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**The Tsimane’ Amazonian Panel Study (TAPS), 2002-2010: Overview**

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***Introduction***. The Tsimane’ Amazonian Panel Study (TAPS) is one of a few panel or longitudinal studies conceived and executed by anthropologists. Every year for nine consecutive years (2002-2010), the TAPS team measured social, economic, and biological variables among the Tsimane’, a native Amazonian society of foragers and horticulturalists in the department of Beni, Bolivia. The team cleaned, merged, and appended the data, and made it freely available to the public as the study unfolded. About 100 international researchers from many disciplines have requested the preliminary data (2002-2007) to explore topics beyond the ones considered by the TAPS team, and over 100 refereed publications by the TAPS team have resulted from the research (Appendix A). The aim of this note is to describe the origins and motivation of the panel, the topics covered, sample, attrition, preliminary findings, weaknesses and strengths, and how to access the complete 2002-2010 data.

***Origins and motivation***. By collecting panel data we wanted to find out how modernization and market exposure affected the well-being of people in a remote rural society. Our definition of well-being included human capital, monetary income, asset wealth, pro-social behavior, consumption, nutritional status, and health. The question of how markets and modernization affect the well-being of rural people goes back to the ancient Greeks and Romans, but has rarely been addressed with panel data ([Friedlaender, 1987](#_ENREF_26); [Shephard & Rode, 1996](#_ENREF_81))

To be considered a panel, the data must: *(a)* cover many entities (e.g., individuals, households), *(b)* come from applying the same protocols on repeated occasions to the same entities, and *(c)* must include variables that change and that do not change with time. So defined, a panel allows users to estimate how levels or changes in explanatory variables at time *t* affect levels or changes in outcomes at time *t*, or how baseline conditions affect end-line values of the outcome, or changes in the outcome.

To estimate the impact of markets and modernization on the well-being of remote rural dwellers, and to identify the processes through which these impacts take place requires many years of data collection. In their edited book entitled, *Long-Term Field Research in Social Anthropology*, Foster et al. ([1979, pp. 1-13, 323-348](#_ENREF_22)) noted that long-term studies need about a decade to detect meaningful changes. The duration of a panel to assess the impact of markets and modernization on well-being will vary inversely with the intensity of exposure to the outside world, but – given the current speed of cultural change -- a benchmark of about ten years seems like a reasonable minimum duration to address our motivation.

Panels are needed to estimate how people, households, or villages in remote corners of the world change as the intensity of contact with the outside world increases. As Damon ([1965](#_ENREF_15)) pointed out long ago, failure to track the same entities over time makes it impossible to separate life-cycle effects from cohort effects, the effects of a normal developmental cycle – whether of individuals, households, or villages -- from the effects of larger changes in society. Aware that our main question was hard to answer with a randomized-controlled trial, with a natural experiment, or with instrumental variables ([Ricardo Godoy, 2001](#_ENREF_28)), we opted to use observational data, at first cross-sectional and later panel.

During 1995-1999, several members of the TAPS team conducted exploratory studies among four lowland indigenous groups in Bolivia to identify those that were large and that varied in market exposure and contact with the outside world. Huanca, at that time a PhD student in cultural anthropology (U Florida), spent two years doing field research on ethnobotanical knowledge and horticulture among the Tsimane’ of the remote Sécure River ([Huanca, 1999](#_ENREF_42)). Godoy, at the time on faculty at the University of Florida, in collaboration with Huanca and Josh McDaniel, another PhD student in cultural anthropology (U Florida), did ethnographic work and pilot surveys among the Tsimane’, Yuracaré, Mosetén, and Chiquitano ([Ricardo Godoy & Cárdenas, 2000](#_ENREF_29); [Ricardo Godoy & Contreras, 2001](#_ENREF_30); [Ricardo Godoy & Jacobson, 1999](#_ENREF_31); [R. Godoy, Kirby, & Wilkie, 2001](#_ENREF_32)).

From these studies we found that some lowland groups had weak links to the market, but also had few people, while other groups were large, but were fully incorporated to the Bolivian nation. The Tsimane’ met our criteria. Although imprecise, estimates of their population during the late twentieth century varied between ~5,000 to 8,000 adults ([Rebecca Ellis & Aráuz, 1998, p. 1](#_ENREF_20); [Ringhofer, 2010, p. 73](#_ENREF_75); [Santamaría, 2005, p. 36](#_ENREF_78)). Tsimane’ also varied in openness to the outside world, from people fluent in Spanish and Tsimane’, who were savvy in Western ways and who valued interactions with Westerners, to monolingual speakers of Tsimane’ dwelling in villages several days away from towns. The Tsimane’ were not an ethnographic *tabula* *rasa*. Several European and Latin American anthropologists, missionaries, and travelers had lived or done research among the Tsimane’ before we arrived ([Chicchón, 1992](#_ENREF_12); [Daillant, 1994](#_ENREF_14); [R. Ellis, 1996](#_ENREF_19); [Hissink, 1955](#_ENREF_41); [Nordenskiöld, 1979 [orig. 1924]](#_ENREF_51), [2001 [orig 1924]](#_ENREF_52); [Pérez Diez, 1983](#_ENREF_56); [Riester, 1978](#_ENREF_74)). They left a rich corpus of writing that continues to inform the work of contemporary researchers.

To begin the research we received approval from the Tsimane’ governing body, the Tsimane’ Council, and from the IRB offices of USA universities managing the research grants. During 1999-2000 we started doing ethnographic and quantitative studies of two villages along the Maniqui River that differed in their proximity to the market town of San Borja (Figure 1). In selecting the two villages that differed in town propinquity we tried to capture the effects of markets and modernization through space. Lilian Apaza, a Bolivian undergraduate majoring in botany at the Universidad Mayor de San Andrés, La Paz, and Elizabeth Byron, a PhD student in cultural anthropology (U Florida), lived in the village of San Antonio only 20-30 minutes by motorcycle from the town of San Borja while Eddy Pérez, a Bolivian undergraduate majoring in zoology, also from the Universidad Mayor de San Andrés, and Victoria Reyes-García another PhD student in cultural anthropology (U Florida) worked in the more isolated village of Yaranda, ~1-2 days up-river by motorized canoe from the town of San Borja ([Apaza et al., 2003](#_ENREF_2); [Byron, 2003](#_ENREF_9); [Pérez, 2001](#_ENREF_57); [Reyes-Garcia, 2001](#_ENREF_62)). The four researchers explored the effects of market exposure and modernization on: *(i)* local ecological knowledge (Reyes-García), *(ii)* perceived health and nutritional status (Byron), and *(iii)* uses of terrestrial animal wildlife (Apaza) and *(iv)* fish (Pérez).

The four researchers spent 18 months collecting data. The first part of the 18 months was spent developing and pilot testing methods of data collection, such as surveys, scans, weigh days, and tasks to measure local ecological knowledge. They spent the rest of the 18 months collecting ethnographic information and six waves of quarterly panel data from all households in the villages of San Antonio and Yaranda. They used the data in panel and cross-sectional analyses for their theses. With insights from the comparative study of the two villages, the same team did a cross-sectional survey of 58 villages to establish the external validity of the initial comparative study ([Z. Foster et al., 2005](#_ENREF_23); [Reyes-Garcia et al., 2003](#_ENREF_64)).

[Insert Figure 1]

 While the comparative study of the two villages unfolded, Vincent Vadez, an agronomist, evaluated the introduction of cover crops in the traditional farming system of the Tsimane’ ([Vadez et al., 2004](#_ENREF_88)). Tsimane’ invest much labor clearing forests to farm, so a cover crop that restored soil nutrients would reduce the need for frequent forest clearing and free up time for other tasks. Building on our preliminary work, and on the finding that the cultivation of pigeon peas (*Cajanus cajan L*.) would fit nicely in a vacant window of time in the cropping cycle of the Tsimane’, the idea emerged that the likelihood of adopting pigeon peas would increase if -- at the same time – people were empowered. To test the idea, the team designed a randomized-controlled trial, which it implemented in 36 villages. The treatment consisted of giving: *(i)* pigeon peas seeds, *(ii)* workshops on agriculture, *(iii)* workshops on cultural and economic empowerment, and *(iv)* training in pigeon pea cultivation. Workshops on empowerment centered on hygiene, nutrition, market math skills, and the use of time when deciding between foraging and farming. After a baseline survey, we assigned the treatment to 18 villages selected at random. The other 18 villages (the controls) received pigeon peas plus a short verbal introduction on how to grow pigeon peas, but without workshops or training in the use of pigeon peas. To minimize possible resentment between people in villages receiving the treatment and people in villages excluded from the treatment, we gave workshops to people in the control villages at the end of the study. The trial allowed us to deepen our understanding of the Tsimane’ way of life, and to build trust with villagers who would later be part of the panel study.

