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How Does Male Ritual Behavior Vary Across the Lifespan?

An Examination of Fijian Kava Ceremonies

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Abstract Ritual behaviors of some form exist in every society known to anthropologists. Despite this universality, we have little understanding of how ritual behavior varies within populations or across the lifespan, nor the determinants of this variation. Here we test hypotheses derived from life history theory by using behavioral observations and oral interview data concerning participant variation in Fijian kava-drinking ceremonies. We predicted that substantial variation in the frequency and duration of participation would result from (1) trade-offs with reproduction and (2) the intrinsic status differences between ritual participants. We demonstrate that when controlling for household composition, men with young offspring participated less frequently and exhibited greater variance in their time spent at ceremonies than men without young children. However, men with a larger number of total dependents in their household participated more frequently than those with fewer. Moreover, we found that men's ascribed rank, level of education, and reliance on wage labor all significantly predict their frequency of attendance. We also found that the number of dependents a man has in his household is positively correlated with total food production, and the amount of kava he cultivates. In general, these results suggest that ritual participation is part of an important strategy employed by Fijian men for both achieving status and developing social alliances. Variation in participation in kava ceremonies by Fijian men therefore reflects the constraints of their current life history condition and their inherited rank.

Keywords Ritual · Life history theory · Fiji · Kava

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Ritual behaviors occur in every human social group and often include enormous investments of time, energy, and other resources (Brown 1991). Not all individuals within a society, however, invest in ritual behaviors to the same extent (Sosis 2006). A significant body of research has shown that investments in ritual behavior return high levels of cooperation (Norenzayan and Shariff 2008; Ruffle and Sosis 2007; Soler 2012; Sosis and Bressler 2003; Xygalatas et al. 2013), but this work has failed to capture how ritual investments and returns from these investments change over the life course (Leinard 2011; Sosis and Bulbulia 2011). Here we aim to fill this gap by generating predictions about variation in ritual behavior derived from life history theory (Charnov 1993; Roff 1992; Stearns 1992). Ritual performances often require extensive material, temporal, and energetic investments that cannot be directed elsewhere. An application of life history theory to the study of ritual behavior suggests that if there are fitness benefits to ritual performances, then these investments will be optimally timed with growth, reproduction, and other fitness-relevant pursuits. Humans invest significant amounts of energy in social capital building, and these investments often occur in the context of energetically expensive ritual behavior. We posit, therefore, that ritual behaviors are strategically performed to maximize social and reproductive gains, and that ritual participation varies across the life course as trade-offs with other fitness-relevant pursuits.

To examine these claims, we use observational data to investigate the determinants of participation in kava drinking rituals in a remote Fijian village. We evaluate hypotheses motivated by life history theory which suggest that variance in ritual participation by Fijian men can be explained by trade-offs between competing somatic and reproductive investments—trade-offs that vary predictably across the life course.

Life History Theory and Ritual Investment

Organisms compete in their ability to extract energy from the environment and to convert that energy into reproduction. Selection processes therefore result in solutions to the time-dependent problems of energy harvesting and reproduction (Hill and Kaplan 1999). A fundamental tenet of life history theory, the principle of allocation, posits that energy invested in one phenotypic trait cannot be invested in another trait; thus energetic trade-offs lie at the core of life history analyses (Levins 1968). Life history theory assumes that natural selection has designed phenotypes that optimize the trade-offs of differential time and energy allocation over the life course (Charnov 1993). All organisms face several fundamental energetic trade-offs, including age and size at physical maturity; number, size, and quality of offspring; duration of reproduction; and senescence (Roff 1992; Stearns 1992).

Kaplan and colleagues propose a life history theory of human evolution that uses the concept of embodied capital to cast human growth and development as a series of somatic investments (Bock 2002; Bock and Johnson 2004; Kaplan 1994, 1996; Kaplan and Bock 2001; Kaplan et al. 1995, 2000). Relative to other species, humans delay reproduction in order to invest in growth, health, and status, which are ultimately translated into reproductive investments and reproductive success (Kaplan 1994).

Despite considerable cross-cultural variation, ritual behavior tends to signal in-group commitments, strengthen social bonds, and return material benefits (Irons 2001). These

signals are often energetically costly and sometimes occur repeatedly across several performances. Although returns accrue across an individual's lifespan, energy allocated to ritual behavior can be likened to capital investments that, via gains in status, enhance reproductive opportunities and increase the survival and quality of offspring. Consequently, ritual behavior may represent energetic investments in embodied capital, reproductive strategies, or both.

As with all organisms, humans face different adaptive challenges at different stages in their lifecycle, and we propose that these lifecycle changes to adaptive energy allocation impact an individual's motivation and ability to invest in collective rituals. In other words, age-related variance in ritual behavior is due to lifecycle changes with regard to adaptive energy allocation. Adolescence represents an "experience expectant" period of symbolic and affective conditioning, and it is generally a time of intense ritual participation and training (Alcorta 2006; Alcorta and Sosis 2005). Among males, energetic investments to ritual peak in young adulthood and involve both bonding and competition (Leinard 2011; van Gennep 2004 [1904]; Weisfeld 1997; Wrangham and Peterson 1996). After adolescence, ritual behavior is expected to steadily decline because of the increased benefits for direct investments in mates and offspring. Across the lifespan, adult individuals of both sexes are expected to participate in rituals strategically, varying their participation according to their current life history condition.

Another fundamental time and energy trade-off is between ritual behavior and food acquisition. Research among foraging and horticultural populations shows that energy acquisition peaks between 30 and 45 years of age and then declines as humans grow older (Gurven and Kaplan 2006; Hill and Kaplan 1999; Walker et al. 2002). If selection favors investments to ritual behavior, the fitness benefits of ritual participation must outweigh the possible losses in resource acquisition. Men produce more food when their children are young in order to subsidize a simultaneous decline in production by females (Marlowe 2003). A critical period for increased male provisioning of young offspring likely corresponds with decreased ritual activity. In general, individuals of both sexes are expected to decrease their ritual behavior when they are married and have young offspring.

Humans also engage in high levels of alloparental investment, and the presence of young kin also likely corresponds to decreased ritual activity. Despite a slow life history, humans reproduce more quickly and obtain higher levels of fertility than our great ape relatives (Walker et al. 2008). High levels of parental investment and fertility are accomplished by means of significant alloparental provisioning (Hawkes et al. 1997; Kaplan et al. 2000), which allows for earlier weaning and a shorter interbirth intervals (Galdikas and Wood 1990; Kuzawa and Bragg 2012). The presence of dependent relatives in the household should therefore correspond to a decrease in ritual activity owing to trade-offs with food acquisition and caretaking.

In addition, a person's social status is likely to influence the value of energetic investments to ritual. Low-status individuals may attempt to manipulate ritual systems in order to gain social benefits, while high-status individuals may be able to receive the same benefits with lower levels of investment. Alternatively, high-status individuals may be able to maintain their status by excluding low-status individuals from participating in ritual activities.

