

# The Terror of History: Solar Eclipses and the Origins of Critical Thinking and Complexity



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## This Paper

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- We propose a novel determinant of pre-modern critical thinking —a precursor of human capital— and social complexity.
  - The incidence of rare events, in particular, solar eclipses.

# Motivation

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- Human capital is crucial for economic growth.
  - Mokyr (2005), Voitgländer and Squicciarini (2015), Valencia Caicedo (2018), Galor and Weil (2000).
- Economic prosperity and social complexity have always been inter-related.
  - Diamond (1997), Harari (2011), Mann (2012), Moav et al. (2018).

# Main Hypothesis and Mechanism

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## Main Hypothesis

- We study the impact of total solar eclipses on critical thinking and social complexity.

## Identification strategy:

We exploit the advantages inherent in rare phenomena.

- They are exogenous.
- They are rare → People do not get used to them.
- Are recurrent → Demand for explanation remains over time.

## Mechanism:

- As such, rare events challenge social groups, that ultimately become better at thinking and solving problems.

## Mechanism

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*"Since the cause of being afraid is not to know, isn't it very worthwhile to know, so we can be unafraid? How much better it is to inquire into the causes and, in fact, to be intent on this with the whole of our mind," for, "there is nothing greater than this: to know nature."*

**(Seneca, Natural Questions, 6.3.4)**

# Solar Eclipses

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## **Definition:**

Alignment between the Sun, the Moon and the Earth.

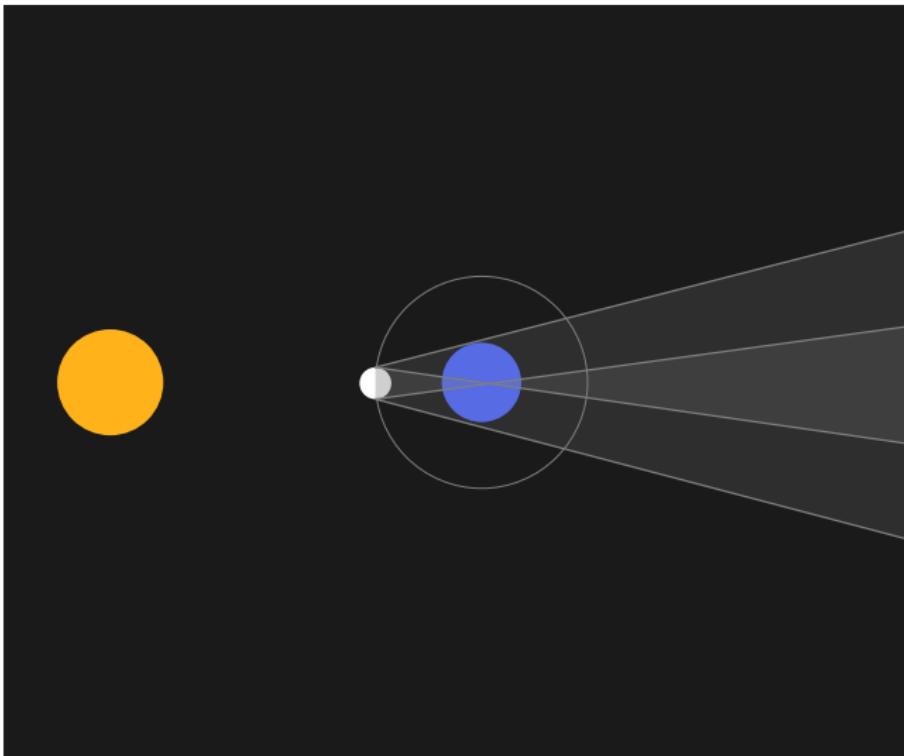
The Moon obscures the Sun.

## **Characteristics:**

- A solar eclipse can be seen from a narrow path on Earth.
- Random occurrence.
- 100 km wide, stretching long distances east-west.
- Affects several locations simultaneously.

