



Working Paper Series

To download this and other publications visit:

<http://people.brandeis.edu/~rgodoy/>

or

www.cas.northwestern.edu/anthropology/LHBR/Bolivia.html

DRAFT: May 11, 2011

The perceived benefits of adult and child height:

Strength, dominance, social concern, and knowledge among Bolivian native Amazonians

Ricardo Godoy^a, Leslie Zebrowitz^a, Eduardo A. Undurraga^a, Dan T. Eisenberg^b,
Victoria Reyes-García^{a,c}, and TAPS Bolivia Study Team^d

^a Heller School for Social Policy, Brandeis University, Waltham, MA 02454, USA

^b Department of Anthropology, Northwestern University, Evanston, IL 60208, USA

^c ICREA and Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona,
08193 Bellaterra, Barcelona, Spain

^d Tsimane' Amazonian Panel Study (TAPS), Correo Central, San Borja, Beni, Bolivia

Abstract

In industrial nations, taller people are attributed positive traits partly because height is positively associated with socioeconomic indicators of well-being, but do people in industrializing societies attribute positive traits to tall people? The question matters for public policies aimed at redressing growth stunting. Here we report the results of a study in a foraging-farming society of native Amazonians in Bolivia (Tsimane') to address this question. Forty women and 40 men >16 years of age were shown 24 photographs of pairs of Tsimane' women, men, boys, and girls. Subjects were presented with four behavioral scenarios and asked to point to the person in the photograph with greater strength, dominance, social concern, or knowledge. The pairs in the photographs were of the same sex and age, but one person was shorter than the other. Subjects did not know the people in the photographs. Women and men attributed greater strength, dominance, and knowledge to taller girls and boys rather than to shorter girls and boys, but they did not attribute most positive traits to taller adults. Only when we asked about strength did we find significant evidence that Tsimane' attributed greater strength to taller adults. The results raise a puzzle: Why would Tsimane' attribute positive traits to tall children, but not tall adults?

Key words: *Tsimane' Amazonian Panel Study (TAPS), hunter-gatherers, cognition, anthropometrics*

Introduction. In industrial nations, taller people are attributed positive socioeconomic and character traits, such as intelligence, professionalism, employability, and leadership (Brackbill and Nevill, 1981; Chu and Geary 2005; Jackson and Ervin 1992; Martel and Biller 1987)ⁱ. In addition, standing physical stature (hereafter height) is positively associated with many socioeconomic and character indicators of well-being at the individual level, such as income, wage, wealth, education, leadership, happiness, self-esteem, cognitive skills, and intelligence (Booth 1990; Case and Paxson 2008a, 2008b; Christensen et al. 2007; Deaton 2007; Deaton and Arora 2009; Ekwo et al. 1991; Hersch 2008; Judge and Cable 2004; Lechelt, 1975; Persico et al. 2004; Shepperd and Strathman 1989; Steckel 2009; Subramanian et al., 2011). Height is associated with positive socioeconomic outcomes at the individual level, probably in part because height influences how we perceive ourselves relative to other people and how other people perceive and react to us (Christensen et al. 2007; Hunt et al. 2000; Lee & Rosenfeld 1987; Underwood 1991). In industrial nations, tallness might signal accurately unobserved traits valued in the economy, such as intelligence or good health (Swami et al. 2008; Wilson 1968). The benefits of height are probably not linear; being too tall (or too short) might be associated with worse outcome, but for most of the height distribution, greater height seems to be associated with better individual outcomes (Nettle 2002a).

Much of the research in industrialized nations has focused on how the sex of the rater or the sex of the target subject mediates perceptions of height. Chu and Geary (2005) recently showed that positive attributions to tall men also apply to tall women. Taller women, like taller men, are attributed positive traits, particularly intelligence, affluence, and dominance compared with their same-sex but shorter peers (Jackson and Ervin 1992). In industrial nations, taller women are perceived as more masculine and less expressive or caring, particularly by male

subjects (Chu and Geary 2005, p. 1928; Deady and Law-Smith 2006). In the USA, parents and teachers viewed taller children (particularly boys) as more competent than shorter children of the same age and sex (Brackbill and Nevill 1981; Eisenberg et al. 1984; Roth and Eisenberg 1983).

In contrast to the benefits of greater height in industrialized nations, research findings from rural areas of industrializing nations using micro-level data have questioned the idea that tallness confers socioeconomic benefits to the individual, or that taller people are attributed positive traits by othersⁱⁱ. For instance, Lee (1979) found a negative association between height and foraging productivity among the !Kung San of Africa (quoted in Sear and Marlowe 2009). Among the Tsimane', a native Amazonian society of foragers and farmers in Bolivia, adult height bore no significant association with many socioeconomic indicators of own well-being, such as schooling, income, or wealth (Godoy et al. 2010). Sorokowski et al. (2010) found no self-reported preference by women for taller men among the Himba, a semi-nomadic pastoral society in Namibia. Sear (2010) recently reviewed the cross-cultural evidence linking height and reproductive success and found much variation, concluding “that while short height is rarely advantageous, particularly for men, tall height is not universally beneficial, particularly for women”ⁱⁱⁱ.

The evidence from rural areas of industrializing nations raises a question: Do people across cultures attribute positive socioeconomic traits to the tall, or is the positive perception of the tall restricted to industrial nations where tallness bears a positive association with socioeconomic outcomes? The studies cited in the previous paragraph document that height bears a weak correlation with socioeconomic outcomes in rural areas of industrializing nations, but we do not know how well perceptions of height map onto socioeconomic realities.

If people across cultures attribute positive traits to tallness irrespective of the socioeconomic benefits of height, then this would suggest that the preference for tallness might have biological roots, perhaps because it confers adaptive advantages (Case and Paxson 2008a; Fink et al. 2007; Nettle 2002; Pawlowski 2003; Sear 2006, 2010)^{iv}. But if some cultures do not attribute positive traits to the tall, then this would suggest that the preference for tallness is not universal, but that it responds to local conditions (Pierce 1996).

