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Original Research Article

The Grandmaternal Niche: Critical Caretaking among Martu Aborigines

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ABSTRACT This paper expands upon the existing literature on the evolutionary importance of grandmothers by examining how direct care by grandmothers differs from care provided by other helpers within a population of Martu Aborigines. Behavioral observations were collected on ten babies who ranged from 3 months to 3 years of age. The results show that Martu grandmothers were in contact with their grandchildren more than any person other than the mother, and they were also more likely than any other category of caregiver to perform high-demand tasks, such as bathing or feeding. These results suggest that Martu grandmothers are specializing in the type of care they provide and posits that high-quality allocare is an important pathway to increased health and survival of grandchildren. Am. J. Hum. Biol. 21:448–454, 2009.

Compared with other primates, human infants are exceptionally altricial, infant mortality rates are high, maturation is delayed, and inter-birth intervals are short (Mace 2000; Stearns 1992). This suite of life-history traits results in human offspring needing a relatively high level of care for an extended period of time. Cooperative breeding, the eliciting of help from individuals other than the genetic parents, has been posited as an important strategy to cope with these demands, and is seen in a wide array of birds and mammals (Emlen 1991; Russell 2004). Among other species, helpers tend to be prereproductive siblings or subordinate group members whose own reproduction has been suppressed. In humans, however, postreproductive individuals constitute another important category of helper. In fact, Hrdy (2005) identifies grandmothers as the "ace in the hole" among a suite of potential helpers because of their unique combination of skill, relatedness, and postreproductive status.

In recent years, there has been a proliferation of studies demonstrating the evolutionary importance of grandmothers to both the reproductive success of their daughters (Bereczkei 1998; Lahdenpera et al. 2004; Leonetti et al. 2005) and the health and welfare of their grandchildren (Beise 2005; Gibson and Mace 2005; Hawkes et al. 1997; Leonetti et al. 2005; Ragsdale 2004; Sear and Mace 2008; Sear et al. 2000, 2002). Most of these studies focus on correlations between grandmaternal presence and health and welfare outcomes for mothers and children. Much less attention has been paid to the pathways through which grandmothers affect these outcomes.

Leonetti et al. (2005) provide data on three categories of help that grandmothers can potentially provide: subsistence provisioning, domestic labor, and child care. Although some important work has been done on the role of grandmothers in cooperative provisioning (Hawkes et al. 1997), there has been little direct behavioral observation of either child care or domestic labor that specifically contrasts the work of elder females with other categories of helpers (for an exception, see Hames 1988). This article focuses on the details of child care among a group of Martu Aborigines to ascertain how grandmother's care differs, quantitatively and qualitatively, from that of other nonmaternal caretakers.

The grandmaternal niche

Grandmothers possess a suite of traits that make them uniquely situated to perform direct care activities that have a positive impact at a relatively low cost. First, grandmothers are closely related to both their children and grandchildren, making them one among a select group of caretakers who would reap significant inclusive fitness benefits from helping to care for their kin. Second, grandmothers are relatively skilled and knowledgeable caretakers, most clearly demonstrated by the fact that they have raised their own offspring to the point of reproduction. In addition to the standard knowledge valuable in everyday caretaking, grandmothers are also more likely to possess specialized knowledge that is useful during critical times. The historical depth of memory that elders have accumulated has been shown to be valuable in responding to relatively rare but recurrent subsistence risk and other forms of environmental change (Cruikshank 2001; Minc 1986; Sobel and Bettles 2000). Similar knowledge about rare events such as childhood illness and injury or maternal dilemmas such as breastfeeding and weaning difficulties would be equally useful, particularly to first-time mothers. Finally, most grandmothers have completed their own childbearing and rearing, and so face fewer fitness trade-offs in diverting energy toward grandchildren than do other categories of allomothers. Although prepubescent children are also able to help at low cost to their own reproduction (Hames and Draper 2004; Henry et al. 2005; Kramer 2002; Turke 1988), these younger caretakers are unlikely to be as reliable as grandmothers, either in their judgment and skill set or in their focus on the task at hand.

