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Demographic and Social Predictors of Intimate Partner Violence in Colombia

A Dyadic Power Perspective

James Holland Jones · Brodie Ferguson

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Abstract Intimate partner violence (IPV) is a major health and human rights problem globally. However, empirical findings on the predictors of IPV cross-culturally are highly inconsistent, and the theory of IPV is underdeveloped. We propose a new analytical framework based on cooperative game theory in which IPV is a function of the power relations of the dyadic relationship, not simply the actors involved. Using data from the 2005 Colombian Demographic and Health Survey, we test the hypothesis that IPV is predicted by large asymmetries in dyadic power using a hierarchical generalized linear model. Results suggest that education, urban residence, age at sexual debut, whether the woman has other sexual partners, and the age difference between spouses have strong effects on the log-odds of a woman experiencing IPV. Cooperative game theory and social network analysis offer a general approach to the problem of intimate partner interactions which can be applied broadly cross-culturally.

Keywords Intimate partner violence · Bargaining · Social networks

A woman who has experienced violence in her life has most likely suffered it at the hands of her intimate partner (Watts and Zimmerman 2002). Research into the causes and correlates of such intimate partner violence (IPV) suggests that with the exception of poverty, the social and demographic correlates of IPV are not consistent across countries and different cultural settings (Jewkes 2002). Where premarital sex is rare, IPV is strongly associated with marriage. However, where premarital sex is more prevalent, there is typically no relationship between marital status and IPV (Jewkes 2002). Education decreases the likelihood of IPV in Cambodia (Yount and

J. H. Jones (✉) · B. Ferguson
Department of Anthropology, Stanford University, 450 Serra Mall, Bldg. 50, Stanford, CA 94305-2034, USA
e-mail: jhj1@stanford.edu

Carrera 2006), Nicaragua, Haiti, and Colombia (Flake and Forste 2006). In Peru, low educational attainment and early union formation increase the risk of IPV (Flake 2005). Flake (2005) also found that causation at multiple levels (e.g., family, community) was important. Women's economic independence tends to mitigate against IPV in Haiti (Gage 2005). Although education and economic autonomy are frequently protective, they are not always so. For example, more-educated professional women were at elevated risk for IPV in Albania (Burazeri et al. 2005). Notably, two other risk factors found in this study were men having less education than their wives and men coming from a rural background. Similarly Flake and Forste (2006) found that female-dominant decision-making was associated with higher risk of IPV in Nicaragua, Haiti, and Colombia.

The welter of empirical studies showing often contradictory relations between IPV and sociodemographic variables or highly culturally bound relationships would seem to preclude the development of a general theory of IPV. Indeed, Gutmann (1997:399) writes that "in anthropological writings on men, the sources of violence, if not its consequences, are often overdetermined and undertheorized." Of particular issue is the fact that intimate partner violence tends to be approached primarily from the stance of male as perpetrator, woman as victim. If, however, we approach IPV as the product of a dyadic interaction between socially embedded actors, the paradox of contradictory causes may be resolved.

In this paper, we suggest a straightforward structural theory for the expression of IPV by examining the social and demographic predictors of intimate partner violence in Colombia, hypothesizing that IPV may be the product of inequalities in bargaining power between partners. Colombia has a history of civil conflict spanning the past half century. From the 1950s to the 1980s, rural land-rights movements in Colombia evolved into sustained guerilla groups. The rise of organized criminal activity accompanying the expansion of the illicit drug economy together with the development of illegal paramilitary groups intensified the violence in Colombia throughout the 1980s. Colombia has lost more than 17,000 lives to homicide per year since 1979 (Jones and Ferguson 2006). The expectations of the *habitus* of violence in Columbia (Bourdieu 1997) may promote inequalities in dyadic power that make women more likely to experience intimate partner violence.

The Structure of Intimate Partner Violence

Violence, of course, is multifaceted. However, one critical feature of violence is instrumentality. Violence is used—whether effectively or not—to achieve desired social ends. As such, the expression of violence in different social contexts will carry certain benefits with respect to the instrumental goals that motivate it. In understanding instrumentality, it is important to consider costs to the perpetrator as well as benefits. When the costs of hitting a wife or partner are vanishingly small, then the likelihood of violence is greatly increased even if the benefits men derive from violence are minimal.

Following Gelles (1974), a great deal of attention has been paid to male identity and masculinity in the expression of violence against intimate partners (Bourgois 1996a, b; Dunkle et al. 2004; Jewkes et al. 2002). While we do not deny the

potential for ideations of masculinity for contributing to the propensity of men to abuse their female partners, we suggest that it is not a sufficient explanation. Furthermore, the work of Bourgois (1996a, b) and Bourdieu (1997), among others, suggests structural features contribute critically to the formation of identities in the first place (White 1992). Instead, we assert that a more general model of dyadic power is required to understand the dynamics of IPV. We argue that a structural understanding of IPV is necessary. Violence against partners is only defined in the context of a partnership, a relational variable that is not adequately described by the attributes of either party in the partnership (Hinde 1976, 1991). As such, ideational explanations limited to the psyches of one of the actors will necessarily be insufficient for understanding the important public health phenomenon of IPV.