# Solar Eclipses

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# Why Solar Eclipses

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- Other intimidating phenomena:
  - Volcano eruptions,
  - Earthquakes,
  - Lunar eclipses
- Why eclipses?
  - Not common (as lightning) but not too rare.
  - Do not destroy physical nor human capital.
  - Narrow area of effect: provides variation.
  - Lunar eclipses can be seen from half of the world,

## Data: Total Solar Eclipses

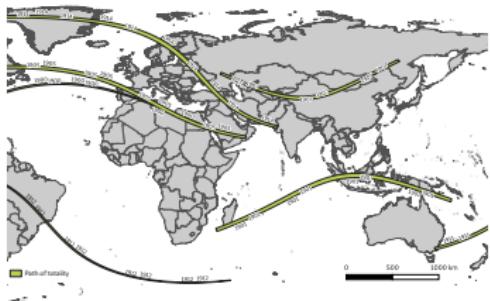
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- We intersect eclipse paths with ethnic homelands.
- We consider all total solar eclipses between -2000 and 2000.
  - Partial eclipses covering less than 90% of the Sun are unnoticeable in terms of darkening.
- We count the number of total solar eclipses visible from within an ethnic homeland.

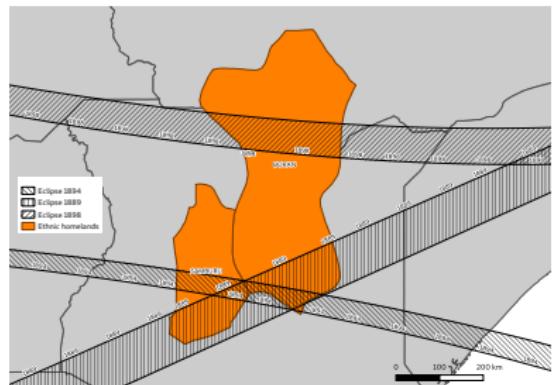
# Data: Total Solar Eclipses

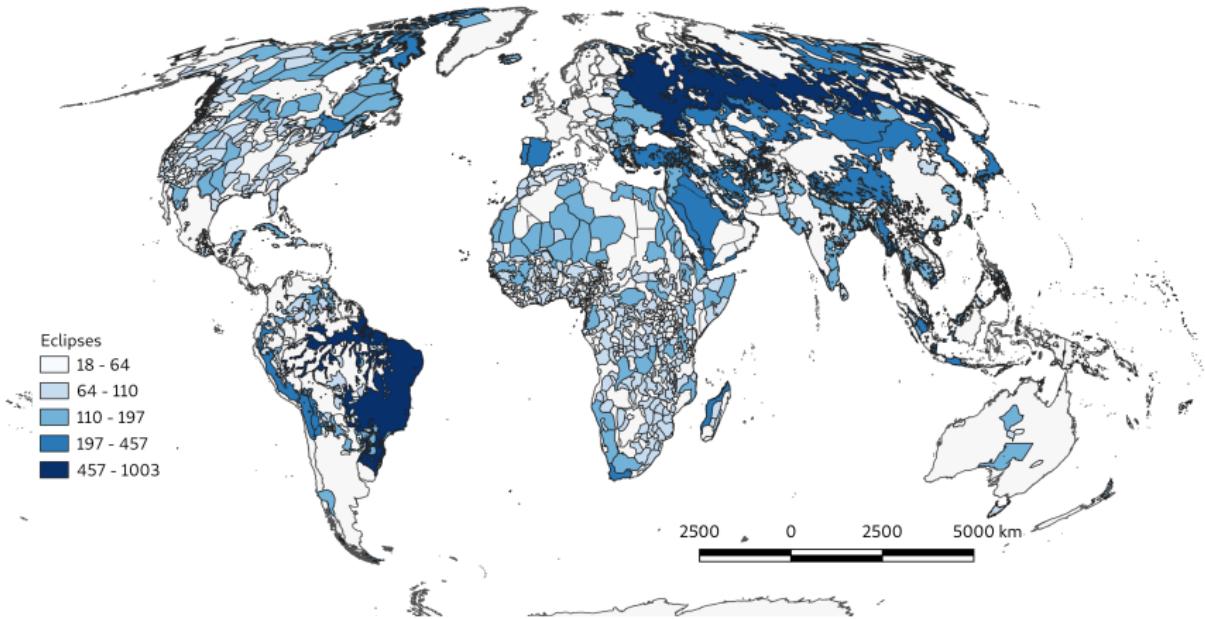
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(a) Paths of totality.



