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Repercussions of patrilocal residence on mothers' social support networks among Tsimane forager–farmers

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While it is commonly thought that patrilocal residence is associated with worse outcomes for women and their children due to lower social support, few studies have examined whether the structure of female social networks covaries with post-marital residence. Here, we analyse scan sample data collected among Tsimane forager–farmers. We compare the social groups and activity partners of 181 women residing in the same community as their parents, their husband's parents, both or neither. Relative to women living closer to their in-laws, women living closer to their parents are less likely to be alone or solely in the company of their nuclear family (odds ratio (OR): 0.6, 95% CI: 0.3–0.9), and more likely to be observed with others when engaging in food processing and manufacturing of market or household goods, but not other activities. Women are slightly more likely to receive childcare support from outside the nuclear family when they live closer to their parents (OR = 1.8, 95% CI 0.8–3.9). Their social group size and their children's probability of receiving allocare decrease significantly with distance from their parents, but not their in-laws. Our findings highlight the importance of women's proximity to kin, but also indicate that patrilocal residence *per se* is not costly to Tsimane women.

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

1. Introduction

Relative to birds and other mammals, humans have particularly flexible patterns of dispersal from natal communities [1–4]. There is wide cross-cultural variation in where married or cohabiting couples decide to live relative to their parents, which may also change over the lifespan, resulting in women being closer or further away from members of their biological family [5–8]. During their reproductive years, women often rely extensively on the support of others, especially close kin, to raise multiple dependent children [9–11], especially in high-fertility

populations. Women's ability to leverage support in the form of direct childcare support and provisioning of labour and resources may explain the relatively short interbirth-intervals for our species despite a much longer juvenile period compared to other great apes [9,10,12]. Accordingly, various studies suggest that access to close kin during a woman's reproductive career promotes her reproductive success [13–16]. Yet, little empirical work has examined how post-marital residence affects women's available social networks, despite post-marital residence significantly affecting women's interactions with their close kin.

In patrilocal societies, where women leave their natal homes to join their husband's natal community after marriage, women may not be able to extensively rely on the support of their parents and siblings. Although in-laws can also provide familial support, they may be less inclined to invest in their sons' children due to paternity uncertainty [17–19]. Cross-culturally, there is evidence that a woman's biological kin—especially her mother—tend to invest more care and resources in herself and her children relative to her in-laws, and their presence is consistently predictive of improved child survival and growth [13,19,20]. Paternity uncertainty may also favour social norms that encourage spouses and in-laws to restrict or control women's mobility or social connections [21–23]. Because in-laws are genetically related to a woman's children but not to the woman herself, women may experience additional pressures and expectations in patrilocal settings, even in contexts where paternity certainty is high [24]. For instance, affinal kin may be more likely than biological kin to pressure women to produce more children than they wish [23,25], or to generally discount the importance of women's health and wellbeing [17,26]. Violence perpetrated against women by in-laws is also not uncommon in some cultures characterized by patrilocality, resulting in femicide in extreme cases [21,24,27–30]. Consistent with this view, studies based on population-level comparisons find that poorer outcomes for women's autonomy and agency are more likely to be concentrated in patrilocal settings; for instance, cross-regional comparisons based on national demographic surveys consistently find that patrilocality is associated with reduced freedom of movement, lower involvement in economic and healthcare decisions, and reduced labour force participation for women [22,31–35].

Although some empirical evidence suggests that patrilocal-ity can be associated with women experiencing more limited access to social ties and support networks, the causal effects of post-marital residence may be confounded by concurrent patriarchal norms impacting women's social lives and outcomes in some, but not all societies where patrilocal residence is normative. Gender norms and norms surrounding women's autonomy greatly influence the nature of the relationship between women, their spouses and their in-laws, as well as the potential for conflicting reproductive interests to result in women being isolated or experiencing violence in patrilocal societies [24]. Although patriarchal societies are generally characterized by patrilocal post-marital residence, the reverse is not always true. In various patrilocal societies, women maintain a high degree of autonomy and may continue to foster their kin networks and other social networks via frequent travel and visitations [20,36,37]. Furthermore, post-marital residence is an imperfect indicator of women's relatedness to community members and access to kin support. In societies that practise reciprocal community exogamy or favour

marriage between close or distant kin such as cross-cousin marriages, women may find themselves surrounded by biological kin despite residing in their husband's communities [38]. Women's relatedness to community members in patrilocal settings also has the potential to increase over time the more children and grandchildren they produce irrespective of the extent to which they maintain ties to their natal communities [8]. Cross-population comparisons of patrilocal and matriloc societies may, therefore, not be able to distinguish the relative importance of post-marital residence, access to biological kin and social norms restricting women's freedom of movement or ability to develop social support networks [39,40]. And though social isolation and resulting vulnerability are commonly hypothesized to be an important mechanism by which patrilocality leads to poorer outcomes for women, few studies have directly investigated the effects of post-marital residence on women's social support networks. Notable exceptions include Power & Ready [38] who examined whom individuals call upon for help in two South Indian Tamil villages where patrilocality is the norm, but where marriage among close kin often means many women remain in their natal community. They found individuals—including women—residing in their natal community have slightly larger social networks than individuals residing further away from their kin, but that women who do not reside in their natal community rely nonetheless heavily on their in-laws for support. Another study focusing primarily on allocare among ambilocal Aka foragers found no significant effects of post-marital residence [41].

