Gendered Fitness Interests: A Method Partitioning the Effects of Family Composition on Socio-Political Attitudes and Behaviors

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Abstract

Whereas most people are biologically either male or female, their genetic interests are almost never aligned with just their own sex. Drawing on the evolutionary theory of inclusive fitness gained through relatives, we suggest it is possible to partition the effects of kin on fitness into those that derive from female versus male relatives. We argue that the balance of these female- and male-derived effects, which we call 'Gendered Fitness Interests' (GFI), might influence human behavior, especially the adoption of socio-political attitudes regarding issues with a gendered dimension. Our proposal builds on previous conjectures within evolution, as well as observations from both within and beyond the evolutionary sciences that parents' socio-political views covary with the sex of their children, and the numbers of relatives of each sex. Further, it is consistent with the relatively small average differences between women's and men's socio-political positions. Using simulated data, we outline a method for partitioning GFI, and derive the testable predictions that the GFI component of women's and men's socio-political attitudes will converge with age, and with larger family sizes. Our proposal does not replace or falsify other theories of sex differences

and similarities, but it does formalize a previously underappreciated component of variance in traits and attitudes with a gendered dimension. In this respect, it may be generally useful in resolving the complex origins of gendered behavior, and the primacy of an individual's gender identification (including but not limited to biological sex) as a fixed and distinctive part of their socio-political identity.

Introduction

Many of the most ideologically polarizing issues in any society include a sex difference, with the probability that an individual will hold a particular view, or the fervor with which it is held, differing between women and men (Eysenck 1975, Feather 1977, Sidanius and Ekehammar 1980, Ekehammar and Sidanius 1982, Devaus and Mcallister 1989, Manza and Brooks 1998, Eagly et al. 2004). Women, for example, are more likely than men to favor gender equitable labor practices and remuneration, express punitive views on intimate partner violence, and favor public goods spending (Twenge 1997, Manza and Brooks 1998, Eagly et al. 2004, Eagly and Diekman 2006, Calvo-Salguero et al. 2008, Donnelly et al. 2016, Bell et al. 2018). Given that these matters differentially impact women's and men's lives, sex differences in the attitudes people hold toward them are not surprising. What is surprising, however, is that many sex differences in attitudes concerning matters such as these, that starkly affect one sex more than the other, are often quite small (see, for example, Hyde 2005, Eagly and Diekman 2006, Lizotte 2015). This pattern has led many social scientists to conclude that other sources of individual variation—including but not limited to wealth, status, race, class, education, religiosity, intelligence, and health—shape socio-political attitudes most strongly, leaving only a small amount of variance accountable to biological sex.

Here we consider another possibility, informed by new insights and existing evidence in evolutionary biology, economics, and psychology. Our argument posits that the sex of one's close kin— especially their descendants—is an under-appreciated source of variation in socio-political attitudes, that causes individual attitudes to polarize but sex differences to grow smaller. We present a method for testing hypotheses about the effects of male versus female kin on an individual's evolutionary fitness, and a framework that we believe holds promise for understanding the origins of socio-political variation, and sex differences in attitudes and behavior. The method we propose suggests possibilities for promoting more nuanced and inclusive politics surrounding gender. In presenting it we aim to stimulate discussion, theoretic development, and future empirical testing.

Where Gender Meets Ideology

Individual views on issues such as abortion, contraception, maternity leave, gendered roles in the home and the workplace, sexual autonomy (especially of women), and rape (e.g., victim-blaming) tend to be tightly held. Many of these socio-political issues have historically been considered 'women's issues', that is they affect women and men differently, often in profound and personal ways. The traditional position on these views usually favors men's interests, hence the push for social progress, or for gender equity, is seen by some as a 'woman's issue', with the 'men's position' mapping onto the conservative side of the socio-political axis. As far as politicians and pollsters are concerned, it is these issues where women and men reliably diverge in their voting behavior (Eysenck 1975, Feather 1977, Sidanius and Ekehammar 1980, Ekehammar and Sidanius 1982, Devaus and Mcallister 1989, Eagly et al. 2003). Yet women and men also diverge, on average, on socio-political issues less directly related to reproduction and bodily autonomy. Sex differences in attitudes concerning the punishment of crime, the treatment of outgroups, economic redistribution, public goods spending, and religiosity have been extensively documented in several societies (Eysenck 1975, Feather 1977, Sidanius and Ekehammar 1980, Ekehammar and Sidanius 1982, Prokos et al. 2010, Lizotte 2016, 2017). These issues assort with those more closely tied to reproduction and gender roles to define the progressive-conservative political axis (Pratto et al. 1994, Sidanius et al. 1994).

Two broad explanatory frameworks have been used to understand why ideologically-contested issues have a gendered component. These frameworks represent two of the main types of general explanation for sex differences in human behavior (Wood and Eagly 2012 for recent overviews, Hyde 2014, see Archer 2019). Social constructionist approaches explain that attitudinal sex differences arise as a consequence of differences in male and female socialization, access to status and resources, and resulting social roles (Eagly et al. 2004, Eagly and Diekman 2006, Diekman and Schneider 2010). These social roles result in a gendered division of labor where

women tend toward roles that emphasize communality, and men toward roles that emphasize independence and self-promotion. Sex differences in socio-political attitudes arise from this gendered division of labor and its effects on psychological processing, including orientations toward social dominance and authoritarianism (Pratto et al. 1994, Pratto et al. 1997, Eagly et al. 2004).