The partnership is fundamentally a relational quality and can only be properly understood at the dyadic level. Figure 1 presents a schematic graph view of a dyad formed by the relation of individuals A and B. Individuals are represented by nodes (i.e., the circles) and relations between them by lines connecting two nodes. Relations depicted by edges in the graph, or sociogram, can be practically any well-defined dyadic interaction. Common examples include friendship, marriage, sexual relations, or economic exchange (Goodreau 2006; Liao and Stevens 1994; Moody 2001; Morris 1993; Padgett and Ansell 1992). The focal relationship is indicated by the thick edge joining A and B. A and B each have a series of alters (people with whom ego interacts) that may represent family, friends, other sexual partners, etc. These relationships exert social influence over individuals and also provide support and social capital (Bras and Neven 2007; Martin et al. 2004; Palloni et al. 2001; Valente 1996). For simplicity, the alters of each individual of the focal dyad do not

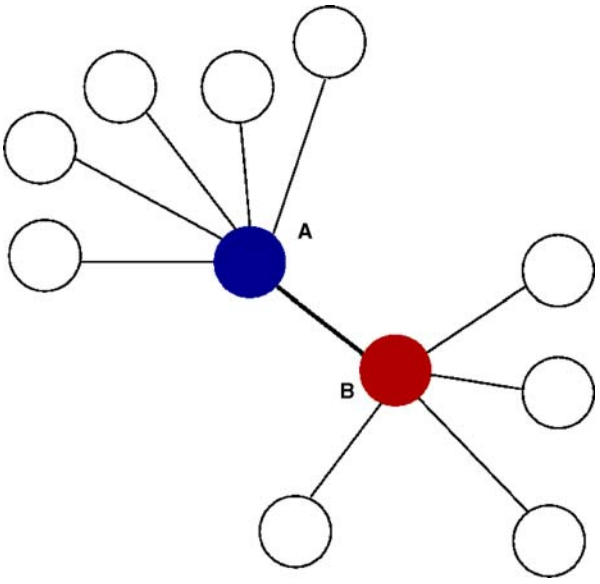

Fig. 1 Schematic representation of a dyad (heavy line connecting actors A and B) with non-overlapping sub-networks of alters (those with whom ego interacts). These alters are critical for understanding the properties of the dyad because it is through them that social influence is exerted, social sanctions are executed, and reputations are reinforced

overlap, though in reality the couple's social spheres will overlap to a greater or lesser degree (Bott 1971).

Intimate partners are generally, as the title suggests, partners in economic or reproductive matters. For our discussion, we will primarily focus on reproductive partnerships, which are frequently economic as well. As a shorthand, we will refer to such partnerships as "marriages," though we note that many reproductive partnerships lack the legal or religious frameworks that define marriage in the modern nation-state.

We adopt an economic approach to the problem of IPV based on the premise that when a couple enters a marriage, they are engaging in a partnership aimed at the production of children. To date, the lion's share of evolutionary economic analyses of household decision-making has been done in the neoclassical framework, largely attributable to Becker (1991). The neoclassical approach to household economics assumes that households make decisions as units. Becker's Rotten Kid Theorem provides the theoretical justification for this assumption by showing that the existence of a single altruistic family member who controls distribution of resources within the household suffices for the household to be treated as a single decision-making unit (Becker 1991). However, conflicts of interest within households, and families more generally, are well recognized in both evolutionary biology and economics (Davis and Daly 1997; Kaar et al. 1998; Lundberg and Pollak 1993, 1994, 1996; Manser and Brown 1980; McElroy 1990; McElroy and Horney 1981; Voland 1998). In economics, this has led to the development of strategic models of household bargaining based on the theory of cooperative (Lundberg and Pollak 1993; Manser and Brown 1980; McElroy 1990; McElroy and Horney 1981) and non-cooperative (Lundberg and Pollak 1994, 1996) games. We adopt the cooperative game theoretic approach, focusing in particular on the Nash Bargaining Solution (NBS) to the problem of allocation of effort in a joint venture (Nash 1950).

The NBS provides us with a simple heuristic position for understanding the context of violence within the intimate-partner dyad. Framing questions surrounding reproduction and household formation in terms of bargaining theory allows the simultaneous recognition of cooperation and conflict inherent in sexual reproduction. Evolutionary biologists have tended to focus predominantly on the conflict (Maynard Smith 1977; Trivers 1972), but the act of sexual reproduction itself is inherently cooperative. Two individuals cooperate by combining their haploid genomes to produce a viable diploid progeny. Of course, this may be where the cooperation ends—an observation that is true for most mammals, in which males provide no parental care (Clutton-Brock 1991). The outcomes of cooperative games can be wide ranging, from what would conventionally be called true cooperation to seemingly quite uncooperative outcomes. Game theory pioneer Robert Aumann has noted that cooperative games can, in fact, be derived from a non-cooperative game framework, which has dominated evolutionary thinking since Maynard Smith's seminal work in the early 1970s (Maynard Smith and Price 1973; Maynard Smith 1974, 1977). The key difference between the cooperative and non-cooperative game frameworks is that the cooperative game framework "abstracts away altogether from procedures and from the question of how each player can best manipulate them for his own benefit; it concentrates, instead, on the possibilities for agreement" (Aumann 1987:469). The key, as noted by Aumann, is that when one formally builds into a

game the rules and procedures for arriving at a solution, as one does when constructing a non-cooperative game, the game's outcome depends very strongly on their precise specification. Cooperative games focus more on outcome and less on procedure, making them attractive tools for understanding complex human social interactions that are typically not bound by complex legal or regulatory frameworks.

