CrossMark

Marriage Markets and Male Mating Effort: Violence and Crime Are Elevated Where Men Are Rare

Ryan Schacht[1] · Douglas Tharp[2] · Ken R. Smith[2,3]

Abstract The negative social outcomes in populations with male-biased sex ratios are a growing concern. In general, the expectation is of heightened violence as a result of excess men engaging in antisocial behavior and crime, thereby threatening societal stability. While intuitive, these claims are largely unsupported in the literature. Using mating market theory as our guide, we examine indicators of male mating effort, including (1) violent competition between men (homicide, aggravated assault) and (2) indicators of uncommitted sexual behavior (rape, sex offenses, and prostitution). Our unit of analysis is U.S. county-level data. We find that counties with more men have *lower* rates of crime and violent behavior. Our findings challenge conventional claims of male excess leading to elevated levels of violence. Instead, in support of mating market predictions, we find that criminal and violent behavior related to male mating effort is least common in male-biased sex ratios. We discuss the implications of our findings for public policy regarding incarceration and criminal behavior.

Keywords Sex ratio · Parental investment · Mating market · Sexual selection · Violence · Competition · Crime

There is a strong intuitive expectation of negative social outcomes in populations with "too many men" (Hudson and den Boer 2002). Because gender is one of the best individual-level correlates of violence, with men being more likely to be both victims and perpetrators than women (Messner and Sampson 1991), populations with an excess

✉ Ryan Schacht
r.schacht@utah.edu

[1] Department of Anthropology, University of Utah, Salt Lake City, UT 84112, USA

[2] Department of Family and Consumer Studies, University of Utah, Salt Lake City, UT 84112, USA

[3] Population Sciences, Huntsman Cancer Institute, University of Utah, Salt Lake City, UT 84112, USA

🖄 Springer

of males are expected to be more violent (Brooks 2012). In particular, the source of this concern centers on the growing pool of risk-prone unmarried men in populations where women are relatively rare. Their abundance at the population level is expected to elevate conflict among males over partners, disrupt the formation of families, destabilize pair bonds, and leave many men unable to find a mate (Hesketh and Xing 2006; Hudson and den Boer 2004). Accordingly, at the macro level, the sex ratio is expected to be an important determinant of rates of crime and violence (Messner and Sampson 1991).

This argument is in line with a long-standing model of sexual selection (Trivers 1972) that links sex differentiated behavior to differences in parental investment by males and females. Gametic investment of males is relatively low and males produce many, and relatively cheap, gametes. This results in a higher potential reproductive rate (i.e., the number of offspring that can be produced per unit time; Clutton-Brock and Parker 1992; Clutton-Brock and Vincent 1991) for males and, potentially, greater male benefits to mating multiply. Accordingly, selection is typically argued to have favored mate-seeking and competitive behavior in males and heavy investment in parental care in females. Furthermore, female rarity is expected to favor ever more intense, antagonistic competition between abundant males over the limited number of females in response to greater male reproductive skew (a measure of the number of males left unmated; Emlen and Oring 1977; Trivers 1972).

The relationship between sex and competitive behavior across the human and nonhuman animal literature implies that the sex ratio should serve as an important predictor of rates of violence. Despite decades of research, however, male-biased sex ratios are, at best, inconsistently associated with elevated levels of violence (Messner and Sampson 1991; Schacht et al. 2014). For example, rates of homicide, sexual assault, and violent crime have all been found to be both positively and negatively associated with the sex ratio across studies (Barber 2000; Drèze and Khera 2000; Edlund et al. 2007; O'Brien 1991; Trent and South 2012). Although some of this "noise" is likely due to study design (e.g., reliance on nation-level data and/or the use of an overly restrictive or inclusive sex ratio; see Schacht et al. 2014 for discussion), nonetheless the question remains: Given a greater male propensity for violent behavior, why has the sex ratio not emerged as an important predictor of violence?

