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## The multiple dimensions of male social status in an Amazonian society

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### 1.0 Introduction

“Behaviour that’s admired is the path to power among people everywhere.”

-*Beowulf* (2000), a new verse translation by Seamus Heaney, p. 5

In all human societies, individuals differ in social status depending upon their age and personal ability (Sahlins, 1958; Service, 1971). In laboratory-based small group studies, status hierarchies emerge spontaneously (Bass, 1954; Campbell et al., 2002; Kalma, 1991). Even among “egalitarian” foragers, who are characterized by widespread resource sharing (Kaplan & Gurven, 2005; Winterhalder, 1986) and some degree of status-leveling (Cashdan, 1980), certain individuals consume more resources, get the best pick of mates, and take a more central role in group decision-making (Boehm, 1999; Trigger, 1985; Wiessner, 1996). Whether implicit or overt, classification by social status is a human universal. While women as well as men compete for status (Campbell, 2002; Hess & Hagen, 2006; Hrdy, 1999; Rucas et al., 2006), this paper focuses exclusively on male status hierarchies.

Social status can be defined as relative access to resources within a social group (Henrich & Gil-White, 2001). A priority of resource access is granted to high status individuals, we argue, due to a group-wide perception that these individuals have a greater relative ability to inflict costs (i.e. dominance) or confer benefits (i.e. prestige) on others. Group members acquiesce to higher status individuals because they believe they will avoid harm or gain some benefit from their deference. Status hierarchies, therefore, are not necessarily pure zero-sum arrangements. In part, status hierarchies represent agreements, maintained by deference signals, to facilitate exchange or to avoid costs of repeated contest competition, as modeled by the war of attrition (Maynard Smith & Price, 1973).

Status hierarchies are not static, however. If an individual becomes less dependent upon the services of particular high-status group members, that individual is perhaps more likely to challenge power inequities between them (Emerson, 1962). Acquiescence to those of high

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status may also vary with subordinates' ability to migrate and their degree of relatedness with high status individuals (Vehrencamp, 1983). Subordinates can also form coalitions against higher status individuals. In many traditional human societies, exploitive leaders are often ridiculed, ostracized, or killed (Boehm, 1999).

Among nonhuman primates, male social status is in large part tantamount to the ability to inflict costs; physically dominant individuals usurp or maintain priority access to food and mates (Boesch et al., 2006; Cowlshaw & Dunbar, 1992; de Waal, 2000). While alliances can be important among nonhuman primates, they are largely to support the above uses of dominance (de Waal, 2000; Duffy et al., 2007; Nishida & Hosaka, 1996). Among humans, however, the cooperative sharing of food, information, labor, and other resources is extensive (Kaplan & Gurven, 2005). Priority access to resources is only sometimes obtained through dominance, and is often mediated by voluntary transfers of inalienable commodities. Henrich & Gil-White (2001) contrast dominance with prestige, which they describe as the deference that accrues to individuals who possess or transmit publicly-esteemed skills. Their discussion of prestige, however, is narrower than the potential range of non-agonistic social status. For example, a man may achieve high status in the market for mates by offering "good genes" or material goods in exchange for sexual access, or he may gain status in the market for influence by offering physical strength or coordinative leadership to potential allies.

Since humans have lived in hunter-gatherer societies for the majority of their existence, modern forager communities can help elucidate the selective forces responsible for human males' status-seeking behavior. Forager societies typically lack major wealth accumulation or formal political or legal institutions (Kelly, 1995). As a result, physical dominance may play a principal role in acquiring male status across social domains. Among foragers who practice some degree of horticulture and who engage in inter-group raiding, warrior-ship is a primary avenue to community-wide influence (Yanomami: Chagnon, 1988; Achuar: Patton, 2000; Waorani: Robarchek & Robarchek, 1998). On the other hand, status acquisition in forager societies has also been linked to attributes like hunting ability (Tsimane: Gurven & von Rueden, 2006; Ache: Kaplan & Hill, 1985; Hadza: Marlowe, 2000; Mbuti: Turnbull, 1965) and generosity (Achuar: Patton, 2005; Yuqui: Stearman, 1989). It is unclear whether male status hierarchies in forager societies are truly multi-dimensional: do traits predictive of dyadic dispute outcomes, for example, contrast or even trade-off with those traits predictive of polyadic influence? Understanding the pursuit of status in different social contexts is crucial precisely because the adaptiveness of this pursuit is often unclear, and the rewards of pursuit may be delayed and vary with the form of status acquired.

This study explores male status hierarchies among the Tsimane forager-horticulturalists of Bolivia. Since status is most palpable in the context of contest competition, we treat the following measures as manifestations of social status among Tsimane adult males: (A) success in dyadic physical confrontation, (B) getting one's way in the context of a conflict within a group, and (C) influence in the context of a community-wide dispute. We also investigate (D) respect because this term is cross-culturally associated with social status. These four measures of social status were chosen because they: represent distinct assemblages of social costs and benefits within small-scale societies, assay relative resource access at different social scales, and lend themselves to empirical evaluation and cross-cultural comparison. None of these measures should be considered equivalent to dominance or prestige; in all likelihood, each of the status measures will reflect elements of both. Furthermore, our four measures are not meant to be exhaustive of the range of social status among the Tsimane.

While prior ethnographies have demonstrated a link between one particular trait and social status (e.g. Stearman, 1989), this study employs a multivariate approach to compare several traits as predictors of status in different social domains. If the predictors of one of our four

status measures differ from those of the other status measures, we could conclude that status hierarchies among Tsimane are multi-dimensional. The predictors of male status we evaluate include age, physical size (e.g. flexed bicep circumference), skill in food production (e.g. hunting ability), level of acculturation (e.g. Spanish fluency), pro-social personality traits (e.g. generosity in meat-sharing), and social support (e.g. number of allies). To quantify these variables as well as the social-status measures, a sample of Tsimane men photo-ranked their fellow villagers. We hypothesized that body size would best predict winning a dyadic physical fight while the other predictors of status, especially ratings of social support, would better predict the other social-status measures that involve  $n$ -person interactions.

The organization of the paper is as follows: Section 2 discusses the socio-ecology of the Tsimane to further motivate our choice of the four status measures; Section 3 presents our hypotheses concerning the predictors of the four social-status measures; Section 4 describes our methods; Section 5 presents our results; Section 6 interprets the results and describes the status characteristics of two recent Tsimane leaders; and Section 7 concludes.

## 2.0 The socio-ecology of the Tsimane of Bolivia

The Tsimane inhabit areas of lowland Bolivia along the Maniqui River and in adjacent forests. While families may spend weeks or months on hunting or field cultivation trips away from settled villages, the Tsimane are semi-sedentary and live in communities ranging from 30 to 500 individuals. Most food the Tsimane consume derives from horticulture, fishing, hunting, and gathering activities. They cultivate plantains, rice, corn, and sweet manioc in small swiddens, and regularly fish and hunt for meat. Polygyny is rare though does occur at low frequencies (~10%) in more remote communities. While exclusive priority of access for individuals or small groups to certain rights and resources is minimal, land close to village centers is *de facto* privately owned. Disputes over land access for horticultural purposes are common, especially between neighboring families. Success in group conflicts- one of our four status variables- is in large part a measure of success in inter-family competition for land or other resources.