(b) Computation of the total number of eclipses.





## Data: Outcome Variables

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- Ethnographic Atlas data:
  - Social complexity.
    - Jurisdictional Hierarchy Beyond Local Community.  
{No levels; . . .; four levels}
    - Political Integration  
{Absence; Local com.; Peace groups; Min. states; Little states; States}
    - Class Stratification  
{Absence; Wealth; Elite; Dual; Complex.}
  - Critical thinking
    - High Gods.  
{No high gods; Not active in human affairs; Active, not supportive of morality; Supportive of morality}
    - Playing strategy games.  
{No games present, Games present}

# Summary Statistics

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	Mean	Std.Dev.	Min.	Max.		Mean	Std.Dev.	Min.	Max.
<i>Eclipses</i>					Annual mean temp.	196.738	85.867	-158.621	301.410
Number of eclipses	77.264	61.576	17.000	1002.000	Annual precipitation	1324.715	945.300	0.264	6415.639
Max. Time between eclipses	2.921	1.239	0.242	8.575	Temp. seasonality	3504.329	3475.523	108.250	20324861
Min. Time between eclipses	0.021	0.025	0.000	0.214	Precipitation seasonality	66.201	33.373	5.048	215.847
Avg. time between eclipses	0.658	0.289	0.040	2.151	Ecological diversity	0.419	0.246	0.000	0.839
Number of lunar eclipses	1584.582	106.359	1521.000	2780.000	Dist. coast (degrees)	4.223	3.921	0.000	16.535
<i>Jurisdictional Hierarchy</i>					Dist. river (degrees)	2.360	7.834	0.002	77.675
No levels	0.447	0.497	0.000	1.000	Dist. Addis Ababa (degrees)	233.323	268.472	1.119	723.192
One level	0.312	0.463	0.000	1.000	Ruggedness	88.099	32.506	0.000	199.000
Two levels	0.149	0.356	0.000	1.000	Elevation	163.290	25.378	0.000	210.116
Three levels	0.071	0.257	0.000	1.000	Malaria	0.170	0.206	0.000	0.688
Four levels	0.021	0.143	0.000	1.000	Caloric yield	1252.093	892.230	0.000	4975.770
<i>Class Stratification</i>					Abs. latitude	21.111	17.447	0.017	78.070
Absence among freemen	0.493	0.500	0.000	1.000	South (0/1)	0.212	0.409	0.000	1.000
Wealth distinctions	0.186	0.389	0.000	1.000	<i>Major Crop Type</i>				
Elite	0.039	0.193	0.000	1.000	None	0.200	0.400	0.000	1.000
Dual	0.216	0.412	0.000	1.000	Non food crop	0.002	0.043	0.000	1.000
Complex	0.067	0.249	0.000	1.000	Vegetables	0.002	0.043	0.000	1.000
<i>Political Integration</i>					Tree fruits	0.070	0.255	0.000	1.000
Absence	0.017	0.129	0.000	1.000	Roots or tubers	0.201	0.401	0.000	1.000
Autonomous local comm.	0.100	0.300	0.000	1.000	Cereal grains	0.525	0.500	0.000	1.000
Peace groups	0.008	0.087	0.000	1.000					
Minimal states	0.064	0.246	0.000	1.000					
Little states	0.023	0.150	0.000	1.000					
States	0.031	0.174	0.000	1.000					
<i>High Gods</i>									
Absent	0.353	0.478	0.000	1.000					
Not active in hum. affairs	0.344	0.476	0.000	1.000					
Active in hum. affairs, not supp. of hum. morality	0.058	0.234	0.000	1.000					
Supportive of hum. morality	0.243	0.429	0.000	1.000					
<i>Strategy Games</i>									
Strategy games	0.177	0.382	0.000	1.000					

