -0.47     | 0.636|
| GDPpc * period [pre_civil_war] |           |             |           |      | 0.34      | -0.27 - 0.96 | 1.09      | 0.274|
| period [post glorious revolution] |           |             |           |      | 0.25      | -0.07 - 0.57 | 1.52      | 0.128|

### Random Effects

- $\sigma^2$: 0.76
- $\tau_{00}$: 0.17
- ICC: 0.18
- N: 308

### Observations
- 919
- 919
- 912

### Marginal R² / Conditional R²
- 0.058 / 0.231
- 0.078 / 0.242
- 0.085 / 0.254

### log-Likelihood
- -1250.175
- -1246.966
- -1238.343

---

**Table S16.** LMM results for Prosociality in England as predicted by time (year), GDP per capita (GDP) and historical period (reference period: Restoration).
Figure S6. Residuals autocorrelation (ACF), partial ACF, and distribution of Models 2 and 3 in Table S15.
2.4.2 Affluence and Cooperation (France)

**Trust – France**

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Estimates</th>
<th>CI</th>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.04</td>
<td>-0.05 – 0.13</td>
<td>0.83</td>
<td>0.409</td>
</tr>
<tr>
<td>year</td>
<td>0.50</td>
<td>0.39 – 0.61</td>
<td>8.85</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>GDPpc</td>
<td>0.03</td>
<td>-0.04 – 0.09</td>
<td>0.81</td>
<td>0.416</td>
</tr>
</tbody>
</table>

**Random Effects**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma^2$</td>
<td>0.59</td>
</tr>
<tr>
<td>$\tau_{00 \text{ author}}$</td>
<td>0.20</td>
</tr>
<tr>
<td>ICC</td>
<td>0.25</td>
</tr>
<tr>
<td>$N_{\text{author}}$</td>
<td>233</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Observations</th>
<th>841</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal $R^2$ / Conditional $R^2$</td>
<td>0.170 / 0.376</td>
</tr>
</tbody>
</table>

**Table S17.** LMM results for Trust in France as predicted by time (year) and GDP per capita (GDP).
Figure S7. Residuals autocorrelation (ACF), partial ACF, and distribution of Model 2 in Table S12.
## Sympathy – France

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Sympathy</th>
<th>Estimates</th>
<th>CI</th>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td></td>
<td>-0.03</td>
<td>-0.13 – 0.07</td>
<td>-0.54</td>
<td>0.592</td>
</tr>
<tr>
<td>GDPpc</td>
<td></td>
<td>-0.03</td>
<td>-0.11 – 0.04</td>
<td>-0.90</td>
<td>0.369</td>
</tr>
<tr>
<td>year</td>
<td></td>
<td>0.19</td>
<td>0.07 – 0.31</td>
<td>3.10</td>
<td>0.002</td>
</tr>
</tbody>
</table>

### Random Effects
- $\sigma^2$: 0.74
- $\tau_{00\text{ author}}$: 0.23
- ICC: 0.24
- N author: 234

<table>
<thead>
<tr>
<th>Observations</th>
<th>856</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal R$^2$ / Conditional R$^2$</td>
<td>0.020 / 0.252</td>
</tr>
</tbody>
</table>

**Table S18.** LMM results for Sympathy in France as predicted by time (year) and GDP per capita (GDP).
**Figure S8.** Residuals autocorrelation (ACF), partial ACF, and distribution of Model in Table S17.
## Prosociality – France

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Estimates</th>
<th>CI</th>
<th>Statistic</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>0.56</td>
<td>-2.19 – 3.30</td>
<td>0.40</td>
<td>0.691</td>
</tr>
<tr>
<td>GDPpc</td>
<td>-0.00</td>
<td>-0.00 – 0.00</td>
<td>-0.42</td>
<td>0.673</td>
</tr>
<tr>
<td>year</td>
<td>0.37</td>
<td>0.26 – 0.48</td>
<td>6.50</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

GDPpc * period
[revolution]

<table>
<thead>
<tr>
<th></th>
<th>σ²</th>
<th>τ00</th>
<th>ICC</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.73</td>
<td>0.16</td>
<td>0.18</td>
<td>252</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>930</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marginal R² / Conditional R²</td>
<td>0.082 / 0.248</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>log-Likelihood</td>
<td>-1235.736</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table S19.** LMM results for Prosociality in France as predicted by time (year) and GDP per capita (GDP).
Figure S9. Residuals autocorrelation (ACF), partial ACF, and distribution of Model in Table S18.
### 2.5. Lag Analysis

