2019

IARIW-World Bank

Special IARIW-World Bank Conference "New Approaches to Defining and Measuring Poverty in a Growing World" Washington, DC, November 7-8, 2019

Money is Everything, or is it? Explorations of the Stability of Welfare Inference across Money-metric, Elicited, and Bio-metric Measures of Wellbeing

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Paper Prepared for the IARIW-World Bank Conference

Washington, DC, November 7-8, 2019

Session 3A: Broader Conceptualizations of Poverty Measures

Time: 8:30 – 10:30, September 8

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Abstract

Money-based measures of wellbeing constitute the core of welfare assessment for much of economics. However, the comprehensiveness of a money-metric measure with respect to total welfare has long been questioned. This study assesses a broad range of well-being measures from 1550 representative adults in two regions of Peru: one urban and one remote rural. Measures include total household income, consumption, household asset wealth, subjective poverty, evaluative subjective welfare, affect, eudaimonic wellbeing, mental health and depression, perceptions of security and physical health, and biometric measures of the stress experience through both diurnal cortisol measured in saliva and long-run cortisol exposure measured in hair samples.

The inter-relation of (a) money-metric measures, (b) elicited welfare, and (c) biometric measures are varied and differ significantly across setting. Individual autonomy and beliefs of competency/self-worth are more aligned with income in the urban setting than the rural. Concerns with health and physical security predominate among the low-income populations in both settings while concerns with relative status are higher in the urban population. The elicitation of dimensional trade-offs reveals that endowment effects, where individuals who experience scarcity in a particular dimension will prioritize that dimension with respect to others, take precedence. If these stated trade-offs are used to generate weights for a multi-dimensional poverty measure, the elicited weights will systematically vary across setting.

Physical stress, as embodied in high cortisol levels, is generally associated with low money-metric wellbeing, however there are many notable deviations from this general pattern. For example, high cortisol, when assessed in the morning, is beneficially related to life satisfaction, affect, and autonomy.

Access to non-market goods and amenities significantly vary across the urban and rural setting, which in turn renders the standard money-metric wellbeing indicators inconsistent with respect to welfare comparisons across location. The creation of a comprehensive measure that enables welfare consistent comparisons across diverse individuals and settings remains elusive.

I. Introduction

Consumption or income, valued at prevailing market prices, is the workhorse metric of human welfare in economic analysis; poverty is almost universally defined in these terms, and the growth of national economies measured as such. Yet for almost as long as economic analysis has utilized these measures, various shortcomings have been widely noted, both in the accuracy of measurement and in the ability of these constructs to comprehensively (including inter-temporally) capture human welfare – perhaps most famously with Amartya Sen's emphasis on human functionings and capabilities. This has led to a diversity of proposed wellbeing measures that cover the broad domains of money-metric, elicited, and bio-metric wellbeing measures.

The foundational paper from Carol Ryff, "Happiness is everything, or is it?" (Ryff, 1989) investigated the covariation of numerous theoretically grounded conceptions of psychological wellbeing in part in order to explore the stability of such associations. This study analyzes new data collected from 1550 Peruvian adults to conduct a similar analysis by contrasting an array of commonly used economic wellbeing measures across the major domains of wellbeing measurement. The study sample was purposively drawn from two disparate settings – urban Lima and the rural region of Central Sierra – to heighten the comparative contrast. Measures include total household income, consumption, household asset wealth, subjective poverty, evaluative subjective welfare, affect, eudaimonic wellbeing, mental health and depression, perceptions of security and physical health, and biometric measures of the stress experience through both diurnal cortisol measured in saliva and long-run cortisol exposure measured in hair samples.

While there are certain similarities in covariation across the various wellbeing measures we study, we find also find various divergences across settings. For example the relation of autonomy measures with money-metric measures are much stronger in urban Lima than rural Central Sierra, as is the relation between a broad array of well-being measures and cortisol levels.

After establishing the patterns of covariation across various measures of well-being, and divergences across setting, we turn to the problem of aggregation across disparate measures and investigate the generation of aggregation weights through the elicitation of direct trade-offs between dimensions. This exercise, while establishing that dimensional preferences are somewhat stable across settings, there are notable differences. Most importantly, the presence of endowment effects, where individuals who report satiated levels of a particular dimension down weight that dimension when trading-off against others, suggest that the elicited trade-off approach will also present challenges to the construction of a welfare consistent aggregate measure.