Unattached Males and the Bachelor Threat

A concern central to most sex ratio research is that female rarity will elevate rates of violence at the population-level because of a growing class of unattached bachelor males (Hudson and den Boer 2002). Although unmarried men are indeed more likely to engage in criminal and violent behavior than married men (Sampson et al. 2006), there is little evidence that unmarried men are more abundant at male-biased sex ratios (Angrist 2002; Jones and Ferguson 2006; Kruger and Schlemmer 2009; Messner and Sampson 1991; Schacht and Kramer 2016). Marriage rates for both men and women are generally higher in populations where women are relatively rare, suggesting that men are quite flexible in their desire to get married and are less *willing* to do so when potential partners are abundant. In addition, when there are more women than men in a population, the prevalence of monogamy decreases (Guttentag and Secord 1983;

Schacht et al. 2014), sexual concurrency increases (Adimora et al. 2013), and relationships are less stable (Otterbein 1965). These findings are also consistent with recent work in the animal literature. For example, male rarity is associated with decreased paternal investment (Liker et al. 2013) and increased male promiscuity (Thomson et al. 2014).

In sum, counter to conventional concerns of male-biased sex ratios, men are more likely to marry, be part of a family, and be sexually committed to a single partner when women are in short supply. Thus, the claim that male-biased sex ratios may lead to societal instability and violence through a surplus of unmarried men is not supported empirically. Rather, it would seem that particular concern should be paid to situations in which men are relatively rare and, as a result, less willing to commit themselves to marriage and a family.

Mating Markets and Reproductive Decision Making

To generate predictions of behavior in response to partner availability, we turn to mating market theory (Guttentag and Secord 1983). This theory avoids simple numerical, sex-based arguments and instead expects facultative shifts in behavioral strategies in response to partner availability. This approach is in line with recent frequency-dependent theoretical reformulations in sexual selection theory (Kokko and Jennions 2008, 2012). Specifically, a population of men and women can be thought of as a mating market, which operates by the principle of supply and demand. The rarer sex has more bargaining power in the marketplace and can leverage their scarcity to realize their preferred mating strategy. The more-common sex must cater to the preferences of the rarer sex in order to acquire a mate. For example, when women are abundant, men are expected to invest more in short-term mating effort and to behave more promiscuously, while offering little parental investment. However, when women are in short supply, men's mating orientation will turn to behavior necessary to secure long-term relationship commitment from a relatively rare partner (Noë et al. 2001).

According to a mating market approach to relationships, male reproductive behavior is expected to respond to partner availability—challenging expectations of largely "static" male behavior that pervade the literature (Hudson and den Boer 2002). When the sex ratio is male-biased, female rarity favors male strategies that attempt to acquire and maintain a single relationship. However, when the sex ratio is female-biased and partners are abundant, female excess favors male strategies that pursue multiple relationships (Guttentag and Secord 1983). Thus, while additional population-level and culturally specific variables play key roles in reproductive decision-making, the crucial insight from mating market theory is that behavior is not seen as simply sex-dependent, but as an individual response to sex-structured payoffs to partner availability (Kokko and Jennions 2008). In support of this prediction, cross-cultural research finds greater male reproductive skew in populations with relatively few men (Schacht et al. 2014), signaling that men may be more likely to be left without a partner when women are abundant, not rare. Across the animal literature, female-biased sex ratios are also associated with higher rates of male reproductive skew and, additionally, male mortality from mating competition (Liker et al. 2013; Székely et al. 2014). Thus across

animal taxa, male investment in mating effort when partners are abundant is well supported (Kokko and Jennions 2008).

Here we seek to answer the question: As males pursue their conditional strategies in response to partner availability, which types of crime and violence are most common in populations with relatively more men or women? Our research will focus on indicators of male mating effort, including violent competition between men (e.g., homicide and assault), and indicators of uncommitted sexual behavior (e.g., prostitution, sexual offenses, and rape). Following mating market theory, we predict that these types of crime and violence will be more common when men are relatively rare. We distinguish these from other mating effort (e.g., mate guarding) or parenting effort (e.g., resource provisioning) behaviors that are expected to be more common in male-biased populations.

Methods

Given the importance of identifying marriage pools to explore reproductive decision-making (Schacht and Borgerhoff Mulder 2015), we use US counties as the unit of analysis (U.S. Census Bureau 2010). We include all counties and county equivalents (i.e., boroughs of Alaska and parishes of Louisiana) with available crime data for a total sample of 3082. The dependent variables are crime rates obtained from the Federal Bureau of Investigation 2010 Uniform Crime Reporting Program (Federal Bureau of Investigation 2010). The outcome measures here are rates of homicide (murder and nonnegligent manslaughter), aggravated assault (attack for the purpose of inflicting severe injury), rape (sex against a woman's will), sex offenses (attempted rape, sexual assault, and offenses against common decency, etc.), and prostitution/commercial vice (unlawful promotion of or participation in sexual activities for profit; definitions from the Federal Bureau of Investigation 2010). Sex ratio data are sourced from 2010 US Census data. We calculate the adult sex ratio (ASR) of men to women 15–45 years of age to include individuals most actively involved in the mating pool in each county.