#### 2.5.1. Lag analysis (England)

**England – Trust**

<table>
<thead>
<tr>
<th></th>
<th>Trust (1)</th>
<th>Trust (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP T+6</td>
<td>0.473***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.095)</td>
<td></td>
</tr>
<tr>
<td>year</td>
<td>0.964***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.184)</td>
<td></td>
</tr>
<tr>
<td>GDPm18</td>
<td>-0.410**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.169)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.036</td>
<td>-0.076</td>
</tr>
<tr>
<td></td>
<td>(0.094)</td>
<td>(0.084)</td>
</tr>
</tbody>
</table>

| Observations        | 176       | 176       |
| Log Likelihood      | -217.680  | -212.781  |
| Akaike Inf. Crit.   | 443.360   | 435.563   |
| Bayesian Inf. Crit. | 456.041   | 451.415   |

**Note:**

* p ** p *** p<0.01

**Table S20.** Best models for Trust in England as predicted by time (year) and GDP per capita (GDP) at time lags ranging from T-20 to T+20. Model selection computed with generalized least squares (GLS) with time (years) as the dimension across other variables are autocorrelated (corrCAR1(form = ~ year)).
## England – Sympathy

### Final Best models with (2) and without time (1) as covariate

<table>
<thead>
<tr>
<th>Sympathy</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>year</strong></td>
<td>0.590*</td>
<td>0.495***</td>
</tr>
<tr>
<td>(0.324)</td>
<td></td>
<td>(0.189)</td>
</tr>
<tr>
<td>GDP T-10</td>
<td><strong>0.520</strong>*</td>
<td>0.477***</td>
</tr>
<tr>
<td>(0.177)</td>
<td>(0.169)</td>
<td>(0.205)</td>
</tr>
<tr>
<td>GDP T-16</td>
<td><strong>0.477</strong>*</td>
<td>0.631***</td>
</tr>
<tr>
<td>(0.169)</td>
<td>(0.205)</td>
<td></td>
</tr>
<tr>
<td>GDP T+19</td>
<td><strong>-0.447</strong>*</td>
<td></td>
</tr>
<tr>
<td>(0.158)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP T-18</td>
<td><strong>-0.486</strong></td>
<td></td>
</tr>
<tr>
<td>(0.194)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP T+18</td>
<td><strong>-0.659</strong>*</td>
<td></td>
</tr>
<tr>
<td>(0.218)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.094</td>
<td>0.075</td>
</tr>
<tr>
<td>(0.084)</td>
<td>(0.079)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>179</td>
<td>179</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-218.445</td>
<td>-215.061</td>
</tr>
<tr>
<td>Akaike Inf. Crit.</td>
<td>448.890</td>
<td>446.123</td>
</tr>
<tr>
<td>Bayesian Inf. Crit.</td>
<td>468.014</td>
<td>471.622</td>
</tr>
</tbody>
</table>

**Note:**
- * p < 0.05
- ** p < 0.01
- *** p < 0.001

**Table S21.** Best models for Sympathy in England as predicted by time (year) and GDP per capita (GDP) at time lags ranging from T-20 to T+20. Model selection computed with generalized least squares (GLS) with time (years) as the dimension across other variables are autocorrelated (corrCAR1(form = ~ year)).
## England – Prosociality

**Final Best models with (2) and without time (1) as covariate**

<table>
<thead>
<tr>
<th></th>
<th>Prosociality2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td><strong>year</strong></td>
<td>0.760***</td>
</tr>
<tr>
<td></td>
<td>(0.293)</td>
</tr>
<tr>
<td><strong>GDP+3</strong></td>
<td>0.850***</td>
</tr>
<tr>
<td></td>
<td>(0.169)</td>
</tr>
<tr>
<td><strong>GDP-14</strong></td>
<td>-0.414**</td>
</tr>
<tr>
<td></td>
<td>(0.162)</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>0.060</td>
</tr>
<tr>
<td></td>
<td>(0.078)</td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>175</td>
</tr>
<tr>
<td><strong>Log Likelihood</strong></td>
<td>-223.656</td>
</tr>
<tr>
<td><strong>Akaike Inf. Crit.</strong></td>
<td>457.312</td>
</tr>
<tr>
<td><strong>Bayesian Inf. Crit.</strong></td>
<td>473.136</td>
</tr>
</tbody>
</table>

|                  | 0.545***      |
|                  | (0.201)       |
| -0.776***        |
| (0.209)          |
| 0.059            |
| (0.074)          |

