Moral foundations tracked over 200 years of lexicographic data, and their predictors

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ABSTRACT: The prediction that reduction of negative selection decreases group-level competitiveness, as reflected in increased individual-focused and diminished group-focused moral foundations, is tested. To measure this hypothesized shift in moral foundations, we conduct a culturomic analysis of the utilization frequencies of items sourced from the moral foundations item pool, tracked among Britannic populations from 1800 to 1999 using Google Ngram Viewer. The resultant higher-order factor, which tracks increasing individualizing values and decreasing binding values, is termed *Asabiyyah* (capturing social cohesion and collective purpose). Two predictors of this factor are examined: change in the strength of intergroup competition and change in levels of indicators of developmental instability. Both the strength of intergroup competition and levels of developmental instability associate with *Asabiyyah*. Rising developmental instability mediates the impact of inter-group competition, indicating that reduced between-group competition might have relaxed negative selection against mutations, which might reduce *Asabiyyah* via their effects on inter-genomic transactions. These results must be interpreted carefully, given the clear real-world evidence that explicit commitment to group-oriented values often features in harmful and maladaptive social and political ideologies of an extreme character.

KEY WORDS: Asabiyyah, Lexicographic data, Moral foundations, Multi-level selection

Introduction

Social epistasis refers to intergenomic transactions that occur between at least two organisms, and which modify the gene expression of at least one of the involved organisms. Such social-epistatic changes of gene expression evidently can have phenotypic effects. For instance, in the work of Linksvayer (2007), an early user of the term "social epistasis," evidence is reported that in "three species of closely related *Temnothorax* ants … adult worker size was determined by an interaction between the genotypes of developing brood and care-giving workers, i.e., intergenomic epistasis. Such intergenomic social epistasis provides a strong signature of coevolution between social partners" (p. 1). Evidence of social-epistatic effects has also been found in mice (see Bachmann et al. 2018; Cross 2019; Kalbassi et al. 2017). Among the most impressive findings concerns a mutation, specifically a gene deletion, in mice that is related to autistic-like behavior; it has been found that social association of mice who carry this mutation with mice who do not can lead to the latter exhibiting the autistic-like behavior of the former (Kalbassi et al. 2017).

Investigating the mechanism through which these behavioral changes in mice occur, Cross (2019) found evidence that social contact of mice that were carriers of this mutation with non-carriers changed RNA expression in the latter's brain cells, which is consistent with a social-epistatic effect.

A relatively new line of primarily theoretical research into social epistasis in hu-

mans has concerned development of the social epistasis amplification model or SEAM (Woodley of Menie et al. 2017a). The SEAM was devised to offer a unified explanation of the apparent falling fitness and declining physical and mental health of Western populations from roughly the twentieth to twenty-first centuries (Woodley of Menie et al. 2017a). This model posits, first, that deleterious mutations have been accumulating in Western populations since the substantial relaxation of negative-selective pressure (i.e., selection that removes deleterious mutations) brought on by industrialization and many of its effects on social, technological, and economic development, especially improved sanitation and increases in wealth, which reduced burdens of infectious disease and general environmental harshness (for research on relaxed negative selection, see Kondrashov 2017; Lynch 2016; Rühli and Henneberg 2017). Second, it posits that the fitness costs of these accumulating deleterious mutations may be amplified via social epistasis, with certain deleterious mutations causing harmful changes in patterns of gene expression even in those who do not carry these variants, potentially reducing physical and mental health as well as reproductive success. A simulation indicates that this social-epistatic amplification of the fitness costs of a certain class of deleterious mutations, known as *spiteful mutations* because of their ability to externalize their fitness costs onto others via (in this instance) their social epistatic effect on the gene expression of other organisms in the same population[1], can theoretically cause very rapid decline in

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[1]   The term *spiteful mutation* was coined by Hamilton (1971), who speculated that mutations that were spiteful in their action in terms of their fitness costs to both carriers and others would have difficulty evolving because of their inability to bring into being complex, individual-level genetic adaptations that would theoretically be needed for them to produce such spiteful effects (he notes specifically that "it seems

the fitness of entire populations (Woodley of Menie et al. 2017a).

One possibility is that differential expressions of moral foundations and

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unlikely that a multigenic spiteful adaptation could evolve"). Were they to arise in "[a] population which is small enough, and sufficiently bunched together, to make possible the distribution of such extensive harm," he notes that "any strongly spiteful mutation is very likely to cause its extinction" and "must act like a final infection that kills failing twigs of the evolutionary tree." Woodley of Menie et al. (2017a) presented a solution to the problems raised by Hamilton in noting, first, that the carriers of such mutations do not need to be executing individual-level adaptative strategies that are specifically tailored toward spite; instead, such mutations can capitalize on preexisting individual-level adaptations (such as those that subserve social cognition) and group-level adaptations (such as religious and social ritual). The impacts of spiteful mutations on the integrity of the latter can negatively affect the fitness of others, who depend on optimal cultural expressions of these adaptations, via social epistasis. Second, based on simulations, it has been found that mutations that are spiteful in their action can only accumulate if the rate at which such mutations are arising due to the relaxation of negative selection in a growing population exceeds their individual and (critically) their group-level fitness cost. Such mutations can be expected to have cumulative and harmful effects on patterns of social epistasis, reducing the fitness of a growing population of socially associated genotypes, with such a process eventually leading to the rapid collapse of the population. It is necessary to note that the term "spiteful mutant" has found currency among some commentators on both the political left and right, who use the term to denigrate political opponents whom these individuals regard as being in some way socially dysfunctional and/or undesirable. But it is inappropriate to use the term in such partisan and abusive ways. In the first place, there is no reliable method by which to comprehensively take account of the relative genetic and environmental contributions to the particular traits or behaviors of any given individual. So, to attribute with certainty a specific trait or behavior in a specific individual simply or even primarily to spiteful mutations is quite ridiculous. Spiteful mutations might partly contribute to a large number of extreme and maladaptive behaviors and beliefs found on both sides of the political spectrum and in other contexts. Therefore, politically partisan use of the term is, to repeat, inappropriate. It is worth noting that in the contemporary political context, individuals on the far left *and* the far right, such as those associated with the "alt-right" and neo-Nazi movements, have exhibited profoundly maladaptive behaviors that disturb and threaten the wellbeing and integrity of the groups in which they are embedded; the behavioral profiles of such persons on the whole are at substantial remove from the normative "centers of gravity" of their societies, both in those societies' modern and in many respects historical forms, and it is possible that unusual genetic factors could have a role in the tendency of certain individuals to gravitate to extreme, non-normative ideologies on both sides of the political spectrum. (While it is true that there is evidence that greater rightism is associated with higher fertility (Fieder and Huber 2018), which would obviously relate positively to fitness, it is unclear if this association persists into the truly extreme right-wing end of the political spectrum, since studies measuring political orientation often fail to adequately capture the strikingly non-normative parts of the left-right continuum; moreover, the association could be driven entirely by the positive association between rightism and religiosity, with the typically pro-natal aspect of at least the Abrahamic faiths being the true causal basis of higher fertility in those on the political right. Although prior research by some of the current authors, in addition to this paper, emphasizes the potential role for harmful mutations in the adoption of individualizing [both in Haidt's more narrow sense of the term and in the broader sense of promoting atomization or individualization] ideologies, past research has failed to emphasize the astonishing frequency with which politically extreme views, both on the left and right, promote destructive behaviors at the group and individual levels that belie many of those ideologies' explicit commitment to pro-group orientations). This case of politicized misrepresentation of a biological concept is not dissimilar to that faced by Richard Dawkins in the 1970s after coining the term selfish gene. The concept, and some associated ideas of which Dawkins availed himself, was widely misunderstood by the lay public and misused by politically motivated actors (in particular those on the far right) as a basis for advancing their goals. Just as Dawkins (1981) took the opportunity to oppose in print this misuse of his concept, we, too, take this opportunity to state our opposition to the casual (mis)labeling of people as "spiteful mutants" for abusive and other objectionable purposes. All uses here of the term spiteful mutations (and associated terms and concepts), as in related scientific literature, are meant to be purely descriptive of biological and psychological phenomena in humans and nonhuman animals (Woodley of Menie et al. 2017a; Woodley of Menie et al. 2020).