The alternative framework considers sex differences in socio-political attitudes from the perspective of evolutionary fitness. This framework builds on the important axioms that individual interests are reproductive interests, and that conflicts of genetic interests between individuals generate many of the most important ethical, moral and ideological tensions that societies face (Alexander 1982, 1987). According to evolutionary sexual conflict theory, individual males and females of all sexual taxa frequently find their fitness interests at least somewhat opposed. Due to sex differences in the physiology and opportunity costs of reproduction, the optimum behavior for one sex might differ substantially from the optimum for the other sex (Parker 1979, Arnqvist and Rowe 2005). In humans, even a woman and a man committed to spending their entire future together can find they differ markedly on how many children to have, when to have them, how often to have sex, the allocation of domestic chores, and any number of other issues (Mulder and Rauch 2009, Shackelford and Goetz 2012). Those conflicts can be far starker between strangers deciding whether to spend the night together, or between two people of whom only one is interested in the other.

That two individuals have different interests is a truism, but the evolutionary perspective predicts that the interests of women and men will differ systematically on particular matters relevant to fitness. Attitudes and behavior related to topics such as coupling, infidelity, sexual frequency, support for single parents, family size and many other behaviors associated, even distally, with sex and reproduction, are frequently investigated by evolutionary scholars and indeed found to express significant sex differences (e.g. Shackelford et al. 2005, Buss and Duntley 2008,

Duntley and Buss 2012, Shackelford and Goetz 2012, Archer 2019). The evolutionary framework argues that these differences manifest because women and men seek to maximize their own individual reproductive fitness given the biological constraints of their sex (e.g., asymmetries in obligatory parental investment, Trivers 1972). The resulting implication is that an individual's stance on a socio-political topic may be a projection of their long-term fitness interests.

Whilst biological and social explanations of human behavior are often treated as competing alternatives (see Berenbaum et al. 2011), no appropriately disinterested reader could deny the mountains of evidence that the dichotomy is a false one. Wood and Eagly (2012) have taken great care to explicate the interaction between biological and social (i.e., "biosocial" processes) in the way social roles shape gendered behavior. Recent evolutionary accounts also consider how sex differences arise as sex-specific phenotypically plastic responses to economic and social conditions (Schmitt 2015, Schmitt et al. 2017). Although there remain considerable disagreements about the relative importance of sex role socialization, patriarchal social control, and sex-specific reproductive adaptations in shaping sex differences (and similarities) in behavior, these productive disagreements have moved well beyond false dichotomies between "nurture" and "nature".

Despite their potential for integration, however, sexual conflict theory and social role theory make different predictions regarding the adoption of socio-political attitudes. If the sexual conflict perspective is correct, then each sex might be expected to favor positions or policies that serve the long-term fitness interests of their biological sex at the expense of the other. Likewise, if gendered attitudes are a consequence of sex-specific socialization and roles, then we might expect similarly big differences between women and men that persist throughout individual lifetimes but shift in accordance with changes in social roles. Despite evidence supporting these predictions, neither is immediately consistent with two sets of observations: (1) that sex differences are smaller than either framework might suggest, (2) the sex of a child can alter the attitudes of its parents.

Observation 1: Sex differences are smaller than one might expect

Few issues cleave public opinion in any polity as deeply as abortion does in the U.S.A.. The conflict between those who believe abortion should be available, safe, and affordable for all, and those who believe it should be outlawed or tightly restricted, defines the left-right divide in contemporary American politics. Abortion is also commonly construed as a 'women's issue'; female bodily autonomy is pitted against the rights of the unborn fetus and of the man whose sperm was involved in its conception.

It is commonly held that pro-choice policies favor women's reproductive interests and pro-life policies work in the reproductive interests of men (e.g., Betzig and Lombardo, 1992). If this is the case, then one would expect the gap in attitudes concerning abortion to be greater than that observed. According to a large, representative poll conducted by Gallup in 2012, biological sex explained only about 6% of the variation in attitudes to abortion. In that poll, 44% of American women but only 38% of men identify as "pro-choice", whereas 46% of women and 53% of men were "pro-life" (Saad 2012). Analyses of polling by the Pew Centre indicate an even smaller sex difference in support for legal abortion in the U.S.A. (60% versus 57% for women and men respectively), a pattern replicated in Europe where sex differences are small and often not statistically significant (Salazar and Starr 2018). In what Mary-Kate Lizotte (2015) calls 'the Abortion Attitudes Paradox', some polls only show sex differences in attitudes to abortion when women's greater average religiosity is entered as a covariate in the analysis.

Differences between women and men in support for various forms of public goods and welfare spending also often vary only as much as 3–4%, but can yield sex differences as high as 10–15% (Clark and Clark 1996). American women and men differed in their support for aspects of the 'Affordable Care Act', for example, by an average of 5% across nine items (Lizotte 2016). In an analysis of US General Social Survey attitudinal domains chosen *because* they showed some evidence of sex differences, multivariate factors concerning Social Compassion and Traditional

Morality differed, on average, by less than 5% between the sexes (Eagly et al. 2004). These various streams of research converge to suggest that although mean sex differences in the expression of a wide variety of attitudes are common, they are often surprisingly small relative to the variation within each sex. Such an observation challenges predictions from sexual conflict theory and social role theory alike.

Observation 2: The transformative nature of parenthood and other forms of kinship

A second observation concerns the curious phenomenon whereby the sex of a person's children can shift their attitudes along the socio-political spectrum (reviewed by Lundberg 2005). Several economic studies have demonstrated so-called "daughter effects" where firms led by CEOs who have daughters adopt more socially and environmentally progressive corporate policies (Cronqvist and Yu 2017). Such firms are also more likely to appoint female directors to their boards than are firms whose CEOs have no daughters (Dasgupta et al. 2018). Venture capital firms led by senior partners who have daughters are also more likely to hire female partners (Gompers and Wang 2017), with positive consequences for overall firm performance.

These effects are by no means confined to the corporate world. Warner (1991) found that support for feminism was greater among parents of daughters than those of sons. Parents, particularly fathers, who have only daughters express stronger support for public policies that address gender equity, whereas those policies gained the least support from men who have only sons (Warner and Steel 1999). The sex of one's children can also affect adherence to traditional gender roles (Downey et al. 1994), attitudes concerning affirmative action (Prokos et al. 2010), and social dominance orientations (Pratto et al. 1994, Sidanius et al. 1994). Mothers with more sons relative to daughters are also more likely to believe that "children always suffer when both parents work outside of the home", and that "the most important thing for children to learn is to obey their parents" (Downey et al. 1994). These "daughter effects" are found in the political sphere as well.

