Research Article

Incel Activity on Social Media Linked to Local Mating Ecology

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Abstract

Young men with few prospects of attracting a mate have historically threatened the internal peace and stability of societies. In some contemporary societies, such involuntary celibate—or *incel*—men promote much online misogyny and perpetrate real-world violence. We tested the prediction that online incel activity arises via local real-world mating-market forces that affect relationship formation. From a database of 4 billion Twitter posts (2012–2018), we geolocated 321 million tweets to 582 commuting zones in the continental United States, of which 3,649 tweets used words peculiar to incels and 3,745 were about incels. We show that such tweets arise disproportionately within places where mating competition among men is likely to be high because of male-biased sex ratios, few single women, high income inequality, and small gender gaps in income. Our results suggest a role for social media in monitoring and mitigating factors that lead young men toward antisocial behavior in real-world societies.

Young heterosexual men with poor prospects of finding a mate represent a potentially tectonic societal force (Hudson & den Boer, 2004; Hudson & Matfess, 2017; M. Wilson & Daly, 1985). In multiple societies and at various times, such men have proved especially likely to discount the future, abuse drugs, show aggression toward others, and commit crime at great cost to public health, safety, and security (Edlund et al., 2013; Guttentag & Secord, 1983; Krahn et al., 1986). In China, such men are referred to as *guanggun* ("bare branches"), unlikely to add fruit to the family tree (Hudson & den Boer, 2004). In Western societies, some have adopted, or had foisted on them, the euphemism *involuntary celibate* and its portmanteau *incel*.

Masculinity Threat and the Incel Subculture

Self-identified incels often blame their celibacy on trends toward gender equity and on the ostensibly superior men (aka *Chads* or *alphas*) chosen by attractive women (aka *Stacys*) as mates (Ging, 2019; Scaptura & Boyle, 2020). Incels are preoccupied with their own subordinate status to alpha men. Although this preoccupation motivates self-improvement for some incels, it fuels resentment, rage, and violence for others. The 2014 Isla Vista killer, who murdered six people and injured a further 14, referred to himself as an incel. The 2018 Toronto van attacker, who killed 10 people and injured 15, posted on social media about an "Incel rebellion" (Scaptura & Boyle, 2020, p. 279). Analyses of the Global Terrorism Database for *The New York Times* showed that right-wing terrorists, such as the man who massacred 51 people at two New Zealand

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mosques in 2019, often admiringly reference violent incels and incel ideology (Cai & Landon, 2019).

Gender norms are highly prescriptive and motivate individuals toward reducing their own gender deviance (Bosson et al., 2005). For this reason, masculinity threats can lead to defensive and sometimes violent reactions among men (Maass et al., 2003). Consistent with this evidence, the few scholarly analyses of the incel phenomenon (e.g., Ging, 2019) emphasize Blumer's (1958) concepts of gendered group dynamics and threatened male identity. Men who believe that they fall short in terms of masculinity (i.e., *acceptance threat*) or whose dominance is threatened by gains made by women (i.e., *status threat*) are more inclined toward the rejection, defeat, and violent anger that characterize incels (Scaptura & Boyle, 2020).

Gendered Cyberhate and Online Misogyny

The incel phenomenon remains a small part of a broader rise in online expressions of antifeminism, including the rise of the "manosphere" and men's-rights activism (Ging, 2019). Given the Internet's importance to the emergence of incels, the manosphere, and cyberhate, these phenomena transcend geographic limits. It is tempting to view these new expressions of misogyny as products of a broad cultural miasma decoupled from local real-world circumstances (Jane, 2017). Nonetheless, socioecological environments affect a range of psychological outcomes (Oishi, 2014), and online misogyny is associated with and can be used to predict real-world consequences, such as domestic and family violence (Blake et al., 2020). Here, we asked whether, and to what extent, local socioecological circumstances drive incel activity. Incels' lamented sexual failures reflect, at least in part, their failure to attract mates in the localities where they live, work, and move. We thus predicted that local mating circumstances would shape online incel activity.

