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A critical period for provisioning by Hadza men Implications for pair bonding

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Abstract

Human pair bonding is often attributed to the importance of male provisioning. However, this has been called into question in recent years. Among tropical hunter–gatherers like the Hadza of Tanzania, the foods that men acquire contribute less to the diet than women's foods, are acquired with less regularity, and are shared more widely outside the household. This forces us to ask what benefits forager women gain from being married. Here, I present data suggesting that Hadza women benefit from a husband's provisioning when they have young nurslings. During this critical period, women have lower foraging returns and return rates, while their husbands have higher returns. These higher returns are not due to more meat, but to less widely shared foods, like honey. Even if women are subsidizing husbands much of the time, provisioning by husbands during this critical period of lactation could be enough to favor pair bonding.

Keywords: Foraging; Hadza; Hunter–gatherers; Lactation; Male provisioning; Pair bonds; Parenting effort

1. Introduction

Human pair bonding has long been considered an adaptation to the demands placed upon mothers by needy offspring and the benefits of provisioning by a husband (Darwin, 1871; Lancaster & Lancaster, 1983; Lovejoy, 1981; Westermarck, 1929). This paternal investment theory of human pair bonding has been challenged over the past two decades. Using data on Hadza hunter–gatherers, Kristen Hawkes et al. have argued that pair bonds may have little to do with male provisioning (Hawkes, 1991; Hawkes, O'Connell, & Blurton Jones, 2001a).

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They note that big game is acquired so sporadically that a woman may go long periods without receiving any meat from her husband. Big game is also shared so evenly across households that the wife of a good hunter may receive no more meat than the wife of a poor hunter, or a single woman. Good hunters give out much more meat than they ever get back, so in-kind reciprocity does not appear to favor their households (Hawkes, O'Connell, & Blurton Jones, 2001b; Woodburn, 1998). Finally, among hunter–gatherers in warm climates, women usually contribute more to the diet than men (Kelly, 1995; Lee, 1968; Marlowe, 2001), which is true of the Hadza. Nevertheless, the trait most frequently cited by Hadza women as important in a potential husband is "good hunter" (Marlowe, ND-a).

I found that Hadza men with reputations as good hunters had more surviving offspring (Marlowe, 2000). Eric Smith reports similar results for other foragers. He argues (as does Hawkes) the link between successful hunting and reproductive success may be due to costly signaling (Smith, 2002). Because hunting is difficult, a woman might prefer to mate with a good hunter even if she gets no extra food, so long as hunting success is a reliable signal of male quality, for example, vigor (Hawkes & Bliege Bird, 2002; Smith & Bliege Bird, 2000). Hawkes et al. (2001a) found that Hadza men who were better hunters had wives and children with better nutrition. They argue that this is only because better hunters are married to better gatherers, because children's weight gains correlated with the mother's foraging returns, but not the father's. However, they did not distinguish stepfathers from fathers. This makes a difference in my data, with one third of all Hadza children $\leq$8 years old being stepchildren (Marlowe, 1999b).

A cross-species analysis of birds and mammals revealed that species in which parental care interferes with a mother's foraging were more likely to form pair bonds (Ember & Ember, 1979). Here, I present data suggesting that this same factor could be important in maintaining pair bonds among the Hadza and, by extension, other foragers. Even if a woman subsidizes her husband most of the time, she might still benefit if he subsidizes her during the period when she is nursing and has reduced foraging efficiency. Hadza men may be doing just that. Women with infants had lower foraging returns than other women. Their husbands had higher returns and brought in more food than other men, so long as the children at home were their own offspring and not their stepchildren. The extra calories they brought in did not come from big game but from nonmeat foods, especially honey. Therefore, despite the problem with big game hunting, which Hawkes et al. have pointed out, Hadza women may prefer good hunters because they do receive direct benefits from a husband's overall provisioning.

2. The Hadza

The Hadza are nomadic hunter–gatherers who number about 1000 and live in a savanna–woodland habitat in northern Tanzania. The average camp has 29 people and moves once every month or two, with people frequently moving in and out. Polygyny is rare; about 4% of men have two wives. Some couples stay married until death, but most people divorce at least once or twice. Couples shift their residence, but more often live with wife's kin than husband's kin.

