SIZE OF HOUSEHOLD FIREARM COLLECTIONS: IMPLICATIONS FOR SUBCULTURES AND GENDER*

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Recent work (Cook and Ludwig, 2003) has linked local firearm density to increased burglary victimization risk. The current work investigates within-household gun density or household firearm collection size. Previous work has suggested two subcultures of gun owners: protection-minded and sport- or hunting-minded. It also has identified gender gaps in reporting any household guns and in the number reported. None of the earlier work, however, has controlled for selection into gun-owning household status. This limitation raises potential questions about earlier findings. The current research controls for selection. If the two subcultures thesis is correct, protection-minded owners should report smaller household firearm collections. The expected impact is observed in one national survey and is partially replicated in a second. Gender gaps seemed more independent than previously suggested. This study is the first to provide evidence of two partially overlapping subcultures of gun owners even after controlling for selection into gun-owning household status. Practical implications for burglary risk may exist.

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> There are three basic reasons—sporting, protection, and criminal—for owning guns (Lizotte and Bordua, 1980: 230).

According to calculations during the mid- to late-1990s for the United States (Cook, Moore, and Braga, 2002), about 200 million firearms were held in private hands. The percentage of households with working firearms had dropped slightly from about 50 percent in the late 1950s to about 36 percent through the mid-1990s. Slightly less than one in three adults owned a firearm; Handguns or revolvers were a bigger percentage of firearms sold than previously, and "44 percent [of gun-owning individuals] have both" (Cook, Moore, and Braga, 2002: 293).

Research on firearms has examined a broad range of issues. How are gun-owning households different from non-gun-owning households (Cook and Ludwig, 1995; Kleck, 1991)? What different types of gun owners exist, and what factors encourage an individual or a household to be one type of gun owner or another (Lizotte and Bordua, 1980; Lizotte, Bordua, and White, 1981)? How do people get weapons (Wright, Rossi, and Daly, 1983)? Why and where do people carry weapons (Kleck and Gertz, 1998; Lizotte et al., 1997; Lizotte et al., 2000; Wilcox and Clayton, 2001; Wilkinson and Fagan, 2001)? How do people store their weapons at home, and what are the public health consequences of gun possession and different gun storage practices (Vernick, Teret, and Webster, 1997)?

Some of these issues are highly controversial. Do guns prevent more crimes or injuries than they cause (Cook and Ludwig, 1998; Hemenway and Miller, 2004; Kleck and Gertz, 1995; Kovandzic, Kleck, and Gertz, 1998; McDowall, Loftin, and Presser, 2000; Wells, 2002)? Does gun availability link to serious violent crimes like homicide (Hepburn and Hemenway, 2004; Stolzenberg and D'Alessio, 2000)? Does local gun density (household gun prevalence rates) increase burglary risk (Cook and Ludwig, 2003)? Researchers with an even broader sweep have asked controversial historical or sociological questions. Has the United States always been a heavily gun-involved culture (Bellesiles, 2000)? Do gun ownership rates or patterns emerge in part from a southern subculture of violence (Dixon and Lizotte, 1987)?

In a more practical vein, researchers and policy analysts have debated impacts of specific gun policies including, among others, gun permit laws (Lott, 1998), the Brady Bill (Ludwig and Cook, 2000), the assault weapons ban (Roth and Koper, 1999), and restrictions on gun purchasers (Wright, Wintemute, and Rivara, 1999).

Consequently, much is known about the regional, structural, social, and subcultural determinants of private firearm possession, and major points will be highlighted below. The current investigation builds on and extends this existing work in the following ways.

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First, attention is turned to a relatively underresearched aspect of firearm possession: the size of working firearm collections or gun stocks in a household. The determinants of collection size are investigated while controlling for well-known demographic and locational determinants of gun-owning household status. Understanding variations in household firearm collection size may help efforts to better classify and understand different types of gun-owning households.

Comprehending the causes of variations in collection sizes may have practical implications for deterring versus attracting potential burglars. Cook and Ludwig provided evidence that local gun density or gun-owning household prevalence rates increased burglary risk because guns are "particularly attractive loot" (2003: 104). Following their line of reasoning, within-household gun density, or firearm collection size, might contribute to target attractiveness for potential burglars.

Second, previous work has suggested two partially overlapping subcultures of gun owners: those who own primarily for sport, including hunting, and those who own primarily for protection. The current work connects the idea of two partially overlapping subcultures with firearm collection size. It anticipates that households with at least one owner acquiring at least one firearm for protection will have *smaller* collections. If the expected difference emerges, it would lend additional support to the idea of two somewhat distinct subcultures of owners. No work of which the authors are aware has provided evidence supporting the two subcultures after controlling for selection into gun-owning household status.

Third, previous work on collection size has suggested gender gaps in reporting any household firearms and in the reported number (see the next section). These studies have failed, however, to control for factors that make households more likely to be gun-owning in the first place. Those controls are applied here. Previous work has treated these two gender gaps as strongly linked, with each dependent on a gender gap in gun ownership status. Should results show independent effects of gender on both gun-owning household status and collection size or effects going in different directions, it would imply the gun–gender link is more complex than previously thought.

The following section outlines some of the main correlates of gun ownership, including work on the two subcultures of gun owners and on gender. The section closes with a statement of the proposed model and the rationale.

CORRELATES OF GUN OWNERSHIP

The correlates of ownership can be organized into three areas: locational, demographic, and social/attitudinal.

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LOCATIONAL

In the United States, firearm ownership is more prevalent in southern and, to a lesser extent, western locations (Cook and Ludwig, 1995). Researchers have suggested cultural explanations that focus on socialization for the southern regional discrepancy (Ellison, 1991). Unique cultural patterns there may contribute to higher rates of gun ownership. A subcultural and social learning explanation suggests gun ownership results from childhood or adult social experiences where pro-gun values are fostered and learned (Cao, Cullen, and Link, 1997). Southern participation is stronger in gun activities such as target shooting and, to an even greater extent, hunting (Ellison, 1991). Participation in these sporting activities predicts firearm ownership (Young, 1985).

