

Review



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Female cooperation: evolutionary, cross-cultural and ethnographic evidence

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Women and girls cooperate with each other across many domains and at many scales. However, much of this information is buried in the ethnographic record and has been overlooked in theoretic constructions of the evolution of human sociality and cooperation. The assumed primacy of male bonding, hunting, patrilocality and philopatry has dominated the discussion of cooperation without balanced consideration. A closer look at the ethnographic record reveals that in addition to cooperative childcare and food production, women and girls collectively form coalitions, have their own cooperative political, ceremonial, economic and social institutions, and develop female-based exchange and support networks. The numerous ethnographic examples of female cooperation urge reconsideration of gender stereotypes and the limits of female cooperation. This review brings together theoretic, cross-cultural and cross-lifespan research on female cooperation to present a more even and empirically supported view of female sociality. Following the lead from trends in evolutionary biology and sexual selection theory, the hope going forward is that the focus shifts from rote characterizations of sex differences to highlighting sources of variation and conditions that enhance or constrain female cooperative engagement.

This article is part of the theme issue 'Cooperation among women: evolutionary and cross-cultural perspectives'.

1. Introduction

The cooperative nature of women and girls is evident in childrearing, food production, market organizations, collaborative sodalities, coalitions, ceremonial institutions, and exchange and helping networks. Female cooperation may form through geographical proximity, relatedness, friendship and reciprocal exchange. It occurs within households, between residential groups and across communities, and fulfils both domestic and institutional goals. Yet much of this information is lost in an ethnographic record that has focused on male sociality.

Outside of cooperative breeding and reproductive concerns, theory building has largely been silent on conditions that promote or constrain human female cooperation. This means that much of what is asserted about the extent, the ways and with whom women and girls cooperate has been formulated on assumptions, not observation. Cooperation is widely recognized to be at the centre of the human adaptation. If so, would females not be expected to have played a primary role in this evolutionary trend?

In the first section, I review a number of research traditions from evolutionary biology, anthropology and psychology that have shaped views of females as cooperators and competitors. This is followed by a discussion about how human sociality and life history generate opportunities for female cooperation, as well as competition. The third section reviews the ethnographic literature on female cooperation in the context of childrearing, food production, coalition formation, political, ceremonial and social institutions, and exchange and support networks, and concludes by suggesting some broad areas for future research.

Female cooperation is vastly under-considered in theoretic constructions of social evolution, and lacks broad empirical synthesis. My aim is to foreground

what is known from observation. The ethnographic record has been extensively drawn on to support the centrality of male cooperation, but has been underused in reference to female cooperation. The intention here is to balance this accounting.

Related topics not covered in this overview of female sociality and cooperation are the gendered division of labour, generalized food sharing, or how cooperators overcome free rider problems. Specialized terms are italicized and defined when first encountered, as are references to specific societies. Note that the use of 'female' as a modifier is not intended to denote gametic sex; rather it is used as the most parsimonious term to refer to both women and girls since cooperation develops in young children and occurs across the lifespan. Likewise, 'female' places humans in a broader comparative primate context, rather than drawing undue attention to human exceptionalism. Cooperation is used here to inclusively refer to an activity done in concert with other women or girls with a common goal (i.e. it subsumes activity that may be mutualistic).

2. Traditions that shape views of females as cooperators and competitors

The characterization of men being more cooperative than women, and women's cooperation being limited in scope and constrained by competition has been inculcated in much of the popular, psychology and social science literature [1–3]. Yet polarized views of sex differences in cooperation and competition are at odds with theoretic and empirical insights from evolutionary biology, primatology and anthropology. This body of research suggests that cooperation and competition often work in tandem (see [4] in this volume), and that sex differences cannot be neatly drawn (see [5] in this volume).

(a) Cooperative breeding

The evolved capacity for female reproductive cooperation is well studied in birds, fishes, mammals and humans. Cooperative breeding centres on how and why other group members aid mothers to help raise offspring who are not their own [6–11]. Humans share in common with other cooperative breeding species that non-breeders (juvenile and post-fertile women) are important helpers [9,12–18] and that mothers and children are the beneficiaries of helping behaviours [10,17,19–23]. However, humans also are unusual in a number of ways that positively affect the potential for female cooperation [23,24] (see the section on human life history).

Evolutionary biologists distinguish *cooperative* (non-breeders cooperate) from *communal breeding* (breeders cooperate) as derived from different selection pressures [25]. This distinction is useful in differentiating circumstances where reproductive-aged women (i.e. other mothers) help each other (communal breeding), which has implications for reproductive conflict, from those where non-breeders (primarily daughters and grandmothers) help to care for and provision children. Non-breeders, particularly a mother's own children, have lower opportunity costs and few conflicting interests to cooperate since they are not raising offspring of their own and benefit by leveraging their non-reproductive status into an indirect fitness gain [10,23]. The fact that humans are described as both communal and cooperative breeders puts a point on how vested human mothers are in reproductive cooperation.

(b) Sexual selection theory

To shed light on cooperation, it is also important to consider how competition has been integrated into views of female sociality. Sexual selection theory forms the basis for many ideas about sex differences in competition (intrasexual selection), and attendant distinctions in physiological traits (size, ornamentation and weaponry) and behaviours—insights articulated by Darwin [26], forwarded by Bateman [27] and expanded on by Trivers ([28], overview in [29]).

However, the simple axiom that males compete for females who choose among available partners has long given way to the more nuanced view that the same rules of behaviour apply to both males and females. Evidence for this is in the many exceptions to sex-determined differences. In most species, aggression and competition are far less prevalent and intense and secondary sexual traits are less developed in females than in males. However, examples of females competing for mates, territory and food, and female expressions of weaponry, ornaments, dominance hierarchies and competitive displays are found across taxa [30,31]. Although competition and choice are often siloed as sex-specific traits in humans [32], following on cross-species research, they are best characterized as varying in degree with ecological constraints, demographic pressure, breeding system and dispersal patterns [30].