Mating-Market Forces

Mating and courtship can be understood as social-exchange transactions (Baumeister & Vohs, 2004; Becker, 1981; Noë & Hammerstein, 1994). Incentives to compete for mates depend on the relative supply of women and men within the mating market and the economic circumstances of the individuals concerned (Baumeister & Vohs, 2004; Chiappori et al., 2002; Guttentag & Secord, 1983). Here, we consider three broad factors known to influence mating markets: sex ratios, income inequality, and gender equity.

Statement of Relevance

The inability of large numbers of men to attain the resources and status necessary to marry drives instability worldwide, exacerbating gender-based violence and conflict. Here, we investigated how mating-market characteristics—such as the supply and demand of romantic partners—increase the activity of involuntarily celibate, or *incel*, subculture online. Using a database of 4 billion Twitter posts and two lexicons of incel-related terminology, we found that local mating markets give rise to incel ideology and are detectable through aggregate patterns of social media posting in the United States. Monitoring social media trends may provide an indication of local attitudes and help identify places to focus interventions that alleviate tensions and diminish gender-based violence.

Sex ratios

Male-biased sex ratios raise the chance of men remaining unpartnered. We predicted that they would thus elevate incel incidence. Prevailing sex ratios alter the "supply" of women and of men, influencing bargaining power within heterosexual relationships (Becker, 1981; Guttentag & Secord, 1983; Noë & Hammerstein, 1994). Correlational and experimental evidence indicates that sex ratios influence within-sex competition in a variety of societies and have downstream consequences for rates of saving, spending, marriage, divorce, violence, crime, and labor-force participation (Chiappori et al., 2002; Griskevicius et al., 2012; Guttentag & Secord, 1983; Schacht & Borgerhoff Mulder, 2015; Schacht et al., 2014; Stone, 2019). A scarcity of women (particularly single women) relative to men excludes the surplus men from the mating market, intensifying competition among those men at greatest risk of remaining unpartnered (Guttentag & Secord, 1983; Hudson & den Boer, 2004).

Income inequality

We predicted that high income inequality would amplify levels of incel activity. Inequality amplifies incentives to strive for economic mobility, not only for the sake of material wealth but also to achieve mating and reproductive success (Blake & Brooks, 2019; Oliveira Ramos et al., 2017; M. Wilson & Daly, 1997). Throughout history, resources and social status elevated reproductive success and child survival (Betzig, 1994; Cashdan, 1993), generating incentives for individuals to attain

wealth and status through economic and social competition and via marriage. For men in particular, this dynamic has led to wealth and status becoming major determinants of success in marriage, mating, and reproduction in a wide variety of societies (Cronk, 1991; Hopcroft, 2006; Nettle & Pollet, 2008; von Rueden & Jaeggi, 2016). Large income differences among men can intensify women's incentives to partner with a high-earning man or, if only lower-earning options are available, to remain unpartnered (Bergstrom, 1996; Blake & Brooks, 2019; Blake et al., 2018). Economically unequal environments also amplify competition among men, intensifying risky status-seeking and status-protecting behaviors and thus elevating rates of violent crime and homicide (Daly, 2016; Krahn et al., 1986; Oliveira Ramos et al., 2017; M. Wilson & Daly, 1985, 1997).

Gender equality

We predicted that places with more gender-equitable circumstances would have more incel activity. When men earn more than women, women enjoy a greater gain from marriage than they do under more equitable earning circumstances (Becker, 1981; W. J. Wilson, 1996). Couples are less likely to marry when the woman earns as much as or more than the man, and when a wife's earnings rise to exceed her husband's, the couple becomes more likely to divorce (Bertrand et al., 2013). When changing patterns of international trade reduced male earnings in parts of the United States over recent decades, they also reduced marriage rates and fertility and elevated male idleness, early mortality, unwed maternity, and child poverty (Autor et al., 2019).

The Current Investigation

We predicted that involuntary celibacy arises as a result of local real-world mating-market forces that affect the numbers of women and men seeking mates and the likely gains to be made from relationship formation. We tested the predictions that these relationships would be detectable in patterns of social media activity concerning incels, specifically that incel-related postings would increase with more male-biased sex ratios, fewer single women, higher income inequality, and smaller gender gaps in employment or income. Further, we predicted that the decline in manufacturing jobs for young men in the United States, previously shown to diminish men's mating-market prospects (Autor et al., 2019), would also elevate incel activity.