Representatives in the U.S. Congress who have daughters vote more progressively on bills concerning reproductive rights, provisions for working families, and tax-free education (Washington 2008). In Great Britain, parents of daughters vote more for left-wing parties than do parents of sons (Oswald and Powdthavee 2010).

Findings such as these are often viewed as effects of the offspring "changing" their parents via parents' ongoing observation of, and social interaction with, their children (Miller and Glass 1989, Warner and Steel 1999, Washington 2008). It is also possible that the sex of a child impacts other forms of social interaction experienced by parents, including different sporting and cultural activities, social interaction surrounding schools, etcetera. One might expect adolescent or adult offspring to have particularly large effects on their parents, given the years of social interaction, both with the child and with others as an indirect result of the child involved. Yet many of the effects outlined here are observed in parents of infants and toddlers (Warner 1991, Warner and Steel 1999), where these various pathways have had relatively little time to become fully realized.

The sex of a new family member provides what economists call an 'exogenous shock', a putatively random imposition of a change that permits, over a replicated sample of such changes, powerful inferences of causality. Several recent studies apply this approach to show that the sex of a newborn—or in the case of prenatal sex screening, a gestating foetus—is associated with behavioral change (Oswald and Powdthavee 2010, Shafer and Malhotra 2011, Pogrebna et al. 2018). From a longitudinal dataset on British voting patterns, Oswald and Powthavee (2010) showed that the birth of a daughter can *cause* parents to move toward the political left, whereas the arrival of a son can do the opposite. Similarly, analysis of data from the U.S.A. National Longitudinal Study of Youth found that having a daughter causes men to weaken their support for traditional gender roles, although the sex of a child had no such effect on women's attitudes (Shafer and Malhotra 2011). The exogenous shock of finding out the sex of one's child at birth, or even *in utero,* can extend beyond changing attitudes or voting intentions to entire syndromes of behavior. Parents who find

out they are having (or have just had) a daughter become almost twice as risk-averse as those who are having or have had sons (Pogrebna et al. 2018).

These examples provide promising support for the idea that the sex of an individual's genetic kin shifts their position along the socio-political spectrum. Yet, they do all concern parents in primarily WEIRD societies (sensu Henrich et al. 2010). Recently, however, we also showed that despite Tunisian men being more supportive of mandatory Islamic veiling of women, women with more sons were more supportive of veiling, and more likely to wear veils themselves than women with fewer sons (Blake et al. 2018). In that paper we suggest that what we call "Gendered Fitness Interests" may be an important consideration in future studies that combine social, evolutionary and economic ideas to study gender and its manifestations. In the case of Tunisian mothers, those with sons adopted a more typically masculine position than those with daughters, which we argue reflects favoring a restricted female sexuality that serves the interests of sons over those of daughters-in-law (Blake et al. 2018).

Gendered Fitness Interests might also extend beyond an individual's children. In a largely neglected paper that precedes most of the examples we cited above, Betzig and Lombardo (1992) showed that people's attitudes to abortion vary with the number of female kin in the 15–50 age group "at risk" of unwanted pregnancy. As this number increases, so does the adoption of pro-choice policies. Yet as the number of reproductive age male kin increases, so does the adoption of pro-life policies. Their analysis extends the highly politicized issue of abortion from being a clash of male and female interests to one where the composition of an individual's broader family might be germane to the position that person takes. It is this idea that sparked our interest in Gendered Fitness Interests.

Gendered Fitness Interests

A rich body of research supports the idea that humans invest time, money and other resources in their kin, and that strategic differences in these investments can be driven by relatedness considerations (Alexander 1982, 1987, Betzig and Lombardo 1992, Gaulin et al. 1997, Alvard 2003, Jeon and Buss 2007, Perry and Daly 2017). The remainder of this manuscript concerns how genetic relatedness considerations might influence socio-political attitudes. In particular we build on the early ideas of Alexander (1982, 1987) concerning how moral paradoxes arise from conflicts of reproductive interests, and the work of Betzig and Lombardo (1992) who drew attention to the importance of the balance of female and male kin on attitudes concerning abortion. We suggest how 'Gendered Fitness Interests' might be detected by careful experimental and analytic work, partitioned from the other effects that shape an individual's socio-political attitudes, and used to generate theoretic predictions.

While most individuals are either male or female, the study of Gendered Fitness Interests (GFI) explores the notion that their evolutionary fitness interests are almost never entirely aligned with just their own sex. Hamilton (1964a, b) showed that evolutionary fitness comprises not only personal fitness through numbers of descendent kin, but also inclusive fitness through all genetic relatives. The effect of a relative on an individual's fitness is moderated by genetic relatedness, r, the probability of the focal individual and the relative sharing a given allele by common descent. Both parents-offspring and full sibling dyads share half of their alleles by descent. Half-siblings share one quarter of their genes by common descent, as do grandparents with their grandchildren, and aunts/uncles with their nephews/nieces. First cousins share one eighth of their genes and so forth. Accordingly, an individual's inclusive fitness should, *ceteris paribus*, be influenced four times more strongly by a sibling than it is by a full first cousin.

The notion of inclusive fitness can be extended to include a gendered dimension that accounts for the sex of the kin through which an individual's inclusive fitness is likely to be gained.

Over large numbers of kin, and generations of yet-to-be-born kin, an individual's fitness is likely to come equally through males and females. But in the space of a generation, or even a few years, currently living members of one sex may have far greater effect on an individual's fitness than the other sex. The extent to which an individual's future fitness on this timescale is likely to come through male or female lines depends on (1) the individual's own sex, (2) the sexes of their kin, and (3) the likely future reproductive success (i.e. residual reproductive values) of the individual and each of those kin.