associated systems[2], which Haidt (2007, see also Haidt 2012) defines broadly as "[i]nterlocking sets of values, practices, institutions, and evolved psychological mechanisms that work together to suppress or regulate selfishness and make social life possible", may correspond to the relative strengths with which group- and individual-level selection have acted on populations over time, as well as their patterns of social epistasis. According to this hypothesis, greater expression of group oriented (or what Haidt (2012) calls *binding*) moral foundations, which are those prioritizing loyalty, sanctity, and respect for authority, reflects higher relative strength of group-level selection than greater expression of more individual-oriented (or what Haidt (2012) calls *individualizing*) moral foundations, which are those prioritizing fairness and avoidance of harm[3].

Hertler, Figueredo and Peñaherrera-Aguirre (2020), proposed that the interpretation of these chronometric factors as reflecting a culture's orientation toward group- versus individual-level selection, resonates quite strongly with the ideas of medieval historian and sociologist Ibn Khaldun (1377), who believed that empires flourish when they are high in *Asabiyyah*. This concept describes a type of cohesive tribalism, and shares similarity with the concepts of *esprit de corps* and *vigor*, which denote a group's legacy of toughness, grit, and resilience.

Taken together, these traits contribute to exceptionally well-integrated groups which are thought to be more organized and capable in the face of conflict with rival groups. Ethnographic and historical evidence suggests that complex sociopolitical systems featuring ultrasocial mechanisms promoting within-group cooperation and proscribing social defection tend to outcompete simpler sociopolitical systems (Hertler et al. 2020). *Asabiyyah* as a prospective measure of groupishness conceptually overlaps with several subsets of terms that are characteristic of highly group-selected populations, including but not limited to *élan*, *panache*, and *dash*, as indicators of martial enthusiasm, *comradery*, *loyalty*, and *compatriotism*, as indicators of fraternal solidarity, and *jingoism*, *nationalism*, and *patriotism*, as indicators of national commitment and cohesiveness. The leixical basis of Haidt's *Binding* higher-order moral foundation clearly also conceptually overlaps with *Asabiyyah*, with the production of words connoting loyalty, sanctity, and deference toward authority, serving as verbal-behavioral markers of orientation toward *Asabiyyah*. Conversely, when cultural emphasis is placed on concepts such as fairness and harm avoidance, reflecting an *individualizing* morality, this can be said to reflect an orientation away from *Asabiyyah*, as such values tend to be associated with personal flourish-

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2   Woodley of Menie et al. (2020) found that advanced paternal age (a strong proxy for de novo mutation load in offspring), net of covariates, is a negative predictor of church attendance in U.S. cohorts born in the 1970s and 1980s, but not among those born in the 1930s and 1940s. One interpretation of this finding is that the accumulation of prospectively spiteful mutations has undermined group-oriented cultural adaptations (such as religious ritual) possibly by promoting attrition. Thus, historically, when cultural pressures to conform to religious norms were strong, we see no effect of paternal age on church attendance; however, among younger cohorts, where these pressures are much weaker, and in some regions virtually absent, we see the expected effect of paternal age on avoidance of engagement with religious ritual.

3   It should be noted that there is some controversy concerning the diachronic stability of the association between moral foundations and ideological dispositions (Smith et al. 2016); however, these objections have been addressed (Haidt 2016).

ing rather than groupishness (Hertler et al. 2020). Ultimately, therefore, the term *Asabiyyah* simply denotes the distinctive observable quality of group-selected populations at the cultural level, and (based on arguments advanced in Hertler et al. 2020) this, in turn, might be reflected in a culture's verbal behavior (e.g., in the generation of texts utilizing certain terms connoting a high *binding* and low *individualising* moral psychology).

Although complex polities initially benefit from the spoils of war, the influx of wealth and ease of living reduces a group's level of *Asabiyyah* (Hertler et al. 2020; Khaldun 1377). Hertler and colleagues (2020) identified a stark macrohistorical decline in a lexicographic *Asabiyyah* factor across two centuries. According to the authors, GDP per Capita significantly reduced the level of *Asabiyyah* above and beyond any temporal autoregressive effects. This negative effect is expected since polities featuring greater macroeconomic growth and stability may allocate their available resources toward reducing morbidity and mortality rates. It follows then that such epidemiological transition should also be associated with relaxation of negative selective pressures facilitating the accumulation of deleterious mutations. Although consistent with SEAM, the authors of the latter study did not explore whether a reduction in between-group competition, an indicator of selective pressures, could positively influence (potential proxies for) mutation accumulation, which in turn may reduce *Asabiyyah* over time.

