
Comment

On Fitness Maximization, Limited Needs, and Hunter-Gatherer Time Allocation

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INTRODUCTION

In a recent issue of this journal, Hawkes et al. (1985), hereafter referred to as HOHC, contrast the logic and empirical predictions of what they term the "limited needs" view of hunter-gatherer foraging effort with the "fitness maximization" model they derive from evolutionary biology. This comment addresses what I feel are some serious problems with their argument.¹

HOHC make the following claims: (1) The postulate of fitness maximization coupled with knowledge of the situation hunter-gatherers commonly face support the prediction that there will usually be a direct and positive relationship between foraging time and fitness. (2) The limited-needs postulate that dominates most anthropological studies of hunter-gatherers assumes that foragers will adjust their foraging effort so as to meet fixed food requirements for themselves and their immediate family on a daily basis. (3) The bulk of the available data on human foragers supports the

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¹ Let me state at the outset that I share HOHC's general goal of using formal models of foraging effort, and theory from evolutionary ecology, to understand human behavior (e.g., Smith 1983a, 1983b). In the present case, however, we differ substantially with regard to the implications of the relevant theory. In offering these criticisms and clarifications, I am not claiming that the faults I see with the HOHC paper apply to any or all of the other works on time allocation written by these authors. Written and oral communications from two of the authors (Hill and Charnov) indicate they no longer endorse some of the conclusions reached in the paper, and consider it out of date. This is a normal pattern in scholarly inquiry, including (perhaps especially) rapidly developing areas of science like human behavioral ecology. As noted in the text, Hill in particular has authored or coauthored a number of papers on Aché time allocation that advance more detailed arguments for what I call the "quantity-maximizing" strategy. Be that as it may, HOHC is a recent publication, and makes a number of strong claims in a prominent forum; timely and critical evaluation of these claims seems fully justified in this light.

fitness-maximizing view of increasing effort with increasing harvest rates, rather than the limited-needs view of decreasing effort with better foraging returns.

An examination of the logic underlying HOHC's model, the manner in which they link it to natural selection theory, and the social and economic contexts of hunter-gatherer foraging strategies, leads me to question each of the arguments just summarized. Specifically, I defend the following claims: (1) The economic and ecological theory of time allocation defines a continuum of foraging strategies, ranging from "quantity-maximizing" at one extreme to "time-minimizing" at the other (these terms are defined below). (2) HOHC's arguments linking one of these strategies—quantity maximizing—more closely to (evolutionary) theory and (hunter-gatherer) evidence than time-minimizing are arbitrary and not well-supported. (3) The limited needs view need not be—and, for many anthropologists, probably is not—conceived of in a way that makes it so contradictory to the theory of natural selection or optimal foraging. (4) In order to make fuller use of the evolutionary ecology approach, we need to place foraging decisions in a broader socioeconomic context than that considered by HOHC; such considerations suggest why some groups, such as the Aché, behave like quantity-maximizers whereas others may not.

THE LOGIC OF INCOME/LEISURE TRADEOFFS

The model presented by HOHC is based on several standard assumptions of the neoclassical theory of consumer choice, which I review briefly here before taking up the specifics of applying this theory to study foraging time allocation. The key assumptions are two: (1) the return from marginal increments of effort allocated to any activity (such as resource procurement) exhibits diminishing value; and (2) the effort allocated to any activity entails "opportunity costs" in that this same effort cannot be allocated to some other value-producing activities. These two conditions—diminishing returns, and scarcity of means relative to ends—define a tradeoff between any two goods or activities that require the same scarce means and yield value in some common currency. The usual method of modeling this tradeoff is in terms of "indifference curves" whose changing slopes signify the marginal rates of substitution between effort allocated to these goods or activities that will maximize total value (at any given level of total effort). In other words, the model predicts that any actor interested in maximizing total gains from the competing ends will allocate effort (or wealth) so as to equalize the marginal value gained from each; hence resources should be invested preferentially in activity or good A as long as the marginal return from doing so is greater than that obtained from investment in B (for further details, see any introductory microeconomics text).

