Who helps Tsimane youth?

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Abstract: We examine various forms of helping behaviour among Tsimane Amerindians of Bolivia, focusing on the provision of shelter, childcare, food, sickcare, cultural influence and traditional story knowledge. Kin selection theory traditionally explains nepotistic nurturing of youth by closely related kin. However, less attention has been given to understanding the help provided by individuals without close genetic relatedness. To explain who provides various forms of help, we evaluate support for several predictions derived from kin selection theory. Our results show that helpers who are most often closely related and from an older generation tend to provide more costly forms of help to youth at early ages. In contrast, alloparents who are not blood related tend to provide lower-cost forms of help to older youth. Since older youth are more capable of reciprocity, we propose that some alloparental aid acts as an investment in future reciprocal relationships or as indirect investment in a relationship with the beneficiary's relatives. Our results support kin selection and relationship effort explanations for who helps Tsimane youth.

Keywords: help, youth, alloparenting, relationship effort, kin selection

Introduction

Humans are exceptional among primates in terms of their reliance on others' aid during an especially prolonged period of early life dependency, and the role of non-parents in providing assistance and support to young people (Chapais 2021; Gurven et al 2012; Hill & Phelps 2024; Sear & Mace 2008). During those times of need, others provide benefits of various forms, such as food provisioning, shelter, direct care and cultural influence.

Direct nurturing of juvenile dependents by people other than biological parents is a common feature of human societies and has been referred to as alloparenting (Hrdy 2007; 2009; Kramer 2010; Page et al 2019). Assistance and support of adults who care for children may be considered indirect alloparenting. These forms of alloparenting are consistent with inclusive fitness interests when parties share biological kin (Hamilton 1964). Likewise, helping behaviours promoting the development of close relationships and gains from exchange, especially the assistance and support of adults, affines and non-kin, may be consistent with reciprocal altruism explanations of cooperation (Trivers 1971). Ultimately, an individual's inclusive fitness depends upon the net costs and benefits of their lifetime of social behaviour on their genes' reproductive success (Hamilton 1963; 1964).

This paper examines help provided to youth (children, adolescents and young adults) among Tsimane forager-farmers in the southern Amazon basin of lowland central Bolivia. Traditional Tsimane subsistence relies on hunting, fishing, gathering and small-scale gardening of mostly plantains, manioc, rice

and corn (Kraft et al 2018). As game abundance has declined in recent decades, cash cropping and wage labour have increasingly contributed to greater market integration. Tsimane are semi-sedentary, residing in 90+ kin-based villages (most between 50 and 250 people) that vary in river access, local game densities, degree of deforestation and access to market goods (Gurven et al 2017). Closely related families often reside together in cooperative residential clusters. Generally speaking, Tsimane have short life expectancy compared to Bolivian national statistics, high workload and poor access to healthcare and infrastructure services such as clean water, sewers, electricity, durable buildings, reliable transportation, and paved roads (Dinkel et al 2020; Gurven & Kaplan 2007).

While we have previously reported that kin provide the majority of support and assistance among the Tsimane (Gurven et al 2012; Stieglitz et al 2013; Hooper et al 2015), it is less clear how support among kin may be influenced by their maternal or paternal relatedness, by their affinal relatedness, by the beneficiary's age or by the relative cost of helping. Here we attempt to explain how the various forms of helping behaviour we have surveyed may be influenced by these aspects of helper–beneficiary relationships.

We develop predictions from kin selection theory; that older generation helpers who are most often closely related favour helping younger beneficiaries with costlier forms of help; and that blood relative helpers tend to be maternal more than paternal kin. We propose relationship effort explanations for helping behaviour. Because some forms of alloparental aid can act as investments in relationships, for example, a future reciprocal relationship with the beneficiary, or a relationship with the beneficiary's relatives, affinal kin and non-kin may also be reported as alloparents, especially for lower-cost forms of help targeting older beneficiaries.

Theory and hypotheses

Studies of foragers demonstrate that kinship explains food exchange (Betzig & Turke 1986; Gurven et al 2000; 2002; Hooper et al 2013; 2014; 2015; Kaplan et al 1985; Koster 2011; Patton 2005; Ziker & Schnegg 2005) and the provisioning of various forms of help (Gurven et al 2012; Phelps et al 2023). People in different cultures recognise and discriminate classes of genetic relatives among kin-relations when directing their assistance to others in need (Lieberman et al 2007; Lieberman & Lobel 2012). Compared to the attention in the literature on help from close kin, the study of unrelated or distantly related helpers has received little attention, aside from a limited focus on grandparental investments

(Meehan 2005; Sear & Mace 2008). Given recent interest in the notion that human reproduction involves various degrees of cooperative breeding (Hill & Hurtado 2009; Hrdy 2007; Kramer 2010; Hill et al 2011; Phelps et al 2023), more studies that both document and attempt to explain non-kin assistance are needed. Along with other studies in this special issue, we draw attention to the role of non-genetic relatives and non-kin in helping children and young adults.

An evolutionary perspective suggests that the shared genetic interests distributed among family kinship networks presented a recurrent influence on selection pressures shaping our social minds and behavioural propensities, resulting in many of the beneficent behaviours we observe among relatives. Kin selection theory (Hamilton 1964) suggests that beneficent behaviour is more likely between individuals who share identical genes by descent because it will improve the chances of replicating those shared genes and thereby increasing inclusive fitness. Specifically, inclusive fitness can be measured by the number of successfully reared 'offspring equivalents' across younger blood relatives including offspring, nieces and nephews, grandchildren, and cousins' children (West Eberhard 1975).

As marriage links reproductive interests among biologically unrelated spouses, an extension of inclusive fitness theory suggests that the shared fitness interests of spouses should result in a preference for helping a spouse and closer affinal kin who share interests in one's current and future reproduction of offspring equivalents (Hughes 1988). Thus, investments to maximise one's inclusive fitness can effectively be made directly through reproduction, parenting and alloparenting, and indirectly by helping one's spouse, or one's affines who are linked to biological kin (eg siblings-in-law). Compared to the certainty helpers have that direct forms of help really benefit their immediate targets, indirect help routed through intermediaries entails greater uncertainty, especially when the intermediary is less well known or less likely to be held accountable. Relatives linked by marriage are often less well known and may be less trusted than blood relatives, suggesting that the effect of affinal relatedness among youth's step-relatives and in-laws will be less strong than the effect of blood relatedness. From these considerations, we generate our first prediction (P1):

P1. Kin-selected nepotism: compared to non-relatives, we expect that more closely related kin are more likely to be reported as helpers. We expect that the likelihood of kin helping youth will be more strongly affected by blood relatedness than by affinal relatedness.

Beneficence is generally expected when the relative costs of helping are low for the helper, such as when the helper has a comparative advantage due to

high efficiency, productivity or specialisation. Where costs are larger for the helper, the helper and beneficiary must be more closely related. Beneficence is also expected when the gains to the recipient are greater – such as when the beneficiary is in need, for example due to lack of skill, illness, disability or dependence on support due to parental or spousal separation and death, or after exogenous shocks including crop losses. Beneficence is also expected when it can be amplified: when a helper provides aid to an individual that makes the latter more productive within a network, the helper also indirectly helps others who benefit.