 Like other panel studies in the behavioral sciences, TAPS did not start as a panel. Rather, the idea jelled slowly during the formative years of the study as we realized that the effects of modernization and market exposure on well-being would be better tracked quantitatively if done over time, rather than over space. The initial six-quarter panel study of the villages of San Antonio and Yaranda prepared us for what would be required of a longer panel. Drawing on our previous work, and taking into account concerns of safety and costs, we selected 13 villages along the Maniqui River for the panel study. The villages extended from Campo Bello near the market town of San Borja up to the village of Yaranda. The 13 villages chosen for the panel had been part of both the study with 58 villages to test the external validity of the comparative study of two villages, and of the experiment with pigeon peas. Thus, we had good ethnographic and quantitative information on the villages for the baseline study. Our specific aim was to measure annually indicators of well-being from the same people, households, and villages.

***Topics covered***. Table 1 contains a summary of the core topics covered in most of the annual surveys. Using the same protocol of data collection, surveyors collected annual information on the following topics: *(1)* demography, *(2)* anthropometric indicators of nutritional status, *(3)* horticultural inputs and outputs, *(4)* uses of natural resources, *(5)* asset wealth and monetary income, *(6)* pro-social behavior, *(7)* perceived health, pregnancy, and lactation, and *(8)* substance use. As shown in Table 2, a variety of other topics were included only in some years.

[Insert Tables 1-2]

 We retained fidelity to the original protocols of data collection to enhance the validity of comparisons over time, but added new questions to: *(i)* capture changes in regional socio-economic conditions, *(ii)* improve the accuracy of measures, and *(iii)* study new topics. For instance, at the outset of the study few Tsimane’ received monetary income from the government, so we restricted measures of monetary income to cash earnings from a person’s wage labor and sale of goods. Toward the end of the panel, government conditional cash transfer programs for such things as pre-natal visits and primary school attendance had become common. As a result, we added questions to capture these new sources of monetary income, but kept the original questions about earnings.

After we started collecting panel data from the 13 villages we did three randomized-controlled trials with larger samples of villages (Table 3). Some of these studies included the villages of the panel, and all of them relied on what we had learned from the panel study and on ethnographic knowledge of the Tsimane’ to inform the trials.

[Insert Table 3]

***Implementation***. To collect data we trained a team of Bolivian university students and young Tsimane’; the latter worked as translators and research assistants. Annual data collection was done by at least two survey teams, each composed of at least one university student and one Tsimane’, each team working in a different village. To facilitate the administration of research projects done by the TAPS team, Huanca in 2006 led the creation of a non-governmental organization (Centro Boliviano de Investigación Socio-Integral; CBIDSI) headquartered in the town of San Borja. Huanca was responsible for implementing the panel surveys and for keeping the Tsimane’ Council updated of TAPS’s work.

Annual surveys took place during the dry season (May-August). The teams stayed in a village for 7-10 days and canvassed all households in each of the villages participating in the panel. Surveys took place in the participant’s home and lasted about two hours per household. We took anthropometric measures during 1-2 days in the village school, with all villagers invited to attend. While in the village, the team tried to find missing participants by re-visiting their homes after the first attempt to interview them, but – except for the 2005 and 2006 surveys -- we did not track attriters who left the 13 villages of the panel.

In repayment for their goodwill and time, we gave goods and services to individuals, households, villages, and the Tsimane’ Council. *Individuals*: During each survey we gave a different basket of goods to the female and to the male household head. The value and composition of goods changed over the study, but was equivalent to at least a half day’s wage. During the final surveys the market value of goods given to household heads amounted to 31 *bolivianos* for a woman and 42 *bolivianos* for a man, a fair compensation since the daily wage for rural unskilled workers in the area in 2010 was 50 *bolivianos* (1 US dollar ≈ 7 *bolivianos*). Children received pencils, erasers, and notebooks, and all participants received cookies and soft drinks after we took their anthropometric measures. *Households*: During the annual surveys we did not compensate the entire household, but during 2001-2002 and 2005-2007 we gave each household pigeon peas and chicks. *Villages*: Each village received two soccer balls during the annual visit. Other ways of compensating villages included giving them a map of their village, a book on local plant knowledge ([Reyes-García, Nate, & Ista, 2001](#_ENREF_70)), and booklets on the cultivation of pigeon peas ([Huanca, Reyes-García, & Vadez, 2002](#_ENREF_43), [2003](#_ENREF_44)). *Tsimane’ Council*: There was no annual compensation to the governing body of the Tsimane’, but we helped them prepare documents for the government and project proposals, and supplied them with computers, printers, and maps of the Tsimane’ territory.

A problem common with the successful implementation of panel studies is panel fatigue. Study participants get tired of answering the same questions year after year. This produced at least three outcomes. First, some Tsimane’ refused to take part in some of the later surveys. Second, expectations of payment for taking part in the surveys increased and made the panel costlier. Third, some study participants might have answered “no” when asked about branching questions because they knew that answering “yes” would lead to more questions.

During our presence in the field the volume of research by the TAPS team, by other research teams, by development agencies, and by public agencies increased. The increased volume put a strain on the Tsimane’ Council’s ability to monitor work in progress in the Tsimane’ territory. The increasing volume of research among the Tsimane’ led the Tsimane’ Council to establish new formalized procedures for granting permission to work in the area. Through the new procedures they enhanced the transparency and accountability of researchers and organizations working in their territory. Furthermore, the frequent shifts in the leadership of the Tsimane’ Council made it necessary for outsiders working in the area to re/communicate the purpose and results of their activities to the Tsimane’ Council.

***The sample***. The baseline sample included all people (n=1,453) residing in the 13 villages during 2002 when the study began (Table 4). The baseline sample included 633 adults ≥16 years of age and 820 children <16 years of age. Since the adult Tsimane’ population at the start of the study numbered ~5,000-8,000, our sample of 633 adults captured ~8-12% of the adult population. The only people excluded from the surveys were the physically handicapped and those unwilling to participate. The baseline sample expanded after 2002 to include new arrivals into the 13 villages of the panel. New arrivals included newborns, people who moved into the villages of the panel at marriage, or those who returned after being absent. The total sample of people and households grew by an annual rate of 3.16% and 4.61%. Since we undertook supplementary studies beyond the 13 villages of the panel study, often using the same survey questions used in the panel, the supplementary data should allow users of the panel data to assess the external validity of some findings from the panel.

[Insert Table 4]

Panel attrition took several forms (Table 5). Temporary attriters were surveyed at baseline or during the first year they moved into a village of the panel study, but were not surveyed in all subsequent years because they: *(i)* temporarily moved to a settlement outside of the villages of the panel but returned and were surveyed again, or *(ii)* declined to be interviewed during some of the later years for some of the reasons noted earlier. Permanent attriters were those who left the panel after the first time we surveyed them, never to be surveyed again, either because of death, permanent out-migration beyond the villages of the panel, or because they declined to participate in all later surveys.

[Insert Table 5]

Table 5 shows that of all study participants during 2002-2008, 53.8% left temporarily and 7.5% left permanently. We limit the analysis of attrition in Table 5 to 2002-2008 because we cannot assess temporary attrition for the last two years of the panel. To assess if permanent attriters differed from the rest of the sample, during 2005 and 2006 we surveyed villagers from the panel who had moved to a common albeit distant village of destination outside of the Maniqui River basin. The 2002-2010 data for public use includes information for the attriters measured during 2005 and 2006; the additional information should allow users to test for attrition bias when using 2002-2010 panel data from the 13 villages.

***Measure of time-varying variables in all nine years***. The panel includes a total of 829 variables about individuals (e.g., body weight), 219 variables about households (e.g., area of forest cleared), and 95 variables about villages (e.g., village-to-town travel time). Many of the variables (e.g., sex; village of birth) were measured only once because they did not change. Some variables were not measured annually because TAPS researchers only needed them during some years (Table 2). The uniqueness of our panel lies in having repeated measures of social, economic, and biological variables, all collected at the same time. For brevity we next discuss only time-varying variables measured during all years of the panel.

*Variables that refer to individuals*. We addressed most survey questions to adults, whom we defined as people ≥ 16 years of age, or younger if they headed a household. We chose 16 years of age as a cut-off to define an adult because Tsimane’ form new households at about that age. Some questions or protocols required that we collect information from people <16 years of age. In such cases, we directed questions to the child’s principal caretaker, typically the child’s mother.