Women dig wild tubers, gather berries, and collect baobab fruit. Men collect wild honey and baobab, and they hunt mammals and birds with bow and arrow. Hadza children forage for themselves from a very early age and are able to meet about half their needs by the time they are 10 years old (Blurton Jones, Hawkes, & O'Connell, 1989; Hawkes, Blurton Jones, & O'Connell, 1995).

The Hadza are egalitarian (Woodburn, 1982). Although some men are much better hunters than others, there is no clear dominance or status hierarchy. When medium to large game is brought into camp, it is shared quite evenly across households. When really large animals are killed, people will go to the kill site and carry their own shares back to camp. Honey is also sometimes shared widely, but its distribution can be targeted to particular individuals more easily because it is easier to hide than large game.

There is a dry season from June through November. During this time, camps grow larger because they must be near the few permanent waterholes. Normally, men hunt alone. However, during the late dry season, men hunt in pairs, waiting all night at a waterhole to ambush animals coming to drink. Rains last from December through May. During these months, honey, which the Hadza say is a good weaning food, becomes very important. Men collect honey alone or in pairs, but also often go collecting with their wives.

Hadza women forage in groups of three to eight, and they take their infants in a sling. Infants nurse on demand, nursing about 20% of the time soon after birth and about 5% of the time when they are over 1 year old. Children are usually completely weaned by age $2^1/_2-3$ years (Marlowe, 2002). Women usually do not take toddlers foraging because they are too small to keep up, but too big to carry. Therefore, someone must stay in camp to watch toddlers, and food must be taken back to provision them.

3. Methods

The data presented here were collected over 9 months in 1995–1996 in five different camps (population mean = 37, median = 24). All food arriving in camp was weighed and edible portions multiplied by caloric value of food type (Marlowe, 1997). This caloric score was divided by the number of days sampled in order to compute daily kilocalories (Kcal), which makes data comparable across camps. These data include only food that is brought back to camp, not what is consumed while out foraging, which is a considerable amount. However, because men forage alone most of the time, and because I am interested in provisioning, food arriving in camp is what matters. These data are only proxies for the actual amount of food eaten in the household, something that is difficult to measure, given how much sharing occurs and how quickly food disappears.

Instantaneous scan observations were conducted each hour to measure the time a person was in and out of camp. Time out of camp was used as a proxy for foraging time. Continuous observations of focal individuals were conducted for 30 min per bout on children ($\leq$8 years old) within three time blocks during daylight hours. From these, and from scan observations, I calculated nursing frequency.

Ages of all individuals were estimated and compared with previous data where birthyears and/or relative age rankings were known (Blurton Jones, personal communication). Paternity was assessed by asking men and several other people whether a child was the man's own offspring or his stepchild (for more details, see Marlowe, 1999a). I use the term "offspring" to refer to a man's own genetic offspring as opposed to his stepchild. Hunting reputation was calculated by asking adults to name the three best hunters they know and summing up the number of times a man was nominated.

In the five camps in this sample, there were 183 individuals altogether, but four of these appeared in two different camps, so $N = 187$ in Table 1 and the top row of Table 2. Seven of these people were excluded from the statistical analyses of the critical period effect, that is, when the sample consists of people with and without young children (for a complete explanation, see Appendix A). Statistical analyses included Pearson correlations, *t* tests, and multiple linear regressions.

4. Results

Table 1 shows the Hadza diet as measured by daily Kcal of food by type. The 6.6% of the diet consisting of maize and millet was given to the Hadza in the largest camp by a missionary, or acquired through trade with neighboring agro-pastoralists. Because much consumption occurs while foraging in the bush, the percent of domesticated food in the total diet was actually less than 6%. During the berry season, the bulk of the diet is berries, and because they are mostly eaten while foraging, they surely comprised a greater percent of the diet than Table 1 implies.