We recognize that a county-level approach to the study of violence and crime raises concerns specific to the analysis and interpretation of results from aggregate data. Of particular concern is when group-level relationships are inappropriately assumed to reflect individual-level behaviors (Pollet et al. 2014). Consequently, cautious interpretations must be applied when attempting to infer behavior with respect to both the level of data and the question of interest. Here, because we are explicitly interested in an ecological focus to the study of crime and violence, we chose county as our unit of analysis. County data have been shown to be appropriate when examining marriage pools because this geographical context better reflects the availability of potential partners than do smaller units of analysis (i.e., counties better capture individual ranges, including where they live, work, and socialize, than do neighborhoods or census tracts; Fossett and Kiecolt 1991; McLaughlin et al. 1999; Schwartz 2006). In addition, although analysis of individual-level data is typically seen as ideal, much data on crime is unavailable at the level of the perpetrator. And, when analyzing crime data, often county-level data are seen as more dependable than smaller units of analysis because local police statistics often underestimate the number of offenses as a result of nondetection or underreporting (Wiersema et al. 2000). Moreover, county data are

recognized as having a wider range of available measures and sufficiently large populations to generate reliable rates of relatively infrequent events such as homicide than smaller units such as census tracts (Messner and Sampson 1991; Schwartz 2006).

Statistical Approach

Many variables potentially covary with rates of crime and violence (e.g., income, ethnicity, and geography). Although we seek to keep our model set small and inclusion of covariates based in theory (following Burnham and Anderson 2002), it is also important to account for possible between-population sources of heterogeneity that may differentially affect our outcomes. To address these concerns, and the nested structure of our data, we fit generalized linear mixed-effect models with ASR as a fixed effect and state ($N = 50$) as a random effect. All analyses were performed in SAS (version 9.4) using proc GLIMMIX to fit Poisson regression models (due to the distribution of our outcome variables) with random intercepts by maximum likelihood. "State" is included to account for likely clustering in the data as a response to shared geographic settlement patterns, histories, culture, legal environments and reporting biases (White and Rogers 2000). Several other fixed effects are also included to account for additional sources of structure in the data following previous research implicating their importance on the patterning of crime and violence: percent living below poverty (Krivo and Peterson 1996), percent white non-Hispanic (Peterson and Lauren 2010), and southern locale (Nisbett and Cohen 1996). Lastly, although counties vary widely in population (e.g., in Alabama the smallest and largest counties have populations of 9045 and 658,466, respectively) and geographical size (e.g., in Alabama the smallest and largest counties cover 534 and 1590 square miles, respectively) we avoid applying statistical weights to our models based on county size. We do so to avoid inappropriately inflating support for mating market predictions that could arise because larger counties are more likely to have female-biased ASRs than smaller ones.

Results

Our analyses examined the following indicators of male mating effort: (1) violent competition between men (homicide, aggravated assault) and (2) indicators of uncommitted sexual behavior (rape, sex offenses, and prostitution/commercial vice). When exploring the first set of outcomes, we find a negative relationship between county ASR and rates of homicide (B = −0.033, SE = 0.003, $p < 0.0001$, Table 1) and aggravated assault (B = −0.008, SE = 0.001, $p < 0.0001$, Table 2). Counties with fewer men than women have higher rates of homicide and aggravated assault. These results are in line with mating market predictions, supporting the claim that when males are relatively rare they are more likely to engage in direct, violent competition.

When analyzing the second set of outcomes, we (again) find a negative relationship between county ASR and rates of rape (B = −0.020, SE = 0.002, $p < 0.0001$, Table 3), sex offenses (B = −0.012, SE = 0.0002, $p < 0.0001$, Table 4), and prostitution/ commercial vice (B = −0.058, SE = 0.007, $p < 0.0001$, Table 5). We find that rates of criminal behavior associated with uncommitted sex are higher when the sex ratio is female-biased. In sum, all of our outcome variables are negatively associated with county ASR as predicted by mating market theory. When women are relatively

Table 1 Model summaries for the relationship between the outcome variable homicide rate (per 100,000 of the population 15–45 years of age) and fixed effects

Effect	Estimate	Standard error	t	p
Intercept	5.625	0.509	11.04	<.0001
ASR 15–45	−0.033	0.003	−9.50	<.0001
Poverty (%)	−0.011	0.010	−1.16	0.245
White (%)	−0.041	0.003	−12.86	<.0001
North/South (0,1)	0.940	0.122	7.72	<.0001

$N = 3082$ counties, DF = 3077; −2loglikelihood = 12,372

abundant, men appear to be more likely to engage in mating effort that results in elevated rates of crime and violence through male-male competition and the pursuit of uncommitted sexual relationships.