Here we report on the results of a study in a non-Western culture to assess if people attribute positive traits to the tall. The study responds to growing interest in establishing the external validity of studies on height perception in industrial nations (Swami et al. 2008; Fink et al. 2007; Jackson and Ervin 1992). We did the study in a society of foragers and farmers in the Bolivian Amazon, the Tsimane', who have been part of an annual longitudinal or panel study since 2002^v. Because people in this relatively isolated, endogamous society have a very different lifestyle, values, and social and economic organization, they provide an apt choice to examine the attribution of positive traits to the tall in a non-Western setting. If most Tsimane' associate tallness with positive traits, then this might not challenge the assumption about the universality of the preference for tallness. But if subjects do not associate positive traits with the tall beyond what one might expect by chance, then this would suggest that the positive attribution to tall people is site specific.

The question matters for public health policies. Child growth stunting is widespread in rural areas of industrializing nations (Godoy et al. 2009), including native Amazonian populations such as the Tsimane' (Tanner et al. 2009). If people do not attribute positive traits to tall children, then some could argue that a contributor to child growth stunting is cognitive or cultural – parents do not assign enough importance to growth faltering because they do not

associate child height with desirable outcomes (Seckler 1982). On the other hand, if people assign positive attributes to the tall, but one finds growth faltering, then this would suggest that the impediment to normal growth does not reside so much in cognition or culture, as much as it does in other areas, such as income, sanitation, or public health services.

Hypotheses and rationale. Our main aim is to address the question: Do people in a rural non-Western society of an industrializing nation attribute positive socioeconomic? More specifically, drawing on findings from industrial nations, we test three hypotheses about perceptions of alter people.

Hypothesis 1 (**H1**): *Tsimane' judges will perceive taller adult women and taller adult men as stronger, more dominant, and more knowledgeable than shorter adults.* We have no a priori reason to expect the effect size to be bigger in one sex versus the other.

Hypothesis 2 (**H2**): *Shorter women will be perceived as more caring than taller women, particularly by male subjects.* We extend this hypothesis to also explore whether shorter men are perceived as more caring than taller men.

Hypothesis 3 (**H3**): *Adults will evaluate taller children as stronger, more competent, and more knowledgeable than shorter children of the same sex and age.*

The three hypotheses predict that Tsimane' will show the same reaction to height that have previously been reported in Western cultures. However, prior research among the Tsimane' suggests that adult height bears weak associations with socioeconomic outcomes (Godoy et al. 2010). The inconsistency then raises an empirical question which this paper seeks

to address: do perceptions of height mirror the actual benefits of height in a society (in which case Tsimane' should not value adult height) or do Tsimane' preferences for tallness resemble the preferences for tallness found in Western industrial societies?

Materials and methods.

Overview. During June-July, 2010, 40 women and 40 men > 16 years of age were shown sequentially 24 color photographs (dimensions: base = 15 cm, height = 10 cm) in an album. Each photograph was on a separate page and showed two Tsimane' of the same sex and ostensibly of the same age and body type standing side by side against the same background. The two people in the photograph differed in height and were unknown to the subjects. Figure 1 contains two examples of the photographs used, with faces intentionally blurred to protect the anonymity of the people shown in the photographs. Surveyors described a short behavioral scenario related to a desirable trait such as physical strength, and then asked the subject to point to the person in the first photograph who could most easily do the task related to physical strength. The surveyor repeated the question for each of the next 23 photographs. After the subject answered the first question, the surveyor presented the subject with a different behavioral scenario, asked a second question about a different trait, and again showed the subject the same 24 photographs in the same order. The surveyor asked subjects four questions, each related to four traits in the following order: **(1)** physical strength, **(2)** dominance, **(3)** social concern (or concern for others), and **(4)** traditional ethno-medicinal plant knowledge (hereafter knowledge). The four traits were chosen because they have been commonly used in studies in industrialized nations, so they

enhance the ability to draw inferences from the cross-cultural comparison. The order of the questions was the same for all subjects. Table 1 contains the wording of the four questions.

INSERT FIGURE 1 AND TABLE 1 ABOUT HERE

Stimuli: The photographs. During September-October, 2009, we took photographs of individual Tsimane'. We photographed people in their village, mostly along a logging road about a day away from the area of the current panel study where the experiment would later take place. We took photographs of Tsimane' in a different region to reduce the likelihood that subjects would know the people in the photographs and thus influence their ratings. When we took photographs, people looked at the camera with a neutral facial expression, and wore normal attire, without hats, sweaters, or jackets.

We used Adobe Photoshop CS5 to make three changes to the photographs. First, we combined the two separate photographs of two people of the same sex and roughly the same age into one photograph. Second, the background of the photographs of individuals varied because we took photographs in natural settings in different villages, so we used Photoshop to ensure that all photographs had the same background. We decided to use a patch of cleared land as the floor on which people stood, with forest vegetation as background behind the two people in the photograph. This type of background was familiar to subjects and would allow them to judge the height of people in the photograph relative to an objective marker (e.g., vegetation in background). A familiar background enhanced the likelihood that subjects would focus on the two people in the photograph rather than on the background.

Third, in one set of photographs we made one subject (A) stand taller than the other subject (B), and we produced a second, identical set of photographs, but in which subject A was

shorter than subject \underline{B} . In resizing subjects we did not follow a well-defined algorithm. Instead, we manipulated height until one subject was visibly shorter or taller than the other, but not too much shorter or taller. As a result, we had a total of 48 different photographs: 24 photographs depicting pairs of people in which subject \underline{A} was taller than subject \underline{B} (A_B) and another 24 photographs depicting the same pairs but in which subject \underline{A} was shorter than subject \underline{B} (${}_A B$).

Sex and age composition of people shown in photographs. When selecting people for the photographs, we focused on four demographic groups: **(a)** woman, **(b)** men, **(c)** girls, and **(d)** boys. Because many Tsimane' do not know their age (Godoy et al. 2008a), we could not rely only on people's self-reported age when selecting pairs for a photograph; we used self-reported age but we also used our judgment in selecting Tsimane' who were obvious adults or children, at least in appearance as judged by outsiders. Women and men had to be middle-aged or young heads of households, but not elderly. When selecting girls or boys for the photographs, we chose pre-teenagers. By excluding people who looked like teenagers or young adults and by excluding the elderly we produced four sets of photographs depicting four distinct, non-overlapping demographic groups.

The test: The 24 photographs shown to subjects. In the text and in the tables we use the term *test* to refer to the 24 photographs seen by a subject. Of the 24 photographs, six photographs depicted six different pairs of women, men, girls, and boys. All six photographs of women, men, girls, or boys were placed together, so subjects saw and had to answer a question about all six pairs of, say, girls, before answering the same question about another demographic group.