The idea that competition for mates and resources might favour cooperation is well established. Debated in human studies is whether cooperation motivated by competition is the outcome of sexual selection *per se* [33]. Regardless of the selective pressure, there seems little question that cooperation and competition are interacting behaviours [34,35].

(c) Primate ethology

Several important observations from the primate literature link cooperation and competition with implications for humans. At its simplest, aggregations of multiple breeding females may promote competition and even intense conflict for mates and resources [36–38]. While female primates not uncommonly compete for resources needed for successful reproduction, they often cooperate to do so [36,39], with positive fitness outcomes [40,41].

In nonhuman animals, cooperation largely, though not exclusively, occurs among kin. Kin-selected cooperation is facilitated by limited female dispersal since it raises relatedness between group members. In many primate species, as in most mammals, females are philopatric. The expectation that follows is that cooperation evolves via kin selection more in females than in males [42]. Thus dispersal is a key variable affecting group composition and the propinquity of female kin. Assumptions about how dispersal played out during human evolution then has direct consequences for perspectives on the potential for cooperation and competition [43].

(d) Misconceptions about human dispersal and patrilocality

Women construed as less cooperative than men stems from several common but unsupported expectations about the prevalence of male philopatry and patrilocality, and the role of hunting and warfare in favouring sex differences in sociality. Together these misconceptions serve to overemphasize women's isolation from their kin, competition with other

women for mating opportunities, allocate and resources and men's primacy to band together.

Based on the chimpanzee pattern and what was presumed to be the universal hunter–gatherer dispersal pattern, human sociality has been described as *male philopatric* (females disperse at maturity) [44–47]. However, the preponderance of male philopatry and female dispersal has long been disputed [48–53]. Empirical studies in small-scale societies show that where couples live after marriage varies cross culturally, individually and across the life course. In some cases, men migrate and in others, women migrate. In some instances, both men and women leave their natal home to marry and in others, both stay. In most societies, multiple dispersal patterns are expressed simultaneously [54–60]. At the species level, the most apt characterization is that human dispersal is variable, flexible and not sex patterned.

Associated with assumptions about male philopatry, is the common characterization of hunter–gatherers, and our ancestral residence pattern, as *patrilocal* (at marriage, women move to live with their husband's family) [45,61–65]. Evidence for patrilocality derives from the often-cited cross-cultural sample [66,67]. These data are based on a society's marriage rules and postmarital residence norms, which do not account for individual patterning or lifetime variation (reviewed in [68]). The preponderance of patrilocality is challenged by studies using high-quality, longitudinal and individual-level residential data, which show that hunter–gatherer residence is fluid, facultative and changes frequently across the life course (also called *bilocal* or *multilocal* residence) [57,69–73]. Spouses often move between local groups, shifting affiliation between maternal and paternal kin. Spousal residence may reassort daily, weekly or seasonally. Together these observations dispute that patrilocality and patrilineality are the normative human pattern. Revising these conventional expectations to more closely reflect the empirical record of flexible, multi-local residence has important implications for how female cooperative relationships are viewed.

Despite unsupported claims, patrilocality and patrilineality are perpetuated as underlying ancestral conditions in some fields [1,32,74,75], and thought to limit women's access to kin, set up competition with in-laws and leave women vulnerable to exploitation (but see [76,77]). Even in contemporary societies that are patrilocal or patrilineal, women are not necessarily cut off from female support. In south India, for example, while women who emigrate have fewer consanguineal relatives, kin are more likely to be named as friends in their social networks (also see [78,79]). In another case, while *Martu* women (West Desert Australian foragers) live in a patrilineal-descent society, they maintain strong female kin ties throughout their lives. Using demographic data from precontact historic bands, *Martu* women remained close to their female relatives because either their husbands joined them, their mothers relocated to live with them, or their sisters were their cowives [80]. Among the patrilocal *Himba* (African pastoralists), married women spend much of their time away from their husband's household, visiting their natal community or relocating back to mother's village during key life events (birth of a child, after a divorce, or death of a spouse [81]). Because residential mobility allows women to maintain lifelong female relationships, it suggests that patrilocality may be less of a handicap for women to gain access to kin support than commonly characterized [81].

Claims also are made that hunting and coalitionary support for within-group dominance and defence favoured male alliances and cooperation [1,63,74,82,83], but were less important for women. It is beyond the reach of this paper to discuss the overemphasis on hunting, preservation biases in the archaeological record and debates over how extensive coalitionary defence is among hunter–gatherers. It suffices to point out that, although protein and fat are integral to the human diet, hunting narrowly focuses on a food that is too ecologically variable as a dietary constituent to be broadly explanatory. It also ignores the many ways that females contribute to dietary diversity, which is equally foundational to human subsistence (overview in [84]). Further, among many hunter–gatherers, it is men who tend to forage alone, and women and girls who forage in groups, and provide the daily, bottom-line calories to their families [49,71,85–87].

(e) Summary

Several summary points can be made about thinking on female sociality: (i) competitive and cooperative behaviours are not sex-determined *per se*, but mediated by social factors, breeding systems, dispersal patterns, ecology and demography [30]; (ii) although cooperation and competition are frequently discussed as countervailing behaviours, they interact such that groups of females may cooperate to secure or compete for resources, territory, status or help; (iii) both in its evolutionary consideration and contemporary context, human female cooperation has been under-represented in both theoretic and empirical treatments owing to an historic emphasis on meat, hunting, warfare, male bonding rituals and initiations and male-centered residence patterns. (iv) Male philopatry and patrilocality as underlying constraints on female cooperation need to be reconsidered on two counts: one, their validity as the predominant human ancestral pattern, and thus a selection force shaping female sociality; and two, in those societies that are patrilocal, the few empirical studies that have been conducted suggest that the effect of patrilocality on limiting female access to kin is overstated, while also understating the importance of affinal kin.

3. Human female sociality: the tug between cooperation and competition

Several features of human sociality generate opportunities for female cooperation and competition. Examples include living in multilevel groups, female life history, cooperative child-rearing, reproductive conflict and male parenting.