Age affects the relative impact of benefits for the recipient and costs of helping for the helper, making it a crucial factor relevant to strategies for maximising inclusive fitness. For long-lived humans with multi-generational systems of support, age-related differences in reproductive value, caloric productivity and cultural expertise affect the calculus of investment in future reproduction via mating effort and reproduction, and investment in kin's future reproduction and productivity (Hooper et al 2015). Investments in one's offspring should be greatest when they are most vulnerable, during the first years of life (Crone 2001; Davison & Gurven 2021; Kaplan & Hill 1985). Due to their close relatedness, parents should also lower their demand for reciprocity (Trivers 1971). Conversely, because less closely related alloparents should place relatively higher demands for reciprocity on beneficiaries, and because individuals are more productive and capable of reciprocation as they get older (Gurven et al 2012), we expect that less closely related alloparents will prefer to complement the pattern of parental investment by helping relatively older youth. Additionally, as individuals age, they accumulate affines who could provide aid in times of need. The relationship between age and productivity should also affect potential helpers' abilities to provide needed help, for example, when individuals at more productive ages have opportunities to support those who are less productive (Hooper et al 2015; Schniter 2009). Human productivity typically increases in the first decades of adulthood before plateauing in middle adulthood (Koster et al 2019). From the age of 45, surviving Tsimane tend to have another 35 years before their caloric production value finally nears zero, suggesting that opportunity for provisioning youth continues well into older age. Beyond their food contributions, older adults are often regarded by others as surrogate caretakers and cultural experts (Gurven & Schniter 2010; Schniter 2014). For example, they are regarded as the best musicians and storytellers, consistent with their roles as teachers and transmitters of traditional culture (Schniter et al 2018 2023). From these hypotheses, we derive our next prediction (P2).

P2. A preference for helping to raise offspring equivalents of younger ages: among close blood relatives, older kin preferentially direct more costly forms of help to younger aged beneficiaries with whom they can make the largest fitness impacts.

Kin-directed help of youth is expected to be provided more by Tsimane maternal kin due to paternal uncertainty (all else equal). The probabilistic degree of relatedness between a child and their kin (eg aunts, uncles, grandparents) is higher for matrilineal than for patrilineal relatives (Hartung 1985). Diverse cross-cultural evidence shows fathers' blood relatives tend to invest less than mothers' blood relatives (Anderson et al 2007; Daly & Perry 2017; 2021; Euler & Weitzel 1996; Sear & Mace 2008; Voland & Beise 2002), suggesting a strong paternal uncertainty effect may be driving the matrilineal support bias of youth. However, matrilineal support bias may also be driven by postmarital residence patterns, available support networks and norms. For example, the matrilineal support bias is not present among South Indian Tamils, a nominally patrilineal society with patrilocal residence norms, where many women remain in their natal villages and where women's affinal and blood relatives both play a role in providing support (Power & Ready 2019). Tsimane have no strong postmarital residence norms or tendencies. Of women with children sampled, 22% reside in neither the husband's nor the wife's community, 29% reside bilocally, 27% reside matrilocally and 23% reside patrilocally (Seabright et al 2022). Under these conditions of flexible ambilocality, where couples can settle into either the husband or wife's natal community, mothers receive more childcare support from their blood relatives than their in-laws (Seabright et al 2022). As such, we expect the following:

P3. Maternal kin help more than paternal kin: controlling for the beneficiary's age and relatedness to the helper, youth are more likely to be reported receiving help from maternal than paternal kin.

Independent of nepotistic investments in closely related youth, investment in unrelated or distantly related youth can result from relationship effort. Below, before deriving our fourth prediction, we briefly review various explanations for helping behaviour among non-kin that are consistent with this perspective.

Tooby and Cosmides (1996) and Morris and Schniter (2018) identify the ubiquity of opportunities for helping others at low or no additional cost to the helper, for example friendships and other supportive relationships that do not depend on shared kinship or reciprocation. Additionally, if the helper is able to 'show off' by signalling their generosity to interested parties, the helper can garner prestige (Hawkes 1991; Vugt & Iredale 2013) and gain their trust

(Gambetta & Przepiorka 2014; Przepiorka & Liebe 2016). Relationship effort in mates can take the form of mating effort – direct investments in a mate that increase future fertility and reciprocity with that mate (Trivers 1972) – and alloparenting, such as among suitors and step-parents who invest in a mate's unrelated children (Anderson et al 1999a; 1999b). Human males are unique among animals in the high levels of care that they provide for step-offspring relative to other unrelated children in their group (Anderson et al 1999a; Hewlett 1991; Kaplan et al 1998; Lancaster & Kaplan 2000). According to models of these helpful relationships, targets of relationship effort will find ways to increase their chance of securing additional future benefits for themselves and kin, explaining pathways to the development of mutually beneficial and synergistically interdependent cooperative relationships.

Adults may encounter opportunities to provide non-kin with crucial help, and for that help to be reciprocated when fortunes reverse, explaining some helping behaviour that is unaccounted for by kin selection (Trivers 1971). For example, commensal and low-cost opportunities to help beneficiaries may arise for skilled raconteurs who can broadcast stories in front of a community audience and for lucky hunters who can redistribute large quantities of meat. Among potential helpers who have fewer opportunities to help younger genetic relatives, beneficent relationships with non-kin may provide greater value, especially when those beneficiaries are in greater need and more likely to reciprocate. A meta-analysis of 16 human forager populations found equal support for the role of food sharing reciprocity among kin and non-kin alike (Jaeggi & Gurven 2013). Among reservation-living Ache, reciprocity rather than kinship explains food transfers among relatives (Allen-Arave et al 2008; Gurven et al 2001). Among Mpimbwe horticulturalists, most helping behaviour is explained by reciprocity, whereas kinship best explains unreciprocated help directed to needy individuals (Kasper & Borgerhoff Mulder 2015). Likewise, among Tsimane, the exchange of commodities and services occurs between households when the asymmetric coincidence of low-cost supply and high-demand needs arises and there is a history of reciprocal exchange (Jaeggi et al 2016). While the dataset we describe below does not allow us to test for reciprocity, we can use it to evaluate our fourth prediction (P4)

P4. Relationship effort explains the forms of help and ages of beneficiaries more likely for affine and non-kin helpers: compared to blood relatives, affinal kin and non-kin are more likely to help older youth with lower-cost forms of help.

Methods

Data sources

The Tsimane Health and Life History Project (THLHP) developed systematic ethnographic interviews to inquire about helping behaviours provided in response to crucial needs common to Tsimane. A detailed retrospective interview was administered from March 2005 to July 2006 to 671 individuals aged 16+ years by a bilingual (Spanish-Tsimane) research assistant (see Gurven et al 2012 for details). In brief, participants were queried about their experiences of crucial need (eg during incapacitating illness), including frequency and severity of need and the type and amount of support received and given to others when they were in need. Helper–beneficiary relationships were coded for when informants were the beneficiaries, where the informants were helpers, and where the informants were the parents of the beneficiaries. The set of described helper–beneficiary relationships discriminates between consanguineal, affinal and non-kin relations, generational differences and helper gender (Table A1). Consanguineal relationship types include grandmothers, great-grandmothers and great-great-grandmothers, grandfathers, great grandfathers and great-great grandfathers, mothers, fathers, aunts and uncles, parent's aunt or uncle, parent's cousin, cousins, nieces and nephews, sons and daughters, and where possible maternal and paternal kin distinctions are made. Affinal relationship types include spouse (wife or husband), sister-in-law, brother-in-law, stepsister, stepbrother, stepmother, mother-in-law, stepfather, father-in-law, stepdaughter, stepson, daughter-in-law and son-in-law.