There were eight test orders created by crossing two photograph sets that varied which of the two people was the taller one with four orders of the demographic groups: **(1)** men, women, boys, girls; **(2)** women, men, girls, boys; **(3)** boys, girls, men, women; and **(4)** girls, boys, women, men. Within a demographic group (e.g., men), the order in which subjects saw the six photographs of pairs of people was determined at random. Of the six photographs within a demographic group, three had the taller person standing on the left, and three had the taller person standing on the right.

Behavioral scenarios to elicit traits. We follow Montepare (1995) by first narrating a behavioral scenario about a trait and then asking a question about the trait. The four scenarios and questions were about strength, dominance, social concern, and knowledge. We next illustrate how we asked the question, using the question on strength as an example.

Pointing to the first photograph in a test, the surveyor said “Look at these two people. There is a heavy bag with rice in the patio [open area outside the house] and it is going to rain. Who of the two is stronger and could bring the bag inside the house faster?” If the question was about children in the photographs, the surveyor prefaced the question as follow: “Look at these two children. They are of the same age”, and then went on to ask the question. Subjects could point to the person on the left or to the person on the right in the photograph. If the subject said the two people in the photograph were equally likely to bring the bag into the house or if the subject said they did not know who could bring in the bag faster, the surveyor pressed the subject to make a choice between the two people shown in the photograph. We coded answer so we could do the analysis with and without induced answers. To elicit answers about perceived dominance in relation to people’s height, the surveyor said: “Look at these two people. They want to spend leisure time together, but one of them wants to take a walk, while the other wants to go fishing.

Who of the two is going to decide what to do?” The question about concern was as follow:
“Look at these two people. They find a juvenile/infant monkey in the old-growth forest. Who of the two will take better care of the monkey?” Last, the question about knowledge was: “Look at these two people. They are trying to find a plant in the old-growth forest to cure diarrhea. Who of the two will know better which plant to use?”

At the end of the surveys, the surveyor asked subjects if they knew any of the people in the photographs, and again showed them the 24 photographs. Subjects could then point to the people they knew. Only two subjects knew people in the photographs; one subject recognized ten people and the other subject recognized three people. For these two subjects, these photographs were dropped from the analysis.

The sample. About five women and five men took each of the eight tests. Most of the subjects (n=73; 91%) lived in the village of Santa Maria, but seven subjects (9%) lived in the nearby village of Maraca (about four hours away walking). We surveyed subjects in the village of Maraca because Santa Maria did not have 80 eligible subjects needed for an N=10 in each of the eight test conditions. All but one of the subjects was part of the longitudinal study with the Tsimane’. Both villages lie along the Maniqui River, department of Beni.

The mean and median age of the 40 women were 35 and 29 years (standard deviation [SD] = 18; range: 16-80) and the mean and median age of the 40 men were 35 and 31 years (SD =17; range: 16-89).

Administration of the experiment. RG trained two Tsimane’ who were not subjects in the experiment to administer the test. The surveyors were well known to the subjects but did not know the purpose of the test so they could not influence participants’ responses. Information

was collected in the Tsimane' language in the home of the subjects, typically outside of the subject's house to enhance the visibility of the photographs to the subjects. Tsimane' houses are often dark inside because they do not have electric lighting and rarely have windows. Only during rainy days did we collect data inside the house. We did not code for the exact venue where the experiment took place, but later discuss how we attempted to control for this possible confound. The experiment lasted an average of 30 minutes (SD = 7 minutes; range: 16-65). No subject declined to participate in the study. For participating in the study, women received a package of gifts that included wool, soap, a metal knife, sugar, and a topical medical ointment, and men received flashlight batteries, bullets, fishing line, fishing hooks, and a cigarette lighter. The study received IRB approval from Brandeis University and the Great Tsimane' Council, the governing body of the Tsimane'.

Analysis. We use the subject's response to the photograph as the unit of analysis and outcome variable, and use probit multivariate regressions to model responses as a function of three main vectors of explanatory variables:

$$[1] Y_{ip} = \alpha + \beta Subject_i + \pi Traits_p + \delta Demography_p + \xi Controls_{ip} + \varepsilon_{ip}$$

In equation [1], Y stands for the dichotomous response of subject i to photograph p (1=subject chooses taller person in the photograph; 0 otherwise). *Subject* refers to the age (in years) and the sex of the subject and allows us to test hypothesis 2 about the greater propensity of male subjects to perceive shorter women as more caring. *Traits* and *demography* refer to characteristics of the stimuli. *Traits* refers to four dummy variables that capture the four traits we asked about (*strength, dominance, social concern, knowledge*), with the excluded category in any one

regression dependent on the hypothesis. For example, for hypothesis 2 we needed to have an interaction variable of the subject's sex with responses to the question about social concern; when testing hypothesis 2 we keep the variable for social concern but left out the variable for knowledge. *Demography* includes four dummy variables to capture the four demographic groups shown in the photographs (*men, women, boys, girls*), with the excluded category dependent on the hypothesis. *Controls* capture variables dealing with the photographs and the context of the test. Control variables include a dummy variable for the position of the taller person in the photograph (*Left=1* if taller person was on left; *Left=0* if taller person was on right), duration of tests in minutes, and a dummy variable for the subject's current village of residence (*Santa Maria=1* if village was Santa Maria; *Santa Maria=0* if village was Maraca). Because each subject had a potential maximum of 96 responses ($96 = 4 \text{ questions} * 24 \text{ photographs/question}$), we do the main analysis with clustering by subject. We say "potential" because we eliminate responses if subjects knew at least one of the people in a photograph. We use Stata Version 11 for the statistical analysis.

Results. Figure 2 shows the distribution of responses by demographic groups and by traits. These descriptive statistics suggest that Tsimane' tend to attribute positive traits to the tall. When shown photographs and asked the four questions about character traits, subjects pointed to the taller men, the taller women, the taller boy, or the taller girl in 54%, 56%, 59%, and 60% of all their responses to the four questions. Of the four traits, subjects were most likely to point to the tall person when the question was about strength (63%), followed by knowledge (57%) and dominance (55%), and they were least likely to select the tall person when the question was about social concern (53%). These descriptive findings are informative, but they do not control

for the role of third variables so we next present the regression results of equation [1]. Table 2 contains the regression results, organized around the three hypotheses.