The dynamic relationship between status and ritual investments is likely to be most intense in highly stratified societies. In many societies some individuals are seen as

closer to the gods, holier than others, or possessing special charismatic attributes. In societies with rigid social hierarchies, some individuals are afforded intrinsic attributions of elevated status by virtue of their birth, and these attributions are assumed to impact ritual participation. Although ritual behavior promotes high levels of intra-group cooperation, the costs and benefits of cooperation may be unequally distributed such that those at the top benefit at the expense of those at the bottom (Cronk 1994; de Aguilar and Cronk 2011), and these differential payoffs to participation based on status might explain significant variance in investments to ritual behavior in stratified societies.

To summarize, life history theory assumes that selection processes result in the optimal timing of energy allocation across the life course. Therefore, energy invested in ritual behavior likely exhibits age-specific distributions owing to variance in energy budgets across the lifespan. Energy investments in ritual behavior can be likened to capital investments that return important fitness benefits. However, investments in ritual behavior are energetically expensive and should therefore reflect trade-offs with other fitness pursuits, the most significant of which are reproduction and food acquisition. Individuals who are married and have offspring are therefore expected to invest relatively lower levels of time and energy in ritual behavior. Individuals whose relatives have young offspring are also expected to exhibit lower levels of participation in ritual behavior because of inclusive fitness benefits that accrue from investing in young kin. Finally, a person's social status will influence their ritual participation. Below we test these hypotheses using observational data collected on Fijian kava drinking ceremonies.

Ethnographic Background: Study Population

Data collection took place in a rural village on the island of Vanua Levu in Fiji's Northern Division. The village sits on Savusavu Bay, approximately 48 km from the closest town of Savusavu, which has a population of 3,285, according to the last known census in 2007. The village is accessible via a 2.5 h bus ride and a 3 km hike from the bus stop to the village itself. During fieldwork (2009–2011) the population of the village varied but hovered around 90, with about 50 adults, spread across 20 households, for an average of 4.5 individuals per household.

The basic social units of Fijian society are *mataqali,* or patrilineages that are differentiated by their founding ancestors, each associated with traditional roles. Five mataqali comprise a clan (*yavusa*), and mataqali are hierarchically ranked: "the most senior provides the chiefs, and the others the chiefs' henchmen, the heralds, priests, and the warriors respectively in order of seniority" (Nayacakalou 1955:50).[1] Yavusa are also ascribed these same social roles, and rank between them is assigned similarly to mataqali. Within a mataqali every man is ranked relative to every other man based on birth order. Given the combined rank within and between mataqali, each male in any village is roughly ranked relative to every other male based on age and birth lineage. In

[1] Both Nayacakalou (1955) and France (1969) note that this idealized structure was imposed upon the peoples of Fiji by the British colonial administration in order to rationalize and record land ownership. Prior to the arrival of colonial officials, social structure was highly variable across Fiji, and although some regional variation exists, the system described by Nayacakalou mirrors informant descriptions from the current study population.

addition to these ascribed status differences, Fijian men also achieve status through educational attainment and service to the Methodist church (Brison 2007).

Fijians practice patrilocal postmarital residence, although this system is somewhat flexible; two men in the present study married into the village. In general, households are centered on the nuclear family, but many have three generations living together, some with multiple adults and children from different parentages. Houses in the village are arranged by mataqali, with related men residing in the same area of the village.

The village economy is a mix of subsistence production and wage earning from copra cutting. Men practice horticulture and cut copra while women fish and forage in Savusavu Bay. There is occasional subsidizing of tasks, with men sometimes fishing and women sometimes assisting men in horticultural labor and copra cutting; however, the division of labor is fairly strict.

Land is collectively owned by mataqali, and fathers grant men access to personal garden plots once they reach maturity. Some men have rights to gardens through matrilineal ties, but these are outside the immediate village area. Men cut copra by collecting fallen coconuts, splitting them with hand axes, and scraping out the coconut meat. Middlemen make monthly trips to the village to purchase the coconut meat and in turn sell it for processing and export. The number of mature coconut trees a man owns and the intensity of recent production limit a man's copra production since cutting copra requires waiting for coconuts to fall before they can be harvested.

Data reported elsewhere (Shaver 2012) show that men on average work 3.82 h/day in their gardens. The proportion of all time spent in gardens is unequally distributed in the pursuit of various economic tasks, the most significant of which are the production of taro (0.29) and cassava (0.16), and the cutting of copra (0.15). Additional time devoted to garden labor is spent resting (0.15), working in kava gardens (0.05), working in gardens where taro and kava are intercropped (0.04), working in yam gardens (0.03), sharpening machetes (0.02), making baskets or rope (0.02), collecting firewood (0.02), and performing other various miscellaneous economic tasks. Other food sources that are the focus of economic labor, but are of lesser dietary significance, include breadfruit (<0.01), bananas (<0.01), coconuts (<0.01), edible hibiscus (<0.01), oranges (<0.01), papayas (<0.01), pineapples (<0.01), and plantains (<0.01). Villagers use money earned from selling copra to purchase items that also contribute to the diet, such as rice and flour.

A primary school in the area serves six villages and concludes after 8 years of education. In the past many villagers did not complete more than 8 years of education, but today, children leave the village and attend secondary school elsewhere. As a result, there are currently no children between the ages of 14 and 18 permanently residing in the village. To complete secondary schooling, villagers either move to towns with their children or send them to live with relatives or other acquaintances near the schools. After completing their education, some individuals return to the village while others continue to live elsewhere.

Ethnographic Background: Fijian Religion and Social Stratification

Pre-Christian Fiji comprised several warring political entities, each with their own hierarchy of gods. Gods had varying degrees of *mana* (i.e., power or efficaciousness) equivalent to their status in the hierarchy, and living chiefs, by virtue of their relationship with ancestor spirits, had more mana than lesser-ranking men. Commoners

(*itaukei*: literally people/owners of the land) were believed to have originated from the land but were ruled by chiefs (*turaga*), who were believed to have originated from across the seas. The divine rule of chiefs was maintained through respect for mana, *tabu* (taboo) places and items, and the *vanua*. Highly polysemous, *vanua* refers to land, tradition, animals, plants, living people, their ancestors, and associated gods and spirits (Hocart 1929; Kaplan 1990, 1995; Ryle 2010; Sahlins 1987).

Although the majority of ethnic Fijians nominally converted to Christianity between 1830 and 1854 (Kaplan 1990), the Fijian religious system is best conceptualized as syncretic. In addition to belief in the Christian God, ethnographic interviews revealed that contemporary Fijians believe in the existence of various ancestor spirits who are omniscient and who punish and reward the behavior of their descendants. Supernatural entities are hierarchically structured with the Christian God as supreme and the ancestor gods as subordinates. Although substantial changes have occurred since the arrival of missionaries, and considerable integration of the two institutions, beliefs and behaviors associated with the traditional religious system fall within the indigenous category of vanua, and those introduced by Christian missionaries are conceived as being in the category of the *lotu*.