# Results: Social Complexity

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	Jurisdictional Hierarchy			Political Integration			Class Stratification		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total number of eclipses	0.014*** (0.003)	0.015*** (0.002)	0.015*** (0.002)	0.011*** (0.003)	0.013*** (0.003)	0.016*** (0.003)	0.008*** (0.003)	0.011*** (0.003)	0.011*** (0.003)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geography	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Ethnic	No	No	Yes	No	No	Yes	No	No	Yes
R <sup>2</sup>	0.148	0.219	0.229	0.093	0.192	0.228	0.082	0.157	0.162
Observations	906	906	906	251	251	251	821	821	821

<sup>1</sup> Geography: avg. temp., temp. seasonality, precipitation, precipitation seasonality, dist. to the coast, to rivers and to Addis Ababa, ruggedness, elevation, malaria, caloric yield, absolute latitude, south dummy, major habitat type dummies. Ethnic: major crop type (Fenske, 2014).

<sup>2</sup> \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

# Results: Critical Thinking

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	Higher Gods			Strategy Games		
	(1)	(2)	(3)	(4)	(5)	(6)
Total number of eclipses	0.009*** (0.003)	0.006*** (0.002)	0.006*** (0.002)	0.002*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Geography	No	Yes	Yes	No	Yes	Yes
Ethnic	No	No	Yes	No	No	Yes
R <sup>2</sup>	0.140	0.238	0.247	0.540	0.617	0.655
Observations	584	584	584	334	334	334

<sup>1</sup> Geography: avg. temp., temp. seasonality, precipitation, precipitation seasonality, dist. to the coast, to rivers and to Addis Ababa, ruggedness, elevation, malaria, caloric yield, absolute latitude, south dummy, major habitat type dummies. Ethnic: major crop type (Fenske, 2014).

<sup>2</sup> \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

# Size of the Effects

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**Table:** Marginal eff. of the avg. number of total solar eclipses per century.

	Jurisdictional Hierarchy	Political Integration		Class Stratification		Higher Gods	Strategy Games
	(2)	(2)		(3)		(4)	(5)
No levels	-0.096*** (0.013)	Absent	-0.033*** (0.012)	Absent	-0.083*** (0.020)	No Gods	-0.033*** (0.011)
1 level	0.012*** (0.005)	Local com.	-0.058*** (0.008)	Wealth	0.008** (0.003)	Not active	0.004 (0.003)
2 levels	0.043*** (0.007)	Peace groups	-0.001 (0.001)	Elite	0.005** (0.002)	Active, no morality	0.005** (0.002)
3 levels	0.030*** (0.005)	Min. states	0.018** (0.008)	Dual	0.045*** (0.011)	Morality	0.024*** (0.008)
4 levels	0.010*** (0.004)	Little states	0.024*** (0.004)	Complex	0.025*** (0.008)		
		States	0.050*** (0.012)				0.057*** (0.012)
<i>N</i>	906		251		821		584
							334

# Competing Mechanisms

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- Other rare events
  - Lunar eclipses,
  - Distance to volcanoes,
  - Distance to tectonic plates.

Rare events

## Other Competing Mechanisms

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- Population density: scalar stress (Johnson, 1982)
- Ecological diversity (Fenske, 2014).

