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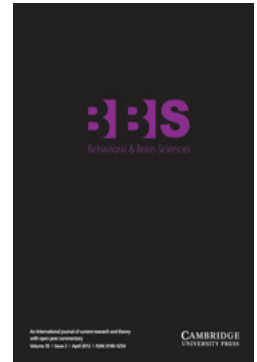Thomas E. Currie and Ruth Mace (2012). Analyses do not support the parasite-stress theory of human sociality. Behavioral and Brain Sciences,35, pp 83-85 doi:10.1017/S0140525X11000963

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Analyses do not support the parasite-stress theory of human sociality

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Abstract: Re-analysis of the data provided in the target article reveals a lack of evidence for a strong, universal relationship between parasite stress and the variables relating to sociality. Furthermore, even if associations between these variables do exist, the analyses presented here do not provide evidence for Fincher & Thornhill's (F&T's) proposed causal mechanism.

There are many problems with the arguments that Fincher & Thornhill (F&T) make, given the data and analyses they present in the target article (and elsewhere). We will limit our criticisms to three main points:

1. The units of analysis are not independent.

2. Correlations may result from association with other variables.

3. There is no evidence of the proposed cognitive mechanism from these analyses.

Because of their historical relationships, countries (F&T's unit of analysis) cannot be considered as independent for the purposes of statistical analysis. Although F&T do acknowledge this, their handling of the issue is flawed. While there is not necessarily a single correct grouping variable, as multiple historical processes may lead to non-independence, the grouping used in their cross-national analyses is problematic. Murdock's (1949) classification of world regions was designed with the analysis of traditional societies in mind. For example, Australia and New Zealand, whose populations are now predominantly of European descent (culturally and biologically), are included in an "Insular Pacific" region along with Indonesia and the Philippines.

We examined the data provided by F&T and reclassified countries into "Europe," "North Africa and Middle East," "Sub-Saharan Africa," "East Eurasia," and "New World" (the Americas, Australia, and New Zealand), reflecting more recent regional historical relationships (see Table 1). A more in-depth analysis would undoubtedly involve some kind of hierarchical linear model (Raudenbush & Bryk 2002), or a phylogenetic comparative method within regions (Currie et al. 2010). However, F&T's argument is for a universal human response to pathogen stress, so if the relationship between the variables is strong, correlations should hold within these groups. As the target article focuses on religiosity, here we examine the variable "Religious participation and value" (although our arguments apply to other aspects of sociality discussed by F&T).

Table 1 (Currie & Mace). *World region classification, absolute latitude, and lnGDP for countries for which Religosity data were available (NAfrME = North Africa and the Middle East)*

Country	World region	Absolute latitude	ln GDP
Albania	Europe	41	8.91
Algeria	NAfrME	28	8.91
Andorra	Europe	42.5	10.71
Argentina	New World	34	9.6
Armenia	Europe	40	8.67
Australia	New World	27	10.63
Austria	Europe	47.33	10.6
Azerbaijan	Europe	40.5	9.31
Bangladesh	East Eurasia	24	7.44
Belarus	Europe	53	9.5
Belgium	Europe	50.83	10.54
Bosnia and Herzegovina	Europe	44	8.79
Brazil	New World	10	9.3
Bulgaria	Europe	43	9.46
Burkina Faso	Africa	13	7.09
Canada	New World	60	10.59
Chile	New World	30	9.65
China	East Eurasia	35	8.91
Colombia	New World	4	9.19
Croatia	Europe	45.17	9.77
Cyprus	Europe	35	9.95
Czech Republic	Europe	49.75	10.15
Denmark	Europe	56	10.51
Dominican Republic	New World	19	9.06
Egypt	NAfrME	27	8.73
El Salvador	New World	13.83	8.9
Estonia	Europe	59	9.85
Ethiopia	Africa	8	6.91
Finland	Europe	64	10.47
France	Europe	46	10.41
Georgia	Europe	42	8.48
Germany	Europe	51	10.49
Ghana	Africa	8	7.38
Greece	Europe	39	10.32
Hong Kong	East Eurasia	22.25	10.73
Hungary	Europe	47	9.85
Iceland	Europe	65	10.51
India	East Eurasia	20	8.13
Indonesia	East Eurasia	5	8.37
Iran	NAfrME	32	9.32
Iraq	NAfrME	33	8.19
Ireland	Europe	53	10.53
Italy	Europe	42.83	10.33
Japan	East Eurasia	36	10.44
Jordan	NAfrME	31	8.58
Kyrgyzstan	East Eurasia	41	7.7
Latvia	Europe	57	9.57
Lithuania	Europe	56	9.67
Luxembourg	Europe	49.75	11.31
Macedonia	Europe	41.83	9.15
Mali	Africa	17	7.09
Malta	Europe	35.83	10.13
Mexico	New World	23	9.53