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The importance of specialized care

Previous behavioral studies of direct care have focused mainly on who was doing the caretaking rather than what type of care was being given, with a few significant exceptions. Meehan (2005) looked at two categories of direct care: high investment and low investment, defining high-investment care as behaviors that require "intimate contact or direct attention." Hames (1988) distinguishes between active and passive care, where the former includes any type of care where the caretaker is solely engaged in that activity. Ivey (2000) makes a further distinction between "active care" and "physical contact," distinguishing between simple behaviors such as holding or playing and more time- and skill-intensive behaviors such as feeding, bathing, or soothing a crying child. Essential to Ivey's distinction is the ability to distinguish between critical and demanding caretaking and more social forms of care such as holding or playing with a child. Building from these previous distinctions, I dichotomize high-demand from low-demand care. High-demand caretaking includes all acts, that require primary focus on the child as well as a modicum of direct, skill-based interaction. Low-demand caretaking includes physical contact activities such as holding or touching as well as social (playing) and more detached (watching) tasks. The category of low-demand care can be subdivided into instances where the caregiver is providing sole attention to the child and those where the caregiver is multitasking.

Grandmothers possess several characteristics that make them more likely than other child-care providers to provide focused and demanding care. First, they are knowledgeable about how to complete caretaking tasks, and so would be less likely to have to turn to the mother or other caretaker for assistance. Second, grandmothers are more socially established than young girls or young men and are less likely to be actively engaged in competition for mates or friends. Effort expended by younger caretakers in these social endeavors may distract them from their caretaking and cause them to pass off a child more easily than would an elder caretaker. Grandmothers also have fewer reproductive trade-offs and so are less likely to have to care for their own children alongside their grandchildren than a mother's sister or cousin who is likely to bias her child-care efforts toward her own children. Therefore, I hypothesize that grandmothers will spend more time performing "high-demand" care than other nonmaternal caretakers. They should also spend less time multitasking than mothers and other reproductively active women, but not necessarily any more or less than siblings or other prereproductive caretakers.

STUDY POPULATION

The Martu (spelled Mardu in older orthographies) are a desert-living group of Aboriginal Australians, residing across the northwest portion of the Western Desert and identified with a few extant language groups including Kartujarra, Manyjilyjarra, Warnman and Nyangajarra (Tonkinson 1991; Walsh 1990). After a partially coerced exodus from their desert homeland during the middle years of the twentieth century, many Martu returned to their traditional lands and now reside in small outstations such as Parnngurr, the study site for this research. Today, Martu at Parnngurr continue to forage on a regular basis, although traditional techniques have been supplemented with modern hunting methods using rifles and 4WD vehicles (Bird et al. 2005; Bliege Bird and Bird 2005, 2008). Modern conveniences such as TVs and refrigerators are now common, although most cooking continues to be done at hearths outside of the house; sites that continue to be major focal points for social activity and conversation.

The core population of Parnngurr is around 100 people, although over the course of a year this could fluctuate from less than 20 to over 200 when there is a funeral or other ritual business being conducted. Households typically consist of extended families, including members of as many as four generations. The classificatory kinship system prohibits contact between certain family members, most notably mother-in-law and son-in-law (the *eumary* relationship), but modern architecture with separate entrances and covered walkways means even these relations can live in the same household. There is also great fluidity between households. Bedding is frequently picked up and moved from one household to another, and children regularly sleep at households away from their primary caretaker.

No previous quantitative data on child-rearing has been collected on the Martu, and previous ethnographies report only briefly on the details of child-care patterns in either traditional or modern settings. Tonkinson (1991) describes Martu parenting practice as "indulgent" and "child-centered," terms that are commonly used to describe child care across hunter-gatherer societies. Tonkinson's descriptions, although almost 30 years old and centered on practice in the bush, remain accurate in the current context. Children are independent from a young age and often travel with the community in small groups visiting various households and playing on their own. Babies are well-loved by everyone, and at public areas such as the shop or community office they are frequently passed from hand to hand and fussed over. Even the smallest infants are held by both children and adults of both sexes, although usually under the watchful eye of a mother or grandmother.