 *Credit, monetary income, and barter (adults)*. When asking about credit, monetary income, barter, and credit we told adults to report separately the amounts for the last seven days and for the last 8-14 days. Breaking up the recall period into two discrete slots allowed us to test for telescoping bias. Questions about monetary income centered on earnings from wage labor and on earnings from the sale of goods. Questions about barter centered on the items and value of goods received, and questions about credit referred to the amount of money borrowed from any source.

 *Wealth in physical assets (adults and households)*. At the outset of the study we identified a basket of physical assets that seemed to capture the spectrum of asset wealth of households. The assets in the basket ranged from assets that only better-off villagers owned (e.g., cattle) to assets most villagers owned (e.g., woven bags). The goods in the basket included industrial products (e.g., metal knives, shotguns), goods made from local materials (e.g., canoes, arrows), and domesticated animals (e.g., chickens, pigs). We did not distinguish between the size and the quality of the assets. During the annual surveys we asked adults to report the number of physical assets they owned from the basket. Because children owned some assets from the basket (e.g., chickens), we also collected data on asset wealth for the entire household, but only asked questions about the wealth of the entire household after having asked adults about their wealth. Wealth data is reported for individuals and for the entire household, in the raw units of the asset (e.g., number of *machetes*). In addition, we also report the monetary value of the asset in *bolivianos*, with village selling prices or town buying prices used to impute values. For example, if a person reported owning three chickens and the village selling price for a chicken was 25 *bolivianos*, then this person was imputed a value of 75 *bolivianos* for the three chickens owned irrespective of the age or the condition of the chickens.

*Perceived health (all) and pregnancy and lactation (adult women)*. Either directly or through a proxy respondent, we asked all study participants about illnesses, symptoms of illnesses, and about the number of bed-ridden days during the seven days before the interview, and during the 8-14 days before the interview. We also asked about their perceived health at the time of the interview compared with their health a year before the interview. We asked women whether they were pregnant and lactating, and, if lactating, about the number of months they had been lactating.

*Substance use (adults).* We asked adults how much and how often they had consumed coca leaves and cigarettes during the seven days before the interview.

*Pro-social behavior (adults)*. To gauge the social support available to an adult in case of mishaps, we asked adults if they would have access to 100 *bolivianos* in an emergency. We measured pro-social behavior through the number of gifts and the amount of labor help given to others during the seven days before the interview.

*Anthropometrics (all)*. Following standard protocols ([Lohman, Roche, & Martorell, 1988](#_ENREF_47)) we measured standing height, body weight, skinfold (triceps, biceps, subscapular, and suprailiac), hip and waist circumference, and body fat. From the raw data we computed and include in the data set for public use sex-specific and age-specific Z-score reference values recommended for international comparisons ([De Onis et al., 2007](#_ENREF_17); [Frisancho, 2008](#_ENREF_27); [WHO, 2006](#_ENREF_93)).

*Variables that refer to the entire household*

 *Agriculture.* We asked the male household head (or the female household head if the male household head was absent) to report the area of old-growth forest and fallow forest cleared for horticulture the previous year, the number of plots cleared, the area planted with plantains and manioc, and the provenience of the rice and maize seeds they had used for sowing.

 *Food consumption.* We asked the female household head to report the household consumption of a basket of food items during the seven days before the interview. The basket included foods from the market (e.g., oil, sugar), local crops (e.g., maize, manioc), meat and products from domesticated animals (e.g., ducks, eggs), and wildlife (e.g., fish). For each food item, we report the units (e.g., kilograms), the total quantity consumed by the household, and the monetary value in *bolivianos* of the total quantity of the item, with village or with town buying prices used to impute values.

*Variables that refer to the village*

*Attributes*. We asked village authorities or teachers about the number of caregivers (e.g., traditional healers), households, and selected physical assets in the village. During the early years of the panel, these assets were likely to be owned by the village rather than by individuals, and included goods such as ham radios and outboard motors for canoes. Other village attributes included the costs of transport to the nearest road or town, and travel time to the nearest town. Travel time turned out to be a time-varying variable owing to improvements in transport infrastructure and transport technology during the life of the panel.

*Prices*. We asked about the village selling or buying price of crops and assets. We used village selling prices to calculate the value of wealth in physical assets, and we used village (or town) buying prices to calculate the value of household food consumption. If a village lacked a price for a good, we imputed the price from nearby villages. If the price was still missing, we imputed the price from a nearby town. These different prices are indicated in the data so users do not have to be bound by our imputation technique.

Appendix B contains an explanation of how we named variables. The naming convention makes it easy for users to identify the entity (e.g., individuals) to which the variable refers, the topic (e.g., health) covered by the variable, and the years we measured the variable. The data dictionary is in a separate Excel file entitled, TAPS DATA DICTIONARY, with variables grouped by whether they refer to people, households, or villages. Some variables include notes, which we added to clarify definitions or to alert users of measurement errors; the notes can be read using the Stata data file.

***Raw and transformed variables***. Most of the variables for public use are presented in their raw (albeit clean) form. Three exceptions include: *(i)* Z scores of anthropometric variables, *(ii)* variables for which we had to compute summary values, and *(iii)* variables about age and education or maximum school grade achieved. *(i)* Z scores are included along with other anthropometric variables; Z scores are easily identified because the name of the variable includes the letter “z” (e.g., ianbazY234567890: BMI-for-age Z-score (children 0-19 years), WHO reference). The raw anthropometric variables are included along with the Z-scores. *(ii)* Appendix C contains a discussion of the rationale for including summary rather than values for some variables. *(iii)* Original measures of reported age and maximum school attainment contain numerous inconsistencies. For this reason Zhang wrote computer programs to make the age variable consistent across years and tried to correct some of the inconsistencies with the education variable. The steps she took to correct these variables and the name of the new variables are described in Appendix E.

***Findings: Substantive and methodological***. Although we have publications using data from the panel, we have tended to treat the data as a cross-section rather than as a panel. TAPS researchers and researchers unaffiliated with TAPS have been unable to fully exploit the panel dimensions of the study because data cleaning was finished in February 2015. As a result, after ~20 years of work researchers are only now in a position to use the panel to study changes. A recent book in Spanish by Reyes-García and Huanca ([2014](#_ENREF_69)) contains a summary of TAPS’s work.

*Substantive*. Analysis of short panels (e.g., 2002-2006, 2002-2007) suggests that stunted children are catching up ([R. A. Godoy et al., 2010](#_ENREF_33); [Tanner, Leonard, Reyes-Garcia, & TAPS, 2014](#_ENREF_84)) but also suggests that stunting is associated with later measures of arm muscularity and body fatness among youth ([Tanner et al., 2014](#_ENREF_84)). Market exposure and modernization have improved individual well-being ([R. A. Godoy et al., 2009](#_ENREF_34)) but put increasing pressure on animal wildlife ([Ricardo A. Godoy et al., 2010](#_ENREF_36)). Findings also suggest that households are resource constrained as evidenced by the fact that sibling composition is associated with anthropometric indicators of nutritional status ([Magvanjav et al., 2013](#_ENREF_48)). In an early study we found that patient and impatient people accumulated different forms of human capital ([Reyes-García et al., 2007](#_ENREF_63)). Repeated cross-sectional surveys and panel data suggest that Tsimane’ adults experienced a net decrease in reported plant use that ranged from 1%/year for women to 3%/year for people living near market towns ([Reyes-Garcia, Gueze, Luz, Macia, et al., 2013](#_ENREF_67)). We have also found that people who live closer to their cultural ideal have better psychological health ([Reyes-Garcia, Gravlee, McDade, Huanca, Leonard, & Tanner, 2010](#_ENREF_65)) but do not have better nutritional status ([Reyes-Garcia, Gravlee, McDade, Huanca, Leonard, Tanner, et al., 2010](#_ENREF_66))

 *Methodological*. People reported accurately the amount of forest cleared ([Vadez et al., 2003](#_ENREF_89)) but they reported inaccurately other types of data. For instance, we found forward telescoping bias and omission bias when reporting the value of monetary income and barter, and the frequency of illness during the two weeks before the day of the interview. We also found random measurement error in variables such as reported age, own and parental education ([Ricardo A. Godoy et al., 2008](#_ENREF_35)), height and weight ([Ricardo A. Godoy et al., 2008](#_ENREF_35)), and math skills ([Undurraga et al., 2013](#_ENREF_87)). The panel allowed us to develop and refine methods to measure the theoretical and practical dimensions of local ecological knowledge ([Reyes-García et al., 2006](#_ENREF_72)).

***Training***. Using the villages of the panel, TAPS ran a summer field school on methods of data collection during 2004-2011 for PhD students in anthropology at USA universities, and, some years, for students from European universities. We trained 46 PhD students from USA universities as part of the program. Fourteen PhD students, 21 MA students, and eight undergraduate students have used TAPS data for their theses.