The Tsimane are particularly relevant to the study of status hierarchies because they lack inter-group warfare; they offer a valuable comparison to other small-scale subsistence societies in lowland South America, such as the Yanomamo (Chagnon, 1988), for whom physical dominance and warrior-ship beget community-wide influence. Tsimane society is not pacifist, however. Violence between adult males is not uncommon, typically in the form of dyadic fights resulting from sexual jealousy, theft, or stinginess. Dispute resolution is typically left to the parties directly involved or, on rarer occasions, adjudicated by an informal gathering of adult men. We include success in dyadic physical confrontation as one of our status measures.

For much of Tsimane history, older adult males and shamans (*cocojsi*) wielded the most community-wide influence as a result of their ability to commune with forest spirits and ancestors (Daillant, 1994). Shamans have all but disappeared among the Tsimane, due in part to the influence of Catholic and evangelical missionaries. In the late 20<sup>th</sup> century, regional political pressure led to the establishment of elected village leaders (*corregidores*). These leaders are principally representatives to outside political bodies, and they generally have short tenure and little coercive authority within their villages. Community-wide meetings are common in Tsimane villages; they often concern disputes over the sale of community lumber or participation in government or NGO-sponsored development projects. Influence within the context of community-wide disputes, the third of our status measures, will often accrue to the individuals who are most persuasive during community meetings. Elected leaders are not necessarily the most influential individuals in their villages, nor are they necessarily the most

respected. “Respect” is more opaque in its meaning than our other status measures but is used by the Tsimane to describe individuals worthy of admiration.

The Tsimane are undergoing rapid acculturation, which is potentially placing premiums on market-related skills and private wealth in addition to more traditional correlates of social status. In Tsimane villages, especially those located near the town of San Borja (population ~14,000), incipient cattle ownership, wage labor with loggers and farmers, and produce sales to local markets are on the rise. Several Tsimane entrepreneurs operate small businesses where they purchase goods in San Borja and then resell them to other village members. Many Tsimane villages now have access to public schooling for their children. One of the more acculturated Tsimane villages, Ton’tumsi, was the location of this study. Ton’tumsi is one of the largest Tsimane villages and is about a two-hour drive, via logging road and highway, to San Borja. Data are not available at present to compare status hierarchies in Ton’tumsi with status hierarchies in less acculturated Tsimane villages. Nevertheless, the process of acculturation is mosaic, and individuals in Ton’tumsi vary greatly in education and income. Among the Tsimane in general, the mean levels of wealth inequality are relatively high for a small-scale society (Godoy et al., 2004). As traditional societies everywhere change under the forces of globalization, it is imperative to better understand how increases in private wealth within a society shape human social motivations.

### 3.0 Hypotheses

The type of disputes particular to the dyad, group, and community will affect which variables best predict social status in those contexts. Among the Tsimane, dyadic fights often involve alcohol and are usually motivated by accusations of theft, stinginess, or sexual jealousy. Size and strength are primary determinants of successful fight outcomes (Archer, 1988), and flexed bicep circumference among U.S. college students was recently found to predict lifting strength and self-reported success in conflicts (Sell, 2005). Although resource holding potential in addition to motivation determine specific dyadic contest outcomes, context-dependent motivation does not influence dyadic relationships relative to fighting ability over the long-term (Lewis, 2002). With respect to rankings of fighting ability, we anticipate that physical-size measures, such as flexed bicep circumference, chest circumference, height, and weight, predict winning dyadic fights better than any other variables. We suspect that bicep and chest circumference will be stronger determinants of fighting ability than height since tall, skinny men may be less likely to win a fight than short, brawny men.

Group conflicts in Ton’tumsi often involve two or more families competing over land or other resources, or they may be the progressive fallout from prior dyadic conflicts. The typical numbers of individuals involved remains small enough that physical size should still play a role in group conflict outcomes, but social support as a result of allies will become important as well. Allies may be family members, friends, or exchange partners, including those who exchange deference for access to the knowledge and wealth of others. Among the Xavante of Brazil, men’s status stems from the in-group social support engendered from one’s athleticism, oratory skill, hunting ability, sense of humor, and other attributes (Maybury-Lewis, 1974). For the Kayapo of Brazil, social status hinges on access to exotic wealth items through extra-group social contacts (Werner, 1981). Among the Hadza of Tanzania, a man can claim political authority, albeit limited, if he has contacts with outsiders and their trade goods (Woodburn, 1979).

Kinship in small-scale societies is of particular importance in generating social support. Efe men form affiliative bonds with consanguineal male kin to generate allies in the face of competitive social situations (Bailey & Aunger, 1989). Yanomamo men with larger intra-village kinship networks are more likely to be polygynous and high status (Chagnon, 1988).

Marriage is a common strategy for constructing alliances. Hughes (1988) documents several ethnographic examples, including the Nuer of Sudan and the Toda of South India, where high status men are individuals on whom both affinal and consanguineal relatedness is concentrated. Among the Coast Salish of the Pacific Northwest, social status was associated with inter-village connections, established through marriage (Elmendorf, 1971). For the Tsimane, interaction with close kin consumes a large part of men's time spent in leisure and resource production activities. Marriage often occurs between cross-cousins, but many men will move to distant communities to marry wives with whom they have no prior kin relation.

Physical size is unlikely to be an important predictor of community-wide influence in Ton'tumsi, especially since the ability to marshal allies in a conflict, i.e. "derived dominance" (Hand, 1986), is likely to trump "intrinsic", size-based dominance in most polyadic contexts. However, height and muscle mass may also indicate health, attractiveness, athletic performance, and resource production, which will all increase the value of an individual to potential mates or coalition partners. A meta-analysis revealed that 97% of applicable studies found significant, positive relationships between height and socio-economic status in urban nation-states (Ellis, 1994). Case & Paxson (2006) suggested the cross-cultural relationship between height and socio-economic status may be driven by cognitive performance. Better nutrition leads to both tallness and intelligence, and it is the latter that produces socio-economic success. Cognitive performance tests, however, were not administered to the Tsimane for this study.

In Tom'tumsi, community-wide dilemmas have in the past concerned allocation of government benefits, sale of community lumber, internal conflicts and those with colonists or other exploiters, and participation in community development and anthropological projects. These community debates often require interaction with Bolivian nationals, and so literacy, Spanish fluency, experience working with loggers or ranchers, and familiarity with the market town of San Borja are of particular importance to community-wide influence. Tsimane men demonstrate their market acumen, in part, through the conspicuous consumption of market goods. A recent study among the Tsimane found that those men who earn more money devote a greater percentage of their income to the purchase of prestigious and conspicuous leisure items like watches and radios (Godoy et al. 2006).

Pro-social personality traits should predict influence independently of one's level of acculturation. Certain traits, such as trustworthiness, may confer influence from their direct benefits to others while other personality traits, such as sense of humor, may confer influence more from their signaling of fitness or intelligence (Miller, 1999). Among the Tsimane, work ethic is often described as a valued trait in a man because it indicates long-term, intrinsic motivation to provide for one's family and to engage in collective action for the sake of the community. In Ton'tumsi, men occasionally assemble to clear community trails and their soccer field or to engage in cooperative fishing.