In keeping with conventional anthropological definitions, we see marriage as a system for assigning rights and responsibilities in the context of childrearing (Gough 1952; Leach 1955; Murdock 1949). These responsibilities are essential, for without them, the tension in which IPV is expressed is not developed. The two parties in a marriage have a mutual interest in the products of their partnership. For instance, the Darwinian fitness, economic success, prestige, and old-age security of both female and male partners benefit from the successful recruitment (i.e., survival to reproductive age) of children. However, given this mutual interest, neither partner in a marriage wants to expend more than his/her perceived fair share of investment (investment is by definition costly to the individual). Clearly such investments will vary across cultures, but the points remain: (1) men and women in a marriage partnership share mutual interest in the products of their marriage, and (2) neither party wants to invest more than they need to.

These two conditions lend the situation to analysis using the theory of cooperative games. The use of cooperative game theory to analyze marriage was pioneered by Manser and Brown (1980) and McElroy and Horney (1981) and then further elaborated by Lundberg and Pollak (1993). One of the central concepts of the theory of cooperative games is the Nash Bargaining Solution (NBS), which provides a tool for understanding how the relative share of costly investment will be allocated in a cooperative partnership (Nash 1950). We imagine a bargaining situation where an investment π is required for successful recruitment. Denote female fitness as w_f and male fitness, w_m. Let d_f and d_m be the fallback fitnesses of females and males, respectively.[1] The fallback fitness is what the individuals comprising the partnership receive should the partnership fail. The goal of the game is for each individual to maximize his or her surplus conditional on the joint fulfillment of the required investment π. The question is, what is the optimal allocation of the required investment π between the partners—in this case, a woman and man in a marital partnership? The NBS is given by:

$$\max\left\{\left(w_f - d_f\right)\left(w_m - d_m\right)\right\}. \tag{1}$$

That is, the NBS is the allocation that maximizes the gains to partnership. This result is illustrated graphically in Fig. 2. The heavy concave line represents the possible combinations of women's and men's contributions. The curve that is tangent to this represents the returns curve, or the possible combinations of $\{(w_f - d_f)(w_m - d_m)\}$, the maximum of which occurs where the curves are tangent to each other. This is the NBS. The dashed horizontal and vertical lines represent women's and men's fallback fitnesses, respectively. Changing these fallback fitness values changes the location of tangency of the returns curve, as shown in Fig. 3.

[1] We use the term "fallback fitness," but the currency could just as easily be strictly economic.

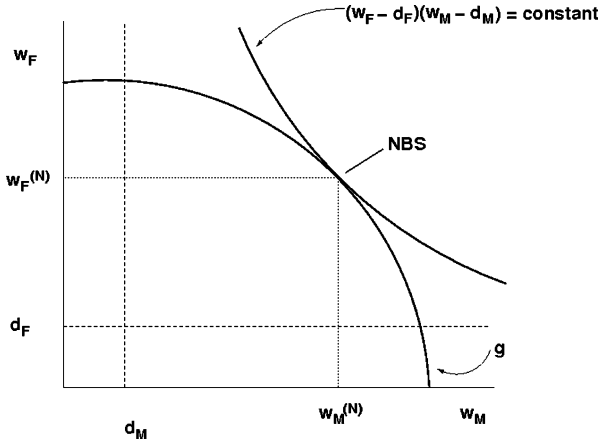

Fig. 2 Graphical demonstration of the Nash Bargaining Solution (NBS). The NBS maximizes returns to partnership. The set of feasible fitness pairs is given by the solid curve *g*. The point where the constraint curve $(w_f - d_f)(w_m - d_m) = c$ is tangent to the feasible set *g* is point of maximal returns to partnership and marks the NBS split of the surplus. The superscript N in both the male and female fitnesses indicates that the point represents the equilibrium given by the NBS

Analysis of the NBS indicates a series of features which systematically favor one side in a bargaining endeavor by changing the parties' fallback fitnesses. Specifically, these are (1) the existence of outside options, (2) differences in risk aversion between partners, (3) differences in time-preference between partners, (4) the possibility that an exogenous shock will lead to total breakdown in negotiations, and (5) the relative magnitudes of the benefit from remaining in the partnership without reaching an agreement (Muthoo 1999).

The first feature that changes the location of the NBS is the existence of outside options—that is, solutions to the problem (e.g., reproduction, sexual gratification,

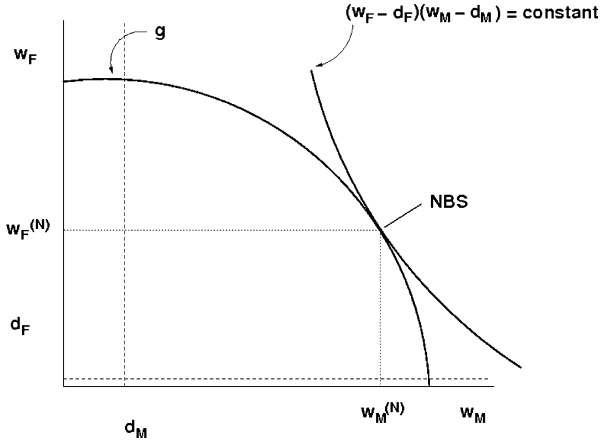

Fig. 3 Graphical demonstration of the Nash Bargaining Solution (NBS), as in Fig. 2, with reduced female fallback fitness. The point of tangency of the constraint curve $(w_f - d_f)(w_m - d_m) = c$ with *g* is shifted to favor a greater share of the surplus for males

household formation) that lie outside the focal dyad. A key observation from eq. 1 is that the greater the fallback fitness for a partner, the greater their share of the pie. A strong fallback position makes for successful negotiation, and outside options make for a strong fallback. Consider the case where female fallback fitness is small (e.g., opportunities for remarriage following the dissolution of a partnership are small, or the prospects for offspring recruitment—successful rearing of offspring to reproductive age—to single mothers is low). This means that a low value of w_f will reduce the overall product of eq. 1 less than if the fallback had been higher, making a reduced share of the surplus for the woman more likely to satisfy the maximum condition of eq. 1. This point is illustrated in Fig. 3. One feature of the Colombian social landscape that may put women at a disadvantage in terms of outside options is the operational sex ratio. Chronic levels of high violence from the ongoing civil conflict in Colombia mean that reproductive-age men are in short supply in many Colombian departments (Jones and Ferguson 2006). When sex ratios are heavily female biased, women are at a severe disadvantage with regard to outside options for their current intimate relationship. Another feature that might have a large effect on outside options is a woman's potential earning power outside the relationship. This earning power is likely affected by a woman's level of education.