Here, we examine whether post-marital residence patterns affect the size of women's social groups (i.e. individuals in close proximity or in conversation) and activity partners (i.e. individuals engaging in the same activity), as well as their access to alloparental childcare, among Tsimane forager-farmers in lowland Bolivia. Tsimane are an ideal study population because families are ambilocal (i.e. couples may settle in either the husband's or the wife's community) and have no strong norms for post-marital residence. Therefore, we can compare within a culturally homogeneous population the size of women's networks in four different post-marital residence settings: patrilocal (when spouses live in the husband's and his kin's community), matriloc (when spouses live in the wife's and her kin's community), neolocal (when the spouses live in neither the husband's nor the wife's community) and bilocal (when both spouses are from the same community). We leverage a rich behavioural scan sampling database which records the location, activity and proximity to others of individuals at 30 min intervals, averaging 66 observations or 33 h of observations per individual in our sample. We count the number of people in women's social and activity groups at each observation and record how many are engaged in the following activities associated with social or material support: (i) resource acquisition (hunting/fishing/gathering); (ii) manufacturing market or household goods; (iii) field and wage labour; and (iv) food processing and preparation. Finally, we measure how often children receive childcare from people other than their parents or siblings.

Given the well-documented cross-cultural matriloc bias in childcare [20] and the importance of biological kin as sources of support among Tsimane [42], we expect women in matriloc settings to have larger social groups and more activity partners than women in patrilocal or neolocal settings. If women living with or near their husbands' families and

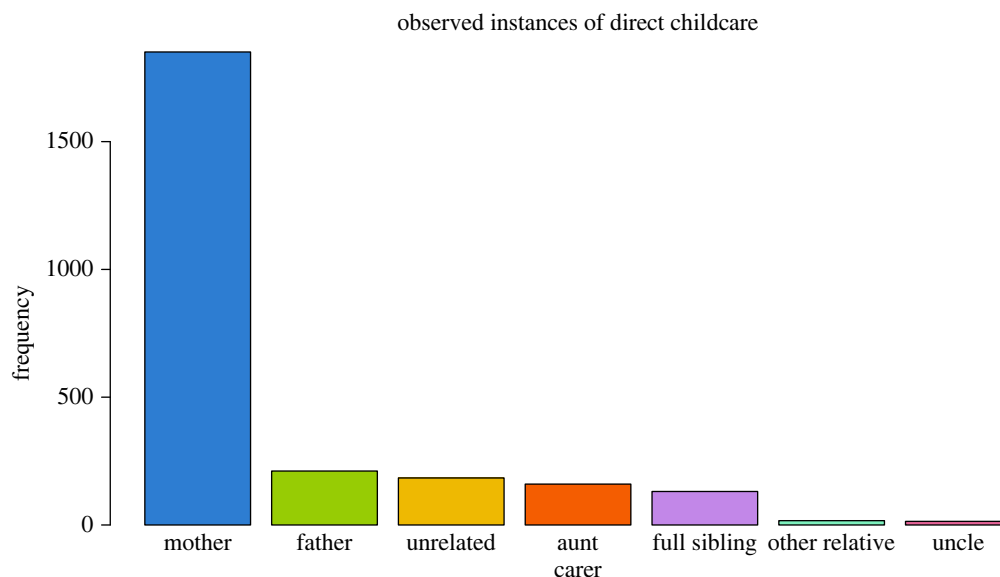


Figure 1. Observed instances of direct childcare by the relationship of the carer.

away from their own are significantly isolated, we expect patrilocality and proximity to in-laws to be associated with women having fewer social partners than either matrilocality or neolocality.

However, because of the potential for in-laws to also provide support [16,38,41], social group size and number of activity partners could be even greater for women in bilocal settings, where women live near both their parents and in-laws.

2. Study population

Tsimane reside in lowland Bolivia, Beni department, in more than 90 villages ranging in size from approximately 50 to 500 residents. Related nuclear families often live in nearby groupings of single-family houses. Tsimane subsistence depends heavily on slash-and-burn horticulture (e.g. rice, plantains, sweet manioc) supplemented by fishing, hunting and gathering. Each family or group of families maintains its set of one or more fields and is economically independent. Men are responsible for clearing and burning fields as well as hunting, while both men and women weed fields, harvest and fish. Although the great majority of Tsimane diet comes from subsistence activities, market items such as salt, sugar and vegetable oil are commonly bought from itinerant merchants or in town with cash earned from wage labour, sales of cultigens, wood and thatched roof panels weaved by women [43].

Fertility among the Tsimane is high. Women have on average nine children by the end of their reproductive career and assume most childcare responsibilities [44,45] (figure 1). In addition to childcare, activities typically conducted by women include preparing and processing food, for example: pounding and dehusking rice, preparing wild game or livestock, cooking and producing *chicha*, a fermented drink made with sweet manioc, corn or bananas served in most social settings. Women also engage in various domestic tasks and produce crafts for sale or domestic use, such as woven baskets, bags, clothing and thatched roof panels.