The relevance of this theory to foraging time allocation was first dis-

cussed by Winterhalder (1983), who still provides the most complete discussion. In the simplest case, the resource invested is time, the investment alternatives are foraging versus other activities, and the return on time investment is measured in marginal increments of fitness (rather than utility), so that the indifference curves are actually conceived of as fitness isoclines. Selection favors foragers who vary their time allocation under different conditions so as to equalize the marginal fitness returns from foraging versus other activities (HOHC, p. 6). It follows that whenever an individual can gain more fitness from another hour spent foraging than gained from the same hour spent in other activities, his/her fitness is "energy-limited" (or more generally, resource-limited), and conversely an individual with high opportunity costs can gain more from ceasing to forage and is "time-limited" (Smith 1979; Winterhalder 1983).

Following Schoener (1971, p. 376), in optimal foraging theory the distinction between strategies favored under resource-limited conditions versus those favored under time-limited ones is conventionally labeled "energy-maximizing" (or more generally, quantity-maximizing) and "time-minimizing," respectively (Pyke, Pulliam, and Charnov 1977, p. 139; Smith 1979, pp. 61–62; Winterhalder 1983, p. 76). Quantity-maximizing foraging strategies are favored whenever the fitness returns of an additional unit of quantity harvested are greater than the return from investing the time and effort required to obtain this same quantity in some other (nonforaging) activity; conversely, time-minimizing strategies are favored when marginal returns from nonforaging activities are higher than those obtained from foraging. However, this distinction can be misleading if taken too rigidly, because it suggests a simple dichotomy rather than a more plausible continuum between two extremes, and because various circumstances may lead foragers to shift from one type of strategy to another, as discussed below.

HOHC (as well as Winterhalder 1983) use separate graphs to model quantity-maximizers (their Figure 1) and time-minimizers (their Figure 2), but it is instructive to combine these so as to model time allocation strategies along a continuum, as done here (Fig. 1).² Doing so reveals that even holding the fitness isocline map constant, the optimal time allocation strategy can shift from quantity-maximizing to time-minimizing (or vice versa) as foraging conditions change. This implies that the same individual may be either a time-minimizer or a quantity-maximizer, depending on conditions, and that without further argument either state is equally likely. The only general statement that can be made with this model, then, is that *at some point* (defined by the particular isocline map) increased foraging return rates shift

² Unlike Winterhalder (1983), for some reason HOHC have drawn their isofitness graphs differently than is conventional for indifference curves. However, other than the somewhat problematic feature that the isofitness curves actually intersect the vertical axis (rather than remaining asymptotic as in the conventional graphs), these graphs can be interpreted in the same basic manner as those in the standard format. In order to facilitate direct comparison with the HOHC graphs, I have adhered to their format.