INSERT TABLE 2 AND FIGURE 2 ABOUT HERE

Hypothesis 1: *Tsimane' judges will perceive taller adult women and taller adult men as stronger, more dominant, and more knowledgeable than shorter adults.* We found partial confirmation for hypothesis 1. First, column H1a, row IAi1, of Table 2 suggests that subjects were, on average, 8% more likely to select the taller adult in the photograph, but only when the question was about strength (standard error [SE]=0.02, $p=0.001$). Subjects were equally likely to select the taller or the shorter adult when asked about dominance or knowledge. Second, the 8% greater propensity to select the taller adult as stronger than the shorter adult applied equally to photographs depicting women and to photographs depicting men (row IAii-Strength). The sex of the person shown in the photograph bore no significant association with the subject's response. Furthermore, the interaction effect between the three traits and the sex of the people in the photographs was never statistically significant at the 95% confidence interval or above [column H1b, rows ii1-ii4]. Taken together these results suggest that Tsimane' adult are equally likely to attribute greater strength to a taller adult women or to a taller adult men. However, they were not more likely to attribute more dominance, social concern, or knowledge to the taller adult in the photographs.

Though not directly related to hypothesis 1, we see in section IIA1 that female subjects were 7% more likely than male subjects to select the taller person in the photographs when asked about any of the traits [SE for variable *female* in column H1b = 0.024, $p=0.003$]. To estimate interaction effects between the subject's sex and traits we ran four additional regressions. In

these regressions we re-estimated the parameters of the regression of column H1a, but added interaction an term *trait*female*, with *female* being the subject's sex (1=female subject; 0=male subject) and *trait* being one of the four traits. We found no significant interaction effects between any of the four traits and the subject's sex.

Hypothesis 2: *Shorter women will be perceived as more caring than taller women, particularly by male subjects.* Since hypothesis 2 centers on women, we limit the analysis to photographs of adult women evaluated by both adult female and male subjects. The results shown in column H2a suggest that subjects were not more likely to attribute greater social concern to the taller woman in the photograph. When asked which of the two people in the photograph had greater social concern, subjects were not significantly more likely to select the shorter than the taller person (SE = 0.03, p=0.79) [column H2a, row IAi3]. In column H2b, row IIB1, we assess whether male raters were more likely to associate the shorter women in the photograph with greater social concern, and found no significant differential effect of responses in relation to the sex of the subject rating the photographs (coefficient *female*social concern* = 0.08, SE = 0.05, p=0.16).

We re-estimated the two regressions for hypothesis 2, but only for men to assess whether shorter men were viewed as having more social concern than taller men. We found no significant results; female and male subjects were equally likely to select the taller man as the shorter man as having more social concern. The sex of the subject did not have a significant association with the answers.

Hypothesis 3: *Adults will evaluate taller children as stronger, more competent, and more knowledgeable than shorter children of the same sex and age.* The regression results of column

H3a suggest that adult female and adult male subjects associated taller girls or taller boys with greater strength, dominance, and knowledge [rows IAi1-3]. When asked which of the two girls or boys in a photograph was stronger, more dominant, or had greater knowledge, subjects were 11% more likely to select the taller child as stronger (*strength*: SE = 0.02, p=0.001), 5% more likely to select the taller child as more dominant (*dominance*: SE = 0.02, p=0.02), and 7% more likely to select the taller child as having more knowledge (*knowledge*: SE = 0.03, p=0.005). The sex of the children shown in the photographs [column H3a, row 1B3] or the sex of the subject rating the photographs [column H3a, row IIA1] bore no significant association with the answers; that is, adult female and adult male subjects were both likely to associate taller girls or taller boys with greater strength, dominance, and knowledge. The interaction effects of the traits with the child's sex were not statistically significant, indicating that the positive associations to height did not differ for boys or for girls.

We did additional analyses to ensure the robustness of the main results. First, to reduce multicollinearity we eliminated all control variables. In this robustness test we found essentially the same results as those just reported, except that the variable for the subject's sex was no longer statistically significant in one case (row IIA, column H2b: coefficient =0.05, SE=0.03, p=0.102). Second, we eliminated induced responses. Of a total of 7,627 responses, only 1.0% (n=81) were induced. Eliminating induced answers did not affect the results of Table 2, probably because of the small sample size of induced answers. Third, we included additional control variables beyond those included in Table 2. For example, we included controls for the surveyors, exact time of day, and date. Time and date variables partially remove the role of the exact venue where the experiment took place since subjects would have taken the test inside the

house only during rainy days. The inclusion of these additional control variables did not affect the main results.

Limitations. The study has several potential limitations.

First, the height of a person or the height differential between the two people shown in the photographs might not have reached the threshold to influence Tsimane' judgments. For example, Tsimane' might perceive only very short or very tall people as endowed with some traits, but the height or the height differential shown in the photographs might have not reached these thresholds. As a result, subjects might have guessed when answering questions because photographs did not convey enough salience in height.

Second, of the four questions, three were unambiguous, but one might have been problematic. When asking about social concern we asked about the propensity of caring for a juvenile monkey. So phrased, the question might capture not just social concern, but also concern for the environment. It is possible that subjects viewed shorter women as having more social concern than taller women (as in industrial nations), but that they did not attribute to shorter women greater concern for the environment. If subjects interpreted the question about concern as being a question about conservation, then they would have been indifferent between the taller or shorter person.

Third, our manipulation of photographs through Photoshop probably introduced distortions in body proportion. By changing height we may have confounded height with perceived body mass – the taller people looked broader as well as taller due to the zooming.

Fourth, our study focused exclusively on socioeconomic traits rather than on health or markers of reproductive success. The sexual appeal or perceived health of taller people might be more universal than other attributions. Unfortunately, we did not collect data on perceptions of health, reproductive success, or health.

Discussion and conclusion. Some of our findings support findings from industrial nations, but some do not.

Like their peers in industrial nations, adult Tsimane' women and men attributed some positive traits to the tall, but the positive attribution to tall people was most marked when judging children, not adults. Both adult women and adult men attributed greater strength, dominance, and knowledge to taller girls than to shorter girls, and to taller boys than to shorter boys; the sex of the subject or the sex of the child did not affect results. We can probably rule out the confounding role of age in the preference for taller children because we told subjects the children were the same age. Thus the attribution of more dominance, knowledge, and strength to the taller of the children cannot reflect the assumption that the children have these traits because they are older.