(a) Living in multilevel groups

An ancient feature of human sociality is living in multilevel societies (e.g. biological families, extended families, bands, tribes) [71,73,88–92]. In these nested, interacting spheres, coordination and cooperation occur at a wide range of scales, among family members, between kin, affines and non-relatives. Within families, *kin selection* (which predicts that individuals will bias help towards kin and direct harm away from them) is often invoked to explain cooperation [93]. Although other benefits (direct, mutual or reciprocal) may govern decisions to cooperate, if you help a close relative, you also receive an indirect benefit. Because of this added benefit,



Figure 1. Female cooperation among Savannah Pumé hunter–gatherers. (a) Women foraging in mixed age groups; (b) children cooking roots, and (c) grooming and allocare. The Savannah Pumé are mobile hunter–gatherers living on the llanos of west-central Venezuela, and are typical of other tropic foragers in many aspects of their social and family lives [60]. They are a population of approximately 500 dispersed in bands averaging approximately 60 adults and children. Several characteristics of Pumé life dampen female competition and encourage cooperation. Women have autonomy when and whom they marry, divorce and remarry. Intimate relations determine marital status and who lives with whom. If individuals are having conjugal relations, they are considered married, and affairs constitute divorce and remarriage. Most marriages are monogamous, though 40% of adults remarry owing to spousal death or divorce [57]. Some 9% of women and 13% of men are polygously married at some point in their lives. These marriages tend to be short-term, and partners commonly reassort into monogamous unions. Jealousy and competition over mates are rarely expressed, in part attributable to the fluid marriage norms and the equality of men and women socially, economically and in decision making. The extreme seasonality and critical contributions of both male and female foods to the diet encourage strong sharing ethics and cooperative relationships [168]. Girls play and work cooperatively together from a young age; 84% of play observations are coded as ‘plays with others’ and 90% of girl’s foraging trips are in groups [111]. By the age of 3–4 years, girls forage together for easy-to-get food at the edge of camp, cook and share the returns (figure 1b). Older girls gather fruit, berries and firewood, dig for roots and haul water from nearby wooded areas and streams, and accompany women on more distant foraging trips (figure 1a). Returns from these trips are pooled and shared out to family and non-family group members [111]. Young girls are also their mother’s main source of allocare (figure 1c). When a female foraging party returns to camp, the food is redistributed among hearths and often secondarily reshared after processing or cooking. Many women maintain life-long affiliations with their natal band and develop strong female bonds, either by marrying endogamously [123], frequent visiting or long residential stays with their female kin. Group interdependence is reified through Toje, all night dances in which women and girls play central roles. Photo credits: Russell D Greaves. (Online version in colour.)

indirect fitness gains have had broad appeal as the evolutionary basis for cooperation and cooperative breeding [94–100].

Although cooperative relationships may be biased towards kin and reciprocating partners, humans cooperate with individuals who extend far outside their family and residence group [101,102]. In small-scale societies, women share food, pool resources and labour, collaborate on collective action projects, have trade and exchange partnerships across groups, and collectively engage in intragroup ritual, political and social activities. Friends are often chosen for their loyalty and willingness to cooperate, and in addition to, or as an alternative to kin, may be preferred as cooperative partners.

(b) Life history and cooperation across the lifespan

The combination of early weaning, short birth intervals and caring for juveniles as well as infants together commit mothers to raise overlapping dependents. This unusual life history, which took shape over millions of years, at some point in the past would have posed a problem for mothers: how to find the time to provide both primary care to young children and the food and other resources to older children [103]. Cooperative assistance from her own children, her mother, and other helpers to solve this time allocation problem is a trait that distinguishes humans among primates [9,10].

The aptitude for cooperation matures across childhood. Toddlers cross-culturally pass through a developmental stage where they are intent on being helpful [104,105], and in early childhood develop much of the cognitive and emotional architecture that establishes their capacity for coordination and cooperation [106–108]. Beginning around the age of 3 years and increasing with age, girls cooperate within their commensal group by

taking care of their younger siblings, doing domestic tasks, collecting fruits, nuts, seeds, berries and small game, and tending animals and crops [12,13,16,23,109–112]. Importantly, the products of their labour are shared with their mothers, siblings and others.

Observations in small-scale societies consistently show that girls spend less time playing and more time in productive tasks at a younger age than do boys [111,113–117]. In a sample of hunter–gatherers, agriculturalists and pastoralists, girls aged 6–14 years spend several hours (3–8 h) a day in economic work that contributes to their own and their family’s wellbeing ([118]: fig. 5). For example, *Savannah Pumé* (South American hunter–gatherers) girls aged 11–14 years have an average root foraging trip return of 3.0 k, an equivalent of approximately 9700 edible calories that are shared out to family and non-family group members [111] (figure 1).

The strong cooperative and economic bonds that form between mothers and daughters during childhood may have been an important evolutionary step in family formation [68,103]. The mother–daughter cooperative bond endures from childhood through adulthood as often noted in the role that grandmothers play in helping to support their adult daughters [54,119–122]. As a suite of features, intergenerational cooperation between women and girls, mothers and daughters, complementarity of childcare and subsistence tasks, and cooperation in collective activities are unmatched in other primates.

(c) Reproductive cooperation and conflict

If the human life history of multiple dependent young implies that mothers depend on others for help, and if mothers rely on the same pool of helpers, reproductive-

aged women may compete over access to that help (reviewed in [43,123] in this volume). The reproductive conflict has been negatively associated with maternal and child outcomes in several patrilocal, polygynous contexts. Studies among the *Dogan* (Malian agriculturalists) show that unrelated cowives have a negative impact on child nutrition and survivorship [124,125]. Among *Gambian* women (West African agriculturalists), mothers whose childbearing years overlap with their daughters may have shorter reproductive careers and lower completed fertility [126].