**Note:** *p<0.1; **p<0.05; ***p<0.01

### Table S22.

Best models for Prosociality in England as predicted by time (year) and GDP per capita (GDP) at time lags ranging from T-20 to T+20. Model selection computed with generalized least squares (GLS) with time (years) as the dimension across other variables are autocorrelated (corrCAR1(form = ~ year)).
### 2.5.2. Lag analysis (France)

**France – Trust**

<table>
<thead>
<tr>
<th>Final Best models with (2) and without time (1) as covariate</th>
<th>Trust</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>GDP T-10</td>
<td>0.570***</td>
<td>(0.203)</td>
</tr>
<tr>
<td>GDP T+12</td>
<td>0.723***</td>
<td>(0.224)</td>
</tr>
<tr>
<td>Year</td>
<td>1.560***</td>
<td>(0.170)</td>
</tr>
<tr>
<td>GDP T-2</td>
<td>0.423***</td>
<td>(0.089)</td>
</tr>
<tr>
<td>GDP T-18</td>
<td>-1.039***</td>
<td>(0.289)</td>
</tr>
<tr>
<td>GDP T-19</td>
<td>0.933***</td>
<td>(0.292)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.446**</td>
<td>0.499***</td>
</tr>
<tr>
<td>(0.193)</td>
<td>(0.097)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>153</td>
<td>153</td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-190.662</td>
<td>-171.945</td>
</tr>
<tr>
<td>Akaike Inf. Crit.</td>
<td>395.324</td>
<td>357.890</td>
</tr>
<tr>
<td>Bayesian Inf. Crit.</td>
<td>416.537</td>
<td>379.103</td>
</tr>
</tbody>
</table>

Table S23. Best models for Trust in France as predicted by time (year) and GDP per capita (GDP) at time lags raging from T-20 to T+20. Model selection computed with generalized least squares (GLS) with time (years) as the dimension across other variables are autocorrelated (corrCAR1(form = ~ year)). Type II Sum of Squares (top), and Type III (below). Models marked with (1) do not include time (year) and models with (2) include time.
France – Sympathy

<table>
<thead>
<tr>
<th>Final Best models with (2) and without time (1) as covariate</th>
<th>Sympathy</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>year</td>
<td>0.696***</td>
<td></td>
<td>0.192</td>
</tr>
<tr>
<td>GDP T-3</td>
<td>-0.731**</td>
<td>-0.805***</td>
<td>(0.286)</td>
</tr>
<tr>
<td>GDP T-4</td>
<td>0.883***</td>
<td>0.814***</td>
<td>(0.290)</td>
</tr>
<tr>
<td>GDP T+18</td>
<td></td>
<td>-0.438***</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.020</td>
<td>0.411***</td>
<td>(0.093)</td>
</tr>
<tr>
<td>Observations</td>
<td>153</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>Log Likelihood</td>
<td>-209.090</td>
<td>-200.996</td>
<td></td>
</tr>
<tr>
<td>Akaike Inf. Crit.</td>
<td>428.180</td>
<td>415.991</td>
<td></td>
</tr>
<tr>
<td>Bayesian Inf. Crit.</td>
<td>443.332</td>
<td>437.204</td>
<td></td>
</tr>
</tbody>
</table>

**p** **p** *** p<0.01

Table S24. Best models for Sympathy in France as predicted by time (year) and GDP per capita (GDP) at time lags ranging from T-20 to T+20. Model selection computed with generalized least squares (GLS) with time (years) as the dimension across other variables are autocorrelated (corrCAR1(form = ~ year)). Type II Sum of Squares (top), and Type III (below). Models marked with (1) do not include time (year) and models with (2) include time.
## France – Prosociality

### Final Best models with (2) and without time (1) as covariate

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>Prosociality2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>GDP-15</td>
<td>0.511***</td>
<td>(0.158)</td>
</tr>
<tr>
<td>year</td>
<td>1.073***</td>
<td>(0.158)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.124</td>
<td>0.383***</td>
</tr>
<tr>
<td></td>
<td>(0.094)</td>
<td>(0.090)</td>
</tr>
</tbody>
</table>

| Observations        | 155           | 155 |
| Log Likelihood      | -213.470      | -198.912 |
| Akaike Inf. Crit.   | 434.940       | 405.824 |
| Bayesian Inf. Crit. | 447.114       | 417.997 |

**Note:** *p<0.1; **p<0.05; ***p<0.01

**Table S25.** Best models for Prosociality in France as predicted by time (year) and GDP per capita (GDP) at time lags ranging from T-20 to T+20. Model selection computed with generalized least squares (GLS) with time (years) as the dimension across other variables are autocorrelated (corrCAR1(form = ~ year)). Type II Sum of Squares (top), and Type III (below). Models marked with (1) do not include time (year) and models with (2) include time.
2.6. Exploratory analyses with additional socio-economic variables for the English Data.

