

# Cultural Consonance and Psychological Well-Being. Estimates Using Longitudinal Data from an Amazonian Society

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**Abstract** Researchers have hypothesized that the degree to which an individual's actual behavior approximates the culturally valued lifestyle encoded in the dominant cultural model has consequences for physical and mental health. We contribute to this line of research by analyzing data from a longitudinal study composed of five annual surveys (2002–2006 inclusive) of 791 adults in one society of foragers-farmers in the Bolivian Amazon, the Tsimane'. We estimate the association between a standard measure of individual achievement of the cultural model and (a) four indicators of psychological well-being (sadness, anger, fear and happiness) and (b) consumption of four potentially addictive substances (alcohol, cigarette, coca leaves and home-brewed beer) as indicators of stress behavior. After controlling for

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individual fixed effects, we found a negative association between individual achievement of the cultural model and psychological distress and a positive association between individual achievement of the cultural model and psychological well-being. Only the consumption of commercial alcohol bears the expected negative association with cultural consonance in material lifestyle, probably because the other substances analyzed have cultural values attached. Our work contributes to research on psychological health disparities by showing that a locally defined and culturally specific measure of lifestyle success is associated with psychological health.

**Keywords** Bolivia · Cultural consonance · Emotions · Indigenous peoples · Lifestyle incongruity

## Introduction

The last decade has seen substantial growth in research examining the health consequences of material deprivation and psychosocial factors (Wilkinson 2000; Lynch 2004; Diener et al. 2003). Along this line, recent developments in biocultural research suggest a direct link between individual health and individual adherence to given dominant cultural models (Dressler 2005, 2008; Dressler and Bindon 2000; McDade 2002; Dressler et al. 2007a, 2007b). In particular, researchers have hypothesized that the degree to which an individual's actual behavior approximates the culturally valued lifestyle encoded in the dominant cultural model—or cultural consonance in lifestyle—has consequences for physical and mental health (Pavot and Diener 1993; Dressler and Bindon 2000; Janes 1990). The presumed mechanism linking cultural consonance to health is the social stress process (Pearlin et al. 1981). Building on work by John Cassel and colleagues (1960; Henry and Cassel 1969) on the health consequences of migration and culture change, researchers have hypothesized that living a life at odds with widely shared understandings of how one ought to live (low cultural consonance) is a chronically stressful experience (Dressler 2005, 2008; Dressler and Bindon 2000; McDade 2002; Dressler et al. 2007a, 2007b). As with other stressors, lack of success in reaching the shared cultural model might force the biological system to persistent adjustative efforts to reach the model with measurable effects (McGarvey 1999; Sapolsky 1999).

Prior empirical research has, indeed, found an association between individual adherence to a cultural model and psychophysiological outcomes, including blood pressure, symptoms of depression, perceived stress and immune function (Chin-Hong and McGarvey 1996; McGarvey 1999; Bindon et al. 1997; Diener et al. 2003; McDade 2002). For example, research in Samoa, a society engaged in a process of Westernization, suggests that incongruities between conspicuous, locally defined markers of a successful lifestyle and other markers of social status based on income, occupation or lifestyle are associated with higher systolic and diastolic blood pressure (Bindon et al. 1997; Chin-Hong and McGarvey 1996). Similar results have been found in studies among Samoan migrants to northern California (Janes 1990), African Americans in the Southeast United States (Dressler et al. 1998b; Dressler

and Bindon 2000) and urban dwellers in Brazil (Dressler et al. 1997, 1998a). Researchers have also found that inconsistency between a household's material lifestyle and its socioeconomic status impacts immune function (McDade 2001, 2002). For example, in research in Samoa, McDade (2001) found that, after controlling for potential confounders, adolescents from households with a material style of life that exceeded its socioeconomic status had reduced cell-mediated immune function, indicating an increased burden of psychosocial stress.

Although suggestive, findings from previous research are limited because they rely on cross-sectional data for the estimations. Cross-sectional data do not allow one to control for the potential confounding effect of fixed attributes that might affect both adherence to the cultural model and health outcomes. Stable personality traits, for example, can explain a significant amount of variability in both people's adherence to culture and their psychological states (Diener et al. 2003; Diener and Lucas 1999). The use of cross-sectional data does not allow one to parse out the effects of individual personality traits, thus biasing the estimations on the effects of adherence to cultural models and psychological health. Examples of other potentially confounding individual fixed attributes include role models and genetic makeup.

In this article, we contribute to research on the link between psychological well-being and individual adherence to given dominant cultural models by analyzing data from a longitudinal study composed of five annual surveys (2002–2006 inclusive) of 791 adults (399 females and 392 males) in one society of foragers-farmers in the Bolivian Amazon, the Tsimane'. We estimate the association between a standard measure of individual achievement of the cultural model—cultural consonance in lifestyle—and (a) four indicators of psychological well-being (sadness, anger, fear and happiness) and (b) consumption of four potentially addictive substances (alcohol, cigarette, coca leaves and home-brewed beer) as indicators of stress behavior. The use of panel data allows us to control for individual characteristics that do not change through time.

This paper makes a significant contribution to research on psychological health disparities by showing that a locally defined and culturally specific measure of lifestyle success is significantly associated with psychological health.

## Definitions and Hypotheses

### Definitions

To measure individual adherence to a dominant cultural model, we follow previous research on the topic and use the concept of cultural consonance. Cultural consonance is defined as the degree to which individuals approximate widely shared cultural models in their own beliefs and behaviors (Dressler and Bindon 2000; Dressler et al. 2007a). Individual measures of cultural consonance are constructed by assessing the shared models of behavior in a given cultural dimension through cultural consensus analysis (Romney et al. 1986; D'Andrade 1995) and then comparing individual responses from actual behavior to the ideal cultural model. Previous measures of cultural consonance have mainly focused in the domains of

material lifestyle and social support (Dressler and Bindon 2000) and, more recently, have been expanded to the domains of family life, national identity and food (Dressler et al. 2007b). Here we use a standard measure of cultural consonance: cultural consonance in material lifestyle.