Method

Procedure

We tested our predictions with data from the mainland United States. Following the approach adopted by Autor et al. (2019), we used U.S. mainland commuting zones as the unit of replication in this study. Tolbert and Sizer (1996) developed and validated the 1990 commuting zones on the basis of cluster analysis of commuter flows, and the zones provide a useful way of demarking labor markets. Because they include both workplaces and the residential areas from which people commute to those workplaces, commuting zones also form a coherent unit for the analysis of large-scale mating markets, as Autor et al. have shown.

To extract incel posts on Twitter, we first determined and validated a dictionary of incel terminology. We gathered terms for this dictionary from Reddit, Urban Dictionary, Twitter, Wikipedia, and other online resources explaining incel jargon. We then validated each term by searching for it on Twitter and confirming the use of the term in the Twitter context. This approach yielded two dictionaries: (a) terms used primarily by members of the incel subculture (we refer to tweets containing these words as *incel tweets*) and (b) terms used to discuss the incel subculture itself (we refer to tweets containing these words as *tweets about incels*). These two dictionaries are in Section S1 in the Supplemental Material available online (note that they contain some offensive language).

We then applied these terms to a database of 4 billion Twitter posts from the years 2012 to 2018 inclusive. The database comprises tweets from Twitter's "sprinkler stream," which is free to the public and contains a random sample of approximately 1% of the full Twitter stream. Following Blake et al. (2018), we geolocated Twitter posts in this database to every U.S. city with a population exceeding 5,000 inhabitants (resulting in 5,567 cities), all U.S. states, the regions and states of the top 10 countries with the most Twitter users, and all cities worldwide with populations exceeding 100,000 inhabitants. For this project, we used only tweets that were geolocatable to a U.S. city level, and we aggregated city tweet numbers to U.S. commuting zones, cross-checking against U.S. county names. We filtered commuting zones that did not contain any of the cities or counties to which tweets had been geolocated out of all our analyses. In addition to extracting the number of both kinds of tweets from each city, we also extracted the total number of all tweets from each city in the same time period. This latter covariate, which we included in all our models as *tweet volume*, reflects the

total Twitter-posting volume in that geographic area. We then aggregated city-level tweet numbers to the level of commuting zones for analysis.

Materials

From U.S. Census 2000 county-level data (U.S. Census Bureau, 2000), we calculated commuting-zone-level inequality (Gini index) and mean income. From the commuting-zone-level data provided by Autor et al. (2019), we used or calculated the following variables for the 18- to 39-year-old age class in 2014: the sex ratio (percentage of men), the percentage of single women, the gender gap in employment, and the gender gap in income at the 50th percentile. We also used the change in employment in manufacturing (2000–2014); Autor et al. showed that this variable was affected by the rise in offshore manufacturing resulting in the loss of U.S. manufacturing jobs, especially for young men, which led to consequences for commuting-zone-level mating markets. We then fitted the overall share of employment in manufacturing within a commuting zone, because changes in manufacturing employment for 18- to 39-year-olds might be affected by the size of the manufacturing sector in the commuting zone. Our least-squares regressions were weighted by the population size of the commuting zone (following Autor et al., 2019).

We estimated mean income for each commuting zone as a weighted mean of U.S. Census 2000 county-level mean incomes; the weighting factor was the proportion of the commuting-zone population that was made up by the county population (2,000 estimates). Likewise, we estimated income inequality from the county-level 2018 five-year Gini index (U.S. Census), weighted in the same way by the contribution of each county to the size of the commuting-zone population (2000). Counties were assigned to commuting zones as per the criteria of the U.S. Department of Agriculture (2019).

Data analysis

Total tweet volume as well as each dependent variable were transformed to $\log_{10}(x + 1)$ in order to account for extreme skew. Our regression analyses for each dependent variable followed the same steps, designated by the models shown in Tables 1 and 2. In Model 1, we fitted only the measure of Twitter activity (total tweet volume), and in Model 2, we added the measures of mate availability (sex ratio, percentage of single women). In Model 3, we added income inequality (2018 Gini index) plus mean income (to account for the fact

that inequality is often correlated with mean income), and in Model 4, we entered the gender gap in employment and income (at the 50th percentile). In Model 5, we added the change in manufacturing employment for 18- to 39-year-olds plus the share of employment in the commuting zone that is in manufacturing. In Model 6, we reduced the model by removing nonsignificant terms from Model 5 so that only significant terms remained.