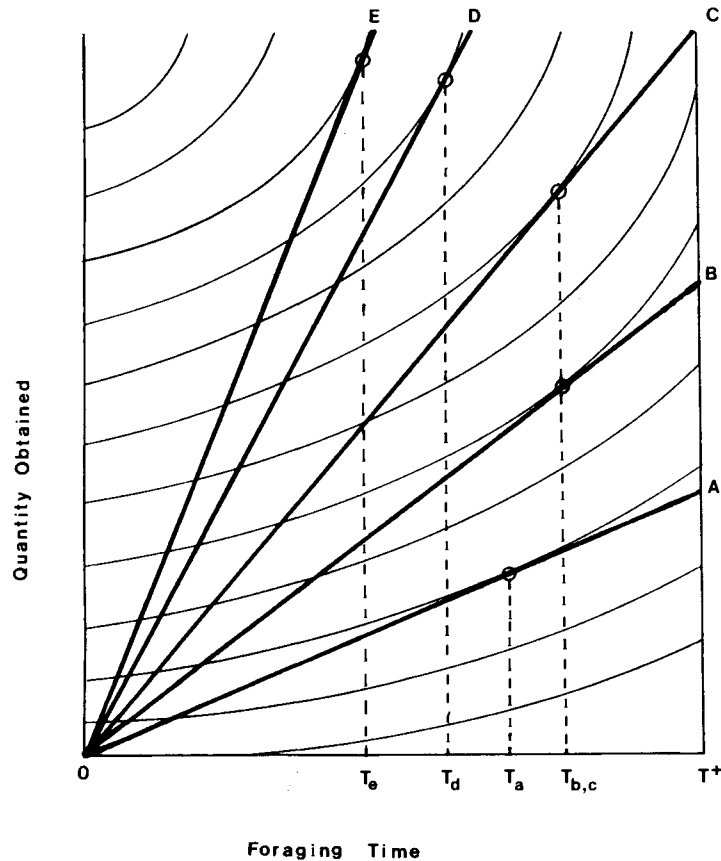


FIGURE 1. Optimal time allocation to foraging under variable return rates and opportunity costs. Time available for foraging varies from zero (0) to T^* (e.g., 24 hours per day). Curved lines represent fitness isoclines, with fitness increasing from lower right to upper left of the graph. Rays from the origin (A, B, etc.) represent different average rates of return, with steeper positive slopes signifying increasing rates ($A < B < C$, etc.). Optimal time allocations to foraging shift as a function of changing rates, and occur at the point vertically below the highest tangency between a return rate ray and a fitness isocline (marked by open circles). Thus, for rate A, the optimal time T_a is less than for rate B (T_b), indicating that over this range of return rates the forager is a quantity-maximizer as defined in the text (the marginal value of an additional unit of time invested in foraging increases faster than the marginal value of time invested in other activities). The optimal time allocation when return rates equal C is the same as for B ($T_b = T_c$), indicating an intermediate position, while return rates higher than C (e.g., D and E) lead to time-minimizing strategies (the optimal time allocation to foraging declines as return rates increase).

the optimal time allocation to reduced foraging effort, whereas below that point increased return rates should elicit increased effort.

The primary reasons we can expect foragers to vary their time allocation strategies, and to shift from quantity-maximizing to time-minimizing, are the same reasons at the very basis of the marginal tradeoff model: diminishing returns, and opportunity costs. The first reason refers to the assumption that the marginal value of foraged goods declines (e.g., the fifth kilo of food taken in a day is "worth" less than the fourth), so that as more and more time is spent foraging less fitness or utility is gained per unit time, even at constant rates of harvest.³ Second, lengthening the foraging period necessarily entails higher opportunity costs as less time becomes available for other beneficial activities (rest, resource consumption, and social interactions), and at some point these costs must outweigh the benefits of increased foraging returns.

Although HOHC recognize both of these factors, they do not take the second one seriously enough. I say this for two reasons. First, they state as a general assumption of their model that there is a "direct relationship" between foraging time, yield, and fitness, so that "the more time spent hunting, the more game acquired, the greater the fitness gain" (p. 5); but this condition actually only holds when the opportunity costs of foraging are lower than the benefits of additional harvest (i.e., in the quantity-limited domain). Once opportunity costs are high enough foraging time has an *inverse* relationship to fitness (fitness is time-limited).

Second, at several critical junctures HOHC invoke the assumption that returns from other activities (and hence opportunity costs) *remain constant*, as in the caption to their Figure 1, and in the following passage:

As long as fitness payoffs for a high return activity increase with greater investment while those from available alternatives remain constant, fitness is maximized by devoting more time to the high return activity (p. 6).

In this and similar passages, HOHC appear to confuse constancy of return rates with constancy of *returns* (total yield). That is, they make reference to "constant returns" from alternative activities; yet given the reasonable assumption that these activities require time, the model they employ predicts that allocating more time to foraging will necessarily reduce absolute returns from competing activities since less time will be devoted to these. The only ways around this result are if (1) opportunity costs vanish because fitness

³ Like HOHC, I have drawn the return rate functions (A, B, etc. in Fig. 1) as straight lines, indicating constant returns per unit foraging time. Realistically, these functions are more likely to be decelerating (show diminishing returns in harvest per unit time) as a result of localized depletion and/or increasing fatigue; this is the standard assumption in the marginal value theorem for time allocation to patches in optimal foraging theory (Charnov 1976; McNair 1982). Incorporating this into the model would lead to a switch from quantity-maximizing to time-minimizing as the optimal strategy *at an earlier point in time* (e.g., earlier in the day) than would be true for linear return rate functions with the same mean rate of return. Although not explored here, the implications of this result serve to further weaken HOHC's arguments for the ubiquity of quantity-maximizing strategies among human foragers. (Thanks to Carolyn Harper for bringing up this point.)