Hadza men (≥18 years old, $n = 51$) foraged 5.7 h/day, and women (≥18, $n = 59$) 4.2 h/day, on average. There was a slight dip in foraging time during the reproductive years for women (age 19–48 years). Table 1 shows that the food brought into camp by women, was comprised mostly of baobab and several species of tubers and berries. Of the food men brought into camp, only 40% was meat of all kinds, from small birds and mammals like bush babies

Table 1
The Hadza diet

Food contributed by:	(a) Berries (%)	(b) Tubers (%)	(c) Honey (%)	(d) Baobab (%)	(e) Meat (%)	(f) Maize/millet (%)	(a–f) Total (%)
(1) Both sexes of all ages	17.2	23.5	14.2	19.2	19.3	6.6	100
(2) Women (≥18 years old)	24.8	38.8	0.7	25.6	1.2	8.9	100
(3) Men (≥18 years old)	6.3	5	30.2	13.8	39.6	5.1	100

Percentages show the amount that each food type contributes to the total diet, as measured by daily Kcal of food brought into camp by: (1) people of all ages, (2) adult women, and (3) adult men.

Table 2
Hadza mean foraging returns as measured by daily Kcal of food brought into camp, and return rates (Kcal/h)

	Females		Males	
Sample	Kcal/day	Kcal/h	Kcal/day	Kcal/h
All ages ($N=187$)	2226 (58%)	561	1633 (42%)	343
	S.D. = 1866	S.D. = 463	S.D. = 1962	S.D. = 555
	($n=94$)	($n=94$)	($n=93$)	($n=93$)
Adults (18 and up)	3076 (57%)	795	2792 (43%)	597
	S.D. = 1726	S.D. = 414	S.D. = 1966	S.D. = 646
	($n=59$)	($n=59$)	($n=51$)	($n=51$)
Married adults	3016 (50%)	764	2990 (50%)	666
	S.D. = 1900	S.D. = 435	S.D. = 2025	S.D. = 706
	($n=41$)	($n=41$)	($n=40$)	($n=40$)
Married adults with offspring	2697 (47%)	768	3049 (53%)	642
<8 years old	S.D. = 2056	S.D. = 550	S.D. = 2369	S.D. = 855
	($n=19$)	($n=19$)	($n=18$)	($n=18$)
Married adults with offspring	2346 (42%)	693	3227 (58%)	678
<3 years old	S.D. = 1650	S.D. = 476	S.D. = 2316	S.D. = 867
	($n=17$)	($n=17$)	($n=17$)	($n=17$)
Married adults with offspring	1713 (31%)	451	3851 (69%)	690
<1 year old	S.D. = 1409	S.D. = 332	S.D. = 1283	S.D. = 137
	($n=6$)	($n=6$)	($n=6$)	($n=6$)

Percentages in parentheses next to daily Kcal are the proportion of the whole diet (100%) contributed by males and females within the sample in each row. Note that while women's returns decline with younger children, men's returns increase.

(*Galago senegalensis*), to the largest game, giraffe (*Giraffa camelopardalis*). Honey accounted for 30% and baobab 14% of the daily Kcal men brought into camp. This is important because men often sneak honey into their huts. It is only medium-sized and larger game that is shared so evenly across households. Big game is not only shared with others in camp, but even with people from other camps. For example, 27.2% of all meat arriving in camp in 1995/1996 was killed by a man from a different camp.

Table 2 shows how many daily Kcal males and females of various categories brought into camp. Adult females brought into camp 3076 daily Kcal (57% of the adult total) and adult males 2792 daily Kcal (43% of the adult total). The relative contribution by sex was about equal for adults who were married. Among couples with young offspring, paternal contribution was greater than maternal contribution. Among those with an offspring under 3 years old, men accounted for 58% of daily Kcal, and 69% of daily Kcal among those with an offspring under 1 year old. These data alone suggest that men might be provisioning in a way that benefits their wives when they have young offspring.

It is clear that women with nursing children could benefit from help with provisioning. Married women who were nursing brought in fewer daily Kcal than married women who were not ($t=2.41$, $P=.021$, $df=35$), and the more frequently a woman nursed, the lower were her returns ($r=-.329$, $P=.047$, $n=37$). In addition, among women with a child under 3

years old, the younger a woman's youngest child was, the lower was her hourly return rate ($r = .629$, $P = .009$, $n = 16$) (Fig. 1).

To assess the potential benefit of a husband's provisioning more precisely, I analyzed the returns of couples. I subtracted from each woman's own returns the returns of her husband. The more negative the number, the more a husband compensates for his wife's returns. I limited the sample to people aged 18–65 to exclude the very old, but not exclude some fathers. Even though women are not caring for their own young children beyond their early 50's, some men do have very young children at 65. Therefore, I controlled for age in the following analyses.