To increase comparability with other studies, we define our outcomes following leads from previous research on the topic. Thus, we use information on self-reported frequency of four common emotions (anger, fear, sadness and happiness) as indicators of psychological well-being (James et al. 1986). We use information on self-reported consumption of four potentially addictive substances (alcohol, cigarettes, coca leaves and home-brewed beer) as indicators of stress behavior (Sinha et al. 2000).

## Hypotheses

We use panel data to test two hypotheses that derive from prior results found on cross-sectional research analyzing the association between cultural consensus and psychological well-being.

**Hypothesis 1** Cultural consonance in material lifestyle will show a negative association with indicators of psychological distress (anger, sadness and fear) and a positive association with a positive emotion (happiness).

Research in the United States and Brazil has found that adherence to the dominant cultural model is associated with lower psychological distress, as measured by symptoms of depression (Dressler and Bindon 2000; Dressler et al. 1997, 1998a). We expect that the association will hold after controlling for individual fixed effects.

**Hypothesis 2** Cultural consonance in material lifestyle will show a negative association with consumption of addictive substances.

Substance addiction is a canonical marker of stress that reflects and influences negative psychological states such as depression (Sinha et al. 2000). So we expect to find a negative association between cultural consonance in material lifestyle and consumption of potentially addictive substances.

## The Tsimane'

The Tsimane' number ~8,000 people and live in the rainforests and savannahs in the foothills of the Andes, mostly in the region of Beni, Bolivia. Relatively isolated until the mid-20th century, they started to engage in more frequent and prolonged contact with Westerners after the arrival of Protestant missionaries in the late 1940s and early 1950s (Daillant 2003; Huanca 2008). Recent contact with non-Tsimane' society has not completely altered Tsimane' society. For example, Tsimane' continue to be autarkic and still practice hunting, plant collection and slash-and-burn agriculture for subsistence (Vadez et al. 2004). Tsimane' still live in small villages of ~20 households, closely linked by ties of blood and marriage, and

follow their traditional social organization (e.g., cross-cousin marriage). Despite the spread of modern health-care facilities and a secular reduction in mortality (Gurven et al. 2007), Tsimane' born during 1920–1980 have not experienced secular changes in adult physical stature (Godoy et al. 2006) or ethnobotanical knowledge (Godoy et al. 2009a).

This said, exposure to the market economy and Westerners has introduced some changes in Tsimane' economy, society and lifestyle. For example, cash cropping of rice is becoming an increasingly important economic activity for Tsimane' households (Vadez et al. 2008). Some Tsimane' also engage in wage labor in the homesteads of colonist farmers or for legal or illegal loggers. Traders regularly visit Tsimane' villages swapping commercial goods, including edibles (canned sardines, noodles, sugar), drinking alcohol (ethanol, 96% concentration), cigarettes and coca leaves, for forest and farm goods (Byron 2003; Rioja 1992; Reyes-García 2001).

In previous articles, we provide descriptive accounts of self-reported occurrence of the four emotions discussed in this paper (Godoy et al. 2009b). Additionally, in our previous work among the Tsimane', we have found changes in the frequency of reported emotions for the period 2002–2006. For example, during 2002–2006 the annual rate of change in the frequency of anger (−10.40%) and fear (−6.19%) decreased, whereas the annual rate of change in a measure of happiness experienced a low growth rate (0.82%/year) (Godoy et al. 2009b).

Ethnographic information suggests that most addictive substances enter Tsimane' households through traders, logging firms and politicians (Byron 2003; Rioja 1992; Reyes-García 2001), although Tsimane' also obtain alcohol, coca and cigarettes in the town of San Borja on their occasional visits. Traders who ply rivers and logging roads give drinking alcohol to Tsimane' as an advance on future deliveries of crops or forest goods. Village stores have started to stock alcohol for sale.

Tsimane' have native varieties of coca and tobacco, but the continual use of coca and commercial cigarettes during work or leisure time is recent and probably reflects the influence of highlanders who have moved into the Amazon basin in the last five decades. Tsimane' buy coca leaves and commercial cigarettes in town or barter them from traveling traders when traders come to villages to get crops and forest goods. In villages near the market town of San Borja, coca chewing is widespread among men, particularly during cold spells or when they engage in wage labor (i.e., agriculture, logging).

The Tsimane' traditional drink is *chicha*, a beverage made by fermenting crops such as manioc and plantains. The alcoholic content of *chicha* varies by the duration of fermentation, but *chicha* generally has less than 5% alcoholic content by volume (1–12%) (Jennings et al. 2005). Any Tsimane' can walk into a household serving *chicha* and expect to be served. Tsimane' stigmatize as misers and hold in contempt people who do not prepare and share *chicha*. People drink *chicha* sitting in a circle with people of the same sex. As they pass time drinking *chicha*, they tell stories and make commentaries on a wide range of subjects. Unlike the drinking of commercial alcohol, which is done alone or in small groups, mostly by men, the drinking of *chicha* takes place in groups, with the participation of all Tsimane' present, men and women, adults and children, who are offered nonfermented *chicha*. Many legends and myths of the Tsimane' center on the drinking of *chicha* (Huanca 2008).

## Methods

For this article we draw on data from a panel study in progress that started in 2002 and continues today. Information was collected annually during June–September of 2002 to 2006 from all adult in 13 villages along the Maniqui River, Beni, Bolivia. Villages differed in their proximity to San Borja (mean = 25.96 km, SD = 16.70 km), the only town along the Maniqui River. Four Tsimane' who have worked on the study from its inception served as translators. Data were collected through interviews lasting about 1 h per adult.