We did not ask about youth beneficiaries' identities at the time of the interview, so where informants referenced their child or children as beneficiaries of help, we impute the identities and ages of their youngest dependent for purposes of understanding the relationship between that beneficiary and the reported helper. Where informants reported receiving helpful cultural influence or story knowledge as youth, we used their ages of skill acquisition derived from other interviews (Schniter 2009). All other ages and relationships of helpers and beneficiaries were derived from census data where possible. In the Discussion section, we address the possibility that some of the reported child helpers in our study are fictive kin, such as those reported to be 'cuñado' (brother-in-law) and 'cuñada' (sister-in-law).

In 2006, using a detailed skills survey reported by Schniter et al (Schniter et al 2015), the lead author (ES) and a team of bilingual (Spanish-Tsimane) research assistants interviewed 421 individuals aged 15+ years (51% male) about

92 essential Tsimane skills. Eleven skills were female-specific, 30 male-specific and 51 considered equally important to both genders. For each skill in the interview that the participant indicated having, we asked questions about who taught, corrected, gave helpful examples and provided encouragement while learning that skill. For each of these questions, responses were recorded by noting the reported transmitter's relationship type to the informant. We coded relationship types according to the same set of helper–beneficiary relationship descriptions used in the 'Shocks' interview above (Table A1). Recorded survey responses do not specify the identities of transmitters, preventing us from indexing transmitter age or evaluating maternal vs paternal kinship status of reported transmitters.

Thirteen percent (n=54) of Tsimane participants from the skills survey reported knowing at least one traditional story (18% of males, 8% of females). In 2006, story-knowledgeable adults were administered a follow-up 'traditional stories survey' by one of the authors (ES) and a bilingual research assistant (Schniter et al 2018). The survey queried whether they knew each of 120 stories from the Tsimane oral tradition, and from whom they learned each of the stories that they knew. We recorded responses by noting the reported story source's relationship type to the informant.

Across our three survey instruments (ie the 'Shocks' interview, the skills survey, and the traditional stories survey), we collected a total of 139,528 reports of 1,048 youth receiving help.

All methods were approved by University of California Santa Barbara and University of New Mexico Human Subjects Review Boards, and approved by the Tsimane government council, village leaders and study participants.

Data preparation, relationship classification and relatedness

Where reports did not already indicate maternal or paternal kinship of non-parental helpers, we coded maternal or paternal kin distinctions using census information. For recorded relationships among blood relatives we use the consanguineal relatedness values expressed with the coefficient of relationship r, as defined by Wright (1922), and for affinal relationships we use the affinal coefficient of relatedness (ra), based on genetic relatedness (rW) calculated from the perspective of spouse or close kin such as offspring or siblings.

Statistical analyses

We use multilevel generalised Poisson regression analysis to model counts of the reported helpers of Tsimane youth according to relationship type as a function of the beneficiary's age, the coefficient of genetic relatedness (rW) or affinal relatedness (ra) between helper and beneficiary, whether the helper is of a same, younger or older generation than beneficiary, and whether the helper is related maternally or paternally to the beneficiary. The generalised Poisson distribution used in these analyses is ideal here because of the under-dispersed nature of helper counts in our count data (Consul & Famoye 1992; Consul & Jain 1973; Joe & Zhu 2005). Each informant may have responded to multiple survey instruments asking about help directed to beneficiaries and provided multiple reports of helpers and their relationship types per instrument, so we nest the outcome variable at the level of the survey instrument and beneficiary. We assess counts for the following characteristics of helpers: i) consanguineal and affinal relatedness, ii) older versus same or younger generation blood kin helpers, iii) older versus same or younger-generation affinal kin helpers, and iv) maternally versus paternally related. Individual-level data needed to reproduce our analyses are stored in the THLHP data repository and available through protected access protocols. All analyses were performed using IBM SPSS Version 29.

Results

We first provide descriptives across eight forms of aid: longer-term shelter provision, short-term shelter provision, regular allomaternal childcare, occasional childcare when parents were sick, longer-term food provision, short-term food provision, helpful cultural transmission influence and sources for learning traditional stories. After summarising reports, we provide an overview and statistical analysis of the reports, followed by a review of how the results support our four predictions.

Reports of who helps youth

Shelter provision and adoption

Youth may depend on alloparents to provide them shelter. Shelter is important for sleeping, processing and eating meals, socialising, security, shade and warmth. We consider reports of longer-term shelter provision in the context

of adoption or foster care following separation from a parent or parents due to parental death or divorce, and shorter-term shelter provision when the child's mother is temporarily out of town.

Twenty-two percent of informants (148/671) reported that, as children or young adults before marriage, they spent time living without both biological parents. Some cases were extended visits with relatives, but others were necessitated by parental death, or divorce and abandonment causing separation from a natal household. Tsimane consider young people to be orphans if they have lost one or both parents, either due to parental death(s) or abandonment. According to this definition, >20% of our sample was orphaned. Before reaching the age of 18, 17% (112/671) of our informants lost one or both parents to death and another 4% (27/671) were abandoned by a parent or parents. A small set of our informants (6/671) reported living away from parents before the age of 18 to provide care and support for an older relative, usually a maternal or paternal grandmother.

Of those informants who experienced a parental death before age 18, 61% (68/112) left their natal community to live in a new location, often with an adopting family. Following a parent's death, most lived with kin (98%), especially a biological parent (45%) or grandparents (20%) (Table A2). Of those who report spending time living away from both parents for any reason, most typically report living with an adoptive or foster family that is kin (75%), especially grandparents (51%) or aunts and uncles (14%) (Table A2).

On occasion, a child's mother or parents will travel to visit relatives in another community, for seasonal employment, to visit nearby towns or for medical consultations or procedures. During such trips, children often do not accompany their parents. Reports indicate that when a mother is out of town or temporarily unable to provide shelter, her child or children temporarily take shelter provided by close kin (100%), especially their siblings (38%), father (29%) and grandparents (21%) (Table A3).

Childcare

Infants, babies and children are primarily cared for by their mothers in Tsimane society (Gurven et al 2009). On average, Tsimane women marry by age 17 (Stieglitz et al 2018) and become mothers by age 18 and, with interbirth intervals of roughly two and a half years, they become grandmothers by age 36 and great-grandmothers by age 54 (Gurven & Kaplan 2007). The relatively high fertility of Tsimane gives older individuals greater opportunity to help descendant kin (Gurven et al 2012). When mothers are indisposed and unable to render care, others care for children (Seabright et al 2022; Winking et al 2009).

Ninety-four percent (567/601) of informants with children provided reports of whom they could regularly rely upon to provide their children care, besides the children's mother (see Table A4). Specifically, the primary allomaternal small-child caretaker was close kin (100%), especially the child's older-generation blood relatives (58%), siblings (30%) and siblings in-law (9%). When the mother was working out of the house, for example, tending to the garden or doing other tasks, childcare was provided most by the father (48%), followed by siblings (28%) and grandparents (16%). When the mother was out of town, for example, visiting the market or with relatives in another village, childcare was provided most by the father (31%), followed by siblings (27%) and grandparents (29%).

A subset (n = 115) of informants with children were mothers who had previously been widowed or divorced with dependent offspring (see Table A4). Tsimane divorce is not frequent (<20% of marriages; Winking et al 2007). Compared to divorce, death of a spouse is more common; nearly 2/3 individuals reaching 20 years of age die before reaching age 55 (Gurven et al 2007). Previously divorced or widowed informants reported who helped care for their children before remarriage. Childcare was provided by kin (99%), especially the children's grandparents (37%), siblings (27%), aunts, uncles, great aunts, great uncles and parents' cousins (21%) and siblings-in-law (10%).