Most Tsimane marriages are monogamous and divorce is relatively rare despite being widely accepted for both men and women [44]. Although there are no strict rules of

post-marital residence, newlyweds often reside near the wife's kin for 1 or 2 years. During this time, the husband commonly engages in bride service for his in-laws. After a few years, the couple and their children may relocate near the husband's kin or in a new community, and the family might continue to change residence within and between villages over time, often in response to new socioeconomic opportunities or conflict [46].

This study was conducted as part of the Tsimane Health and Life History Project (THLHP), an anthropological and biomedical project operating in Tsimane communities since 2002 [47]. All data collection procedures were approved by the IRB at the University of California-Santa Barbara, the Tsimane governing council (Gran Consejo Tsimane), village leaders in community meetings and study participants.

3. Methods

Data collection took place between March 2002 and November 2007 in nine separate Tsimane communities. In each community, households were sorted into clusters of multiple physically close houses from within which researchers could easily monitor the activity of all inhabitants. Clusters were then selected for data collection at random without replacement until all clusters were sampled. Data collection involved monitoring each member of the cluster households for 2–3-h blocks between 07.00 and 19.00, with point scans every half hour. During point scans, the location, activity and objects of the interaction of each individual was recorded. Individuals were coded as being in the same social group if they were either (i) engaged in active conversation or (ii) within 3 m of each other, and in the same activity group if they were engaged in the same activity. When household members from the sampled cluster were absent, their whereabouts, activity and (where possible) companions were ascertained by asking their family members.

For this analysis, we selected scans of mothers of children under the age of 14, excluding visitors to the communities. This resulted in a total sample of 11 940 observations of 181 Tsimane women, ranging in age between 15 and 59 with an average age of 32 (table 1). For each woman's scan we examined the list of individuals aged 14 or over who were in (i) her social group or (ii) her activity group during the scan, excluding her husband and children. From this list we then calculated the

Table 1. Descriptive statistics of women by residence.

residence	patrilocal	bilocal	matrilocal	neolocal	total
no. women	41	53	48	39	181
no. children < 7	81	105	97	74	351
average woman's age	30.3	28.9	30.4	38.8	31.7
mean %R in community (s.d.)	0.9 (1.2)	4.2 (3.3)	4.7 (4.2)	1.7 (2.3)	3 (1.2)
mean husband's %R (s.d.)	5.5 (5.09)	4.3 (2.88)	1.8 (2.29)	2 (1.75)	3.4 (5.09)
mean distance to parents in km (s.d.)	20.5 (19.6)	0.6 (1.4)	0.4 (1.3)	17.3 (23.3)	6.5 (19.6)
mean distance to in-laws in km (s.d.)	0.66 (1.7)	1.02 (1.9)	38.37 (29.4)	27.8 (22.2)	14.95 (1.7)
no. with complete parental GPS data	21	41	39	17	83

total number of individuals engaged in: (i) any activity; (ii) hunting, fishing or gathering food; (iii) manufacturing cloth, bags or jatata thatch; (iv) garden labour or wage labour; and (v) processing or preparing food. Next, we selected observations of the children under the age of 7 years, which corresponds to the age range when Tsimane children require most supervision. This amounted to a sample of 21 938 observations of 351 children (52% male). Children were coded as receiving extra-familial childcare either if they were recorded receiving direct care (e.g. holding, playing, feeding, teaching, etc.) or if they were engaged in some social interaction with an individual 11 years or older, at which age we determined any social interaction with a child under 7 years could be reasonably construed as childcare based on ethnographic insights and existing literature in traditional societies [48,49]. Siblings were excluded as providers of childcare in this analysis since their presence is not tied to the post-marital residence choices of their parents. Because Tsimane adults often supervise children passively rather than actively caring for them, we also tested whether residence patterns affected children's probability of being unsupervised, which we coded as being in a social group with no adults.

The post-marital residence choices of the women in our sample were coded in two ways. First, we categorized the women as being either patrilocal, matrilocal, bilocal or neolocal based on the known residences of their parents and parents-in-law, following Gruijters & Ermisch [50]. Couples for whom no information existed for either set of parents were assigned according to the presence of siblings in their home community. Accordingly, women coded as neolocal lived in communities where none of their or their husbands' nuclear family lived. Bilocal families had at least one parent of each of the husband and the wife living in the same community. As a robustness check, we also analysed a subsample of families for whom GPS data existed for at least one parent of both the husband and the wife. Starting in 2007, the THLHP and its collaborators have collected GPS data for every household, which we used to reconstruct a subsample of the households where data were collected. When the precise GPS location was unavailable, but the community was known, which generally occurred when the parent or in-law lived in a non-sample community, we took their location to be the central point of their community, which given the distances between communities is a fairly accurate estimate on the log scale. This subsample included 83 women and 180 children, which corresponds to approximately 50% of the total sample. Using these data, we were able to model women's social group size and children's probability of receiving allocare as a function of the (ln-transformed) distance from the woman's parents (the child's maternal grandparents) and her in-laws (the paternal grandparents).