### Sample

The sample used in this article contains 399 females and 392 males over the age of 16 with complete data on all outcome and explanatory variables for at least two survey years. In a previous article using data from the same sample, we assessed bias from attrition in the sample (Godoy et al. 2009a). About 6% of the people in the 2002 sample left permanently after the first survey, about two-thirds (62%) stayed on the panel for 5 years and the remaining 32% of the sample were present for between two and four surveys. We found that attrition in our sample is random and therefore unlikely to introduce large bias in our estimations.

### Explanatory Variable

#### *Cultural Consonance*

Following insights from previous research, we took four steps to construct an individual annual measure of cultural consonance in lifestyle.

(a) *Tsimane' Definition of Lifestyle.* First, we used free listings to elicit a range of items that Tsimane' associate with a good life (Weller 1998; Dressler and Bindon 2000). We asked 35 individuals from 12 villages to list “things or events that make a good life.” Individuals were selected across age and gender (Bernard 1995). Informants listed 37 different reasons. We calculated the importance of each reason across all of the lists using the Saliency index (Bernard 1995). Spending time with close family was the most salient item in the list ( $S = 0.56$ ), followed by having a good agricultural plot ( $S = 0.46$ ), having good food ( $S = 0.35$ ) and succeeding in hunting ( $S = 0.35$ ). Other reasons that contribute to a good life for the Tsimane' include drinking *chicha* ( $S = 0.24$ ), succeeding in fishing ( $S = 0.23$ ), enjoying good health ( $S = 0.21$ ), being visited ( $S = 0.21$ ), acquiring commercial goods ( $S = 0.19$ ) and visiting kin ( $S = 0.19$ ).

(b) *Evaluation of the Shared Cultural Model.* We then used rankings to evaluate the existence of a shared cultural model for Tsimane' lifestyle (Dressler and Bindon 2000). Rankings were conducted with 42 people aged 17–80 in four villages with different levels of market exposure and across age and gender (Bernard 1995). We asked informants to rate 14 items on a scale of “not important at all” (coded as 1), “a little important” (2) or “very important” (3). Specifically, for each item on the list, we asked informants “How important is X for Tsimane' lifestyle (not for

**Table 1** Ten most important reasons for defining Tsimane' lifestyle: Free listing ( $n = 35$ ; Tsimane' > 16 years of age)

Reason	Frequency	Percentage <sup>a</sup>	Avg. ranking <sup>b</sup>	S <sup>c</sup>
To spend time with close family	24	69	2.75	0.56
To have a good agricultural plot	25	71	4.00	0.46
To have good food	19	54	3.89	0.35
To succeed in the hunt	23	66	5.26	0.35
To drink home-brewed beverage	14	40	4.93	0.24
To succeed in fishing	16	46	4.87	0.23
To enjoy good health	15	43	6.00	0.21
To be visited	12	34	4.75	0.21
To acquire commercial goods	17	49	6.71	0.19
To visit kin	10	29	2.00	0.19

<sup>a</sup> Percentage of people who mentioned each reason

<sup>b</sup> Average rank in which each reason was mentioned across lists

<sup>c</sup> Saliency or weighted average of the inverse rank of an item across multiple free lists, where each list is weighted by the number of items on the list

yourself)?” so informants were prompted to think about the Tsimane' in general when giving their responses and not in terms of their own behaviors. The list of 14 items included seven material goods and the seven most salient reasons from free listings on Tsimane' lifestyle (Table 1). To make our work methodologically comparable to previous research on the topic referring to specific material goods (Dressler and Bindon 2000), and since the Tsimane' did not mention particular material items in their free listings, for the rankings task we expanded the reason “acquiring commercial goods” into seven material goods. The selection of the seven material goods was based in our own ethnographic understanding of the area and captured wealth differences between individuals as well as differences between women and men. For instance, even the poorest households own mosquito nets and machetes, but wealthier households also own shotguns and radios. We mostly included assets that all Tsimane', men and women, own, but do include one asset that women generally own (pots) and one that men generally own (guns). We excluded “To drink *chicha*” from the rating list because it is one of the outcomes examined. The 14 items rated are presented in the first column in Table 2.

To test whether there was cultural consensus regarding the importance of these 14 items in the definition of Tsimane' material lifestyle, we used the formal consensus model in the software ANTHROPAC 4.02 (Borgatti 1996). The routine performs a factor analysis using the ratings as units of analysis and the informants as variables and then calculates the degree of agreement in ratings between each pair of informants to determine whether there is a single factor along which informants cluster. Results from rating data show evidence of substantial cultural consensus. The ratio of the first to the second eigenvalue (6.37) indicates that there is sufficient agreement to assume that all informants in the sample were drawing on the same repository of cultural knowledge (Romney et al. 1986). For 11 of the 14 items in our

**Table 2** Consensus ratings of key informants ( $N = 42$ ) and percentage owning item/reporting behavior in the survey sample ( $N = 2,444$ ,  $> 5$  years)

Lifestyle item	Weighted average of consensus rating <sup>a</sup> (key informants)	Percentage reporting behavior or owning item (survey sample)
To own machetes	2.08	75.53
To own mosquito nets	2.07	86.09
To own cooking pots	2.05	21.93
To have good food	2.05	50.33
To own enough clothing	2.01	2.54
To own a shotgun	1.92	27.41
To have a good agricultural plot	1.90	48.73
To be in good health	1.89	47.14
To own a radio	1.85	27.74
To own a fishing net	1.82	20.34
To spend time with close family	1.73	55.40
To succeed in hunting	1.62	4.21
To be visited	1.61	9.98
To succeed in fishing	1.60	14.11

<sup>a</sup> Averages are weighted by the cultural competencies of the 42 key informants

list, the culturally correct answer is estimated to be “very important.” For the other four items, the correct answer is estimated to be “of some importance.” No item had a consensus answer of “not important at all.”