gains from alternative activities fall to zero (itself a “limited needs” assumption about these activities, which include everything besides collecting resources), or (2) the fitness return rates from alternatives to foraging just happen to increase in synchrony and exact proportionality with the return rates from foraging, so as to exactly compensate for reduced time investment in them (a rather improbable occurrence). As long as time has opportunity costs, (or in HOHC’s terms, as long as all time is allocated to fitness-enhancing activities), then it is unlikely that returns from other activities “remain constant” while foraging time increases.

Despite these problems, HOHC recognize that time-minimizing strategies are consistent with evolutionary theory. However, they expect that these will be “fairly rare” whereas the quantity-maximizing alternative will be “fairly common” among human foragers (p. 6). The major reason they give for this expectation is that:

hunters use food to gain fitness in many different ways, not only to meet their own nutritional needs and those of their close kin but also to attract mates and to give away to others in return for future assistance, cooperation, and alliance (p. 5).

Although I agree that humans have a multitude of uses for foraged goods, I find this a weak basis for predicting the prevalence of quantity-maximizing strategies among human foragers.

The problem with HOHC’s argument here is that diminishing returns and increasing opportunity costs do not go away simply because of multiple uses for harvested resources. Even when there are multiple fitness-enhancing uses for additional production, foragers can—and eventually must—reach some plateau where the marginal return on foraging time will be less than that from other activities (or even fall to zero if they harvest more resources than they can exchange, store, or otherwise convert into fitness enhancement). And even if multiple uses for foraged goods cause returns from foraging to diminish more slowly than they would if foragers did not exchange their products, we must remember that human foragers also have multiple and extraordinary uses for time not devoted to production. These alternatives must be balanced against the multiple benefits of more meat to distribute or display.

Indeed, the “multiple avenues of fitness enhancement” argument can easily be stood on its head: with so many fitness-enhancing ways of allocating time, such as extended parental care, tool production and maintenance, political intrigue, displays of ritual ability, and so on, human foragers should usually be time-minimizers. This is at least as plausible as the argument for quantity-maximizing presented by HOHC, though just as incomplete. I see no theoretical basis for preferring one assumption over the other. Preferable to either prejudice is a recognition that theory holds shifts between time-minimizing and quantity-maximizing to be both possible and expectable—indeed, that they are part of a single strategy of optimal time allocation.

This theoretical result—that increased returns per unit labor time can lead first to increases and then to decreases in the optimal amount of time allocated to work—is one that is well-established in neoclassical economics, where it goes under the label of the “income–leisure tradeoff” (e.g., Hirshleifer 1980, pp. 451ff; Nicholson 1983, pp. 487ff). Specifically, it is recognized that increases in wages (return rates to labor time) have two opposing effects on time allocation: the “income effect” and the “substitution effect.”⁴ The substitution effect refers here to an increase in the cost of “leisure” (where “leisure” is a label for any activities other than income production), as the higher returns from working make each hour of leisure more expensive in terms of income foregone; this favors an increase in working time. The income effect arises because higher income fuels increased consumption of leisure (as of any normal good); but since leisure and work are mutually exclusive allocations of time, this favors a decrease in working time. The optimal time allocation results from the *net effect* of these opposed tendencies. As a result,

It is impossible to predict on *a priori* grounds whether an increase in w [the wage rate] will increase or decrease the demand for leisure time. Since leisure and work are mutually exclusive ways to spend one’s time, it is also true that it is impossible to predict what will happen to the number of hours worked. The substitution effect tends to increase hours worked when w increases; whereas the income effect, because it increases the demand for leisure time, tends to decrease the number of hours worked. Which of these two effects is the stronger is an important empirical question (Nicholson 1983, p. 487).