Among all married women without a child under 1 year old, women actually brought in slightly more daily Kcal than their husbands. However, among married women with a child under 1 year old that was the offspring of her husband, women brought in an average of 2138 daily Kcal less than their husbands. Having an offspring under one year old was a significant predictor of the gap between a man's returns and those of his wife ($\beta = -.387$, $P = .030$, $df = 30$, controlled for the woman's age) (Fig. 2).

Husbands appear to compensate for their wives' returns until about the time of weaning. Women who had children less than 3 years of age that were the offspring of their husband brought in less food than their husbands, whereas those who did not brought in more food than their husbands. Having an offspring under 3 years old was also a significant predictor of

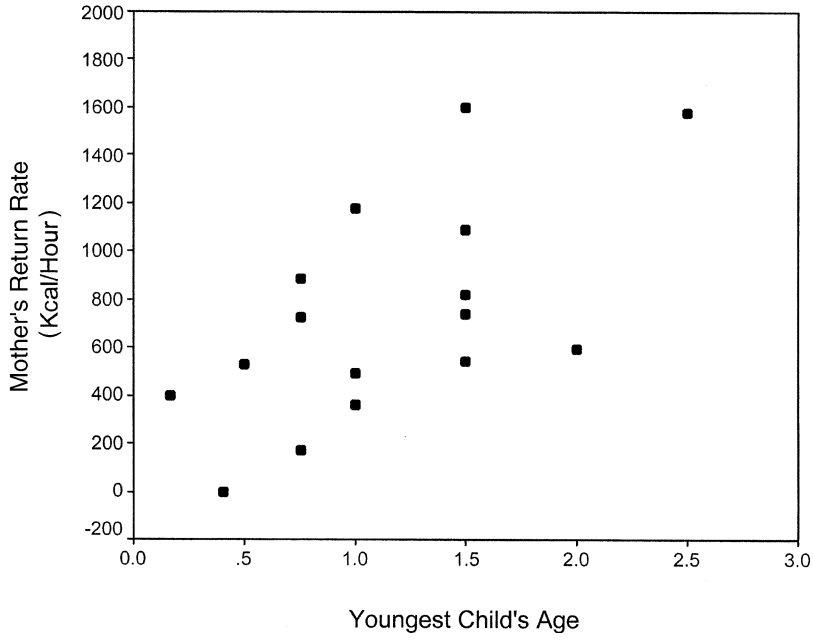

Fig. 1. Foraging return rate, as measured by daily Kcal of food taken back to camp by women per hour of foraging time, by the age of a woman's youngest offspring ($r = .629$, $P = .009$, $n = 16$). The data show a newborn lowers a woman's foraging efficiency.