Additional controls

## Other Competing Mechanisms

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- Bigger ethnic homelands experiences more eclipses.
- We tackle this by:
  - Control for area.
  - Redefine the main variable:  
Total number of eclipses in a 100-km radius circle around ethnic homelands' centroids.

Area

# Robustness

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- Validity of eclipses measure:
  - Average time between eclipses,
  - Maximum time between eclipses,
  - Minimum time between eclipses.
  - Other time frames: -2000 to -1500, -1500 to -1000, etc.

Alt. eclipses

## Robustness: Other Ethnic Controls

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- Other ethnic controls:
  - Reliance on agriculture,
  - Reliance on hunting and gathering,
  - Subsistence types.

Alt. ethnic

# Spatial Correlation

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- Control for neighbour's number of eclipses,
- Different clustering,
- Control for language family.

Spatial cor.

## Concluding Remarks

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- We find that higher exposure to total solar eclipses is related with:
  - More complex thinking,
  - More complex societies.
- We hypothesize that the underlying mechanism is the need to understand and, ultimately, tame nature.

# Results: Other Rare Events

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	Jurisdictional Hierarchy	Political Integration	Class Stratification	Higher Gods	Strategy Games
	(1)	(2)	(3)	(4)	(5)
Panel A: Volcanoes					
Total number of eclipses	0.015*** (0.002)	0.013*** (0.002)	0.012*** (0.003)	0.006*** (0.002)	0.001*** (0.000)
Dist. Volcano	0.014 (0.021)	0.004 (0.020)	-0.055** (0.026)	-0.009 (0.035)	0.001 (0.004)
<i>R</i> <sup>2</sup>	0.229	0.211	0.167	0.248	0.655
Observations	906	267	821	584	334
Panel B: Tectonic plates					
Total number of eclipses	0.015*** (0.002)	0.013*** (0.002)	0.011*** (0.003)	0.006*** (0.002)	0.001*** (0.000)
Dist. Tec. Plate	-0.018 (0.016)	-0.011 (0.020)	-0.024 (0.025)	0.011 (0.027)	-0.002 (0.002)
<i>R</i> <sup>2</sup>	0.229	0.212	0.163	0.248	0.656
Observations	906	267	821	584	334
Panel C: Lunar Eclipses					
Total number of eclipses	0.016*** (0.003)	0.013*** (0.003)	0.012*** (0.003)	0.007** (0.003)	0.002*** (0.000)
Total number of lunar eclipses	-0.001 (0.002)	-0.000 (0.002)	-0.001 (0.001)	-0.001 (0.002)	-0.000 (0.000)
<i>R</i> <sup>2</sup>	0.229	0.211	0.162	0.248	0.656
Observations	906	267	821	584	334
Controls (common to all regressions)					
Fixed effects	Yes	Yes	Yes	Yes	Yes
Geography	Yes	Yes	Yes	Yes	Yes
Ethnic	Yes	Yes	Yes	Yes	Yes

<sup>1</sup> Geography: avg. temp., temp. seasonality, precipitation, precipitation seasonality, dist. to the coast, to rivers and to Addis Ababa, ruggedness, elevation, malaria, calorific yield, absolute latitude, south dummy, major habitat type dummies. Ethnic: major crop type (Fenske, 2014).

<sup>2</sup> \* *p* < 0.1, \*\* *p* < 0.05, \*\*\* *p* < 0.01.