Unlike their peers in industrial nations, Tsimane' did not associate most positive traits with tall adults. In fact, only when we asked subjects about strength did we find significant evidence that Tsimane' attributed greater strength to taller adults. As the coefficients in Table 2 [row IAi1, columns H1a-H2b] suggest, Tsimane' were 8-9% more likely to judge taller adult women or men as stronger than would have occurred by chance (after conditioning for the covariates in the multivariate regression). Some have argued that tallness might be a more

desirable trait among men because it signals the ability to intimidate others (Salska et al. 2008), but we found no such evidence. The absence of a strong association between tallness and most desirable traits among adults is consistent with an earlier study in which we showed weak associations between measured adult height and a wide range of indicators of own well-being (Godoy et al. 2010). The results of this study are also consistent with an earlier study in which we found low but positive assortative mating for height (Godoy et al. 2008); these two studies are consistent because they both show a limited preference for taller adults. Last, unlike some studies from industrial nations, we found no evidence that subjects perceived taller women as less caring, or that men, in particular, were more likely to judge shorter women as more caring.

The results raise a puzzle: Why would Tsimane' adults attribute positive traits to tall children, but not tall adults? One possibility is that the Tsimane' economy and society are changing, from a largely foraging-horticultural economy and highly endogamous society to one based on cash cropping and wage labor where people have to increasingly interact with anonymous strangers. It is possible that with these changes come changes in perceptions about the benefits of height, particularly if outsiders are taller than Tsimane'. As Sear and Marlowe (2009) note, in a small-scale, subsistence economy and in a highly endogamous society, people might not need to rely on height as a marker of unobserved traits because people can use other, more reliable markers, such as first-hand experience with the person they wish to evaluate. As societies and economies grow in size and complexity, people need to rely on easily observed markers of unobserved traits for anonymous strangers, with height being one such marker across many societies. Of course, Tsimane' may select other markers, such as body-mass index. In our study, when subjects did not attribute positive traits to tall adults, they may have been summarizing what they had observed about the relation between height and desirable traits they

had experienced in the old economy when height in fact bore a weak association with indicators of well-being or character traits. As the Tsimane' economy and society opens up to the rest of the world, adults might realize that height bears an association with desirable outcomes – particularly if outsiders are taller and are perceived as more successful -- but the positive attribution to the tall applies to the young who will have to grow up in a new world. This line of thinking might explain why subjects differed in their perception of taller adults versus taller children, but it does not explain why they attributed positive traits to the tall child.

Quite aside from the academic contributions of this article, the article might have policy implications about how to redress child growth stunting. If Tsimane' did not attribute positive traits to tall children, then one could have argued that one impediment to child growth stunting so widespread among Tsimane', was cognitive or cultural. But that does not seem to be the case here. What we find instead is dissonance. Adults value child height despite the prevalence of growth stunting. This would suggest that the impediment to growth faltering probably does not reside so much in cognition or culture, as much as it does in more material conditions.

Acknowledgements

The Cultural Anthropology Programs of NSF provided funding for the research. DTAE is funded by an NSG GRF grant. The IRB for research with human participants of Brandeis University, and the Great Tsimane' Council approved the study. Before enrollment in the study we obtained oral assent from participants. Thanks to Robert Hammer for using Photoshop to produce the photographs used in the study and to Jimena Vásquez for research assistance.

Figure 1. Example of photograph of *(i)* girls and *(ii)* boys used in the study.



Note: Each photograph was on a separated page. Numbers on the bottom left correspond to the unique identification number of the photograph.

Table 1. Behavioral scenarios about traits

Strength

Look at these two people*. There is a heavy bag with rice in the patio and it is going to rain.

Who of the two is stronger and could bring the bag inside the house faster?

Dominance

Look at these two people. They want to spend leisure time together, but one of them wants to take a walk, while the other wants to go fishing. Who of the two is going to decide what to do?

Social concern

Look at these two people. They find a juvenile/infant monkey in the old-growth forest. Who of the two will take better care of the monkey?

Knowledge

Look at these two people. They are trying to find a plant in the old-growth forest to cure diarrhea. Who of the two will know better which plant to use?

* When asking about children, the surveyor prefaced the question as follow: “Look at these two children. They are of the same age”, and then went on to ask the question.