Consider a hypothetical example, where two unrelated women each have a single child but no other close surviving kin. Each woman has, in the language of evolutionary life-history theory, the same residual reproductive value (RRV, her expected number of future offspring, Fisher 1930, Stearns 1992), here denoted n. If N is the average number of offspring a woman has in her lifetime, let us assume that both women are at the age where women have had, on average, $n = 0.8N$ offspring, and can expect to have an average of $n = 0.2N$ more.

The existing child of woman a is a daughter, a_1. Assume a_1 is on the threshold of adulthood, where the average girl is likely to have N offspring in the future. Her contribution to her mother's inclusive fitness is Nr, and because she is a daughter, r=0.5. Thus, woman a can expect to have inclusive fitness of $0.2N + 0.5N = 0.7N$. Moreover, note that all of woman a's fitness due to individuals currently alive will come through females.

Woman b has a son, b_1 who is also on the threshold of adulthood and thus has the same expected offspring number, N. Woman b's expected fitness is also $0.7N$, but only 2/7ths through females (i.e., herself = $0.2N$) and 5/7ths will come through existing males (i.e. her son $b_1 = 0.5N$). Thus, woman b has 2.5 times more of her future fitness interests in living males than females.

The same approach can be used for individuals with more living kin. The fitness effects, k, of all y kin of sex x, including the individual her/himself, can be summed as:

$$k_x = \sum_{i=1}^{y} n_i r_i$$

Where n_i is the expected future reproductive success of individual i as a proportion of the overall population mean reproductive success, and r_i is the relatedness of individual i to the focal individual. One might estimate n_i by referring to the individual's position on sex- and age-specific fecundity curves for the population they live in, and more complex treatments could include individual terms for mate value, survival and other traits.

One could then express the gendered nature of fitness interests either absolutely as a difference

$$GFI = k_m - k_f$$

or on a proportional scale from -1, entirely female, to 1, entirely male:

$$GFI = \frac{k_m - k_f}{k_m + k_f}$$

For simplicity, we use the second approach in the simple illustrations that follow.

Example – Two Children

We consider now for illustration the simplified case of a focal individual with two children, and 100% paternity confidence, such that each child is related with $r = 0.5$ to the focal individual. We assume that every woman and man has 25 reproductive years (from age 20 to 44 inclusive), and that the likelihood of reproducing in any one of these years is the same. Thus n equals 1 at age 20, and declines monotonically to zero at age 45. Each child has 100 percent survival to reproductive age, so n=1 for all individuals younger than 20, and then from the age of 21 onwards, diminishes by 0.04 per year, until n=0 at age 45. Assuming, for simplicity, no other living relatives, from birth

until age 20 all of an individual's future fitness will derive from their self. Thus Gendered Fitness Interests, expressed as *GFI*, equals -1 for women and 1 for men up to the age of 20.

Descendants begin to influence an individual's GFI when they are born. In Figure 1 we illustrate how this simplified example of GFI might work for a man (Fig 1, Panel A) and a woman (Fig 1, Panel B), each of whom have one child at age 24 and a second at age 27, in relation to the sexes of those two children. For a man, the birth of each daughter dramatically reduces *GFI*, and then there is a more gradual decline in *GFI* until the man reaches the end of his own reproductive career at 45. What happens over the remaining years depends on whether the other child is a son or daughter, and the order if it is a son. The opposite pattern pertains to women when they have at least one son.

<Figure 1 about here>

The rather dramatic swerves toward the extremes of the *GFI* range in each subject's sixties occur as a result of the first child in mixed-sex families reaching the end of their own reproductive career. We do not predict that *GFI* will show such pronounced swerves in most actual cases, as subjects will have grandchildren and other relatives, likely drawing their *GFI* toward 0.5. We explore these effects in the next section.

Simple Simulation

We built a simple simulation model in MS Excel in order to explore some of the properties of Gendered Fitness Interests for three generations, only including descendent kin (i.e., children and grandchildren) and assuming no parents, siblings or other relatives. As in the previous example, we assume individuals can begin reproducing at age 20 and cease reproducing at 45. For simplicity, we divide the reproductive career into five-year intervals (20–24, 25–29 etc.). In each five-year interval, each individual could produce between 0 and 5 sons, by sampling at random from a Binomial distribution of 5 events, each with the probability, p, of a son being born as a result of that

event. To do so we applied the BINOM.INV function in MS Excel with *Trials* = 5, *Probability_s* = *p*, and *Alpha* drawn as a random number (function *Rand()*). This is effectively the same as saying every focal individual could produce one son per year, at probability *p*. Independently, but otherwise in exactly the same way, each individual could produce between 0 and 5 daughters in each five-year interval.

From the interval 40–44 onward, offspring cohorts began to mature (i.e. reach 20 years old) and could produce grandchildren. We applied the same formula to allocating grandsons and, independently, granddaughters, but the number of trials was set to equal five times the number of offspring (both sons and daughters) of reproductive age. Thus each offspring of reproductive age could produce up to five grand offspring of each sex in a given 5-year interval.

We calculated *GFI* at the end of each five-year interval up to the age of 65. To simplify these calculations, we assume that offspring and grand-offspring are as old as it is possible to be in their cohort. For example, offspring born in the first cohort (parental age 20–24) are assumed to be 25 when the focal individual (i.e. parent) is 45. To confine our attention to three generations, we only present simulation results up to the focal individual age of 65. We present the outputs of simulations with $p = 0.1$, where each reproductive-age individual had a 10% chance of producing a son and an independent 10% chance of producing a daughter in a given year. This resulted in the following numbers (mean ± S.E; range) of descendent kin across a focal individual's entire career: sons (2.49 ± 1.56; 0–5); daughters (2.52 ± 1.46; 0–5); grandsons (4.59 ± 3.47; 0–11); granddaughters (4.65 ± 3.54; 0–11).