Generosity is likely to vary as a source of influence depending upon local resource availability, the level of group-wide sharing, and the opportunity to recruit and maintain political allies through gift-giving (Patton, 2005). The costly signaling of cooperative intent through generous donations of food, money, and services may be an important means of being recognized as a valuable potential social partner or ally (Frank, 1988; Gintis et al., 2001; Gurven et al., 2000). The potlatch of the Pacific Northwest (Barnett, 1938) and *moka* of highland New Guinea (Strathern, 1971) enabled chiefs and big men to flaunt their material and social capital through grandiose displays of generosity. Among the Gitksan, individuals would move to new households after potlatches where they felt their leader was not as generous, hence powerful, as others (Adams, 1973). Among Amazonian societies such as the Yuqui (Stearman, 1989) and the Achuar (Patton, 2005), meat-sharing is predictive of social status. Among the Tsimane,



sharing is generally restricted to close kin in extended family household clusters; intra-family generosity may therefore have less relevance as a group-wide predictor of influence than less frequent acts of extra-household exchange.

We anticipate that social support will mediate much of the effects of the size, acculturation, and personality variables upon community-wide influence. People seek social proximity to the strong, skilled, wealthy, or generous because of the knowledge or material goods they might acquire (Henrich & Gil-White, 2001) and because of the indirect social value of association with powerful individuals. In exchange for social proximity to high status group-members, individuals offer their deference and support. Since many conflicts are with kin (Borgerhoff Mulder, 2007), the number of one's allies may be a better indicator of social support in conflicts than the size of one's kin network.

We also investigate the Tsimane understanding of "respect" since the term is commonly viewed by the Tsimane and other cultures as synonymous with social status. "Respect" will vary cross-culturally in meaning, but here we posit that being respected connotes other people's acknowledgment of an individual's social status: his or her relative ability to inflict costs or confer benefits on others. However, "respect" is likely more than mere acknowledgment of social status. Exploitation of others is likely to erode how well one is respected. If the exercise of power by those of high status is illegitimate or unjustified in the eyes of the community, then respect is lost. The perceived legitimacy of social status is crucial to its maintenance and expansion, particularly social status generated via social alliances. Bass (1981) found that legitimate use of power will increase acceptance of demands made by high status individuals. Blau (1964) describes the process of power legitimation: 1. powerful individuals who are viewed as magnanimous and fair 2. receive the collective approval (i.e. respect) of group members, which 3. leads to social norms compelling compliance. Whether the result of formal laws or informal norms, legitimacy is best viewed as a constraint on or target of social status rather than as a form of status itself.

In Ton'tumsi, several aggressive, dominant men are prone to drunken brawls and spousal abuse. Anecdotally, these men are viewed unfavorably by others. Personal gain based solely on violence or the threat of violence is in most cultures considered illegitimate (Harsanyi, 1966; Riches, 1986). While the ability to win a physical fight does not guarantee respect, neither does polyadic influence. Certain of the more educated and materially wealthy men of Ton'tumsi are known to manipulate community discussions and decision-making to their advantage. Those with less education or market acumen often resent the influence of their more acculturated peers. People are more wary of what they don't understand. Thus, respect is less likely to accrue to men who excel in novel, market-related skills than to men who excel in more traditional skills, such as horticultural knowledge or hunting ability.

Hunting prowess is the archetypal male skill among foragers and correlates positively with social status almost everywhere the relationship has been tested (Gurven & von Rueden, 2006; Smith, 2004; Wiessner, 1996). Oratory skill, expert tool manufacture, skill in warfare, and shamanic knowledge are other valued, traditional skills in Amazonian small-scale societies, though the latter two skills are currently of low importance among the Tsimane. Tool manufacture is probably of decreasing importance in Ton'tumsi since much of the resource-production technology, including rifles and cooking pots, is purchased in San Borja or from traveling merchants. However, many men still hunt and fish with bows and arrows and travel in self-made wooden canoes.

Cross-culturally, older individuals are typically of higher status because they have had more time to accrue knowledge, skill, wealth, or social support. In most small-scale societies, older men (but not necessarily the oldest men) exercise the greatest social power and receive the

most deference (Silverman & Maxwell, 1978; Simmons, 1945). Given the strength requirements of many status-related activities, such as dyadic contest competition, age may not linearly predict the social-status measures. Strength in male foragers tends to peak in the twenties (Walker et al. 2002). Among the Tsimane, hunting kill rate doesn't peak until age forty but declines afterwards as men physically senesce (Gurven et al. 2006). About 40% of Tsimane men survive to age sixty and beyond (Gurven et al. 2007); these individuals are not as likely to win a dyadic fight or get their way in a group as are younger, stronger individuals. Older individuals, however, may rank highly in community influence since they are likely to be sought after for advice, i.e. wisdom, and have more social support in the form of direct descendants. Wisdom has been defined as a high level of contextual and procedural knowledge regarding life's problems and an ability to formulate appropriate judgments in the face of uncertainty (Baltes & Smith, 1990). With increasing age, influence may plateau or show diminishing returns rather than decline. On the other hand, older males have had limited access to market-related skills, which are likely an increasingly important predictor of influence in Ton'tumsi. The majority of schools in Tsimane villages have existed for less than thirty years and so individuals currently above age fifty are less likely to be literate or speak Spanish. Maxwell and Silverman (1970) conjecture that rapid institutional change, leading to information obsolescence, translates into reduced prestige for the elderly. We anticipate that the social-status measures will increase with age until the forties and decline thereafter; the ability to win a dyadic fight should show the strongest quadratic relationship with age.

## 4.0 Methods

### 4.1 Photo-ranking

All analyses are of the entire adult male population from one of the more acculturated Tsimane villages, Ton'tumsi. There were 57 adult men over eighteen years old among a total village population of approximately 300 individuals. At the time of data collection, only eight of the 57 men were unmarried and no one had more than one wife.

To generate rankings of our status measures and their predictors, Tsimane males were asked to photo-rank other males in their community. Status hierarchies are less determined by the actual distribution of status within a community than by people's *perceptions* of its distribution. We believe this justifies the measurement of status in this study as the quantified rankings by Tsimane raters of other community members' social standing. Furthermore, subjective impressions are based on years of interpersonal relationships and so are probably better metrics of personal attributes than researchers' observations. Observation and subjective impression do tend to correlate, however. Among the Ache, there is a strong positive correlation between a hunter's actual meat returns and his ranking of hunting success by other Ache (Hill & Hurtado, 1996). Among the Shuar, one's work effort as perceived by others is highly correlated with actual work effort (Price, 2006).

A random sample of 29 Tsimane adult males was used as raters of their fellow villagers. The raters represented most ages and all extended families within Ton'tumsi. Status rankings of the men in Ton'tumsi by two individuals not picked as raters indicated that the rater sample was not biased towards lower or higher social standing. Irrespective of these precautions, no evidence was found that raters over-estimated the qualities of family members. Sons actually tended to rate their fathers below their fathers' average scores!

The raters answered "yes or no" to questions concerning the presence or absence of a trait for other men in Ton'tumsi. These traits are: hunting ability, being a hard worker, being funny, keeping promises, trustworthy, generosity in meat sharing, generosity in lending money, giving good advice, and how often visited. These variables were chosen from the theoretical discussion above, personal intuition, and ethnographic experience as a result of focus group

interviews with several Tsimane men and women concerning what they consider important traits in adult men. Twenty-eight of the raters each evaluated photographs of sixteen other men in the village, and one randomly selected rater evaluated photographs of only eight other men in the village. Since the photographs were counterbalanced using a block design, this rating procedure ensured that the 57 men's photographs were evaluated eight times for every trait, each of the eight times by a different rater. A subject's score on these measures ranges from zero to eight and indicates the number of raters who answered "yes" to the question.