The additional fixed effects sometimes performed meaningfully as well. The covariate "poverty" has significantly positive and negative associations with aggravated assault and prostitution/commercial vice, respectively. Southern locale is significantly positively associated with homicide and aggravated assault. Percent white non-Hispanic is significantly negatively associated with all outcomes.

Discussion

Of growing concern, both popularly and within the academic literature, are the societal consequences of male-biased sex ratios (Brooks 2012; South et al. 2014; Tybur and Griskevicius 2013). Fears of elevated levels of aggression driven by a glut of testosterone-fueled, unmarried men lead to the portrayal of a violent world. However, although it is indeed true that men experience higher mortality rates (Kruger and Nesse 2006) and are more violence-prone than women (Messner and Sampson 1991), is it also true that a surplus of men will necessarily lead to a surplus of violence? Plausible as this supposition may seem, as a result of our analyses, we find that rates of mating-effort-related crime and violence are highest when men are relatively rare. Although we wish to remain cautious in our interpretation of individual behavior from

Table 2 Model summaries for the relationship between the outcome variable aggravated assault rate (per 100,000 of the population 15–45 years of age) and fixed effects

Effect	Estimate	Standard error	t	p
Intercept	6.338	0.245	25.86	<.0001
ASR 15–45	−0.008	0.001	−6.43	<.0001
Poverty (%)	0.019	0.005	3.69	<.001
White (%)	−0.018	0.002	−10.34	<.0001
North/South (0,1)	0.187	0.067	2.77	0.006

$N = 3082$ counties, DF = 3077; −2loglikelihood = 12,108

Table 3 Model summaries for the relationship between the outcome variable rape rate (per 100,000 of the population 15–45 years of age) and fixed effects

Effect	Estimate	Standard error	t	p
Intercept	4.858	0.401	12.12	<.0001
ASR 15–45	−0.020	0.002	−8.44	<.0001
Poverty (%)	−0.013	0.008	−1.62	0.104
White (%)	−0.020	0.003	−7.54	<.0001
North/South (0,1)	−0.010	0.104	−0.09	0.927

N = 3082 counties, DF = 3077; −2loglikelihood = 19,928

aggregate data, we find rates of homicide, aggravated assault, rape, sex offenses, and prostitution/commercial vice to be more common in counties with more women than men. These findings offer support for mating market predictions which expect men to be more likely to engage in violent competition and uncommitted sexual behavior when women are in excess.

There has been considerable speculation about the effects of male-biased sex ratios on social stability (Hudson and den Boer 2004). In general, the concern is of heightened violence, but fears quite quickly take on a sensationalistic flavor, particularly in reference to India and China (e.g., Ferguson 2011). However, because the impact of male-biased sex ratios on Asian society has largely been based on anecdotal and historical accounts (Hudson and den Boer 2004), the association between male abundance and social instability may be overstated (Hesketh and Min 2012). Recent research in China, for example, suggests that the position of women has been elevated as a result of gains in both education and employment opportunities as well as increased bargaining power because of their relative rarity. Families have had to provide more resources to enhance the attractiveness of sons (Wei and Zhang 2011), and divorce and remarriage rates for women are on the rise as women are able to select more desirable partners (Shi 2002). In addition, although public concern over male-biased sex ratios elevating the risk for female trafficking and prostitution has risen, supporting data are lacking. In China, areas with male excess are not associated with elevated numbers of sex workers (Hesketh et al. 2005). Moreover, sexually transmitted disease rates are lowest in male-biased populations (South and Trent 2010). These trends corroborate our finding that

Table 4 Model summaries for the relationship between the outcome variable sex offense rate (per 100,000 of the population 15–45 years of age) and fixed effects