Sickness was experienced in the past year by 98% (661/673) of informants, with an average sickness duration of 10 days (Mdn = 5, SD = 26, n = 647). Most cases of sickness were incapacitating and required help from others. Among those with incapacitating sickness in the past year, a set of female and male informants with children (n = 325 and 242, respectively) provided reports of who helped provide care for their own children when they themselves were unable due to sickness. Childcare while a parent was sick was provided by kin (100%), especially the children's other parent (46%) siblings (35%), and grandparents (10%) (Table A5).

Food provision

Tsimane face the regular challenge of obtaining enough food to meet their needs. As children, they produce less than they consume and depend on adults for food provision. Previous work shows the downward net flow of calories in multi-generational networks that support dependents, and the role of close kin – especially parents – for providing the bulk of calories (Hooper et al 2014; 2015).

Young people may experience extended and acute separation from a parent or parents that may impact their primary source of food. For example, most (96%, 107/112) informants who had experienced parental death or abandonment as

children report that they received help from others to meet their food needs over the longer term. These informants who were orphaned as children report being fed by kin (98%), especially grandparents (33%), siblings (23%) and their remaining parent (12%), as well as in-laws (16%) (Table A6).

Ninety-three percent (559/601) of informants with children reported that others, 100% close kin, helped provide their children food over the shorter-term when the mother or father could not (see Table A7). Specifically, when the mother was working out of the house, food was provided most by the child's father (52%), followed by siblings (25%) and grandparents (10%). When the mother was out of town, food was provided most by the child's siblings (29%), followed by grandparents (25%) and father (21%).

Among informants who reported incapacitating sickness in the past year, female and male informants with children provided reports of who helped feed their children when they could not (Table A7). Children's food provision while the mother was sick was provided by kin (100%), especially the child's father (38%) siblings (28%) and grandparents (15%). Children's food provision while the father was sick was mostly provided by kin (98%), especially the child's siblings (38%), mother (38%) and grandparents (12%).

Cultural transmission

Tsimane survival and well-being depends on acquisition and development of a broad set of essential skills, abilities and forms of knowledge. Basic mastery of most Tsimane skills (90% for females, 91% for males) is acquired before adulthood with the remaining skills acquired during the first decade of early adulthood (Schniter 2009; Schniter et al 2015). Proficiency with acquired skills continues to develop for decades after they have been acquired, forming older adults into 'banks' of accumulated cultural solutions, practical knowledge and oral traditions (Schniter 2014; Schniter et al 2018). Due to late-life cultural expertise, older adults are instrumental transmitters of traditional culture, providing practical guidance for young people's skill and knowledge acquisition. Additionally, adults are often relied upon for helpful advice.

We investigated Tsimane acquisition of skills involving foraging, domestic chores, crafts and tool manufacture, childcare and oral traditions. Specifically, we asked adults to report who provided them with a positive influence on their skill acquisition as youth by active teaching and correction, by passive example and by encouragement. Compared to the less costly provision of passive examples, we consider active forms of teaching and correction to be more costly forms of culture transmission influence. Ninety-five percent of this influential culture transmission is reported as coming from kin, especially parents (49%),

aunts and uncles (14%), siblings (11%), and grandparents (9%) (Table A8). Kin represent 97% of all reported influencers for teaching and 96% for correction, compared to 93% of all reported influencers who provided passive example (Table A8).

Storytelling is a fundamental form of the oral tradition used for pedagogy among Tsimane and in many other cultures. Stories often encode fitness relevant information about hazards, subsistence, morality, mythology, norms, marriage and relationships (Scalise Sugiyama 1996). As children, Tsimane begin learning their culture's rich corpus of oral tradition, especially at fireside gatherings when kin, friends and neighbours visit with one another and older adults retell traditional stories (Schniter 2014; Schniter et al 2018).

We investigated the sources from whom knowledgeable informants learned traditional stories. Informants made most story source reports of kin (91%), especially of grandparents (45%), followed by parents (32%), and aunts and uncles, (14%) (Table A9).

Overview and analysis of 'who helps youth' reports

We present an overview of the 19 unique forms of help reported by relationship category and macrocategory in tables A2–A9. Figure 1 shows average percentages for macrocategories of all reported helpers who provided youth longer-term shelter (Table A2), short-term shelter (Table A3), regular allocare (Table A4), childcare when a parent was sick (Table A5), food over a longer-term (Table A6), food over the short-term (Table A7), cultural transmission influence (Table A8), and a source from whom to learn traditional stories (Table A9).

Reports of kin helpers (blood and affinal) reveal that the majority of help directed to youth comes from older-generation kin (70%). Most older-generation kin reported are blood relatives (M = 68%, SD = 9). Relative to the beneficiary, same- and younger-generation blood relatives are the second most reported macrocategory of helpers on average (M = 23%, SD = 12), and for 7/8 forms of youth assistance (Figure 1).

Across all forms of youth help, close kin related by blood or marriage make up most of all help reports (97%). A Poisson regression indicates that compared to non-kin, blood relatives (genetic relatedness: M = 0.36, SD = 0.18) are up to 2.5 times more likely to be reported as helpers, and affines (affinal relatedness: M = 0.04, SD = 0.14) are up to 2.1 times more likely to be reported (both $p < .001$) (Table 1).

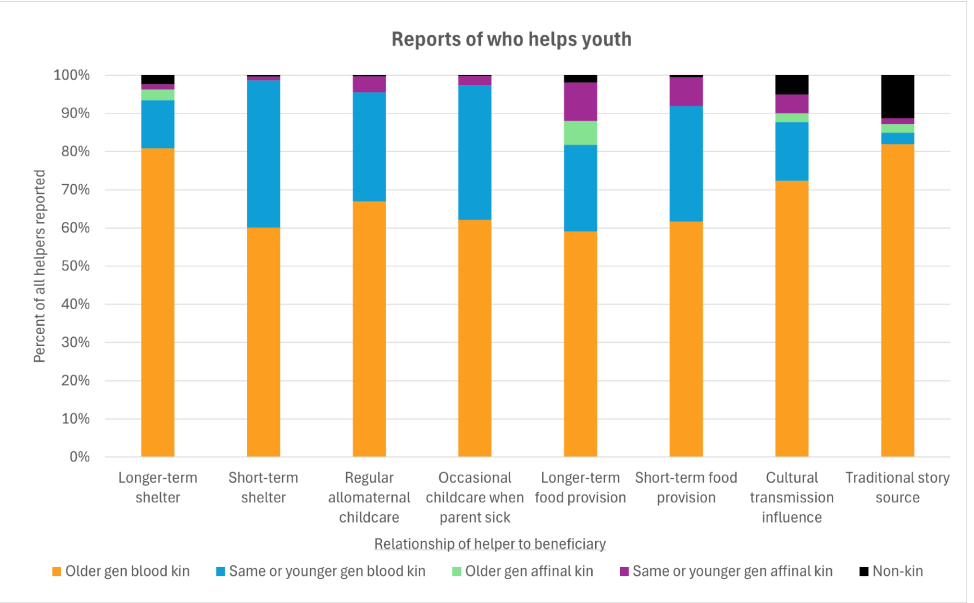

Figure 1 Average percentages of all helpers reported are shown for five categories of relationship between helper and youth recipient of the help, across eight forms of youth assistance and support

Table 1 Poisson regression predicting reports of kin helping youth

	B	*SE B*	Wald χ^2	*p*	*OR*	95% *CI OR*	
						lower	upper
Dependent variable: kin reported helping of youth							
Intercept: non-kin	-.425	.0111	1469.290	<.001	.654	.640	.668
Blood relatedness	.925	.0238	1515.610	<.001	2.521	2.407	2.641
Affinal relatedness	.744	.0206	1309.039	<.001	2.104	2.021	2.191

Note: B = coefficient estimate, SE B = Standard Error of the coefficient estimate, Wald χ2 = Wald Chi-Square statistic, p = p-value, OR = Odds Ratio, 95% CI OR = 95% Confidence Interval of the Odds Ratio. This key applies to Tables 1–6.