**England**

<table>
<thead>
<tr>
<th>Variable</th>
<th>GDPc</th>
<th>Books</th>
<th>Wages</th>
<th>Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>trust</td>
<td>0.4</td>
<td>0.24</td>
<td>0.28</td>
<td>0.53</td>
</tr>
<tr>
<td>sympathy</td>
<td>0.2</td>
<td>0.32</td>
<td>0.20</td>
<td>0.25</td>
</tr>
<tr>
<td>prosociality</td>
<td>0.96</td>
<td>0.5</td>
<td>0.26</td>
<td>0.21</td>
</tr>
</tbody>
</table>

**Figure S10.** Correlation table and cross correlation analyses with additional socio-economic variables for the English Data. GDP: GDP per capita (see main text); Books (Fink-Jensen, Jonathan (2015). Book Titles per Capita. http://hdl.handle.net/10622/AOQMAZ, accessed via the Clio Infra website); Wages (1), Life (Zijdeman, Richard and Filipa Ribeira da Silva (2015). Life Expectancy at Birth (Total). http://hdl.handle.net/10622/LKYT53, accessed via the Clio Infra website).
Figure S11. Correlation table and cross correlation analyses with additional socio-economic variables for the French Data. GDP: GDP per capita (2); Books (Fink-Jensen, Jonathan (2015). Book Titles per Capita. http://hdl.handle.net/10622/AOQMAZ, accessed via the Clio Infra website); Wages (3).
3. Method validation

In this section we perform a series of tests to evaluate whether our tools provide adequate measures of cooperation. In the first section, Internal Validation, we will assess whether our different bags of words related to cooperation form distinct constructs in relation to the bags of words related to dominance. To that purpose we will perform 1) an exploratory Factor analysis with the basic categories Sympathy, Trustworthiness, Prosociality, Anger, Authoritarianism and Strength; and 2) We will assess whether there are particular words within each bag which exert a disproportional influence in the analysis and repeat the analysis without these influential words. In the second section, external validation, we will assess how well our bags of words – which are specifically designed for the early modern period - correlate with modern proxies of cooperation and dominance from the Linguistic Inquiry and Word Count (LIWC) (4, 5).

3.1. Internal validation

3.1.1. Factor Analysis

We performed a factor analysis to assess whether our bags of words related to cooperation measured homogenous constructs across all proxies (trustworthiness, prosociality and sympathy), and most importantly, whether these were distinct from the measures of dominance (anger, strength and authoritarianism).

For English plays, the exploratory factor analysis yielded two factors ($\chi^2 (4) = 122.04, p < 0.001$). Anger, Strength and Authority loaded higher in Factor 1, which explained 24% of the variance, while Trust, Sympathy and Prosociality loaded higher in Factor 2, explaining 21% of the variance (Figure S12). For French plays, the exploratory factor analysis also yielded two factors ($\chi^2 (4) = 34.12, p < 0.001$). Anger, Strength and Authority loaded higher in Factor 1, which explained 33% of the variance, while Trust, Sympathy and Prosociality loaded higher in Factor 2, explaining 32% of the variance (Figure S12).
Figure S12. Exploratory factor analysis with the basic bag-of-words categories: sympathy, trust, prosociality, anger, trustworthiness and authoritarianism. For both England and France, we obtain two factors which clearly separate the proxies of cooperation (Factor 2) and dominance (Factor 1). Then we plotted the time distribution of the plays’ factor scores and confirm that the cooperation grows the fastest before the revolutionary periods.
3.1.2. Robustness

A potential pitfall of using the bag-of-words approach is that a few words within each bag might be disproportionately more frequent than the others and thus skew the data. In this section, we first assess whether this was the case (Table S25) and then plot the historical analysis while removing the 2 most frequent words within each bag (Figures S12–S13).