Fijians believe that while their ancestor gods and chiefs still have mana, ancestors are less powerful than they were in the past, as can be seen today by evidence of more devotion to the Christian God (Tomlinson 2006; Toren 1990). The supernatural system of Fijians represents a continuation of traditional religion within a larger framework of Christianity, a pattern that is recurrent across the Pacific (e.g., Barker 1992; Burt 1994; Guo 2009; Strathern and Strathern 2009).

Today's ancestor spirits are particularly concerned with Fijians maintaining "tradition" and living *vakavanua* (literally the way of the land) (Shaver 2012). To live vakavanua means to respect the village protocol by observing taboos such as proper dress, behavioral norms, and respect for the ascribed status hierarchy. To live vakavanua also means carrying out traditional rituals associated with the vanua. Vanua rituals are many; the largest are those associated with lifecycle feasts such as marriages and funerals and involve large-scale ceremonial exchanges of goods, which are both materially and symbolically significant.

Sevusevu, or the ritual presentation of kava (a plant with mild narcotic properties), are a necessary component of all vanua rituals. Although sevusevu presentations occur for various reasons, they are most frequently performed by individuals upon arrival at any village that is not their father's village. Through the acceptance of a sevusevu, a host chief symbolically welcomes visitors and offers hospitality and protection. Since sevusevu are performed when individuals visit their non-natal village, several sevusevu occur within larger ritual contexts that involve many visitors to a village (e.g., during weddings or funerals). Other socially significant events requiring sevusevu include petitions of approval to build a new structure in a village, to acquire something of significant value from someone, and to forgive in the context of ritual reconciliation ceremonies (*soro*). In addition to the formal ritual presentation of sevusevu in these various contexts, Fijian men drink kava in villages in less formal ceremonies almost every night. Generally, men begin drinking kava around the age of 18, and in Fijian villages women are not permitted to drink kava. These nightly ceremonies appear in the ethnographic record over many generations of anthropological fieldwork and across many islands (e.g., Raven-Hart 1956; Tomlinson 2009; Toren 1990; Turner 1986).

Ethnographic Background: Kava Ceremonies

Kava (*Piper methysticum*) is cultivated and consumed in most areas of Polynesia, some areas of Melanesia, and traditionally in two places in Micronesia (Brunton 1989; Lebot 1995; Lebot et al. 1992; Norton and Ruze 1994). Both botanical studies (Lebot 1995; Lebot et al. 1992) and linguistic similarities (Brunton 1989) point to a common origin, as do the many structural features associated with kava drinking, including kava's place in religious rituals and its use in invoking the supernatural (Brunton 1989; Kirch 1984; Lebot et al. 1992). Turner (1986, 1995) lists six features of what he calls a "shared ritual format" inherent in kava ceremonies that is recurrent across the Pacific. Kava is (1) collectively (rather than individually) (2) drunk (rather than eaten or chewed) (3) exclusively by males (4) for use in healing ceremonies and (5) as a medium for communication with ancestors and deities, and as with all rituals (6) is set apart from normal activities (in what Turner calls a "time out"). More geographically specific, in the areas of Fiji, Tonga, Samoa, and Wallis and Futuna, (1) during a similarly stylized preparation of the kava for consumption, (2) commands are given by a chief or his representative to oversee the kava preparation, (3) participants are seated in order of rank, and (4) kava is served to participants in that order (Turner 1986:203).

Kava is a psychoactive plant that takes 3 to 7 years of cultivation to harvest. The chemicals in kava responsible for creating psychological effects are called either kavapyrones or kavalactones and are concentrated in the roots (Singh and Singh 2002). Kavapyrones/lactones have antidepressant effects and are known to disrupt motor abilities with anesthetic and muscle-relaxing properties (Cairney et al. 2002). Larger doses of kava produce intoxication, sedation, and paralysis of the extremities; however, all of these effects completely reverse with time (Cawte 1986). Meta-reviews of kava's effects on cognition suggest that kava consumption does not negatively impact cognitive ability (Cairney et al. 2002). However, heavy users have higher levels of dermopathy, lower body mass index, and elevated liver enzymes (Cairney et al. 2003).

A feature common to all kava ceremonies is that low-ranking men perform most of the work associated with kava drinking, especially its processing and preparation. Typically, lower-ranking men process kava, fetch water, mix kava, and serve it in half coconut shells to higher-ranking men. Initial processing begins with cutting the roots into pieces approximately 6 in long, leaving them in the sun for 2 days to dry, and then pounding the dried roots into a fine powder with a large metal mortar and pestle.

At the beginning of a kava ceremony, low-ranking men mix kava in a large carved wooden bowl called a *tanoa*. Across the top of the tanoa, men stretch out a piece of thin cloth upon which they place the powdered kava. Other young men will have fetched water. One man will then pour a half coconut shell's worth of water over the powdered kava, one bowl at a time, as another pushes the powdered mixture into the cloth so as to filter the water through the kava.

Initially a whole tanoa is not prepared, but just enough for the chief and his hereditarily assigned spokesman. During formal ceremonies, the kava is served with formulaic body movements and stylized hand clapping, with one man serving the kava standing and bowing to show respect. In less formal ceremonies, the lowest-ranking men remain seated and pass the kava.

Before the consumption of nightly kava, as in more formal settings, the man who will serve the kava gives a brief speech that mentions the vanua and the vanua of any guests present. At times a Christian prayer will be recited following speeches that make reference to the vanua and the ancestors, although sometimes a speech will reference both the vanua and the Christian God. Afterwards, everyone present rhythmically claps with cupped hands a specific number of times at a specific rhythm (which varies regionally). The highest-ranking man drinks first and is always handed the bowl by a lower-ranking man. When a person is handed a bowl, he claps once, drinks the entire bowl in one gulp, claps twice, and then returns the bowl to the lower-ranking man. After the chief drinks, his herald drinks next. This format is followed regardless of whether the actual chief or his herald is present. If they are not, the highest-ranking men who are present take their place.

Regardless of who occupies the roles of the chief and his herald, after the first round, each of these two men are served another bowl, but this time with only a small amount of kava, again with both men clapping before and after they drink. After both men drink for the second time, every man present again claps seven times in the same rhythmic order as before.

After this opening ceremony, social hierarchy dictates subsequent drinking order; however, every man present drinks out of the same bowl. Men are also seated at kava ceremonies according to social hierarchy (for a detailed description of seating at kava ceremonies see Toren 1990). Each tanoa has a marker on the bottom of the bowl, and the bowl is arranged so this marker is pointed toward the chief. The area around the chief is the "high" area, whereas the area 180° from the chief is seen as being "low." Men then sit from "high" to "low" based on their status in the hierarchy, and this is the order in which they drink.