MATERIALS AND METHODS

Sampling

The main qualification for babies to be included in this dataset was that they be under 3 years of age at the start date of January 1, 2006. Because the population is extremely transient, it was important to identify a core set of babies who were likely to be in residence for the majority of the study and, therefore, would enable a sufficient number of data points to be collected per individual. Using data from two censuses, (August 2004 and November 2005), along with informal conversations about people's residential histories, I was able to define a core group of 10 babies ranging in age from 6 months to 2.9 years. A sub-sample was then chosen for focal follows, since this method is more time intensive to collect and more intrusive for participants. This sub-sample was made up of six babies, stratified by age and gender. Participants were chosen based on willingness of the primary caretaker to participate in this aspect of the study.

Data collection

Instantaneous scans were routinely conducted over 6 months (January to June, 2006). Scans were conducted

TABLE 1. Caregiving activities according to relationship to focal child

	Mothers	Fathers	Grandmothers	Siblings	Other relatives[a]	Nonrelatives
Average bout length (min)[b]	14.2 (n = 37)	8.0 (n = 1)	10.9 (n = 13)	4.0 (n = 8)	4.4 (n = 42)	3.8 (n = 47)
High-demand care (% of observations)						
Feeding	18.08	4.54	13.86	5.88	5.00	0
Bathing/grooming/changing	2.83		10.89	0	2.85	4.48
Soothing/disciplining	1.09	0	4.95	0	0	0
Active care total	22.00	4.54	29.70	5.88	7.85	4.48
Low-demand care (% of observations)						
Holding	13.67	18.18	18.81	44.12	31.43	23.88
Playing	1.08	4.54	0	20.59	3.57	7.46
Talking to	0.65	0	3.96	0	4.29	2.99
Noncontact observance	39.05	45.45	34.65	26.47	34.29	31.34
Passive care total	54.45	68.17	57.42	91.18	73.58	65.67
Multitasking[c] (% of observations)						
Socializing	4.12	0	6.93	2.94	1.43	1.49
Domestic labor	10.63	4.54	0	0	2.14	7.46
wage labor	5.64	0	1.98	0	0.70	0
Caring for other children	1.74	0	3.97	0	11.44	16.42
Other (driving, eating, etc.)	3.04	22.75	0	0	2.86	4.48
Multitasking total	25.16	27.29	12.88	2.94	18.57	29.85

[a]Other relatives include any family members with a degree of relatedness >0.0625.
[b]Mean bout length was calculated using the focal follow data on six babies. The number of bouts in each category is shown in parentheses.
[c]Multitasking is a subset of low-demand care where the caregiver is simultaneously caring for the focal child and engaging in another activity. There were no instances of multitasking in the high-demand category as one of the qualifications of high-demand care is primary attention on the focal individual.

by walking around the community, visiting both households and public buildings such as the shop and office, until all members of the main sample were found. At the time they were first seen, the behavior of the babies and the caregiver were recorded. No attempt was made to retrospectively determine who was caring for a baby who was not in the community during the scan period. Therefore, this study is limited to caretaking that took place within the community. Although Martu families are quite mobile and will often leave the community for a few days or even weeks at a time, when families are at home, young children spend the majority of their time in the community. A total of 111 scans were conducted, evenly spread across days of the week and all daylight hours (7 am to 7 pm).

In addition to spot sampling, the instantaneous scan dataset was expanded using focal follow data on a subsample of six babies. Unlike other focal follow data, which records behavior continuously, I recorded behavior and vocalizations of the focal individual and his or her caretaker at 2-min intervals during the follow. This was done so that the two datasets could be easily combined for analysis, essentially enabling me to convert the follow-up data into a series of scans. Focal follows were carried out in a mix of 1- and 2-h time blocks. The follows took place during daylight hours. The only prerequisite for the start of a follow was that the baby be awake, to have the highest chance of observing active caretaking events. Whenever possible, the whereabouts of the mother were recorded if she was not present during any portion of the follow. Just under 26 h of follow data were collected for the subsample of six babies. In total, 1,088 observations were recorded, 679 from follow data, and 409 from scans. Scan type (follow-up vs. spot) was controlled for in the analysis.