The output of these simulations leads to a number of observations (see Figure 2a). First, GFI converges in males and females as the self's residual reproductive value diminishes. By focal individual age 45 years, when reproduction is over and all fitness interests reside in descendants, male and female average gendered fitness interests are neutral (mean *GFI* = 0.5). Second, there remains considerable variation among individuals within sexes in GFI. The convergence of

gendered fitness interests as we have conceptualized them leads to the prediction that attitudes that have a gendered dimension will show diminishing sex differences in mid- to late adulthood, and that they will retain a great deal of within-sex variation.

<figure 2 about here>

Simulation with Unequal Career Durations

Our observed convergence at age 45 is an artificial result of our constraining reproduction to the 20–44 age range. Women often debut earlier than men as parents, and menopause curtails women's reproduction from mid- to late adulthood whereas men peak later and can go on to reproduce at older ages than women. As a simple illustration of how different durations in men's and women's reproductive careers might alter gendered fitness interests, we altered the model above to allow men to reproduce for 15 years more than women (i.e., to 60 vs 45 years of age).

The probability of a woman bearing a son in a given year of her 25-year career remained set at p=0.1, and likewise the probability of her bearing a daughter in a given year equaled $p = 0.1$. For men, however, with a 40-year reproductive career these probabilities were scaled to $p=0.1 \times (25/40) = 0.063$, in order to satisfy the assumption that the population total reproductive output through males and females was the same. The results of 1000 simulations show that focal men were, on average, slower to converge toward $GFI = 0.5$ due to the longer persistent of the effects of the self (Figure 2b).

Future attempts to model GFI will need to account for the complex effects of demographic factors, notably sex differences in age-specific fecundity. Differences in the age of debut, the age at which reproduction peaks, and the properties of its decline in each sex will alter the trajectory of GFI across an individual's lifetime, as well as the average differences in GFI between women and men. The accurate estimation of GFI, especially as siblings and other non-descendent kin are also accounted for, is likely to become a very complex business. It is our hope that theoreticians will

develop more extensive models and predictions, and that empiricists will, in time, conduct direct tests of those predictions.

Discussion

The examples above illustrate some simple cases in which men who have daughters and women who have sons should diverge from the typical attitudinal position of their own sex as they grow older. Their own age (a proxy for residual reproductive value), the sex and age of any children they have, as well as the age and sex of their other relatives, will determine the overall strength of the GFI component of their attitudes. Here our simple modeling presents a first attempt to understand how Gendered Fitness Interests might behave, and might be partitioned from the many other likely sources of variance in socio-political attitudes. We welcome more comprehensive attempts to understand GFI and how to tackle the complex job of partitioning it, as well as to extract predictions for empirical testing. For now, our modeling gives rise to two straightforward observations.

Observation 1 – Sex Differences Will Diminish with Age

Our first observation from our simple illustrative model is that an individual's Gendered Fitness Interests will change as they get older, as they and their surviving kin age, and as other kin are born or die. This change in GFI will, on average, be toward the typical position for the other sex, thus narrowing the average difference between the sexes. This expectation is due both to a weakening in the effect of their self on GFI, due to diminishing residual reproductive value, and to the sex ratios of kin, all of which may cause GFI to regress toward the mean sex ratio (approximately 0.5). As a result, gaps in attitudes between women and men should usually be bigger in early adulthood and converge with age.

Despite a rich literature on the gendered nature of attitudes and orientations (e.g. Twenge 1997, Eagly et al. 2004, Calvo-Salguero et al. 2008), there is a surprising dearth of evidence on how individual attitudes change with age, and no evidence at all on the effects of kin on those changes. The majority of studies on attitudes have, for pragmatic reasons, been conducted on undergraduates or young adults (e.g., Sidanius and Ekehammar 1980, Ekehammar and Sidanius 1982, Twenge 1997). Those studies that have considered older adults, and the relationship between age and socio-political attitudes (e.g, Rice and Coates 1995, Cornelis et al. 2009), have usually involved cross-sectional comparisons. Valuable as these cross-sectional data can be, they confound cohort effects with the within-individual change over time that is of interest to our hypothesis.

In one of the few studies to take a longitudinal view of attitude change over time, and also test for interactions between age and sex, Judge and Livingston (2008) found that people became less traditional in their gender role attitudes over time and that this effect was stronger for men. Thus, although women are, as expected, less traditional in their gender role attitudes than men, and there is an overall trend toward less traditional attitudes (likely due to secular change), men's attitudes do appear to change faster than women's, and the sex difference diminishes. This finding is consistent with our predictions, but we note that there is no direct evidence that it arises due to convergence in GFI.

Testing our prediction regarding age and attitude change will require longitudinal studies of individuals in order to separate true changes in attitudes from cohort effects. Convergence in attitudes is a prediction not unique to our proposed mechanism. Women and men might be expected to converge due to all manner of shared experiences and socialization, notably those encapsulated in Bourdieu's (1977) notion of habitus. Preferably, tests of our idea will also track the sex and age of subjects' close kin in order to separate effects of GFI from other sources of convergence. The perfect test, though laborious, will follow individuals longitudinally through a variety of exogenous changes in GFI due to births and unanticipated deaths, extending the approach used for single births

by Oswald and Powthavee (2010), and Shafer and Malhotra (2011). Note that we make no claim that GFI is the only source of variance in socio-political attitudes, only that it is likely to be important. Thus we predict a narrowing of the gap with age, as *GFI* tends toward 0.5, but we not necessarily predict complete closing of the gap as factors other than GFI, including those discussed throughout this manuscript, are almost certainly always at play.