The second feature that has an impact on the outcome of bargaining games is risk aversion. The less-risk-averse player is at a great advantage in any bargaining situation (Rubinstein 1982). One interpretation of this is that the player with more to lose is less likely to adopt a strategy of playing for a hard bargain that risks the breakdown of the bargaining solution. Consider a household investment negotiation between two individuals. The person who has more to lose from the dissolution of the household is bound to invest disproportionately. The more-risk-prone partner can reduce his investment—to a point—without fear of household dissolution. In reproductive partnerships, women almost invariably have sunk more investment in the form of children they have borne, nursed, and for whom they typically assume the majority of childcare (Hrdy 2000). Indeed, it is this asymmetry in sunk investment—anisogamy—that is believed to have led to the differential parental investment that characterizes most sexually reproducing organisms in the first place (Trivers 1972). Loss of such investment owing to the loss of offspring that might arise from relationship dissolution would mean women would need to substantially reinvest just to get back to the same level of fitness. Given this fundamental asymmetry in parental investment, we expect women to be more risk-averse than men in reproductive and household bargaining situations. It is this intuition that perhaps motivated Guttentag and Secord (1983), in their classic sociological analysis of low sex ratios, to suggest that women are more interested in marital stability and why men are more responsive to local marriage market fluctuations and alternatives to marriage.

Related to the point of risk-aversion is the third feature that systematically changes the outcome of bargaining games, time preference. Individuals with a shorter preference horizon are at a fundamental disadvantage in bargaining games. In general, there is no obvious intrinsic advantage to men or women in terms of time preference in reproductive bargaining games. Women's reproductive lifespans are shorter than the potential reproductive lifepsans of men. However, men generally have higher mortality. The latter is particularly true in Colombia. It is possible that

the large female bias in operational sex ratios in Colombia could change women's time preferences. Female-biased sex ratios typically lead women to experience difficulty in finding and maintaining marital relationships (Cready et al. 1997; Fossett and Kiecolt 1993; Greene and Rao 1995; Lichter et al. 1991; South and Lloyd 1992). Such marriage market dynamics could induce women to develop strong preferences for a mate in the present, as the likelihood of acquiring a mate later becomes highly uncertain in low-sex-ratio populations, particularly when there is a substantial preference on the part of men for younger mates.

The fourth feature that systematically biases the outcome of a bargaining game is the probability of the breakdown of negotiations because of some exogenous shock. Two potential shocks that seem particularly apropos to the Colombian case are (1) death of one of the participants, particularly the man (Ferguson et al., work in preparation), and (2) forced displacement resulting from the ongoing political conflict (Martínez Gómez 2002).

Finally, there is the differential benefit derived by the woman and the man from remaining in a partnership, known as the "inside options" in the economic literature (Muthoo 1999), in the absence of any agreement over how to divide investments. The party with greater inside options has a major advantage in bargaining because they are more willing to accept the status quo.

Dyadic power mediates the outcome of household bargaining. The partner with greater dyadic power has the ability to tip the balance of a bargaining game in his or her favor. This can come about, for example, through the manipulation of the partner's outside options or through the generation of information asymmetries which can also bias the outcome of bargaining (Bloch and Rao 2002). A woman who does not suffer from a large power asymmetry with respect to her husband is more likely to have access to support outside her intimate partnership, has greater information with which to make decisions, and is likely to derive greater benefits from her current relationship status, regardless of whether a more formal agreement has been negotiated. Given, these expectations, we predict that women with less dyadic power in their intimate partnerships are more likely to suffer IPV.

Two factors that are consistently associated with women's lack of power in relationships are lack of education and early age at sexual debut (Blanc 2001; Clark 2004; Luke 2003; Mensch and Lloyd 1998). We operationalize the hypothesis that the experience of IPV is a function of dyadic power by postulating that power is related to the age difference in partners, the age of women at first sexual intercourse, and the educational attainment of the woman. We expect that age difference may correlate with power differentials over and above the woman's age at sexual debut because, all else being equal, older men control more resources (economic and social). In the behavioral science literature on sexually transmitted infections (STIs), early sexual debut is known to be a major risk factor for acquiring an STI and is generally seen as a marker of lack of power (Krauss et al. 2006; Moore 2006). Education provides women with information and increased earning potential, which can have a systematic effect on their intersexual power relations (Riley 1997). We thus expect women with little formal education to have less dyadic power in their intimate partnerships. Women with relatively more dyadic power bargain from a position of increased economic and, potentially, social power through improved outside and inside options. Women with little bargaining power are vulnerable to

what Bloch and Rao (2002) describe as "terror as a bargaining instrument." When power differentials are large, the potential cost to male perpetrators is low, and even small benefits accruing from IPV may favor its use.