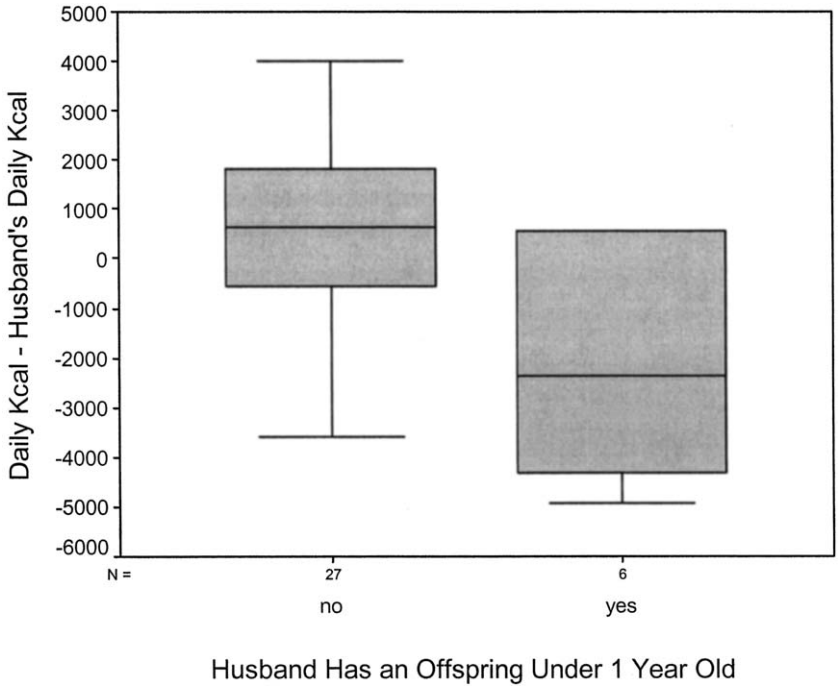

Fig. 2. Foraging returns, as measured by daily Kcal that a woman takes back to camp, minus the daily Kcal that her husband takes back to camp, for couples (age 18–65) with, and without, a child under 1 year old who is the offspring of the husband. The presence of an offspring under 1 year old predicts a greater amount of food brought back by a husband relative to his wife ($\beta = -.387$, $P = .030$, $df = 30$, controlled for the woman's age). Lines inside boxes show medians, box boundaries show quartiles, and T's show extremes.

the gap between a couple's daily Kcal ($\beta = -.366$, $P = .048$, $df = 30$, controlled for the woman's age).

This disparity between a couple's returns is not due merely to the lower returns of women with young children. Men who had an offspring ≤8 years old at home, young enough to still require considerable provisioning, brought in more daily Kcal than men who did not ($\beta = .358$, $P = .029$, $df = 36$, controlled for the man's age).

Some men had both their own offspring and stepchildren at home, and the presence of a stepchild was associated with lower returns for men. After controlling for the presence of a stepchild ≤8 years old, married men brought in more daily Kcal if their youngest offspring was younger. The presence of an offspring ≤8 years old predicted higher returns for men ($\beta = .379$, $P = .022$, $df = 35$, controlled for the man's age). Without controlling for the presence of a stepchild, this relationship was obscured.

The difference between the returns of men who did, and did not, have offspring ≤8 years old at home was greater when meat was excluded from the analysis. Men who had offspring ≤8 years old at home had higher nonmeat returns than men who did not ($\beta = .464$, $P = .004$, $df = 36$, controlled for the man's age). This was due largely to those men getting more honey

($\beta = .387$, $P = .018$, $df = 36$, controlled for the man's age). There was no difference between men who did, and did not, have young offspring in terms of daily Kcal of meat. Focusing only on meat, therefore, obscures the benefits of a husband's provisioning, just as does ignoring the presence of a stepchild.

As long as men do not focus exclusively on big game, hunting may not be such a poor strategy for household provisioning. Hunting reputation was correlated with men's meat returns ($r = .275$, $P = .051$, $n = 51$), but more strongly correlated with nonmeat returns ($r = .341$, $P = .014$, $n = 51$). It was most strongly correlated with total returns of all foods ($r = .375$, $P = .007$, $n = 51$). Returns of all foods were even more highly correlated with nonmeat ($r = .862$, $P = .000$, $n = 51$) than meat returns ($r = .486$, $P = .000$, $n = 51$). Men with reputations as good hunters, therefore, are not just good at getting big game, but also good at acquiring all types of food.

5. Discussion

These data show that an infant lowers a Hadza mother's foraging efficiency. Similar findings have been reported for the Hiwi and Ache (Hurtado, Hill, Kaplan, & Hurtado, 1992), and even for the Hadza (Hawkes et al., 2001a). What I add here is that Hadza husbands compensate for their wives' lower returns if they have young offspring. My data are only proxies for household provisioning. However, because men with young offspring brought in the same amount of meat as other men, plus more of other foods like honey, their higher returns probably resulted in more food going to their own households.

Hawkes et al. have argued that hunting is not an efficient strategy for provisioning one's household. They have described Hadza men as targeting big game, whereas I found them willing to shoot at almost any mammal or bird they felt they could hit (see Appendix B). Hadza men do express a preference for larger game because, as they say, "there is more meat." Even though big game is shared more widely in camp than small game, in each encounter with a prey animal the hunter gets more absolute kilograms of meat (and so do others) when he kills a big animal than a small animal. For example, 1/20th of a 200-kg zebra shared by 20 people is greater than 1/2 of a 5-kg rock hyrax shared by two people, so Hadza men are happier when they encounter a zebra than a rock hyrax. Therefore, as long as men are not targeting big game exclusively, taking big game when possible is not a bad strategy for household provisioning.