A prediction deriving from the SEAM is that *Asabiyyah* is likely to decline with time as a consequence of this relaxed negative selection leading to the accumulation of (in particular) spiteful mutations reducing the group-level cohesion of populations, and that this trend might

be captured and measured lexicographically, as in Hertler et al. (2020), using changing cultural expressions associated with decreased *binding* morality, coupled with increased *individualizing* morality, marking the shift away from the sorts of values that are essential to the internal cohesiveness of groups (this being a key component of *Asabiyyah*).

There are also other factors that might influence a population's level of *Asabiyyah*. Heightened expression of individualizing moral sentiment is very likely adaptive under low intergroup competition (peace), as reflected in the conditions that characterize Western late modernity (Hertler et al. 2020). This is likely because being more focused on the mitigation of harms and the promotion of fairness and personal flourishing, and a reduced emphasis on matters promoting group-level fitness, would be more beneficial to individuals under conditions of intergroup peace. This hypothesis is consistent with the *evoked culture* model of Tooby and Cosmides (1992), as flexibility in the development of moral foundations may constitute a kind of evolved plasticity which facilitates the adaptive calibration of behavior in response to various evolutionarily familiar environmental cues. Having gone through periods of both intergroup conflict and peace, human populations may have acquired behavioral and innate moral repertoires that adapt their members to both conditions, with such populations having become evolutionarily prepared for the expression of a range of moral sentiments that adaptively match the situation. Selection may also act via gene-culture coevolution to differentially promote the fitness of various moral genotypes under different regimes of group- and individual-level selection.

To compare these two models (the SEAM versus the evoked culture plus gene-culture coevolution model), in the current study Haidt's *moral foundations theory* will be used to derive a lexicographic diachronic measure of *Asabiyyah*, as indicated by the decline in a latent common factor among the levels of both *binding* and (reverse scored) *individualizing* morality, measured via the utilization frequencies of words corresponding to Haidt's moral foundations in the textual outputs of Britannic populations. It will then be determined whether a diachronic trend in measures of the strength of group-selection have direct effects on the level of this factor, or whether this is mediated by measures of increasing developmental instability (as a proxy for increasing mutation load). It is expected that the developmental instability factor should largely mediate the impact of the intergroup competition measure on the moral foundations factor. This is because decreased intergroup competitiveness likely relaxes negative selection via reductions in social conflict.

Methods

Populations

Data were collected for the following Britannic nations ranging from AD 1800 to 1999, essentially comprising the former British Empire and its various successor states: UK, USA, Canada, New Zealand, and Australia (Figueredo et al. 2019a).

Lexicographic Measures

The historical utilization of these specific classes of words was quantified via their relative frequencies of usage in English language texts across the 200 years spanning AD 1800–1999 through Google Ngram Viewer, an interactive textual corpus encompassing more than 5.9 million texts and 500 billion written words from AD 1500 to 2019 (Michel et al. 2011). The forward extent of our analysis is restricted to 1999, as the post-2000 corpus is known to be highly incomplete. This is consistent with other studies using this database (see: Greenfield 2013; Hills and Adelman 2015; Younes and Ulf-Dietrich 2019). Google Ngram Viewer has been used to track temporal trends in public sentiment (Figueredo et al. 2019a, 2019b; Greenfield 2013; Ladle et al. 2016; Michel et al. 2011), changes in expressions of religiosity (Younes and Ulf-Dietrich 2019), changes in population-level cognitive characteristics (as ascertained by the utilization frequencies of words with known item-level psychometric difficulties; see Roivainen 2014; Woodley of Menie et al. 2015 and historical estimates of word learnability; see Hills and Adelman 2015), shifts in lexicographically estimated life history characteristics (Woodley of Menie et al. 2019), and the temporal stability of cultural stereotypes (Del Giudice 2012). These applications of Ngram to the quantification and study of cultural trends are referred to as *culturomics* (Michel et al. 2011).

The lexical items connected with the moral foundations were retrieved from Graham, Haidt, and Nosek's (2009) moral foundations dictionary: (1) harm, (2) fairness, (3) loyalty, (4) authority, and (5) purity (an abridged list of the words collected is presented in Table S1). The lexical items used in constructing each of these scales were psychometrically selected based on their possessing satisfactory part-whole correlations for each word to the corresponding aggregate scale score for each lexicographic scale. The best words were thus empirically selected from the initially larger item pool. This psychometric procedure for selecting

items has the benefit of being the most straightforward approach to creating robust and internally consistent chronometric constructs, with the items exhibiting differential validity based on their degree of convergence with each of the five moral foundations.

Unit-weighted common factor scales (Gorsuch 1983) were estimated as the means of the standardized scores for the lexicographic items on each scale (Figueredo et al. 2000). As per moral foundations theory, the five scales were aggregated into two lower-order factors: (1) binding and (2) individualizing. By reverse-scoring the individualizing factor, these two lower-order factors were further aggregated into a single higher-order factor—the *Asabiyyah* factor discussed in Hertler et al. (2020). The resultant chronometric factors, along with their Cronbach's alpha values and unit-weighted factor loadings are presented in Table 1. Binding and individualizing exhibited a strong tendency toward negative correlation across time, indicating that these two trends were diverging from each other systematically. Therefore, there is a clear tendency for the rise in cultural expressions of morality emphasizing personal flourishing and self-actualization to occur at the expense of groupishness, deference to authority, and sanctity, which would be consistent with a decrease in *Asabiyyah* over time. This trend is graphed in Figure 1. It is important to note that the division of moral foundations into the categories of individualizing and binding does not reflect the explicit intent of the original authors to attribute these categories to individual versus group fitness; rather, this division more accurately describes alternate loci of moral values that both function to inhibit selfishness (Graham et al. 2011; Haidt 2008). The attribution of these diachronic changes to individual versus group selection was made by some of the current authors based on the application of multilevel selection theory (e.g., Hertler et al. 2020). Nevertheless, as discussed in the introduction, Haidt (2007, 2012) does speculatively attribute the evolution of binding values to cultural group selection, foreshadowing the present application. The logic expounded by Graham, Haidt, and Nosek (2009) is as follows: a society that takes a predominantly individualizing approach to suppressing selfishness will honor the rights and well-being of other individuals (care and fairness); in contrast, a society that takes a binding approach to suppressing selfishness will emphasize the imperative for individuals to conform to the needs of the group (loyalty, authority, sanctity/purity). If this reasoning is correct, then the implications for multilevel selection are quite manifest.