All analyses were conducted in R v.4.1.2. We fit generalized linear multilevel models (GLMMs) using the `glmmTMB` package,

which allows for mixed-effect hurdle and zero-inflation models. To account for the possible overdispersion of the count data, specifically the observed size of women's social and activity groups, we compared multilevel Poisson, negative binomial and zero-inflated Poisson models, all adjusting for mothers' age, age squared and the time of day of the observation block (morning or afternoon), with random intercept terms to control for repeated observations of individuals as well as the communities. Mother's age was selected because of its possible causal influence over both residence and social group size. Including age squared significantly improved model fit according to likelihood ratio tests ($\chi^2 = 9.06$, $p = 0.011$). Time of day also had a significant effect on group size in many models, and due to sampling randomness may have varied across residence patterns, so was included in the model as a control.

Likelihood ratio tests confirmed that the zero-inflated models were much better fit to the data than Poisson and negative binomial models (electronic supplementary material, table S1). Accordingly, each model fit two sets of parameters, one for the zero-inflation component and one for the count component. For the analyses of children's probability of receiving non-sibling childcare, we fit multilevel Bernoulli logit models controlling for child's age, with random intercepts terms for the child's ID, their mother's ID and the community.

4. Results

Relative to women in patrilocal settings, women in matrilocal settings are less likely to be observed with no-one in their social group (excluding husbands and children) at any given time (odds ratio (OR): 0.56, 95% CI: 0.34–0.90) (figure 2; electronic supplementary material, table S2), although there is no evidence that their social groups are larger when they are not alone or solely in the company of their husbands and children (rate ratio: 1.08, 95% CI: 0.82, 1.42) (figure 2, electronic supplementary material, table S2). Breaking these social groups down into specific activities, we find strong evidence that women in matrilocal settings are more likely to be observed with at least one person engaging in manufacturing (OR of no-one manufacturing: 0.19, 95% CI: 0.07–0.47) (figure 2, electronic supplementary material, table S2), and weaker evidence—no longer significant after correcting for multiple tests—that they are likely to be observed with people preparing or processing food (OR of no-one preparing food: 0.20, 95% CI: 0.04–1.00) (figure 2, electronic supplementary material, table S2). However, there is no evidence that women's social groups differ in the number of people engaged in either garden and wage

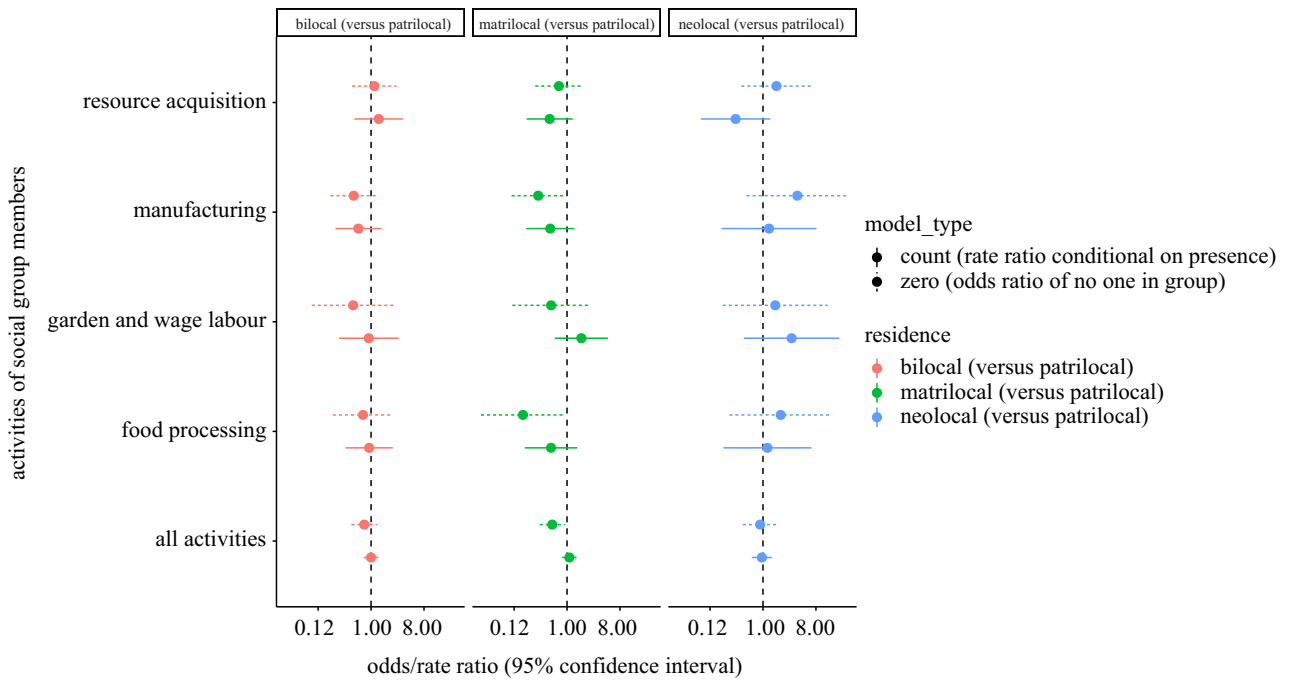


Figure 2. Model estimates from zero-inflated poisson generalized linear mixed models of women's social group size as a function of post-marital residence. Outcome variables are number of people observed during a scan in women's social group engaged in: any activity; resource acquisition (i.e. hunting, fishing or gathering); manufacturing; field or wage labour or processing/preparing food. All models control for age, with random intercepts for women's ID and community. See electronic supplementary material, table S2 for full parameter estimates.