***Weaknesses***. *First*, the panel included too many variables, and would have benefitted from a sharper focus on fewer outcomes. *Second*, the training of field staff was not as systematic as it could have been. For example, after initially training the field staff to take anthropometric measures and do surveys, TAPS did not have a consistent policy of refresher courses for its surveyors or translators. TAPS did not a metric to ensure surveyors and translators understood well the tasks before being sent to the field. *Third*, we were lax on participant attrition. Except for 2005 and 2006, we did not pursue attriters who moved out of the study area. *Fourth*, our presence most likely affected behavior. For reasons discussed earlier, we offered goods and services to villagers during our annual visits. In addition, some of the randomized controlled trial assigned treatments (e.g., new farm technologies) to villages, households, and individuals (Table 3). *Last*, the panel lacked a control group, so we cannot tell whether changes taking place in the panel are unique to the panel, or whether they reflect regional changes.

***Strengths***. *First*, survey information has been made available to the public as soon as it was clean. Other than signing a short release form, researchers worldwide have had access to the data from the study’s outset. This contrasts with data from some longitudinal studies in anthropology, which can no longer be found or which are so poorly documented as to make them inaccessible to third-party users ([G. M. Foster et al., 1979](#_ENREF_22)). *Second*, the panel contains multiple measures of social, economic, and biological variables that vary over time. The variables allow users to examine the two-way relation between changes in biological and changes in socio-economic variables, thereby moving beyond the common approach in past anthropological panel studies of viewing changes in biological outcomes as a function of only baseline conditions. *Third*, one can use the data as a nine-year panel to measure changes taking place while the study unfolded, but one can also use it as a baseline with multiple observations against which to compare outcomes in the future, and thus assess changes beyond the life of the panel. *Last*, the study was grounded in a strong ethnographic understanding of Tsimane’ culture and of the changes taking place in Tsimane’ society.

 The panel has contributed to studies beyond the life of the panel and beyond the Tsimane’ territory. For example, cross-cultural comparisons that include the Tsimane’ have examined the effect of ethnobotanical knowledge on health ([Gómez-Baggethun, Corbera, & Reyes-García, 2013](#_ENREF_37)), short-term stress responses ([Nyberg, 2011](#_ENREF_53)), math learning ([Piantadosi, Jara-Ettinger, & Gibson, 2014](#_ENREF_58)), olfactory sensitivity ([Sorokowska, Sorokowski, Hummel, & Huanca, 2013](#_ENREF_82)), and musical preferences ([McDermott, Schultz, Undurraga, & Godoy, 2015; under review](#_ENREF_50)). Still, less research has been done to compare the Tsimane’ with neighboring indigenous groups that have longer histories of market exposure. This represents a future direction for research to tease apart the more subtle distinctions between different paths of indigenous integration to the market economy.

***Comparison with other panel studies to measure modernization in anthropology***. Panel studies conceived and executed by anthropologists to study the effects of modernization in non-industrial rural societies are rare (Table 6). Cultural anthropologists have done many long-term ethnographic studies overseas ([Firth, 1990](#_ENREF_21); [G. M. Foster et al., 1979](#_ENREF_22); [Kemper & Royce, 2002](#_ENREF_45); [Vogt, 1994](#_ENREF_90)), but with one exception, these studies do not qualify as panels as defined earlier ([Gravlee, Kennedy, Godoy, & Leonard, 2009](#_ENREF_39)). The only longitudinal ethnographic study to have also collected repeated quantitative measures from the same entities – people, households, and communities -- is the Gwembe study in southern Zambia. Clark et al. ([1995](#_ENREF_13)) analyzed demographic data gathered on six occasions during 1956-1961 from four communities. Clark and his co-workers pooled their data across the four communities to enlarge the sample size for each of the six time periods, and estimated demographic trends for the mean of their entire sample, turning what could have been a panel study of four communities into a time-series analysis of one ethnic group over time.

[Insert Table 6]

Although we found no panel study headed and entirely implemented by cultural anthropologists, we found one panel study where cultural anthropologists played a prominent role as part of multidisciplinary teams. In rural Ecuador, Trostle et al. assessed the impact of road construction on diarrhea among rural and town dwellers ([Eisenberg, Cevallos, Ponce, & al., 2006](#_ENREF_18); [Markovitz et al., 2012](#_ENREF_49)). Focused on ~24 villages varying in town propinquity, researchers collected information from all villagers about diarrhea, sanitation, hygiene, human capital, social networks, occupation, anthropometry, and migration, and tracked them weekly for 176 consecutive weeks (February 2004-July 2007). Between 2003 and 2013 they also collected information about household attributes every 1-2 years. Some of their data has been used as a cross-section, and some has been aggregated as a panel of ~21 villages.

We found only three panel studies in biological anthropology to assess the impact of modernization. The Solomon Island study took repeated measures of many bio-medical outcomes among seven societies in the Solomon Island and Papua New Guinea ([Damon, 1974](#_ENREF_16)). To our knowledge their data does not contain repeated measures of social, economic, or cultural variables. The authors constructed an index of modernization at the start of the study, with each of the seven ethnic groups assigned a value from the index, and then estimated how bio-medical outcomes varied in relation to the baseline index of modernization ([Friedlaender, 1990](#_ENREF_24), [2009](#_ENREF_25), [1987](#_ENREF_26); [Lot B. Page, Friedlaender, & Moellering, 1977](#_ENREF_55)). When treating their data as a panel, the Solomon Islands Project has used biological predictors for biological outcomes. In 2002 in the Brazilian Amazon, Piperata et al. ([2011](#_ENREF_60)) measured anthropometric indicators of 204 people and socio-economic indicators of their households (n=49). In 2009 Piperata and her co-workers repeated the measures from the same sample. Their study is unusual because they used regression analyses to correlate changes in anthropometric outcomes with changes in socio-economic covariates. As part of the same study, Piperata et al. ([2011a](#_ENREF_59)) measured dietary changes among 20 adult women. Because of the small sample size they limited the analysis to a statistical description of dietary changes and, for each of the two years, they correlated levels of diet with manioc cultivation. Last, Shephard and Rode ([1996](#_ENREF_81)) measured every ten years (1969-70, 1979-80, and 1989-1990) many anthropometric and human-biological outcomes among Inuit adults in one community of Canada. They also measured anthropometric outcomes and handgrip strength for children twice a year during 1981-1989. The study is unusual for its duration but the authors never seemed to have exploited the panel dimensions of their sample. Rather, they analyzed their pooled data as repeated cross-sectional data, with larger samples in each of the later surveys. They use their panel mainly to analyze secular trends of bio-medical outcomes, with age and period of birth as covariates. It is not clear from their work whether their analysis includes only people who were measured on repeated occasions, or both members of the baseline sample plus any adult who moved into the community.

Like cultural anthropologists, biological anthropologists have taken part in multidisciplinary panel studies. These studies have focused on human growth, inter-generational nutrition, food insecurity, and diet changes rather than on modernization. Some of the better-known studies have taken place in the Philippines ([Adair et al., 2011](#_ENREF_1)), Brazil ([Béhague, Goncalves, Gigante, & Kirkwood, 2012](#_ENREF_6); [Béhague, Goncalves, & Victora, 2008](#_ENREF_7); [Piperata et al., 2011a](#_ENREF_59)), Ethiopia ([Belachew, Lindstrom, Hadley, Gebremariam, & Kasahun, 2013](#_ENREF_8)), South Africa ([Radin & Cameron, 2012](#_ENREF_61); [Richter, Norris, Pettifor, Yach, & Cameron, 2007](#_ENREF_73)), and China ([Gordon-Larsen et al., 2014](#_ENREF_38)).

 Beyond anthropology, development economists have been collecting socio-economic panel data from villagers in several non-industrial nations ([Harpham, Huttly, Wilson, & De Wet, 2003](#_ENREF_40)). Some of the better-known studies have taken place in Ethiopia ([Caeyers & Dercon, 2013](#_ENREF_10)), India ([Badiani & Dercon, 2007](#_ENREF_4); [Townsend, 1994](#_ENREF_85)), and Thailand ([Townsend, Sakunthasathien, & Jordan, 2013](#_ENREF_86)). Although they do not focus on indigenous populations or on biological outcomes, these studies stress the impacts of market economies on the well-being of villagers. The studies come close in spirit to longitudinal studies in anthropology because they often rely on ethnographic fieldwork and because they focus on the vulnerability of the rural poor.