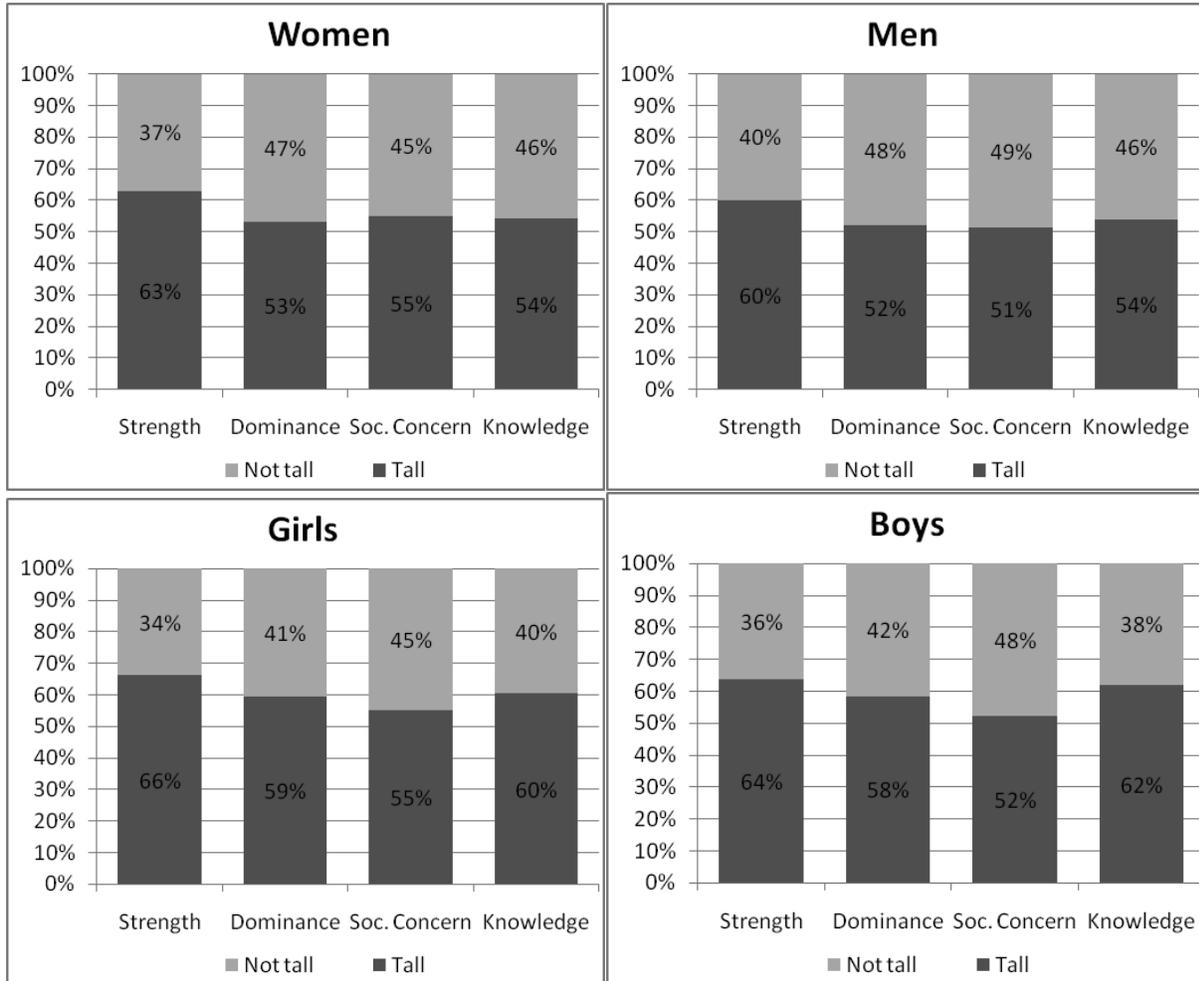
Table 2. Probabilities of attributing positive traits by 80 Tsimane' adults (>16 years of age) to taller person shown in photographs, 2010: Results of probit multiple regressions with clustering by subject and robust standard errors

| Explanatory variables: | Dependent variable: 1=subject chose taller of the two people in a photograph in response to a behavioral scenario; 0=otherwise | | | | | |
|--|--|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| | <i>Hypothesis 1</i> | | <i>Hypothesis 2</i> | | <i>Hypothesis 3</i> | |
| | <i>H1a</i> | <i>H1b</i> | <i>H2a</i> | <i>H2b</i> | <i>H3a</i> | <i>H3b</i> |
| [II]. EXPLANATORY VARIABLES RELATED TO STIMULI (photographs) | | | | | | |
| [A] Traits: | | | | | | |
| [i] Direct effects: | | | | | | |
| <i>1-Strength</i> | 0.08** (0.02) | 0.08* (0.03) | 0.09** (0.03) | 0.09** (0.03) | 0.11** (0.02) | 0.11** (0.03) |
| <i>2-Dominance</i> | -0.006 (0.02) | -0.02 (0.04) | -0.01 (0.03) | -0.01 (0.03) | 0.05* (0.02) | 0.04 (0.02) |
| <i>3-Social concern</i> | + | + | 0.008 (0.03) | -0.03 (0.04) | + | + |
| <i>4-Knowledge</i> | 0.009 (0.02) | -0.008 (0.03) | + | + | 0.07** (0.03) | 0.05 (0.03) |
| [ii] Interaction effects of trait*sex (men or boys) of person shown in photographs: | | | | | | |
| <i>1-Strength*men</i> | ^ | 0.007 (0.04) | ^ | ^ | ^ | 0.002 (0.03) |
| <i>2-Dominance*men</i> | | 0.03 (0.05) | | | | 0.01 (0.02) |
| <i>3-Social concern*men</i> | | + | | | | + |
| <i>4-Knowledge*men</i> | | 0.04 (0.04) | | | | 0.04 (0.03) |
| [B] Demographic group shown in photographs | | | | | | |
| <i>1-Women</i> | + | + | NA | NA | ^ | ^ |
| <i>2-Men</i> | -0.02 (0.02) | -0.04 (0.04) | ^ | ^ | | |
| <i>3-Boys</i> | ^ | ^ | | | -0.01 (0.01) | -0.02 (0.02) |
| <i>4-Girls</i> | | | | | + | + |
| [III]. EXPLANATORY VARIABLES RELATED TO SUBJECT | | | | | | |
| [A]. Direct effects: | | | | | | |
| <i>1-Female</i> | 0.07** (0.02) | 0.07** (0.02) | 0.09** (0.03) | 0.07* (0.04) | 0.03 (0.03) | 0.03 (0.03) |
| [B]. Interaction effects of subject's sex (female)*trait: | | | | | | |
| <i>1-Female*Socia l concern</i> | NA | NA | ^ | 0.08 (0.05) | NA | NA |
| [III]. ADDITIONAL INFORMATION ABOUT REGRESSIONS AND SAMPLE | | | | | | |
| [A]. Observations | 3799 | | 1900 | | 3828 | |
| [B]. % choosing taller | 55 | | 56 | | 59 | |
| [C]. Pseudo R² | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| [D]. Photographs show only: | Women and men | | Women | | Girls and boys | |

Notes: * and ** significant at $\geq 95\%$ and $\geq 99\%$ confidence intervals. Coefficients represent the probability of selecting the taller person from a discrete change in the binary explanatory variable. Robust standard errors are in parenthesis. ^=variable intentionally left out. +=

reference category in regression. NA = not applicable. See text for list of control variables not shown in the table.