A Poisson regression indicates that among reports of youth helped by blood relatives, each additional year of the beneficiary's age (M = 14.82, SD = 2.57) is associated with a marginal decrease in the report rate by a factor of 1.01 (p <. 001). Additionally, compared to helpers who are not blood related, closely related (genetic relatedness: M = 0.36, SD = 0.18) blood relatives with relatedness of 0.5 are 5.7 times more likely to be reported and older-generation blood relatives are 1.3 times more likely to be reported (both p <. 001) (Table 2).

Table 2 Poisson regression predicting reports of blood relatives helping youth

	B	*SE B*	Wald χ^2	*p*	*OR*	95% *CI OR*	
						lower	upper
Dependent variable: blood kin reported helping of youth							
Intercept: not blood kin	-.942	.0187	2536.831	<.001	.390	.376	.404
Beneficiary's age	-.005	.0006	62.263	<.001	.995	.994	.996
Blood relatedness	2.428	.0414	3433.736	<.001	11.331	10.447	12.289
Older generation	.240	.0068	1227.266	<.001	1.271	1.254	1.288

We compare reports of older-generation kin's more costly to less costly forms of help for four domains where we have comparable measures of helping youth: shelter provision, childcare, food provision, and cultural transmission influence. Estimated marginal means for reports of older-generation helpers are consistently higher for the more costly forms of these help (Table A10). Poisson regressions indicate that older-generation kin helpers are more likely reported for longer-term than for short-term shelter provision (OR = 1.37, p <. 001), for regular rather than occasional allocare (OR = 1.08, p =.010), and for cultural transmission influence through active instruction or correction rather than by passive example (OR = 1.08, p <. 001), but not for reports of longer- versus short-term food provision (p =.38) (Table 3).

Table 3 Poisson regressions predicting reports of older-generation kin helping youth with more costly versus less costly forms of help

	B	*SE B*	Wald χ^2	*p*	*OR*	95% *CI OR*	
						lower	upper
Dependent variable: Older gen kin reported helping of youth with shelter provision							
Intercept: not older gen kin	-.183	-.0318	33.196	<.001	.833	.782	.886
More costly help	.313	.0477	43.174	<.001	1.368	1.245	1.502
Dependent variable: older gen kin reported helping of youth with childcare							
Intercept: not older gen kin	-.401	.0170	557.436	<.001	.670	.648	.692
More costly help	.076	.0295	6.641	.010	1.079	1.018	1.143
Dependent variable: Older gen kin reported helping of youth with food provision							
Intercept: not older gen kin	-.425	.0654	42.101	<.001	.654	.575	.744
More costly help	.059	.0676	0.772	.380	1.062	0.929	1.212
Dependent variable: Older gen kin reported helping of youth with cultural transmission influence							
Intercept: not older gen kin	-.257	.0072	1287.149	<.001	.773	.762	.784
More costly help	.077	.0140	29.846	<.001	1.080	1.050	1.110

A Poisson regression controlling for beneficiary's age and blood relatedness indicated that among blood relative helpers, while the difference in likelihood of maternal kin (OR = 1.50, p <. 001) versus paternal kin (OR = 1.51, p <. 001) being reported is small, more closely related beneficiaries of younger ages are helped more (both p <. 001): each additional year of the beneficiary's age (M = 14.83, SD = 2.56, Min = 1, Max = 26.5) after the first year of life is associated with a 0.5% decrease in the report rate (Table 4).

Table 4 Poisson regression predicting reports of maternal versus paternal kin helping youth

	B	*SE B*	Wald χ^2	*p*	*OR*	95% *CI OR*	
						lower	upper
Dependent variable: blood kin reported helping of youth							
Intercept: not blood kin	-.942	.0187	2531.946	<.001	.390	.376	.404
Beneficiary's age	-.005	.0006	62.536	<.001	.995	.994	.996
Blood relatedness	2.428	.0414	3435.421	<.001	11.334	10.451	12.293
Maternal kin	.407	.0075	2946.896	<.001	1.502	1.480	1.524
Paternal kin	.410	.0075	3004.398	<.001	1.507	1.485	1.529

While blood relatives make up most reported helpers (91%), most of the remaining reports of help are from either the same- and younger-generations affinal kin (M = 4.2%, SD = 3.2), from non-kin (M = 2.7%, SD = 2.8), or from older-generation affinal kin (M = 1.7%, SD = 2.2). A Poisson regression indicates that for reports of non-kin helpers, compared to blood relatives, each additional year of the beneficiary's age after the first year of life is associated with a 17% increase in the report rate and more costly forms of help are 40% less likely to be reported (p <. 001) (Table 5).

Table 5 Poisson regression predicting reports of non-kin helping youth

	B	*SE B*	Wald χ^2	*p*	*OR*	95% *CI OR*	
						lower	upper
Dependent variable: non-kin reported helping youth							
Intercept: blood kin	-5.038	.1265	1585.409	<.001	.010	.005	.008
Beneficiary's age	.154	.0063	597.729	<.001	1.167	1.153	1.182
More costly help	-.502	.0770	45.572	<.001	.595	.511	.692

A Poisson regression controlling for affinal relatedness, more costly help and older-generation kin helpers indicates that among affinal kin helpers, there is a negative effect of being an older-generation kin helper (p <. 001) and a strong

positive effect of affinal relatedness on receiving help (affinal relatedness: M = 0.04, SD = 0.15): more closely related affines with affinal relatedness values of 0.5 were 105 times more likely to be reported than blood kin with no affinal relatedness (p <. 001) (Table 6). Additionally, among affinal kin helpers, each additional year of the beneficiary's age after the first year of life is associated with an 8% increase in the report rate (p <. 001) and more costly forms of help are 29% less likely to be reported (p <. 001) (Table 6).

Table 6 Poisson regression predicting reports of affinal kin helping youth

	B	*SE B*	Wald χ^2	*p*	*OR*	95% *CI OR*	
						lower	upper
Dependent variable: affinal kin reported helping youth							
Intercept: blood kin	-4.631	.1145	1634.771	<.001	.010	.008	.012
Beneficiary's age	.082	.0054	229.939	<.001	1.086	1.074	1.099
More costly help	-.338	.0624	29.273	<.001	.713	.631	.806
Older-generation kin	-.233	.0689	11.428	<.001	.792	.692	.907
Affinal relatedness	5.348	.0921	3370.702	<.001	210.238	175.509	251.840

Support for predictions

We summarise our results and their support for predictions in Table 7 below.

Table 7 Review of support for predicted results

Prediction	Support?	Notes
P1. Kin-selected nepotism	Yes	Youth are reported to receive more help from closer relatives than from non-relatives. These effects are stronger for blood relatives than for affines.
P2. Preference for helping raise younger-generation offspring equivalents of younger ages	Yes	Helpers tend to be older-generation close kin (blood and affinal) who favour making larger marginal fitness impacts by targeting younger beneficiaries with more costly forms of help.
P3. Maternal kin help youth more than paternal kin	No.	There is no support for a maternal kin bias among helpers. Youth receive slightly more help from close paternal kin than from close maternal kin but the difference is small.
P4. Relationship effort explains the forms of help and ages of beneficiaries more likely for affine and non-kin helpers	Yes	Compared to blood relatives, affinal kin and non-kin are more likely to help older youth with lower-cost forms of help.