Following the opening rituals, the chief and his herald drink another time, again clapping before and after they drink. Subsequently, everyone else present drinks according to status in the ascribed hierarchy. After this first round of communal drinking, there is a pause for a few minutes, and then the chief claps and drinks, followed by his herald and the next highest-ranking man, all the way down the social hierarchy. A bowl of kava is typically consumed by each man present every 5–10 min. Kava drinking can go on for many hours, with many bowls consumed, each time with the order being repeated. At the extreme end, for instance during a funeral, kava ceremonies can last up to 4 days. No matter the occasion or the length of the event, at its close, a man, usually the herald, will give a short speech that tells the vanua that the kava is finished and the tanoa is empty. At this point, everyone claps and the kava ceremony is completed.

Kava ceremonies have undergone tremendous change since the arrival of missionaries and British colonial officials. In precontact Fiji, a hereditary class of priests used kava to induce shamanic trances to enable supernatural communication, and kava consumption was limited to priests and chiefs (Brewster 1922; Thornley 2005; Thomson 1908; Waterhouse 1997[1866]:290). Following their conversion to Christianity, these restrictions were lessened, and now all men are permitted to drink kava. Even though commoners can now drink it, the consumption of kava is still viewed positively because it possesses mana and therefore pleases the ancestor spirits (Turner 1995). Moreover, Fijians believe that communication with the ancestors is still possible through the use of kava, and this communication enables witchcraft, or the

curing of illnesses. In other words, kava can be employed to interact with the ancestors for various reasons if the drinker wishes to do so (Toren 1994). In fact, men are often encouraged to talk to one another during the course of kava ceremonies to show that they are not communicating with ancestral spirits for malevolent reasons, such as witchcraft (Tomlinson 2009).

In nightly ceremonial settings, kava drinking can be overtly competitive (Tomlinson 2007) and may function as a venue for male status achievement, even though the ascribed hierarchy is on vibrant display. At times men attempt to "punish" each other by "forcing" each other to drink larger than normal bowls all at once (from very large coconut shells). Moreover, when the highest-ranking men in the village are not present, the highest-ranking man in attendance sits at the top of the seating hierarchy and gains elevated status, at least temporarily. It is therefore likely that in addition to displaying the ascribed hierarchy, kava ceremonies may also function as an arena for male status achievement.

In kava ceremonies a man's prestige may be enhanced owing to his temporal investments as well as his demonstrated ability to withstand the physiological costs associated with kava consumption. After drinking a bowl of kava, men often wince, punch the ground as if in pain, and many times spit and make exasperated noises to express their displeasure with the substance. Men are also frequently heard lamenting that drinking kava makes one lazy, tired, and disinterested in work the subsequent day. Excessive kava consumption also results in dry, cracked, and scaly skin (*kanikani*), possibly because it blocks cholesterol absorption (Norton and Ruze 1994). Moreover, men delay eating an evening meal until after they are finished participating in kava ceremonies, a time when their stomachs are full of kava.

To summarize, the production and consumption of kava by Fijian horticulturalists may entail the following costs:

1. Land devoted to kava cannot be devoted to food.
2. Kava plants must be tended for 3 to 7 years (in the form of monthly weeding) prior to harvesting.
3. Kava requires substantial processing time prior to consumption.
4. Kava ceremonies often involve significant time and energy investments.
5. Fijians report that the consumption of kava inhibits energy expenditure the following day.
6. High levels of kava consumption result in dermopathy.
7. The consumption of kava comes at the expense of healthier dietary habits and is associated with lower relative body mass index and elevated liver enzymes.

These are extensive costs, but they likely return significant social benefits. Men gain prestige through their participation in kava ceremonies across their lifetimes, and these gains in prestige likely result in increased cooperation and reproductive benefits. In informal interviews men indicated that they view men with *kanikani* (resulting from excessive kava consumption) positively and afford them a special kind of prestige. Informants suggested that a man with kanikani "is a man of the village," since a man with kanikani is always in the village, spending time with other village men, drinking kava. Further, men reported that men suffering kanikani are likely to live vakavanua and adhere to other forms of village protocol. Fijians engage in both cooperative farming and the

extensive sharing of food and other material resources, and men with kanikani are better able to realize these cooperative benefits.[2] On various occasions during fieldwork, many village men cleared and planted several gardens for the man in the village who was known to drink the most kava. Moreover, men who drank a lot of kava also frequently worked together in each other's gardens. Conversely, men who do not participate in kava ceremonies, or participate infrequently, are often withheld from the benefits of multiple forms of cooperation, including collective horticultural labor. For example, although village men commonly worked cooperatively in each other's gardens, over the course of fieldwork the garden plots of two men who never drank kava were never collectively cultivated.

Hypotheses

Preliminary fieldwork indicated that men spend considerable time and energy attending kava ceremonies. As discussed above, we anticipate that these temporal and energetic investments associated with ritual participation will reflect ongoing life course stages. Participation in kava ceremonies may increase prestige and/or social bonding, both of which are assumed to translate into increased reproductive success. After marriage and the onset of reproduction, however, we expect investments in ceremonies to decline significantly owing to the increased benefits of investing in mates, children, and young kin. Therefore,

> $H_{1a:}$ Married men, men with dependent children, and men with dependent kin in the household will attend kava ceremonies less frequently and for shorter durations.

Since many Fijian households contain multiple adult males (e.g., brothers, fathers, adult sons) and females (sisters, mothers, adult daughters, etc.), these coresident adults may offset some of the costs of ritual participation:

> H_{1b}: Number of coresident adult males and females will be positively correlated with frequency and duration of attendance in kava ceremonies.

Ethnographers of Fijian culture often argue that kava ceremonies are ritual arenas that function to strengthen, display, and replicate the ascribed social hierarchy (e.g., Toren 1990; Turner 1986, 1992, 1995). This may be true, but these interpretations do not predict or explain variance in ritual behavior, nor do they explain why lower-ranking men would ever participate in kava ceremonies. Indeed, younger and lower-ranking men have much to gain in the status hierarchy, and participation in kava ceremonies may be a route to achieve status. Although older and higher-ranking men can also achieve additional status in kava ceremonies, their attendance is likely to have quick diminishing returns. In other words, for high-status men, kava drinking may serve as status maintenance, whereas for low-status men, it may be a strategy for status achievement. Thus, we expected that young, low-status men would attend kava ceremonies for longer durations

[2] There is likely an optimal level of kanikani signaling. If a man has high levels of kanikani but largely shirks his work and/or family responsibilities, he will not realize these cooperative benefits. Rather, men with kanikani must also work hard and invest in their family in order to realize these benefits.

when they were at risk of attending, but that their duration of participation would also exhibit greater variance. Moreover, wealth (as derived from copra sales) and education may be alternative paths to status and reproductive gains. Therefore,

H_{2a}: Age, education, wealth, and ascribed rank will all be negatively correlated with frequency and duration of attendance in kava ceremonies.

H_{2b}: Variance in duration of attendance will be negatively correlated with a man's age and ascribed rank.