Effect	Estimate	Standard error	t	p
Intercept	4.791	0.316	15.15	<.0001
ASR 15–45	−0.012	0.002	−6.69	<.0001
Poverty (%)	−0.009	0.007	−1.31	0.190
White (%)	−0.012	0.002	−5.19	<.0001
North/South (0,1)	−0.013	0.085	−0.15	0.881

N = 3082 counties, DF = 3077; −2loglikelihood = 28,259

Table 5 Model summaries for the relationship between the outcome variable prostitution/criminal vice rate (per 100,000 of the population 15–45 years of age) and fixed effects

Effect	Estimate	Standard error	t	p
Intercept	11.948	0.989	12.08	<.0001
ASR 15–45	−0.058	0.007	−8.14	<.0001
Poverty (%)	−0.148	0.018	−8.47	<.0001
White (%)	−0.083	0.006	−14.70	<.0001
North/South (0,1)	−0.345	0.212	−1.63	0.104

$N = 3082$ counties, DF = 3077; −2loglikelihood = 9414

rates of prostitution/commercial vice, which serve as a proxy for uncommitted sexual behavior, are lowest in counties where men are most abundant.

Rather than populations becoming ever more violent when faced with a deficit of women, we find violence to be most common in counties with a surfeit of women. Although this may appear somewhat counterintuitive, by taking a mating market approach, violent behavior is not simply assumed to be an inherent characteristic of "maleness." Instead, aggression is viewed to be instrumental and implemented situationally in response to reproductive payoffs (see Borgerhoff Mulder and Schacht 2012 for a description of context-dependent decision-making). Therefore, we do not claim that all violence will be elevated in female-biased sex ratios; violence related to male-male competition and mate-seeking behavior is expected to be more common when partners are relatively abundant. However, mate guarding behavior may be more common when women are relatively rare (Schacht et al. 2014). Although males are more likely to be in a committed relationship when partners are scarce, they may employ violence to maintain a relationship. In the animal literature, the defense and control of a partner through male mate-guarding can result in males directing violence at females (Byrne et al. 1987). We predict that intimate partner violence will be more common in populations where women are relatively rare because of greater male mate-guarding behaviors. Some evidence exists that rates of domestic abuse are indeed higher with male-biased sex ratios (D'Alessio and Stolzenberg 2010).

Cross-culturally, male-biased sex ratios are generally associated with a greater proportion of men being married (Pedersen 1991; Kruger and Schlemmer 2009; Schacht and Kramer 2016), less promiscuity in both sexes (Adimora et al. 2013; Pouget et al. 2010), greater marital stability (Otterbein 1965), and higher rates of paternal involvement (Schmitt 2005). These findings directly contradict many alarmist predictions about the hazards of there being too many men. Male-biased sex ratios are consistently associated with relatively fewer single men than female-biased sex ratios because men appear to be flexible in their desire to marry and seem less willing to do so when they are rare and potential partners are abundant (Guttentag and Secord 1983). In addition, not all single men are equally prone to taking risks and engaging in violent competition. For example, recent work in China finds instead that, at male-biased sex ratios, unmarried men are more likely to be shy, withdrawn, and depressed than married men (Zhou et al. 2011, 2013). Consequently, unmarried men living in areas with an excess of males should be of less concern when it comes to violence and other negative societal consequences than unmarried men living in areas with an excess of women.

Conclusion

Violence, and violence against women in particular, has long been recognized as a public health problem (Campbell 2002; Crowell and Burgess 1996). However, despite more than 40 years of focused research on violence, large gaps remain in our understanding. A growing body of literature calls for special attention to be paid to the sex ratio as a robust, cross-culturally relevant comparative measure for predicting patterns of violence (Schacht et al. 2014). Consistent with mating market expectations (Guttentag and Secord 1983) and frequency-dependent reformulations within sexual selection theory (Kokko and Jennions 2008), we find rates of homicide, aggravated assault, rape, sex offenses, and prostitution/commercial vice to be more common in counties with more women than men. These results support mating market predictions that males are more likely to engage in mating effort behavior related to male-male aggressive competition and the pursuit of uncommitted sexual opportunities when they are available.