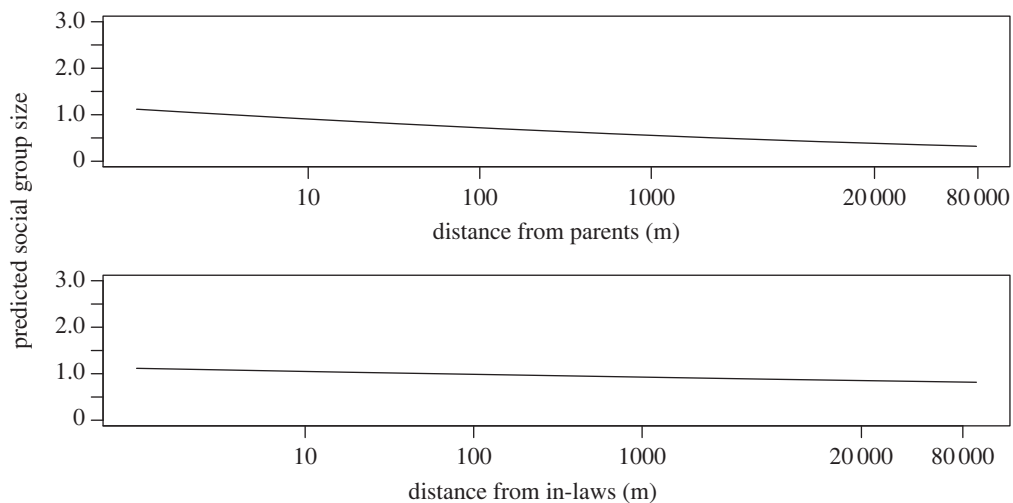


Figure 3. Marginal predicted effect of living further away from parents (top) and parents-in-law on social group size. Plotted points represent partial residuals. See electronic supplementary material, table S4 for full parameter estimates.

labour, or resource acquisition (figure 2, electronic supplementary material, table S2). Furthermore, when we look at activity groups—i.e. groups of people engaged in the same activity as opposed to simply in proximity or conversation with each other—we find no association between group size and post-marital residence across any of the activity types (electronic supplementary material, table S3).

Surprisingly, while women in matrilocal settings are less likely to be alone relative to women in patrilocal settings, women in bilocal settings (i.e. who lived in the same community as both their own and their husband's parents) are not (figure 2; electronic supplementary material, table S2). Women in bilocal settings tend to live further away from

their parents than women in matrilocal settings (643 m versus 414 m on average; table 1), which may explain this result. For the subsample of women for whom we have parental GPS data, a woman's average social group size is significantly negatively associated with distance from her parents, but not her in-laws, in a model controlling for age and time of day (figure 3; electronic supplementary material, table S4).

Looking at children, we find generally very low levels of alloparenting. Mothers are the carers in the vast majority (72%) of observed instances of childcare (figure 1), followed distantly by fathers (8%). Siblings provide childcare in 5% of cases, while non-sibling childcare is provided primarily