Following Dressler and Bindon (2000), we used the cultural competence score of the individuals (or the factor loading of each informant on the first factor, a measure of how strongly each individual’s knowledge is correlated with the composite knowledge of the group) to calculate a weighted average of the ratings for each of the 14 items in our list. This analysis gives more weight to informants who showed more agreement with the culturally correct answer.

(c) *Behavior Occurrence*. Each year during our survey, we asked informants the occurrence of behaviors and the ownership of items in the rated list. Survey questions referred to respondent’s assets ownership and reported behaviors during the week prior to the interview. For example, we asked respondents, “During the last 7 days, have you spent time with your close family?” We coded survey questions as binary variables, with 1 indicating behavior presence or item ownership and 0 indicating its absence.

(d) *Cultural Consonance*. Finally, we constructed a measure of cultural consonance for each individual and year by combining the ratings for each of the 14 items on our list and the behavior occurrence measures. Specifically, for each year, we multiplied the cultural saliency of each item by the binary variables measuring behavior occurrence. We then add results to obtain an individual measure of cultural consonance for each year of the survey. Responses result in a quantitative assessment of cultural consonance at the individual level, with higher values

indicating higher cultural consonance, which in turns indicates a higher quality of life, as defined by local norms and expectations (Dressler et al. 1998a, b; Dressler and Bindon 2000).

### Outcome Variables

We measured psychological well-being through self-report of one positive (happiness) and three negative (anger, fear, sadness) emotions. To measure occurrence of emotions, we asked people how often they had felt each of the four selected emotions during the 7 days before the day of the interview. For the analysis reported here, we coded the answers 1 if the person had experienced the emotion and 0 otherwise.

To measure consumption of potentially addictive substances, we asked about (i) frequency of consumption of commercial alcohol, (ii) number of commercial cigarettes smoked, (iii) number of times the person had chewed coca leaves and (iv) number of days the person drank *chicha*. The four questions referred to the 7 days before the day of the interview. As with emotions, we coded the answers 1 if the person had incurred in the behavior and 0 otherwise.

### Control Variables

Control variables included personal-, household-, village- and year-level variables. Personal-level variables included the person's age in years, sex, maximum school attainment and body mass index (BMI; weight in kg/height in m<sup>2</sup>). Control variables at the household level included household wealth (measured by the monetary value of a basket of traditional and modern physical assets owned by the household), household income (amount of cash earned by members of the household through sale, barter or wage labor during the 2 weeks previous to the interview) and household size (total the household).

### Estimation Strategy

We estimate the association between cultural consonance in material lifestyle (explanatory variable) and our eight outcomes using multivariate analysis. Since our outcomes are binary variables, for the empirical estimation we use conditional individual fixed-effect logistic regressions with clustering by person. In addition to individual and household controls that have been used in previous research, we run the regressions with a full set of dummies ( $n = 13$ ; 1–12) to control for village attributes that remain fixed during the period of research. For example, some villages are closer to market towns than others. Proximity to market towns could affect our outcomes. For example, some potentially additive substances, such as alcohol, are more available in villages closer to market town. We also use a full set of dummy variables for years ( $n = 5$ ; 1–4). For the statistical analysis we used Stata for Windows, version 10 (StataCorp, College Station, TX, USA).

## Caveats

At least two caveats merit attention. First, our estimations might be affected by omitted variable bias. It is possible that the relation found is spurious—that unmeasured factors change both cultural consonance and the outcomes, but there is no causal association between the two. We have included in our model variables that previous research suggests affect psychological well-being, but we cannot rule out the possibility that there are other covariates not included in our model. Second, data to construct Tsimane' cultural domain in material lifestyle—a needed step for the measure of cultural consonance—were collected at the end of the research period. Previous research has collected this information at the onset of the research. We assume that cultural domains do not change over short periods of time, but if they do, our estimations might be biased in an unknown direction.

## Results

### Descriptive Statistics

Table 3 shows the descriptive statistics for variables included in the analysis. The average participant had a cultural consonance of 9.48 (SD = 3.87, min = 1.6, max = 22.93). We ran a series of Pearson correlations between the individual measures of cultural consonances for each year. We found a high ( $r \leq 0.5$ ) and statistically significant correlation ( $p < 0.0001$ ) between measures of cultural consonance of the same individual taken in different years. The results of a Chronbach alpha also suggest a high association between the measures for the same subject in different years ( $\alpha = 0.85$ ). In sum, the analysis of our measure of cultural consonance suggests that the measure displays a large variation across subjects but consistency for measures of the same subject across years.

Descriptive statistics of self-reported occurrence of emotions suggest that negative emotions were less common than positive emotions measured. Twenty-nine percent of the sample reported experiencing anger during the 7 days before the day of the interview, 39% reported experiencing fear and 58% reported experiencing sadness. As many as 79% of the sample reported experiencing happiness during the 7 days before the day of the interview.

The descriptive statistics of information on consumption of potentially addictive substances show that an average person in the sample reported drinking alcohol 0.23 times, smoking 1.35 cigarettes, chewing coca leaves 0.66 times and drinking *chicha* 0.46 days during the 7 days before the day of the interview. We found a positive and statistically significant association ( $p < 0.0001$ ) between the four measures of consumption of potentially addictive substances. Nineteen percent of the sample reported drinking alcohol at least once during the week previous to the interview; 20% reported smoking cigarettes, 21% reported chewing coca and 37% reported drinking fermented *chicha* (not shown).