Although we are interested in, among other things, the impact of sex ratio on the likelihood of IPV, we are not able to explicitly model that impact. The marriage market that individuals experience is a fairly local phenomenon, particularly in a country where geographic mobility is relatively restricted. Second, mate availability depends on a number of factors, such as education and wealth, and the use of marriage squeeze metrics in the absence of information on these factors has limited predictive power (Goldman et al. 1984). Unfortunately, we are not able to construct local (e.g., neighborhood or community) marriage squeeze metrics, and the data for marriage squeeze calculations are not disaggregated by education or SES. Consequently, we focus on measures of dyadic power, recognizing that one source of unmeasured heterogeneity in the models may be local marriage market conditions experienced by women. In the next section, we turn to the details of the statistical model.

Methods

Data

We use the 2005 wave of the Demographic and Health Survey (DHS) interviews for Colombia. DHS interviews a nationally representative sample of women ages 18–49 about health, family planning, fertility, and a variety of other country-specific topics. In the 2005 Colombia survey, 41,344 women were sampled in a nationally and departmentally representative, population-based sample.[2]

The Colombia DHS survey contains a domestic abuse module, which we use to construct variables on IPV and spousal control. We were interested in the occurrence of some event of violence or control perpetrated on women in a defined time (either lifetime or last year), rather than the occurrence of specific types of violence or control. We therefore constructed four variables based on whether women answered yes to any of the physical abuse or control questions for their lifetime or in the past year. In all the questions for the domestic abuse module the term "husband" is used for the woman's primary partner, allowing for the inclusion of consensual unions. For the variable *hurt,* women received a score of 1 if they answered yes to any of the following questions: husband ever pushed, shook, or threw something; husband ever slapped or twisted her arm; husband ever punched with fist or something harmful; husband ever kicked or dragged; husband ever tried to strangle or burn; husband ever threatened or attacked with knife/gun or other weapon; husband ever physically forced unwanted sex; or husband ever bit her.

The variable *control* was scored 1 if the woman answered yes to any of the following questions: husband accuses her of unfaithfulness, husband does not permit her to meet her girlfriends, husband tries to limit her contact with family, husband insists on

[2] Full details of the DHS sampling methodology are available at the Measure/DHS webiste: http://www.measuredhs.com/aboutsurveys/dhs/questionnaires.cfm

knowing where she is, husband doesn't trust her with money, husband ignores her, husband doesn't consult with her on important family decisions.

Our independent variables of interest are the woman's age at first sexual intercourse, the age difference between her and her primary partner, and her level of educational attainment. In addition to the variables of interest related to dyadic power, we wish to control for household socioeconomic status, which is the one variable consistently related to IPV cross-culturally (Jewkes 2002). Since violence is less likely when men and women are apart from each other, we include as an exposure control the categorical variable of whether the woman lives with her primary partner. Sexual jealousy is a common proximate trigger for IPV (Gage and Hutchinson 2006). We therefore include a categorical measurement for the total number of unions a woman has reported (i.e., has she had a previous union?) as well as a categorical measurement for the existence of multiple partnerships in the present. We also expect the type of residence (rural vs. urban) to predict IPV, independent of the other variables, a topic we take up again in the discussion.

Independent variables used in the models are women's education (years of schooling), household wealth, the number of unions a woman reports ever having (constructed dummy variable: 1 = multiple unions, 0 = single union), age at first sexual intercourse (years), age difference between the woman and her partner (years), urban vs. rural residence, and whether the woman reports current sexual partners other than her husband or domestic partner (constructed dummy variable: 1 = multiple partners, 0 = single partner). Household wealth is an ordered categorical variable with five levels: poorest, poorer, middle, richer, richest. These categories correspond to the quintiles of the national wealth distribution.

Statistical Methods

There is a great deal of heterogeneity in Colombian departments, and we need to account for the possibility that, for example, wealth scores mean different things in different places. That is, being in the lower part of the income or wealth distribution does not mean the same thing in a poor department as it does in a rich department. Because of the possibility for departments exerting their own effects on the outcomes over and above the individual-level covariates, we fit a hierarchical logistic model to the data. We model the log odds of the *i*th woman in the *j*th department experiencing intimate partner violence using a random intercepts model:

$$\log\left(\frac{\pi_i}{1-\pi_i}\right) = \alpha_{j[i]} + X_i\beta + \varepsilon_i \tag{2}$$

where π_i is the probability that woman i experiences IPV, $\alpha_{j[i]}$ is the intercept for the jth department, X_i are the covariates associated with individual i, β is a vector of regression coefficients, and ε_i are the residuals assumed to be normally distributed around a zero mean (Rodriguez and Goldman 2001; Snijders 2003).

Models were fit in the R statistical programming language (R Development Core Team 2008) using the library lme4, which fits hierarchical GLMs using restricted maximum likelihood (Gelman and Hill 2007).

Results

In our DHS sample, approximately 24.5% of women report ever being hurt by an intimate partner. Fully 41% of women report ever being controlled by their intimate partners. Summary statistics broken down by department are presented in Table 1.