For fighting ability, whether the individual gets his way in a group dispute, level of influence in the community, whether the individual is well respected, and whether the individual is likely to have more allies in the event of a conflict, a different rating procedure was employed. For each of these traits, a rater was shown an array of eight photographs of Tsimane men and asked to rank them from highest to lowest, with a score of eight assigned to highest and one for lowest. Twenty-eight of the raters evaluated two arrays of photographs per question while one randomly selected rater evaluated one array of photographs per question. A block design was employed so that no two subjects appeared together in the same array more than once. Thus, each of the 57 men was ranked eight times by eight different evaluators, yielding a range in scores from 8 (lowest) to 64 (highest). Fighting ability was ranked last so as not to bias a rater's previous rankings.

In general, the raters found the photo-ranking highly engaging and intuitive. Each rater photo-ranked his peers with no one else present but CVR. The raters were made aware of the confidentiality of their individual rankings. Photos were polaroids of the top-half of each man's body, set against as neutral a background as possible. All photo-ranked measures were translated into Tsimane from Spanish and then, as a test of the accuracy of translation, back-translated into Spanish by Tsimane men from outside the community of Ton'tumsi. All interviews of the raters were conducted in Tsimane. For definitions of the photo-ranked measures, see Appendix 1 in the supplementary material.

## 4.2 Interviews and anthropometrics

All demographic data used to age individuals and describe kinship relations come from extensive reproductive history interviews done by MG during 2002-2004. For a description of methods, see Gurven et al. (2007). Demographic data in Ton'tumsi were updated during the 2005 field season when the photo-ranking took place. The demographic data allow calculation of each male's degree centrality within the kinship network of Ton'tumsi. This measure is the total number of households in Ton'tumsi in which a man or his wife can claim a full sibling, parent, or offspring. We assumed 100% paternity certainty. Our kinship measure purposely conflates affinal and consanguineal kin in light of Hughes (1988), who finds that leaders in small-scale societies possess both high consanguineal and high affinal relatedness with other group members.

Data on commerce income (i.e. sales of horticultural produce) and wage labor income were collected over the summer and fall of 2005 through weekly interviews of Ton'tumsi households. Flexed bicep circumference (of the dominant arm), chest circumference, height, literacy, Spanish fluency, and highest completed school level were also recorded for each adult male in the sample. A tape measure was used for bicep and chest circumference, while height was recorded with a Seca 214 Portable Stadiometer. Literacy was determined by the ability to read a standardized sentence in Tsimane; the men were recorded as unable to read, able to read poorly, or able to read well. Each man was questioned about his Spanish fluency and could indicate no knowledge of Spanish, minimal knowledge, or fluency.



### 4.3 Data Analysis

Since we can analyze over twenty predictors of status but our sample size is limited to the 57 adult men in Ton'tumsi, factor analysis was employed to improve the subjects-to-variables ratio. We used a maximum likelihood factor extraction, which allows goodness-of-fit tests, and an oblimin factor rotation, which simplifies the factor structure such that variables load highly on one factor and less on others. We chose an oblique factor rotation method since orthogonal rotation methods generate uncorrelated factors, resulting in a loss of valuable information if the factors are indeed correlated. Of the predictor variables analyzed, five contained non-systematic missing values, which were replaced with the sample means. To reduce our errors of inference due to small sample size, we divided our predictor variables into two smaller groups before performing a factor analysis on each group. The first group, the "size and skills" variables, yielded three factors: a *physical-size factor* (on which loaded 1. bicep circumference, 2. chest circumference, 3. height, and 4. weight), a *food-production factor* (on which loaded 1. hunting ability, 2. hard-working, and 3. commerce income), and an *acculturation factor* (on which loaded 1. literacy, 2. Spanish fluency, 3. education level, and 4. wage labor income). The size factor captured 26% of the variance in the data, the food-production factor captured 31% of the variance, and the acculturation factor captured 11% of the variance. The factor extraction fit the data well ( $\chi^2_{25}=17.906, p=.846$ ). The second group of predictors, the "social" variables, yielded two factors: a *pro-social personality factor* (on which loaded 1. keeps promises, 2. trustworthy, 3. gives good advice, 4. lends money, 5. generously shares meat, 6. funny, and 7. visited often) and a *social-support factor* (on which loaded 1. number of allies and 2. kin network centrality). The pro-social personality factor captured 52% of the variance in the data, and the social-support factor captured 13% of the variance. The factor extraction fit the data well ( $\chi^2_{19}=19.114, p=.450$ ). See Appendix 2 in the supplementary material for the rotated factor loadings.

To determine the best predictors of status in Ton'tumsi, we linearly regressed our five factors on the four status measures: (A) winning a dyadic fight, (B) gets his way in a group, (C) community-wide influence, and (D) being respected. To each least-squares regression model, we added age and age<sup>2</sup> as controls. See Table 1 for the regression results. Standardized betas are reported for ease of comparison of the strength of each factor in predicting the status measure.

## 5.0 Results

### 5.1 Success in dyadic physical confrontation

The regression model is significant and explains 71.1% of the variance in winning dyadic fights. As anticipated, the strongest predictor of winning fights is the physical-size factor. Height is probably least responsible for this relationship since it loads the least on the physical-size factor among the four physical-size variables (see Appendix 2). Additionally, height produces a smaller bivariate correlation with success in dyadic fights ( $r=.571, N=53, p<.001$ ) than does bicep circumference ( $r=.715, N=57, p<.001$ ), chest circumference ( $r=.595, N=57, p<.001$ ), or weight ( $r=.779, N=53, p<.001$ ).

The social-support factor is also a significant predictor of winning dyadic fights. Marginally significant are the age and age<sup>2</sup> terms. The food-production, acculturation, and pro-social personality factors do not independently predict winning dyadic fights in the regression model.

### 5.2 Getting one's way in a group

The regression model is significant and explains 35.1% of the variance in getting one's way in a group. Social support is the strongest predictor of getting one's way in a group though

physical size is also significant. Neither the age terms nor the other status-predictor factors even marginally approach significance.

### 5.3 Community-wide influence

The regression model is significant and explains 76.2% of the variance in community-wide influence. Neither the physical-size factor, food-production factor, pro-social personality factor, nor the age and age<sup>2</sup> terms independently predict influence in the regression model. The relationship between social support and influence is the strongest of all the regression results in this study. The number of one's allies is probably a greater contributor to influence (as well as to the other status measures) than is number of close kin. Number of allies alone explains 40% of the variance in winning a dyadic fight, 28% of the variance in getting one's way in a group, 78% of the variance in community influence, and 43% of the variance in respect (*adj. R<sup>2</sup>* values). Number of allies, furthermore, loads more heavily on the social-support factor than does kin network centrality (see Appendix 2).