Yet, other studies find that access to female kin has a positive effect on fertility. For *Gambian* women, the presence of her mother and sisters is associated with improved survival and the nutritional status of her children [127,128]. In other *Gambian* studies, women who live with a mother-in-law have higher chances of giving birth [129]. *Tsimane* women (Bolivian horticulturalists) are suggested to invest in social capital (relationships with kin and friends) as a means to improve their inclusive fitness [130]. A study among *Savannah Pumé* using longitudinal residence and kinship data found that neither the number of co-residential women, the number of female kin, nor a woman's position in her social network had a negative effect on a mother's probability of giving birth or of a child dying ([123] in this volume). Residential mobility and bilateral kinship, traits that are common in hunter-gatherers, effectively both maintain flexibility in a mothers' access to help and resources, while attenuating conflict [57,81,131].

Mixed results across studies for the effects of reproductive conflict suggest that the conditions under which kin are collaborative or a hinderance vary. Several social factors appear to tip the benefits of having female helpers over to competing with them: (i) if male philopatry and rigid patrilocal residence limit women's access to help; (ii) living with unrelated cowives; (iii) heritable and divisible wealth [132]; (iv) if husbands divert assets or time from children to status competition, women may face steeper trade-offs between allocating time to childcare or economic production; and (v) where the quality of paternal care benefits women's reproductive success [19,20,133–137], and becomes a resource over which women compete [138].

By contrast, competition among adult women is mollified under conditions of: (i) sororal polygyny where cowives are allied [80,139,140], (ii) being the plural wife of a wealthy man [141], or (iii) in instances where having a cowife assuages spousal pressure to reproduce at birth intervals that compromise her or the child's wellbeing [142]. (iv) Reproductive conflict among adult females may also be attenuated if a mother's juvenile children provide a reliable source of help. The introduction of schooling is often implicated in altering the opportunity cost for girls to spend their time helping [143]. In the long run, since women and girls do cooperate with each other, it suggests that the benefit of cooperation, outweighs the negative effect of female kin on those outcomes.

4. Ethnographic evidence for female cooperation in small-scale societies

The ethnographic record evidences the many ways in which women and girls cooperate. Examples are taken primarily from contemporary, small-scale societies for several reasons. Urbanization, industrialization, the nuclearization of the

family and the demographic transition over the last centuries have profoundly affected women's social lives and disrupted the ways in which they organize. The multigenerational effects of low fertility and longer generational times mean that women are likely to have fewer daughters, as well as fewer female collateral kin (aunts, nieces and cousins). The secular trends towards living in nuclear families and geographical dispersal often isolate women from their kin, shrinking cooperative networks. Schooling and wage labour can further age-segregate women and girls who in subsistence economies often cooperated and worked in intergenerational groups. Small-scale subsistence societies are not free from these modernizing influences. However, they offer an empirical glimpse into cooperative behaviours prior to the accelerated pace of globalization, and the market and governmental influences that often perturb women's autonomy and cooperative networks.

This search pulls from both nineteenth and early twentieth centuries ethnographies, and later web-accessible research-oriented articles, and is by no means exhaustive. The early ethnographies often lack quantitative information, but are rich in qualitative descriptions of women's collective and cooperative activities. Many accounts of female activities are embedded in discussions of the division of labour, which became a focal point in ethnographies from the 1960s forward. These are usually general descriptions about what women and girls do in contrast to what men and boys do. However, they are often vague on whether these activities are preformed alone or in collaborative groups. I draw on those exceptions to illustrate that women and girls cooperate at scales and across domains as broad reaching as men and boys.

(a) Childcare

Numerous studies show that women and girls cooperate with mothers to care for children. In a cross-cultural sample of time allocation studies, mothers on average give about half of the care that an infant receives, meaning that others cooperate with mothers to provide the balance ([144]: table 1 and references within). Although a kin-bias is evident in childcare [144,149,154,193–196], who cooperates with mothers varies situationally, with individual preferences and across societies. In a sample of agriculturalists and hunter-gatherers, girls aged 7–14 years spend upward of 16% (approx. 2 h) of daylight hours caring for their younger siblings, more than any other age or sex group [144]. The pattern of girls cooperating with mothers as allocare specialists has been noted by many ethnographers [117,146,152,196–198].

Allonursing is a specialized form of cooperation among mothers and is noted in some societies, although is normative in few [199]. Among hunter-gatherers, allonursing is commonly observed among the *Aka* (Congo River hunter-gatherers) and *Efe* (Ituri forest hunter-gatherers). It occurs, though rarely, among the *Savannah Pumé* and is absent in the *!Kung* and *Hadza* (sub-Saharan hunter-gatherers).

Although the care of infants and babies tends to occur within families ([144]: fig. 1, [150]: fig. 2), a mother's childcare network can be large and diverse. As examples, *Efe* infants interact with 11 allo-caretakers on average (range from 2 to 21 [14, p. 860]). A similar network size is found among Central African hunter-gatherers, where childcare networks average 12.1 caretakers (range 3–24 [150]: table 1). *Savannah*

Table 1. Select list of ethnographic references for cooperative female activities.

activity	society	reference ^a
cooperative childcare	Alyawara	[145]
	Ye'Kawana	[146]
	Trinidadian	[147]
	Mundurucú	[148]
	Martu	[149]
	Aka	[150,151]
	savannah Pumé	[144]
	Maya	[144]
	Toba	[152]
	Trinidad	[147]
	Ngandu, Sidama	[150]
	Efe	[14,153]
	Hadza	[154]
cooperative foraging	Hadza	[87]
	Ache	[155,156]
	!Kung	[49, pp. 118, 123]
	Gunwinggu	[157]
	Australian Aborigines	[85]
		[158, p. 105]
		[159]
	Tlingit	[160, p. 80]
	Owens Valley Paiute	[161, p. 239]; [162, pp. 44, 257]
	Yup'ik	[163, p. 49]
	Chippewa (berries)	[164]
	Agta (fish drives)	[165]
	Paiute	[166, p. 14]
cooperative food processing	Martu	[167]
	Savanna Pumé	[168]
	Gunwinggu	[157]
	Chippewa	[164]
	Paiute (fish)	[166, p. 10]
cooperative resource processing	Tlingit (fish oil)	[160, pp. 69–70, 82]
	Mundurucú	[148]
	Blackfoot (hides, tipi covers)	[169,170]
	Lakota (hide prep)	[171, p. 64]
	Great Plains Native Americans (multiple tribes)	[169,170,172–174]
	Navajo (animal husbandry)	[175, p. 95]
	Crow (tipi covers)	[176]
trade partnerships and exchange networks	Enga (production of exchange items)	[177, p. 114]
	Agta	[165]
	Australia	[158, p. 107]
	Enga	[177]
general labour help	!Kung	[178,179]
	Navajo	[180]
	Crow	[176]
	Mandan, Arikara, Hidatsa (field prep)	[181, pp. 78, 87]
	Lakota (sewing circles)	[171, p. 64]

(Continued.)