***Access to the complete TAPS data***. The complete annual panel data (2002-2010) made available to the public has been cleaned, appended, and merged in Stata 13. We have cleaned the panel to the best of our abilities, but realize that the data still contains measurement errors we have been unable to spot, correct, or both. As we detect and correct errors, we will make available the cleaner versions of the panel for public use. To access the data fill out the release form in Appendix D and send it to any of the following people:

Baylor University (Alan Schultz: Alan\_Schultz@baylor.edu)

 http://alanfschultz.com

Brandeis University (Ricardo Godoy: rgodoy@brandeis.edu)

<http://heller.brandeis.edu/sustainable-international-development/tsimane/index.html>

Northwestern University (William Leonard: w-leonard1@northwestern.edu)

<http://www.anthropology.northwestern.edu/people/faculty/leonard.html>

Universidad Autónoma de Barcelona (Victoria Reyes-García: victoria.reyes@uab.cat) http://icta.uab.cat/Etnoecologia/proyecto.php?Id\_proyecto=60

University of Georgia (Susan Tanner: stanner1@uga.edu; Asher Rosinger: rosinger@uga.edu; www: asherrosinger.com)

Users who need the raw data, or who need some of the data not currently included in the panel (e.g., scan data) should contact Ricardo Godoy: rgodoy@brandeis.edu.

Fig 1. Map showing villages of the TAPS panel study, department of Beni, Bolivia



***Table 1. Summary of core topics and variables measured annually during most years, 2002-2010***

|  |  |  |
| --- | --- | --- |
| *Level or entity & Topic* | *Approximate # of variables* | *Example of variable* |
| **Individual** (*italics=only adults*) |
| *Credit*  | 7 | Money owed to others |
| *Addiction* | 5 | Commercial alcohol/cigarette consumption last week |
| Anthropometrics | 27 | Standing height, body weight |
| Demography\* | 35 | Age, birth place, travel frequency to towns |
| *Expenditures &* *barter*  | ~70 | All monetary expenditures in last 14 days and year; value of goods received in barter |
| Human capital | 5 | Tests of reading and math; assessment of Spanish spoken fluency; schooling level |
| Perceived health | 4 | All symptoms and ailments experienced in last 14 days |
| *Emotions* | 18 | Frequency of emotions (e.g. anger) last week |
| *Monetary income* | 18 | Monetary earnings from sales and wage labor, and remittances received |
| *Shocks* | 14 | Mishaps experienced in last year & ways of coping with mishaps |
| *Pro-social*  *behavior* | 19 | Gifts given/received last week |
| *Assets* | 48 | # of bows or cooking pots owned by person |
| **Household** |
| Agriculture | 30 | Forest area cleared previous year |
| Food consumed | 31 | Basket of food items consumed in last 7 days |
| Assets | 48 | Total bows or chickens owned by entire household |
| **Village** |
| Prices | 23 | Market prices for basket of assets and foods |
| Attributes | 11 | # households, teachers; village-town travel time |

***\****Some of these variables were only measured once (e.g., birth place, sex)

***Table 2. Summary of topics measured occasionally in the TAPS panel***

|  |  |  |
| --- | --- | --- |
| *Level or entity* | *Topic* | *Years* |
|  |  |  |
| Individual | Local ecological knowledge of |  |
|  | Plants | 2002, 2003, 2005, 2006, 2007 |
|  | Parasites | 2007 |
| (children) | Fecal samples, parasite detection and treatment | 2003, 2007 |
|  | Cultural orientation | 2002, 2007 |
|  | Encroachment | 2002 |
|  | Vaccination history | 2002 |
|  | Time allocation via scans or spot observations\* | 10/2002-8/2003 |
|  | Pigeon pea cultivation | 2003-2007 |
|  | Household decision making | 2004 |
|  | Correlates of happiness/sadness | 2004 |
|  | Perceived parental height | 2005 |
|  | Status, trust | 2005 |
|  | Regret | 2005-2006 |
|  | Perceived beauty | 2006 |
|  | Siblings, mortality, marriage, residence | 2007 |
|  | Blood pressure and pulse rate | 2007 |
|  | Aspirations for offspring | 2010 |
| Household | Pigeon pea cultivation | 2003-2007 |
|  | House construction | 2002 |
|  | House position (GPS)\* | 2007 |

[\*] Not included in the panel available to the public.

***Table 3. Randomized-controlled trials done by TAPS team with Tsimane’***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Years* | *Outcome* | *Intervention* | *Villages included:* | *Data availability* |
| *TAPS* | *Total* |
| 2007-09a | Map village lands | Participatory mapping of village lands | Yes | 32 | Yes; UAB |
| 2008-09b | Child & adult health | Unconditional food transfers to all households in village or to poorest 20%  | No | 40 | Yes; Brandeis |
| 2010-11c | Savings | Locked boxes with and without keys | Yes | 59 | Pending |

*Notes*:

[a] Data is available at <http://icta.uab.cat/Etnoecologia/proyecto.php?Id_proyecto=1> and the trial is described by Reyes-García et al. ([2012](#_ENREF_71)).

[b] The trial is described in Undurraga et al. ([2013](#_ENREF_87)) and the data is available at:

<http://heller.brandeis.edu/sustainable-international-development/tsimane/index.html>

[c] At the time of this writing (February 2015) the analysis has not yet been completed. Currently the data is housed at Innovations for Poverty Action (IPA, Yale) and at Brandeis (rgodoy@brandeis.edu)

***Table 4: Unique sample size of individuals, households, and villages at baseline (2002) and additions (2003-2010)***

|  |  |  |  |
| --- | --- | --- | --- |
| *Year* | *Individuals* | *Households* | *Villages* |
| *Adult (≥16)* | *Children(<16)* | *Total* |
| Baseline | 2002 | 633 | 820 | 1453 | 245 | 13 |
| Additions | 2003 | 28 | 78 | 106 | 10 | 13 |
|  | 2004 | 34 | 128 | 162 | 24 | 13 |
|  | 2005 | 41 | 111 | 152 | 23 | 13+ (1) |
|  | 2006 | 21 | 97 | 118 | 28 | 13+ (1) |
|  | 2007 | 9 | 74 | 83 | 14 | 13 |
|  | 2008 | 35 | 122 | 157 | 33 | 13 |
|  | 2009 | 26 | 109 | 135 | 15 | 13 |
|  | 2010 | 36 | 147 | 183 | 23 | 13 |
| Total without repeats | 863 | 1686 | 2549 | 415 | 13 (14) |
| Annual growth rate 2003-2010 | -1.08% | 4.34% | 3.16% | 4.61% | 0 |

*Note*: In 2005 and 2006 we included a village that attracted permanent attriters from the panel.

***Table 5: Annual sample size and attrition rate***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Person entered panel in*  | *n &* *(%)* | *Total n & (100%)* | *Attriters:* | *Non-attriter**n & (%)* |
| *Temporary* | *Permanent* |
| 2002 | n | 1453 | 858  | 74  | 521  |
|  | (%) | (100) | (59.1) | (5.1) | ( 35.9) |
| 2003 | n | 106 | 55  | 17  | 34  |
|  | (%) | (100) | (51.9) | (16.0) | (32.1) |
| 2004 | n | 163 | 80  | 21  | 62  |
|  | (%) | (100) | (49.1) | (12.9) | (38.0) |
| 2005 | n | 155 | 77  | 21  | 57  |
|  | (%) | (100) | (49.7) | (13.5) | (36.8) |
| 2006 | n | 118 | 61  | 10  | 47  |
|  | (%) | (100) | (51.7) | (8.5) | (39.8) |
| 2007 | n | 83 | 30  | 6  | 47  |
|  | % | (100) | (36.1) | (7.2) | (56.6) |
| 2008 | n | 158 | 42  | 19  | 97  |
|  | (%) | (100) | (26.6) | (12.0) | (61.4) |
| 2009 | n | 135 | na | 30  | 105  |
|  | (%) | (100) | na | (22.2) | (77.8) |
| 2010 | n | 184 | na | na | 184 |
| Total (2002-2008) | n | 2236 | 1203 | 168 | 865 |
|  | (%) | 100 | 53.8 | 7.5 | 38.6 |

*Note*: na = not applicable. Temporary attriters were people who left the panel but returned. Permanent attriters were people who were only measured when they entered the panel, and never measured again.