Focal follow data revealed that taro, cassava, and kava are the crops that receive the highest levels of investment. However, since kava is not a food, its production should decline with the benefits of food production for mates, offspring, and young kin. Again, the presence of coresident adults may offset the costs of kava production. Hence,

H_{3a}: Married men, men with dependent children, and men with dependent kin in the household will plant less kava and more taro and cassava.

H_{3b}: Number of coresident males and females will be positively correlated with the amount of kava, taro, and cassava planted.

Moreover, because energy invested in ritual may not be available for resource acquisition:

H_4: Frequency and duration of attendance in kava ceremonies will be negatively correlated with overall horticultural productivity.

Methods

Demography

While conducting oral interviews with all village households (n=20) in April 2010, data were collected on marital status, number of offspring, number of dependents (non-offspring children under age 14 years), household composition, the number of years of school completed, average weekly income from copra sales, and total crops under cultivation.

Ascribed Rank

Following a second round of interviews with village members, each male was assigned two scores in order to quantify his ascribed status. To assign rank within the mataqali, males were ranked according to informant descriptions. Internal mataqali rankings reflect generational differences, and within each generation rank is based on birth order. To assign a village-wide rank, a man's internal mataqali rank was multiplied by the ranking of his mataqali relative to the others based on informant descriptions of relative mataqali rank. This quantitative assignment of rank system is derived from

informant interviews and matches ethnographic descriptions found elsewhere (e.g., Nayacakalou 1955).

Time Allocated to Kava Ceremonies

Kava ceremonies occurred every night during the calendar month of June 2010 and data were collected on each of these nights. When men are processing kava, the production makes a loud noise that echoes throughout the village. Village men use these sounds and vibrations as a notification, at which point they begin to congregate around the tanoa. When this occurred each evening, Shaver went to the location of the kava ceremony and noted the participants and the duration of participation for each man. Because of the village's proximity to two other villages, men from other villages were frequently present; however, none of these men participated with enough regularity to be included in the following analyses. Also, because of the proximity of neighboring villages, men could participate in ceremonies elsewhere. Since self-report data may not be accurate for men in other villages, however, for each event men were coded as having attended, capable of attending but did not (i.e., present in the village but did not attend), or not able to attend (out of the area and activity unknown). Data collection ceased at 12:00am regardless of whether or not men continued to consume kava. The latter situation occurred on 6 of 30 observation events. Thus, on 20% of data collection days, some men participated longer than these data reveal.

Monthly Horticultural Investments

Oral interviews were conducted each month for 6 months and men were asked how many of each crop they had planted the previous month. These interviews covered horticultural activity from May 2010 to October 2010 and took place at men's homes during the first few days of each month.

The University of Connecticut Institutional Review Board approved all data collection procedures. All interviews were conducted after acquiring informed consent, and all village members were informed of the data collection on kava participation.

Results

Table 1 illustrates the demographic characteristics of the 28 adult men during the data collection period. The average age was 46.4 and ranged from 20 to 78. Seventeen of these men were married. The average number of total offspring for males was 2.9, with 1.1 offspring under the age of 14 residing in the household (henceforth referred to as resident offspring) and an average of one other dependent child residing in the household. On average there were 1.7 adult females and an additional 1.6 adult males resident per household. Average number of years of education for all men resident was 8.7. Villagers on average earned $10.04 Fijian/week per household by cutting copra, or about $5.00 U.S.

The overall hazard ratio of attendance at kava ceremonies for all 28 men at risk of attending across the 30-day sample period was 0.66 (488/752). Two men never participated, and the man who participated most frequently exhibited a hazard ratio

Table 1 Variables used in analyses

Variables	Mean	SD
Demographic		
Age (yr.)	46.4	17.1
Currently married (0/1)	0.62	–
Total offspring	2.9	2.4
Resident offspring (<14 yr.)	1.1	1.4
Resident offspring in household (0/1)	0.47	–
Additional children in household	1.0	1.2
Total dependents	2.1	1.6
Females coresident	1.7	0.7
Males coresident	1.6	0.8
Education (yr.)	8.7	2.3
Weekly copra sales (FJ$)	10.04	5.28
Horticultural production (under cultivation)		
Avg. taro planted in June	146.3	147.7
Avg. cassava planted in June	37.0	50.7
Avg. kava planted in June	11.4	21.7
Avg. taro per month May–Nov.	102.6	57.4
Avg. cassava per month May–Nov.	41.3	36.3
Avg. kava per month May–Nov.	17.6	30.4
Total taro	443.5	384.8
Total cassava	238.0	172.6
Total kava	292.2	388.2
Kava participation		
Hazard ratio of attendance	0.66	0.25
Average minutes of duration	213.59	98.19

of 0.96 (Fig. 1). These data indicate that on every day of the week, a majority of the men in the village participated in kava ceremonies. The average amount of time spent at a kava ceremony for all men in the village across the data collection period was 213.59 min/event. Again, two men never participated, but of those who did, the man who participated for the shortest duration averaged 19.75 min/event, and the man with the longest average duration stayed 317.08 min/event (Fig. 2). Below we present separate analyses for participation and duration.

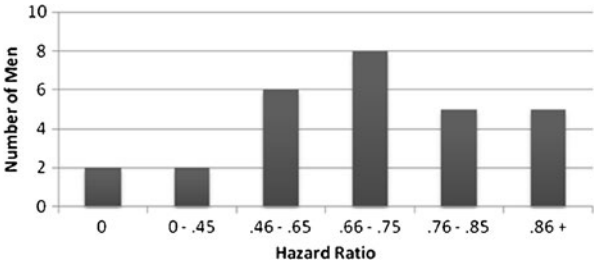

Fig. 1 Hazard ratio of attendance at kava ceremonies (n=28)

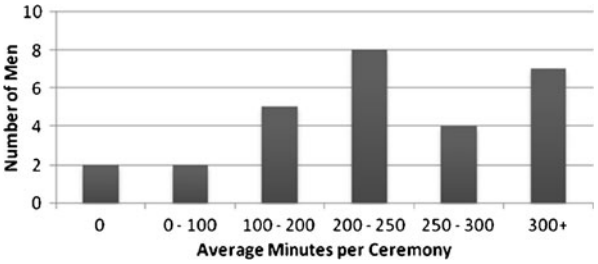

Fig. 2 Average minutes spent at kava ceremonies (n=28)

Attendance

We predicted that certain life history events would predict kava attendance owing to the costliness of kava ceremonies and trade-offs associated with reproduction.

Univariate logistic regression models indicate that younger men participated more frequently (b=−0.206, p<0.001, n=752), as did unmarried men (b=−0.589, p<0. 001, n=752). Also, men with lower levels of education (b=−0.178, p=<0.001, n=752) and those who earn more money from cutting copra participated significantly more often (b=0.068, p=<0.001, n=752). In a multivariate model these variables, with the exception of marital status, remain significant (Table 2, Model 1).