Our predictions that sex differences will diminish with age extend beyond population means to differences between spouses. Alexander (1987) noted that spouses share, as a result of their mutual offspring, similar avenues to fitness, and thus that their world views might converge due to shared reproductive interests. Observations from our similar model are consistent with Alexander's conjecture. Spouses are well known to evince highly similar socio-political attitudes (Bouchard 2009, Alford et al. 2011). Most of that similarity, however, is already present early on in the relationship (Alford et al. 2011), and does not appear to increase with the duration of the relationship (Martin et al. 1986). Spousal similarity would appear to arise mostly from assortative dating and mating (Hatemi et al. 2010, Huber and Malhotra 2017), although it would be informative to test how changes in GFI through shared kin (e.g. children) enhance spousal similarity, and whether changes due to the births of nephews, nieces, etc. might open up some spousal differences. There exists great scope for time-series analyses, including data that track shifting individual roles (as per Eagly et al. 2004, Wood and Eagly 2012), and shifting constellations of close non-kin (e.g. stepchildren, adoptees) and affinal kin, in order to quantify the importance of GFI relative to other candidate hypotheses.

Relation to Behavior Genetic Evidence

One intriguing study of socio-political attitudes and age comes from the behavior genetic study of twins (Eaves et al. 1997). The resemblance in "conservatism" between juvenile twins (younger than 20 years old) is no greater in monozygotic (r=1) than dizygotic (r=0.5) twins,

suggesting that the resemblance is largely due to the social influence of the family. The correlation rises through the teens for both sorts of twins, reaching approximately 0.6-0.65 at age 20. After the age of 20, however, the resemblance between dizygotic twins drops away to about 0.4 at age 40, where it remains until age 75. The correlation in conservatism between monozygotic twins remains at or just above 0.6. The authors interpret this finding as evidence that genetic differences play a bigger role in shaping attitudes as adulthood progresses (Eaves et al. 1997).

We suggest that those genetic factors might include Gendered Fitness Interests. Monozygotic twins have identical GFI. Moreover, their high relatedness to one another means that they, and their descendent kin, affect one another's GFI identically. Dizygotic twins, however, diverge in their GFI as soon as one has their first child because that child is related by r=0.5 to the parent, but only r=0.25 to the parent's twin. We believe that twin registries, coupled with the extensive expertise in variance partitioning among quantitative geneticists, may prove a productive place to begin critical tests of our proposal. One considerable drawback to this idea, however, is the fact that it requires some way for monozygotic twins to identify their genetic unity and thus value their twin as they do their own self. While thinking about inclusive fitness often leads down this path, there is not good basis for expecting that monozygotic twins act in this way.

More generally, our theory of GFI may bear on the question of genetic factors shaping social and political attitudes. Despite strong opinions that such attitudes are acquired environmentally, particularly due to socialization (Miller and Glass 1989, Downey et al. 1994, Eagly et al. 2004, Eagly and Diekman 2006), quantitative genetic analysis, notably from twin studies, has demonstrated substantial additive genetic variance in political and social attitudes (Martin et al. 1986, Eaves et al. 1989, Hatemi et al. 2010). Our theory of GFI adds a hitherto unknown genetic cause of familial resemblance that may, in part, explain the high heritabilities of social and political attitudes that entail a gendered component.

Gendered Fitness Interests are explicitly genetic interests, with relatives exerting an influence on a focal individual's gendered attitudes in proportion to their genetic relatedness. Relatives that share numbers of mostly male kin (i.e., high *GFI*), or other sets of relatives that share numbers of mostly female kin (i.e., low *GFI*) will come to resemble one another in GFI more than equally related sets of relatives that share a mix of male and female kin (i.e. *GFI*~0.5). GFI may thus have the effect of amplifying familial resemblance in gendered attitudes more than it would be likely to do for familial resemblance in non-gendered traits such as, say, personality traits, food preferences, or intelligence. If so, GFI may inflate heritability estimates in a way that has, to our knowledge, not been anticipated by quantitative geneticists.

Family size and GFI

We predict that sex differences in GFI, and thus sex differences in the component of socio-political attitudes that is shaped by GFI, will be smaller when family sizes are large. The biggest differences observed in our models pertain to the age before reproduction has begun. In large families, the presence of large numbers of offspring, siblings, cousins etc. is likely to draw GFI toward 0.5, as larger numbers of random events, in this case sex determination events at conceptions, tend toward the population mean more than smaller samples. An investigation of whether declining family sizes (such as those through the demographic transition) polarize socio-political attitudes would be an informative topic for future research. Demographic transitions involve changes in mortality and fertility schedules, as well as migration patterns, and investment in individual descendent kin. Data that traverses demographic transition events, or even component interventions (e.g. the opening of new family planning clinics) may provide fertile grounds to test the importance of GFI relative to other hypotheses.

Weaknesses and Opportunities

We presented a few simple intuitions and predictions concerning the idea of Gendered Fitness Interests. In particular, we restricted our simple model to two generations of descendent kin, without including any effects of siblings, parents, aunts, uncles, cousins or more distant relatives. Further, we modeled simplistic functions for the relationship between residual reproductive value and age. We hope that our preliminary suggestions, despite their simplicity, stimulate further discussion and theoretic development. Immediate questions worth asking include whether, by including these other relatives, any meaningful variation in GFI remains. Further, how far does one have to go in order to capture the individuals who influence GFI the most? Whether it will it be worth sampling beyond first cousins (r=0.125), for example, remains to be seen.

We stop short of arguing that socio-political attitudes are, themselves, subject to evolution via kin selection. The research on kin selection is sophisticated and highly mathematical. Since Hamilton's (1964a, b) seminal papers, kin selection has benefitted from more than half a century of intense theoretic development and empirical testing, mostly on non-human organisms. Should our Gendered Fitness Interests idea hold up to direct empirical testing, it might do so simply because people intuit what is in the interests of those closest – geographically or emotionally - to them, and their attitudes shift to reflect those interests. For ideology to form the kind of 'altruism' that Hamilton sought to explain via kin selection, an individual's ideological positions would have to influence relatives' fitness in a manner that obeyed Hamilton's Rule. That may be unlikely to occur at the level of a community or society, where the efforts of those with high or low GFI will likely cancel out under most circumstances. At the family level, however, we may find that socio-political beliefs could tip behaviors in favor of one sex or another. We suggest that this may be occurring in our study of Islamic veiling practiced in Tunisian households (Blake et al. 2018).