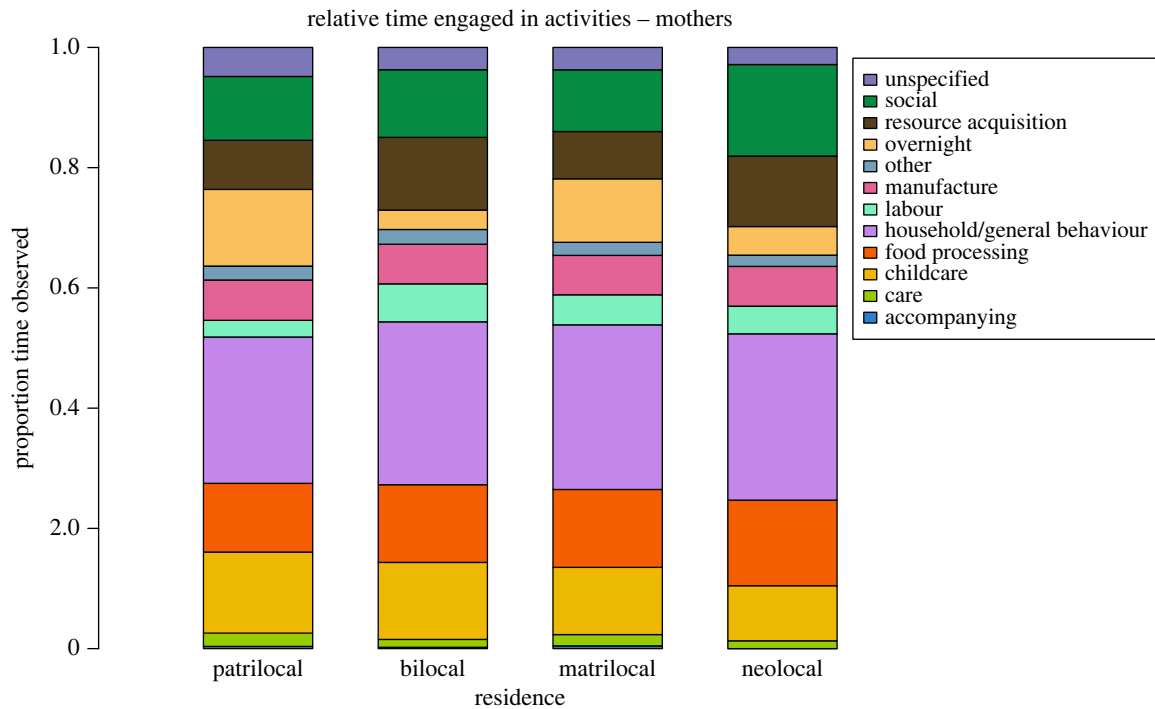


Figure 4. Relative time mothers are engaged in different activities by post-marital residence type (11 940 observations; 181 mothers). (Online version in colour.)

Table 2. Bernoulli logit generalized linear mixed model of children's distance to maternal and paternal grandparents on the probability of receiving direct childcare (excluding from parents and siblings), including random intercepts for ID, mother's ID and community.

<i>dependent variable: probability of receiving non-sibling childcare</i>				
	log-odds ratio	standard error	odds ratio	95% CIs
distance to maternal kin	−134	62	0.87	0.77–0.99
distance to paternal kin	66	69	1.07	0.93–1.22
age (centred on mean)	−486	82	0.62	0.52–0.72
constant	−4.752	777	0.01	0.00–0.04
number of observations	11 313			
log likelihood	−927.926			

by unrelated individuals (7%) and aunts (6%) (figure 1). Surprisingly, there are no observed cases of grandparents providing direct childcare to their grandchildren (figure 1). Relative to patrilocal settings, women in matrilocal settings are less likely to be engaged in active childcare at any given observation, controlling for their age and their number of children under the age of 7 years (OR: 0.68, 95% CI: 0.45–1.02) (figure 4, electronic supplementary material, table S5). Furthermore, children are approximately 50% more likely to receive (non-sibling) childcare in matrilocal versus patrilocal settings, although there is a large amount of uncertainty (OR: 1.51, 95% CI: 0.71–3.10) (electronic supplementary material, table S5), likely because of the low numbers of observed cases of extra-familial childcare (figure 1). However, looking at the subset of children with data on distance to grandparents, we find a statistically significant negative effect of distance from maternal grandparents on the probability of receiving alloparental care (OR: 0.87 for each log-metre increase in distance, 95% CI: 0.77–0.99) (table 2), but not from paternal grandparents (OR: 1.07, 95% CI: 0.93–1.22) (table 2). In other words, children who live closer

to their maternal grandparents are more likely to receive childcare, but the distance from paternal grandparents is not associated with childcare. On the other hand, we find that children in patrilocal settings are significantly less likely to be in a social group unsupervised than in any other setting (electronic supplementary material, table S5).

5. Discussion

Patrilocal post-marital residence is commonly associated with poorer outcomes for women and their children in studies based on population-level comparisons of patrilocal and matrilocal societies. Lack of kin support is a commonly hypothesized pathway through which patrilocal settings hinders women's autonomy and wellbeing. However, patrilocal post-marital residence norms and patriarchal social norms often co-occur, making it difficult to tease out their effects independently. Moreover, the cross-culturally well-documented matrilineal bias in grandparental investment suggests patrilocal settings are *a priori* a suboptimal form of social

organization for women [13,20]. Yet many studies have shown that under certain circumstances, women living in patrilocal settings are not at a disadvantage compared to women living near their biological kin [14,15,38]. Here, we focus on a single and culturally homogeneous society where, despite a pronounced sexual division of labour, women's mobility is not restrained and post-marital residence patterns are flexible. We compared the size of women's social groups (i.e. individuals in close proximity or in conversation) and activity groups (i.e. individuals engaging in the same activity) in various post-marital residence settings among Tsimane forager–farmers using a large behavioural scan sample database.

Consistent with research showing matrilocality has positive effects on women's access to helpers and support, we found that Tsimane women living in matrilocal settings are more likely (80% higher odds) to be observed in close proximity or in conversation with people other than their husband or children relative to women in patrilocal settings (figure 1, electronic supplementary material, table S2), and possibly receive more help with childcare (electronic supplementary material, table S5). Importantly, however, the magnitude of these effects is small. For example, 25-year-old women living matrilocally are predicted to have an average social group size across observations of 0.68, compared to 0.45 if they live patrilocally.

While we expected that women living in bilocal settings would have the largest average social group size or the highest number of social interactions, we did not find that in our results (figure 2, electronic supplementary material, table S2). One possible explanation is that women in bilocal settings live slightly further away from their parents than women in matrilocal settings. Another possible explanation is that some women residing bilocally are endogamously married, and therefore may be a self-selected subsample with fewer extra-community connections and smaller social network size.