Clearly, the microeconomic theory of time allocation provides no general basis for expecting one type of time allocation strategy (quantity- or income-maximizing) to be more common than another (time-minimizing)—as our economist notes, this must be determined *empirically*. And as in economics, so too in evolutionary theory, since the model (if not the casual mechanism) is the same.

The general point is that a valid time allocation model must consider both the marginal returns from an activity and the marginal changes in opportunity costs from alternative activities foregone. Since the slopes of the isofitness curves in this model are determined by the interaction of these two factors (i.e., by what economists term the marginal rate of substitution, and evolutionary biologists the fitness equivalence, of returns from foraging vs. returns from other activities), it is illogical to refer to just one of them in making inferences about the shape of the curves.

To establish the fitness-maximizing pattern of time allocation under par-

⁴ The tradeoff between work (which produces “income”) and “leisure” (any other allocation of time and resources which produces something of value to the actor) is a special case of the general theory of consumer choice portrayed in indifference-curve analysis. However, as is made clear in the text (see below), because of the way in which work “purchases” leisure and is mutually exclusive with it, leisure has some unique properties as a good, specifically those that lead to time-minimization when income rates are high enough.

ticular conditions, we need to know both the overall structure of the fitness isocline space, and the location within this space of the feasible set of time allocations established by foraging return rates realized at particular times and places (Fig. 1). The issue posed by HOHC—Are quantity-maximizing strategies more typical of hunter-gatherers than time-minimizing ones?—can then be seen to have both an empirical aspect (How frequently is one pattern observed relative to the other?) and a theoretical or explanatory one (What selective conditions or constraints are important in determining the optimal patterns of time allocation?). These issues are addressed in the following section.

WHEN SHOULD FORAGERS BE TIME-MINIMIZERS?

It is difficult if not impossible to measure marginal fitness returns from naturalistic behavior like time allocation, but rough measures of proxy benefits and costs are feasible. HOHC present useful data from a number of societies on the returns from foraging, but none on those from other activities (though they discuss these briefly with respect to the problematic Yanomamo). They conclude from the available evidence that the !Kung, the Cree, and the Bisa follow the quantity-maximizing predictions, the Aché do so in most regards, but the Yanomamo and Ye'Kwana do not.

The !Kung data are scanty, and the interpretation HOHC offer for why good hunters spend more days hunting than bad hunters is hard to reconcile with Lee's observations that good hunters often take extended "vacations" from active foraging (Lee 1979, pp. 248ff). However, the limited data do show that more efficient hunters tend to hunt more frequently. This does not mean that any of these hunters would respond to an increase in their own return rates by foraging even more frequently; it also says nothing about foraging strategies of female !Kung, who provide the larger share of the food supply. (I will comment on the Cree in the following section.)

The evidence for the Bisa and the Aché is more convincing. Yet if they are more consistent in following a quantity-maximizing trend, I suggest this is for reasons that highlight their differences from most full-time foragers. The Aché pattern of sedentary settlement at the mission (where they keep gardens) combined with multiday treks for the sole or primary purpose of foraging, is not likely to be typical of hunter-gatherers with less "mixed" economies. But it *is* a pattern conducive to very low opportunity costs from nonforaging activities during a trek, and hence to quantity-maximizing patterns of optimal time allocation in that context. In other words, I propose that Aché spend so much time hunting *while on a trek* because, having left much of their life back at the mission, there is little else for them to do. The trekking party is but a segment of Aché society, and the opportunity costs of hunting long hours are likely to be markedly less than would face most foragers, who have much greater political, parental, ritual, and technological

claims on their time back at the camp they return to after foraging. For the Aché, the trek—be it 3 or 30 days long—is a special-purpose activity analogous to a day trip on the part of central-place foragers such as the !Kung. By limiting their time-allocation data to treks, HOHC make it quite difficult to observe any tendencies toward time-minimizing that might exist if the sample were drawn from the entire Aché time budget—just as would be the case if !Kung time allocation data covered only the period when foragers were away from the camp. This is a key flaw. HOHC's analysis is incapable of explaining why the Aché ever return to the mission, or why they engage in activities there (Winterhalder, personal communication).