Table 1 displays the psychometric results of these analyses. *p*-values here and later are based on two-tailed tests unless otherwise noted.

Following Woodley of Menie et al., (2017b), we also used the ten altruism words employed by Charles Darwin in *The Descent of Man* (1871) to describe changing levels of within-group altruism and between-groups competition in humans[4]. Diachronic part-whole

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4   In the *Descent of Man* Darwin uses a set of ten terms (including *self-sacrifice*, *obedience*, and *heroism*) in describing broadly altruistic virtues that would lead to group-level benefits in competition. In previous research (e.g., Woodley of Menie et al. 2017b) it has been found that a diachronic factor comprised of the utilization frequencies of these "Darwin altruism" terms sampled from the Ngram viewer, exhibits high levels of internal consistency, in addition to external validity with respect to other prospectively more direct measures of inter-group competition (such as per capita war fatalities). This can be taken

Table 1. Cronbach's alphas and part-whole correlations (unit-weighted factor loadings) for the lexicographic scales and lower-order Moral Foundations factors of the higher-order Asabiyyah factor from AD1800–1999

	Cronbach's Alpha	Unit-Weighted Factor Loading
INDIVUALIZING		
Harm Scale	0.974	0.988*
Fairness Scale	0.980	0.988*
BINDING		
Loyalty Scale	0.974	0.985*
Authority Scale	0.991	0.995*
Purity Scale	0.994	0.990*
ASABIYYAH		
INDIVUALIZING	0.988	-0.987*
BINDING	0.997	0.978*

* *p*<.05

correlations of the Darwin *Descent of Man* Altruism Words ranged from .29 to .92 (*p*<.05), with the overall factor scale accounting for 55% of the chronometric factor variance.

Biodemographic Measures

Population sizes were obtained from the *Maddison Project* database (Bolt at al. 2018), a repository curated by the Groningen Growth and Development Center. These were used to construct a corporate or group-level fitness measure by dividing the share of the Britannic populations by the rest of the world's population at different points in time, yielding a relative measure of the success of their biocultural-group relative to the rest of the world's population. The proportion of the world population was estimated based on the various demographic database compiled by Roser, Ritchie, and Ortiz-Ospina (2013, see also references therein).

Warfare mortality estimates (a fairly uncontroversial measure of inter-group competitiveness) were obtained from Sarkees and Wayman's (2020) *Correlates of War* database, we excluded civil (within-state) conflicts, retaining only between-state conflicts. Any conflict involving one or more Britannic nation was retained. Mortality rates (expressed per capita, per 100,000) were estimated, controlling for population size. This was necessary, as population size could confound warfare intensity owing to the observation that larger populations will exhibit greater absolute death numbers.

Following Woodley of Menie et al. (2017b), a latent Intergroup Competition (*IGC*) Factor was constructed using the three convergent group-selec-

as evidence that "everyday language" contains information about the sorts of selective pressures that shape the attitudes and behaviors undergirding its use. Thus, Darwin's choice of these terms in relation to describing altruistic attitudes that promote group competitiveness makes them potentially good stand-alone indicators of societal altruistic sentiment of a sort that is specifically directed toward a particular biocultural group.

tion indicators: (1) Darwin's Descent of Man Altruism Words; (2) Britannic corporate fitness; and (3) War Mortality per 100,000. The single lexicographic indicator used in the *IGC* factor model, the Darwin *Descent of Man* Altruism Words, converged well with the two biodemographic ones, the proportion of the world's population and war mortality; part-whole temporal correlations of the *IGC* factor ranged from .42 to .66 ($p <$.05), with the overall factor scale cumulatively accounting for 27.5% of the chronometric factor variance.

Developmental Instability Measures

This measure includes three convergent phenotypic measures that are believed to be associated (in part) with individual differences in burdens of deleterious mutations. The measures are percentage sinistrals (meaning those who are left-handed, sourced from McManus et al. 2010), craniofacial fluctuating asymmetry (sourced from Kimmerle and Jantz, 2006, with supplementary data from Woodley of Menie and Fernandes 2016), and body mass index (BMI; sourced from Komlos and Brabec 2010). The data were recovered from graphs in their respective publications using *Web-Plot Digitzer* (Rohatgi 2017). Both sinistrality and fluctuating asymmetry have long been theorized to be indicators of developmental instability, and possibly also elevated mutational load (e.g., Markow 1992; van Valen 1962). The association between both the level and variance in BMI and deleterious mutations has only recently been evidenced however, with national-level indicators of relaxed negative selection functioning as substantial predictors of national differences in levels and variance of BMI (Budnik and Henneberg 2017),

even when lifestyle covariates (e.g., calories consumed and levels of exercise) are controlled. Budnik and Henneberg (2017) have hypothesized that variation in BMI might be partly reflective of the action of deleterious variants that reduce the efficiency of metabolic processes, leading to either excessive body mass, or (in some cases) an inability to accumulate body mass.

In total, these variables are available for the years spanning 1825 to 1985. Sinistrality was sampled between the years 1835 to 1976, for a total of 99 measurement occasions. BMI was sampled between the years 1885 to 1985, for a total of 21 measurement occasions. Craniofacial fluctuating (specifically size) asymmetry was sampled between the years 1825 to 1985 for a total of 16 measurement occasions.

All variables were sourced from the population of the USA. The reason for focusing on the European-American samples in this instance is because the majority of the USA population for the majority of the set of years sampled here were of European descent. The incorporation of data on non-European-origin populations might therefore bias the sample characteristics in ways that are unrepresentative of the true time trends.