Coding

Data points from both the focal and spot scans were coded as either "high-demand" or "low-demand" caretaking. High-demand caretaking included bathing, grooming, feeding, nursing, changing, soothing, and disciplining. Low-demand caretaking included physical contact activities such as holding and pushing a stroller as well as playing and noncontact observance. When a baby simultaneously received both high-demand and low-demand care (e.g. being held and fed) the scan was recorded as high demand. To better understand differences in caregiver behavior, in addition to care received by the baby, instances where the caregiver was multitasking were identified within the low-demand care category. Multitasking included cases where the caregiver combined child care with other activities such as domestic work or minding children other than the focal individual. Because concentrated attention was a requirement for my definition of high-demand care, there were no instances of multitasking in this category.

Analysis

Primary descriptive analysis was used to break down the types of care provided by mothers and various categories of helpers (Table 1). The average caretaking bout length was constructed using focal follow data on the subsample of six babies, and was rounded off to the nearest 2-min interval. Small sample size precluded multivariate analysis of bout length.

Multivariate regression was used for the main analysis on high-demand caretaking. A logistic regression model was used to determine how various caretakers affect the level of high-demand care babies receive with a dependent variable of "high-demand care" (1 = high-demand care, 0 = low-demand care). The focal and scan data were combined in this analysis, as described above. Only those data points where one specific caretaker could be determined were included in this analysis, for a total of 874 out of 1,088 observations. Clustered robust standard errors were used to account for lack of independence in data points from the same baby. A dummy variable was created to identify the effects of various caretakers including mother, father, grandmother, grandfather, sibling, and "other relatives," with unrelated individuals as the reference category. Age and parity of the baby were also included in the

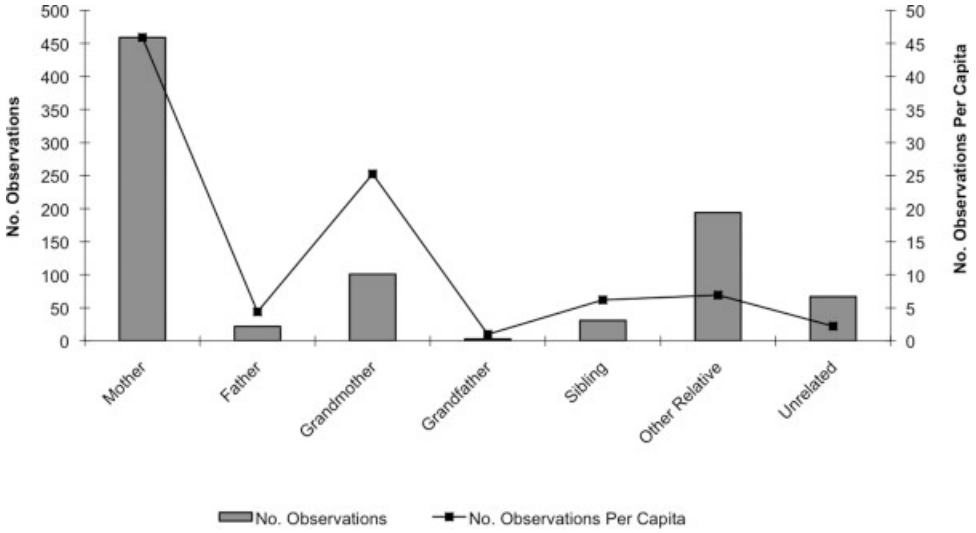

Fig. 1. Allocare provided to Martu babies aged 0-3yrs according to kinship category.

analysis, along with a variable for observation type (focal = 1, spot = 0).

RESULTS

Overall, Martu babies exhibit typical patterns of behavior. They are held 23.7% of the time; for the youngest age set (0–6 months) this number rises to 74.3%. Martu babies are not held as often as those among more traditional hunter-gatherers, due at least in part to the introduction of strollers and cribs (although the latter are still rarely used). Still, there is a much higher level of physical contact directed toward Martu babies than has been reported for American babies (Tulkin and Kagan, 1972). As expected, babies are more active and independent as they age, spending more time playing, and walking around. Crying and fussing are minimal, especially after the first 6 months.