**Table 3** Definition and summary statistics of variables used in regressions

Variable	Definition	<i>N</i>	Mean	SD
<b>I. Explanatory variable</b>				
Cultural consonance <sup>a</sup>	Degree to which individuals, in their own beliefs and behaviors, approximate shared cultural models	2,597	9.48	3.87
<b>II. Outcome variables</b>				
<i>Emotions</i>				
Anger <sup>b</sup>	Subject experienced anger (=1) or not (=0) during the 7 days before the interview	2,596	0.29	0.45
Fear <sup>b</sup>	Subject experienced fear (=1) or not (=0) during the 7 days before the interview	2,596	0.39	0.49
Sadness <sup>b</sup>	Subject experienced sadness (=1) or not (=0) during the 7 days before the interview	2,596	0.58	0.49
Happiness <sup>b</sup>	Subject experienced happiness (=1) or not (=0) during the 7 days before the interview	2,596	0.79	0.41
<i>Consumption of potentially addictive substances</i>				
Alcohol <sup>b</sup>	No. of times person drank alcohol during the 7 days before the interview	2,082	0.23	0.56
Cigarette <sup>b</sup>	No. of industrial cigarettes smoked during the 7 days before the interview	2,596	1.35	5.09
Coca leaves <sup>b</sup>	No. of times person chewed coca during the 7 days before the interview	2,595	0.66	1.81
Chicha <sup>b</sup>	No. of days person drank fermented home breed beer during the 7 days before the interview	2,596	0.46	0.76
<b>III. Control variables</b>				
<i>Individual level</i>				
Age	Age of participant (yr)	2,597	35.59	16.40
Schooling	Maximum school grade achieved by participant	2,597	1.94	2.28
BMI	Body mass index (weight in kg/height in m <sup>2</sup> )	2,597	23.44	2.69
<i>Household level</i>				
Household income	Bolivianos of income from sale, barter and wage labor	495	250	342
Household wealth	Monetary value of a basket of traditional and modern physical assets owned by household (Bolivianos)	495	2,974	2,107
Household size	No. of people in household	495	5.39	2.71

<sup>a</sup> Variable transformed to logarithm for multivariate analysis

<sup>b</sup> Variables transformed to binary for multivariate analysis

### Cultural Consonance in Material Lifestyle and Occurrence of Emotions

Table 4 shows results from a conditional individual fixed-effects logistic regression testing the association between cultural consonance in material lifestyle and

**Table 4** Conditional fixed-effects logistic regression of cultural consonance in material lifestyle (explanatory variable) and self-reported occurrence of emotions (outcome)

	Anger	Fear	Sadness	Happiness
Cultural consonance, log	-0.713*** (0.169)	-0.673*** (0.169)	-0.629*** (0.174)	0.401** (0.189)
Age	-0.331 (0.756)	0.226 (0.702)	0.454 (0.721)	0.103 (0.834)
Schooling	0.075 (0.092)	0.078 (0.087)	0.015 (0.082)	0.149 (0.128)
BMI	-0.536 (10.468)	0.648 (10.295)	10.107 (10.38)	-0.670 (10.588)
Household income	0.00002 (0.0001)	0.0002 (0.0001)	-0.0003* (0.0001)	0.00004 (0.0002)
Household wealth	0.00006 (0.00003)	0.00002 (0.00003)	0.00005 (0.00003)	-0.00003 (0.00004)
Household size	-0.083** (0.042)	-0.097** (0.040)	-0.022 (0.039)	-0.031 (0.049)
No. of observations	1,576	1,674	1,767	1,391
No. of individuals	386	408	442	348

*Note:* Regressions include constant and full set of dummy variables for villages and years (not shown). Standard errors in parentheses. \* Significant at <10%, \*\* Significant at 5%, \*\*\* Significant at 1%

self-reported occurrence of four selected emotions. As hypothesized, we found a negative association between cultural consonance in material lifestyle and the presence of three negative emotions (anger, sadness and fear). The association is large and significant at the 99% confidence interval for the three emotions. Conditioning for individual, household, village and year fixed effects, a 1% increase in the index of cultural consonance is associated with a 0.71% lower probability of a person experiencing anger ( $p < 0.0001$ ) in the week before the interview. Similarly, a 1% increase in the index of cultural consonance is associated with a 0.67% lower probability of a person experiencing fear and a 0.63% lower probability of a person experiencing sadness ( $p < 0.0001$ ).

As hypothesized, the association between cultural consonance and self-reported occurrence of a positive emotion, happiness, was positive. The coefficient for happiness was lower than the coefficients for negative emotions, but significant at the 95% interval of confidence. A 1% increase in our measure of cultural consonance is associated with a 0.40% higher probability of a person reporting having experienced happiness in the week before the interview ( $p = 0.03$ ).

### Cultural Consonance in Material Lifestyle and Consumption of Potentially Addictive Substances

Table 5 reports results from a set of conditional individual fixed-effects logistic regression models testing the association between cultural consonance in material

**Table 5** Conditional fixed-effects logistic regression of cultural consonance in material lifestyle (explanatory variable) and consumption of potentially addictive substances (outcome)

	Alcohol	Cigarettes	Coca	Chicha
Cultural consonance, log	-0.835** (0.328)	0.124 (0.304)	-0.449 (0.333)	0.346* (0.161)
Age	0.387 (10.24)	-0.016 (0.020)	0.023 (0.022)	-0.023 (0.015)
Schooling	0.059 (0.132)	0.090 (0.138)	0.050 (0.170)	0.075 (0.084)
BMI, log	30.176 (20.71)	-30.594 (20.49)	-0.079 (20.55)	40.307*** (10.61)
Household income	0.0009** (0.0004)	0.0005* (0.0003)	0.0005 (0.0003)	0.0002 (0.0002)
Household wealth	0.00002 (0.00006)	0.00001 (0.00006)	0.00003 (0.00007)	-0.00004 (0.00004)
Household size	-0.068 (0.060)	-0.065 (0.063)	-0.100 (0.077)	-0.060 (0.044)
Consumption of home-brewed beer	-0.896*** (0.156)	0.390*** (0.118)	0.470*** (0.129)	-
No. of observations	585	674	579	1,258
No. of individuals	173	199	171	356

*Note:* Regressions include constant and full set of dummy variables for villages and years (not shown). Standard errors in parentheses. \* Significant at <10%, \*\* Significant at 5%, \*\*\* Significant at 1%

lifestyle and reported consumption of four potentially addictive substances. Regressions resemble those in Table 4, except that the models in Table 5 include *consumption of home-brewed beer* as a control. As we have seen before, self-reports of consumption of the four potentially addictive substances are highly correlated. Our ethnographic understanding suggests that much of the consumption of alcohol, cigarettes and coca leaves occurs during traditional *chicha* drinking. So, to be able to differentiate the confounding effects of those events, in our regressions of consumption of commercial alcohol, cigarettes and coca leaves, we include *consumption of home-brewed beer* as a control.