Parametric analyses such as regressions do not always capture multivariate effects, and their estimated functions often do not provide informative visualizations. We fitted nonparametric thin-plate splines, using the *fields* package for R (Version 13.3; Nychka et al., 2021), to visualize bivariate relationships between significant predictors from the reduced models. Each thin-plate spline visualization of a pair of predictor variables was estimated from a model that included all other significant predictors in the relevant parametric model.

Data generated for this study have been made publicly available on OSF (https://osf.io/jghq4/), and data obtained from the study by Autor et al. (2019) can be obtained from those authors. For instructions on which of Autor et al.'s variable names we used and any calculations we performed with them, contact the Corresponding Author of this article.

Results

Over 321 million tweets were geolocated to cities in 582 commuting zones, ranging from 1,173 to 26.75 million tweets per zone (total tweet volume: $M = 552,285$, $SD = 1,922,843$). The number of incel tweets was 3,649, ranging from 0 to 409 across commuting zones ($M = 6.27$, $SD = 25.96$). The 3,745 tweets about incels ranged from 0 to 337 across commuting zones ($M = 6.43$, $SD = 25.115$). Total tweet volume, number of incel tweets, and number of tweets about incels were all transformed to $\log_{10}(x + 1)$. Both dependent variables were significantly associated with overall Twitter activity from a commuting zone—number of incel tweets: $r(581) = .82$, $p < .00001$; number of tweets about incels: $r(581) = .84$, $p < .00001$. The partial correlation between number of incel tweets and number of tweets about incels, controlling for the effect of total tweet volume, was also positive, strong, and significant—$r(579) = .61$, $p < .00001$. Figure 1 illustrates the volume of incel tweets across U.S. cities in relation to inequality.

The regression models for the dependent variable, incel tweets, indicated that hashtags and terms used largely or exclusively by incels were more common in commuting zones in which sex ratios were more male biased and income inequality was greater (Table 1).

Table 1. Results of Regression Models Predicting the Number of Incel Tweets Including Both Hashtagged and Nonhashtagged Words That Incels Use Exclusively or Predominantly

Predictor	Model 1 (adjusted R^2 = .893) β	Model 2 (adjusted R^2 = .897) β	Model 3 (adjusted R^2 = .901) β	Model 4 (adjusted R^2 = .901) β	Model 5 (adjusted R^2 = .901) β	Model 6 (adjusted R^2 = .901) β	SE	VIF
			Variables of interest					
Sex ratio (ages 18–39)		0.069****	0.065****	0.063****	0.062****	0.072****	0.014	1.05
Women, percentage single (ages 18–39)		0.001	−0.027	−0.027	−0.027			
Gini index 2018			0.047***	0.033*	0.033*	0.042***	0.014	1.09
Gender gap in employment (ages 18–39)				0.028	0.026			
Gender gap in income 50% (ages 18–39)				−0.038*	−0.036†			
Change in manufacturing employment (ages 18–39)					0.001			
			Control variables					
Total tweet volume ($\log_{10}$)	0.945****	0.951****	0.904****	0.889****	0.885****	0.896****	0.019	2.14
Mean income			0.074****	0.093****	0.092****	0.066****	0.015	2.06
Share of all employment in manufacturing					−0.011			

Note: VIF = variance inflation factor.
†p < .10. *p < .05. ***p < .001. ****p < .0001.

The nonparametric thin-plate spline (Fig. 2) showed a similar result despite the loosening of the constraints of parametric-function estimation: Commuting zones with high inequalities and above-average sex ratios experienced the most incel tweets. There was some suggestion that smaller gender-income gaps were also associated with more tweets using these terms, but the reduced model (Model 6) did not retain this term. There was no support for an effect of the percentage of single women, the gender gap in employment, or the change in manufacturing employment.

Tweets about incels were more common in commuting zones in which sex ratios were more male biased, fewer women were single, income inequality was greater, and gender-income gaps were smaller (Table 2). The pairwise relationships are visualized again in thin-plate splines (Fig. 3). These show that commuting zones are likely to have high rates of tweeting about incels if the zones have high sex ratios, high economic inequality, and few single women. Again, there was no support for an effect of the gender gap in employment or the change in manufacturing employment.