# Results: Additional Controls

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Panel A: Population density					
Total number of eclipses	0.017*** (0.003)	0.020*** (0.008)	0.018*** (0.005)	-0.002 (0.005)	0.001 (0.001)
<i>Population density</i>					
< 1 p. / 1-5 sq. mile	Ref.	Ref.	Ref.	Ref.	Ref.
1 p. / 1-5 sq. mile	-0.203 (0.821)	-1.763 (1.730)	2.969*** (0.968)	0.677 (0.539)	-0.021 (0.182)
1-5 p. / sq. mile	2.227 (1.673)	1.151 (1.772)	-0.085 (1.109)	-0.502 (1.194)	0.312** (0.135)
1-25 p. / sq. mile	3.517** (1.752)	1.087 (1.168)	0.757 (0.952)	0.169 (1.182)	0.275 (0.233)
26-100 p. / sq. mile	2.503 (1.786)	2.842** (1.325)	1.131 (0.793)	0.007 (0.657)	0.007 (0.156)
101-500 p. / sq. mile	3.187* (1.837)	2.353 (2.387)	1.313 (1.019)	0.827 (0.959)	0.164 (0.388)
> 500 p. / sq. mile	3.962** (1.965)	3.939*** (1.358)	1.333 (1.464)	-0.552 (1.170)	0.403 (0.343)
R <sup>2</sup>	0.411	0.439	0.408	0.337	0.799
Observations	113	86	114	103	76
Panel B: Ecological Diversity					
Total number of eclipses	0.015*** (0.002)	0.012*** (0.002)	0.011*** (0.003)	0.006*** (0.002)	0.001*** (0.000)
Eco. diversity	1.379*** (0.335)	1.443** (0.625)	1.458*** (0.322)	-0.205 (0.431)	-0.040 (0.086)
R <sup>2</sup>	0.236	0.218	0.171	0.248	0.656
Observations	906	267	821	584	334
Controls (common to all regressions)					
Fixed effects	Yes	Yes	Yes	Yes	Yes
Geography	Yes	Yes	Yes	Yes	Yes
Ethnic	Yes	Yes	Yes	Yes	Yes

<sup>1</sup> Geography: avg. temp., temp. seasonality, precipitation, precipitation seasonality, dist. to the coast, to rivers and to Addis Ababa, ruggedness, elevation, malaria, calorific yield, absolute latitude, south dummy, major habitat type dummies. Ethnic: major crop type (Fenske, 2014).

<sup>2</sup> \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

# Results: Area

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	Jurisdictional Hierarchy (1)	Political Integration (2)	Class Stratification (3)	Higher Gods (4)	Strategy Games (5)
Panel A: Area					
Total number of eclipses	0.016*** (0.003)	0.011*** (0.003)	0.012*** (0.003)	0.006*** (0.002)	0.001*** (0.000)
Area	-0.002 (0.005)	0.007 (0.006)	-0.003 (0.004)	0.001 (0.008)	0.000 (0.001)
R <sup>2</sup>	0.229	0.213	0.162	0.247	0.655
Observations	906	267	821	584	334
Panel B: Buffer					
Total number of eclipses (buffer)	0.017* (0.010)	0.035** (0.015)	0.004 (0.008)	0.039** (0.016)	0.000 (0.002)
R <sup>2</sup>	0.187	0.168	0.137	0.245	0.626
Observations	906	267	821	584	334
Controls (common to all regressions)					
Fixed effects	Yes	Yes	Yes	Yes	Yes
Geography	Yes	Yes	Yes	Yes	Yes
Ethnic	Yes	Yes	Yes	Yes	Yes

<sup>1</sup> Geography: avg. temp., temp. seasonality, precipitation, precipitation seasonality, dist. to the coast, to rivers and to Addis Ababa, ruggedness, elevation, malaria, caloric yield, absolute latitude, south dummy, major habitat type dummies. Ethnic: major crop type (Fenske, 2014).