***Table 6. Panel studies conceived and executed by anthropologists in non-industrial rural societies***

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Study name &**Main reference* | *Country* | *Societies* | *Cohort age* | *Years & frequency (t)* | *Baseline sample* | *Attrition* | *Outcome* | *Time-varying covariates* | *Data for public use & (requests)* |
| ***I*** | ***II*** | ***III*** | ***IV*** | ***V*** | ***VI*** | ***VII*** | ***VIII*** | ***IX*** | ***X*** |
| **Cultural** |
| **[1]** Gwembe | Zambia | Tonga | All | 1956/7, 1962/3, 1972/3, 1981/2, 1978/8, 1992 (6) | 10000i, 4c | NA | Demography*a* | Survey date*b* | Demography; (0)  |
| **[2]** Environmental change and diarrheal disease: A natural experiment | Ecuador | Smallholders, town dwellers, & Chachis | All | 2003-13; 1 observation/village;2/18/2004-7/4/07, weekly (~3; 176 weeks)a | 4196i, 21c | 23%c | Diarrhea & three marker pathogens | Household network, exposure, hygiene, wealth, demographicsa | Someb; (2) |
| **[3]** TAPS | Bolivia | Tsimane’ | All | 2002-10; annual (9) | 1453i, 13c | Table 5 & text | Many bio-social | Wide range | All; (~100) |
| **Biological** |
| **[1]** Solomon Islands (SI)**[1a]****[1b]** | PNG, SI | Nasioib, Nagovisi, Aita, Lau, Baegu, Kwaio, Ulawa, Onton Java | 0-19 y | 1966-72 & 1985-86 (2) | 1710 | 34% | Lipids | Anthropometricsa | See note below; (2) |
| 1966-72, 1978-80, 1985-86 (3) | 294a2a1 | 45% | BMI | Anthropometricsa |
| Blood pressure | Age, muscle, adiposity, height |
| **[2]** Ribeirinhos Longitudinal Study**[2a]** | Brazilian Amazon | Mixed ethnicity river dwellers | 0-77 | 2002 & 2009 (2) | 469 | 56% | ∆ in HAZ, WHZ, BMIZ, ZTSF, ZUMA | ∆ in cash income, schooling, farming, | See note below; (0) |
| 16-59 | 30 | 33% | ∆ in diet | Manioc cultivation |
| **[3]** IBP-HAP**[3a]** | Canada | Inuit | Adults, 20-69 | 1969-70, 1979-80, 1989-90 (3) | 118i1c | NAa | Many biological outcomes | Age,  | Unavailable |
| School age 5-17 | 1981-89 (2/year) | 547i1c | Height, BMI, skinfold, handgrip | Age |

i=individuals, c=communities. X=# of requests by third parties unaffiliated with study.

Table 6 – continued

**Cultural:**

**[1]** Clark et al. (1995). a***=***Demography = dates of birth, marriage, deaths, divorce, and migration. b=Wealth and education are coded but still not available to the public.

**[2]** Eisenberg et al.([2006](#_ENREF_18)) and Markovitz et al. ([2012](#_ENREF_49)). a=Diarrhea data collected weekly, but covariates collected every 1-2 years. b=Data collection finished in 2013; the complete data set is not yet available to the public. c = Since the study started with 21 villages, but 5 villages were dropped in 2009, we estimate the gross attrition rate at 23%. During 2004-08 they conducted 11 surveys with a total of 4196 individuals. Of these, 13% were surveyed only once, 27% were surveyed 2-4 times, and 46% were surveyed seven or more times (J. Trostle personal communication).

**Biological**:

**[1]** Weitz et al. ([2014](#_ENREF_91)).a=Baseline height-for-age and BMI-for-age Z scores and subscapular skinfolds. b=The baseline surveys of the 8 societies differed; 2 were done in each of the following years: 1966, 1968, 1970, and 1972, making it an unbalanced panel. The data is available to qualified users via Professor Jonathan Freidlaender, Temple U, Philadelphia.

**[1a]** Weitz et al. ([2012](#_ENREF_92)). a=Baseline height-for-age Z score.

**[1b]** Page and Friedlaender ([1987](#_ENREF_54)).

**[2]** Piperata et al. ([2011](#_ENREF_60)). Data is not available for public use at the time of this writing (February 2015) but might be made available to qualified users in the future.

**[2a]** Piperata et al. ([2011a](#_ENREF_59))

**[3]** Shephard and Rode ([Rode & Shephard, 1994](#_ENREF_76); [1996](#_ENREF_81)). International Biological Program Human Adaptability Project. Upper age bracket varies by the outcome measured. The main outcomes were related to physical fitness and included such things as skinfold, BMI, handgrip and knee extension force, and hemoglobin. a = They do not report attrition but they note that only 50% of the adults (usually the more physically fit) volunteered.

**[3a]** Shephard and Rode ([1995](#_ENREF_80)). The authors do not report the initial sample size or the attrition rate.

**Appendix A: Bibliography of refereed journal publications in English on the Tsimane’ by**

**TAPS team, including results from exploratory studies (1997-2001)**

2014

Tanner S, Leonard WR, Reyes-García V, and TAPS Bolivia Research Team. *The consequences of linear growth stunting: Influence on body composition among youth in the Bolivian Amazon*. American Journal of Physical Anthropology 153(1):92-102.

Tanner S, and TAPS Bolivia Research Team. *Health and disease: Exploring the relation between parasitic infections, child nutrition status, and markets.* American Journal of Physical Anthropology 155(2):221-228.

Fernández-Llamazares, Á., Díaz-Reviriego, I., Méndez-López, M.E., Sánchez, I.V., Pyhälä, A., Reyes-García, V. *Cambio climático y pueblos indígenas: Estudio de caso entre los Tsimane', Amazonía boliviana*. REDESMA Online Journal, 7, 110-119. ISSN : 1995-1078.

Guèze, M., Luz, A.C., Paneque-Gálvez, J., Macía, M.J., Orta-Martínez, M., Pino, J., Reyes-García, V. *Are Ecologically Important Tree Species the Most Useful? A Case Study from Indigenous People in the Bolivian Amazon*. Economic Botany. 68(1):1-15.

Riu-Bosoms, C., Vidal, T., Duane, A., Fernández-Llamazares, Á., Guèze, M., Luz, A.C., Paneque-Gálvez, J., Macía, M.J., Reyes-García, V. *Exploring Indigenous Landscape Classification across Different Dimensions: A Case Study from the Bolivian Amazon*. Landscape Research (e-version).

Reyes-García V., Paneque-Gálvez J., Bottazzi P., Luz A.C., Guèze M., Macía M.J., Orta-Martínez M., Pacheco, P. *Indigenous land reconfiguration and fragmented institutions: A historical political ecology of Tsimane’ lands (Bolivian Amazon)*. Journal of Rural Studies 34: 282-291.

Reyes-García V., J. Paneque-Gálvez, M. Gueze, A. C. Luz, M.J. Macía, M. Orta-Martínez, J. Pino. *Cultural Change and Traditional Ecological Knowledge: An Empirical Analysis from the Tsimane’ in the Bolivian Amazon*. Human Organization. 73(2).

Rosinger A**.** In press. *Dehydration among Lactating Mothers in the Amazon: A Neglected Problem*. American Journal of Human Biology.

Rosinger A, Tanner S. In Press**.** *Water from fruit or the river? Examining hydration strategies and gastrointestinal illness among Tsimane’ adults in the Bolivian Amazon*. Public Health Nutrition.

2013

Paneque-Gálvez, J., J.F. Mas, G. Moré, J. Cristóbal, M. Orta-Martínez, A. C. Luz,  M. Gueze, M. Macía, V. Reyes-García. [*Enhanced land cover classification in heterogeneous tropical landscapes using support vector machines and textural homogeneity*.](http://www.sciencedirect.com/science/article/pii/S0303243412002085)International Journal of Applied Earth Observation and Geoinformation. 23: 372–383.

Rosinger, Asher, Susan Tanner, William R. Leonard, and TAPS Bolivia Research Team. *Precursors to overnutrition: The effects of household market food expenditures on measures of body composition among Tsimane’ adult in lowland Bolivia*. Social Science & Medicine. 92:53-60.

Wu Zeng, et al. *Adult obesity: Panel study from native Amazonians*. Economics and Human Biology. 11:2:227-235.

Gueze, M., J. Paneque-Gálvez, A. C. Luz, J. Pino, M. Orta-Martínez, V. Reyes-García, and M. Macía*. Determinants of tree species turnover in a southern Amazonian rainforest*. Journal of Vegetation Science. 24:284-295.

Paneque-Gálvez, J., JF Mas, M Guèze, AC Luz, M Orta-Martínez, J Pino, M Macía, V Reyes-García. *Land tenure and forest cover change. The case of southwestern Beni, Bolivian Amazon, 1986-2009.* Applied Geography. 43:113-126.

Pérez-Llorente, I., J. Paneque-Gálvez, A.C. Luz, M. Guéze, J. Pino, MJ Macía, J.A. Domínguez-Gómez, V. Reyes-García. *Changing indigenous cultures, economies and landscapes. The case of the Tsimane', Bolivian Amazon.* Landscape and Urban Planning. 120:147-157.