Of the four variables analyzed, only the consumption of commercial alcohol shows the expected negative association with cultural consonance in material lifestyle. A one-point increase in cultural consonance is associated with a 0.83% lower probability of consuming commercial alcohol during the week previous to the interview ( $p = 0.03$ ). The associations between cultural consonance and consumption of commercial cigarettes and coca leaves were statistically insignificant. Furthermore, of the two, only the consumption of coca leaves bears the expected negative sign (Table 5). Finally, contrary to what was hypothesized, the consumption of a traditional alcoholic beverage, *chicha*, bears a positive association with cultural consonance in Tsimane' material lifestyle. The coefficient of the association

was lower than for commercial alcohol and statistically significant only at the 90% confidence interval ( $p = 0.06$ ).

## Discussion

We organize the discussion around two main issues that emerge from our work. First, after controlling for individual fixed effects, we found the expected association between cultural consonance in material lifestyle and psychological states. Second, we found that only the consumption of commercial alcohol, and not the consumption of other potentially addictive substances, bears the expected negative association with cultural consonance in Tsimane' lifestyle. Furthermore, the consumption of one potentially addictive substance, home-brewed fermented beer, bears a positive association with cultural consonance.

First, as hypothesized, we found a negative association between cultural consonance in material lifestyle and psychological distress and a positive association between cultural consonance in material lifestyle and psychological well-being. The magnitude of the association was higher for negative than for positive emotions, but significant in statistical and real terms in both cases. This finding meshes with findings from previous research on the association between adherence to the dominant cultural model and psychophysiologic outcomes (Bindon et al. 1997; Chin-Hong and McGarvey 1996; Diener et al. 2003) but takes research on the topic one step further.

Previous research on the topic was based on the analysis of cross-sectional data, leaving open the possibility that fixed attributes of an individual explain both cultural consonance and outcomes. If the occurrence of emotions is stable over time, there would be no association between cultural consonance and emotions once we control for fixed attributes of the individual. From previous research in the area during the same period of time, we know that the incidence of self-reported anger and fear declined during the study period. The passage of each year lowered the probability of reporting fear by 6.19% ( $p = 0.001$ ) and the probability of reporting anger by 10.40%/year ( $p = 0.001$ ) (Godoy et al. 2009b). Results presented here move research on the association between cultural consonance and psychological well-being one step further because they suggest that the variation in the occurrence of emotions is associated with success in reaching the shared cultural model even *after* controlling for fixed attributes of the individuals.

One important caveat from this first result merits attention. Previous research on the topic has been based on measures of blood pressure (Dressler 2005; Dressler and Bindon 2000), whereas we use self-reported information. From the three negative emotions measured, we found that anger had the largest association with cultural consonance in real terms. Since the experience of anger increases blood pressure more than the experience of other negative emotions (James et al. 1986; Schwartz et al. 1994), our results seem to fit well with previous findings. However, since self-reported health measures are less reliable than objective health measures, further research should obtain panel data on measures of cultural consonance and blood pressure to obtain estimates more reliable than those offered here.

Our second important finding is that from the four potentially addictive substances analyzed, only the consumption of commercial alcohol bears the expected negative association with cultural consonance in Tsimane' material lifestyle. The consumption of two other substances, commercial cigarettes and coca leaves, is not associated in a statistically significant way with our measure of cultural consonance, and the consumption of a traditional alcoholic beverage bears a positive and significant association with cultural consonance.

What might explain those puzzling associations? We studied the association between the consumption of potentially addictive substances and cultural consonance under the assumption that consumption of addictive substances is a marker of stress that reflects negative psychological states (Sinha et al. 2000). However ethnographic information suggests that Tsimane' attach different cultural values to the consumption of those substances. For example, results from the free listings show that consumption of home-brewed beer is important in Tsimane' lifestyle. Tsimane' drink *chicha* probably not because they are sad, depressed or stressed but, rather, because it is a culturally appropriated behavior and—still today—a major social event in Tsimane' life. The cultural value attached to the consumption of *chicha* explains the positive association found between cultural consonance and *chicha* drinking.

Similarly, Tsimane' have traditionally attached cultural values to the consumption of tobacco and coca. Tsimane' have traditionally consumed tobacco for medicinal and religious purposes (Huanca 2008), and they have learned to chew coca from highland colonists, who also attach cultural values to coca chewing. The overlap between traditional uses of tobacco and coca and more recent uses (as an anodyne to accompany hard work) might explain the lack of a consistent association between the consumption of those substances and cultural consonance.

Finally, we do find the expected negative association between consumption of commercial alcohol and cultural consonance. Tsimane' whose actual behavior does not approximate the culturally valued lifestyle encoded in the dominant cultural model are more likely to consume commercial alcohol than Tsimane' whose behavior approximate cultural consonance in Tsimane' lifestyle. The finding has important implications for the well-being of indigenous peoples. Several studies have reported the widespread and growing consumption of commercial alcohol among Amazonian (Seale et al. 2002, 2003; Nawaz et al. 2001) and other indigenous peoples. Researchers debate the role of trade opening on alcohol consumption but so far have not found a consistent pattern (Tavares et al. 2003; Godoy et al. 2010). Results of our research suggest that, more than trade opening per se, it is the stress associated with the inability to conform to the dominant lifestyle that is associated with higher alcohol consumption.