Similarly, commercial foragers like the Bisa (and some other African and Asian foragers who sell or barter much of their catch), as well as foragers specializing in logistical strategies involving specialized task groups who absent themselves from the main settlement (and its opportunity costs) for lengthy trips (cf. Binford 1980), are other likely places to look for quantity-maximizing strategies of time allocation. For societies of human foragers who do not fit these special criteria—which are likely to pertain to only a minority of the ethnographically known sample of foragers—a tendency toward intermediate or time-minimizing strategies of time allocation may plausibly be hypothesized as the normal state of affairs.

To develop robust predictions concerning the conditions under which we should expect individuals to employ quantity-maximizing, time-minimizing, or intermediate or more complex strategies, we need to adopt the logic of evolutionary ecology: that is, we need to focus on the environmental and social variables that determine fitness payoffs to different strategies. HOHC make some preliminary efforts toward this goal in their discussion of different Yanomamo strategies. However, I would question their assumption that it is marital status *per se* rather than variable roles in village politics and shamanism—correlated with age and hence marital status—that structures the opportunity costs of village absence for Yanomamo males. In any case, hard empirical data on opportunity costs for Yanomamo and others are sorely needed. Members of the Aché group are making detailed observations and analyses of Aché time allocation to various activities (Hill 1983; Hill and Kaplan 1985; Hill et al. 1985a, 1985b; Hurtado et al. 1985), and as more of these are published we will be in a better position to evaluate the questions raised here.

FITNESS MAXIMIZATION VERSUS LIMITED NEEDS

The larger claim of the HOHC essay is that models "grounded in the theory of natural selection" provide superior, more complete explanations of hunter-gatherer behavior than do more orthodox approaches in ecological anthropology. I agree with this assessment. However, I disagree with the way in which HOHC draw the contrast between the Darwinian or evolu-

tionary ecological approach and that of standard ecological anthropology. In particular, I find their attempt to identify natural selection theory closely with their particular views of time allocation misleading.

In the first place, as noted above, there is no particular reason to link quantity-maximizing strategies more closely than time-minimizing strategies with the optimum favored by natural selection. Yet HOHC repeatedly refer to the quantity-maximizing model as “the fitness maximizing model” in order to contrast it with “the limited needs model,” as in the following:

The fitness maximization model leads us to expect that foragers will hunt longer on days when the hunting is better; the limited needs model suggests the reverse (p. 8).

They do this even though elsewhere in their article they admit that a time-minimizing model also “grounded” in the theory of natural selection produces predictions at least partially congruent with “limited needs.”

It is important to be cognizant of what the time-minimizing and limited-needs strategies have in common, as well as how they differ. As noted earlier, a time-minimizer is defined as a forager with a relatively high opportunity costs who responds to increased return rates by reducing foraging time; this is also the response expected from a forager with limited needs (i.e., fixed food requirements that are obtained with least cost). However, the time-minimizing strategy differs from the limited-needs strategy in several ways, of which the most germane is that the time-minimizer not only reduces foraging time under favorable conditions, but may also increase the total harvest, even if only slightly (compare C with D or E in Fig. 1).⁵ This difference provides an avenue for testing the comparative empirical reliability of the optimal time allocation model (whether the strategy at hand be quantity-maximizing or time-minimizing) versus the limited needs model.

In addition to relatively straightforward factors affecting opportunity costs, there are additional issues that will arise as we attempt to use evolutionary theory to explain patterns of time allocation. I will mention three such issues here.

First, for social foragers (such as human hunter-gatherers) the optimal time allocation strategy will usually depend on what others are doing. This is especially true where the products of foraging are extensively shared within the local group. Accordingly, game theory will be needed to predict the “evolutionarily stable strategy” or mix of strategies favored by selection (e.g., Maynard Smith 1982; Pulliam and Caraco 1984). For example, the “slacking-off” behavior reported in some cases even for successful hunters

(e.g., Lee 1979, pp. 248ff), frequently interpreted as an expression of “limited needs,” may represent part of a mixed strategy of “lazy” and “over-achieving” allocations of foraging effort that is more evolutionarily stable than any single allocation strategy, even holding return rates and opportunity cost curves constant.