The use of phenotypes as proxies for tracking the underlying burden of deleterious mutations has been promoted in the absence of sufficiently high-resolution genomic sequencing and variant-calling protocols to detect the hypothesized increase in mutation accumulation that may have accompanied the reduction in opportunity for negative selection through mortality since industrialization (for discussion of this topic see Kondrashov 2017). It should

furthermore be noted that factors independent of mutation accumulation may partly, and in some cases, mostly account for the time trends associated with these variables. For these variables to serve as useful proxies for mutation accumulation, it is only necessary that some of the temporal trends among them stem from relaxed negative selection however.

The results of the unit-weighted factor model (estimated using multivariate imputation; see Figueredo at al. 2000; McKnight at al. 2000) on the developmental instability factor are presented in Table 2. All factor loadings are statistically significant and high magnitude ranging in value from .68 to .99 ($p < .05$). The latent factor accounted for 75.5% of the chronometric variance.

Table 2. Part-whole correlations (unit-weighted factor loadings) for the Developmental Instability factor from AD1825-1985

	Unit-Weighted Factor Loading
Developmental Instability	
Craniofacial Fluctuating Size Asymmetry	0.68*
Body Mass Index	0.91*
Sinistrality	0.99*

* $p < .05$

Hypotheses

The following set of hypotheses are examined with reference to the data employed in the present study.

H1: Year will negatively predict the *Intergroup Competition Factor*.

H2: The *Intergroup Competition Factor* will negatively predict the *Developmental Instability Factor*.

H3: Year will positively predict the *Developmental Instability Factor*.

H4: The *Developmental Instability Factor* will negatively predict the *Asabiyyah Factor*.

H5: The *Intergroup Competition Factor* will positively predict the *Asabiyyah Factor*.

H6: Year will negatively predict the *Asabiyyah Factor*.

Statistical analyses

All univariate and multivariate analyses were performed using SAS 9.4 (SAS Institute Inc., 2015) and Unimult 2 (Gorsuch 2016). Using SAS PROC STANDARD and DATA, unit-weighted common factor scales (Gorsuch 1984) were estimated as the means of the standardized scores for all non-missing subscales on each factor (Figueredo et al. 2000). Using SAS PROC CORR, Cronbach's alphas and the part-whole correlations of the subscales with the unit-weighted factor scales were also computed.

Results

Multilevel Models

The lexicographic scales function as manifest variables for the purposes of longitudinally estimating multilevel models (MLMs). We estimated four nested MLMs in total, so as to determine the need for increasing parameterization as a function of testing alternative hypotheses. The four models are as follows: *MLM1* was an unconditional *Asabiyyah* model, in which a single logarithmic slope and intercept were estimated for all lexicographic factors, scales, and items (words) over time. *MLM2* involved the estimation of a separate intercept and logarithmic slope over time for each lexicographic factor. However, the same intercepts and

logarithmic slopes were estimated for all within-factor scales and words over time. *MLM3* involved the estimation of separate, lexicographic-scale-specific, logarithmic slopes and intercepts over time, but with each within-factor scale word having the same logarithmic slope and intercept over time. *MLM4* involved the estimation of separate word-specific logarithmic slopes and intercepts over time. All MLMs were statistically controlled for the effects of the year of *FirstUse* recorded for each word in the analyses; this is an important control, as it has been found that older words tend to be better known to users of texts as a result of the lag between changes in spoken and written texts (Curzan 2009; Woodley of Menie et al. 2015); LNT is the natural logarithmic function of time.

All nested model comparisons are displayed in Table 3. Systematic -2RLL and AIC comparisons were performed by comparison among nested models. AIC and AIC weights were computed with the statistical package *qpcR* (Ritz and Spiess 2008) in R version 4.1.0. Each level of the aggregative hierarchy contains and accounts for specific variance components. Their estimation revealed that the majority of incremental model fit improvements were relatively trivial in magnitude, but nevertheless statistically significant ($p < .05$). When the four nested MLMs were compared in terms of the squared multiple correlations among them, it was found that they yielded basically the same results. Although statistically significant, the magnitudes of specific variances associated with each level of aggregation (ΔR^2), were negligibly small, which contrasts sharply with the finding that the common factor variance associated with the highest-level of aggregation (unconditional *Asabiyyah*) was quite large (69%). It is worth noting that the model comparison identified *MLM4*, with Word and the Word*LNT interaction, as the best model based on its AIC weight (1.000).

Table 3. Fit Indices for Nested Multilevel Models (MLMs) for Haidt Moral Foundation Dictionary Factors, Scales, and Words from AD1800–1999

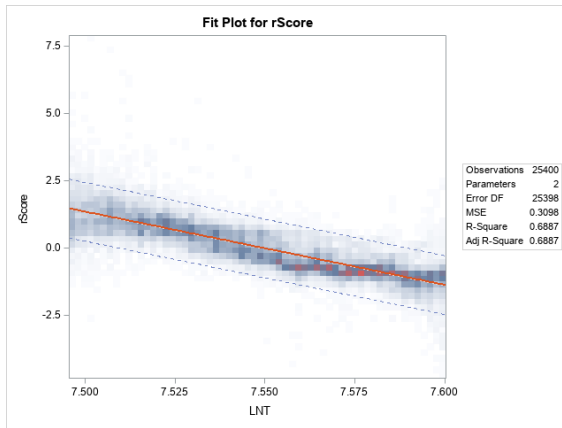| Multilevel Model	**MLM1**: FirstUse + LNT	**MLM2**: + Factor + Factor*LNT	**MLM3**: + Scale + Scale*LNT	**MLM4**: + Word + Word*LNT
AIC	42323.8	42313.8	42307.1	41700.1
AIC	623.70	613.70	607.00	0.00
AIC weight	0.000	0.000	0.000	1.000
-2RLL	42313.8	42299.8	42281.1	41186.1
	$\Delta\chi^2 =$	**14.0***	**18.7***	**1095.0***
R^2	0.68869	0.68886	0.68909	0.70221
	$\Delta R^2 =$	**0.00017***	**0.00023***	**0.01312***
NDF	2	4	10	253
	$\Delta NDF =$	2	6	243

* $p < .05$

Fig. 1. Heat Map for Bivariate Linear Regression of Asabiyyah as a Natural Logarithmic Function of Time (AD 1800–1999).