Mothers spend more time caring for their children than any other caretaker type (see Fig. 1). Grandmothers also spend a great deal of time caring, more than fathers, siblings, or grandfathers. When the number of caretakers in each category are considered, the level of grandmaternal care rises considerably, while care given by other relatives and nonrelatives drops. Babies receive high-demand care 19.7% of the time. The raw data show that mothers provided the largest proportion of high-demand care, followed by grandmothers. However, when the data are adjusted, grandmothers are shown to make a contribution per capita that is almost equal to that of mothers (see Fig. 2).

Breakdowns of caregiver behavior are shown in Table 1. For each caregiver type, low-demand care greatly outweighs high-demand care, with grandmothers dedicating the largest proportion of their care to high-demand activities (29.70%), followed by mothers (22.00%). Although the majority of high-demand care that mothers provide is allocated to feeding or nursing, grandmothers spend more time on hygiene-related activities like bathing, grooming, and changing babies. Other caretakers spend only trivial amounts of time on high-demand care. Siblings spend almost half of their caregiving time holding babies, much more than either parent or grandmothers. They also spend almost triple the time playing with babies than any other category of caregiver. Other relatives and nonrelatives also spend proportionally more time holding babies than either parents or grandmothers.

Mothers and fathers spend more than a quarter of their time multitasking during child care (Table 1) but the activities they engage in differ considerably. When mothers multitask, they tend to combine care of the focal child with domestic labor activities such as cooking and cleaning. Fathers, on the other hand, tend to combine activities such as driving or eating, with child care. Grandmothers multitask less than all categories of caretaker except for siblings, and when they do, it is primarily to engage in social activities (mainly watching a child while conversing with other adults). Other relatives and nonrelatives spend considerable amounts of time multitasking, nonrelatives an even larger percentage of their caretaking time than mothers (29.85 vs. 25.16%). This is largely due to time spent caring for other children (usually their own) while also watching the focal child.

In the main logistic regression analysis, grandmothers were the only category of caretaker significantly more likely to provide high-demand care than a nonrelative (Table 2). Mother's effect was positive (OR = 6.62) but insignificant ($P = 0.062$). Grandfathers were dropped from the analysis due to a lack of data. Age also affected the likelihood of active caretaking, with younger babies significantly more likely to receive high-demand care than older babies. Scan type also was significant, with high-demand caregiving occurring about twice as often in the focal follows than in the instantaneous scans.

DISCUSSION

Grandmothers show the strongest positive trend among nonmaternal caregivers across these analyses. They are in contact with their grandchildren more than any relative other than the mother, and when they care, they are more likely to provide high-demand care than any other caretaker, including the mother. There were several