**Acknowledgments** This research was funded by grants from the Cultural and Physical Anthropology Programs, National Science Foundation (USA), and the World Bank. The Great Tsimane' Council approved the study. We obtained consent from participants before enrollment in the study. We thank M. Aguilar, J. Cari, S. Cari, E. Conde, D. Pache, J. Pache, P. Pache, M. Roca and E. Tayo for help with data collection and logistical support and to ICRISAT-Patancheru for provision of office facilities to V.R.-G. Thanks go also to the Gran Consejo Tsimane' for their continuous support throughout this research project.

## References

- Bernard, H. Russell  
1995 *Research Methods in Anthropology. Qualitative and Quantitative Approaches*. Walnut Creek, CA: Altamira Press.
- Bindon, James R., Amy Knight, William W. Dressler, and Douglas E. Crews  
1997 Social Context and Psychosocial Influences on Blood Pressure among American Samoans. *American Journal of Physical Anthropology* 103(1): 7–18.
- Borgatti, Stephen P.  
1996 ANTHROPAC 4.0. Natick, MA: Analytic Technologies.
- Byron, Elizabeth  
2003 *Markets and Health: The Impact of Markets on the Nutritional Status, Morbidity, and Diet of the Tsimane' Amerindians of Lowland Bolivia*. Department of Anthropology, University of Florida.
- Cassel, John C., Donald Patrick, and David Jenkins  
1960 Epidemiological Analysis of the Health Consequences of Culture Change. *Annals of the New York Academy of Sciences* 84: 938–949.
- Chin-Hong, Peter V., and Stephen T. McGarvey  
1996 Lifestyle Incongruity and Adult Blood Pressure in Western Samoa. *Psychosomatic Medicine* 58(2): 130–137.
- Daillant, Isabelle  
2003 *Sens Dessus Dessous. Organization sociale et spatiale des Chimane d'Amazonie bolivienne*. Nanterre: Societe d'ethnologie.
- D'Andrade, Roy G.  
1995 *The Development of Cognitive Anthropology*. Cambridge: Cambridge University Press.
- Diener, Ed, and Richard E. Lucas  
1999 Personality and Subjective Well-Being. In *Well-Being: The Foundations of Hedonic Psychology*. Daniel Kahneman, Ed Diener, and Norbert Schwarz, eds., pp. 213–229. New York: Sage Foundation.
- Diener, Ed, Shigehiro Oishi, and Richard E. Lucas  
2003 Personality, Culture, and Subjective Well-Being: Emotional and Cognitive Evaluations of Life. *Annual Review of Psychology* 54: 403–425.
- Dressler, William W.  
2005 What's Cultural about Biocultural Research? *Ethos* 33(1): 20–45.  
2008 Meaning, Structure in Research in Medical Anthropology. *Anthropology in Action* 14(3): 30–43.
- Dressler, William W., and James R. Bindon  
2000 The Health Consequences of Cultural Consonance: Cultural Dimensions of Lifestyle, Social Support, and Arterial Blood Pressure in an African American Community. *American Anthropologist* 102(2): 244–260.
- Dressler, William W., Mauro C. Balieiro, and Jose E. dos Santos  
1997 The Cultural Construction of Social Support in Brazil: Associations with Health Outcomes. *Culture Medicine and Psychiatry* 21(3): 303–335.  
1998a Culture, Socioeconomic Status, and Physical and Mental Health in Brazil. *Medical Anthropology Quarterly* 12(4): 424–446.  
2007a Cultural Consonance and Psychological Distress: Examining the Associations in Multiple Cultural Domains. *Culture, Medicine and Psychiatry* 31(2): 195–224.  
2007b A Prospective Study of Cultural Consonance and Depressive Symptoms in Urban Brazil. *Social Science & Medicine* 65(10): 2058–2069.
- Dressler, William W., James R. Bindon, and Yasmin R. Neggers  
1998b Culture, Socioeconomic Status, and Coronary Heart Disease Risk Factors in an African American Community. *Journal of Behavioral Medicine* 21(6): 527–544.
- Godoy, Ricardo, William R. Leonard, Victoria Reyes-García, Emily Goodman, Thomas W. McDade, Tomas Huanca, Susan Tanner, and Vincent Vadez  
2006 Physical Stature of Adult Tsimane' Amerindians, Bolivian Amazon in the 20th Century. *Economics and Human Biology* 4(2): 184–205.