Figure 2. Distribution of responses for each trait (strength, dominance, social concern, and knowledge), by demographic group



References

- Akachi, Y., & Canning, D. (2007). The height of women in Sub-Saharan Africa: The role of health, nutrition, and income in childhood. *Annals of Human Biology*, 34(4), 397-410.
- Behrman, J. R., & Wolfe, B. L. (1987). How Does Mothers' Schooling Affect Family Health, Nutrition, Medical-Care Usage, and Household Sanitation. *Journal of Econometrics*, 36(1-2), 185-204.
- Berlin, C. M., McCarverMay, D. G., Notterman, D. A., Ward, R. M., Weismann, D. N., Wilson, G. S., et al. (1997). Considerations related to the use of recombinant human growth hormone in children. *Pediatrics*, 99(1), 122-129.
- Booth, N. D. (1990). The Relationship Between Height and Self-Esteem and the Mediating Effect of Self-Consciousness. *Journal of Social Psychology*, 130(5), 609-617.
- Brackbill, Y., & Nevill, D. D. (1981). Parental Expectations of Achievement as Affected by Children's Height. *Merrill-Palmer Quarterly-Journal of Developmental Psychology*, 27(4), 429-441.
- Case, A., & Paxson, C. (2008a). Height, health, and cognitive function at older ages. *American Economic Review*, 98(2), 463-467.
- Case, A., & Paxson, C. (2008b). Stature and status: Height, ability, and labor market outcomes. *Journal of Political Economy*, 116(3), 499-532.
- Christensen, T. L., Djurhuus, C. B., Clayton, P., & Christiansen, J. S. (2007). An evaluation of the relationship between adult height and health-related quality of life in the general UK population. *Clinical Endocrinology*, 67(3), 407-412.
- Chu, S., & Geary, K. (2005). Physical stature influences character perception in women. *Personality and Individual Differences*, 38(8), 1927-1934.
- Deady, D. K., & Law-Smith, M. J. (2006). Height in women predicts maternal tendencies and career orientation. *Personality and Individual Differences*, 40(1), 17-25.
- Deaton, A. (2007). Height, health, and development. *Proceedings of the National Academy of Sciences of the United States of America*, 104(33), 13232-13237.
- Deaton, A. (2008). Height, health, and inequality: The distribution of adult heights in India. *American Economic Review*, 98(2), 468-474.
- Deaton, A., & Arora, R. (2009). Life at the top: The benefits of height. *Economics & Human Biology*, 7(2), 133-136.

- Eisenberg, N., Roth, K., Bryniarski, K. A., & Murray, E. (1984). Sex-Differences in the Relationship of Height to Children's Actual and Attributed Social and Cognitive Competencies. *Sex Roles, 11*(7-8), 719-734.
- Ekwo, F., Gosselink, C., Roizen, N., & Brazdziunas, D. (1991). The Effect of Height on Family Income. *American Journal of Human Biology, 3*(2), 181-188.
- Fink, B., Neave, N., Brewer, G., & Pawlowski, B. (2007). Variable preferences for sexual dimorphism in stature (SDS): Further evidence for an adjustment in relation to own height. *Personality and Individual Differences, 43*(8), 2249-2257.
- Godoy, R. A., Eisenberg, D. T. A., Reyes-Garcia, V., Huanca, T., Leonard, W. R., McDade, T. W., et al. (2008). Assortative mating and offspring well-being: theory and empirical findings from a native Amazonian society in Bolivia. *Evolution and Human Behavior, 29*(3), 201-210.
- Godoy, R. A., Leonard, W. R., Reyes-Garcia, V., Goodman, E., McDade, T. W., Huanca, T., et al. (2006). Physical stature of adult Tsimane' Amerindians, Bolivian Amazon in the 20th century. *Economics & Human Biology, 4*(2), 184-205.
- Godoy, R. A., Magvanjav, O., Nyberg, C., Eisenberg, D. T. A., McDade, T. W., Leonard, W. R., et al. (2010). Why no adult stunting penalty or height premium? Estimates from native Amazonians in Bolivia. *Economics & Human Biology, 8*(1), 88-99.
- Godoy, R. A., Colleen Nyberg, D.T.A. Eisenberg, O. Magvanjav, E. Shinnar, et al. (2009). Short but catching up: Statural growth among native Amazonian Bolivian children. *American Journal of Human Biology 20*: 431-446.
- Godoy, R. A., Reyes-Garcia, V., Tanner, S., Leonard, W. R., McDade, T. W., & Huanca, T. (2008). Can we trust an adult's estimate of parental school attainment? Disentangling social desirability bias and random measurement error. *Field Methods, 20*(1), 26-45.
- Hacker, J. D. (2008). Economic, demographic, and anthropometric correlates of first marriage in the mid-nineteenth-century United States. *Social Science History, 32*(3), 307-345.
- Hensley, W. E. (1993). Height as a measure of success in academe. *Psychology, 30*(1), 40-46.
- Hersch, J. (2008). Profiling the new immigrant worker: The effects of skin color and height. *Journal of Labor Economics, 26*(2), 345-386.
- Huanca, T. (2008). *Tsimane' oral tradition, landscape, and identity in tropical forest*. La Paz, Bolivia: Wa-Gui.
- Hunt, L., Hazen, R. A., & Sandberg, D. E. (2000). Perceived versus measured height - Which is the stronger predictor of psychosocial functioning. *Hormone Research, 53*(3), 129-138.
- Jackson, L. A., & Ervin, K. S. (1992). Height Stereotypes of Women and Men. The Liabilities of Shortness for Both Sexes. *Journal of Social Psychology, 132*(4), 433-445.