Table 1. (Continued.)

activity	society	reference ^a
ritual and ceremonial collaboration ^b	Navajo	[180]
	Australia	[158]
	Ainu	[182]
	Enga	[177]
	Mundurucú	[148]
female sodalities and congresses ^c	Tiwi	[183, p. 81]
	Mandan, Arikara, Hidatsa	[181, pp. 62–63, 78]
	Mehinaku	[184, p. 1100]
	Mali	[185, p. 248]
	Mandan, Arikara, Hidatsa	[181, pp. 78, 85]
	Trobriand Islanders	[186]
	Marakwet	[187, p. 193]
female coalitionary support	Wape	[188, pp. 145–146]
	Enga	[177]
	Navajo	[180]
	Garifuna	[189]
	!Kung	[190]
	Nagovisi	[191]
	Mundurucú	[148]
	mangrove Australian Aborigines	[192]
	Marakwet	[187, p. 183]

^aPage numbers indicate specific discussion in reference.

^bFemale cooperation in the context of ritual, social or political ceremony, or shamanism, where women collaborate either in support roles or have public roles in the collective production of food or goods for the ceremony.

^cAge-graded societies, political or ritual institutions where affiliative groups are based on age, cohort or descent and membership involves cooperative activities.

Pumé focal infants receive direct care on average from nine different caretakers (range 5–12).

(b) Economic cooperation

Economic cooperation and sharing practices may incorporate female kin, affines and non-kin. Most theoretic treatments of cooperation and food sharing have focused on hunted foods. Plant foods have received much less attention, despite numerous examples in the ethnographic literature of their dietary importance and being women's contributions [49,71,85–87].

Female cooperation to produce food for domestic consumption largely occurs within the commensal group, or household. Depending on how the household is defined in a particular society, the commensal unit may be a nuclear family, i.e. include mothers and daughters, as among the *Shoshone* (North American Great Basin hunter–gatherers) [162]. Or it may involve cooperation across large extended families including female in-laws, collateral and ascendant kin, as among the *Tlingit* (Northwest Coast hunter–gatherers) [160]. *Yucatec Maya* (Yucatan Peninsula subsistence agriculturalists) and Savannah Pumé women who live in very different agricultural and hunter–gatherer societies, respectively, have similar sayings, 'those who eat together, work together'.

In her study of the rural *Navajo* (American southwest agro-pastoralists) in the 1960s, Lamphere [180] describes concentric

spheres of female cooperation where domestic activities (cooking, hauling wood and water) were jointly performed by the household (nuclear family), and labour-intensive sheep herding and farming activities by the residence group (cluster of related families). In another sphere, ceremonial cooperation links female kin and non-kin across residence groups and communities.

Another way reproductive-aged women expand and strengthen their economic alliances, access to status, rights and authority is through marriage between women, documented in over 40 precolonial African societies [200].

(i) Cooperative foraging

Hunter–gatherer women often are described as foraging in groups (table 1) [49,85,87,155,157,158,160,162,163,168]. Across Aboriginal Australia, for example, from the early twentieth century on, women are the stable day-to-day food provisioners [85], often foraging collectively for roots, seeds, shellfish, reptiles and other small game [85,158, p. 105]. Aboriginal women also work in collaborative groups when the task involves a collective work implement, such as managing a fire drive or trapping fish [157]. *Yup'ik* women (western Alaska SubArctic hunter–gatherers) collect berries, fish and process fish in cooperative groups that were described as often being larger than men's hunting parties [163]. !Kung women with young children often forage in

parties to augment their efficiency; mothers take turns watching children play together, leaving others to gather food unencumbered [201].

The extent to which women in a foraging party share their returns, or forage in groups for company or protection is variable. Among the Martu, for example, sand monitors are a common food usually hunted by women, who may coordinate in search and pursuit efforts, or take turns digging them out of their burrows. Returns from these efforts are pooled, cooked and distributed first among the hunting party participants. Each hunter then secondarily shares the cooked meat to others [167]. Savannah Pumé women and girls leave camp in a group to collect fruit and roots. They travel together to a patch, then forage independently. However, they will often redistribute their returns among each other's baskets to balance carrying loads for the trip back to camp [168]. After food is cooked, it is then secondarily shared across both related and unrelated households. By contrast, among the *Ainu* (Japanese hunter-gatherers), women from neighbouring camps foraged together, but each woman collects food only for her own family [202].

(ii) Alternating childcare and foraging responsibilities

Mothers have finite time and resource budgets out of which various competing expenditures are funded: taking care of themselves, caring for infants, providing specialized food for younger children and adult food for older children. One way that women cooperate to meet this challenge is by alternating roles as food producers and caregivers. Mothers with young children may either spend time away from home foraging or in other economic pursuits while others care for her children. Conversely, she may care for her children while others substitute for her lost economic production [80,120,195,203,204]. Many cross-cultural studies show that mothers spend less time foraging, farming, doing domestic activities or at wage labour jobs when they have an infant [135,146,155,194,204–206]. Mothers can afford to focus on childcare because others fill in for her lost economic contributions.

Older females may be important in caring for young grandchildren while their daughters spend time away from home foraging or in other economic pursuits [106]. In other instances, mothers with young children might reduce the time they spend in economic activities while grandmothers take on these support tasks [120,195,203,204,207]. In a study of the energetic effects of helping, Aka grandmothers reduce maternal workloads by about 200 kcal per day, and also substitute the time mothers spend in direct care [136].