Table 1 Summary statistics by department

Deptartment	*n*	Age	Wealth	Education	Age diff	P(hurt)	P(control)
La Guajira	2454	28.13	2.57	8.19	4.61	0.25	0.44
Cesar	2200	27.82	2.55	7.69	5.26	0.28	0.47
Magdalena	2521	28.72	2.41	7.82	4.74	0.24	0.45
Atlántico	1451	28.92	3.26	9.49	4.07	0.18	0.36
San Andrés and Providencia	1130	30.91	3.15	9.70	3.45	0.16	0.33
Bolívar	1093	28.79	2.78	8.67	4.60	0.20	0.41
Córdoba	1050	28.56	2.08	7.81	5.31	0.19	0.40
Sucre	1381	28.67	2.46	8.32	5.08	0.18	0.37
Norte de Santander	1412	28.70	3.03	7.93	4.43	0.30	0.46
Santander	1427	29.85	3.19	7.94	4.29	0.26	0.42
Boyacá	1190	29.00	2.35	7.46	4.98	0.25	0.39
Cundinamarca	1029	29.55	2.78	7.53	5.06	0.24	0.36
Meta	1456	28.60	3.25	8.12	4.61	0.29	0.45
Antioquia	1392	29.44	3.12	7.89	4.51	0.24	0.41
Caldas	1315	30.46	3.22	8.46	4.80	0.21	0.40
Quindio	1044	30.20	3.50	8.72	5.84	0.21	0.40
Risaralda	1514	29.69	3.32	8.03	4.65	0.18	0.44
Caquetá	1200	28.19	2.47	7.01	5.20	0.31	0.48
Huila	1204	29.28	2.64	7.34	4.69	0.28	0.39
Tolima	1094	29.49	2.93	8.05	4.97	0.26	0.38
Valle de Cauca	1175	29.34	3.47	8.17	4.98	0.23	0.40
Cauca	1517	27.81	2.42	7.40	4.32	0.24	0.42
Nariño	1249	29.22	2.68	7.66	3.81	0.25	0.38
Chocó	2547	27.94	1.88	7.90	4.84	0.25	0.45
Bogota	773	29.40	3.95	9.38	3.81	0.31	0.44
Arauca	651	28.40	3.19	8.65	4.72	0.29	0.42
Amazonas	758	27.87	2.78	9.00	5.67	0.31	0.47
Casanare	547	27.34	3.35	8.80	5.53	0.26	0.43
Guainia	802	28.98	2.39	8.00	5.89	0.26	0.44
Guaviare	668	28.54	2.49	7.79	4.91	0.31	0.51
Putumayo	804	28.36	3.28	8.72	4.23	0.22	0.36
Vaupés	661	28.36	1.68	8.32	5.29	0.28	0.41
Vichada	635	28.35	2.24	8.23	5.76	0.32	0.45

P(hurt) = probability a woman reports being hurt; *P*(control) = probability a woman reports being controlled.

The model fit is summarized in Tables 2 and 3. We find that education, age at sexual debut, whether the woman has other sexual partners, and the age difference between spouses have strong effects on the log-odds of a woman experiencing IPV. Urban women are far more likely to experience IPV. Furthermore, IPV is strongly predicted by poorer wealth status. Weaker effects are associated with multiple partnerships and middle wealth status.

While the model for *control* was largely similar to that for *hurt*, it nonetheless contained two substantial differences. In particular, age difference was not a significant predictor of whether a woman reported being controlled by her partner. Similarly, the odds of a woman experiencing control were unaffected by economic status.

For wealth categories, "poorest" represents the reference category, so the significant coefficients associated with "poorer" and "middle" mean that being in either of these two categories increases the odds of IPV to 1.15–1.21 times that of the poorest women.

The departmental level random effect explains a fair degree of variance. At the departmental level, the standard deviation for the state was approximately 0.29 in the model for *hurt* and 0.21 in the model for *control*. This translates into approximately a 7.25% and 5% difference, respectively, among states on the probability scale (Gelman and Hill 2007). These results suggest that there is unmeasured heterogeneity in the way that wealth affects the likelihood of IPV across departments. Furthermore, it suggests that unmeasured heterogeneity between departments in general accounts for a substantial amount of the variance in the odds that a woman experiences IPV.

In terms of effect size, the covariates with the greatest impact on the odds of being hurt were whether the woman had a concurrent sex partner, followed by poorer and middle wealth classes. Although education appears to have a very small effect

Table 2 Results of the hierarchical logistic regression for whether the woman ever experienced IPV with her current partner

Covariate	Estimate	Std. Error	*z*
(Intercept)	0.641	0.117	5.464****
Education	−0.032	0.005	−7.056****
Living together	0.110	0.035	3.145**
>1 Partnerships	−0.113	0.041	−2.786**
Age Difference	0.010	0.003	4.563****
Sexual Debut	−0.064	0.005	−12.446****
Poorer	0.190	0.051	3.729***
Middle	0.136	0.059	2.288*
Richer	−0.001	0.066	0.984
Richest	−0.011	0.075	0.885
Rural	−0.196	0.048	−4.071****
Other Sex Partners	0.692	0.130	5.322****

**** $p<0.0001$; *** $p<0.001$; ** $p<0.01$; * $p<0.05$

Table 3 Results of the hierarchical logistic regression for whether the woman ever experienced control from her current partner

Covariate	Estimate	Std. Error	z
(Intercept)	0.926	0.095	9.707****
Education	−0.024	0.004	−5.603****
Living together	0.271	0.033	8.210****
>1 Partnerships	−0.120	0.040	2.980**
Age Difference	0.002	0.002	0.874
Sexual Debut	−0.027	0.004	−7.146****
Poorer	0.069	0.050	1.405
Middle	0.021	0.057	0.373
Richer	0.023	0.063	0.364
Richest	0.072	0.071	1.010
Rural	−0.175	0.046	−3.793***
Other Sex Partners	0.991	0.168	5.896****

**** $p<0.0001$; *** $p<0.001$; ** $p<0.01$; * $p<0.05$

($\beta_{educ}=-0.032$), it is important to remember that this means a change in the odds of $\exp(-0.031)=0.97$ per year of education. The interquartile range for women's education in the DHS sample is 5–11 years. The reduction in the odds of experiencing IPV moving between the 25% and 75% education percentiles is therefore 0.83 and the reduction in odds between a woman with no education and a woman who has completed secondary school is 0.69. Rural residence decreases the odds of IPV by a factor of 0.83. The strongest predictors for whether the woman experienced control were cohabitation and whether a woman had concurrent sexual partners.