Discussion

Tweets that use incel-specific terms or refer to the incel subculture emanated from places where demographic and economic factors are most likely to intensify mating competition among men. This was particularly true for the combination of male-biased sex ratios and high income inequality, but there were also significant effects of low percentages of single women and small gender gaps in income at the 50th percentile. Taken together, these results indicate that a local scarcity of women (especially single women), high income inequality, and small gender gaps in income—individually and in combination—are associated with more aggregate incel activity online.

Our results extend the insight that economic and demographic circumstances alter behavior via mating-market dynamics (Becker, 1981; Guttentag & Secord, 1983; W. J. Wilson, 1996) and extend them to the realm of online activity and specifically to the incel phenomenon. These findings are necessarily preliminary, resting on a correlational analysis of spatial trends. They also pertain only to the United States, which limits their generalizability to other countries and cultures. The problems of inferring cause from associations such as these largely remain, and stronger analyses of causation, including via experimental or quasiexperimental designs, would help distinguish drivers from correlates of incel sentiment.

These links between local demographic and economic factors and online incel activity are consistent with some themes and ideas popular on incel and

Table 2. Results of Regression Models Predicting Tweets About Incels Including Both Hashtagged and Nonhashtagged Words That Refer to the Incel Subculture

Predictor	Model 1 (adjusted R^2 = .906) β	Model 2 (adjusted R^2 = .909) β	Model 3 (adjusted R^2 = .912) β	Model 4 (adjusted R^2 = .913) β	Model 5 (adjusted R^2 = .914) β	Model 6 (adjusted R^2 = .913) β	SE	VIF
Variables of interest								
Sex ratio (ages 18–39)		0.049****	0.048****	0.047***	0.043***	0.050****	0.013	1.18
Women, percentage single (ages 18–39)		−0.015	−0.042*	−0.052*	−0.055*	−0.063***	0.016	2.41
Gini index 2018			0.053****	0.040**	0.038*	0.046***	0.013	1.20
Gender gap in employment (ages 18–39)				0.019	0.014			
Gender gap in income 50% (ages 18–39)				−0.043*	−0.038*	−0.036*	0.017	1.62
Change in manufacturing employment (ages 18–39)					0.006			
Control variables								
Total tweet volume ($\log_{10}$)	0.952****	0.965****	0.925****	0.915****	0.901****	0.926****	0.019	2.29
Mean income			0.061***	0.082****	0.077****	0.077****	0.015	2.51
Share of all employment in manufacturing					−0.038			

Note: VIF = variance inflation factor.
*p < .05. **p < .01. ***p < .001. ****p < .0001.

manosphere forums, such as blaming the relative scarcity of women, intense competition from high-status men, and gender equity for male involuntary celibacy (see Ging, 2019; O'Malley et al., 2020; Van Valkenburgh, 2021). Observations from economics, evolutionary psychology, and the cultural-psychology subfield of sexual

Fig. 1. Distribution of incel tweet volume across the United States, corrected for total tweet volume. Marker size represents tweet volume, and marker color represents the level of income inequality (as indexed by the 2018 five-year Gini coefficient).

economics (e.g., Baumeister & Vohs, 2004) are often deployed on such forums (O'Malley et al., 2020; Van Valkenburgh, 2021). Our results lead to the conclusion that incels are at least partly accurate about the external conditions that contribute to their lack of success establishing heterosexual relationships. However, the fact that groups such as incels have insights into their predicament that are consistent with science should never be interpreted to mean that those scientific ideas legitimize unacceptable behavior by members of those groups.