Discussion

Our study of reported help directed to Tsimane youth provides clear results from which we can interpret the role of kinship, beneficiary age and beneficiary–helper generational difference affecting helping behaviour. Through childhood and early adulthood, youth experience changing needs, reproductive and productive value, and kinship ties with their communities (Chagnon 1982; Gurven et al 2012; Koster et al 2019). These age-related changes affect the social landscape of helpers providing help and the types of help received.

During childhood and early adulthood, Tsimane allocare is more likely to come from closely related older-generation kin and is preferentially directed to beneficiaries at younger ages. These reports of helping behaviour from close relatives are stronger for blood relatives than for affines. Where higher and lower costs of help can be compared, we see that kin from older generations are more likely to provide youth the more costly forms of help than are those from peer generations. Compared to blood relatives, affinal kin and non-kin are more likely to help older youth with lower-cost forms of help.

While our estimations are well powered, they are limited by the errors that may have been introduced through our interpretation of the relationship categories identified by informants (for example, the possibilities of fictive kinship discussed below), our inability to calculate exact genetic relatedness, and our use of the affinal coefficient of relatedness, which does not account for paternal uncertainty. As the reported helpers were identified by category, we did not have unique individual-level information sufficient to evaluate helper effects associated with a helper's marital status, age, productivity, expertise and social network. Lacking personal identity information about helpers also prevents us from verifying reported relationships with our census records or evaluating helper–beneficiary relationships for evidence of reciprocity. Across cultures, and equally among Tsimane, there is a tendency to blur some categories of kinship, resulting in 'fictive' kin classifications. For example, half-siblings may be identified as siblings, and step-parents as parents. These types of reporting tendencies may have contributed to what may appear to be relatively low stepfamily contributions, though the marginal role of stepfamilies may also be a consequence of the relatively low levels of divorce and remarriage.

Our results about in-law contributions also warrant some discussion. Some of the same-generation in-laws reported in our study may have been older young-adult siblings' spouses. An age difference of as much as 30 years between youngest and oldest siblings could result in younger siblings receiving help from older young-adult siblings and their spouses or spouses' kin. However,

such cases are not frequent. We expect that some of the in-laws reported to have helped youth were fictive or potential kin, rather than the true affinal kin of those beneficiaries. Reports of siblings-in-law (tables A2–A9) helping youth could be identifying a fictive kin class of helpers who may represent close friends and exchange partners, especially those who also qualify as 'potential' affinal kin with marriageable sibling(s). Across many Latin American settler and indigenous cultures, siblings-in-law, actual or fictive, known as *cuñado* (brother-in-law) and *cuñada* (sister-in-law) in Spanish, play close and supportive roles in family dynamics and social structures (eg see Lévi-Strauss 1943). We have regularly encountered cuñado and cuñada forms of fictive, potential and actual kinship used in conversation among Tsimane when referring to their close friends and exchange partners.

Another possible interpretation for the retrospective reports of in-laws helping youth is that some informants refer to a help event that occurred during the first decade of adulthood. We suspect that among the marginal proportions of stepchild, children-in-law (table A8), siblings-in-law and parents-in-law (Table A8 and A9) reported helping with culture acquisition, some come from informants who acquired skills and stories as young adults.

We make a novel contribution to the study of alloparental care by integrating kin selection theory with the study of productive value, reproductive value and cultural knowledge – age-dependent traits that reliably develop throughout childhood, to explain reports of helping behaviour. To address the broader question of who provides the most help to Tsimane youth, more research is still required: we need more careful measures of the costs to fitness from helping and the benefits to fitness from providing and receiving help, many of which dynamically mature over time as helpers and beneficiaries develop and encounter opportunities for reciprocity.

The findings from this study extend our understanding of helping behaviour among both kin and non-kin in subsistence societies by illustrating how changes in age, life stage and relatedness affect distinct types of help in an Amerindian forager-farmer society. The versatility of Hamilton's rule helps us make sense of not only the costly nepotistic nurturing of related children by parents and older close kin, but also the less costly forms of help consistent with relationship efforts that affinal kin, non-kin and peer generation helpers may prefer to contribute. These findings illuminate the intricate dynamics of social relationships and underscore the importance of considering kin relationships, beneficiaries' ages and relationship effort in determining the reported direction of beneficent behaviours across generations in a multi-generational kin-based society.

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Appendix

Table A1 Kinship categories, relatedness, and descriptions for relationship types

Relationship type described	English translation	Sex	Consanguineal, affinal, or non-kin	Relatedness	Generational difference (0< older, 0 same, 0> younger)
madre	mother	female	consanguineal	0.5	+1
padre	father	male	consanguineal	0.5	+1
abuela maternal	maternal grandmother	female	consanguineal	0.25	+2
abuelo maternal	maternal grandfather	male	consanguineal	0.25	+2
abuela paternal	paternal grandmother	female	consanguineal	0.25	+2
abuelo paternal	paternal grandfather	male	consanguineal	0.25	+2
visabuela maternal*	maternal great grandmother	female	consanguineal	0.125	+3
visabuelo maternal*	maternal great grandfather	male	consanguineal	0.125	+3
visabuela paternal*	paternal great grandmother	female	consanguineal	0.125	+3
visabuelo paternal*	paternal great grandfather	male	consanguineal	0.125	+3
tataraabuela maternal*	maternal great grandmother	female	consanguineal	0.0625	+4
tataraabuelo maternal*	maternal great grandfather	male	consanguineal	0.0625	+4
tataraabuela paternal*	paternal great grandmother	female	consanguineal	0.0625	+4
tataraabuelo paternal*	paternal great grandfather	male	consanguineal	0.0625	+4

Relationship type described	English translation	Sex	Consan-guineal, affinal, or non-kin	Related-ness	Generational difference (0< older, 0 same, 0> younger)
tia abuela*	parent's aunt	female	consanguineal	0.125	+2
tio abuelo*	parent's uncle	male	consanguineal	0.125	+2
tia segunda*	parent's cousin (f)	female	consanguineal	0.0625	+1
tio segundo*	parent's cousin (m)	male	consanguineal	0.0625	+1
tia*	aunt	female	consanguineal	0.25	+1
tio*	uncle	male	consanguineal	0.25	+1
hija	daughter	female	consanguineal	0.5	-1
hijo	son	male	consanguineal	0.5	-1
sobrina*	niece	female	consanguineal	0.25	-1
sobrino*	nephew	male	consanguineal	0.25	-1
nieta*	granddaughter	female	consanguineal	0.25	-2
nieto*	grandson	male	consanguineal	0.25	-2
hermana	sister	female	consanguineal	0.5	0
hermano	brother	male	consanguineal	0.5	0
prima*	cousin (female)	female	consanguineal	0.125	0
primo*	cousin (male)	male	consanguineal	0.125	0
esposa	spouse (wife)	female	affinal	*1*	0
esposo	spouse (husband)	male	affinal	*1*	0
cuñada	sister-in-law	female	affinal	*0.5*	0
cuñado	brother-in-law	male	affinal	*0.5*	0
hermanastra	stepsister	female	affinal	*0.5*	0
hermanastro	stepbrother	male	affinal	*0.5*	0
madrastra	stepmother	female	affinal	*0.5*	+1
suegra	mother-in-law	female	affinal	*0.5*	+1
padrastro	stepfather	male	affinal	*0.5*	+1
suegro	father-in-law	male	affinal	*0.5*	+1
hijastra	stepdaughter	female	affinal	*0.5*	-1
hijastro	stepson	male	affinal	*0.5*	-1
yerna	daughter-in-law	female	affinal	*0.5*	-1
yerno	son-in-law	male	affinal	*0.5*	-1
otro pariente (mujer)	other female Tsimane	female	non-kin	0	
otro pariente (hombre)	other male Tsimane	male	non-kin	0	
amiga	female friend	female	non-kin	0	
amigo	male friend	male	non-kin	0	
comerciante	merchant/trader		non-kin	0	
misionero	missionary		non-kin	0	
otro napo	non-Tsimane		non-kin	0	