Second, the time scale over which we hypothesize—and measure—allocations of effort needs to be carefully considered. HOHC assume that limited needs must apply one day at a time, so that a forager who gains no benefits beyond some ceiling of food harvest will ignore opportunities to harvest more than his/her average daily requirement when foraging efficiency is high. I doubt that most “limited needs” theorists hold this view, especially in situations where some food storage is possible. In any case, a day-by-day interpretation of limited needs is not inherent in the concept that foragers have fixed requirements, even in the simplest version of that view.

Fixed needs coupled with storage (even the metabolic storage of extra fat tissue) could lead to a pattern of variable time allocation quite similar *in short run* (day-by-day, or even season-by-season) to that of quantity-maximizers. The statements of Winterhalder’s Cree informants, and my general hypothesis that contemporary Cree will be time-minimizers—both quoted (though inappropriately juxtaposed) by HOHC (p. 10)—should be examined in this light. That is, Cree foragers might [and probably do, as Winterhalder (1977, 1981) shows] respond opportunistically to variation in foraging opportunities by allocating more or less effort (and obtaining varying levels of harvest) in the short run; this does not mean they will continue to respond to good or poor foraging opportunities in a quantity-maximizing fashion over longer periods. Yearly harvest levels (holding population constant) may not vary much at all, even though average conditions in one year may be very different than those in another. Again, the question of opportunity costs is crucial. Neither the statement quoted by HOHC nor any other data presented by Winterhalder contradict the hypothesis that Cree are time-minimizers in the long run—which is the hypothesis I meant to articulate (Smith 1979, p. 66) although I was not as explicit on the issue of temporal scale as I should have been.

In conclusion, I suggest that the theory of natural selection and the standard view of limited needs are not so incompatible as HOHC argue. If the limited needs concept is defined as the view that hunter-gatherers harvest food only for their own household, strictly meet fixed metabolic requirements on a daily basis, and never indulge in food storage, exchange, or population growth, then the contradiction with both fact and evolutionary theory is as clear-cut as HOHC portray it. But setting aside this view, which I suspect most anthropologists would agree is a caricature, we can expect that many hunter-gatherers will find themselves in ecological situations where fitness-correlated opportunity costs frequently exceed the benefits of increased food harvests. Under such conditions, the theory discussed here provides an adaptive explanation for time-minimizing behavior. (For ex-

⁵ This result only holds if the indifference or isofitness curves are parallel to each other, as in Figure 1 (or Figures 1 and 2 in HOHC). Nonparallel curves may result in *declines* in total harvest, as well as total foraging time, when return rates increase (Winterhalder, personal communication). It remains true that time-minimizing in the sense discussed here differs from the limited-needs strategy in leading to *optimal* amounts of harvest rather than any *fixed* amount, and hence leads to variable amounts of time allocation that may differ in detail, if not in form, from that expected under the limited needs assumption.

ample, such conditions might arise where fluctuations in resource availability occur on a moderate wavelength, one too short for demographic tracking, but too long for buffering via storage in caches or fat cells.) The resulting explanation differs in form from the orthodox view of limited needs, but refers to similar behavioral content (see fn. 5). Rather than being simply *wrong*, the limited needs concept is best viewed as *incomplete*.

The real problem with the limited needs view is that in itself it cannot explain variation, why some foragers tend toward time-minimizing and others towards quantity-maximizing. Lacking a general currency (fitness or utility) and an explanatory framework (evolutionary or economic), the ecological anthropologist can only describe variation, not explain it. On this aspect of their critique, I am in full agreement with HOHC.⁶ But their positive program fails to identify the proper links between fitness maximization and the allocation of foraging effort. More general and rigorous models are available (Winterhalder 1983); tests of their explanatory power with empirical data await future research.

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⁶ As discussed further elsewhere (Smith 1983, in press) I do not necessarily restrict the evolutionary currency to fitness, nor the causal mechanism to genetical evolution. Models of cultural evolution (Boyd and Richerson 1985) provide an additional—if yet untested—explanatory framework.