Another way that women manage childcare demands is by living near their natal communities, proximate to their mothers and sisters early in their marriage [57,80,81,208]. For example, because of high male absenteeism, Martu women are the major food producers of both plant and small animal resources. Since foraging is not compatible with caring for young children, Martu women solve this through cooperative relationships with cowives, who often are their sisters, or by residing in the same band as their mother and daughters [80].

(iii) Cooperative food and resource processing

A characteristic of the human diet is that most food is processed (e.g. cracked, ground, pounded, leached, plucked, scaled, deboned, butchered, cooked) to render wild foods either

edible or more digestively accessible and nutritious (reviewed in [84]). For both hunter-gatherers and agriculturalists, food processing often is a multi-staged, daily, arduous, if not tedious task that women and girls tend to do together, dividing up and switching tasks. When under a time constraint, women may complete the task in one household, and then move onto the next. For example, teams of *Gunwinggu* women (west Arnhem Land, Australia) forage and fish together. The size of cooperating groups varies with season, and are largest during seasonal harvests when related and unrelated females across households join together [157, pp. 120–122]. *Chippewa* women (North American boreal forest hunter-gatherers) process most of the fish and caribou after it comes into camp, often working collaboratively to expedite the work in one household before the flesh spoils, and moving onto the next [164, p. 232]. Many American Great Plains hunter-gatherers aggregate in the late summer, when a large number of bands camp together for several weeks before the autumn hunt (e.g. Sun Dance). Ethnographic attention has been on the male rituals, dances, vision quests and self torture that are associated with these aggregations [169,172,173]. Yet a closer look reveals another reason for the timing and amassing of large groups in the late summer. Berries are a critical component as a preservative to pemmican on which Great Plains hunter-gatherers depend throughout much of the winter. Berry picking required a large female labour corps to harvest and process the berries quickly after they ripened in advance of birds or other scavengers. These large late summer aggregations had several functions, but were scheduled around the needs of women's collective work to gather berries.

Great Plains women also collectively produced much of the technology for domestic use, either for social reasons or because of time constraints. In addition to berry processing, the late summer tribal gatherings are also described as sewing camps [171,176,181,209], where women worked in groups, moving from household to household to process and tan the hides that were used to make clothing and tipi covers before the onset of winter [169,210–212]. Hide tanning was about a 10-day process that could not be interrupted. *Blackfoot* women (American northern Great Plains hunter-gatherers) replaced tipi covers once a year if the labour and hides were available [172]. In anticipation, women gathered stores of food and invited a group of friends and relatives to share the work [170]. When they finished one tipi cover, they moved on to help other women [169]. Similarly, groups of *Crow* women (American northern Great Plains hunter-gatherers) collaborated in constructing tipi covers, the host remunerating helpers by feasting at the task's completion [176].

(c) Collaboration for large-scale gatherings

'without women, no big ritual could function' Berndt & Berndt [213, p. 54]

Men are highly visible as cooperators through their participation in ritual and ceremony. However, a close read, particularly of early twentieth-century ethnographies, often describes women collectively taking part in large-scale social events and ceremonial gatherings. Not only did they cooperate in support tasks, but they hosted ceremonial events in parallel to those of men (table 1). Women often collectively produced the gear used in ceremonial events, working in groups to gather the raw materials, make pigments and construct ritual attire and accoutrements. Many ethnographies refer to women working together to supply,

prepare and serve food for group consumption at feasts. For example, *Mundurucú* (South American horticulturalists) women collectively process manioc for domestic consumption and to produce the large quantities of fermented manioc beverage that features in many celebrations [148].

Besides support roles, women and girls have their own ceremonies that depend on collective action and community-wide female collaboration. For instance, while male initiation has a well-documented central role in Aboriginal society, girls have their own initiations [158,214,215]. Although female initiation usually occurs at a smaller scale, women have autonomy how they organize and pass on their own sacred knowledge [216]. Among the *Walbiri* (Australian Aborigine hunter-gatherers), though boys are the central figures during male initiations, their sisters, mother, wives-to-be, other matrilineal kin and future wives in-laws work together as a group during ritual events [214].

Both *Navajo* men and women can initiate a call for a ceremony (a chant, sing, healing or rites of passage) and request aid in the preparations. Participation is voluntary, and both geographical and genealogical proximity were important determinants of who cooperated [180]. Female assistants prepared and cooked food, butchered animals, chopped wood and performed ritual tasks. Ceremonial networks were temporary and nonfixed social groups (rather than being determined by kin affiliation), whose membership varied from ceremony to ceremony.

(d) Female trade and exchange partnerships

Trading and exchange partnerships are formalized forms of cooperation among women. Perhaps best known is *hxaro*, the *!Kung San* network of reciprocal exchange partnerships. This structured set of social relationships creates ties across extensive geographical areas, different bands and language groups. The underlying function of *hxaro* is to ensure the long-term survival of the group by maintaining alternative options for territory access in the event of local environmental downturn [217]. Girls start to develop *hxaro* partnerships, learning the ethics of delayed reciprocal exchange early in childhood (boys and men do as well), and maintain these relationships throughout their lives. Adolescents have on average 10 *hxaro* partners, the number increasing with marriage and adulthood to an average of 24 partners ([217]: table 3.1). Many *hxaro* partners are consanguineal relatives. The gifts that a woman receives are not uncommonly passed onto her husband and his relatives, expanding the reach and solidity of both men's and women's exchange relationships.

A network of exchange partnerships much like *hxaro* is described for Australian Aborigines [158] in which women give gifts and exchange labour in anticipation of reciprocity. Girls begin to learn about the duties, debts, rights and obligations of this web of exchange relationships at a young age.