A more contested explanation for the southern regional difference suggests a broader southern subculture of violence (Ellison, 1991; Gastil, 1971; Hackney, 1969). In general, disagreements about a southern subculture of honor or violence and its origins are widespread (Cohen and Nisbett, 1994; Loftin and Hill, 1974; Nisbett, 1993). For example, some evidence suggests that individuals raised and residing in the South do not have more violent attitudes than others (Dixon and Lizotte, 1987, 1989). Weak research designs argue against concluding that the southern subculture of violence drives gun ownership and/or homicide rates (Dixon and Lizotte, 1989; cf. Hepburn and Hemenway, 2004). A second key locational difference repeatedly observed (Cook and Ludwig, 1995; Kleck, 1991; Lizotte, Bordua, and White, 1981; Weisheit and Wells, 1996) has been that a rural or small town location or upbringing increases firearm ownership rates.

DEMOGRAPHICS

The demographic correlates of gun ownership have proven consistent across studies and are easily summarized. "Most owners are men. . . . Blacks are less likely to own guns than whites, in part because the black population is more urban. The likelihood of gun ownership increases with income and peaks in middle age" (Cook, Moore, and Braga, 2002: 293). Males are more likely to report being in a gun-owning household than females. This "gender gap" in reporting may emerge in part from a higher ownership rate among males (Ludwig, Cook, and Smith, 1998). Some suggest, however, that the gap and its origins are still open questions. Cao, Cullen, and Link (1997: 630–1) asked whether "unique gender effects persist when other socialization variables are controlled" and whether the effects might be context-dependent.

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ATTITUDES

Attitudes about local and personal dangers, as well as about government in general, predict gun ownership. According to the "fear and loathing" explanation, people purchase handguns to protect themselves from perceived increases in crime (Wright, Rossi, and Daly, 1983; see also Archer and Erlich-Erfer, 1991 for fear and "loading"). People who are more afraid for their own safety because they have less faith in the federal government as a security provider are more likely to own firearms (Jiobu and Curry, 2001). Purchase may be motivated by danger arising from nearby minorities perceived as dangerous (Hill, Howell, and Driver, 1985).

A protective model of firearm ownership assumes handgun ownership is primarily for defensive purposes. Difficulties in classifying people who are purely protective handgun owners, however, call this assumption into question (Marciniak and Loftin, 1991).

Although these attitudinal correlates of gun ownership prove intriguing, they also raise questions about causal direction. Fear of crime may elevate *subsequent* to the adoption of some anti-crime protective behaviors (Taylor and Shumaker, 1990). Firearm purchase subsequently might alter views about personal safety or government. Shifts subsequent to purchase may arise from more time spent with other gun owners. Consequently, the models presented here, because they rely on cross-sectional data, will exclude attitudinal variables that having guns, or having more guns, could influence.

SPECIFIC SUBCULTURES FOR PROTECTION VERSUS SPORT GUN OWNERS?

The two potential subcultures investigated have been sport gun owners, (e.g., hunters and target shooters) and protection-minded owners (i.e., those who acquire weapons for defense of self, family, or property). Three features suggest subculture involvement (Lizotte and Bordua, 1980: 231): owning a gun for the specific purpose of protection or sport, processes for maintaining the subculture across generations, and "contact among members of the group."

Lizotte, Bordua, and White's (1981) analysis of a survey of Illinois residents in the 1970s considered two different outcomes: sport owners (18 percent of sample) versus all others and protection-minded owners (6 percent of sample) versus all others. Respondents were asked about each firearm they owned and about the primary reason for purchase so that the outcome could reflect owning only one firearm or several for the stated purpose. Evidence showed that sporting subculture involvement spurred sport gun ownership; socialization, behavior, and contact variables all predicted sport ownership. There was only "partial evidence" (Lizotte,

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Bordua, and White, 1981: 500) of a protection subculture.[1] The work suggests four points: 1) A sporting gun subculture drives sporting gun ownership, 2) a weaker or more indirectly driven protection gun subculture increases protective gun ownership, 3) overlap exists between these two types of ownership, but 4) that overlap is only partial.[2]

Using an early 1990s survey of Cincinnati residents, Cao, Cullen, and Link (1997) also classified respondents into sport owners versus protection owners. In contrast to the Lizotte, Bordua, and White (1981) models, Cao et al. forced the two groups to be exclusive and defined the contrast differently. Owners indicating any weapons had been purchased for protection were classified as protection owners and were contrasted with all other gun-owning respondents; the latter were classified as sport owners. Multinomial logit models contrasted each of these two groups with non-gun-owning respondents.

In very general terms, despite different definitions, Cao et al.'s (1997) results supported Lizotte et al.'s (1981) idea of partially overlapping subcultures. Sometimes the same predictor predicted both types of ownership in the same direction; sometimes an attitudinal predictor linked to one type of ownership but not the other. At the same time, however, Cao, Cullen, and Link (1997) also raise questions about specific owner types with demographic predictors working differently than in Lizotte, Bordua, and White (1981).[3]

In sum, both of these studies suggest partially overlapping gun subcultures. They further imply that among gun owners there are probably some who are more involved and others who are less involved in the sporting subculture. Third, those less involved in the sporting subculture may be involved in a protection subculture, although the evidence for the latter subculture is less clear-cut.

Beyond these three points, however, some key divergent findings make it hard to generalize about the specific features of each of the two groups of owners. Both studies included attitudinal and behavioral indicators that

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1. Their results suggested "a subculture of protection [that] could be accepted on grounds that socialization occurs through participation in the subculture of sporting gun use" (Lizotte, Bordua, and White, 1981: 501) and a partial overlap between the two subcultures. Questions left open (see their footnote 4) included causal direction—which type of ownership came first—and whether the two types mutually influenced one another.
2. Impacts of some predictors differed across the two outcomes, after controlling for the other type of ownership (Lizotte, Bordua, and White, 1981: table 5).
3. Race linked to neither type of ownership in the Cao, Cullen, and Link (1997) findings, whereas for Lizotte, Bordua, and White (1981), race influenced protective ownership but not sport ownership. Males in the Cao, Cullen, and Link study were more likely to be either protection or sport owners, whereas in the Lizotte, Bordua, and White study, sex only had an impact on sport ownership.

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may have shifted after owners received or purchased firearms. A second and perhaps more crucial limitation of the earlier work is the failure to separate the disposition to live in a gun-owning household from the disposition to be a member of a specific subculture. Neither study clarified the features specific to each subculture that were distinct from features predisposing one to live in a gun-owning household in the first place.

The current study uses the above notion of differential involvement in the sporting subculture. It proposes that one indicator of less involvement in the sport subculture is an owner mentioning that at least one weapon was acquired primarily for protective purposes. Furthermore, it claims that weaker involvement in the sport subculture and perhaps stronger involvement in a protection subculture implies less of a need for a large collection. These ideas are discussed after work specifically on firearm collection size is reviewed.