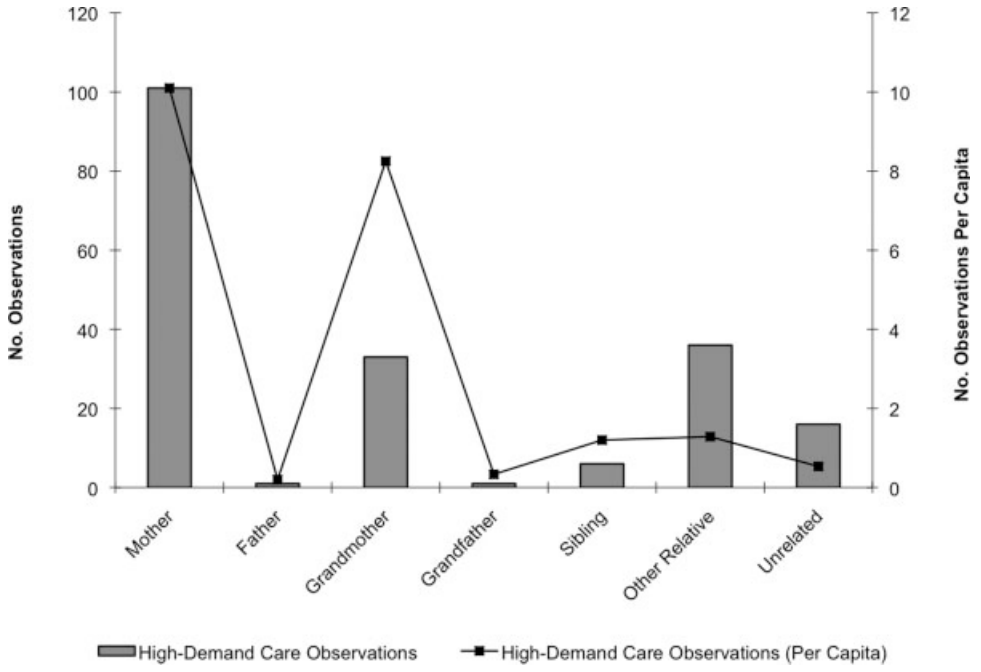

Fig. 2. High-demand caretaking of Martu babies according to kinship category.

instances over the course of this field research where this care was shown to be critical to children's health. In one instance, a baby was burned by hot tea and the grandmother was able to quickly find and prepare an antiseptic salve using local flora. In another instance, both a mother and her daughter had babies who were breastfeeding. The daughter developed an infection in her breast and was unable to breastfeed for a short period during the first few months after the baby was born. The grandmother took over the breastfeeding of her grandchild while her daughter healed and also provided the daughter with advice and instruction on ridding herself of the infection. Although these examples demonstrate how grandmothers can effectively use their unique combination of skill and experience to benefit children's welfare, the fact that they allocate more of their time to feeding, bathing, and other high-demand activities than other caretakers shows that even in everyday caretaking, grandmothers fill a special role.

In comparison with mothers, grandmothers are more likely to provide focused, high-demand care in any given caring observation. This result should be tempered by the fact that mothers provide more care overall, and therefore, the high-demand care they provide is likely to be diluted in analysis. Mothers, as the primary and most consistent caretakers, will necessarily have high variability in the treatment of their children. They clearly provide a lot of high-demand care, but they also are more likely to be recorded providing low-demand care since babies do not need high-demand care all of the time, and mothers spend more time caring overall. Therefore, while the percent of high-demand care provided by mothers is lower, the overall amount of high-demand care they provide is higher. Mothers also spend more time multitasking than grandmothers, which is expected considering that allocaretakers such as grandmothers are better able to choose when they care and can therefore minimize conflicts over their time. This is further emphasized by the fact the majority of mother's multitasking time is spent engaging in domestic or wage labor, while the majority of grandmother's multitasking is spent socializing.

TABLE 2. Logistic regression analysis of high-demand caretaking

Variable	Odds ratio	Robust SE	Z	95% CI
Scan type (0 = spot, 1 = follow)	0.551	0.113	−2.90**	0.368–0.824
Baby age	0.485	0.071	−4.97***	0.365–0.645
Birth order	0.926	0.047	−1.51	0.838–1.023
Mother	6.620	6.704	1.87	0.910–48.18
Father	1.609	1.659	0.46	0.213–12.15
Grandmother	11.439	11.044	11.44*	1.724–75.91
Sibling	1.343	1.437	0.28	0.165–10.94
Other relative	4.156	4.451	1.31	0.496–34.82

Results were clustered by baby to account for lack of independence between data points. Caretaker categories were converged into a dummy variable, with unrelated caregivers as the reference category. For example, grandmothers are shown to be significantly more likely to provide high-demand care than unrelated individuals, but siblings are not.
*$P < 0.05$, *$P < 0.01$, *$P < 0.001$.

Paternal care in this study was shown to be almost nonexistent. In fact, some men who were fathers were recorded caring for babies who were not their own, but were not recorded caring for their own children. When they care, fathers spend more than a quarter of their time multitasking. However, most cases of multitasking involved taking care of personal needs (driving, eating, etc.) while watching a child, whereas multitasking by mothers involved combining household work with child care. Although some cultural "rules" about child care as women's work show up in the rhetoric when young people discussed parenting, in general there are no stigmas or prohibitions associated with paternal care. One reason for the conspicuous lack of paternal care might be the age restrictions of this study. Although no scans