The acculturation factor is an independent predictor of community-wide influence in the regression model. Unlike wage labor income, we surmise that commerce income neither predicts influence nor loads on the acculturation factor because horticultural commerce is a less rewarding enterprise and does not require tremendous initial investment in one's education. Compared to horticultural commerce, wage labor offers Ton'tumsi men both higher average weekly earnings (\$4.37 US vs. \$3.43 US) and potentially higher absolute earnings (wage labor income  $\sigma^2=27.50$  vs. commerce income  $\sigma^2=12.80$ ). Wage labor, such as working as a ranch-hand, logger, teacher or agro-forestry consultant for Bolivian nationals, correlates highly with Spanish fluency ( $r=.454, N=56, p=.001$ ), literacy ( $r=.425, N=56, p=.001$ ), and influence ( $r=.256, N=56, p=.056$ ) while commerce income is un-related to Spanish fluency ( $r=-.073, N=56, p=.593$ ), literacy ( $r=-.040, N=56, p=.768$ ), or influence ( $r=-.109, N=56, p=.426$ ). The question remains, however, whether literacy and Spanish fluency are the results of wage labor or are in fact generating wage opportunities. Controlling for age and age<sup>2</sup>, completed grade level (*std. beta*=.597,  $p=.001$ ) and not wage labor income (*std. beta*=-.050,  $p=.678$ ) predicts literacy in a multiple regression ( $F_{4,38}=9.832, p<.001$ ). Similarly, completed grade level (*std. beta*=.882,  $p<.001$ ) and not wage labor income (*std. beta*=-.024,  $p=.861$ ) predicts Spanish fluency ( $F_{4,38}=16.879, p<.001$ ).

### 5.4. Respect

The regression model is significant and explains 38.8% of the variance in respect. While the physical-size factor, acculturation factor, pro-social personality factor, and the age and age<sup>2</sup> terms do not predict respect in the regression model, social support and food production are strong independent predictors of respect. Hunting ability loads the highest on the food-production factor (see Appendix 2), and hunting ability correlates strongly with respect ( $r=.469, N=57, p<.001$ ). Since respect is not as strongly correlated with reputation as a hard worker ( $r=.286, N=57, p=.031$ ) or horticultural commerce income ( $r=-.028, N=56, p=.837$ ), hunting ability appears to drive the food production-respect relationship.

The food-production and acculturation factors negatively co-vary (see Table 2 below), which suggests that investments in community-wide influence trade-off with investments in respect. Controlling for age, however, attenuates the inverse relationship between food production and acculturation (*partial r*=-.213,  $N=57, p=.115$ ). Furthermore, acculturation is neither a significant negative nor positive bivariate predictor of respect. Table 2 presents the cross-correlations among all the status predictors and measures of status.

## 5.5 Social support

The social-support factor is probably a strong mediator of the other status predictor variables, so we performed a regression to gauge which predictor variables most associate with social support (see Table 1, column 6). The regression model is significant and explains 51.7% of the variance in social support. The acculturation factor is the strongest predictor of the social-support factor, but the physical-size factor and the pro-social personality factor are also significant.

Since the pro-social personality factor correlates with all four status measures, especially influence and respect (see Table 2), the effects of pro-sociality on status acquisition are likely mediated by social support. The mediating effect of social support is largely due to number of allies. Pro-sociality correlates with alliance strength ( $r=.508, N=57, p<.001$ ) but not with kin network centrality ( $r=.188, N=57, p=.161$ ). Likewise, level of acculturation correlates with alliance strength ( $r=.473, N=57, p<.001$ ) but not with kin network centrality ( $r=-.019, N=57, p=.887$ ).

Among the pro-social personality variables, giving good advice loads highest on the pro-social personality factor (see Appendix 2) and produces the strongest correlation with community-wide influence ( $r=.507, N=57, p<.001$ ). Generous meat-sharing and how often one is visited load nearly as high on the pro-social personality factor. Among the pro-social variables, meat-sharing is the strongest bivariate predictor of respect ( $r=.450, N=57, p<.001$ ).

## 5.6 Social status and age

Figure 1 displays non-parametric LOWESS smoothed curves of each status measure by age.

Figure 1 suggests that the social-status measures relate to age quadratically, i.e. show a mid-life peak. The ability to win a dyadic fight produces the strongest quadratic relationship with age ( $F_{2,54}=6.843, p=.002$ ), and respect produces the weakest quadratic relationship with age ( $F_{2,54}=1.418, p=.251$ ). None of the status measures produce a linear relationship with age (see Table 2). With the exception of getting one's way in a group, status peaks in the thirties for the average Tsimane male, which is earlier than we predicted. Respect shows only slight declines with old age.

In Ton'tumsi, there are only ten men older than age fifty. On aggregate, these individuals are not recognized as high status, and they lack many of the traits that are crucial to status acquisition. Age does not linearly predict the physical size, food-production, pro-social personality, and social-support factors (see Table 2). Age negatively predicts the acculturation factor. Older individuals are in general not overcoming deficits in wage labor income ( $r=-.406, N=56, p=.002$ ) by pursuing alternative income strategies. Age shows no linear relationship with commerce income ( $r=.065, N=56, p=.636$ ). While older men can not claim more allies ( $r=-.104, N=57, p=.442$ ), they may possess relatively more support from kin ( $r=.234, N=57, p=.079$ ). This latter relationship would be even stronger were the oldest male in Ton'tumsi not a recent immigrant to the community.

When controlling for the acculturation factor, age does produce significant partial correlations with getting one's way in a group (*partial*  $r=.270, N=57, p=.045$ ), respect (*partial*  $r=.281, N=57, p=.036$ ) and community influence (*partial*  $r=.398, N=57, p=.002$ ). Wins dyadic fights produces no partial correlation with age (*partial*  $r=.136, N=57, p=.318$ ). In Tom'tumsi, the lack of a linear age effect on the polyadic-status measures is in large part an artifact of novel conditions.

## 6.0 Discussion

### 6.1 Interpretation of the results

Among Tsimane men of Ton'tumsi, physical size is the primary determinant of dyadic fight outcomes. Social support is slightly more predictive than physical size of getting one's way in a group. Greater social support and acculturation result in community-wide influence, and greater social support and skill in food production (i.e. hunting ability) generate respect. Larger physical size, greater acculturation, and pro-social behavior are independently associated with more social support, and social support mediates their effects on the status measures. Age predicts status quadratically. Figure 2 illustrates the most significant linear predictors of male social status in Ton'tumsi, given the results of our multiple regression analysis.

Our results suggest male fighting ability is determined more by muscle size and weight than by height. In a study of U.S. college students, flexed bicep circumference predicts lifting strength and self-reported conflict outcomes better than height, weight, or chest circumference (Sell, 2005). However, in a study of Indian men, height, weight, and flexed bicep circumference all significantly correlate with aggression, but height and weight produce higher bivariate correlations with aggression than does bicep size (Archer & Thanzami, 2007). Since the cross-correlations among all of these variables are as high in the Indian and U.S. samples above as among the Tsimane, the different results reported by these studies may be more apparent than real.

Independent of physical size, social support shows a strong relationship with winning a dyadic fight. Our interpretation is that dyadic fighting ability is perceived as indistinguishable from one's ability to elicit social support. The downstream consequences of any dyadic fight may involve retaliation by the disputing parties' coalitions, and large size is a predictor of more social support within Ton'tumsi. Alternatively, having more allies may simply make one *seem* more physically formidable even when coalitional retaliation is not anticipated.