The benefits of 'altruism' can depend on dispersal rates and population viscosity, both of which influence the probability of altruism being directed at kin (Hamilton 1964b). Those same

benefits can be undermined, however, by the increased competition among relatives that results from an actor's altruism (West et al. 2002). Whether a socio-political position could take the shape of Hamiltonian altruism, then, depends not only on the positive effects of that position on relatives' fitness, but also on the countervailing effects of any increase in competition among relatives. A position that favored one daughter might be undermined, for example, if it intensified competition among a family of sisters (i.e. multiple daughters). This notion would need to be accounted for in any argument that socio-political positions are subject to selective forces.

Dispersal, too, might provide the opportunity to separate the effects of kin via intuited GFI versus other more proximate cognitive and social mechanisms involved in knowing and interacting with one's kin, affines, and step kin etcetera. Data that not only tracks the birth and death of relatives, affines, step kin and other family members, as well as the time spent with them, distance they live away, or simply emotional closeness, might help to disentangle the mechanisms underpinning why the sex of one's children—and possibly other kin—affects attitudes.

The possibility of kin selection via gendered fitness interests shaping the positions people take on socio-political and ideological issues represents a hypothesis that we believe is worth testing, particularly if 'big data' sets and greater computing power permit powerful tests of what would probably only constitute small effects. If upheld, Gendered Fitness Interests might go some way to explaining not only why social and political positions are so strongly held, so variable among people, and so likely to shift with age, but also why some people project their ideological positions so avidly. It might also undermine the idea that the interests of individual women and men are perennially, and necessarily at odds. Most people's Gendered Fitness Interests will be close to equity due to large numbers of both female and male kin. Many individuals, however, with have GFI that are aligned more with the opposite sex than with their own. Both of these observations challenge the idea of biological sex as a fixed and immutable element of individual identity.

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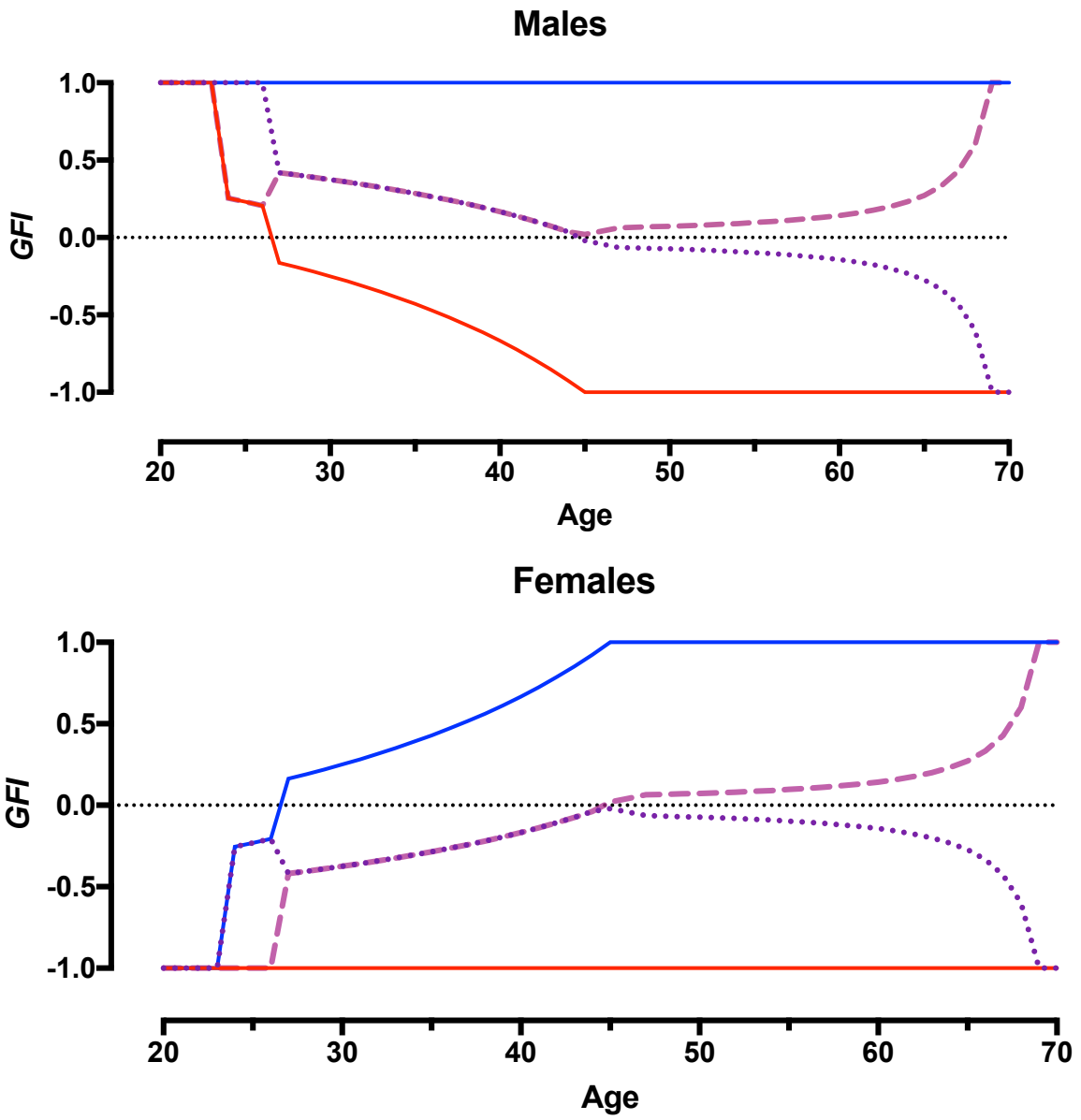
FIGURE CAPTIONS

Figure 1. Proportion of Gendered Fitness Interests through the male line for focal males and females in relation to age and the sex of offspring born to them at ages 24 and 27. Blue = son, son. Purple = daughter, son. Black = son, daughter. Red = daughter, daughter.