GENDER AND SPECIFIC STUDIES ON COLLECTION SIZE

Two recent studies specifically investigated gun collection sizes and gender. Neither one sought to gauge the impact of differential sport subculture involvement on collection sizes.

Using reports of household gun collection sizes from three different national surveys, including several years of the General Social Survey (GSS), Ludwig, Cook, and Smith (1998) contrasted household gun collections reported by males versus females from married-couple households. Married males were more likely to personally own a gun than married females from different households. Furthermore, females in married-couple households compared with males in different married-couple households reported smaller collections. This second finding suggested a second gender gap in collection size. The size of both these gaps varied, however, depending on both the data source and the year.[4]

A more recent study of married male and female parents living in the same households with children who had presented at a hospital emergency department in one county in the Southeast (Coyne-Beasley et al., 2005)

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4. The Cook/Ludwig "National Survey of Privately Owned Firearms," one of the two data sets used here, showed a mean gender collection size gap of 1.3 firearms (median gap = 1) when contrasting married males and females from different households, whereas the Gallup Poll from 1997 suggested almost no gap (mean gap = 0.1, median = 0). Furthermore, when observing the prevalence of household gun ownership rather than collection size, the GSS reported gender gaps ranging from 10.5 percent to –.2 percent over various years. The years in which the GSS was giving different gender gaps for prevalence rates were also years when no increasing differences between male and female handgun owners existed (Sheley et al., 1994).

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found husbands and wives largely agreed on the household firearm prevalence rate (8 percent difference). Agreement was lower, however, on size of gun collections.

In sum, only two studies on household gun collection size have emerged. In only one of these studies do male and female reports correspond to the same household. The studies do not present a clear picture on a gender gap in collection size. The one multiyear, multisource study (Ludwig, Cook, and Smith, 1998) found varying gender-based collection size gaps across sources and years. Furthermore, neither of these studies has simultaneously controlled for the splitting process that makes some households gun-owning but not others. Given the scarcity and limitations of work to date, the gender gap as it applies to household gun collection sizes should perhaps still be treated as an open question (Cao, Cullen, and Link, 1997) as should the broader question of the determinants of collection sizes.

STATEMENT OF THE MODEL

This work will examine factors influencing household gun collection size after controlling for factors making households more likely to be gun-owning in the first place. Some overlap between these two sets of factors is anticipated. Past work specifies locational and demographic factors that should predict whether the respondent reports being in a gun-owning or non-gun-owning household. Those respondents more likely to report being in gun-owning households are expected to be white, older or middle-aged, male, earning higher incomes, living in rural locations, and located in the South or the West.

After controlling for what predisposes a household to be gun-owning, an initial model (model A) will use gender and a protective versus nonprotective acquisition rationale to predict collection size. Given the above suggestion of differential owner involvement in the sport gun subculture, the owners who report acquiring at least one firearm for protection purposes are expected to be less involved in that sport subculture, and thus, to report smaller collections.

The processes linking protective-minded owners to smaller collections may include the following. 1) Someone reporting at least one gun acquisition for protection is currently less fully involved in hunting or sport shooting compared with one not reporting this ownership reason. An owner less fully involved in hunting and/or sport shooting is less likely to require a broad array of weapons. For protection, a single handgun might suffice in urban or suburban settings or a single long gun in rural settings. 2) Additionally, someone involved in the protection subculture, or less fully involved in the sport subculture, is less likely, given the Lizotte, Bordua, and White (1981) socialization results, to have been acquiring/receiving

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firearms from an early age and/or less likely to have inherited firearms from relatives.

Previous work on the gender gap and household collections (Ludwig, Cook, and Smith, 1998) suggests that males should report larger collections. The research literature on self-disclosure, however, offers the opposite suggestion. Males may be more inclined to underreport their household gun collections, even after controlling for the greater likelihood of males owning firearms, because males are generally more reluctant to reveal information about themselves to others (Cozby, 1973; Derlega and Chaikin, 1977; Dindia and Allen, 1992; Jourard, 1971).

A subsequent model (model B) adds additional demographic controls to the collection size portion of the model to determine whether effects of gender and protective ownership on collection size weaken. These additional variables should perform as they did in the portion of the model that splits gun-owning from non-gun-owning households. Larger collections are expected for white, higher income, and middle-aged or older respondents.[5] To check on the robustness of findings, the analyses were repeated ignoring extremely large collections (>19 or >20). Above this level, reports on collection sizes became discontinuous.

Regarding the dependent variable itself, Lizotte and Bordua (1980) are usually referenced as a caution against analyzing household gun collections (e.g., Cao, Cullen, and Link, 1997). But the specifics of their caution were as follows: "Attaching the respondent's attitudes or motivations for ownership to the household results in reification and overgeneralization" (1980: 236). The models used here do *not* include specific attitudes and socialization practices that can only be linked to the individual respondent. These attitudes and practices are excluded for two reasons: The answers on these items may have shifted subsequent to firearm acquisition, and the study does not seek to generalize respondent attitudes to the household. The only attitudinal item asked is whether the weapon was acquired for self-defense or protection. It is hypothesized that if at least one household member reports that at least one weapon was acquired for protection, then a smaller collection is more likely.

DATA AND METHODS

DATA SOURCES

Parallel analyses were completed on two national surveys collected in

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5. Clearly, respondent demographics are different from household demographics. It is suggested that, for example, if one white individual or one higher income individual resides in the household, then he/she may contribute more working firearms to the household collection than if he/she were not white or if he/she reported a lower income level.

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the mid-1990s, the "National Study of Private Ownership of Firearms in the United States" (Police Foundation, 1998), called Cook/Ludwig, and the "Survey of Gun Owners in the United States" (Hemenway and Azrael, 2000b), called Hemenway/Azrael. Each study used a national random-digit-dial telephone survey of one randomly selected adult aged 18 years or older within each household.

HEMENWAY/AZRAEL

Overall, 1,905 interviews were completed between May and July 1996. The sample was stratified by state proportional to the 1990 population of each state; the sample is self-weighting and representative of households (Hemenway and Azrael, 2000a).[6]

COOK/LUDWIG

In total, 2,568 interviews were completed from November to December 1994. Minimum sampling quotas were set for racial minorities and gun-owning households. Given the quotas, weights are applied to make the sample representative of households (Cook and Ludwig, 1995, 1996, 1998).