For group dispute outcomes, coalitional support is paramount, but physical size still plays an important independent role. Thus, getting one's way in a group is a form of social status among Tsimane males that is intermediate between winning a dyadic fight and community-wide influence.

In generating community-wide influence, physical size has no effect independent of social support. Individuals who are more pro-social have more influence, but again only as a result of their social support. Within one's social group, individuals make decisions concerning how much of their resources to share and with how many others (Gurven 2004). Sharing decisions which optimize resource consumption via reciprocal altruism might trade off with sharing decisions which optimize status acquisition via alliance formation.

The regression results for community-wide influence reveal the growing impact of acculturation within Tsimane society. Independent of their effects on social support, skills gained through formal education are of increasing importance to community-wide influence because they 1. provide exclusive access to knowledge germane to community-wide debates and/or 2. increase opportunities to gain and flaunt material wealth. Differences in time-discounting among Tsimane males may determine who reaps more wealth and influence later in life. In a recent study of the Tsimane, more patient individuals reported more years of schooling, and four years later they had earned greater wage labor income (Reyes-Garcia et al., 2007).

Measures of inequality in the distribution of income and literacy show that relatively few individuals in Ton'tumsi currently benefit from the effects of acculturation. The Gini

coefficient is one measure of inequality in which the actual distribution of a trait is compared to its uniform distribution. Gini coefficient values range from 0 (perfect equality) to 1 (perfect inequality). Gini coefficients for wage labor income (.59), commerce income (.53), and literacy (.35) are among the highest for all the predictors of status analyzed in this study. For comparison, the 2005 U.S. household income Gini coefficient was .47 (DeNavas-Walt et al., 2006) and the 2003 EU household income Gini coefficient was .31 (Central Intelligence Agency, 2008). Unequal distribution of a trait does not necessarily mean that trait is strongly tied to social status, however. The Gini coefficients for Spanish fluency (.18), number of allies (.16) and bicep circumference (.04) are relatively low. Most of the measures in this study, including all four social-status measures, produce Gini coefficients of .20 or less. The other measures with Gini coefficients above .20 are kinship network centrality (.38), money-lending (.31), and meat-sharing (.25).

The strong relationship between hunting ability and respect is noteworthy. In Ton'tumsi, men hunt for an average of seven hours per week, and hunting returns contribute on average 22% of men's total daily food production (Gurven and von Rueden, 2006). Despite its proximity to San Borja, Ton'tumsi is on the periphery of old-growth forest where game animals remain relatively abundant. In a less acculturated, more remote Tsimane village, however, men hunt for eleven hours per week, and hunting returns contribute on average 50% of men's total daily food production (Gurven and von Rueden, 2006). Perhaps the reduced contribution of hunting to food production in Ton'tumsi explains in part why the food-production factor does not predict the other social-status measures. Nevertheless, hunting remains culturally venerated, as gauged by its relationship with respect. Analysis of unpublished data also suggests Tsimane women in both Ton'tumsi and a more remote community place similar emphasis on hunting ability in a prospective husband.

As the Tsimane become more integrated in Bolivian national society, the allocation of respect may remain highly conservative relative to the more labile nature of the predictors of community-influence. The acculturation factor shows no bivariate or multivariate relationship with respect; it is possible that novel skills like literacy and the wealth it brings are perceived as a less legitimate, though an increasingly more successful, means of achieving social status. In any society, it seems, the *nouveau riche* are seldom accorded respect by their peers.

Social support is the *sine qua non* of social status among the Tsimane. Our results suggest that social support is either mediating or out-competing the other status predictors in generating polyadic social status. The strongest determinant of social support, and in particular one's number of allies, is level of acculturation. Men with labor-market skills and wage labor income may attract allies because, in part, they can afford to be more pro-social. Income positively predicts the number of times a Tsimane household gave gifts of money, food, or labor to other households (Godoy et al., 2007). On the other hand, community-wide market integration and inequality in consumed goods negatively predicts household generosity among the Tsimane (Godoy et al., 2007). At the community level, acculturation has adverse consequences on social bonds within traditional societies, perhaps because people begin to invest more in private wealth than in social support as a means of risk reduction (Fafchamps, 1992; Rosenzweig, 1988).

Old age is not a guarantor of social status among the Tsimane. Given the senescence of physical size with age, the relative lack of dyadic fighting ability among older men is unsurprising. The decline or stasis in getting one's way in a group, community-wide influence, and respect after age 40 differs from reports of deference towards elderly men in other small-scale societies (Silverman & Maxwell, 1978; Simmons, 1945). However, our result is perhaps not uncommon for a rapidly acculturating small-scale society where the elite ritual knowledge of older men has decreased in value. Furthermore, the lack of influence among Ton'tumsi males older than



age fifty is in large part a cohort effect due to their limited exposure to public education and market-based knowledge. Income opportunities and the ability to purchase prestigious, foreign items (e.g. watches and radios) have shifted the basis of power from folk knowledge (e.g. shamanism and hunting skill) to market acumen. Respect shows the least decline with old age in Tom'tumsi, which supports our interpretation of respect as slow to reflect changes in the predictors of the other status measures. Since hunting ability is a strong predictor of respect, senescence in the former may, in part, explain senescence in the latter. Men older than fifty are still contributing significant amounts of food to their households, but their hunting performance is decreased relative to men in their thirties and forties (Gurven et al., 2006). Despite their relative lack of social status compared to middle-aged men, the oldest males in Tom'tumsi do retain one significant asset: their relatively greater number of co-resident adult kin.

The results of this study are highly robust in at least one sense: they are drawn from the *entire* adult male population of Tom'tumsi. At present, the extent to which the more and less acculturated Tsimane villages differ in the predictors of male social status is unknown. It is unlikely that physical size or hunting ability will be any less relevant in the less acculturated communities. It is also probable that nowhere among the Tsimane will social support not be the preeminent source of status.

## 6.2 Different pathways to status: a tale of two leaders

The elected leader of Tom'tumsi since 2006 is rated as having the most allies of any man in the village, and he is tied for second in kin network centrality. He is also rated as most able to win a fight and most influential. The previous leader ranks fairly high in terms of allies and influence even though he has one of the lowest kin centrality scores in the sample and is also relatively short and un-muscular. However, he has nearly double the total income of any other man in the village, in principal due to his business of reselling goods from San Borja to the residents of Tom'tumsi. Perhaps as a result of his wealth, he is ranked only sixteenth in terms of respect. The current leader, on the other hand, received the third highest respect ranking. Both the current leader and his predecessor are young men, aged 38 and 28 years old respectively.

Are the differences between these two leaders representative of the multidimensionality of status among the Tsimane? The four forms of social status and most of the predictors of status tend to concentrate within the same individuals (see Table 2). The two most recent leaders of Tom'tumsi may have gained their leadership positions through different means, but in general a certain, few men rank the highest in most predictors of status and all four manifestations of social status. It is to the advantage of high status individuals to diversify their bases of status, thereby increasing the scope of their power and precluding others from gaining ascendancy in a new status niche. Phenotypic correlations (e.g. better nutrition, health, and general intelligence among the higher status men) may underlie the lack of social niche specialization in Tom'tumsi. Because the predictors of the status measures tend to concentrate in the same people, traits correlated with status lose significance in our regression models. In other published studies of social status, similar bivariate relationships may likewise not hold up to multivariate analysis. The relationship between warrior-ship and status in some societies, for example, may be driven by such underlying traits as intelligence or strength. Our study of social status is among the first to consider different determinants of status simultaneously.