Phenomena such as online misogyny and incel violence have real-world consequences for incels and for individuals they harass or attack. These phenomena require as rich as possible an understanding, including an awareness of how they arise through thwarted motivations to partner, mate, and reproduce (Kenrick et al., 2010). Beyond the United States, social scientists have found that understanding men's competition for mates in relation to local circumstances provides important insights into antisocial behavior in a variety of nations and over recorded history (Brooks, 2021; Hudson & den Boer, 2004; Hudson & Matfess, 2017). In China, for example, substantially skewed sex ratios leave large surpluses of unpartnered young men relative to young women (Hudson & den Boer, 2004; Zhu et al., 2009),
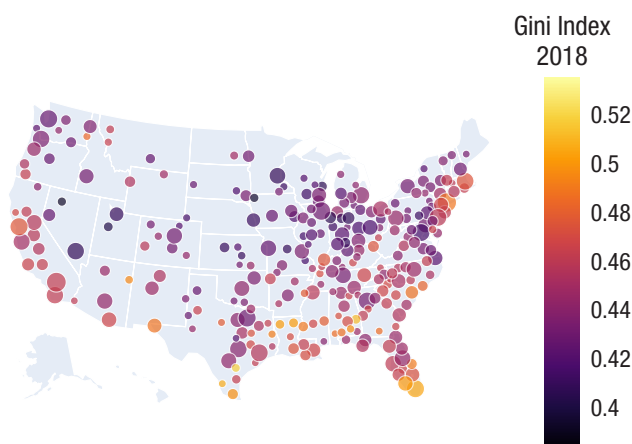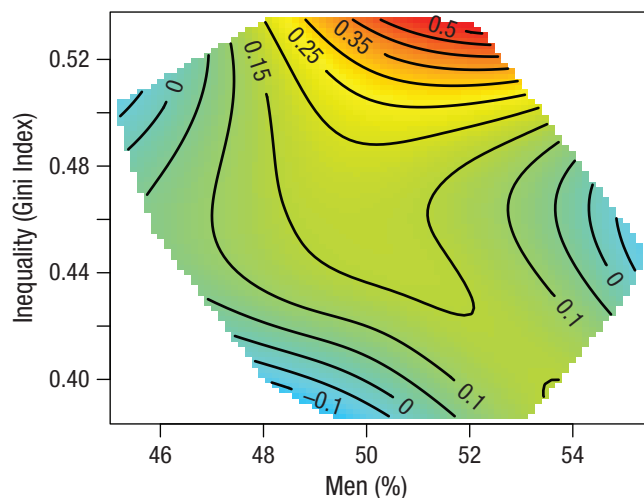
Fig. 2. Nonparametric thin-plate spline showing the relationship between sex ratio (percentage of men), income inequality (Gini index), and the number of incel tweets. Red represents greater frequency of incel tweets, and blue represents lower frequency. The thin-plate spline model fits both covariates, plus the control variables total tweet volume (log_{10}) and mean income (see Model 6 in Table 1), to predict the dependent variable (incel tweets) in a way that is not constrained to parametric functions.

resulting in rises in violent and property crime (Edlund et al., 2013) and deteriorating male mental health (Zhou & Hesketh, 2017).

Political scientist Valerie Hudson and her colleagues argue that the inability of large numbers of men to attain the necessary resources and status to marry drives conflict and instability throughout the world (Hudson & den Boer, 2004; Hudson & Matfess, 2017). Examples include the civil war in South Sudan and the Boko Haram insurgency in northern Nigeria (Hudson & Matfess, 2017). Hudson and Matfess argue that the practice of "brideprice" imposes a "profoundly regressive tax" (p. 37) on especially poor young men and those with older brothers, pricing them out of the marriage market. They present evidence that "for many young men, the only means to accumulate the assets needed to marry may be looting, raiding, or joining a rebel or terrorist group" (p. 37). Hudson and Matfess made actionable recommendations, including the development of early warning systems to track indicators of marriage-market dynamics in order to predict likely destabilization.

Misogynistic content promoted by incels has similarly heinous effects in everyday life that require both prevention and mitigation. Our results suggest not only that the antisocial behaviors of the incel movement and, possibly, the broader manosphere have their origins in local mating markets but also that they are detectable via aggregate patterns of social media posting. Together with findings of a recent investigation showing that misogynistic posts on Twitter correlate with and prospectively predict family violence in the United States (Blake et al., 2020), the present results suggest that social media might not only facilitate the problem but also provide an important part of the response. It is possible that social media trends might provide an indication of local attitudes and help identify places to focus interventions that alleviate tensions and prevent violence.