Reyes-García V., A. C. Luz, M. Gueze, J. Paneque-Gálvez, M. Macia, M. Orta-Martínez,  J. Pino, and TAPS Bolivian Study Team. *Secular trends on traditional ecological knowledge: An analysis of different domains of knowledge among Tsimane' men*. Learning and Individual Differences. 27: 206-212.

Reyes-García V., M. Gueze, A. C. Luz, M. Macia, M. Orta-Martínez, J. Paneque-Gálvez, J. Pino, X. Rubio-Campillo. *Evidence of traditional knowledge loss among a contemporary indigenous society.* Evolution and Human Behavior. 34:249-257.

Tanner S, Rosinger A, Leonard WR, McDade TW,Reyes-García V, and TAPS Bolivia. *Health and adult productivity: The relation between adult nutrition, helminths and agricultural, hunting, and fishing yields in the Bolivian Amazon*. American Journal of Human Biology. 25 (1):123-130.

Ruiz-Mallén, I., C. Morsello, V. Reyes-García, R. Barros Marcondes De Faria. *Children's use of time and traditional ecological learning. A case study in two Amazonian indigenous societies. Learning and Individual Differences Learning and Individual Differences*. 27:213-222.

Undurraga, E. A. et al. *Savings at the periphery of markets: Evidence from forager-farmers in the Bolivian Amazon*. Journal of Development Studies. 50(2):288-301.

Undurraga, E. et al. *Math skills and market and non-market outcomes: Evidence from an Amazonian society of forager-farmers*. Economics of Education Review. 37:138-147.

Gómez-Baggethun, E & V Reyes-García. Reinterpreting change in traditional ecological knowledge. Human Ecology. 41(4):643-647. 2013.

2012

Reyes-García, V., Orta-Martínez, M., Gueze, M., Luz, A. C., Paneque-Gálvez, J., Macía J, M., Pino, J., & TAPS Bolivian Study Team. *Does participatory mapping increase conflicts? A randomized evaluation in the Bolivian Amazon.* Applied Geography. 34:650-658.

Undurraga, E., Zebrowitz, L., Eisenberg, D., Reyes-García, V., TAPS Bolivia Study Team & Godoy, R. A. *The perceived benefits of height: strength, dominance, social concern, and knowledge among Bolivian native Amazonians.* PLoS ONE. 7(5):1-10.

Zeng, Wu.., et al. *The effects of sibling composition on child educational attainment: Evidence from native Amazonians in Bolivia*. Economics of Education Review. 31:6:1017-1027.

Masferrer-Dodas, E., L. Rico García-Amado, T. Huanca, TAPS Bolivia Study Team, and V. Reyes-García. *Consumption of market goods and wellbeing in small-scale societies: An empirical test among the Tsimane' in the Bolivian Amazon*. Ecological Economics. 84:213-220..

Reyes-García V., J. C. Ledezma, J. Paneque-Galvez, M. Orta-Martínez, M. Gueze, A. Lobo, D. Guinard, T. Huanca, A.C. Luz, and TAPS Bolivia Study Team. *Presence and Purpose of Nonindigenous Peoples on Indigenous Lands: A Descriptive Account from the Bolivian Lowlands.* Society and Natural Resources. 25(3):270-284.

Morsello, C., Ruiz-Mallén I. , Montoya, M. D., Reyes-García, V. The Effects of Processing Non-Timber Forest Products and Trade Partnerships on People's Well-Being and Forest Conservation in Amazonian Societies. PLoS One. 7(8): 2012.

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**Appendix B: Naming convention of variables**

To make easier the use of the panel data, we followed a simple rule when naming variables:

* The first letter of a variable -- *i*, *h*, or *v* – indicates whether the variable refers to *i*ndividuals, *h*ouseholds, or *v*illages. For instance, we might have collected data from *i*ndividuals about their height, or from *h*ouseholds about the number of forest plots they had cleared for horticulture, or from village leaders about *v*illage prices. We merged all information about the three entities in a single row for each of the annual surveys. Variables that start with the letter *V* refer to village prices, but were created by imputing prices to villages that had missing values.
* The next 2-3 letters after the first letter indicate the topic covered under the variable. For example, a variable beginning with the prefix *hag* indicates that data about the variable came from answers by a *h*ousehold head [first letter of the variable]; the answer and data about the topic, *ag*riculture (*ag*), refers to the entire household (*h*); in this example, the topic, *ag*riculture, is abbreviated in the second-third character of the name of the variable.
* The next few letters capture sub-topics. For instances, the variable *hagareaforest* indicates that we asked a *h*ousehold head to report the *area* of *forest* cleared for *ag*riculture by the entire *h*ousehold.
* The suffixes of variables start with the letter *Y* (*y*ear), followed by digits indicating the years in which the variable was measured. For instance, the variable *ianbmiY234567890* indicates we measured the variable every year from 2002 until 2010, whereas the variable *ianlactatemonY23467* indicates that the variable was measured in 2002-2004 (inclusive) and 2006-2007 (inclusive), but not in 2005 or 2008-2010.

 The variables that uniquely identify individuals, households, villages, or survey years are: *idssnY234567890* (*i*ndividuals), *hhidY234567890* (*h*ouseholds), *vidY234567890* (*v*illages), and *yearY234567890* (*y*ear).

To find out what the variables mean, users can rely on Stata by typing the command “describe *varname*”, where *varname* is the name of the variable, or they can search the data dictionary file in Excel.

**Appendix C: Variables for which the TAPS team had to compute a summary value -- Monetary income, barter, perceived health, and pro-social behavior**

 When making the TAPS panel available to the public we had to make a decision on what unit of analysis to use. We could have averaged data and presented village-level or household-level averages for each year of the panel. Instead we decided to present data at the individual level, but merged with appropriate household-level and village-level observations for the individual during the survey year. Our choice has the advantage of presenting the data in one of its most disaggregated forms, allowing users to estimate village-level and household-level statistics of their choice. Our decision works well for individual-level variables such as body weight or age. As long as a measure or an answer to a question takes only one value at the time of the survey, using the individual as the unit of analysis works well.

 But suppose one asks people to list all their expenditures or all their sources of income, or all their illnesses during the seven days before the day of the interview, as in Table A below. Since TAPS retained fidelity to the way participants responded to questions, some people might have many entries or rows when answering questions on these topics, but others might have only one row because they had only one or no episodes to report. One cannot include separate columns or variables for each answer in the final annual panel data because the total number of columns for these questions would vary between and within years. To harmonize the responses of participants to questions where the unit of measure (e.g., all the different symptoms of illness) differs from the unit or entity of analysis (e.g., the person) so that answers to all responses fit into one row/person/year, one must make arbitrary decisions since one cannot include the raw data. Thus, since one cannot list all the specific ailments of a person in the last seven days as part of the final individual panel, one ailment in each separate column, one is forced to create a summary measure, such as the “total number of illness episodes experienced by the participant”, which is what the current TAPS data contains. The solution comes at a price. One has pigeonholed all answers to a question into a summary measure that allows analysts to use the new variable in the annual individual panel with the individual as the unit of analysis. But users who want to track the incidence of, say, self-reported respiratory illness, or the particular goods people acquire in barter or market transactions, or the monetary expenditures in particular foods bought as they earn more monetary income ([Rosinger, Tanner, Leonard, & TAPS, 2013](#_ENREF_77)), will be stymied with the current panel since they will confront a summary measure that glosses over the specifics.

 These finer-grained distinctions – the specifics that make up the average -- matter because much of the debate in cultural anthropology, medical anthropology, and ethnohistory centers on the particulars of how people and cultures change. For instance, in the ethnohistory of North America one debate has centered on whether when trading with colonists, Indians wanted beads of particular colors and shape that fitted with their traditional sense of aesthetic and religious values or whether as *homo economicus* they wanted mainly utilitarian metal tools to reduce work effort ([Axtell, 2000](#_ENREF_3); [Carlos & Lewis, 2010](#_ENREF_11); [Krech, 1999](#_ENREF_46)). In medical anthropology and in public health researchers want to know the specific ailments which gain salience as people become exposed to the market economy, accumulate more years of formal schooling, change their work habits, or earn more monetary income ([Bago D'uva, van Doorslaer, Lindeboom, & O'Donnell, 2008](#_ENREF_5); [Sen, 2002](#_ENREF_79); [Subramanian, Subramanyam, Selvaraj, & Kawachi, 2009](#_ENREF_83)). In cultural anthropology researchers want to know how different domains of local knowledge change in response to greater schooling, fluency in the national language, and employment in the formal labor market ([Reyes-Garcia, Gueze, Luz, Paneque-Galvez, et al., 2013](#_ENREF_68)). Currently one cannot use the publicly available TAPS data set to answer these finer-grained queries, despite having collected such data.