- Judge, T. A., & Cable, D. M. (2004). The effect of physical height on workplace success and income: Preliminary test of a theoretical model. *Journal of Applied Psychology, 89*(3), 428-441.
- Kirchengast, S., & Winkler, E. M. (1995). Differential Reproductive Success and Body Dimensions in Kavango Males from Urban and Rural Areas in Northern Namibia. *Human Biology, 67*(2), 291-309.
- Lechelt, E. C. (1975). Occupational Affiliation and Ratings of Physical Height and Personal Esteem. *Psychological Reports, 36*(3), 943-946.
- Lee, R. B. (1979). *The !KungSan: Men, women, and work in a foraging society*. Cambridge, UK: Cambridge University Press.
- Lee, P. D. K., & Rosenfeld, R. G. (1987). Psychosocial Correlates of Short Stature and Delayed Puberty. *Pediatric Clinics of North America, 34*(4), 851-863.
- Leonard, W. R., & Godoy, R. A. (2008). Tsimane' Amazonian Panel Study (TAPS): The first 5 years (2002-2006) of socioeconomic, demographic, and anthropometric data available to the public. *Economics & Human Biology, 6*(2), 299-301.
- Martel, L. F., & Biller, H. B. (1987). *Stature and Stigma: The biopsychosocial development of short males*. Lexington, MA: D.C. Heath.
- Montepare, J. M. (1995). The Impact of Variations in Height on Young Childrens' Impressions of Men and Women. *Journal of Nonverbal Behavior, 19*(1), 31-47.
- Nettle, Daniel. (2002). Women's height, reproductive success and the evolution of sexual dimorphism in modern humans. *Proceedings of the Royal Society of London Series B-Biological Sciences, 269*(1503), 1919-1923.
- Nettle, Daniel. (2002a). Height and reproductive success in a cohort of British men. *Human Nature 13*:4: 473-491
- Pawlowski, B. (2003). Variable preferences for sexual dimorphism in height as a strategy for increasing the pool of potential partners in humans. *Proceedings of the Royal Society of London Series B-Biological Sciences, 270*(1516), 709-712.
- Persico, N., Postlewaite, A., & Silverman, D. (2004). The effect of adolescent experience on Labor market outcomes: The case of height. *Journal of Political Economy, 112*(5), 1019-1053.
- Pierce, C. A. (1996). Body height and romantic attraction: A meta-analytic test of the male-taller norm. *Social Behavior and Personality, 24*(2), 143-149.
- Ringhofer, L. (2010). *Fishing, foraging, and farming in the Bolivian Amazon on a local society in transition*. New York: Springer.

- Roth, K., & Eisenberg, N. (1983). The Effects of Childrens' Height on Teachers' Attributions of Competence. *Journal of Genetic Psychology, 143*(1), 45-50.
- Salska, I., Frederick, D. A., Pawlowski, B., Reilly, A. H., Laird, K. T., & Rudd, N. A. (2008). Conditional mate preferences: Factors influencing preferences for height. *Personality and Individual Differences, 44*(1), 203-215.
- Sandberg, D. E., & Voss, L. D. (2002). The psychosocial consequences of short stature: a review of the evidence. *Best Practice & Research Clinical Endocrinology & Metabolism, 16*(3), 449-463.
- Sear, R. (2006). Height and reproductive success - How a Gambian population compares with the west. *Human Nature, 17*(4), 405-418.
- Sear, R. (2010). Height and reproductive success: is bigger always better? . In U. Frey, C. Stormer & K. Willfuhr (Eds.), *Homo Novus: A Human Without Illusions*: Springer.
- Sear, R., & Marlowe, F. W. (2009). How universal are human mate choices? Size does not matter when Hadza foragers are choosing a mate. *Biology Letters, 5*(5), 606-609.
- Seckler, D., 1982. Small but healthy: a basic hypothesis in the theory, measurement and policy of malnutrition. In: Sukhatme, P.V. (Ed.), *Newer Concepts in Nutrition and their Implications for Policy*. Maharashtra Association for the Cultivation of Science Research Institute, Pune, India, pp. 127-137.
- Shepperd, J. A., & Strathman, A. J. (1989). Attractiveness and Height. The Role of Stature in Dating Preference, Frequency of Dating, and Perceptions of Attractiveness. *Personality and Social Psychology Bulletin, 15*(4), 617-627.
- Sorokowski, P., Sorokowska, A., Fink, B., & Mberira, M. (2010). Variable preferences for sexual dimorphism in stature (SDS) might not be universal: Data from a semi-nomad population (Himba) in Namibia. *Journal of Cross-Cultural Psychology* [Forthcoming].
- Steckel, R. H. (2009). Heights and human welfare: Recent developments and new directions. *Explorations in Economic History, 46*(1), 1-23.
- Strauss, J., & Thomas, D. (1998). Health, nutrition, and economic development. *Journal of Economic Literature, 36*(2), 766-817.
- Subramanian, S.V., Emre Ozaltin, and Jocelyn E. Finlay. Height of nations. *PLoSOne* 6:4:e18962, 1-13.
- Swami, V., Furnham, A., Balakumar, N., Williams, C., Canaway, K., & Stanistreet, D. (2008). Factors influencing preferences for height: A replication and extension. *Personality and Individual Differences, 45*(5), 395-400.

- Tanner, S., Leonard, W. R., McDade, T. W., Reyes-Garcia, V., Godoy, R., & Huanca, T. (2009). Influence of Helminth Infections on Childhood Nutritional Status in Lowland Bolivia. *American Journal of Human Biology*, 21(5), 651-656.
- Underwood, L. E. (1991). The Social Cost of Being Short - Societal Perceptions and Biases. *Acta Paediatrica Scandinavica*, 3-8.
- Voss, L. D. (2001). Short normal stature and psychosocial disadvantage: A critical review of the evidence. *Journal of Pediatric Endocrinology & Metabolism*, 14(6), 701-711.
- Voss, L. D. (2006). Is short stature a problem? The psychological view. *European Journal of Endocrinology*, 155, S39-S45.
- Wilson, P. R. (1968). Perceptual Distortion of Height as a Function of Ascribed Academic Status. *Journal of Social Psychology*, 74(1), 97-102.

ⁱ One also finds additional evidence for the perceived benefits of height in the growing trend in pediatric practices of parents asking for -- and physicians offering -- medical solutions for child shortness and the ethical debate this has triggered (Berlin et al. 1997; Sanberg and Voss 2002; Voss 2001, 2006).

ⁱⁱ Skepticism about the link between height and indicators of well-being have also been raised by researchers using population-level data (Deaton 2007; Akachi and Canning 2007).

ⁱⁱⁱ For example, Sear and Marlowe (2009) found no positive assortative mating for height among Hadza foragers. Sear (2006) found no association between height and reproductive success in rural Gambia, and Kirchengast and Winkler (1995) also found weak links between reproductive success and male height.

^{iv} The preference for tallness, at least in many Western cultures, refers mainly to males. The studies by Nettle (2002) and others (e.g. Pawlowski 2003) suggest that women prefer relatively taller men and that men prefer relatively shorter women, and that – avoiding the extremes in

height (Nettle 2002a) -- tallness among men and shortness among women tend to be associated with greater reproductive success. See Sear (2010) and Sear and Marlowe (2009) for a cautionary view of the reproductive advantages of height.

^v Ringhofer (2010) and Huanca (2008) provide recent descriptions of the history and culture of the Tsimane'. See also (Leonard and Godoy, 2008).