## 7.0 Conclusion

Social status may be viewed as a growth process in which one invests to gain fitness-related benefits over the life-course. Across small-scale societies, gains in status enable men to marry a younger, more fecund wife (e.g. Hadza: Marlowe, 2000; Meriam: Smith et al., 2003; Ifalukese: Turke & Betzig, 1986), marry more wives (e.g. Kipsigis: Borgerhoff Mulder,

1987; Yanomamo: Chagnon, 1988; Aka: Hewlett, 1988), or engage in more extra-marital affairs (e.g. Ache: Kaplan & Hill, 1985), because status signals mate quality or represents a priority of resource access valuable to potential mates. High social status typically leads to higher total fertility (e.g. Achuar: Patton, 2005; Gabbra: Mace, 1996; !Kung: Wiessner, 2002a), and status can improve average offspring survivorship (e.g. Ache: Hill & Hurtado, 1996; Yomut: Irons, 1979; Datoga: Sellen et al., 2000) or own and spouse survivorship from a preferential access to resources during times of need. Greater access to food or allies will be especially rewarding in times of food scarcity and sickness (Boone, 1998; Gurven et al., 2000; Sugiyama & Chacon, 2000) or in times of political conflict (Patton, 2005). In the face of risk and uncertainty, social status acts as a form of social insurance important for improving survival and capitalizing on resource consumption opportunities.

The fitness benefits that accrue to high status individuals may depend on the form of social status acquired. In this study, we investigated four measures of male social status among the Tsimane: (A) success in dyadic physical confrontation, (B) the ability to get one's way in a group, (C) community-wide influence, and (D) respect. These status measures represent distinct social contexts in Tsimane society through which resource access is mediated. While the status measures tend to concentrate in the same individuals, in multivariate analysis they are predicted by different sets of traits.

Among the Tsimane, male status hierarchies are best viewed as multidimensional. While dyadic fighting ability is determined largely by physical size, the ability to get one's way in a group dispute, community influence, and respect arise primarily from social support. Even the ability to win a dyadic fight is viewed as indistinguishable from the strength of one's alliances. Although in many traditional societies old age is accompanied by increases in influence or respect, among the Tsimane the oldest adults do not wield the most social status. Older men have senesced in physical size and they lack market-related acumen, which has eclipsed traditional skills, such as hunting ability, in generating community-wide influence. On the other hand, hunting ability produces respect whereas level of acculturation does not.

Over several generations, inequalities in income and privately held wealth may potentiate institutionalized status hierarchies among the Tsimane. Across small-scale societies, greater access to predictable, defensible, and/or storable food and wealth attenuates inter-family resource sharing, de-emphasizes status-leveling norms, and produces more strictly demarcated social inequalities (Gould, 1982; Hames & Vickers, 1983; Keeley, 1988; Matson, 1985). When tied to economic surpluses, private ownership and inter-generational inheritance enable certain families to accrue and maintain more wealth than other families. Patron-client systems (Boone, 1992) or managerial mutualisms (Smith & Choi, 2005) may catalyze further status inequality. Among the Enga of highland New Guinea, the introduction of the sweet potato produced a booming surplus economy in which particular families gained managerial control over exchange networks and political institutions (Wiessner, 2002b). Private ownership and inter-generational inheritance of wealth are primary inducements of social hierarchies that are institutionalized and polarized, i.e. social classes (Bowles, 2005).