Relationship type described	English translation	Sex	Consan-guineal, affinal, or non-kin	Related-ness	Generational difference (0< older, 0 same, 0> younger)
antropologo o medico	anthropologists or doctors		non-kin	0	

Note: Relatedness values for the helper are the larger of either Wright's coefficient of genetic relatedness to the beneficiary (*rw*) or via affinal relatedness to spouse or close kin (*ra*). Asterisks among consanguineal kin indicate that, when possible, maternal and paternal kin values are differentiated for grandmothers, great-grandmothers, and great-great-grandmothers, grandfathers, great grandfathers, and great-great grandfathers, aunts and uncles, parent's aunt or uncle, parent's cousin, cousins, nieces and nephews, sons and daughters.

Table A2 Reports of who provided shelter before age 18 following loss of parent or upon separation from one or both parents

Provider category	Lived with the provider after parents divorced or parent died		Lived with the provider away from both parents (for any reason)	
	#	%	#	%
Step-parents	5	4.1	1	0.8
Siblings-in-law	1	0.8	1	0.8
Step siblings	1	0.8	0	0.0
Maternal grandparents	12	9.9	39	32.0
Paternal grandparents	12	9.9	23	18.9
Biological parent	55	45.5	--	--
Siblings	17	14.0	10	8.2
Aunts or uncles	15	12.4	17	13.9
Non-kin	3	2.5	2	1.6
All kin (blood or affinal)	119	98.3	91	74.6
Older gen blood kin	94	77.7	79	64.8
Older gen affinal kin	5	4.1	1	0.8
Same or younger gen blood kin	17	14.0	10	8.2
Same or younger gen affinal kin	2	1.7	1	0.8

Note: Informants often gave multiple reports of who provided them shelter following parental loss or separation. Shown are frequencies of these reports according to the category of provider relationship to informant for cases where either the informant 'Lived with provider after parents divorced or parent died', or where the informant 'Lived with the provider away from both parents (for any reason)' – including death or divorce of parent(s). Percentages indicate the percentage of all providers reported lived with following parent loss or separation. All provider categories above 'All kin (blood & affinal)' are mutually exclusive.

Table A3 Reports of who provided youth short-term shelter when mother was temporarily unable to

Provider category	#	%
Siblings-in-law	6	1.0
Maternal grandparents	78	13.1
Paternal grandparents	48	8.0
Father	174	29.1
Siblings	225	37.7
Aunts or uncles, great aunts or uncles, parents' cousins	59	9.9
Cousins	2	0.3
Younger gen blood kin	3	0.5
Non-kin	2	0.3
All kin (blood or affinal)	595	99.7
Older gen blood kin	359	60.1
Older gen affinal kin	0	0.0
Same or younger gen blood kin	230	38.5
Same or younger gen affinal kin	6	1.0

Note: Informants often gave multiple reports of who provided their children shelter when out of town or temporarily unable to. Shown are frequencies of these reports according to the category of provider relationship from the youths' perspective. Percentages indicate the percent of all providers reported. 'Younger gen blood kin' includes one's children, nieces and nephews, and grandchildren. All provider categories above 'All kin (blood or affinal)' are mutually exclusive.

Table A4 Reports of who provided childcare besides the mother

Caretaker category	Small-child caretaker, primary allomaternal alternative		When mother working out of house		When mother out of town		When mother single (widowed or divorced)		All allomaternal childcare support	
	#	%	#	%	#	%	#	%	#	%
Siblings-in-law	43	9.4	18	1.9	20	2.6	9	9.5	90	4.0
Step siblings	2	0.4	1	0.1	0	0.0	0	0.0	3	0.1
Maternal grandparents or great grandparents	46	10.1	104	11.2	139	18.4	32	33.7	321	14.4
Paternal grandparents or great grandparents	59	12.9	43	4.6	79	10.5	3	3.2	184	8.2
Father	20	4.4	443	47.7	232	30.7	4	4.2	699	31.3
Siblings	135	29.5	259	27.9	202	26.8	26	27.4	622	27.8
Aunts or uncles, great aunts or uncles, parents' cousins	139	30.4	56	6.0	78	10.3	20	21.1	293	13.1
Cousins	10	2.2	2	0.2	3	0.4	0	0.0	15	0.7
Younger gen blood kin	1	0.2	0	0.0	1	0.1	0	0.0	2	0.1
Non-kin	2	0.4	2	0.2	1	0.1	1	1.1	6	0.3
All kin (blood or affinal)	455	99.6	926	99.8	754	99.9	94	98.9	2229	99.7
Older gen blood kin	264	57.8	646	69.6	528	69.9	59	62.1	1497	67.0
Older gen affinal kin	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Same or younger gen blood kin	146	31.9	261	28.1	206	27.3	26	27.4	639	28.6
Same or younger gen affinal kin	45	9.8	19	2.0	20	2.6	9	9.5	93	4.2

Note: Reports of others' providing childcare help are from the informants who had children to care for and whose children received childcare help from others when the children's mother was unable to provide childcare herself. Informants often gave multiple reports of who provided their children childcare. Shown are frequencies of these reports according to the category of provider relationship from the youths' perspective. Percentages indicate the percentage of all caretakers reported. 'Younger gen blood kin' includes one's children, nieces and nephews, and grandchildren. All provider categories above 'All kin (blood or affinal)' are mutually exclusive.

Table A5 Reports of who provided childcare when a parent was sick and unable to

Caretaker category	When mother sick		When father sick		All childcare when parent sick	
	#	%	#	%	#	%
Siblings-in-law	13	2.1	12	2.9	25	2.4
Maternal grandparents	53	8.7	6	1.4	59	5.7
Paternal grandparents	14	2.3	29	6.9	43	4.2
Mother	--	--	246	58.6	246	23.9
Father	225	36.9	--	--	225	21.8
Siblings	240	39.3	116	27.6	356	34.6
Aunts, uncles, parents' cousins	59	9.7	8	1.9	67	6.5
Cousins	3	0.5	1	0.2	4	0.4
Younger gen blood kin	2	0.3	1	0.2	3	0.3
Non-kin	1	0.2	1	0.2	2	0.2
All kin (blood or affinal)	609	99.8	419	99.8	1028	99.8
Older gen blood kin	351	57.5	289	68.8	640	62.1
Older gen affinal kin	0	0.0	0	0.0	0	0.0
Same or younger gen blood kin	245	40.2	118	28.1	363	35.2
Same or younger gen affinal kin	13	2.1	12	2.9	25	2.4

Note: Reports of others' providing childcare help are from the informants who had children to care for and reported being sick in the past year and unable to provide the childcare themselves. Informants often gave multiple reports of who provided their children childcare. Shown are frequencies of these reports according to the category of provider relationship from the youths' perspective. 'Younger gen blood kin' includes one's children, nieces and nephews, and grandchildren. All provider categories above 'All kin (blood or affinal)' are mutually exclusive.