<sup>2</sup> \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

# Results: Alt. Eclipses

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	Jurisdictional Hierarchy	Political Integration	Class Stratification	Higher Gods	Strategy Games
	(1)	(2)	(3)	(4)	(5)
Panel A: Maximum time between eclipses					
Total number of eclipses	0.012*** (0.002)	0.017*** (0.004)	0.008*** (0.003)	0.005 (0.003)	0.001*** (0.000)
Max. time between eclipses	-0.258* (0.140)	0.089 (0.224)	-0.211 (0.154)	-0.115 (0.144)	-0.015 (0.024)
<i>R</i> <sup>2</sup>	0.233	0.229	0.165	0.248	0.656
Observations	906	251	821	584	334
Panel B: Minimum time between eclipses					
Total number of eclipses	0.014*** (0.002)	0.017*** (0.003)	0.011*** (0.003)	0.006** (0.002)	0.002*** (0.000)
Min. time between eclipses	-7.932 (6.208)	8.792* (4.835)	0.506 (4.366)	-2.041 (5.253)	1.608*** (0.333)
<i>R</i> <sup>2</sup>	0.230	0.231	0.162	0.248	0.661
Observations	906	251	821	584	334
Panel C: Avg. time between eclipses					
Total number of eclipses	0.008*** (0.002)	0.012*** (0.004)	0.007*** (0.002)	0.003 (0.003)	0.002*** (0.000)
Avg. time between eclipses	-1.986*** (0.706)	-0.931 (1.014)	-1.109* (0.663)	-0.915 (0.578)	0.108 (0.095)
<i>R</i> <sup>2</sup>	0.236	0.230	0.165	0.250	0.657
Observations	906	251	821	584	334
Controls (common to all regressions)					
Fixed effects	Yes	Yes	Yes	Yes	Yes
Geography	Yes	Yes	Yes	Yes	Yes
Ethnic	Yes	Yes	Yes	Yes	Yes

<sup>1</sup> Geography: avg. temp., temp. seasonality, precipitation, precipitation seasonality, dist. to the coast, to rivers and to Addis Ababa, ruggedness, elevation, malaria, calorific yield, absolute latitude, south dummy, major habitat type dummies. Ethnic: major crop type (Fenske, 2014).

<sup>2</sup> \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

# Results: Additional Ethnic Controls

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	Jurisdictional Hierarchy	Political Integration	Class Stratification	Higher Gods	Strategy Games
	(1)	(2)	(3)	(4)	(5)
Panel A: Gathering					
Total number of eclipses	0.015*** (0.002)	0.012*** (0.002)	0.010*** (0.003)	0.005*** (0.002)	0.001*** (0.000)
Dependence on gathering	-0.342*** (0.079)	-0.509*** (0.108)	-0.356*** (0.086)	-0.234** (0.110)	-0.027* (0.015)
R <sup>2</sup>	0.237	0.232	0.172	0.252	0.660
Observations	906	267	821	584	334
Panel B: Agriculture					
Total number of eclipses	0.015*** (0.002)	0.013*** (0.002)	0.012*** (0.003)	0.006*** (0.002)	0.001*** (0.000)
Dependence on agriculture	0.121* (0.062)	0.247*** (0.069)	0.226*** (0.056)	-0.014 (0.075)	0.036*** (0.011)
R <sup>2</sup>	0.231	0.220	0.171	0.247	0.667
Observations	906	267	821	584	334
Panel C: Agricultural intensity					
Total number of eclipses	0.014*** (0.002)	0.011*** (0.002)	0.010*** (0.002)	0.006** (0.002)	0.001*** (0.000)
<i>Agricultural intensity</i>					
No agric.	Ref.	Ref.	Ref.	Ref.	Ref.
Casual agric.	1.010 (0.838)	2.645** (1.220)	1.108* (0.652)	0.328 (1.903)	0.338*** (0.102)
Extensive agric.	0.845 (0.973)	2.920* (1.577)	1.487 (1.076)	0.260 (1.917)	0.420*** (0.083)
Horticulture	-1.861* (1.100)	0.984 (2.193)	-0.081 (1.385)	0.060 (2.131)	0.298** (0.119)
Intensive agric.	1.796** (0.891)	3.557* (1.843)	2.669*** (0.861)	0.420 (1.906)	0.456*** (0.116)
Intensive irrigated agric.	1.823* (1.042)	4.198** (1.753)	2.594*** (1.003)	0.276 (2.111)	0.494*** (0.124)
R <sup>2</sup>	0.253	0.231	0.185	0.248	0.662
Observations	906	267	821	584	334