were done on children over the age of three, it was very common to see fathers with children between the ages of 3 and 6, and fathers appeared to be particularly involved with the eldest of multiple siblings. The interim period between weaning and regular school attendance might be a critical time for father's help if there are younger siblings who are drawing more resources from the mother. Further study on child care beyond the age of three could address this question. Fathers were also less likely to show up in the dataset than either mothers or grandmothers, as only 50% of babies had a known father present in the community. The high level of father absence is also likely to affect grandmaternal strategies, as the absence of the father may prompt more direct care by the grandmother to compensate. Although this sample is not large enough to statistically analyze this type of sub-group comparison, the only two cases where grandmother and mother were coresident both occurred in households where the father was absent. More father-centered data collection in future research would help to identify the details of how paternal and grandmaternal strategies interrelate (see Leonetti et al. 2007 for an example of this type of study).

Siblings provide low-demand care almost exclusively (94% of the time), focused mainly on holding, watching, and playing with babies. They spend very little of their time multitasking, meaning that although their care is classified as low-demand, they are quite focused on the task at hand. The small effect of siblings overall in these analyses may be partly circumstantial, as 40% of the babies in the sample were first-borns and another 30% did not have a sibling over the age of 5. Although these demographics reduce the probability of observing sibling caretakers, they also highlight the importance of grandmothers during the first years of a woman's childbearing career. In a paper on postmarital residence among precontact Martu, Scelza and Bliege Bird (2008) show that daughters are more likely to coreside with their mothers after marriage than are sons, a trend which is especially prominent when married daughters are younger and in the early stages of their reproductive careers. The evidence shown here suggests that one possible reason for these residence patterns is that daughters can get child care help from their mothers (and other relatives) in the years before their own children are old enough to assist them.

Care by grandfathers was minimal in this sample. When they did care, it tended to be in the presence of their wives, who were significant grandmaternal caretakers. There were several instances in the community where the grandmother was the primary caretaker (data from these grandmothers were not included in these analyses so as not to confound primary caretaking effects with grandmaternal ones) and in each of these cases, the grandfather provided a significant amount of care. Grandfathers have the potential to be important supplementary caretakers as they share many of the same characteristics that make grandmothers suitable caretakers, notably their social stability and lack of reproductive trade-offs. However, grandfathers rarely cared for babies when their wives weren't also important caretakers, suggesting that it is the grandmothers who are driving grandparental care in general.

CONCLUSION

The unique confluence of reproductive timing, high levels of knowledge and skill, and inclusive fitness benefits set grandmothers apart from other caretakers. Among the Martu, grandmothers take advantage of these circumstances and specialize in providing relatively high levels of high-demand care. This specialization is part of a complex web of support that mothers receive from various caretakers. Whereas siblings and other caretakers spend most of their time performing low-demand, but often very necessary, care; grandmothers focus more of their time on tasks which other caretakers are either less able or less willing to provide given their reproductive position and experience levels. A strategy of directed grandmaternal care has been previously proposed in regard to residence patterns, where grandmothers would position themselves in households where their help would have the biggest effect (Blurton Jones et al. 2005). Here, I suggest that grandmothers are filling a specialized niche at the micro-level, parsing out their help to the tasks for which they are best suited given their relative constraints and expertise.

Previous studies on the correlation between grandmother's presence and child growth and survival have established a causal pathway for the evolutionary importance of grandmothers. The work done by Hawkes et al. (1997, 1998, 2000) theorized that critical provisioning done by hard-working, postmenopausal women could have been the mechanism for this pathway during hominid history, and provided relevant modern data from the Hadza to illustrate the point. The data presented here are not applicable to the larger debate around why the postmenopausal lifespan evolved, as current Martu life-ways are not representative of the majority of human evolutionary history. It is probable, however, that allocare was an important component of intergenerational relationships throughout human history, particularly in societies where mothers and daughters retained contact after marriage, as well as in regions where female subsistence tasks hindered child-care abilities (e.g. small game hunting or high-mobility gathering). Grandmothers, in particular, may have played an important role in providing high-quality and reliable care for their grandchildren, particularly in the early years of her daughter's childbearing career, when other potential caretakers such as siblings were not yet available. The data presented here showing the active and consistent care that grandmothers can provide complements previous studies on critical provisioning by elder females and presents another pathway for grandmothers to provide vital help to their kin.

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