Table A6 Reports of who provided food to orphan before age 18 following death of or abandonment by a parent(s)

Provider category	#	%
Step-parents	10	6.3
Siblings-in-law	16	10.1
Maternal grandparents	38	23.9
Paternal grandparents	15	9.4
Mother	5	3.1
Father	14	8.8
Siblings	36	22.6
Aunts, uncles	22	13.8
Cousins	0	0.0
Younger gen blood kin	0	0.0
Non-kin	3	1.9
All kin (blood or affinal)	156	98.1
Older gen blood kin	94	59.1
Older gen affinal kin	10	6.3
Same or younger gen blood kin	36	22.6
Same or younger gen affinal kin	16	10.1

Note: Reports of who provided food to orphaned children are from informants who lost a parent or parents before reaching age 18 due to parental death or abandonment. Informants often gave multiple reports of who provided them with food. Shown are frequencies of these reports according to the category of provider. Percentages indicate the percentage of all providers reported. 'Younger gen blood kin' includes one's children, nieces and nephews, and grandchildren. All provider categories above 'All kin (blood or affinal)' are mutually exclusive.

Table A7 Reports of who provided food for child when parent(s) temporarily unable to

Provider category	When mother working out of house		When mother out of town		When mother sick		When father sick		All food provision support	
	#	%	#	%	#	%	#	%	#	%
Siblings-in-law	36	4.1	86	11.9	40	6.4	40	8.7	202	7.5
Step siblings	0	0.0	1	0.1	0	0.0	2	0.4	3	0.1
Maternal grandparents	74	8.4	108	15.0	73	11.7	29	6.3	284	10.6
Paternal grandparents	36	4.1	73	10.1	19	3.0	24	5.2	152	5.7
Mother	–	–	–	–	–	–	125	27.3	125	4.6
Father	459	51.8	148	20.6	240	38.3	–	–	847	31.5
Siblings	225	25.4	206	28.6	173	27.6	172	37.6	776	28.8
Aunts, uncles, great aunts, great uncles, parents' cousins	52	5.9	82	11.4	67	10.7	49	10.7	250	9.3
Cousins	3	0.3	9	1.3	5	0.8	4	0.9	21	0.8
Younger gen blood kin	0	0.0	4	0.6	8	1.3	5	1.1	17	0.6
Non-kin	1	0.1	3	0.4	1	0.2	8	1.7	13	0.5
All kin (blood or affinal)	885	99.9	717	99.6	625	99.8	450	98.3	2677	99.5
Older gen blood kin	621	70.1	411	57.1	399	63.7	227	49.6	1658	61.6
Older gen affinal kin	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Same or younger gen blood kin	228	25.7	219	30.4	186	29.7	181	39.5	814	30.3
Same or younger gen affinal kin	36	4.1	87	12.1	40	6.4	42	9.2	205	7.6

Note: Reports of others' providing food are from the informants who had children to feed but were temporarily unable to provide food to themselves. Informants often gave multiple reports of who provided their children food. Shown are frequencies of these reports according to the category of provider. Percentages indicate the percentage of all providers reported. 'Younger gen blood kin' includes one's children, nieces and nephews, and grandchildren. All provider categories above 'All kin (blood or affinal)' are mutually exclusive.

Table A8 Reports of who influenced youths' skill acquisition

Influencer category	Teaching		Correction		Example		Encouragement		All skill acquisition influence	
	#	%	#	%	#	%	#	%	#	%
Spouse	215	0.6	189	0.6	132	0.4	223	0.7	759	0.6
Parents in-law	560	1.6	728	2.3	1018	3.0	646	2.0	2952	2.2
Step-parents	22	0.1	30	0.1	21	0.1	16	0.0	89	0.1
Siblings-in-law	1069	3.1	1297	4.0	1724	5.1	1553	4.8	5643	4.3
Children in-law	81	0.2	33	0.1	55	0.2	71	0.2	240	0.2
Stepchildren	1	0.0	1	0.0	0	0.0	1	0.0	3	0.0
Maternal grandparents	1566	4.6	1498	4.7	1942	5.8	1222	3.8	6228	4.7
Paternal grandparents	1393	4.1	1374	4.3	1896	5.6	1057	3.2	5720	4.3
Biological parents	19768	57.9	15735	49.1	13375	39.7	15762	48.4	64640	48.8
Siblings	3744	11.0	3633	11.3	3182	9.4	3523	10.8	14082	10.6
Aunts, uncles	3824	11.2	4676	14.6	5878	17.4	4711	14.5	19089	14.4
Cousins	729	2.1	1396	4.4	2045	6.1	1655	5.1	5825	4.4
Younger gen blood kin	47	0.1	85	0.3	208	0.6	91	0.3	431	0.3
Non-kin	1138	3.3	1352	4.2	2218	6.6	2048	6.3	6756	5.1
All kin (blood or affinal)	33019	96.7	30675	95.8	31476	93.4	30531	93.7	125701	94.9
Older gen blood kin	26551	77.7	23283	72.7	23091	68.5	22752	69.8	95677	72.2
Older gen affinal kin	582	1.7	758	2.4	1039	3.1	662	2.0	3041	2.3
Same or younger gen blood kin	4520	13.2	5114	16.0	5435	16.1	5269	16.2	20338	15.4
Same or younger gen affinal kin	1284	3.8	1486	4.6	1856	5.5	1776	5.5	6402	4.8

Note: Reports of cultural transmission influence are from the informants who reported having acquired an essential skill. Informants reported acquiring multiples skills and often gave multiple reports of who influenced them while acquiring each skill. Shown are frequencies of these reports according to the category of influencer. Percentages indicate the percentage of all influencers reported. 'Younger gen blood kin' includes one's children, nieces and nephews, and grandchildren. All influencer categories above 'All kin (blood or affinal)' are mutually exclusive.

Table A9 Reports of sources from whom traditional stories were learned

Story source category	**#**	**%**
Parents in-law	3	2.3
Siblings-in-law	2	1.5
Great-great grandparents	2	1.5
Maternal grandparents	18	13.5
Paternal grandparents	29	21.8
Biological parents	42	31.6
Siblings	1	0.8
Aunts, uncles,	18	13.5
Cousins	2	1.5
Younger gen blood kin	1	0.8
Non-kin	15	11.3
All kin (blood or affinal)	118	88.7
Older gen blood kin	109	82.0
Older gen affinal kin	3	2.3
Same or younger gen blood kin	4	3.0
Same or younger gen affinal kin	2	1.5

Note: Reports of story sources are from the informants who reported knowing and being able to tell a traditional Tsimane story. Informants reported learning to tell multiple traditional Tsimane stories and often gave multiple reports of who they learned the story from. Shown are frequencies of these reports according to the category of story source. Percentages indicate the percentage of all story sources reported. 'Younger gen blood kin' includes one's children, nieces and nephews, and grandchildren. All story source categories above 'All kin (blood or affinal)' are mutually exclusive.

Table A10 Estimated proportions of older-generation kin helpers reported for more and less costly forms of helping youths

Estimated proportions of older-generation kin helpers reported						
Domain of help	**More costly form of help**	**Estimated marginal mean**	**S.D.**	**Less costly form of help**	**Estimated marginal mean**	**S.D.**
Shelter provision	Longer-term shelter	0.83	0.026	Short-term shelter	0.61	0.026
Childcare	Regular alloma-ternal childcare	0.67	0.011	Occasional childcare when parent sick	0.62	0.015
Food provision	Longer-term food provision	0.65	0.043	Short-term food provision	0.62	0.011
Cultural transmission influence via	Cultural transmission influence via active instruction or correction	0.77	0.006	Cultural transmission influence via passive example	0.72	0.009