- Godoy, Ricardo, Victoria Reyes-García, James Broesch, Ian Fitzpatrick, Peter Giovanninni, Maria Ruth Martínez-Rodríguez, Naveen Jha, Tomas Huanca, William R. Leonard, Thomas W. McDade, Susan Tanner, and TAPS Bolivia Study Team
- 2009a Secular Changes of Indigenous Knowledge of Useful Plants: Separating Age and Cohort Effects. *Journal of Anthropological Research* 65(1): 51–67.
  - 2009b Moving Beyond a Snapshot to Understand Changes in the Well-Being of Native Amazonians: Panel Evidence (2002–2006) from Bolivia. *Current Anthropology* 50(4): 560–570.
- Godoy, Ricardo, Erina Zeinalova, Victoria Reyes-García, Tomas Huanca, H. Kosiewicz, William R. Leonard, Thomas W. McDade, and Susan Tanner
- 2010 Does Civilization Cause Discontentment among Indigenous Amazonians? Test of Empirical Data from the Tsimane' of Bolivia. *Journal of Economic Psychology*. In press.
- Gurven, Michael, Hillard Kaplan, and A. Zelada Supa
- 2007 Mortality Experience of Tsimane Amerindians of Bolivia. *American Journal of Human Biology* 19: 376–396.
- Henry, James P., and John C. Cassel
- 1969 Psychosocial Factors in Essential Hypertension: Recent Epidemiologic and Animal Experimental Evidence. *American Journal of Epidemiology* 90(3): 171–200.
- Huanca, Tomás
- 2008 Tsimane' Oral Tradition, Landscape, and Identity in Tropical Forest. La Paz: Imprenta Wagui.
- James, Gary D., L.S. Yee, Gregory A. Harshfield, Seymour G. Blank, and Thomas G. Pickering
- 1986 The Influence of Happiness, Anger and Anxiety on the Blood Pressure of Borderline Hypertensives. *Psychosomatic Medicine* 48: 502–508.
- Janes, Craig R.
- 1990 *Migration, Social Change and Health*. Stanford, CA: Stanford University Press.
- Jennings, Justin, Katheleen L. Antrobus, Sam J. Atencio, Erin Glavich, Rebecca Johnson, German Loffler, and Christine Luu
- 2005 “Drinking Beer in a Blissful Mood”: Alcohol Production, Operational Chains, and Feasting in the Ancient World. *Current Anthropology* 46(2): 275–294.
- Lynch, John W.
- 2004 Is Income Inequality a Determinant of Population Health? Part I. A Systematic Review. *Milbank Quarterly* 8: 25–99.
- McDade, Thomas W.
- 2001 Lifestyle Incongruity, Social Integration, and Immune Function in Samoan Adolescents. *Social Science & Medicine* 53(10): 1351–1362.
  - 2002 Status Incongruity in Samoan Youth: A Biocultural Analysis of Culture Change, Stress, and Immune Function. *Medical Anthropology Quarterly* 16(2): 123–150.
- McGarvey, Stephen T.
- 1999 Modernization, Psychosocial Factors, Insulin, and Cardiovascular Health. *In* *Hormones, Health and Behavior*. Catherine Panter-Brick and Carol M. Worthman, eds. Cambridge: Cambridge University Press.
- Nawaz, Haq, Mustapha A. Rahman, Devon Graham, David L. Katz, and James F. Jekel
- 2001 Health Risk Behaviors and Health Perceptions in the Peruvian Amazon. *American Journal of Tropical Medicine and Hygiene* 65(3): 252–256.
- Pavot, William, and Ed Diener
- 1993 Review of the Satisfaction with Life Scale. *Personality Assessment* 5: 164–172.
- Pearlin, Leonard I., Elizabeth G. Menaghan, Morton A. Lieberman, and Joseph T. Mullan
- 1981 The Stress Process. *Journal of Health and Social Behavior* 22(4): 337–356.
- Reyes-García, Victoria
- 2001 Indigenous People, Ethnobotanical Knowledge, and Market Economy: A Case Study of the Tsimane' Amerindians in Lowland Bolivia. Ph.D. dissertation. University of Florida, Gainesville.
- Rioja, Guillermo
- 1992 The Jatata Project: The Pilot Experience of Chimane Empowerment. *In* *Sustainable Harvest and Marketing of Rain Forest Products*. Mark J. Plotkin and Lisa Famolare, eds., pp. 192–196. Washington, DC: Island Press.
- Romney, A. Kimball, Susan Weller, and William Batchelder
- 1986 Culture as Consensus: A Theory of Culture and Informant Accuracy. *American Anthropologist* 88(2): 313–338.

- Sapolsky, Robert M  
1999 The Physiology and Pathophysiology of Unhappiness. *In* *Well-Being: The Foundations of Hedonic Psychology*. D. Kahneman, E. Diener, and N. Schwarz, eds., pp. 453–469. New York: Russell Sage Foundation.
- Schwartz, Joseph E., Katherine Warren, and Thomas G. Pickering  
1994 Mood, Location and Physical Position as Predictors of Ambulatory Blood Pressure and Heart Rate: Application of a Multilevel Random Effects Model. *Annals of Behavioral Medicine* 16: 210–220.
- Seale, J. Paul, Josiah D. Seale, Manuel Alvarado, Robert L. Vogel, and Nebbie E. Terry  
2002 Prevalence of Problem Drinking in a Venezuelan Native American Population. *Alcohol and Alcoholism* 37(2): 198–204.
- Seale, J. Paul, Silvia Shellenberger, Carlos Rodriguez, Josiah D. Seale, and Manuel Alvarado  
2003 Alcohol Use and Cultural Change in an Indigenous Population: A Case Study from Venezuela. *Alcohol and Alcoholism* 37(6): 603–608.
- Sinha, Rajita, Tiffany Fuse, Lisa Renee-Aubin, and S. Stephaine O'Malley  
2000 Psychological Stress, Drug-Related Cues, and Cocaine Craving. *Psychopharmacology* 152: 140–148.
- Tavares, Edelweiss F., Joao P. B. Vieira-Filho, Adagmar Andriolo, Adriana Sanudo, Suely G.A. Gimeno, and Laercio J. Franco  
2003 Metabolic Profile and Cardiovascular Risk Patterns of an Indian Tribe Living in the Amazon Region of Brazil. *Human Biology* 75(1): 31–46.
- Vadez, Vincent, Victoria Reyes-García, Ricardo Godoy, Lilian Apaza, Elizabeth Byron, Tomas Huanca, William Leonard, Eddy Pérez, and David Wilkie  
2004 Does Integration to the Market Threaten Agricultural Diversity? Panel and Cross-sectional Evidence from a Horticultural-Foraging Society in the Bolivian Amazon. *Human Ecology* 32(5): 635–646.
- Vadez, Vincent, Victoria Reyes-García, Tomas Huanca, and William R. Leonard  
2008 Cash Cropping, Farm Technologies, and Deforestation: What Are the Connections? A Model with Empirical Data from the Bolivian Amazon. *Human Organization* 67(4): 384–396.
- Weller, Susan  
1998 Structured Interviewing and Questionnaire Construction. *In* *The Handbook of Methods in Cultural Anthropology*. H. Russell Bernard, ed. Walnut Creek, CA: Altamira Press.
- Wilkinson, Richard G.  
2000 *Mind the Gap: Hierarchies, Health, and Human Evolution*. London: Weidenfeld & Nicolson.