Demographics of each sample appear in table 1.

ANALYTIC MODEL

A model is sought that separately considers two processes: those driving gun-owning household status and those driving collection size among the gun-owning households. Zero-inflated negative-binomial models or zero-inflated Poisson models permit such modeling (Greene, 1997; Long and Freese, 2006). These models presume a "dual regime data-generating process" (Zorn, 1998: 371) or a splitting model (Greene, 1997). Distinct from the processes driving the count itself, a "separate process is simultaneously at work influencing this outcome [Y=0]" (Greene, 1995: 572). Two latent groups are assumed: an "Always Zero group compared with the Not Always Zero group" (Long and Freese, 2006: 399). In the portion of the model predicting collection size, the exponentiated coefficient (e^b) indicates the factor by which a 1-unit change in the predictor affects the expected count. In the zero inflation portion of the model, each exponentiated coefficient indicates the factor change in the odds of being in the Always Zero group (non-gun-owning households) versus the Not Always Zero group (gun-owning households); an exponentiated coefficient greater than 1 indicates that the predictor makes it more likely that the respondent will be in the Always Zero group.

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6. For additional study details see Hemenway and Azrael (1997, 2000b) and Kovandzic, Kleck, and Gertz (1998).

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Table 1. Demographic Characteristics of Samples[a]

Hemenway/Azrael		Cook/Ludwig (weighted)	
	Full Sample **N = 1,905**		**Full Sample** **N = 2,568**
Gender			
Male	814 (42.7%)	Male	1,100 (42.8%)
Female	1,091 (57.3%)	Female	1,468 (57.2%)
Race[b]			
White	1,537 (80.7%)	White	2,041 (79.5%)
African American	162 (8.5%)	African American	215 (8.4%)
Hispanic	91 (4.8%)	Hispanic	155 (6.0%)
Age			
18–29	353 (18.5%)	18–29	526 (20.5%)
30–39	431 (22.6%)	30–39	610 (23.8%)
40–49	402 (21.1%)	40–49	484 (18.9%)
50–64	383 (20.1%)	50–64	447 (17.4%)
65 or over	322 (16.9%)	65 or over	436 (17.0%)
Household Income			
Under $15,000	231 (12.1%)	Under $15,000	539 (21.0%)
$15,000–$35,000	485 (25.5%)	$15,000–$19,999	224 (8.7%)
$35,000–$50,000	414 (21.7%)	$20,000–$29,999	332 (12.9%)
$50,000–$75,000	294 (15.4%)	$30,000–$49,999	501 (19.5%)
Over $75,000	229 (12.0%)	$50,000–$74,999	340 (13.2%)
		$75,000 or more	243 (9.5%)
Census Divisions			
New England	99 (5.2%)	New England	133 (5.2%)
Middle Atlantic	287 (15.1%)	Middle Atlantic	381 (14.8%)
East North Central	334 (17.5%)	East North Central	444 (17.3%)
West North Central	141 (7.4%)	West North Central	190 (7.4%)
South Atlantic	354 (18.6%)	South Atlantic	458 (17.8%)
East South Central	130 (6.8%)	East South Central	167 (6.5%)
West South Central	192 (10.1%)	West South Central	271 (10.6%)
Mountain	104 (5.5%)	Mountain	151 (5.9%)
Pacific	264 (13.8%)	Pacific	373 (14.5%)
Community			
Rural area	584 (30.7%)	Open country	301 (11.7%)
Suburb	627 (32.9%)	Farm	136 (5.3%)
City	666 (35.0%)	Small city	834 (32.5%)
		Medium city	402 (15.7%)
		Suburb	361 (14.1%)
		Large city	492 (19.2%)

[a] Percentages do not add up 100 in the case of race, age, income, and community because of missing data. In constructing the dummy variables used as predictors, however, these cases were not lost.

[b] In Hemenway/Azrael, 80 respondents indicated their race/ethnicity as Native American, Asian, or other. In Ludwig/Cook, 85 respondents indicated their race/ethnicity as Asian, Pacific Islander, American Indian, Eskimo, Aleut, or other.

INDEPENDENT VARIABLES

The propensity to be a gun-owning household is driven by the position of the household and respondent in the broader social structure as

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reflected in demographics, region of country, and type/size of community. Demographics include gender [female (0)/male (1)] and two ethnicity dummy variables [other (0)/African American (1) and other (0)/Hispanic (1)]. Dummy variables captured age categories except 18–29 years, leaving that as the reference string. Dummy variables were used for each income category above $35,000 in Hemenway/Azrael and each category above $30,000 in Cook/Ludwig.[7] Dummy variables were included for all the census divisions save *two*, the New England and the Mid-Atlantic divisions.[8] Degree of urbanization was handled slightly differently in the two surveys, which required different reference strings in each survey: city respondents in Hemenway/Azrael and medium and large cities combined for Cook/Ludwig.[9]

Gun ownership reasons were obtained using different question sequences and response formats in the two surveys. In the Hemenway/Azrael survey, after verifying a gun was present in the household, the respondent was asked, "Do you personally own a gun?" An owner was then asked, "What are the main reasons you own a gun [of any kind]?" and provided the following options: "for work," "for protection," "for hunting," "for recreation," "as part of a collection," and "for some other reason." Multiple options could be endorsed. In the Cook/Ludwig survey, the sequence was as follows: If a respondent admitted that there were one or more working firearms in the household, he/she was then asked how many working firearms were in the home and whether any of the guns belonged to him/her. An owner was then asked how many guns he/she owned for each of several different types. If a handgun was owned, the respondent was asked the most important reason for owning this type of weapon; if one or more long guns were owned, the respondent was asked the most important reason for owning this type of weapon. For both handguns and long guns, the respondent was not read response categories, and only one response was allowed. Some of these were later coded to "self defense or protection" by the original researchers. The two surveys arrived at reasons for owning via different routes, with different response options, and with different levels of specificity, asking separately about handguns and long guns in Cook/Ludwig.

Contrast coding (Wendorf, 2004) distinguished owners reporting at least

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7. The data collection instrument for Hemenway/Azrael does not clearly show distinct real limits for the income categories.

8. To see which specific states are in which specific census divisions, go to http://www.eia.doe.gov/emeu/reps/maps/us_census.html.