Our findings challenge conventional claims regarding the relationship between sex ratios and violence, which have been criticized for being largely speculative and based on anecdotal and historical accounts (Hesketh and Min 2012). In addition, a recent review of the literature finds no straightforward relationship between the sex ratio and violence (Schacht et al. 2014). Through our analysis and findings we seek to move the literature forward and offer mating market theory (Guttentag and Secord 1983) as a potentially robust framework from which to draw clear predictions for male behavior at male- and female-biased sex ratios. Our results also raise concerns regarding "tough on crime" policies in highly policed areas of the United States. These high rates of male incarceration create extremely skewed female-biased adult sex ratios (Adimora et al. 2013; Pouget et al. 2010; Johnson and Raphael 2009) and likely, following our findings, only exacerbate the very types of criminal and violent behavior they are attempting to alleviate. Not explored here, but likely a fruitful direction for future research, is to test expectations of greater male mate guarding in response to partner rarity at male-biased sex ratios. This work could further help to clarify the relationship between sex ratio imbalance and violence, particularly against women, and to dispel notions of violence simply being positively or negatively associated with the number of men in a population.

References

Adimora, A. A., Schoenbach, V. J., Taylor, E. M., Khan, M. R., Schwartz, R. J., & Miller, W. C. (2013). Sex ratio, poverty, and concurrent partnerships among men and women in the United States: a multilevel analysis. *Annals of Epidemiology, 23*, 716–719.

Angrist, J. (2002). How do sex ratios affect marriage and labor markets? Evidence from America's second generation. *The Quarterly Journal of Economics, 117*, 997–1038.

Barber, N. (2000). The sex ratio as a predictor of cross-national variation in violent crime. *Cross-Cultural Research, 34*, 264–282.

Borgerhoff Mulder, M., & Schacht, R. (2012). Human behavioural ecology. *In Encyclopedia of life sciences*. Wiley Online. doi:10.1002/9780470015902.a0003671.pub2.

Brooks, R. (2012). Asia's "missing women" as a problem in applied evolutionary psychology? *Evolutionary Psychology, 10*, 910–925.

Burnham, K. P., & Anderson, D. R. (2002). *Model selection and multimodel inference: A practical information-theoretical approach* (2nd ed.). New York: Springer-Verlag.

Byrne, R. W., Whiten, A., & Henzi, S. P. (1987). One-male groups and intergroup interactions of mountain baboons. *International Journal of Primatology, 8*, 615–633.

Campbell, J. C. (2002). Health consequences of intimate partner violence. *Lancet, 359*, 1331–1336.

Clutton-Brock, T. H., & Parker, G. A. (1992). Potential reproductive rates and the operation of sexual selection. *The Quarterly Review of Biology, 67*, 437–456.

Clutton-Brock, T. H., & Vincent, A. C. J. (1991). Sexual selection and the potential reproductive rates of males and females. *Nature, 351*, 58–60.

Crowell, N. A., & Burgess, A. W. (Eds.) (1996). *Understanding violence against women*. Washington, DC: National Academies Press.

D'Alessio, S. J., & Stolzenberg, L. (2010). The sex ratio and male-on-female intimate partner violence. *Journal of Criminal Justice, 38*, 555–561.

Drèze, J., & Khera, R. (2000). Crime, gender, and society in India: insights from homicide data. *Population and Development Review, 26*, 335–352.

Edlund L, Li H, Yi J, Zhang J, 2007. *Sex ratios and crime: Evidence from China's one-child policy.* IZA Discussion Paper 3214. Bonn: Institute for the Study of Labor (IZA). Available online at http://ftp.iza.org/dp3214.pdf.

Emlen, S., & Oring, L. (1977). Ecology, sexual selection, and the evolution of mating systems. *Science, 197*, 215–223.

Federal Bureau of Investigation. 2010. Uniform Crime Reporting Program Data: County-Level Detailed Arrest and Offense Data, 2010. Inter-university Consortium for Political and Social Research (ICPSR). Available online at http://www.icpsr.umich.edu/icpsrweb/NACJD/studies/33523.

Ferguson N, 2011. The rise of Asia's bachelor generation. *Newsweek*, March 6. Available online at http://www.newsweek.com/ferguson-rise-asias-bachelor-generation-66103.

Fossett, M., & Kiecolt, K. J. (1991). A methodological review of the sex ratio: Alternatives for comparative research. *Journal of Marriage and the Family, 53*, 941–957.

Guttentag, M., & Secord, P. (1983). *Too many women?* Beverly Hills: Sage.

Hesketh, T., & Min, J. M. (2012). The effects of artificial gender imbalance. *EMBO Reports, 13*, 487–492. doi:10.1038/embor.2012.62.