Exchange relationships, gift giving and ethics of generosity are also at the centre of *Enga* society (Papua New Guinea agriculturalists). While husbands negotiate most exchange ties and are visibly at the centre of gift-giving ceremonies (called *tee*), the relationships are sustained by women who are largely responsible for raising the pigs and other goods that are the main source of wealth, and used as commodities for exchange and gift giving. *Enga* women also develop reciprocal partnerships with other women.

The hierarchy of *Enga* exchange ceremonies functions similarly to potlatch among Northwest Coast hunter-gatherers. During small exchanges between families, potlatches secured goods that are then used at larger and larger aggregate levels, involving clans, villages, even tribes and hundreds of people [218]. Similar to *Enga* *tee* ceremonies, it is women who collaboratively produce many of the prestige goods.

Agta women (Pilipino hunter-gatherers) have formalized trading partners with local agriculturalists with whom they exchange meat for roots and grain, metal, cloth, beads, tobacco or other goods [165]. While both men and women have trade partnerships, women often are known as the most active and competent negotiators. Likewise, while trading partnerships among men are usually highlighted, many American Great Plains ethnographies mention women's female trade networks, and point to women as the successful barterers.

(e) Women's institutions, societies and sodalities

Female sodalities exist in many small-scale populations, integrating women and girls across residential units, camps, villages, tribes and at larger scales for a wide range of political, religious, economic and social purposes. Often these institutions function to socially strengthen bonds across families and kin groups [177], to aid the sick, old and widowed, or to coordinate activities at group gatherings. Some women's societies have been described as resembling guilds, such as the *Lakota* (northern American Great Plains) quillworkers [219].

In many small-scale societies, political authority is rare; there are no specialized bodies or offices, no central authority and leaders cannot issue commands expecting that others will follow. In these societies, women often organize in age-graded or life stage (e.g. widows) cohorts. For example, *Tiwi* women (North Coast Australia hunter-gatherers), as among many Australian Aborigines, belong to number of matrilineal organizations, such as sibling sets, age sets, phratries and moieties, that represent layers of exclusive group identity, cohesion and loyalty [183].

In those small-scale societies where centralized political roles and bodies do exist, while women seldom hold office, this can be deceptive. Among the *Mehinaku* (Native South American horticulturalists), although most attention has been on men's political and public displays, women have equivalent political and ritual institutions where a female chief presides over women's intertribal rituals [184]. The *Enga* have two levels of social organization: the patrilineal-patrilocal clan that holds men together as a group and within which individual men compete for position based on their status in exchange and ethics of generosity, and a corresponding level of exchange and status relationships among women and affines [177].

In other examples of women's collaborative political organization, the *Igbo* (African agriculturalists) are patrilocal and exogamous, such that the adult women in a community are composed of those who have married in, or have returned to their natal village after being widowed or divorced. Women, many of whom are not related, convene in village-wide meetings (*mitiri*) to decide on trade regulations and market exchange rates, and to vet domestic and spousal disputes. A main function of *mitiri* is to collectively agree and relay the women's group decisions to their spouses. Individual women may not be able to compete with men

economically, but they collectively hold their own by boycotting or striking as a group (refusing to make food, or do domestic chores) if husbands are found to violate certain ethics [220]. Among the Great Plains hunter-gatherers, when large groups aggregated during the Sun Dance, women's societies met to reaffirm their bonds and perform ceremonies [172].

Men are doubtlessly more visible as collective actors in the context of formal institutions. However, it is difficult to know the extent to which female sodalities are less notable because of under-reporting (male ethnographers having less access to women and women's organizations), or because many traditional female institutions broke down during colonialism. Colonialization in many cases disrupted female political, social, ritual and economic engagement, excluded women from decision making, and minimized their status and visibility in the social fabric [220,221].

Filling this wake, however, women organize and cooperate in new ways. Examples are global trends in women's evangelized church groups and the re-emergence of women's work, craft and lending collectives common in market integrating and emerging economies. Yucatec Maya women have a central role in consolidating individual interests in collective organizations that facilitate producing goods for market [16]. Another example is the collective organization of women that commonly occurs with the introduction of mechanized technology, such as grain grinders and water pumps, which have great advantages in saving women time but are too expensive for any one individual to afford [222]. In Mali, a multipurpose collectively owned diesel-powered peanut grinder, referred to as 'the daughter-in-law who doesn't speak' [185, p. 248], fosters collective efficiency among villagers by saving individual women many hours of grinding work per day.

(f) Female coalitions

Female coalitions often are assumed to be weak in human societies and counterbalanced by strong male coalitions [45]. There are, however, notable exceptions where women cooperate to intervene against male aggression [77,188–191,223]. Among *Mangrove Australian Aborigines* (Arnhem Land, Northern Australia), groups of women take up the cause of other women, supporting and assisting them in conflicts that may be verbal, or escalate to physical confrontation [192, pp. 125–126]. In cases of infidelity or a husband wanting to take on additional wives, the man's mother, sisters and other female relatives may rally to support the wife. Matrilineal Navajo women form female bonds that remain strong throughout life, and are invoked during spousal disputes [180]. Kerns [189] describes *Garifuna* (Caribbean mixed economy) neighbours assisting women against male aggression. *Wape* women (Pagua New Guinea horticulturalists) have low levels of domestic violence, which is attributed to the strong village-wide female bonds that help dampen spousal conflict [188]. Marakwet women (Kenyan agriculturalists) are described as clubbing together to chastise and beat, verbally and physically, husbands who have harmed their wives [212].

The Enga have a formalized and ritualized venue for competition among women during courtship. During traditional dances and male initiations when hundreds of Enga gather, groups of courting aged boys and girls publicly compete for favours [177]. During ceremonial exchanges, Enga girls

engage in a ritualized competition where a group of girls seeks to advance one of their love interests by competing with other groups for the attentions of the girl's intended [224,225].

(g) Female social networks

Social network models are a statistical and graphical tool that have been recently used to observe the structure of women's affiliative relationships. Ties of association are usually drawn from name nominations or photo selections elicited from participants in response to questions that free list, for example, who one's friends are, to whom one would give or receive help, borrow or loan food, goods or money [226–228]. The web of ties that is consequently generated builds a picture of affiliations among women who may exchange resources or reciprocate support.