 Users interested in unbundling some of the summary variables we present should contact Ricardo Godoy. He will make available the de-identified data and the method for linking the raw data with the publicly available TAPS data.

***Table A. Example of data sets with unit of measure versus unit of analysis in answer to the question: “What illness symptoms did you experience during the last 7 days?” TAPS data available in form [2***

|  |  |  |  |
| --- | --- | --- | --- |
| [1] Unit of measure: person-symptom |  |  | [2] Unit of analysis: person |
| Person | Symptom | # days |  |  | Person | Total symptoms | Total person-days symptoms |
| 1 | Fever | 2 |  |  | 1 | 3 | 6 |
| 1 | Vomit | 3 |  | 2 | 2 | 3 |
| 1 | Pain | 1 |  | 3 | 0 | 0 |
| 2 | Rash | 2 |  |  |
| 2 | Cough | 1 |  |
| 3 | None | 0 |  |

**Appendix D: Requesting the 2002-2010 TAPS data**

Your complete name:
Title:
Organization:
Department:
Address:
Telephone:
Email:

Date:

I am interested in using the most up to date TAPS panel data set. In requesting the data I agree to the following:

1. Use the TAPS panel data set for research or educational purposes only
2. Not attempt to identify any individual, household, or community
3. Not share the copy of the data with other users who have not agreed to these confidentiality terms.
4. Any publication resulting from my request must: (a) include me as an author or as a co-author, and (b) acknowledge the Program of Cultural and Biological Anthropology of the National Science Foundation (NSF) in the USA and TAPS for making the data available.

**Appendix E: Correcting inconsistencies in age and education variables**

**by Rebecca Zhang**

 **[I]** **Estimating Age**

-only used when birthday year is not available

Problems

Many people do not know their ages. Following are some main issues with self-reported ages and years:

* Ages are not consecutive: first year John is 27 years old; second year John is 32 years old.
* Ages are not strictly increasing: first year John is 27 years old; second year John is 20 years old; third year John is 20 years old again.
* Lapse in years: John is surveyed in 2003, but John is not surveyed in 2004 or 2005. John’s information returns in 2006 and continues to the most recent year.
* When a year is skipped, age does not skip by the same amount: In 2003 John is 27 years old; no information on John in 2004; then in 2005 John is anything but 29 years old. (Similar to non-consecutive age problem above).

Terms (individual-wise) – defined to clarify the steps in “Method” section.

Self-reported age – what the person reports or estimates for himself, idageaproxY234567890.

Observed number of years – the number of years that is available in the data set, excluding skipped years.

 i.e. John has self-reported age in 2003, 2006, 2007. Then observed number of years is 3.

Actual number of years – actual number of years between the most recent observed year and the earliest observed year.

 i.e. John has self-reported age in 2003, 2006, 2007. Then actual number of years is 5.

Method

1. Take the average of self-reported age using observed number of years.

Ex: John’s information:

|  |  |
| --- | --- |
| YEAR | SELF-REPORTED AGE |
| 2003 | 19 |
| 2006 | 22 |
| 2007 | 23 |

Observed number of years = 3

Average of self-reported age = (19+22+23)/3 = 21.333

1. Find the median of the actual span of years

Ex: John’s actual span of years: 2003, 2004, 2005, 2006, 2007

 Median of actual span of years: 2005

1. Assign the rounded average age to the median year

Ex: 21.333 is rounded to 21. If it were 21.7, it would be rounded to 22.

 In 2005, John is estimated to be 21 years old.

1. If the median year is in between two whole numbers, we assign the floor of the average to the largest whole number year that is less than the median year.

Example:

|  |  |
| --- | --- |
| YEAR | SELF-REPORTED AGE |
| 2003 | 19 |
| 2005 | 21 |
| 2006 | 22 |

Observed number of years = 3

Actual number of years = 4

Average age = (19+21+22)/3 = 20.67

Actual span of year: 2003, 2004, 2005, 2006

Median: 2004.5 which is in between year 2004 and year 2005

So floor of average (round down): 20

Assign floor of average to largest whole year that is less than median year: For 2004, John is estimated to be 20; and in 2005, John is 21.

More Examples

EX I: Ages are reported correctly, and consistent with year

|  |  |  |  |
| --- | --- | --- | --- |
| Year | IdageaproxY (reported age) | Average age(15+17+18+19)/4 | Age\_bday\_becky (estimated age) |
| 2003 | 15 | 17.25 | 15 |
| 2005 (median) | 17 | 17.25 | 17 |
| 2006 | 18 | 17.25 | 18 |
| 2007 | 19 | 17.25 | 19 |

EX II: Ages are not reported correctly, and therefore not consistent with year

(median is a whole number)

|  |  |  |  |
| --- | --- | --- | --- |
| Year | IdageaproxY (reported age) | Average age(15+20+19+21)/4 | Age\_bday\_becky (estimated age) |
| 2003 | 15 | 18.75 | 17 |
| 2005 (median) | 20 | 18.75 | 19 |
| 2006 | 19 | 18.75 | 20 |
| 2007 | 21 | 18.75 | 21 |

EX III: Ages are not reported correctly, and therefore not consistent with year

(median is not a whole number)

|  |  |  |  |
| --- | --- | --- | --- |
| Year | IdageaproxY (reported age) | Average age(37+37+40+46)/4 | Age\_bday\_becky (estimated age) |
| 2003 | 37 | 40 | 38 |
| 2006 (above median) | 37 | 40 | 41 |
| 2007 | 40 | 40 | 42 |
| 2008 | 46 | 40 | 43 |

**Name of new variable**: idage\_beckyY234567890.

**[II] Estimating education**

Ihcedu\_newY234567890 Documentation

* Based on ihceduY234567890

The following steps are performed before correction began:

1. Replace all 0.1000000015 with 0.
2. Manually replaced the following ihceduY234567890 for idssnY234567890 because they are too troubling and I used my best judgment:

1, 38, 107, 137, 257, 1150, 1396, 1534, 2160, 2164, 2167

An example of subject idssn=38:



Corrected to =>

1. Kept all observations that had a decrease in ihceduY234567890 for subjects under 16 years old

Now Correction:

Step 1. Oddity in one year + the value after the odd year does not increase enough from the values before the odd year according to time span









All of the above cases would be evaluated using the average between the year before and the year after weighted by how many years are apart. Then the result is rounded.

Step 2. Oddity in one year + the value after the odd observation increases too much from the value before the odd year according to the time span



*



Above cases would be corrected by following the previous years with appropriate addition due to increase of years.

Step 3. Oddity in one year + the values before and after the odd observation are the same



Above case is included in step 1, but because STATA works down the row, this case would re-emerge after the first two steps.

Step 4. Last observation decreases



If the last observation decreased, it would be corrected by taking the previous observation’s value.

Step 5. First observation larger



If the first observation is larger than the second, it would take on the next observation’s value.

Step 6. Step 1 through Step 5 is run again to fix missed entries.

Step 7. Skipping two years but should follow the year before





*





If two consecutive years appear to need correction, the average of the values before and after the two observations are taken and weighted by how many years they are apart, then rounded. Only the first observation would have a change because STATA works row by row.

Step 8. Re-run Step 1 through Step 5. This is meant to target observations left from Step 7.

Step 9. Last touch-up manually adjusting: the following subjects’ age were manually adjusted. They couldn’t be correct by the program due to various reasons including: missing values in a few years, extreme cases (often hard to correct even manually, I just used my best judgment)

241, 271, 284, 402, 689, 1008, 1306, 1460, 1688, 1725, 1793, 1809, 1818, 1876, 1982, 2027, 2230

Step 10. Last, I checked to see if any subjects’ starting age for school conflicts with how many years of education they had. For example, someone 8 year old cannot have 7 years of education. The following subjects are corrected for such problems:

2033, 2113, 2232

Note:

* The examples given are simplified. Data are usually a combination of multiple scenarios listed above. That is why step 1 through 5 are repeated.
* Although idschoolageY (age when first started school) was considered, it was not used extensively because it contains many missing values, and data is not very reliable. I.e. someone will report he started school at the age of 6, then next year it becomes 10, then 7 the following year.
* This program is meant to eliminate any decrease in ihceduY234567890. Cases where subjects report more than 1 year of education increase is not fixed. I.e. subject reports 5 years of education, then in the next year he reports 9.

**Name of new variables**: ihcedu2Y (peak) or ihcedu1Y (smoothing)

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