Foraging men may specialize in meat and honey because these foods have the highest trade value with women. A Hadza woman is undoubtedly more pleased if her husband comes home with meat or honey rather than extra piles of tubers and berries, which she can get herself. It is because women acquire foods that can be counted on everyday that men are free to pursue less predictable, but potentially more rewarding foods. Still, when men failed to kill game or find honey, I often saw them stop on the way home to get baobab fruit to take back. Hawkes et al. interpret much food sharing as tolerated scrounging, and I agree (Blurton Jones, 1987; Hawkes, 1992; Hawkes et al., 2001b; Marlowe, ND-b). When a Hadza man has food (especially meat) and others see it, he feels he simply must share it. However, what others do

not see, one does not have to share. In larger camps, people sometimes waited just outside camp until dark then signaled me to come and weigh their food, but to be discreet about it. When Hadza men sneak food into their huts, they tell me that they are doing so because they want to feed their family. Men do indeed lose much of their food to tolerated scrounging, as Hawkes et al. note, but this should not count as evidence that they are uninterested in provisioning their households. That would only be true if men were passing up foods that are less likely to be scrounged but still highly valued by their wives, which is something I did not see.

There are several ways besides costly signaling that it could pay a woman to marry a good hunter even if his food is widely shared. (1) Variance in daily family consumption should be reduced if, in general, he targets different foods than she does (Winterhalder, 1986). (2) If his gifts of meat were repaid with nonmeat foods, variance would be reduced and diet breadth increased. (3) If many of those in camp receiving his meat were her close kin, she may gain inclusive fitness benefits. (4) She should always be living in a camp with at least one good hunter (her husband). Even if she receives only a little more food than other women do in the short term, this could add up to a significant benefit in the long run. Hawkes et al. (2001a) have argued that provisioning by a woman's mother is more important than provisioning by her husband. However, there is no reason not to get help from both, or whichever one is available, as Hadza women do with direct childcare (Marlowe, 2002).

There are reasons to suspect that Hadza women gain some economic benefit from a husband. They cite "good hunter" as the single most important trait in a potential husband (Marlowe, ND-a). They get angry when they catch their husbands pursuing other women; if they did not risk losing some benefit, it is difficult to see why they should get jealous. Men say they feel pressure from their mothers-in-law to be productive foragers. Men with reputations as good hunters (who, as I show here, are good foragers in general), have higher reproductive success. Good hunters do not have more wives over their lifetimes, but they do have a better chance of marrying reproductive-aged women after their previous wives reach menopause (Marlowe, 2000). The most parsimonious explanation to account for all of these observations is that a wife can receive direct benefits from her husband's provisioning. He does not even need to bring home more food than her, just more than he consumes (of his food and hers).

There is an alternative interpretation of these data that is more consistent with costly signaling. If the best hunters are desired by females for their inherent qualities, not for their household provisioning, then better hunters should have first choice of wives. If better hunters choose younger, more fecund women, they should be more likely to have young offspring. This could result in a correlation between having a young offspring and having higher foraging returns (as observed here). One strike against this interpretation, however, is that most Hadza men do get married and reproduce. It seems unlikely that the chance of having a young offspring would be so much greater for the best hunters, great enough to account for these results. It is more plausible that men increase the amount of food that they take back to camp, at least a bit, when they have young offspring.

Women's foraging strategies surely reflect parenting effort more than men's do (Bird, 1999; Hawkes et al., 2001a; Marlowe, 1999b), yet male provisioning could still be an

important factor in pair bonding. Men's foraging might be motivated by gains from increased mate access and retention, rather than increased offspring survivorship. Pair bonds could be a mate-guarding strategy for males, but a way to get help with rearing children for females. Still, in the data presented here, the presence of a stepchild did make a difference. This means that either (a) men are less motivated to provision unrelated children, or (b) better foragers are less likely to be living with a stepchild. If the latter is true, it would presumably be because good foragers have higher mate value, which affords them greater choice of mates, and they more often choose to marry women who do not already have other men's young children. Either way, paternity matters, as it should. Even if mate acquisition and retention is what motivates a man's foraging, he gets more fitness benefit if his food goes to feed his own offspring rather than his stepchildren.