While women residing in neolocal settings were found to have the smallest average social group size and the fewest social interactions, these effects are entirely driven by their relatively older age (electronic supplementary material, table S2). Older women may be more likely to move away from both their own and their husband's natal community due to greater self-sufficiency and a lower burden of childcare. Consistent with this interpretation, we also found that children in neolocal settings are less likely to receive childcare due to their relatively older age (electronic supplementary material, table S5). Interestingly, women residing neolocally are on average more related to community members than their husbands, suggesting they are able to maintain kin networks at least as well as their husbands in these settings (table 1).

We found no evidence that the number of people women engage in productive activities with—resource acquisition, manufacturing, food preparation or field and wage labour—differs across residential settings (electronic supplementary material, table S3). However, because of high levels of sharing in Tsimane communities [42], a woman may also benefit from others engaging in these activities nearby, even if she is not herself participating. For instance, a woman may be engaged in childcare while her mother prepares food for the whole family. As a result, we also examined differences in the number of people engaged in productive activities in close proximity to women. We found no association with residence for field and wage labour or resource acquisition, but some evidence that women in matrilocal settings are more likely to be in

the company of people when engaged in food processing (although this lost significance after correcting for multiple tests) and manufacturing. Among Tsimane, food preparation and manufacturing are the most heavily female-biased activities after childcare (figure 5*a*), and the activities most likely to be undertaken by relatives of the wife rather than the husband (figure 5*b*). Our results suggest Tsimane women in matrilocal settings may especially benefit from the presence of female kin and help with female-biased activities. Among Tsimane, manufacturing and the preparation of food and chicha are highly social activities during which women can chat, bond and gossip. They also provide opportunities for younger women to acquire important skills which require expertise and experience to perfect.

We found no relationship between post-marital residence and the size of women's activity groups (electronic supplementary material, table S3). This result may be due to low statistical power. Women were only observed to be engaged in activities with individuals other than their spouses or children in a minority of point scans (only 13%). However, this result highlights that post-marital residence does not have a significant impact on women's day-to-day lives.

Our results further indicate that the community of residence may be a less relevant factor for Tsimane women's social wellbeing than the physical distance from their parents. Both women's social group size and their children's probability of receiving extra-parental childcare were best predicted by geographical distance from their parents, irrespective of post-marital setting (figure 3, electronic supplementary material, table S4). Tsimane communities vary considerably in size and density. More remote communities are often loosely defined and characterized by scattered households. Thus, a woman residing bilocally in a remote community may live further away from her kin than a woman residing patrilocally in a more densely populated community near her natal village. On the other hand, women in matrilocal settings tend to reside closer to their parents than women in bilocal settings, which also helps explain the smaller social groups of women residing bilocally relative to matrilocally.

Women who lived further away from their relatives spent more time engaged in childcare, and their children were less likely to receive non-sibling childcare (table 2). Children in patrilocal settings, however, were less likely to be left unsupervised (electronic supplementary material, table S5). This suggests that patrilocality is associated with different norms for childcare, with less direct interaction with children but a stricter control of movement.

We observed surprisingly low rates of direct alloparental childcare among the Tsimane. Most childcare observations involved the mother herself (72%) (figure 1). None of our observations of direct childcare involved a grandparent (figure 1). In many small-scale societies grandmothers in particular play vital supporting roles in childcare [9,13,51,52], but this does not necessarily involve direct interactions with infants or children [49,51,53]. Among Tsimane and other high-fertility small-scale populations, women experience a relatively fair amount of reproductive overlap with their mothers, which may also help explain the low levels of grandmaternal care [54]. Grandmothers may nevertheless provide crucial help with arduous domestic tasks while their daughters engage in direct childcare [51]. Grandparents can also be important sources of intergenerational transfers of wealth or labour. Although Tsimane grandparents may be involved in little direct childcare, they