# Results: Additional Ethnic Controls

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	Jurisdictional Hierarchy	Political Integration	Class Stratification	Higher Gods	Strategy Games
	(1)	(2)	(3)	(4)	(5)
Panel D: Subsistence economy					
Total number of eclipses	0.014*** (0.002)	0.013*** (0.003)	0.011*** (0.003)	0.005*** (0.002)	0.001*** (0.000)
<i>Subsistence</i>					
Gathering	Ref.	Ref.	Ref.	Ref.	Ref.
Fishing	0.398 (0.500)	-0.622 (0.538)	0.701 (0.542)	0.198 (0.491)	0.005 (0.051)
Hunting	0.555 (0.569)	1.330*** (0.505)	-0.149 (0.630)	0.255 (0.573)	0.019 (0.055)
Pastoralism	1.227** (0.549)	1.081 (0.919)	0.466 (0.604)	1.186 (0.745)	0.008 (0.166)
Int. agric.	0.552 (0.357)	0.627 (0.717)	0.458 (0.550)	0.388 (0.626)	0.137 (0.085)
Two or more sources	1.643*** (0.518)	1.922** (0.806)	1.678*** (0.606)	0.455 (0.518)	0.186** (0.080)
Agric.	0.417 (0.465)	0.182 (0.580)	0.236 (0.525)	0.829 (0.645)	-0.038 (0.041)
Ext. agric.					
<i>R</i> <sup>2</sup>	0.244	0.236	0.183	0.251	0.668
Observations	906	267	821	584	334
Controls (common to all regressions)					
Fixed effects	Yes	Yes	Yes	Yes	Yes
Geography	Yes	Yes	Yes	Yes	Yes
Ethnic	Yes	Yes	Yes	Yes	Yes

<sup>1</sup> Geography: avg. temp., temp. seasonality, precipitation, precipitation seasonality, dist. to the coast, to rivers and to Addis Ababa, ruggedness, elevation, malaria, caloric yield, absolute latitude, south dummy, major habitat type dummies.

<sup>2</sup> \*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

# Results: Spatial Correlation

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	Jurisdictional Hierarchy (1)	Political Integration (2)	Class Stratification (3)	Higher Gods (4)	Strategy Games (5)
Panel A: Clustering at linguistic families					
Total number of eclipses	0.016*** (0.002)	0.013*** (0.003)	0.013*** (0.002)	0.007*** (0.002)	0.001*** (0.000)
R <sup>2</sup>	0.226	0.209	0.158	0.269	0.653
Observations	861	247	779	552	311
Panel B: Clustering at ecoregions					
Total number of eclipses	0.016*** (0.002)	0.013*** (0.003)	0.013*** (0.003)	0.007*** (0.002)	0.001** (0.000)
R <sup>2</sup>	0.226	0.209	0.158	0.269	0.653
Observations	861	247	779	552	311
Panel C: Language Family Fixed Effects					
Total number of eclipses		0.016*** (0.004)	0.011*** (0.003)	0.005* (0.003)	0.001** (0.001)
Language FE	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup>		0.308	0.215	0.354	0.729
Observations		267	821	584	334
Controls (common to all regressions)					
Fixed effects	Yes	Yes	Yes	Yes	Yes
Geography	Yes	Yes	Yes	Yes	Yes
Ethnic	Yes	Yes	Yes	Yes	Yes

<sup>1</sup> Geography: avg. temp., temp. seasonality, precipitation, precipitation seasonality, dist. to the coast, to rivers and to Addis Ababa, ruggedness, elevation, malaria, calorific yield, absolute latitude, south dummy, major habitat type dummies. Ethnic: major crop type (Fenske, 2014).

<sup>2</sup> \* p < 0.1, \*\* p < 0.05, \*\*\* p < 0.01.