<table>
<thead>
<tr>
<th>Category</th>
<th>Mean word frequency (% in texts)</th>
<th>Mean % of text comprised of words in the bag</th>
<th>Top 2 most common words per category (frequency in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>England</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sympathy</td>
<td>0.01</td>
<td>0.286</td>
<td>pity (0.072) mercy (0.045)</td>
</tr>
<tr>
<td>Anger</td>
<td>0.01</td>
<td>0.25</td>
<td>grief (0.056) rage (0.049)</td>
</tr>
<tr>
<td>Trust</td>
<td>0.001</td>
<td>0.169</td>
<td>friendship (0.038) goodness (0.025)</td>
</tr>
<tr>
<td>Strength</td>
<td>0.02</td>
<td>0.45</td>
<td>power (0.137) virtue (0.092)</td>
</tr>
<tr>
<td>Prosociality</td>
<td>0.015</td>
<td>1.11</td>
<td>care (0.112) help (0.077)</td>
</tr>
<tr>
<td>Authority</td>
<td>0.017</td>
<td>1.79</td>
<td>lord (0.386) master (0.163)</td>
</tr>
<tr>
<td><strong>France</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sympathy</td>
<td>0.15</td>
<td>0.33</td>
<td>soin (0.110) bonte (0.042)</td>
</tr>
<tr>
<td>Anger</td>
<td>0.023</td>
<td>0.37</td>
<td>furour (0.058) haine (0.055)</td>
</tr>
<tr>
<td>Trust</td>
<td>0.013</td>
<td>0.21</td>
<td>tendresse (0.045) zele (0.033)</td>
</tr>
<tr>
<td>Strength</td>
<td>0.02</td>
<td>0.39</td>
<td>vertu (0.104) courage (0.054)</td>
</tr>
<tr>
<td>Prosociality</td>
<td>0.016</td>
<td>1.0</td>
<td>soin (0.110) sentiment (0.058)</td>
</tr>
<tr>
<td>Authority</td>
<td>0.024</td>
<td>1.35</td>
<td>seingeur (0.151) honneur (0.135)</td>
</tr>
</tbody>
</table>

Table S26. Word and bag-of-word mean frequencies.
Figure S13. (A) Density plots of word frequencies within each basic category. To test whether our main effects were caused by one or two influential words within each group, we identified the two words with the highest frequency and removed them from the analysis. The vertical red dotted line is a reference for the frequency above which words were removed for each category. Graphs (B)-(D) depict the historical analysis without those high frequency words.
Figure S14. (A) Density plots of word frequencies within each basic category. To test whether our main effects were caused by one or two influential words within each group, we identified the two words with the highest frequency and removed them from the analysis. The vertical red dotted line is a reference for the frequency above which words were removed for each category. Graphs (B)-(D) depict the historical analysis without those high frequency words.
3.2. External validation – Modern word lists

**England**

![Correlation diagram](image)

**Figure S15.** Correlation between our ratios (based on early modern word use) and well-standardized measures for modern English from the Linguistic Inquiry and Word Count (LIWC). The blue area (on the left) depicts the correlation with possible LIWC proxies of prosociality and the red area (on the right) the correlation with possible LIWC proxies of dominance.
Figure S16. Correlation between our ratios (based on early modern word use) and well-standardized measures for modern French from the Linguistic Inquiry and Word Count (LIWC). The blue area (on the left) depicts the correlation with possible LIWC proxies of prosociality and the red area (on the right) the correlation with possible LIWC proxies of dominance.
Figure S17. Genre analysis across potential proxies of cooperation (Social, Friend, Affiliation) and dominance (Anger, Clout, Power) from the LIWC tool, which is validated for modern texts. (Upper row, blue) France. The ‘Social’ categories and ‘Anger’ seem to correctly differentiate comedies from tragedies. The category ‘Friend’ is higher in tragedies thus is a poor proxy of cooperation. (Lower rows, red) England. The ‘Social’ categories and ‘Anger’ seem to correctly differentiate comedies from tragedies. The category ‘Power’ might also be used as a proxy of Dominance. ‘Clout’ and ‘Affiliation’ do not distinguish between genres. Note: LIWC have different available categories for different languages.
**Figure S18.** Time series and historical analyses using the adequate LIWC proxies selected from Figure S16, for both England (red) and France (blue). We calculated cooperation-to-dominance ratios - Social-to-Anger and Social-to-Power using a similar formula to own proxies. Crucially, these LIWC ratios generate similar time series and cooperation slopes to those obtained using our own tools.
References