Only the model parameters associated with the unconditional *Asabiyyah* level (*MLM1*) were retained, as the extra model parameters added by all the lower levels of aggregation (*MLM2, MLM3,* and *MLM4*) in the moral foundations dictionary factors, scales, and words only increased the proportion of variance explained from 69% to 70%. The logarithmic slope of this unitary higher-order *Asabiyyah* factor over time was negative and statistically significant: $r = -.83$, $F(1,25398) = 56190.9$, $p<.0001$. No significant heterogeneous serially autoregressive effects were identified (*ARH1* = 0), and the effect of year of *FirstUse* (of each word) was statistically nonsignificant ($p>.05$).

Cascade Model: Hierarchical Multiple Regressions

We constructed a sequential canonical cascade model from the following system of three ordered hierarchical multiple regressions:

1. *IGC = YR*
2. *DI = IGC + YR*
3. *ASABIYYAH = DI + IGC + YR*

The purpose of a sequential canonical cascade model is to test for mediation by using each prior criterion variable as the first predictor in each successive hierarchical regression to control for any indirect effects transmitted through it, thus estimating only the residual direct effects of each subsequent predictor variable (Figueredo and Gorsuch 2007). As fewer historical data were available for the developmental instability (*DI*) variable, the sequential canonical cascade model was estimated exclusively on data spanning the years from AD 1825–1985. The protective omnibus Pillai-Bartlett trace test for the entire sequential canonical analysis model was statistically significant: $V = 0.984$, $E = 0.57$, $90\%CI = (0.56, 0.58)$, $F(3,104) = 2068.47$, $p <.0001$.

Table 4 displays Cascade Equation 1, with time (*YR*) having a statistically significantly and negative direct effect on intergroup competition (*IGC*; supporting *H1*). The semipartial correlation coefficient is indicated by the symbol *sR*; Figure 2 shows this relation graphically, using the standardized (*z*) scores of both predictor and criterion variables. These results indicate that intergroup competition has been decreasing across time since AD 1825.

Table 4. Cascade Equation 1: Hierarchical Regression for IGC with YR from AD1825–1994

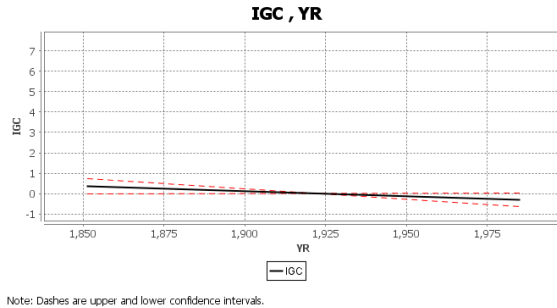| Predictor	*sR*	**C.I. (90%)**	*F*	*df1, df2*	*p*
YR	-0.19*	-0.36,0.01	3.77	1, 106	0.05

*p <.05

Fig. 2. Hierarchical Regression of the direct effect (semipartial correlation) of YR on IGC (AD 1825–1985).

Table 5 displays Cascade Equation 2, in which *IGC* had a statistically significant and negative direct effect on developmental instability (*DI*; supporting *H2*), while *YR* had a statistically significant and positive residual direct effect on *DI* (supporting *H3*). The semipartial correlation coefficient is indicated by the symbol *sR*; Figures 3 and 4 illustrate these relations graphically, using the standardized (*z*) scores of both predictor and criterion variables. These all indicate that *DI* is reduced by higher levels of intergroup competition, which Cascade Equation 1 shows to be declining, but that *DI* has otherwise been increasing through time since AD 1825.

Table 6 displays Cascade Equation 3, wherein *DI* had a statistically significantly and negative direct effect on *Asabiyyah* (supporting *H4*), while *IGC* had a statistically significantly and positive residual direct effect on *Asabiyyah* (supporting *H5*), and *YR* had a statistically significant and negative residual direct effect on *Asabiyyah* (supporting *H6*). The semipartial correlation coefficient is indicated by the symbol *sR*; Figures 5, 6, and 7 show these relations graphically, using the standardized (*z*) scores of both predictor and criterion variables. These all indicate that *Asabiyyah* is reduced by higher levels of developmental instability, which Cascade Equation 2 has shown to be rising, but that *Asabiyyah* increases with higher levels of intergroup competition, which Cascade Equation 1 shows to be declining, and *Asabiyyah* has otherwise been decreasing over time since AD 1825.

Table 5. Cascade Equation 2: Hierarchical Regression for DI with IGC and YR from AD1825–1985

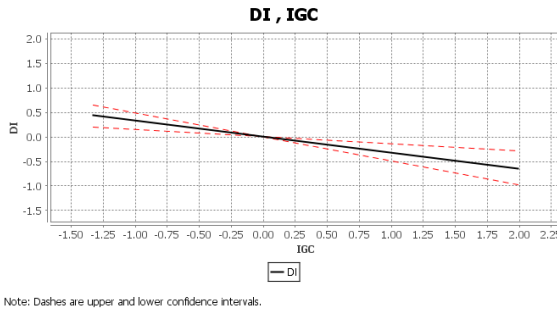| Predictor	*sR*	C.I. (90%)	*F*	*df1, df2*	*p*
IGC	-0.33*	-0.49, -0.14	22.89	1, 105	<0.0001
YR	0.63*	0.50, 0.74	86.23	1, 105	<0.0001

*p <.05

Fig. 3. Hierarchical Regression of the residual direct effect (semipartial correlation) of IGC on DI (AD 1825–1985).
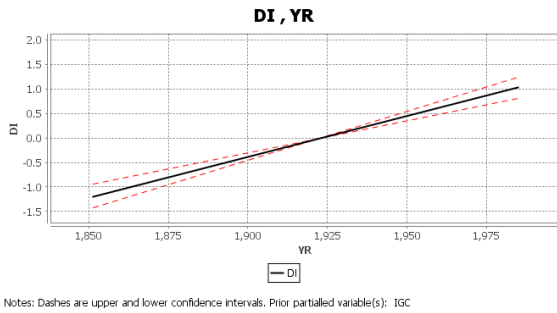

Fig. 4. Hierarchical Regression of the residual direct effect (semipartial correlation) of YR on DI, statistically controlled for the effect of IGC (AD 1825–1985).