Summary and Discussion

The theory of cooperative games provides a rigorous and powerful framework for understanding the dynamics of human relationships. In this paper, we have outlined the possible application of cooperative game theory to domestic (and other intimate) partnerships and suggested how the expression of intimate partner violence is explicable within this framework. Within the intimate-partner context, the game-theoretic perspective we adopt focuses attention on the dyadic relationship between the woman and man and how this relationship is negotiated with respect to each partner's alters.

Domestic investments (e.g., in reproduction and the welfare of children) are cooperative inasmuch as the successful outcomes of domestic ventures are mutually beneficial to both women and men. For example, in the case of reproduction, the Darwinian fitness of both women and men is served by successful recruitment of their offspring. The marginal gains to any particular bout of reproduction may differ between women and men, but both nonetheless benefit from the recruitment of offspring. The negotiation framework can then be conceived in terms of splitting a

surplus beyond the minimum required investment. The Nash Bargaining Solution provides a specific framework for understanding how this surplus is split. In particular, the common features of bargaining games and how they systematically change the split of a surplus provide important insights for understanding domestic power relations. Under the NBS, the party with the better fallback position will reap a greater share of the surplus. We postulate that bargaining strength lies at the heart of IPV. Men who maintain a substantial power asymmetry over their intimate partners are in a better bargaining position for matters of domestic and reproductive cooperation. Both violence directed toward their partners and attempts at controlling their partners' behavior can be profitably seen as strategies to undermine women's fallback payoffs and seek outside options. Women's disadvantage in domestic negotiations is exacerbated by the marriage squeeze that applies in Colombia (Jones and Ferguson 2006), which makes securing outside options all the more difficult.

We operationalize the hypothesis that IPV is driven by bargaining strength by predicting that women who have young ages of sexual debut, low educational attainment, and a large age difference with their spouse are more likely to experience IPV. Using survey data from the Colombian DHS-2005 we test this hypothesis using hierarchical logistic regression. The model assumes differing intercepts of the linear predictor by department, accounting for the likelihood that departments differ systematically in aggregate economic and social variables that contextualize the individual-level predictors.

Our results indicate that the odds of a woman experiencing IPV are increased if there is a large age difference between her partner and herself, if she has low educational attainment, and if she has an early age at first sexual intercourse, supporting our general hypothesis. Cohabitation with her intimate partner (which measures exposure) and the woman reporting multiple concurrent sexual partners strongly increase the odds of her experiencing IPV. Urban residence is also highly predictive. Wealth status is related to the experience of IPV in complex ways, with women of intermediate wealth (second to fourth quintiles) experiencing increased risk while women in the lowest and highest quintiles experience lower risk. The hierarchical term for department of residence added approximately 5% to the explained variance.

In contrast to IPV, the odds of a woman reporting controlling behavior from her partner are not increased by the partner age-difference. Otherwise, this model was very similar to that for IPV.

Relationships

The cooperative game framework that we adopt focuses attention on the dyad formed by a woman and her intimate partner and how this dyadic relationship is embedded in relationships with others. The existence of relationships with others is clearly a commonality of all human societies, and these relationships exert strong influence over individual agency. However, the composition of the relationships in which specific dyads are embedded varies tremendously from society to society. The DHS sample is predominantly an urban sample, with 76% of the women interviewed reporting urban residence. Large-scale population movement from rural to urban areas is one of the many social transformations wrought by the long-standing

Colombian civil conflict. In her pioneering work on urban interpersonal networks, Elizabeth Bott noted that the action of social influence in urban societies differs systematically from that in more traditional, kinship-based societies. Regarding social influence she writes,

> Urban families are not isolated, since members maintain many relationships with individuals and groups outside the family. But they are more "individuated" than families in relatively small, closed communities. Many of the individuals and groups to which an urban family is related are not linked up with one another, so that although each external individual or group may control some aspect of familial activity, social control of the family as a whole is dispersed among several agencies. This means that each family has a relatively large measure of privacy and of freedom to regulate its own affairs. (Bott 1971:217).

In light of the autonomy that individuated families—and actors within these families—experience in urbanized nation-states, the question of social control over the primary dyadic relationship that traditionally defines a household becomes critical. Men attempt to exert control over the central intimate relationships of their lives because of the importance of social influence from interpersonal networks. When women enjoy the type of autonomy in generating the composition of interpersonal networks described by Bott, there is real jeopardy for men's ability to maintain a favorable bargaining position. Rich, supportive interpersonal networks can provide women with information and agency that improve their ability to make decisions and increase the scope of their options outside their intimate dyadic relations. Women's interpersonal networks also provide a potential source extramarital sexual opportunities, a truly dangerous outside option from the man's perspective.

The Colombian DHS data upon which we base our analysis does not include a local network module so we are unable to test the hypothesis that the quality of social networks affects the likelihood that a woman experiences IPV. However, our findings suggest that women with less-rich social networks are more vulnerable to IPV. A second, related hypothesis is that women whose personal support (i.e., kin, friendship, work) networks are more embedded with those of their partners are less likely to experience IPV (Youm and Laumann 2003). Youm and Laumann note that when a couple's personal networks overlap, several mechanisms may lead to more equitable household relationships. These include (1) increased monitoring efficiency by spouses, (2) increased social reputation effects for behavior violating social norms, (3) shared networks facilitating shared attitudes and norms, and (4) increased emotional commitment owing to greater degrees of mutual social reinforcement. Testing these network hypotheses in relations to the experience of IPV is a major goal for future empirical work.