9. In the Cook/Ludwig file, the rural dummy combined open country and farm into rural (1) versus other (0) and the suburban dummy combined small town and suburb into suburban (1) versus other (0).

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one protective acquisition (+1) from those owners not reporting any protective acquisition (–1); nonowners were coded (0). For brevity, the first group will be called protection-minded owners and the second non-protection-minded owners.[10] Appendix A, available online (http://www.rbtaylor. net/firearm_collections_appendix_a.pdf), tables out for each survey the breakdowns of gun-owning versus non-gun-owning households, personal owners versus those who are not personal owners, and protection-minded owners versus non-protection-minded owners, by gender.[11] It also shows the 25th/50th/75th percentiles for collection size by gender and acquisition rationale. With the Cook/Ludwig sample, the contrast coded variable for protection-minded versus non-protection-minded owners also was developed by weapon type.

DEPENDENT VARIABLE

In the Hemenway/Azrael survey, 787 or 41.3 percent of the households reported a firearm, 713 or 37.4 percent reported the size of the household gun collection, and 74 in gun-owning households (3.9 percent) did not know the size. Collections ranged from 1 to 35. In the Cook/Ludwig survey, 848 or 33 percent of the households reported a working firearm. Of all households, 775 or 30.2 percent could report collection size and 73 (2.8 percent) did not know the size or reported (inappropriately) a collection size of 0. Collections ranged from 1 to 50.

RESULTS

In both data sets, significant chi-squared tests of α confirmed overdispersion in the data and, thus, the appropriateness of negative binomial as compared with Poisson models ($p < .001$). Furthermore, for both data sets, the Vuong test confirmed ($p < .001$) the negative binomial distributions were zero inflated. Finally, in both data sets, both models A and B significantly predicted the outcome ($p < .001$).

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10. It is not inferred that an owner who reports self-defense or protection as a (Hemenway/Azrael) or the (Cook/Ludwig) purpose of his/her acquisition of one firearm uses other weapons primarily or solely for self-defense.

11. Protection-minded owners appear more frequently in Cook/Ludwig (9.5 percent of weighted sample) than in Hemenway/Azrael (4.6 percent), which seems not unexpected given the different question sequences and response options described above. The 99 percent confidence intervals overlap, however, for the prevalence rates of protection-minded owners in both surveys. These confidence intervals in turn both overlap, with the 99 percent intervals derived from both Lizotte, Bordua, and White (1981) and Cao, Cullen, and Link (1997) using the conservative method of Blalock (1979: 215) and $p = .4$ as an upper limit on the assumption that all gun owners are protection-minded owners.

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HEMENWAY/AZRAEL

In model A (table 2), the demographic variables predicting being in a gun-owning versus a non-gun-owning household worked as expected based on previous research. Males were much less likely ($p < .001$) to live in non-gun-owning households as were those in rural locations ($p < .001$). In contrast, African Americans ($p < .001$) and Hispanics ($p < .01$) were more likely to be in households with no guns.[12] Controlling for a suburban versus a rural location, part of the country still mattered. Anywhere outside the reference string states (New England + Mid-Atlantic), respondents were more likely to be in gun-owning households.

Turning to collection size, the two predictors each proved significant after controlling for the processes splitting households into gun-owning versus non-gun-owning. In line with a self-disclosure-based gender hypothesis, being male reduced expected collection size by a factor of .75 ($p < .01$). The average predicted collection size for males was three quarters of the corresponding average for females. In line with the distinct gun subcultures argument, the protection-minded owner variable reduced expected collection size ($p < .001$) by a factor of .46.

In combination with the zero-inflation or splitting portion of the model, these results suggest gender contributed in two different ways to gun collections in this survey. The gender gun prevalence gap emerged in the direction observed in earlier studies; males were more likely to report living in gun-owning households. But among gun-owning households, after controlling for ownership and protective acquisition rationale, and the splitting process, men reported smaller collections. This second point is in line with a reverse gender gap hypothesis based on gender-linked self-disclosure patterns.

Perhaps most importantly, the contrast between protection-minded owners and non-protection-minded owners emerged in the predicted direction. Owners reporting a protective rationale for at least one gun were more likely to report smaller collections than other owners. This finding supports the idea of only partial overlap between the protection and sporting gun subcultures. Alternatively, if one does not accept that a protective gun culture exists, this finding suggests differential involvement in the sporting gun culture influences collection size.

In model B, focusing first on the collection size portion of the model, the two key findings observed in model A remained intact and at about the same strength after controlling for a host of demographic factors in

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12. In the splitting portion of the model, the reference string comprised white females with a household income of less than $35,000 a year in 1996, under 30 years old, and living in an urban location in either the New England or the Mid-Atlantic states.

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Table 2. Zero-Inflated Negative Binomial Model of Household Firearm Collection Size: Hemenway/Azrael

	Model A				Model B			
	b	SE	exp(*b*)	*p* <	*b*	SE	exp(*b*)	*p* <
Predicting Collection Size								
Protection-minded owners (+1) vs. other owners (−1)	−.778	.071	.459	.001	−.772	.075	.462	.001
Male	−.282	.108	.754	.01	−.318	.111	.728	.01
Hispanic					−.620	.292	.538	.05
African American					.250	.252	1.284	ns
Income: $35,000–$50,000					.454	.120	1.575	.001
Income: $50,000–$75,000					.171	.130	1.187	ns
Income: Over $ 75k					.523	.140	1.688	.001
Age 30–39					−.065	.148	.937	ns
Age 40–49					−.191	.150	.826	ns
Age 50–64					−.105	.152	.900	ns
Age 65–plus					−.360	.172	.698	.05
Constant	.674				.599			
Predicting Non-Gun-Owning Households								
Income: $35,000–$50,000	−.608	.262	.544	.05	−.207	.267	.813	ns
Income: $50,000–$75,000	−.975	.326	.377	.01	−.796	.350	.451	.05
Income: Over $ 75k	−1.108	.378	.330	.01	−.601	.369	.548	ns
Age 30–39	−.372	.306	.689	ns	−.410	.322	.664	ns
Age 40–49	−.328	.325	.720	ns	−.449	.342	.638	ns
Age 50–64	−.576	.329	.562	ns	−.630	.349	.533	ns
Age 65--plus	.058	.319	1.060	ns	−.253	.368	.777	ns
Male	−1.840	.306	.159	.001	−1.853	.308	.157	.001
Hispanic	1.520	.480	4.574	.01	.938	.598	2.555	ns
African American	1.108	.342	3.027	.001	1.236	.377	3.442	.001
Rural location	−2.085	.351	.124	.001	−2.112	.359	.121	.001
Suburban location	−.190	.229	.827	ns	−.238	.229	.788	ns
Census division: East North Central	−1.223	.316	.294	.001	−1.253	.318	.286	.001
Census division: West North Central	−1.743	.451	.175	.001	−1.738	.442	.176	.001
Census division: South Atlantic	−1.395	.315	.248	.001	−1.363	.311	.256	.001
Census division: East South Central	−2.111	.460	.121	.001	−2.090	.461	.124	.001
Census division: West South Central	−2.255	.408	.105	.001	−2.351	.424	.095	.001
Census division: Mountain	−3.095	.753	.045	.001	−3.100	.792	.045	.001
Census division: Pacific	−1.786	.414	.168	.001	−1.711	.401	.181	.001
Constant	2.526				2.503			
Alpha	1.56				1.43			
LR chi-squared test of alpha	1,097				994			
p <	.001				.001			
Log likelihood	−2,621				−2,604			
LR chi-squared	120				153			
p <	.001				.001			