Univariate logistic regression models reveal that a man's rank within his lineage (b=−0.107, p<0.001, n=752) and his village-wide rank (b=−0.071, p<0.001, n=752) were both significantly negatively related to his attendance. Rank is largely based on age and thus the two are highly correlated; this is true for both a man's rank within his own lineage (r=0.646, p<0.001, n=28) and for his village-wide rank (r=0.791, p<0.001, n=28). However, a multivariate model that includes age and both status rankings indicates that village-wide rank most strongly predicts kava ceremony attendance (Table 2, Model 2).

Univariate logistic regression models indicate that total number of offspring was significantly negatively correlated with a man's attendance (b=−0.156, p<0.001, n=752). However, contrary to our predictions, the total number of resident offspring was positively correlated with a man's attendance (b=0.264, p<0.001, n=752), as was the total number of household dependents (b=0.152, p<0.01, n=752). Having males coresident did not influence a man's attendance (b=−0.012, p=0.898, n=752); men with more coresident females participated significantly more often (b=0.236, p<0.05, n=752), but the strength of this effect is weak.

Men had between zero and four resident offspring, but almost half of the men had no resident offspring. Therefore, to further explore the effect of resident offspring on kava attendance, a dichotomous variable was created to represent the presence or absence of resident offspring in the household. In a multivariate model controlling for household composition, the presence of resident offspring significantly predicts a man's attendance (Table 2, Model 3), but in a model with age, education, copra sales, and rank, the presence of resident offspring did not predict a man's attendance (Table 2, Model 4). Model 5 illustrates that men with more total dependents participate more often even when controlling for other predictors of attendance.

Table 2 Logistic regression analyses of the probability of attending kava ceremonies for at risk males (n=752)

Independent variable	Model 1 Parameter estimate (SE)	Model 2 Parameter estimate (SE)	Model 3 Parameter estimate (SE)	Model 4 Parameter estimate (SE)	Model 5 Parameter estimate (SE)
Intercept	5.496 (0.666)	1.462 (0.255)	0.124 (0.233)	4.860 (0.658)	0.124 (0.233)
Age	−0.051 (0.007)***	0.011 (0.008)	–	−0.024 (0.010)**	-0.017 (0.010)*
Marital status	0.114 (0.208)	–	–	–	–
Education	−0.372 (0.049)***	–	–	−0.316 (0.049)***	-0.295 (051)***
Copra income	0.075 (0.017)***	–	–	0.052 (0.019)***	0.047 (018)**
Within-lineage rank	–	0.075 (0.043)*	–	–	–
Village-wide rank	–	−0.101 (0.015)***	–	−0.051 (0.016)***	-0.065 (0.017)***
Resident offspring (0/1)	–	–	−0.701 (0.194)***	−0.171 (0.189)	–
Coresident females	–	–	−0.001 (0.156)	–	–
Coresident males	–	–	0.103 (0.119)	–	–
Total dependents	–	–	–	–	0.125 (0.061)**
Full model χ^2	122.848***	82.443***	18.555***	134.417***	137.795***

*p<0.10, **p<0.05, ***p<0.01

Duration

A man's total events attended and total minutes of attendance were highly correlated (r=0.834, p<0.001). Age and total minutes of attendance were significantly negatively correlated (r=−0.555, p<0.01). Men invest less time in kava ceremonies as they age (see Fig. 3). There was no difference between unmarried (M=4,761.38, SD=2,524.30) and married men (M=3,602.35, SD=2,275.94) in total minutes of duration at kava ceremonies (t=1.61, p=0.218). Total number of offspring was negatively correlated with total minutes spent in kava ceremonies, and this relationship approached significance (r=−0.366, p=0.055, n=28). However, resident offspring was not significantly related to total minutes (r=0.277, p=0.154, n=28), nor was total number of dependents (r=0.159, p=0.419, n=28). Of these life history variables, only age significantly predicts a man's total minutes spent at kava ceremonies, with younger men participating for longer (Table 3, Model 1).

We predicted that residing with other adult males would offset some of the costs of kava ceremonies, enabling members of multimale households to participate for longer durations. However there was no correlation between coresident males and total minutes (r=0.182, p=0.354, n=28). There was a positive correlation between coresident females and total minutes and this relationship approached significance (r=0.349, p=0.069, n=28).

A man's level of education was uncorrelated with his total minutes of stay at kava ceremonies (r=0.041, p=0.826, n=28), but men who earn more money from cutting copra spent significantly more time in kava ceremonies (r=0.427, p=0.024, n=28). Model 2 in Table 3 shows that younger men and those who earn more income from copra attend for greater durations, and controlling for these factors lesser-educated men's longer attendance approached significance.

A man's rank within his lineage was uncorrelated with his total minutes of stay at kava ceremonies (r=−0.268, p=0.169, n=28), but his village-wide rank was significantly negatively correlated with his duration (r=−0.660, p<0.01, n=28). Men who rank lower in the village participate for significantly longer periods of time in kava ceremonies. This is true even when controlling for a man's age and rank within his lineage (Table 3, Model 3), and when controlling for his education and income from copra sales (Table 3, Model 4).

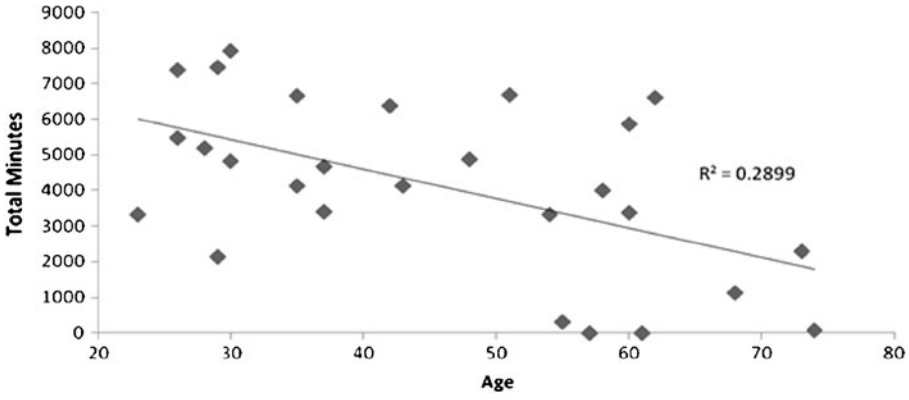

Fig. 3 Age by total minutes invested in kava ceremonies (n=28)

Table 3 Standardized beta coefficients from linear regressions of total minutes of duration in kava ceremonies on select life history and other demographic variables (n=28)

	Model 1	Model 2	Model 3	Model 4
Age	−0.466**	−0.670***	−0.274	
Marital status	−0.097			
Resident offspring	0.247			
Education		−0.328*		−0.115
Copra income		0.408***		0.296*
Within-lineage rank			0.306	
Village-wide rank			−0.613**	−0.578***
adj. R^2	0.269**	0.474***	0.388***	0.422***

p<0.10, **p<0.05, ***p<0.01

Variance in Duration of Attendance

It is possible that some men attended infrequently but for long durations, whereas others attended frequently but for short durations, and despite these differences in attendance patterns these two types of men could exhibit similar duration totals. We therefore analyzed men's variance in their duration of attendance to explore these strategies further. Specifically, we predicted that higher-ranking men would exhibit less variance in their duration of attendance at kava ceremonies. As predicted, a man's standard deviation for minutes attended across all events is highly negatively correlated with his village-wide rank (r=−0.664, p=<0.001, n= 28; see Fig. 4). This relationship remains significant when controlling for age (Table 4, Model 1). Model 2 of Table 4 indicates that unmarried men and men with more resident offspring exhibited greater standard deviations of time spent at ceremonies.