Figure 2. Output from 1000 runs of the three-generation descendent kin simulation model giving GFI_m at five-yearly intervals. A. Means and standard deviations for males (red circles) and females (blue squares) when both sexes can reproduce between ages 20-44. Females offset by 0.5 years; dotted line denotes equal fitness interests in males and females. B. Means only for 25 year reproductive career (as in panel a), or for males (filled pink circles) and females (filled blue squares) when males have a 40-year reproductive career (20-59 years old).


Males
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Age
Females
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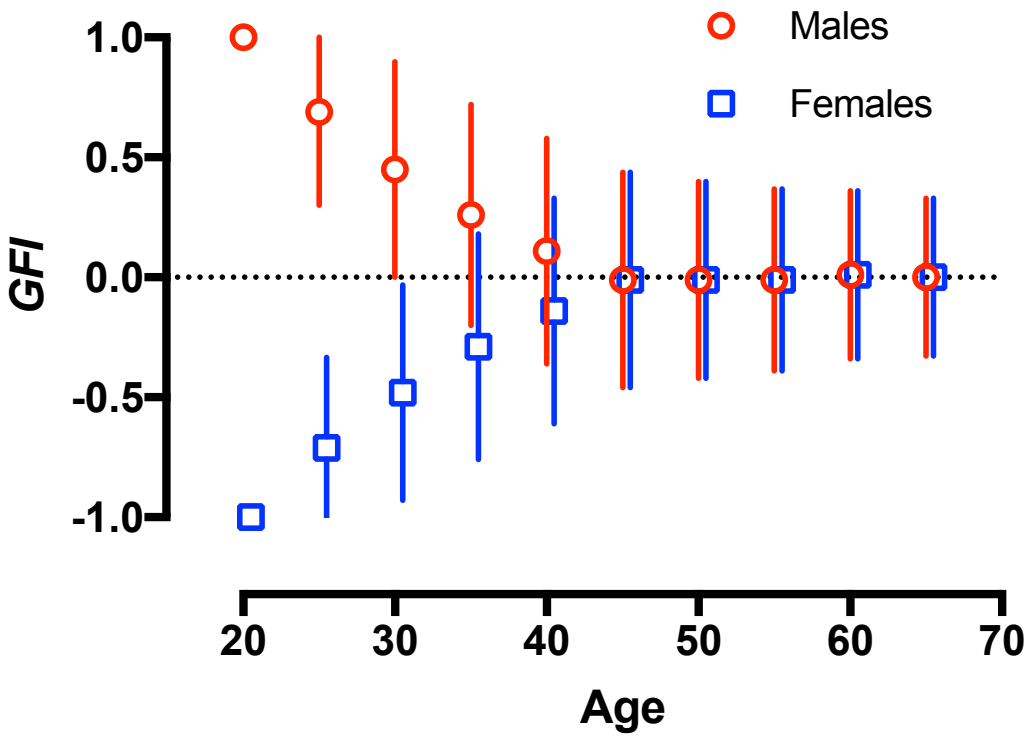
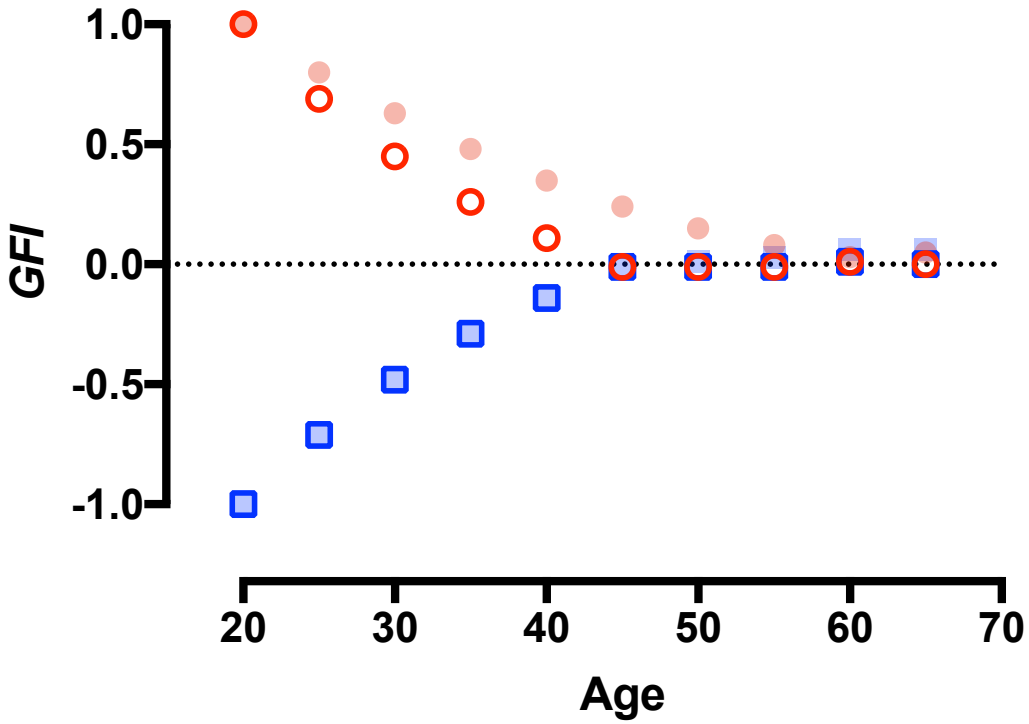
Age

a. Reproduction 20-44 both sexes



b. Extended male reproductive career