Abbreviations: ns = not significant.
Note: n = 713 gun-owning households reporting collection size.

this portion of the model. In gun-owning households, the average expected collection size reported by males as compared with females was smaller by a factor of .73 ($p < .01$). The protection-minded-owner variable continued to reduce expected collection size by a factor of .46 ($p < .001$). Additionally, Hispanics and those aged 65 years or above reported smaller collections, whereas those reporting incomes between $35,000 and $50,000, or

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over \$75,000, were more likely to report larger collections.[13]

Figure 1 shows median spline plots of predicted collection sizes against reported collection sizes, for collection sizes between 1 and 15. Separate plots are shown by gender and acquisition rationale. In the center panels of figure 1, nonowners are reporting about guns owned by other household members. The figure suggests two points. Among those *not* reporting a protective rationale, women reporting collections of from 4 to 10 guns had a median expected collection size of close to 4 (top left panel), whereas the median expected collection size for men was closer to 3 (bottom left panel). Therefore, the reverse gender gap observed in the results emerged from the difference between these two groups of owners, both presumably heavily involved in sport and hunting firearm uses. Second, moving from left to right (non-protection-minded owners, nonowners, and owners reporting protective acquisition rationale), predicted collection size decreases. Collapsing across gender showed median predicted collections sizes around 3, 1.5, and 1 for, respectively, the non-protection-minded owners, nonowners, and protection-minded owners.[14]

Sensitivity analyses were conducted to see whether results were affected by a small number of extremely large collections. Analyses were repeated cutting off collections above 20, and again above 19. The impacts of gender and protective-minded acquisition on collection size remained significant (results not shown).

In sum, controlling for demographics, in gun-owning households, protective-minded owners were more likely to report smaller collections than other owners, and males were more likely to report smaller collections even though they were more likely to report being in a gun-owning household. Respondent ethnicity affected different parts of the model. Hispanics were more likely to report smaller collections, but African Americans were more likely to report being in a non-gun-owning household.

COOK/LUDWIG

Turning first to the collection size portion of model A (see table 3), protective acquisition rationale failed to influence collection size ($b = -.02$; ns). The expected average collection size among protection-minded owners was only smaller by a factor of .983, compared with non-protection-minded owners. Opposite the direction observed in Hemenway/Azrael,

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13.   In the splitting portion of the model, there was one change from model A. Hispanic ethnicity was no longer significant.

14.   This finding matches up with the exponentiated coefficient because it is a 2-unit change from protection-minded owners (1) to non-protection-minded owners (–1).

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Figure 1. Hemenway/Azrael Data

Predicted and Reported Collection Size by Gender and Rationale
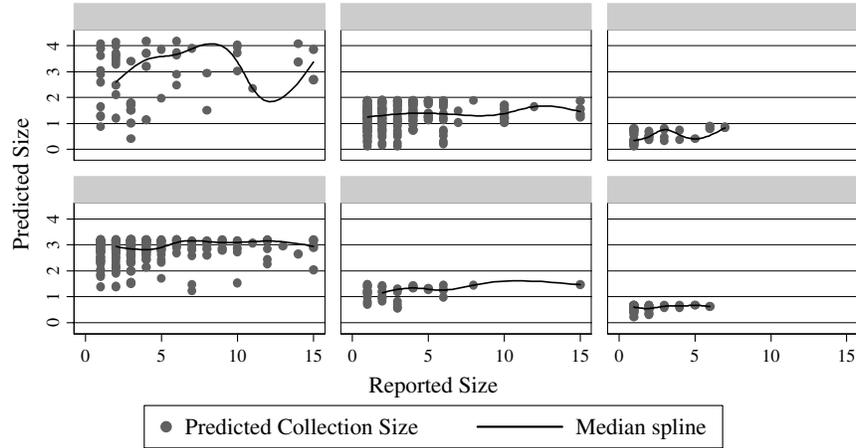
Notes: Women in top row, men in bottom row.
Left = non-protective owners; Center = non-owners; Right = protective owners

the expected average collection size of males was larger than that of females by a factor of 1.64 ($p < .001$).

Turning to the splitting portion of the model, results almost perfectly replicated model A with the Hemenway/Azrael data set. Those more likely to be in gun-owning households—less likely to contribute to zero inflation or to be in the Always Zero group —were male, higher income, neither Hispanic nor African American, in rural locations, and living outside of the reference string (New England + Mid-Atlantic) states. The only specific impacts that did not match those from the first survey were the results for some age categories.

Adding additional demographic variables to the collection size portion of the model did not change the gender impact (model B). In gun-owning households, the average expected collection size for males was larger than that for females by a factor of 1.75 ($p < .001$). Protective rationale remained nonsignificant.

Figure 2 shows median spline plots of predicted collection sizes against reported collection sizes, from 1 to 15. Separate plots are shown by gender and acquisition rationale. The pattern is quite different than observed with the Hemenway/Azrael data. Here, among nonprotective owners, the median predicted collection size for men (bottom left panel) was above 2, whereas the median expected collection size for women (top, left) ranged from slightly less than 1 to slightly less than 2. Among those protection-minded owners reporting collections between about 3 and 12 guns, the

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median predicted collection size for men was about 2.5 (bottom, right), and the corresponding number for women was about 1 (top, right). Among the nonowners, and ignoring the last spline, the median predicted collection size for men was around 2 (bottom, center) compared with a figure of 1 for women (top, center). Regardless of acquisition rationale, men were predicted to have larger collections for much of the reported collection size range.