Hesketh, T., & Xing, Z. W. (2006). Abnormal sex ratios in human populations: Causes and consequences. *Proceedings of the National Academy of Sciences USA, 103*, 13271–13275.

Hesketh, T., Zhang, J., & Qiang, D. J. (2005). HIV knowledge and risk behaviour of female sex workers in Yunnan Province, China: potential as bridging groups to the general population. *AIDS Care, 17*, 958–966.

Hudson, V. M., & den Boer, A. (2002). A surplus of men, a deficit of peace: security and sex ratios in Asia's largest states. *International Security, 26*, 5–38.

Hudson, V. M., & den Boer, A. (2004). *Bare branches: The security implications of Asia's surplus male population*. Cambridge: MIT Press.

Johnson, R. C., & Raphael, S. (2009). The effects of male incarceration dynamics on Acquired Immune Deficiency Syndrome infection rates among African American women and men. *Journal of Law and Economics, 52*, 251–293.

Jones, J. H., & Ferguson, B. D. (2006). Excess male death leads to a severe marriage squeeze in Colombia, 1973-2005. *Social Biology, 54*, 140–151.

Kokko, H., & Jennions, M. D. (2008). Parental investment, sexual selection and sex ratios. *Journal of Evolutionary Biology, 21*, 919–948.

Kokko, H., & Jennions, M. D. (2012). Sex differences in parental care. In N. Royle, P. T. Smiseth, & M. Kölliker (Eds.), *The evolution of parental care* (pp. 101–116). Oxford: Oxford University Press.

Krivo, L. J., & Peterson, R. D. (1996). Extremely disadvantaged neighborhoods and urban crime. *Social Forces, 75*, 619–648.

Kruger, D. J., & Nesse, R. M. (2006). An evolutionary life-history framework for understanding sex differences in human mortality rates. *Human Nature, 17*, 74–97.

Kruger, D. J., & Schlemmer, E. (2009). When men are scarce, good men are even harder to find: Life history, the sex ratio, and the proportion of men married. *Journal of Social Evolutionary Cultural Psychology, 3*, 93–104.

Liker, A., Freckleton, R. P., & Szekely, T. (2013). The evolution of sex roles in birds is related to adult sex ratio. *Nature Communications, 4*, 1587.

McLaughlin, D., Gardner, E., & Lichter, D. (1999). Economic restructuring and changing prevalence of female-headed families in America. *Rural Sociology, 64*, 394–416.

Messner, S. F., & Sampson, R. J. (1991). The sex-ratio, family disruption, and rates of violent crime: the paradox of demographic-structure. *Social Forces, 69*, 693–713.

Nisbett, R. E., & Cohen, D. (1996). *Culture of honor: The psychology of violence in the South*. Boulder, CO: Westview Press.

Noë, R., Van Hooff, J. A., & Hammerstein, P. (2001). *Economics in nature: Social dilemmas, mate choice and biological markets*. Cambridge, UK: Cambridge University Press.

O'Brien, R. M. (1991). Sex ratios and rape rates: a power control theory. *Criminology, 29*, 99–114.

Otterbein, K. F. (1965). Caribbean family organization: a comparative analysis. *American Anthropologist, 67*, 66–79.

Pedersen, F. (1991). Secular trends in human sex ratios. *Human Nature, 2*, 271–291.

Peterson, R., & Lauren, K. (2010). *Divergent social worlds: Neighborhood crime and the racial-spatial divide*. New York: Russell Sage Foundation.

Pollet, T. V., Tybur, J. M., Frankenhuis, W. E., & Rickard, I. J. (2014). What can cross-cultural correlations teach us about human nature? *Human Nature, 25*, 410–429.

Pouget, E. R., Kershaw, T. S., Niccolai, L. M., Ickovics, J. R., & Blankenship, K. M. (2010). Associations of sex ratios and male incarceration rates with multiple opposite-sex partners: potential social determinants of HIV/STI transmission. *Public Health Reports, 125*, 70–80.

Sampson, R. J., Laub, J. H., & Wimer, C. (2006). Does marriage reduce crime? A counterfactual approach to within-individual causal effects. *Criminology, 44*, 465–508.

Schacht, R., & Borgerhoff Mulder, M. (2015). Sex ratio effects on reproductive strategies in humans. Royal Society Open Science, 2. doi:10.1098/rsos.140402.