Transparency

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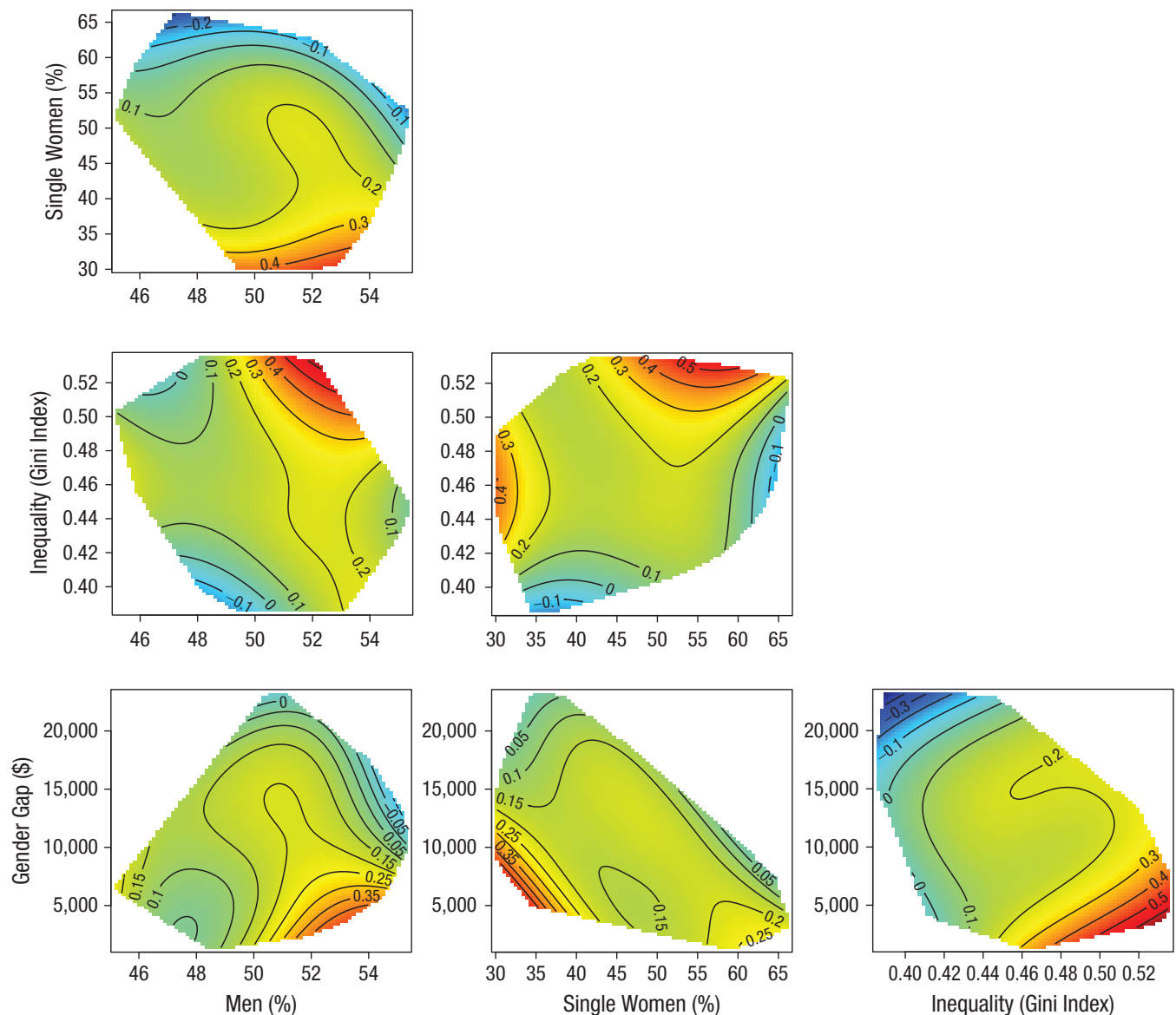
Acknowledgments

Fig. 3. Nonparametric thin-plate splines showing the pairwise relationships of sex ratio (percentage of men), percentage of single women, income inequality, and gender gap in earnings at the 50th percentile with the number of tweets about incels. Red represents greater frequency of incel tweets, and blue represents lower frequency. The thin-plate spline model fits all four covariates, plus the control variables total tweet volume ($\log_{10}$) and mean income (see Model 6 in Table 2), to predict the dependent variable (tweets about incels) in a way that is not constrained to parametric functions.

Supplemental Material

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/10.1177/09567976211036065

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