On Machismo

Schelling (1960) noted that there is strength in weakness in bargaining situations. An individual can negotiate a strong position when they can claim their "hands are tied" with regard to negotiating power. The bargaining framework allows us to understand how macho cultures of honor are related to IPV. Machismo pre-commits men to a

hard bargaining position. This is exogenous to the actual dyadic interaction between intimate partners; rather it is directed toward the man's non-intimate-partner alters. Men lose face in the eyes of their alters if they are seen expressing weakness in domestic affairs. This form of triadic, structural explanation was anticipated by Evans-Pritchard (1929) in his classic analysis of the relationships between Azande mothers and their sons. Evans-Pritchard argues that the tense relations that characterize Azande mothers and sons are explicable only by understanding the triadic relationships between mothers, sons, and fathers/husbands. Sons inherit their status from their fathers and so must maintain positive relations with them if they are to preserve their social standing. The tense relations between Azande women and their husbands puts sons in a difficult position of simultaneously maintaining positive relationships with two individuals. Evans-Pritchard's insight led to the theory of structural balance. In the case of *machismo*, it is the relationship with their male alters that constrains men's ability to negotiate beneficently with their intimate partners.

Framing domestic relations within the context of bargaining theory provides insight into why women suffer in societies governed by codes of masculine honor, even in the absence of patrilineal descent. It may seem tautologous to note that women suffer in highly patriarchal societies, but as Yanagisako and Collier (1987) note, taking the phenomenon one is trying to explain as axiomatic leads to rather dissatisfying explanations for social and cultural phenomena. When men's social relations depend critically on their ability to maintain face with fellow men—particularly non-kin—in honor cultures, their hands are tied in terms of domestic negotiations. When men's hands are tied, women lose. This condition is further exacerbated when women are removed from the protective sphere of their natal kin.

A rather paradoxical notion emerges that social constraints on men explain why women are treated so badly in societies characterized by male cultures of honor. Violence spillover, or Bourdieu's (1997) "law of the conservation of violence" (men are violent toward other men, why not be violent toward women or children?) is not incompatible with our approach. However, we suggest that approach, as exemplified also by the work of such scholars as Bourgois and Jewkes, is not a sufficient explanation for the phenomenon of IPV or other forms of violence. The instrumentality of violence induces a structure that facilitates the expression of violence in social relationships. Indeed, from this perspective, the identity of a controlling man follows from the structure. As suggested by White et al. (2007), identity emerges from efforts to establish control in uncertain surroundings.

It is important to note that by suggesting that the theory of cooperative games is applicable to understanding power dynamics in intimate partnerships, we do not mean to suggest that these relationships are based on a simple transactional model. That is, we do not mean to suggest that women are in any way trading sex for money or other material gains. Relationships based on simple pecuniary transactions have, in fact, been found to predict the expression of male violence on intimate partners (Dunkle et al. 2007).

Instrumental Violence

Violence is clearly multifaceted and imbued with many meanings for different parties. However, ultimately, there is a degree to which violence is used for

instrumental purposes. This statement does not imply that violence is either a good thing or the best way to achieve a given end. Nevertheless, ignoring the instrumentality of violence is not likely to be intellectually productive and blinds us to potential interventions. Much of the anthropological and public health literature on IPV focuses on psychological and symbolic aspects of violence for men. Clearly, there is an undercurrent of structural explanation in works such as those of Bourgois (1996a, b). Men use violence to gain respect in El Barrio because they are themselves the victims of structural violence at the societal level (Galtung 1969). However, structural violence is itself a multilevel phenomenon, and the lower-level structural relationships (i.e., social network) that facilitate violence and their interaction with agents' instrumental goals have received less attention.

The sensible functional observation that the expression of violence is frequently related to the instrumental goals of the perpetrator has important implications. In particular, it focuses attention on the costs of violence for the perpetrator. When the costs of beating one's intimate partner are effectively zero, then the benefits also need only be vanishingly small to warrant the behavior. The costs of violence perpetration can be increased by a variety of means. The one that comes most naturally to mind is the development of legal protections for women. However, it is unclear if such law-enforcement approaches are effective, and such approaches are particularly problematic in resource-poor populations or in populations where the incentives for policing such behavior are lacking. Shenk (2007) has suggested that protection against dowry harassment has largely failed in India despite very strong legal protections because of the lack of both public support and actual on-the-ground law enforcement.

An alternative approach is to increase the social costs of IPV for men through their status in personal social networks. This perspective is used, for example, in IPV interventions discussed by Jewkes (2002). Social influence and diffusion is used in public health research more generally (Bongaarts and Watkins 1996; Casterline 2001; Entwisle et al. 2007; Watkins 2000, 2004). Developing effective interventions based on a network-informed social influence approach is a major challenge with great promise.

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James Holland Jones is an assistant professor of anthropology and a fellow in the Woods Institute for the Environment at Stanford University. He received his Ph.D. in biological anthropology from Harvard University. His research focuses on biodemography and life history theory, social networks, and the ecology of infectious disease

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Brodie D. Ferguson is a Ph.D. candidate in the Department of Anthropology, Stanford University. He holds an M.S. in international health from Johns Hopkins University and is interested in the demography of violence, migration, and the evolution of human life histories.