II. Wellbeing measures and challenges

Measurement challenges of money-metric utility

Money-metric wellbeing is commonly viewed as an "objective" measure, and contrasted with elicited wellbeing measures, in so far as it attempts to record a quantity of monetary resources, typically valued at prevailing local prices. However, the measurement of money-metric wellbeing faces an array of

challenges, especially in low- and middle-income settings. For virtually all LMIC populations, measures of resource availability at the individual and household level – whether income, consumption, or wealth – are almost entirely assessed through surveys. The global diversity in survey approaches is vast with little existent rigorous evidence concerning which particular approach, and in which context, is most accurate. A recent methodological experiment in Tanzania highlighted these inferential challenges when it found large differences in assessed mean consumption, poverty, and inequality across seven common survey modules when compared to the gold standard consumption measure of intensely supervised individual diaries (Beegle et al. 2012).

In part inspired by Sen's view that people intrinsically value capabilities and functionings as opposed to money-metric measures per se, a burgeoning sub-field of poverty research has proposed various measures of subjective, or self-reported, wellbeing (SWB). SWB is widely seen as multi-dimensional and unable to be captured in only one question (Ryff, 1989; Stiglitz Commission, 2009). Hence there are numerous approaches to the measure of SWB, most notably (a) evaluative approaches – which seek respondents to assess satisfaction with life overall or with specified sub-domains such as housing or familiar relations, (b) affective approaches – which seek to assess positive and negative emotions either directly or through related symptomatology and (c) "Euidaimonic" measures – which seek to assess the functionings of individuals in key domains such as individual autonomy and relatedness to others. Dolan et al. (2011) presents a succinct overview of the dominant approaches to the conceptualization of SWB and possible uses of such measures in policy analysis.

Despite the range of research in this broad literature, there has been little systematic thought over what can be termed the hermeneutics of SWB, i.e. an understanding of how respondents interpret the meaning of SWB questions and constructs and how these interpretations may differ across populations or sub-populations of interest.[1] A recent challenge by Bond & Lang (2014) underscores the extreme gaps in our knowledge of these issues, including how individual respondents discretize responses in relation to a presumed continuum of underlying subjective perception.

Further compounding these interpretive difficulties is the fact that salient characteristics such as gender and education are heterogeneous in the population and can influence how SWB is understood and reported, thus complicating cross-group comparisons. Gender and education are two of the more obvious differences, but even subtle personality characteristics may compound interpretive difficulties. DeNeve and Cooper (1999) identified 137 personality traits associated with standard measures of subjective wellbeing.

One key assumption in the SWB analysis described above is that stated preference conveys an unbiased measure of true preference – a necessary assumption but, at least in certain contexts, perhaps a strong one. A third class of measures, physical or bio-metric markers of wellbeing, stands in contrast to the elicitation of stated preferences in so far as bio-metric measures are invariant to possible biases in the response patterns of subjects.

[1] There have been attempts to normalize SWB responses to situational vignettes in an attempt to impose scale validity, however these approaches shift the interpretive burden of respondents away from the direct SWB questions to the interpretation of the vignettes themselves (Kristensen and Johansson (2008), Ravallion et al. (2013)). These attempts may result in greater normalization of meaning across populations, but no known work has yet demonstrated this to be the case.

The emergent bio-markers most tied to economic wellbeing are those linked to the physical experience of stress. Recent cross-disciplinary research has focused on the role that stress plays in causing sub-optimal decision-making and posits the stress mechanism as a key enforcer of poverty status (see Haushofer and Fehr (2014) and Mani et al. (2013) for reviews). The subjective experience of stress manifests in the body through various channels including elevated blood pressure and heart rate as well as elevated levels of alpha-amylase (sAA) and cortisol in the saliva (Piazza et al., 2010). There is a well-identified gradient of cortisol levels with respect to social markers of status and income – one study found significantly higher cortisol levels amongst British civil servants with lower socio-economic status even 30 minutes after awakening in the morning (Kunz-Ebrecht et al. (2004)). The stress response is higher among subjects with relatively little control and autonomy (Dickerson and Kemeny, 2004) and, since autonomy is often seen as an important dimension of SWB and itself exhibits a clear gradient with respect to economic resources, the inter-relation between SWB, money-metric utility, and physical markers of stress appears to be strong. However, few to no studies in LMICs have collected comprehensive data from the same respondents for all three domains.

The goal of this study is to achieve exactly this – to generate high-quality data from all three domains of wellbeing in a population representative survey. The dataset used in this paper is from survey responses in the Measuring Welfare Study (MW), conducted by the World Bank from October to December 2018. The sample of over 800 households were taken from two regions in Peru, Metropolitan Lima and Sierra Central. The households are a subset of the ENAHO 2018 sample and all socio-economic measure captured by the ENAHO are linked to the MW sub-sample. The MW interview, which supplemented the ENAHO living standards survey with extensive questions on elicited welfare and the collection of biologic samples (saliva, hair) for bio-metric measurement, occurred an average of three months after the initial ENAHO interview.