Figure 2. Cook/Ludwig Data

Predicted and Reported Collection Size by Gender and Rationale
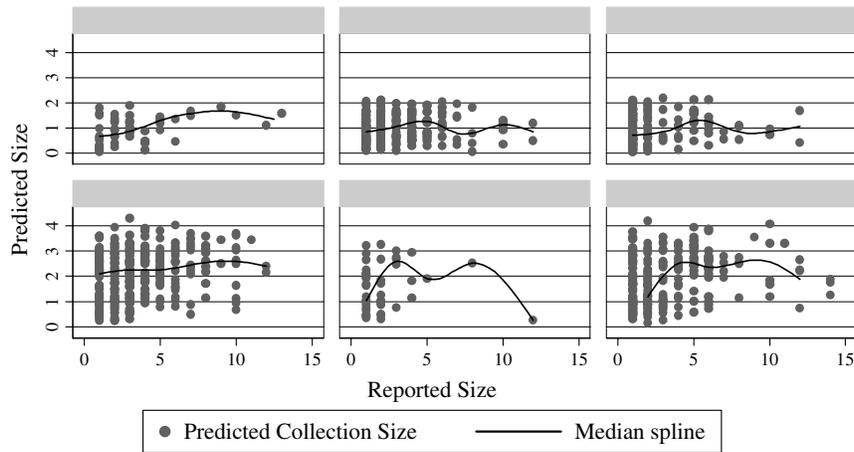
Notes: Women in top row, men in bottom row.
Left = non-protective owners; Center = non-owners; Right = protective owners

Looking at how demographics contributed to collection size showed the following: Compared with the reference group, Hispanics, African Americans, and those 65 years and older reported smaller collections; males reported larger collections. The results for Hispanic, the income variable, and the age variable each replicated significant impacts observed in model B with the Hemenway/Azrael survey.

Sensitivity analyses showed that cutting off extremely large collections produced results closely comparable with those from the full sample (results not shown).[15]

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15.   The only changes from significance shown in table 3 for model B were as follows. Focusing on collections of less than 20, the income variable $35,000–$50,000 became nonsignificant in the collection size portion of the model and significant in the splitting portion of the model. In the splitting portion of the model, being

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Table 3. Zero-Inflated Negative Binomial Model of Household Firearm Collection Size: Cook/ Ludwig (weighted data)

	Model A				Model B			
	b	SE	exp(*b*)	*p* <	*b*	SE	exp(*b*)	*p* <
Predicting Collection Size								
Protection-minded owners (+1) vs. other owners (−1)	−.017	.052	0.983	ns	.033	.051	1.034	ns
Male	.497	.101	1.644	.001	.558	.099	1.748	.001
Hispanic					−.934	.218	.393	.001
African American					−.981	.208	.375	.001
Income: $35,000–$50,000					.276	.136	1.318	.05
Income: $50,000–$75,000					.115	.112	1.122	ns
Income: Over $ 75k					.071	.125	1.073	ns
Age 30–39					.067	.158	1.069	ns
Age 40–49					.279	.156	1.321	ns
Age 50–64					.098	.156	1.103	ns
Age 65–plus					−.578	.189	.561	.01
Constant	.566				.478			
Predicting Non-Gun-Owning Households								
Income: $35,000–$50,000	−.609	.226	.544	.01	−.349	.239	.705	ns
Income: $50,000–$75,000	−.984	.219	.374	.001	−.829	.239	.436	.001
Income: Over $ 75k	−.501	.233	.606	.05	−.429	.254	.651	ns
Age 30–39	−.175	.221	.840	ns	−.149	.256	.862	ns
Age 40–49	−.516	.243	.597	.05	−.297	.265	.743	ns
Age 50–64	−.710	.257	.492	.01	−.649	.284	.523	.05
Age 65–plus	.344	.246	1.410	ns	−.072	.300	.931	ns
Male	−.817	.180	.442	.001	−.704	.181	.495	.001
Hispanic	.716	.208	2.047	.001	−.174	.358	.840	ns
African American	1.278	.247	3.589	.001	.588	.318	1.800	ns
Rural location	−1.095	.201	.335	.001	−1.200	.221	.301	.001
Suburban location	−.181	.214	.834	ns	−.249	.211	.780	ns
Census division: East North Central	−.775	.233	.461	.001	−.787	.236	.455	.001
Census division: West North Central	−1.457	.349	.233	.001	−1.459	.345	.232	.001
Census division: South Atlantic	−1.394	.275	.248	.001	−1.320	.274	.267	.001
Census division: East South Central	−1.869	.342	.154	.001	−2.007	.442	.134	.001
Census division: West South Central	−1.757	.345	.173	.001	−1.753	.398	.173	.001
Census division: Mountain	−1.328	.413	.265	.001	−1.257	.390	.285	.001
Census division: Pacific	−.695	.247	.499	.01	−.694	.248	.500	.01
Constant	2.269				2.295			
Alpha	1.41				1.26			
LR chi-squared test of alpha	1,008.20				903.40			
p <	.001				.001			
Log pseudo-likelihood	−2,973				−2,946			
Wald chi-squared	29.32				88.70			
p <	.001				.001			

Abbreviations: ns = not significant.
Note: weighted *n* = 775 gun-owning households reporting collection size.

Hispanic became significantly associated with being more likely to report no firearms in the household. The same changes were observed when focusing on collections of less than 21.

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PROTECTION AND WEAPON TYPE

The Cook/Ludwig survey allowed a contrast effect variable for each weapon type. Using the same framework as models A and B above, results (not shown) suggested that protective ownership impacts depended in part on weapon type. When long gun protection-minded owners were contrasted with all other gun owners, the former group reported smaller collections ($p < .001$). This result appeared in both models A and B and was robust even when extremely large collections were excluded. Collections reported by protective handgun owners, however, were of the same size as those reported by all other gun owners. Examining collection sizes directly, without any control variables, verified the weapon-specific connection between protective ownership and collection size.[16]

Why would acquiring a long gun for protection link to smaller collections more powerfully than acquiring a handgun for protection? Perhaps, since long guns are used primarily for hunting, long gun protective ownership signals *non*involvement in the hunting/sporting subculture more strongly than ownership of a handgun for protective reasons.