The paternal investment theory of pair bonding tends to put the cart before the horse by suggesting men provision because offspring are needy. Surely, ancestral females did not begin to bear offspring so needy that they could not rear them on their own before others began to acquire more food than they consumed. The surplus production that makes provisioning possible must have come first. Life history then coevolved with provisioning. Women in many societies like the Hadza can rear offspring without husbands. However, they may take longer to conceive the next child, especially if they do not have a mother around to help. If so, women should be able to rear more offspring in less time when they have a husband providing food (Marlowe, 2001).

In conclusion, Hawkes and colleagues have greatly advanced our understanding of hunter-gatherer mating systems by exposing problems with the paternal investment theory. However, the pendulum may now be swinging too far in the opposite direction because they have focused too much on big game hunting and too little on the difference between fathers and stepfathers. Hadza men acquire foods other than big game. This means that despite widespread sharing, much of their food probably stays in the household. Hadza women are less efficient foragers when they are burdened with infants and toddlers. During this period, their husbands bring in more food, but only if the young children are not their stepchildren. Women stand to benefit most from provisioning when lactation places the greatest demands upon them. At that time, they are less likely to be ovulating, and should be less sexually desirable. Without pair bonds then, this is just when they should be least likely to get food from males. Offering men increased paternity confidence through pair bonding may be the best strategy for women to gain provisioning for themselves and their children during this critical period.

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Appendix A. People excluded

I worked in six camps but one whole camp was excluded because it was close to a village where both men and women, but especially men, went almost everyday in search of alcohol and where foraging was quite altered by normal bush standards. All 187 people in the other five camps were included in Table 1, and in the top row of Table 2 where $N = 187$ (actually 183 people, but 4 people appeared in two camps).

In statistical analyses of the critical period, that is, when the sample is married couples with and without young children, or men with and without young children, the people described below were excluded from the total of 187.

Two married men with young offspring were excluded because they were disabled and did not forage at all. One had recently broken his arm badly and could not use a bow. He stayed in camp with his young offspring, while his wife brought in more daily Kcal than any other person. The other man had severe asthma. He and his wife normally spent most of their time in a village. Both he and his wife stayed in camp all day long and brought in no food, being fed by relatives. A third man who was blind, not married, had no children, and brought in no food was also excluded.

One woman appeared in two different camps with her infant. Her husband was the only man in the sample with two wives, and he frequently traveled between the two different camps where his wives lived. While the wife with an infant resided in the first camp, he appeared only sporadically. In the second camp, she moved in with him and his other wife. Data used on this couple come only from the second camp because only there was the couple actually frequently together. Another woman with a young child had a husband who was gone most everyday for a month pursuing a younger woman in another camp. When he returned briefly his wife yelled at him all day. This couple is also excluded. Both of these couples divorced soon afterwards.

One might object to excluding these subjects, but their exclusion reveals that when a man is disabled, or when a marriage is unraveling, provisioning levels are affected, just as they are if men are unmotivated to provision a stepchild. The inclusion or exclusion of these cases actually sheds light on the potential for women to benefit.

Finally, two other men were excluded. One is an outlier excluded simply because, if he is not, his extremely high returns for a brief period of extraordinary hunting success obscure the results presented here. Because this man had such high returns and happened to have no young offspring, the results presented here are not significant unless another man, who did have a young offspring, is included. However, I excluded this other man because scoring his returns is problematic. If I score all the meat from a buffalo as his returns, then he also has incredibly high returns, and because he does have a young offspring, these results are significant. This buffalo, however, was actually killed, along with another one, by neighboring Datoga pastoralists. They gave one buffalo to him as repayment of meat that they had received from him in the past, according to him. Although he did not kill the buffalo, perhaps it should be counted as his. However, because several men and women went to carry the meat back, I gave credit to each one of these people for the amount each brought in (in Table 1, these meat Kcal are assigned to the total for males). Because I must exclude the one

successful hunter without any young child to find these significant results, it seemed only fair to also exclude the other man as well, because he did not actually kill the buffalo. The important thing is that if I leave both of these men in, all the significant results reported here do hold.

Appendix B

Perhaps I observed less big game hunting in 1995–1996 than Hawkes et al. did in 1985–1986. Although they provide no figures on the percent of the diet that was meat, I found it to be 19.3% of daily Kcal, which appears to be no less than what Woodburn (1968) observed in the early 1960s. He estimated 20% of the diet by weight was meat and honey combined. Meat and honey accounted for 22.2% of the diet by weight in my data.

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