Table 1 summarizes the individual measures assessed in the ENAHO-MW study, organized by the three domains of money-metric, elicited, and bio-metric wellbeing. The next section explores the inter-relations of these measures in the overall sample and by sub-group.

III. Inter-relation of measures

The analysis begins with a straightforward within-subject Pearson correlation table for the entire study sample of 1550 adults.

Table 2 presents the correlation table every wellbeing measure over the full sample. Table 3 divides the sample by region, and Table 4 by gender. <Discussion to follow>

IV. Aggregation across disparate dimensions, the marginal trade-off approach

If we accept that the various measures discussed above assess complementary but conceptually distinct domains of wellbeing, the aggregation of these different dimensions into an overall welfare measure remains another challenge. The second part of this study pilots a promising new approach to the aggregation of disparate wellbeing measures using respondents' stated preferences of trade-offs between distinct wellbeing dimensions.

The locally validated and comprehensive elicited wellbeing questions that are part of the ENAHO-MW These SWB surveys will be implemented in using personal choice scenarios on tablets in order to elicit responses in a form that can be aggregated into a welfare metric based on self-assessed marginal trade-offs of different underlying SWB dimensions. This technique, first described in Benjamin et al. (2014), has had few applications to date in a LMIC setting.

One fundamental problem in elicited welfare studies is the lack of observable prices that can be used to proxy for marginal utilities and thus any attempt to aggregate responses across dimensions of wellbeing into a broader measure has traditionally relied on ad-hoc weights (see Ravallion (2012) for a summary of this criticism). This proposed method attempts to directly estimate marginal tradeoffs and, if successful, will indicate the dimensions of wellbeing most valued by the study populations as well as offer an alternative means of modeling multi-dimensional welfare or poverty more grounded in economic models of consumer choice and less prone to the deserved criticism of ad-hoc weights – in the taxonomy of Decancq and Lugo (2013), this method generates a form of *stated preference weights*, but unlike others of this type the weights are explicitly calibrated through the consideration of trade-offs.

More formally, the recent work by Benjamin et al. (2014) presents a framework anchored in the revealed preference approach to welfare measurement that elicits from the respondents their stated preferences of particular trade-offs. The theoretical framework assumes that utility u(w) depends on a vector w of fundamental aspects of well-being. The marginal utilities of such aspects – evaluated for the individual at the existent levels of w – constitute the relative weights that enable the aggregation of the components of w across dimensions of welfare and across individuals into an index that can track changes in well-being (at least for relatively small changes in individual aspects). In a consumption context, a change in utility in often proxied by a price weighted change in the consumption vector

$$\Delta u \approx \sum_1^M p_m \Delta c_m$$

For broader notions of well-being, the analog is given by

$$\Delta u \approx \sum_1^J \frac{\partial u(\boldsymbol{w})}{\partial w_j} \Delta w_j$$

Unfortunately, there is no available equivalent for observable prices (used to proxy for marginal utilities) in elicited welfare space and attempts to aggregate often rely on ad-hoc weights.

If one goal of wellbeing research is to draw welfare comparisons across disparate populations it is also critically important to replicate and measure the self-assessed marginal trade-offs of different dimensions in a variety of settings to better understand the degree of generalizability of any aggregate index across populations and across key individual characteristics such as gender, hence the value of this proposed research to conduct this activity in two very different settings.

After the questions seeking individual assessment of wellbeing dimensions (or sub-dimensions, also called aspects) are administered, respondents will then be presented with hypothetical choice scenarios across the various dimensions previously asked. These choice scenarios, averaged over a population or subgroup, will generate aggregation weights for each dimension in order to explore wellbeing indices both within and across the study sites.

Benjamin and co-authors compile a list of 136 aspects of well-being – relating both the individual and the individual's perceptions of the wider society and community – that encompass satisfaction, affect, and eudaimonic measures, as well as items such as freedoms, relationships, and the well-being of others. Once the list was specified, an internet survey offered to 4600 respondents presented hypothetical choice scenarios in order to estimate a vector proportional to the vector of marginal utilities for the population of interest. Each scenario elicits the respondent's stated preference in terms of trade-offs between two to six SWB aspects, at a pre-specified magnitude of trade-off between the two aspects. (See Appendix Figure 2 for an example of a hypothetical trade-off from Benjamin et al. (2014)) It is the repeated application of choice scenarios – each respondent was presented with 10 scenarios – and the relatively large sample size that allows for the estimation of the full trade-off matrix of the 136 elements.