(continues)

Table 1 (Currie & Mace). *(Continued)*

Country	World region	Absolute latitude	ln GDP
Moldova	Europe	47	7.82
Montenegro	Europe	42	9.2
Morocco	NAfrME	32	8.5
Netherlands	Europe	52.5	10.61
New Zealand	New World	41	10.24
Nigeria	Africa	10	7.78
Norway	Europe	62	10.99
Pakistan	East Eurasia	30	7.78
Peru	New World	10	9.13
Philippines	East Eurasia	13	8.16
Poland	Europe	52	9.84
Portugal	Europe	39.5	10.04
Puerto Rico	New World	18.25	9.7
Republic of Korea (South)	East Eurasia	37	10.32
Romania	Europe	46	9.35
Russia	Europe	60	9.67
Rwanda	Africa	2	7
Saudi Arabia	NAfrME	25	10.09
Serbia	Europe	44	9.31
Singapore	East Eurasia	1.37	10.95
Slovakia	Europe	48.67	10.01
Slovenia	Europe	46	10.25
South Africa	Africa	29	9.28
Spain	Europe	40	10.29
Sweden	Europe	62	10.57
Switzerland	Europe	47	10.67
Taiwan	East Eurasia	23.5	10.49
Tanzania	Africa	6	7.31
Thailand	East Eurasia	15	9.07
Trinidad and Tobago	New World	11	10
Turkey	NAfrME	39	9.42
Uganda	Africa	1	7.09
Ukraine	Europe	49	8.81
United Kingdom	Europe	54	10.47
United States	New World	38	10.77
Uruguay	New World	33	9.57
Venezuela	New World	8	9.44
Vietnam	East Eurasia	16	8.04
Zambia	Africa	15	7.31
Zimbabwe	Africa	20	5.99

Plotting out the relationship between combined parasite stress and religious participation reveals a number of interesting patterns (see our Fig. 1). Europe, for example, exhibits relatively little variation in parasite stress but relatively substantial variation in religious participation. Furthermore, while taking all regions together a positive relationship between the two variables can be seen, the correlation within these regions is not consistent (Pearson correlation coefficients, sub-script represents n: Africa, $r_{11} = 0.39$, $p = 0.24$; East Eurasia, $r_{12} = 0.34$, $p = 0.28$, Europe, $r_{43} = -0.02$, $p = 0.92$, North Africa, $r_8 = 0.05$, $p = 0.90$, New World, $r_{15} = 0.69$, $p = 0.005$). Although these are admittedly small sample sizes within all regions except Europe (where there is practically no relationship in any case), the only region in which there is a substantial relationship between parasite stress and religious participation is the "New World." However, even within this region further inspection
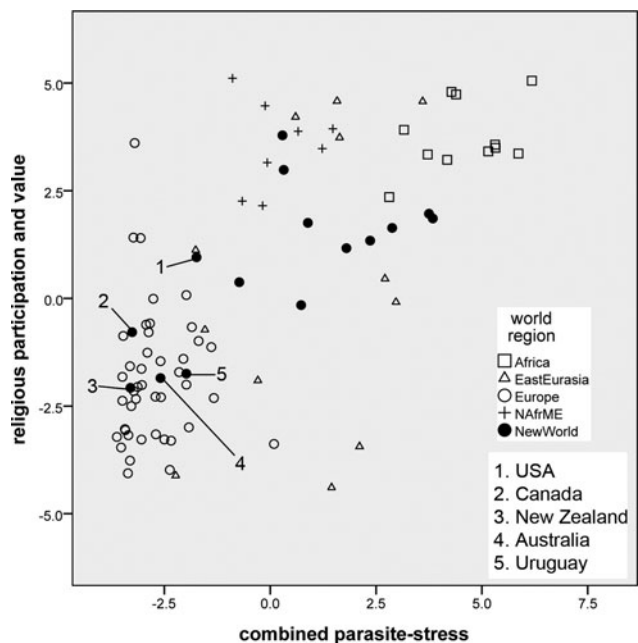
Figure 1 (Currie et al.). Relationship between the variables *religious participation and value* and *combined parasite-stress* with countries grouped according to world region. Although overall there is a negative relationship between the two variables, a strong negative relationship exists only within the "New World" region (see text for details).