One limited exploratory way to test this idea was to look at the relationship between protective acquisition rationale and hunting involvement by weapon type. Only one out of seven protective long gun owners reported recent hunting activity compared with about one in four protective handgun owners.

In the Cook/Ludwig survey, protective rationale did affect collection size when the focus was on long guns but not when the focus was on handguns. This result may have been because protection-minded long gun owners were linked more weakly to involvement in the hunting/sporting subculture than were protection-minded handgun owners. Since the main analyses grouped these two types of protective owners, an effect did not emerge.[17]

DISCUSSION

The effects of protective firearm acquisition on household collection size observed in the first data set and partially replicated with the second

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16. Categorizing owners relative to median collection size, there was very little difference when handgun protective owners (42.3 percent had collections above the median size) were contrasted with all other owners (38.5 percent reported collection sizes above the median size). Only 29.8 percent of protective long gun owners reported collections above the median size, however, in contrast to 40.1 percent of all other owners.

17. Analyses also suggested some impacts on collection size of gender, acquisition rationale, and weapon type, but given the extremely small number of individuals in some cells (gender x acquisition rationale x weapon type), those exploratory analyses are not presented.

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supported the idea of only partially overlapping gun subcultures for sport gun owners versus protection gun owners. This is the first study of which the authors are aware that provides evidence of this distinction while controlling for selection into gun-owning household status. The argument constructed avoids overgeneralizing; it suggests that if at least one protection-minded gun owner in the household acquired at least one gun for defense, the reported household collection was smaller. The underlying rationale was that protective-minded owners' weaker involvement in hunting or sport, and/or at least minimal involvement in the protection culture, meant they "needed" fewer firearms and/or were less likely to have inherited working firearms or been given them early in life. In the second data set, this same relationship appeared but only for long gun protective owners.

Others have highlighted important limitations in past studies with measures of protective gun ownership (Marciniak and Loftin, 1991). Classifying those who own a handgun and do not hunt as purely protective handgun owners, for example, misses the overlap between sporting and protection gun subcultures previously pointed out by Lizotte, Bordua, and White (1981). That overlap is not denied here. In fact, exploratory analyses clearly show evidence of it. Some protective owners do hunt.[18]

Turning to gender, earlier work suggested three aspects to a gender gap, as follows: 1) Men as compared with women were more likely to own working firearms (the ownership gap). 2) Men as compared with women, due in part to the first gender gap, were more likely to report any firearms in the household (the prevalence reporting gap). 3) Men as compared with women reported larger household firearm collections (the size reporting gap). The previous evidence was consistent for the first two gaps but not the third (Ludwig, Cook, and Smith, 1998: 1717). The leap made by others, however, was that the first gender gap in ownership was driving the second and third reporting gaps. Current results suggested otherwise. Both data sets confirmed the independence of the prevalence reporting and size reporting gender gaps. Both confirmed the prevalence gap in the expected direction.

The two analyses, however, showed significant gender size reporting gaps in different directions. In the Hemenway/Azrael analyses, men reported *smaller* collections. This report agrees with the meta-analyses of self-disclosure work (Dindia and Allen, 1992) confirming a main effect of gender—males reveal less—on the intimacy of personal information shared. Males perhaps were more willing to answer whether there were any guns in the household but were more reluctant to reveal the more "intimate" details, the full number of firearms present. In contrast, the

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18.   These connections should be viewed cautiously, of course, since the temporal ordering of acquisition and hunting were not known.

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more widely expected results appeared in the Cook/Ludwig analyses. Males were more likely to report any guns, and more of them.[19]

Different gender gaps have surfaced in different surveys before (Ludwig, Cook, and Smith, 1998). Here, as in previous work, these variations may be caused by important methodological differences. The numerous differences in question sequencing, response option formats, and level of detail make it difficult to discern which particular differences between the two studies are most relevant.[20] Perhaps the key lessons at this juncture are as follows: There are multiple gender gaps operative, at least two of them function somewhat independently, and one of them, the size reporting gap, does not always go in the same direction.

Turning briefly to a third issue beyond the main focus, race also presented a perhaps more nuanced picture than observed previously. In both full models, the effects of race depended on the group in question and on whether the modeling was considering gun-owning household status or collection size.

Of course, this study has numerous limitations. The two surveys asked about household gun collections. Thus, there was slippage between that household attribute and respondent attributes. In addition, temporal orderings between acquisition and attitudes or behaviors were not known, thus prohibiting attitudes or behaviors as predictors. Discussion and results were framed in recognition of both these slippages. In addition, each study took a different approach to asking about and coding ownership reasons, thus defining protective-minded owners differently.

Partially mitigating these concerns, however, were some strengths. First, each data source was national. Second, both surveys were fielded around the same time, permitting an attempt at replication. This attempt had some success. The protection effect appeared as expected in the Hemenway/Azrael data set. It was replicated in the Cook/Ludwig study but only if the focus was on long guns. The significant prevalence gender gap appeared and replicated across studies. Third, the analytic models were appropriate and took into account the full range of gun possession processes, separating the transition to gun-owning household status from collection size.

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19. The gender impact on collection size was not explained by markedly different associations between gender and the protective acquisition variable in the two studies.

20. For example, one reviewer has suggested that Hemenway/Azrael's interview items and sequence resulted in fewer women reporting ownership, save those heavily involved in a hunting/sport gun subculture, and thus expected there were few protective women owners in their sample. In support of this idea in Hemenway/Azrael, there were 39 (2 percent of total) protective women owners, whereas there were 87 (3.4 percent of total) in Cook/Ludwig.

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In sum, both protective ownership rationale and gender proved relevant to household firearm collection sizes. If at least one owner acquired a firearm for protection (Hemenway/Azrael), or a long gun for protection (Cook/Ludwig), there were fewer firearms in the house because, it is inferred, that owner was less involved in the sport hunting subculture or was more involved in a protective subculture. The evidence supports two partially overlapping subcultures of gun owners, independent of factors predisposing a household to be gun-owning in the first place. Results also confirmed multiple gender gaps and suggested they were more independent than previously thought.

The patterns observed here may have implications for burglary risk. Earlier work has linked local gun density to increased burglary victimization risk (Cook and Ludwig, 2003). Increasing per household gun density, or collection size, may make defense against burglars more lethal but also might increase initial burglary victimization risk. The outcome considered here may deserve attention for practical as well as for theoretical reasons.

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