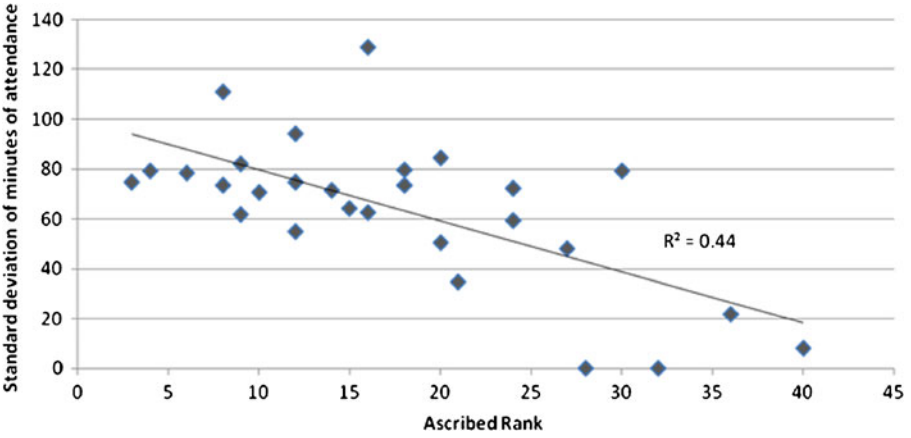

Fig. 4 Variation in duration of attendance at kava ceremonies by ascribed rank

Table 4 Standardized beta coefficients from linear regression of standard deviation of minutes of attendance in kava ceremonies on select life history and other demographic variables (n=28)

	Model 1	Model 2
Age	−0.127	
Village-wide rank	−0.564**	
Marital status		−0.525***
Resident offspring		0.456**
adj. R^2	0.402***	0.226**

*p<0.10, **p<0.05, ***p<0.01

Horticultural Investments

Here we examine data on labor investments for the three most significant horticultural products: taro, cassava, and kava. Across 6 months of data collection, men on average each month planted 102.6 taro plants, 41.3 cassava plants, and 17.6 kava plants. The data reveal that as men age they plant significantly less kava per month (r=−0.416, p=0.031), but there is no relationship between new taro plants by month and age (r=−0.117, p=0.562) nor new cassava plants by month and age (r=0.320, p=0.104). Total number of crops under cultivation reveals slightly different totals, with men averaging 443.5 total taro, 292.2 kava, and 238.0 total cassava plants. The higher number of total kava plants is likely due to its substantially longer maturation time relative to taro and cassava. Although there is no significant decrease in total taro plants by age (r=−0.042, p=0.834), nor in total cassava plants by age (r=−0.039, p=0.847), there is a significant decrease in total kava plants with age (r=−0.435, p=0.023). Since productivity predictably varies across the lifespan (Gurven et al. 2006; Gurven and Kaplan 2006), we control for age to test for trade-offs with reproduction and ritual investment. In initial analyses we examined interaction effects between variables, but since they were either not significant or did not greatly improve the predictive power of the models, we do not report on these analyses here.

Table 5 shows that married men, men with more resident offspring, and men with more dependents in the household plant more taro, cassava, and kava. There is no relationship between number of new crops and number of coresident males or females, education, or wealth. Participation in kava ceremonies does not negatively impact the total number of crops by any of our measures, contrary to our predictions. In fact, there was a positive correlation between total minutes spent in kava ceremonies and number of new cassava and kava plants during the study period.

Discussion

More than 20 years ago, Hames (1992:233) noted that time allocation methods had successfully advanced our understanding of human behavior in several regards, but surprisingly there were no time allocation studies of ritual behavior. This remains as true today as it was then, despite burgeoning interest in the evolutionary study of religion and recent empirical studies on ritual (Atkinson and Whitehouse 2011; Ginges et al. 2009; McKay et al. 2013; Xygalatas 2013). As we have shown here, however,

Table 5 Partial correlations between life history variables, ritual participation, and horticultural investments when controlling for age (n=28)

	Taro			Cassava			Kava		
	June	Avg/ mo	Total	June	Avg/ mo	Total	June	Avg/ mo	Total
Marital status	0.42**	0.35*	0.31	0.05	−0.13	0.26	−0.17	−0.19	0.20
Resident offspring	0.45**	0.22	0.25	0.21	0.20	0.44**	−0.01	0.06	0.46**
Total dependents	0.33*	0.16	0.32	0.04	0.15	0.23	0.03	0.06	0.52***
Coresident males	−0.25	−0.22	0.09	−0.16	−0.26	0.13	−0.04	0.08	0.02
Coresident females	−0.25	−0.29	0.14	−0.12	−0.14	0.30	0.07	0.01	0.17
Education	0.16	0.28	−0.20	0.16	0.21	0.06	−0.10	0.00	0.14
Copra sales	0.20	−0.29	−0.10	0.35*	0.18	−0.20	−0.05	−0.27	−0.16
Within-lineage rank	−0.23	−0.04	0.20	0.08	0.01	0.07	−0.18	−0.09	−0.28
Village-wide rank	0.00	0.14	0.20	−0.05	0.16	0.09	−0.07	0.12	0.09
Kava attendance	−0.11	−0.18	0.23	0.28	0.21	0.10	0.31	0.14	−0.02
Kava duration (total min.)	−0.18	−0.14	0.16	0.36*	0.20	0.13	0.42**	0.21	−0.04

* p<0.10, ** p<0.05, *** p<0.01

there is no reason why time allocation methods cannot be fruitfully applied to the study of variation in ritual behavior across the life course.

We predicted that participation in kava ceremonies would decline due to trade-offs associated with reproduction. We found that married men participate less frequently than unmarried men. When controlling for household composition, men with dependent offspring participate less often and also exhibit greater variance in their duration of attendance. This higher level of variance may reflect trade-offs associated with the caretaking of young offspring. Although Fijian men invest in direct childcare, women are the primary caretakers of children in Fijian villages. Still, the data illustrate that when controlling for coresident males or females, men with resident offspring participate in kava ceremonies less frequently. We also found that men with adult women in their households participate more often and for longer durations, presumably because these coresident females are looking after a man's offspring while he is attending kava events.