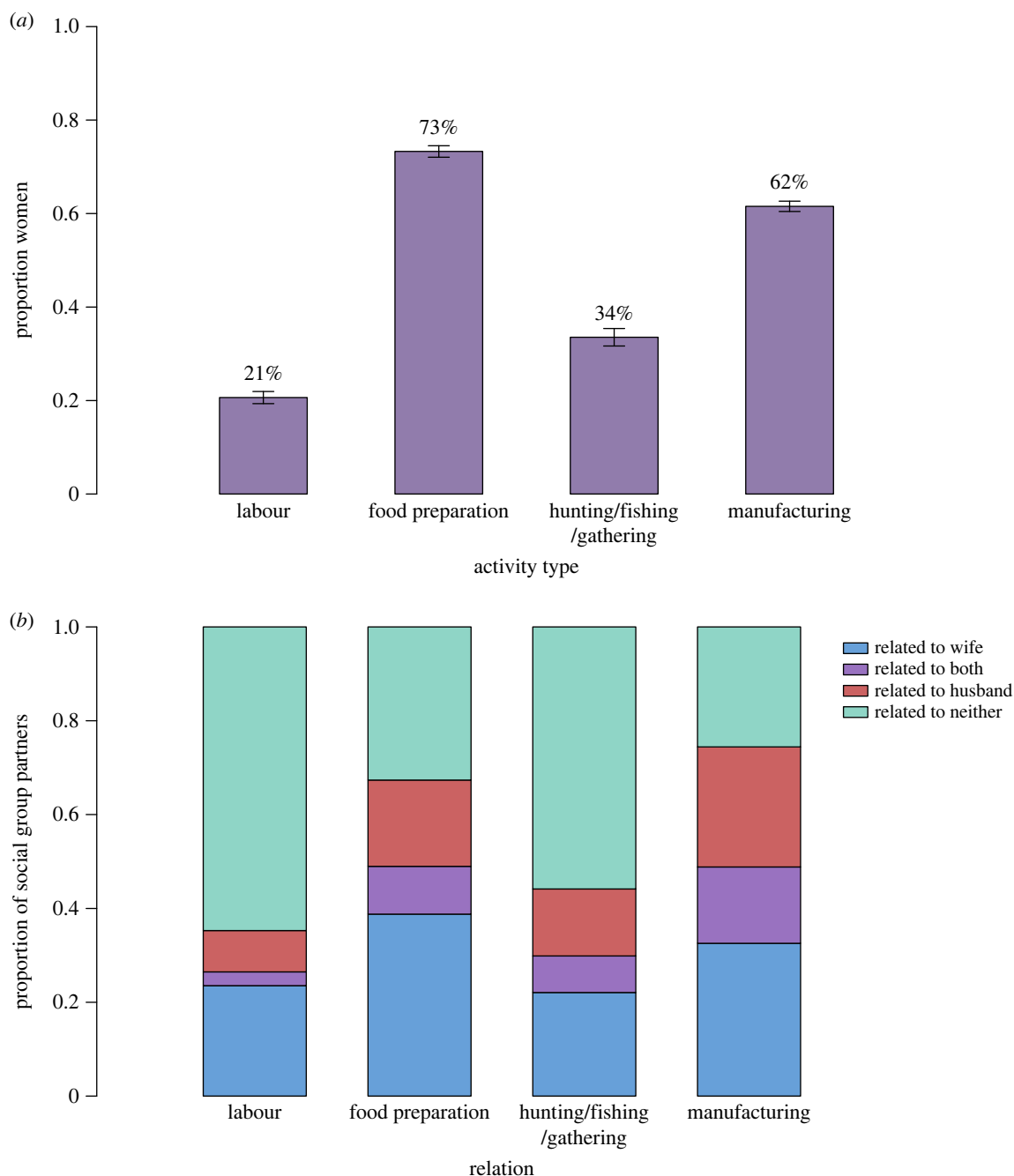


Figure 5. (a) Sex bias of activities. Sex ratio (proportion women) of people observed in the full scan sample engaged in field or wage labour, food processing, resources acquisition and manufacturing. (b) Women's social group partners across different activities by their relation to her. (Online version in colour.)

nonetheless play an important role in provisioning their grandchildren and supporting their parents. Both Tsimane men and women remain economically productive and provide net transfers of resources to their children, children-in-law and grandchildren well into their seventh decade of life [55].

Taken together, our findings suggest a positive effect of kin proximity on women's access to social support, especially with female-biased activities such as manufacturing, food processing and childcare. However, these effects are small, and we find no effect of post-marital residence on the number of activity partners. There is also no negative effect of proximity to, or residence with in-laws, who are important sources of support with food acquisition and other resource production activities (figure 5b). While some patrilocal residential ecologies have the potential to isolate women from their kin and limit their access to social support, our results suggest this is likely due to concurrent patriarchal norms

limiting women's mobility and autonomy, and not a result of patrilocality itself. Parents' presence in matrilineal settings may nevertheless make it easier for women to maintain their premarital social networks, which may have major benefits for women's autonomy, health and wellbeing [56].

Ethics. All data collection procedures were approved by the IRB at the University of California-Santa Barbara, the Tsimane governing council (Gran Consejo Tsimane), village leaders in community meetings and study participants.

Data accessibility. The data and statistical analyses that support the findings of this study are available from the Dryad Digital Repository: <https://doi.org/10.25349/D9KK7B> [57].

The data are provided in electronic supplementary material [58].

Authors' contributions. E.S.: conceptualization, data curation, formal analysis, methodology, visualization, writing—original draft, writing—review and editing; S.A.: conceptualization, data curation, formal analysis, methodology, visualization, writing—original draft, writing—review and editing; T.S.K.: data curation, methodology, writing—

review and editing; H.D.: data curation, investigation, writing—review and editing; A.E.C.: investigation, writing—review and editing; P.H.: investigation, writing—review and editing; L.M.: investigation, writing—review and editing; S.M.: investigation, writing—review and editing; A.V.: data curation; C.v.R.: investigation, writing—review and editing; B.T.: investigation, writing—review and editing; J.S.: investigation, writing—review and editing; M.G.: conceptualization, funding acquisition, investigation, methodology, supervision, writing—review and editing; H.K.: conceptualization, funding acquisition, methodology, supervision, writing—review and editing.

All authors gave final approval for publication and agreed to be held accountable for the work performed therein.

Conflict of interest declaration. We declare we have no competing interests.

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