Schacht, R., & Kramer K. L. 2016. Patterns of family formation in response to sex ratio variation. PLoS One, in press.

Schacht, R., Rauch, K. L., & Borgerhoff Mulder, M. (2014). Too many men: the violence problem? *Trends in Ecology & Evolution, 29*, 214–222.

Schmitt, D. P. (2005). Sociosexuality from Argentina to Zimbabwe: a 48-nation study of sex, culture, and strategies of human mating. *Behavioral and Brain Sciences, 28*, 247–311.

Schwartz, J. (2006). Effects of diverse forms of family structure on female and male homicide. *Journal of Marriage and Family, 68*(5), 1291–1312.

Shi, R. (2002). The consequences and features of imbalanced sex ratio—an observation from Taiwan. *Population Research, 26*, 57–60.

South, S. J., & Trent, K. (2010). Imbalanced sex ratios, men's sexual behavior, and risk of sexually transmitted infection in China. *Journal of Health and Social Behavior, 51*, 376–390.

South, S., Trent, K., & Bose, S. (2014). Skewed sex ratios and criminal victimization in India. *Demography, 51*, 1019–1040.

Székely, T., Liker, A., Freckleton, R. P., Fichtel, C., & Kappeler, P. M. (2014). Sex-biased survival predicts adult sex ratio variation in wild birds. *Proceedings of the Royal Society B: Biological Sciences, 281*.

Thomson, R., Pakanen, V.-M., Tracy, D., Kvist, L., Lank, D., Rönkä, A., & Koivula, K. (2014). Providing parental care entails variable mating opportunity costs for male Temminck's stints. *Behavioral Ecology and Sociobiology, 68*, 1261–1272.

Trent, K., & South, S. J. (2012). Mate availability and women's sexual experiences in China. *Journal of Marriage and the Family, 74*, 201–214.

Trivers, R. L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man, 1871–1971* (pp. 136–179). Chicago: Aldine.

Tybur, J. M., & Griskevicius, V. (2013). Evolutionary psychology: a fresh perspective for understanding and changing problematic behavior. *Public Administration Review, 73*, 12–22.

U.S. Census Bureau. 2010 Census: American community survey. 5-year estimates. Retrieved Janurary 23, 2016

Wei, S., & Zhang, X. (2011). The competitive saving motive: evidence from rising sex ratios and savings rates in China. *Journal of Political Economy, 119*, 511–564.

White, L., & Rogers, S. J. (2000). Economic circumstances and family outcomes: a review of the 1990s. *Journal of Marriage and the Family, 62*, 1035–1051.

Wiersema, B., Loftin, C., & McDowall, D. (2000). A comparison of supplementary homicide reports and National Vital Statistics System homicide estimates for U.S. counties. *Homicide Study, 4*, 317–340.

Zhou, X., Li, L., Yan, Z., & Hesketh, T. (2013). High sex ratio as a correlate of depression in Chinese men. *Journal of Affective Disorders, 144*, 79–86.

Zhou, X. D., Wang, X. L., Li, L., & Hesketh, T. (2011). The very high sex ratio in rural China: impact on the psychosocial wellbeing of unmarried men. *Social Science & Medicine, 73*, 1422–1427.

Ryan Schacht is a postdoctoral fellow in the Department of Anthropology at the University of Utah. He received his PhD from the University of California, Davis, and conducted his dissertation research among the Makushi of southwestern Guyana. His research focuses on the multilevel determinants of marriage and family formation, as well as the cross-cultural patterning of violence in response to sex ratio imbalance. Schacht is the lead editor of an upcoming themed issue on sex ratios in the journal *Philosophical Transactions of the Royal Society B*.

Douglas Tharp is a population data scientist who works in public health research in the Department of Family and Consumer Studies at the University of Utah and in Population Sciences at the Huntsman Cancer Institute. Educated at Baylor (BA) and the University of Texas (MA, Economics), Doug has worked in consulting and in financial services in addition to academia.

Ken R. Smith is Distinguished Professor of Family Studies and Population Science at the University of Utah and director of the Utah Population Database, which links genealogical, medical, environmental, and demographic data. His research interests in biodemography include exceptional human longevity, the impact of intergenerational and early life circumstances on later life health, and the effects of kinship, family networks, and neighborhoods on human health. He is immediate past co-editor of *Biodemography and Social Biology*.