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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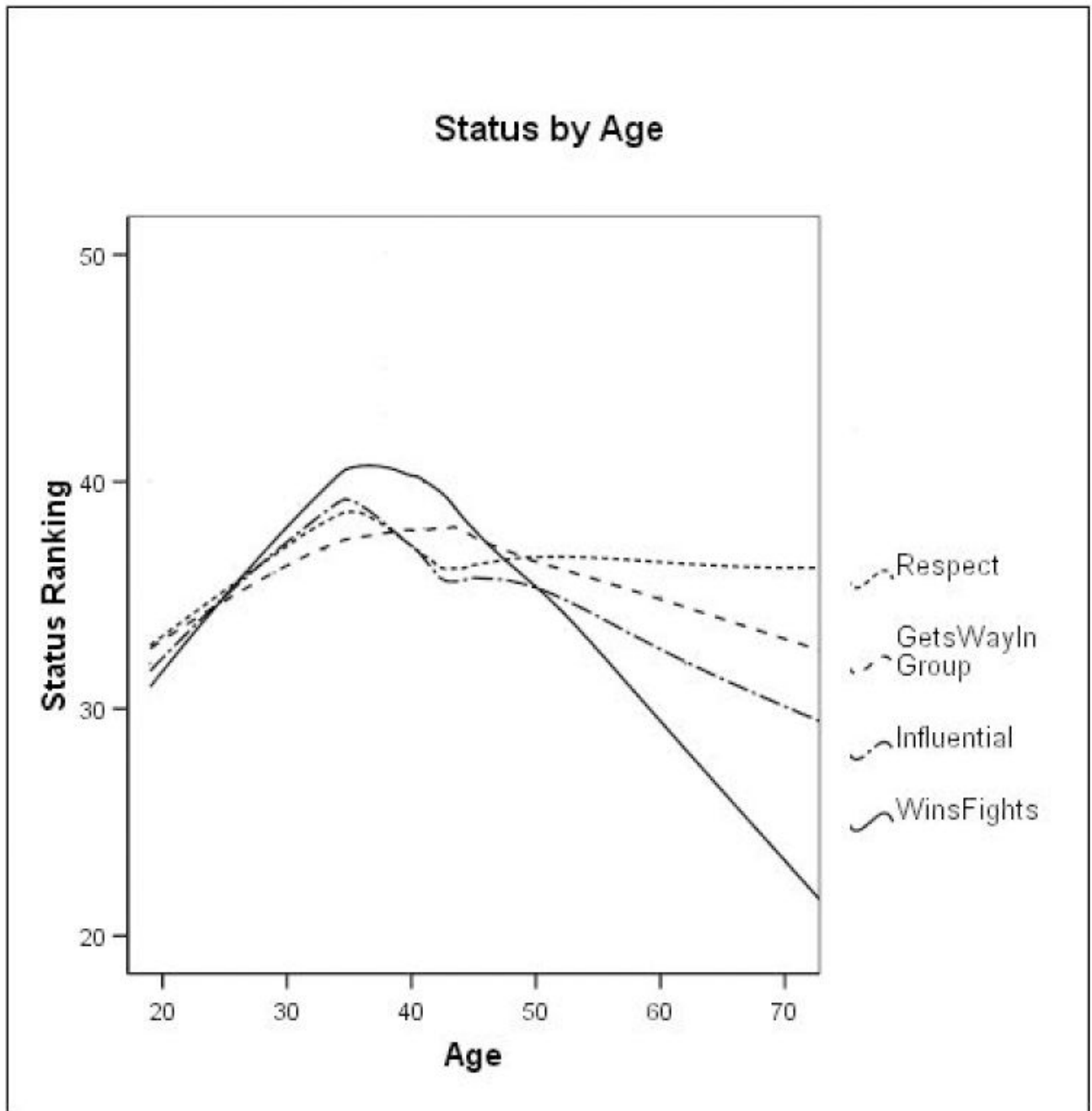
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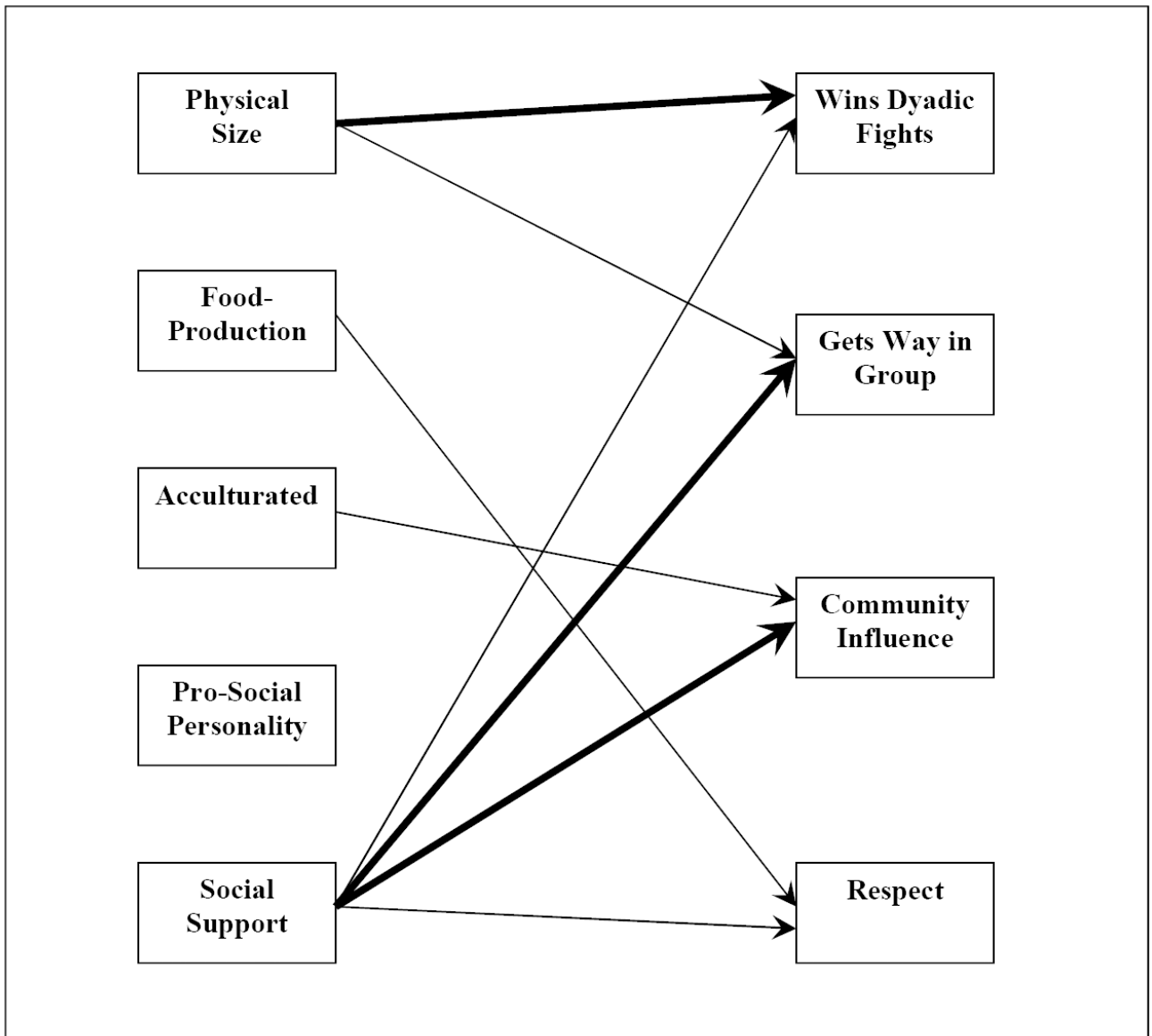
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**FIGURE 1.** non-parametric LOWESS smoothed curves fitted to the status-measure rankings by age ( $N=57$ )



**FIGURE 2.**

Schematic of the independent, linear predictors of four measures of social status among the adult males of Ton'tumsi ( $N=57$ ). Due to the small sample size, this figure presents results from four separate multiple regression analyses (see Table 1) rather than an overall path analysis. Arrows indicate multiple regression weights with standardized values  $>.25$  and  $p$  values  $<.05$ ; bolded arrows indicate multiple regression weights with standardized values  $>.45$  and  $p$  values  $<.01$

**TABLE 1**

Standardized betas from multiple regression analysis of the social-status measures<sup>1</sup> (N=57)

	<b>Wins Dyadic Fights</b>	<b>Gets Way in Group</b>	<b>Community Influence</b>	<b>Respect</b>	<b>Social Support<sup>3</sup></b>
<b>Age</b>	.972*	.305	.199	-.716	.860
<b>Age Squared</b>	-1.049†	-.221	-.026	.882	-.601
<b>Physical Size<sup>2</sup></b>	.536‡	.285†	.093	.027	.269†
<b>Food Production<sup>2</sup></b>	.046	-.065	.102	.360†	.112
<b>Acculturated<sup>2</sup></b>	.196	.010	.301†	.056	.546‡
<b>Pro-Social Personality<sup>2</sup></b>	-.093	-.013	.069	.159	.263†
<b>Social Support<sup>2</sup></b>	.265†	.468‡	.628‡	.400†	-
<i>Adj. R Squared</i>	.711	.351	.762	.388	.517
<i>F<sub>7,49</sub></i>	20.656‡	5.323‡	26.585‡	6.071‡	10.989‡

<sup>1</sup> \* = p < .10, † = p < .05, and ‡ = p < .01

<sup>2</sup> Predictors derived from factor analysis (see Methods)

<sup>3</sup> Initially a predictor variable but subsequently analyzed as a dependent variable due to its strong relationship with the other social-status measures

TABLE 2

Pearson correlation coefficients among the social-status measures and their predictors<sup>4</sup> (N=57)

	Age <sup>5</sup>	Physical Size <sup>5</sup>	Food Production <sup>5</sup>	Acculturated <sup>5</sup>	Pro-Social Personality <sup>5</sup>	Social Support <sup>5</sup>	Wins Dyadic Fights in Group <sup>5</sup>	Gets Way in Group <sup>5</sup>	Community Influence <sup>5</sup>	Respect <sup>5</sup>
Age	1	.036	.205	-.665‡	-.096	-.078	-.179	.049	-.070	.146
Physical Size		1	.292†	.234*	.184	.518‡	.781‡	.524‡	.535‡	.328†
Food Production			1	-.289†	.350‡	.225*	.242*	.151	.244*	.459†
Acculturated				1	.334†	.474‡	.424‡	.250*	.497‡	.115
Pro-Social Personality					1	.541‡	.301†	.278†	.545‡	.455‡
Social Support						1	.654‡	.602‡	.863‡	.548‡
Wins Dyadic Fights							1	.588‡	.675‡	.419†
Gets Way in Group								1	.525‡	.339†
Community Influence									1	.653‡
Respect										1

<sup>4</sup> \* = p < .10, † = p < .05, and ‡ = p < .01

<sup>5</sup> Predictors derived from factor analysis (see Methods)