In our application, we list 22 aspects that are mapped to 11 dimensions of wellbeing, summarized in Table 5. In terms of aspects to include in the study, the research team was guided by two principles: the proposed set should be comprehensive – covering every element in the welfare vector – as well as non-overlapping – each element should be conceptually distinct to avoid confusion among respondents. Dimensions include: satisfaction measures, affect, eudaimonic measures related to autonomy, competency, and relatedness, as well as command over material resources and the ability to insure against risk.

A central assumption in this approach is that a respondent's stated preferences is a truthful summary of her actual preferences. While this assumption is undoubtedly strong, it is very difficult to go beyond this assumption as actual behavior and preferences expressed through choice are rarely (or never) comprehensive enough to allow a full estimation of marginal utility trade-offs across different elements of well-being. Another assumption is that preferences are linear around the local status quo so that preferences can be represented by a simple differentiable utility function. This assumption reduces the number of trade-offs that any respondent need answer since it rules out local non-linearities in the indifference surface.

To reduce the cognitive burden on respondents, we only elicit stated preference over welfare trade-offs at the status quo (rather than ask respondents to envision alternate states of the world). When appearing on the tablet screens, the instruction section will be clear that what follows is a series of personal-choice scenarios over a single period of time of one year.

In implementation, each option was randomly matched with another option from a different dimension forming a total of 220 pairs. Each respondent faced 20 pairs that were randomly assigned to each individual making sure to maintain similar weights across pairs. One of the options was assigned a value of +1 and the other the value of -1.

Pooling all such scenarios across all respondents, we report results from the following OLS regression:

$$Stated\ Preferences = \alpha_1 + \beta_j AspectRatings + \epsilon_i$$

Each observation captures the information from a single scenario faced by a respondent (i.e., we have 20 observations per respondent). StatedPreferences encodes the response to the choice question (i.e., +1, or -1). AspectRatings, a 21-element vector (J) (we omit the first one to avoid collinearity), encodes the value of the option (i.e., +1 or -1); all of its entries are 0 except for the entries representing the

aspects on which the options was asked. We cluster standard errors at the respondent level and control for enumerator fixed effects.

We could have chosen other values different from +1 and -1, however, the scales should have little effect on the estimated aspect coefficients relative to each other. Moreover, since we are interested in the ranking and not the value per se, our results are essentially unaffected when we relax many of the restrictions imposed by this specification.

Our estimates can be translated in rankings. We further use a Minmax normalization which linearly transforms x to y= (x-min)/(max-min), where min and max are the minimum and maximum values of all X (i.e., of the different specifications that we do), where X is the set of observed values of x. We replicate the analysis of equation 1 for several socio-economic characteristics such as gender, income, age, marital status, and also look at cognitive characteristics like autonomy and security. We also look at the results by level of endowment for each of the 22 options. We analyze equation 1 restricting the sample to that group and by expanding it to include iteration terms following the following specification:

$$Stated\ Preferences = \alpha_1 + \beta_j AspectRatings + \alpha_2 X + \gamma_j AspectRating * X + \epsilon_i$$

Where X is a binary number that represents the characteristic to be analyzed (e.g., X=1 if male, X=0 if female; X=1 if high income, X=0 lower income).

VI. Valued dimensions, overall and by sub-group

Table 6 lists all 22 aspects in order of preference, first for the overall sample and then separately by location – urban or rural – and by gender. Table 7 investigates the preference over the 11 dimensions, again first overall and then stratified first by location and then gender. <Discussion to follow>

VII. Conclusions

Money-based measures of wellbeing constitute the core of welfare assessment for much of economics. However, the comprehensiveness of a money-metric measure with respect to total welfare has long been questioned. This study assesses a broad range of well-being measures from 1550 representative adults in two regions of Peru: one urban and one remote rural. Measures include total household income, consumption, household asset wealth, subjective poverty, evaluative subjective welfare, affect, eudaimonic wellbeing, mental health and depression, perceptions of security and physical health, and biometric measures of the stress experience through both diurnal cortisol measured in saliva and long-run cortisol exposure measured in hair samples.

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Table 1. Overview of wellbeing measures in ENAHO-MW study, by general domain

Measure	Brief description
Money-metric	
Income	Log household per capita income (Soles/month) Log individual income (Soles/month)
Consumption	Household per capita consumption (Soles/month)
Wealth	House quality and household asset index (standardized)
Elicited welfare	
Subjective poverty	Perception of economic condition (10 rung ladder)
Evaluative	Overall life satisfaction (10 rung ladder)
Affective	Two measures from Gallup World Survey (each normalized to 10 point scale) a. Positive affect, feelings of enjoyment, happiness in past day b. Negative affect, feelings of sadness, stress in past day
Eudaimoinc	Basic Psychological Needs scale from Self-Determination Theory a. Autonomy, feelings of control over life and self-determination b. