

**CULTURAL CONSONANCE AND PSYCHOLOGICAL WELL-BEING.
ESTIMATES WITH 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) from 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-breed beer), as indicators of stress behavior. After controlling for 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.

Key words: 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; Dressler and Bindon, 2000; McDade, 2002; Dressler, 2008; Dressler, et al., 2007). 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 in 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; Dressler and Bindon, 2000; McDade, 2002; Dressler, 2008; Dressler, et al., 2007). 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 psycho-physiologic outcomes, including blood pressure, symptoms of depression, perceived stress, and the 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 U.S. (Dressler, et al., 1998; Dressler and Bindon, 2000), and urban dwellers in Brazil (Dressler, et al., 1997; Dressler, et al., 1998). Researchers have also found that inconsistency between a household's material lifestyle and its socioeconomic status impacts the immune function (McDade, 2001; McDade, 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 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 model and psychological health. Examples of other potentially confounding individual fixed attributes include role models and genetic make up.

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) from 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-breed 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 in their own beliefs and behaviors approximate widely shared cultural models (Dressler and Bindon, 2000; Dressler, et al., 2007). 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.,

2007). 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-breed 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 with symptoms of depression (Dressler and Bindon, 2000; Dressler, et al., 1998; Dressler, et al., 1997). 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 at the foothills of the Andes, mostly in the Department of Beni, Bolivia. Relatively isolated until the mid-twentieth 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 the 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 of 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 homestead 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 for 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 or 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 about 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 non-fermented *chicha*. Many legends and myths of the Tsimane' centre 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 nowadays. Information was collected annually during June-September of 2002 to 2006 from all adult in 13 villages along the Maniqui river, department of Beni, Bolivia. Villages differed in their proximity to San Borja (mean=25.96 km; standard deviation [S.D.]=16.70), the only town along the Maniqui river. Four Tsimane' who have worked in the study from its inception served as translators. Data was collected through interviews lasting about one hour/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 have 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 in the panel for the five years, and the remaining 32% of the sample were present 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*: Followed 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; Reyes-García, et al., 2009). Spending time with close family was the most salient item in the lists (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).

INSERT TABLE 1 ABOUT HERE

a) *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” (2), or “very important” (3). Specifically, for each item on the list, we asked informants “how important is X for Tsimane' lifestyle (not for 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 in 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 include one asset that women generally own (pots) and one that that men generally own (guns). We excluded "To drink *chicha*" from the rating list because is one of the outcomes examined. The 14 items rated are presented in the first column of Table 2.

INSERT TABLE 2 ABOUT HERE

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 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 seven days, have you spend 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*: Lastly, we constructed a measure of cultural consonance for each individual and year by combining the ratings for each of the 14 items in 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., 1998; 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 seven days before the day of the interview. For the

analysis reported here, we coded the answers as one if the person had experienced the emotion and zero 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 seven days before the day of the interview. As with emotions, we coded the answers as one if the person had incurred in the behavior and zero otherwise.

Control variables: Control variables included personal, household, village, and year level variables. Personal-level variables included the person's age measured in years, sex, maximum school attainment, and body-mass index (BMI, weight in kg/height in m²). 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 two weeks previous to the interview), and household size (total number of people living in 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 addictive 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, Texas).

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 can not 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—was 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 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 ($r \geq 0.5$) 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 of the same subject for 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.

INSERT TABLE 3 ABOUT HERE

Descriptive statistics of self-reported occurrence of emotions suggest that the negative emotions were less common than the positive emotion measured. 29% of the sample reported experiencing anger during the seven days before the day of the interview, 39% reported experiencing fear, and 58% reported experiencing sadness. As much as 79% of the sample reported experiencing happiness during the seven 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 seven 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. 19% 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).

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 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 one-percent increase in the index of cultural consonance is associated with a 0.71% lower probability of a person experiencing anger ($p < 0.0001$) the week before the interview. Similarly, a one-percent 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 ($p < 0.0001$).

INSERT TABLE 4 ABOUT HERE

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 one percent increase in our measure of cultural consonance is associated with a 0.40% higher probability of a person reporting having experienced happiness the week before the interview ($p = 0.03$).

Cultural consonance in material lifestyle and consumption of potentially addictive substances. Table 5 shows results from a set of conditional individual fixed-effects logistic regression models testing the association between cultural consonance in material 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 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 control.

Of the four variables analyzed, only the consumption of commercial alcohol shows the expected negative association with cultural consonance in material life style. A one-point increase on 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 association 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). Last, 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 ($p=0.06$).

INSERT TABLE 5 ABOUT HERE

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, but 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. Our finding meshes with findings from previous research on the association between adherence to the dominant cultural model and psycho-physiologic 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 in the topic had been based in the analysis of cross-sectional data, leaving open the possibility that fixed attributes of the individual explain both cultural consonance and outcomes. For example, studies in industrial nations have suggested that negative emotions, such as anger, might be stable personality traits that do not suffer changes over time (Chang, 2002). 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 to 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 more reliable estimates than the ones 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 to 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 additive 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 free listing 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 nowadays- 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.

Last, 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; Seale, et al., 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., 2009c). Results from our research suggest that, more than trade opening *per se*, is the stress associated to the inability to conform to the dominant lifestyle what is associated to higher alcohol consumption.

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

Reason	Obs	Percentage^a	Avg ranking^b	S^c
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

^a Percentage of people who mentioned each reason;

^b Average rank in which each reason was mentioned across lists;

^c 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.

Table 2: Consensus ratings from key informants (*N*- 42) and percentage owning item/reporting behavior in the survey sample (# = 2 444, over 5 years).

Lifestyle Item	Weighted Average of Consensus Rating ^a (Key informants, <i>N</i> = 42)	Percent reporting behavior or owning item (Survey sample, <i>N</i> = 2444)
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
^a Averages are weighted by the cultural competencies of the 42 key informants		

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

Variable	Definition	N	Mean	SD
I. Explanatory variable:				
<i>Cultural consonance</i> **	Degree to which individuals in their own beliefs and behaviors approximate shared cultural models	2597	9.48	3.87
II. Outcome variables				
Emotions				
<i>Anger</i> *	Subject experienced anger (=1) or not (=0) during the 7 days before the interview	2596	0.29	0.45
<i>Fear</i> *	Subject experienced fear (=1) or not (=0) during the 7 days before the interview	2596	0.39	0.49
<i>Sadness</i> *	Subject experienced sadness (=1) or not (=0) during the 7 days before the interview	2596	0.58	0.49
<i>Happiness</i> *	Subject experienced happiness (=1) or not (=0) during the 7 days before the interview	2596	0.79	0.41
Consumption of potentially addictive substances				
<i>Alcohol</i> *	Number of times the person drank alcohol during the 7 days before the interview	2082	0.23	0.56
<i>Cigarette</i> *	Number of industrial cigarettes smoked during the 7 days before the interview	2596	1.35	5.09
<i>Coca leaves</i> *	Number of times the person chewed coca during the 7 days before the interview	2595	0.66	1.81
<i>Chicha</i> *	Number of days the person drank fermented home breed beer during the 7 days before the interview	2596	0.46	0.76
III. Control variables				
Individual level				
<i>Age</i>	Age of participant (years)	2597	35.59	16.40
<i>Schooling</i>	Maximum school grade achieved by participant	2597	1.94	2.28
<i>BMI</i>	Body-mass index (weight in kg/ height in m ²)	2597	23.44	2.69
Household level				
<i>Household income</i>	Bolivianos of income from sale, barter, and wage labor	495	250	342
<i>Household wealth</i>	Monetary value of a basket of traditional and modern physical assets owned by the household	495	2,974	2,107
<i>Household size</i>	Number of people in the household	495	5.39	2.71
Notes: * Variables transformed to binary for multivariate analysis. ** Variables transformed to logarithms for multivariate analysis				

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

	<i>Anger</i>	<i>Fear</i>	<i>Sadness</i>	<i>Happiness</i>
<i>Cultural Consonance, log</i>	-.713*** (.169)	-.673*** (.169)	-.629*** (.174)	.401** (.189)
<i>Age</i>	-.331 (.756)	.226 (.702)	.454 (.7 21)	.103 (.834)
<i>Schooling</i>	.075 (.092)	.078 (.087)	.015 (.082)	.149 (.128)
<i>BMI</i>	-.536 (1.468)	.648 (1.295)	1.107 (1.38)	-.670 (1.588)
<i>Household income</i>	.00002 (.0001)	.0002 (.0001)	-.0003* (.0001)	.00004 (.0002)
<i>Household wealth</i>	.00006 (.00003)	.00002 (.00003)	.00005 (.00003)	-.00003 (.00004)
<i>Household size</i>	-.083** (.042)	-.097** (.040)	-.022 (.039)	-.031 (.049)
Number of observations	1576	1674	1767	1391
Number of individuals	386	408	442	348
Regressions include constant and full set of dummy variables for villages and years (not shown). Standard Errors in brackets. ***, ** and * significant at < 10%, 5%, and 1%.				

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

	<i>Alcohol</i>	<i>Cigarette</i>	<i>Coca</i>	<i>Chicha</i>
<i>Cultural consonance, log</i>	-.835** (.328)	.124 (.304)	-.449 (.333)	.346* (.161)
<i>Age</i>	.387 (1.24)	-.016 (.020)	.023 (.022)	-.023 (.015)
<i>Schooling</i>	.059 (.132)	.090 (.138)	.050 (.170)	.075 (.084)
<i>BMI, log</i>	3.176 (2.71)	-3.594 (2.49)	-.079 (2.55)	4.307*** (1.61)
<i>Household income</i>	.0009** (.0004)	.0005* (.0003)	.0005 (.0003)	.0002 (.0002)
<i>Household wealth</i>	.00002 (.00006)	.00001 (.00006)	.00003 (.00007)	-.00004 (.00004)
<i>Household size</i>	-.068 (.060)	-.065 (.063)	-.100 (.077)	-.060 (.044)
<i>Consumption home-breed beer</i>	-.896*** (.156)	.390*** (.118)	.470*** (.129)	^
Number of observations	585	674	579	1258
Number of individuals	173	199	171	356
Individual fixed effect linear regressions. Regressions include constant and full set of dummy variables for villages and years (not shown). ***, ** and * significant at < 10%, 5%, and 1%.				

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