reveals that this correlation is being driven by the four English-speaking countries that were settled predominantly by northern Europeans (Canada, USA, Australia, New Zealand). The relationship in the "New World" is no longer statistically significant if these four countries are removed ($r_{11} = 0.43$, $p = 0.18$). Additionally, the remaining positive relationship appears entirely due to the presence of Uruguay (the correlation coefficient in the remaining ten countries is 0.05, $p = 0.90$). The apparent overall strong relationship between religious participation (and other sociality variables) and parasite stress therefore appears at least partly a result of not adequately identifying and controlling for sources of non-independence in the data.

Even if a relationship does remain between the dependent variables and parasite stress after properly controlling for the problem of non-independence, this does not necessarily indicate a causal relationship. As we have pointed out before (Currie & Mace 2009; in press; Mace & Jordan 2011), many ecological variables (including parasite stress) co-vary with latitude. Furthermore, religious participation and parasite stress also co-vary with economic indicators of development such as gross domestic product (GDP). Therefore, the positive association between religious participation and parasite stress may be due to their common co-variation with other factors. Although F&T claim to have controlled for a number of potential confounds, this does not appear to have been conducted in a systematic manner. Indeed, if we enter *lnGDP*, *absolute latitude*, and *combined parasite stress* into a multiple regression model with *religious participation* as the dependent variable then both lnGDP ($\beta = -0.26$, $p = 0.02$) and *absolute latitude* ($\beta = -0.53$, $p < 0.001$) are statistically significant predictors, while *combined parasite stress* is not ($\beta = 0.06$, $p = 0.73$). Teasing apart causal relationships from spurious associations is not easy; however, future work should at least assess alternative models more thoroughly to see whether they do at least as well, if not better, than F&T's favoured hypothesis. We feel it is likely that some other ecological factor or factors that co-vary with latitude (and therefore parasite stress) and affect such things as subsistence strategies and population densities, may ultimately underlie the relationships reported by F&T here and elsewhere.

Finally, even if a robust relationship were to be shown between parasites and the various measures of sociality, using cross-national data, it does not demonstrate that the causal mechanism is the same as that proposed by F&T. They argue for a cognitive mechanism that is sensitive to parasite stress and causes people to exhibit more in-group favouritism accordingly. Yet, there is no direct evidence for such a cognitive mechanism from these analyses. An alternative explanation could be that it is purely cultural evolution, with groups that have a social organization or cultural practices that expose them to greater parasite stress, leaving behind fewer representatives in subsequent generations. These issues will not be addressed by yet more cross-national studies attempting to show that parasite stress is correlated with everything imaginable.

In short, while parasites and diseases have undoubtedly played an important role in shaping human history (Diamond 1997), the analyses presented here do not demonstrate that parasite stress is the strong, universal shaper of human psychology and social behaviour in the manner proposed by F&T.