Although we predicted a positive relationship between number of food plants (taro and cassava) under cultivation and marital status and young offspring, we predicted a negative relationship between kava production and these reproductive variables. Although kava production declines with age, we found, contrary to our prediction, that men with resident offspring and dependent children plant more kava. Informants reported that they plant kava for two reasons: for ritual functions and to sell. The increase in kava production for sale by men with young dependents may reflect direct investment in children, particularly to pay for school fees and the other costs associated with sending children to towns for education. However, even if kava is destined for sale, upon harvest, men are expected to contribute some kava for village-wide use.

Kava production may therefore also reflect indirect investment in offspring as it may aid in the maintenance and strengthening of social alliances and prestige.

Interestingly, men with many dependents attended kava ceremonies more often, suggesting a complex relationship between reproduction and participation in kava ceremonies. It is tempting to conclude that at this stage in their lives, men invest directly in their children in the form of increased food production but also indirectly in the form of increased production of goods used during group activities and increased ritual behavior. If there are multiple adults in a man's household (mothers, fathers, adult brothers and sisters, etc.), then men with more dependents are able to participate more frequently, presumably because kin are available to invest in childcare while he invests in kava ceremonies. If household composition allows, indirect investment in the form of ritual behavior and material goods used for ritual may serve as a means to increase reproductive success. Men who demonstrate their commitment to the group in the context of ritual may be rewarded with higher status; acts of cooperation, such as food sharing or childcare; protection of dependents; and in general more embodied capital. Increased ritual participation may therefore represent indirect investment in offspring, or alloparental investment by grandfathers, uncles, and older brothers. Upon the maturation of their offspring, and the achievement of higher rank, men appear to reduce participation in kava ceremonies as well as kava production. This relationship between increased ritual participation and dependents is also evident in Fijian Christian ritual participation. Data reported elsewhere (Shaver 2012) reveal a positive relationship between number of dependents and church attendance, despite the fact that kava participation and church attendance are significantly negatively correlated.

It is also possible that men with dependents participate more frequently in rituals simply because they are in the village more often at this stage in their lives owing to the necessities of childcare and the corresponding need for increased horticultural labor in garden plots near the village. At other times in their lives, men may have more time to engage in other activities in other villages, particularly those activities related to future reproduction. However, for the study period reported here, there is no evident relationship between being at risk for attending and number of resident offspring ($r=0.021$, $p=0.457$) or number of dependents ($r=0.030$, $p=0.386$).

It is equally plausible that we failed to find a trade-off between ritual behavior and productivity levels because of phenotypic correlation problems—men with young offspring are also likely to be the most active. The association between copra income and increased ceremonial participation also reflects variation in payoffs to ritual involvement. Copra sales can be used to purchase staple foods at the village store (rice, flour, etc.), and these purchases may offset some of the costs of trade-offs with horticultural labor. But Fijians associate store-bought foods with outsiders and they generally are not seen as favorably as taro and cassava since they are not *kana dina* (true food) or traditional foods. In fact, even though the data presented here do not show an overall decrease in horticultural investment owing to ritual participation, a man's reputation as a hard worker is negatively correlated with his average duration at kava ceremonies ($r=-0.450$, $p<0.05$, $n=28$) and his average weekly copra income ($r=-0.398$, $p<0.05$, $n=28$) (Shaver 2012). Even though some men may actually be working harder to overcome the costs of ritual participation, the perception is that they are working less. When village men were asked why they did not drink kava the night before, they often reported that it was so that they could "rest."

We also hypothesized that ritual participation would vary owing to status differences among ritual participants. First, we found that education accounts for some variance, with lesser-educated men attending more often and for greater durations than higher-educated men. If status investments work additively across the life course, then younger men are expected to participate more, particularly before they begin reproduction. These investments early in life presumably pay off later, namely, after energy is diverted away from group-directed behavior (e.g., building social alliances) and toward reproduction. The data show that age accounts for significant variance in kava investments, with younger men participating more often and for longer durations than older men. However, when controlling for age, the data indicate that lower-ranking men participate more often, for longer durations, and exhibit greater variance in their stay than higher-ranking men. It appears that men with fewer other opportunities for social success (ascribed rank and education) are more likely to attend these ceremonies.

Human societies vary greatly in their degree of stratification, and in stratified societies the gods may function to support inequalities (Swanson 1960). One outcome of these hierarchical systems is the differential costs and benefits of ritual participation across individuals (Cronk 1994; de Aguilar and Cronk 2011). In Fijian society these differential costs and benefits, which are due to a man's village-wide rank, explain a significant amount of variation in participation. For low-ranking Fijian men, kava participation is an avenue for status achievement whereas for high-ranking men participation is a pathway for status reinforcement. These findings suggest that by virtue of previous investments and/or supernatural attributions, high-ranking men can achieve higher status levels with lower levels of ritual investment.

Conclusion

Humans are a social species that exhibit extraordinary levels of sociality and cooperation relative to other primates. If energetically expensive ritual behaviors can yield stable cooperation, as recent work suggests (Norenzayan and Shariff 2008; Sosis and Alcorta 2003), then these energetic investments should reflect trade-offs with reproduction and resource production. Moreover, if ritual participation can impact one's status, then an individual's embodied capital (education, income, skills, etc.) should influence his ritual participation. Only by examining ritual behavior in the socioecological contexts in which it is performed can we begin to understand the extent to which ritual behavior is patterned, timed with growth and reproduction, and how the costs and benefits of ritual behavior are distributed within populations. Indeed, here we found support for various hypotheses derived from these considerations, but also the refutation of others, suggesting that further investigation is imperative.

In small, closed societies it is likely that individuals build reputations through repeated interactions, and that group members use these reputations to decide with whom to cooperate (Sosis 2005). Repeated interactions often occur in ritual formats, and investments in ritual settings return a specific kind of prestige and status. There is considerable evidence across cultures that higher-status men have higher reproductive success (e.g., Irons 1979; von Rueden et al. 2011). If individuals gain status by virtue of their group investments, then it is likely that optimizing group-directed behavior positively influences relative fitness owing to increased offspring success.

Interestingly, the data presented here indicate that ritual investments increase when men have young dependents in the household, which suggests that in this population the benefits of maintaining social alliances created in the context of ritual venues may indirectly increase reproductive success.

However, these benefits come at a cost, which includes substantial time investments in kava ceremonies and the production and consumption of a psychoactive substance, and men ascribed with low rank pay them disproportionately. These differential payoffs are supported by a social system that exacts costs and benefits unequally within the population, and this variance may have negative relative fitness outcomes for men of low rank. For example, higher-ranking men may benefit from more time available for other pursuits while not facing the same status losses as lower-ranking men. Although the nature of kava ceremonies has evolved since the arrival of missionaries, these ceremonies seem to exacerbate inequality based on an ascribed hierarchy. Future work must address the complex relationships between social inequality, ritual behavior, and reproduction.

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