Table 6. Cascade Equation 3: Hierarchical Regression for ASABIYYAH with DI, IGC, and YR from AD1825–1985

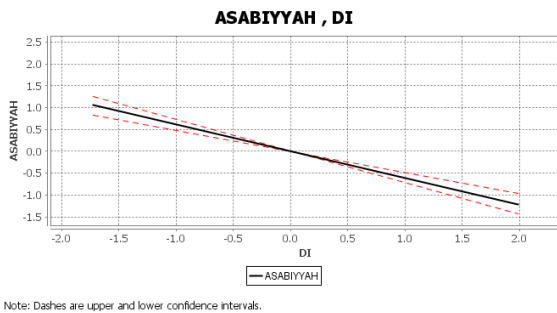| Predictor	sR	C.I. (90%)	F	df1, df2	p
DI	-0.61*	-0.72,-0.48	543.44	1, 104	<0.0001
IGC	0.06*	-0.25,0.14	4.75	1, 104	0.03
YR	-0.74*	-0.82,-0.64	785.70	1, 104	<0.0001

*p <.05

Fig. 5. Hierarchical Regression of the direct effect (semipartial correlation) of DI on ASABIYYAH (AD 1825–1985).

Fig. 6. Hierarchical Regression of the residual direct effect (semipartial correlation) of IGC on ASABIYYAH, statistically controlled for the effect of DI (AD 1825–1985).
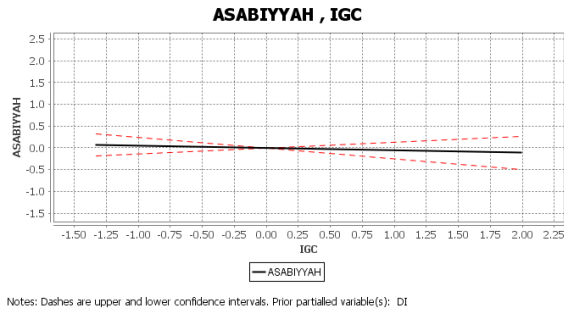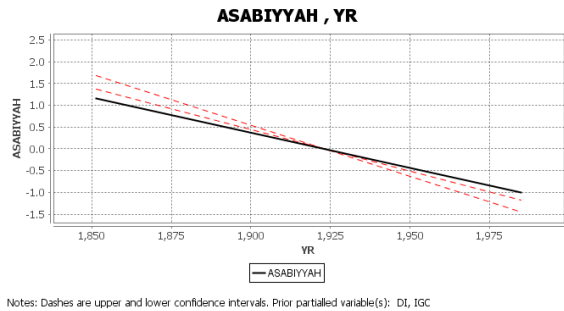

Fig. 7. Hierarchical Regression of the residual direct effect (semipartial correlation) of YR on ASABIYYAH, statistically controlled for the effect of DI and IGC (AD 1825–1985).

Discussion

Consistent with predictions from both the SEAM and the evoked culture model, the temporal decline in the *Asabiyyah* factor is independently predicted by both the (declining) intergroup competition and (rising) developmental instability factors. Critically, the developmental instability measure seems to substantially mediate the impact of declining intergroup competition on the *Asabiyyah* factor, consistent with the hypothesized impact of diminished intergroup competition on mutation accumulation, as predicted by SEAM. Furthermore, these results demonstrate a novel application of Haidt's moral foundations theory to the elucidation of culturomic shifts and their determinants. We also note that the decline in Asabiyyah noted here is consistent with the work of Younes and Ulf-Dietrich (2019), who, in employing Google Ngram Viewer, found indications of a general decrease in collectivistic religious expression across multiple languages between 1900 and 2000, with (temporary) reversals to this trend having occurred during times of conflict (e.g., World War II).

The small and positive residual direct effect of intergroup competition on the *Asabiyyah* factor, after statistically controlling for that of developmental

instability, was minimally consistent with the predictions of the evoked culture model. This model would hypothesise that declining intergroup competition might serve as a direct driver of changes in preferences from group-oriented to individual-oriented textual expressions of moral psychology. As discussed in the introduction, the process by which this path-dependency arises might relate to diminished levels of intergroup competition evoking pre-existing evolved psychological mechanisms that adaptively upregulate preferences for individualizing morality, with more fairness- and harm-avoidance-oriented moral expressions being more adaptive under conditions of intergroup peace. This process might also establish a selective context in which, via gene-culture coevolution, rapid selection can take place favoring the fitness of genotypes that predispose toward the development of these individualizing moral foundations. Such selection can conceivably even act over relatively short periods of time[5].

Further, the measurement model for the latent structure of *Asabiyyah* was not meaningfully confounded by temporal autocorrelations, which were found to be of negligible magnitudes, nor were the lexicographically convergent results confounded with the age of the words sampled, which is significant as age has been found in previous work on Ngram viewer to be a significant predictor of temporal changes in the utilization frequencies of words (Woodley of Menie et al. 2015). The developmental instability factor may therefore capture changes in the strength of negative selection on indicators that may serve as proxy measures of disturbed patterns of social epistasis. Moreover, evidence for this mediational pathway strengthens the case for lexicographic moral foundation measures serving as diachronic indicators of either positive or negative social epistasis.

These findings also have relevance for ongoing debates in evolutionary psychology concerning the possibility that certain levels of trait expression might be maladaptive – meaning that they stem from some process that is leading to long-term reductions of fitness. A related debate concerns the possibility that the extremely low fertility rates characteristic of post-demographic-transition Western populations, in particular, might be maladaptive in so far as their fertility is at sub-replacement levels. Arguments have been made to the effect that this consequence of the demographic transition merely reflects changes in patterns of bioenergetic investments stemming from adaptive, developmentally mediated transitions into slower life history, and specifically a regime of significantly diminished child, infant, and general mortality. Based on this alternative argument, lower individual-level fertility might therefore be "paid for" in other ways by changes in such patterns of investments resulting in for example, greater somatic persistence (longevity) and greater allocations of effort into certain communitarian domains (e.g., Colleran 2016).