Expectations of sex differences in social networks, largely developed in psychology, have been posited to stem from two evolutionary roots. One is seen to arise from differences in reproductive biology [229]. Because mothers provide much of the *primary childcare* (breastfeeding, holding, carrying), women are expected to invest in activities that do not conflict with competent childcare [224,225], and as such invest in social relationships that facilitate their role as caretakers [230]. Female peer sociality is often further argued to be influenced by female dispersal and patrilocalty [32,74]. While dispersal patterns underlie the potential for affiliative relationships [79], as discussed above, patrilocalty cannot be assumed to be the human ancestral or current norm.

By contrast, male peer sociality is expected to issue from evolved propensities for coalitionary support to aid in hunting, within-group dominance hierarchies and group defence [1]. These differences favour men to seek relationships that are oriented to the larger group, while women favour more intimate dyadic relationships, and smaller, denser networks [74,82,231,232].

Support for this gender-driven view of social networks largely comes from studies in industrialized settings where the association index is friendship and ties are generated from social media databases. The few analyses of female networks in small-scale societies challenge the view that gender *per se* is a determinant of network structure. Rather, female networks appear to be flexible and adapt to local social environments. For example, indigenous *Mosuo* (agriculturalists in southwest China) descent rules vary such that some communities are matrilineal and others patrilineal [233]. In a test of how gender-fixed networks structure is, the study found that differences between matrilineal and patrilineal communities were greater than between men's and women's networks. This makes the compelling case that the socio-environment, rather than gender, has a more salient influence on observed differences [102]. To this point, population structure and household demography also are found to structure social ties [79].

Recent analyses of market integration give insight into women's cooperative relationships under changing socioeconomic conditions. In a rural Yucatec Maya village, the majority of families are subsistence farmers, although some households have abandoned farming and make a living by wage labour. Multilevel analyses show that living in a wage labour household did not affect the size of women's visiting or helping networks, suggesting that in a transitioning economic environment, women play a central role in

sustaining local support relationships [234]. A similar effect of market integration was found in rural Poland where farmers are transitioning between small-holder farming and a labour-market economy. In households that were more market integrated, the kin density in women's friendship networks was reduced, but not the overall density of their network [235]. Another study with the Maya showed that, while households that help each other are often closely related, a portion of supportive helping relationships are between households with no kin or affinal affiliation [236]. An example of the women's role in maintaining community ties is the daily exchange of equal-sized food servings across families; mothers give children a bowl of their midday meal to deliver to a neighbouring household, who receive the food and refill the bowl with a serving from their midday meal [16]. Although there is no net gain, the exchange reifies ties among women.

While network analyses of cooperation in other animals are based on the time individuals spend in proximity to others, in human studies association indices are often constructed from name nominations. Networks drawn from this method are suggestive of reciprocal support. However, whether women actually cooperate or exchange resources is unknown (the few network studies that track resource flows are not specific to female networks [237,238]). Corroborating behavioural observations are needed to push forward understanding key trade-offs in cooperation, and the costs and benefits of aiding others.

(h) Summary

Several summary observations can be drawn from the ethnographic record. (i) Women who form a commensal group work together in domestic production. (ii) But cooperation also extends far beyond the commensal groups; women aggregate and coordinate their activities across households and communities. Inter-household cooperation is commonly reported when there is a time constraint to complete the activity (as in harvest or processing seasons), when the technology to accomplish a task is facilitated by women working in groups, or when food or nonfood items are produced for collective actions that integrate large groups. (iii) Although it is unclear how common female sodalities were in the non-domestic sphere in the past, numerous examples exist. Women's institutional cooperation and collaboration are well documented in several regional ethnographic surveys [158,239], suggesting that they may be more common than often characterized. (iv) Although men often take visibly central roles in ceremonial, political and social institutions, many examples show that women have comparable cooperative roles.

5. Conclusion

The ethnographic record contains bountiful detailed observations of female domestic cooperation, as well as

underappreciated accounts of women's spheres of influence and collective activity across political, ritual, social and economic domains. Institutional cooperation may have been less formalized for women, although the extent to which this reflects reporting bias in who collected ethnographic data up until the mid-twentieth century is unknown.

The value of older ethnographies remains an important heritage of anthropological research and often offers the only empirical glimpse into women's cooperative behaviours prior to the recent accelerated pace of market integration. I have highlighted a small fraction of these examples to demonstrate that gender-typical stereotypes are not reflective of the ethnographic record, and should be rethought.

Various theoretic traditions have contributed to ideas about how female cooperation and conflict shapes women's and girl's sociality. Discussed here were sexual selection, cooperative breeding and life-history theories, social network and reproductive conflict studies. These traditions have tended to focus on cooperation directed toward women's reproductive concerns. Assumptions about the predominance of male philopatry and patrilocality in the human past further underlie many false assertions about the limited nature of female cooperation. The overemphasis on the centrality of male cooperation in shaping human sociality ignores the abundant ethnographic evidence that women and girls cooperate across domains and at scales comparable to that of men and boys.

It is clear from the empirical record that cooperation is not simply gender determined. In reconsidering gender stereotypes, productive next steps lie in developing predictions about sources of variation and conditions that favour or constrain female cooperation. Research in evolutionary biology suggests that dispersal patterns, mating systems, the concentration of breeding females and kin contact are important variables. Specific to humans, rigid patrilocality and patriarchy, unrelated cowives, heritable wealth, institutionalized male status competition and male coercive norms may attenuate the scope of female cooperation. However, these circumstances represent a very limited view of the cross-cultural diversity of human social organization now and in the past.

Hunted food, male parental investment and coalitionary support have dominated evolutionary speculation about what shaped human sociality. As broad-spectrum cooperators whose cooperative tendencies develop very early in life, discussion around the evolution of human sociality merits a shift to more inclusive thinking. Cogent synthesis and evidence-driven ethnographic support are needed to dispel common assumptions and construct useful predictions about variation in female cooperative behaviour.

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