These results should be interpreted with caution, insofar as some may

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5   Consistent with the idea of rapidly shifting selection on moral foundations is the finding of Huber and Fieder (2018) who have observed that selection, as proxied by relative fertility, has increasingly come to favor those whose political values are closer to the extremes, with significant shifts in the focal point of this selection having occurred over just a handful of decades. But as noted in an earlier footnote, how far this tendency goes is unclear.

be inclined to read them as suggesting that group-oriented ideologies are simply "better," in terms of their effects on group fitness, than their individual-oriented counterparts. It is becoming increasingly apparent, from real-world evidence, that this is flatly incorrect, however. In the contemporary Western context at least, the adoption of extreme ideologies, including and perhaps especially group-oriented ones, for instance Communism on the left and neo-Nazism on the right, seems to be uniquely attractive to those whom criminologists would term "socially deviant" individuals. Such individuals are at elevated risk of a number of undesirable outcomes, such as engagement in crime (including violent crime and terrorism) and low social status. The organized actions of these individuals often seriously harm, particularly through violence, the welfare of the broader populations in which they are embedded (Institute for Economics and Peace 2020) and occasion the rapid dissolution of the movements with which they are associated. Even if it is true, as these results suggest, that genetic change in Western populations has been favoring the rise of excessively individualistic (from a group-fitness perspective) values, it does not follow from this that all groupish alternatives are functional or in some way desirable. Indeed, it could be that genetic and social-epistatic dynamics have taken long-standing individualistic tendencies in Western populations to problematic levels, while also giving rise to damaging group-oriented efforts to "correct" these developments. Pathological manifestations of extreme and groupish political and social ideologies obviously are nothing new. The especially catastrophic results, in moral and biological terms, of Communism and Nazism in the twentieth century speak for themselves – and it is hardly surprising that the intellectual heirs of these movements clearly share psychological traits widely considered to be highly socially undesirable (Costello et al. 2022; Moss and O'Connor 2020 a,b). Although the groupish social and political arrangements of premodern societies in the more distant past across the world were hardly liberal, and involved various moral evils, the disastrous totalitarianisms of recent history, and their contemporary ideological progeny, suggest the appearance of uniquely perverse extremisms. It must be stressed that all authors on the current paper unequivocally oppose extremist political views.

Availability of data and material

Google Ngram Viewer data can be obtained from the following url: https://books.google.com/ngrams. The lexical items used as the basis for constructing diachronic measures of moral foundations were obtained from Graham, Haidt, and Nosek's (2009) moral foundations dictionary. The diachronic data used here have been made publicly available in Hertler et al. (2020), Woodley of Menie et al. (2017b), and from and sources contained therein.

Code availability

All code will be made available upon request.

Ethics approval

Not applicable.

Conflict of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Consent to participate

Not applicable.

Authors' contributions

MWOM, MAS, and MPA drafted the manuscript. AJF, MPA, and MJ prepared the data analyses. All authors approved the final version.

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Abandon	Brutality	Cruelty	Disgust	Exploiting	Hierarchy	Insider	Loyalty	Position	Respect	Solidarity	Unchaste
Abstemiousness	Cadre	Crusher	Dishonest	Exploits	Holiness	Insubordination	Maiden	Preference	Respected	Spurn	Uncleanliness
Abstention	Care	Damage	Disloyalty	Fair	Holy	Insurgent	Member	Prejudice	Respectfulness	Spy	Unequal
Abstinence	Caring	Debasement	Disobedience	Fair play	Homeland	Integrity	Miscreant	Preserve	Respects	Stain	Unfairness
Abuse	Caste	Debauchery	Disproportion	Fairly	Homologous	Intemperate	Modesty	Pristine	Rights	Status	Unfaithful
Adultery	Celibacy	Deceiver	Disrespect	Fairmindedness	Honesty	Jilter	Mother	Profanity	Riot	Sterility	Unison
Agitation	Chastity	Decency	Dissent	Fairness	Honorable	Joint	Mothering	Profligate	Ruin	Stomp	Uniter
Alienate	Class	Defector	Dissident	Familial	Humble	Justice	Motherland	Promiscuity	Sacredness	Subversion	Unjustness
Ally	Cleanliness	Defense	Dissociate	Families	Hurt	Justification	Mothers	Prostitute	Safety	Suffering	Unprejudicedness
Amity	Clique	Defiance	Egalitarianism	Family	Illegality	Justness	Mutinous	Protection	Saint	Supremacy	Unscrupulous
Annihilation	Cohort	Defiler	Empathy	Father	Immaculate	Kill	Nation	Protest	Security	Taint	Upright
Apostasy	Collective	Denounce	Endangerment	Favoritism	Immigrant	Killed	Noncomformist	Pureness	Sedition	Tarnish	Violence
Apostate	Command	Depravity	Enemy	Fellowship	Impair	Killer	Obeyance	Purity	Segregation	Terrorism	Virgin
Attack	Communal	Desecration	Equable	Fight	Impartiality	Killing	Obscenity	Rank	Sequester	Together	Virginal
Austerity	Commune	Deserted	Equality	Filth	Impiety	Kills	Obstruct	Ravage	Shelter	Tolerant	Virginity
Authority	Communism	Deserter	Equity	Foreigner	Impious	Law	Oppose	Reasonable	Shield	Tradition	Virgins

Balance	Community	Deserting	Equivalent	Gross	Imposter	Lawfulness	Order	Rebel	Sickness	Traitor	Virtuous
Benefit	Compassion	Destroy	Evenness	Group	Indecency	Lawlessness	Peace	Reciprocity	Sin	Tramp	Wanton
Betrayal	Compliance	Detriment	Excluder	Guard	Individual	Lax	Permission	Refined	Sinfulness	Trashy	War
Bias	Comrade	Devotee	Exclusion	Guild	Inequitable	Leader	Permit	Refuse	Sinned	Treachery	Warlord
Bigotry	Constant	Dirt	Exploit	Harm	Ingroup	Legality	Pervert	Remonstrate	Sinner	Treason	Warring
Blemish	Contagion	Discrimination	Exploitation	Harm	Injustice	Lewdness	Piety	Renegade	Sinning	Unadulterated	Wars
Bourgeoisie	Control	Disease	Exploited	Heretic	Innocent	Limpid	Pious	Repulsion	Sins	Unbiasedness	Wholesomeness

S1. Abridged list of Moral Foundation words collected from Haidt (2012) and the online version of the Moral Foundations Questionnaire.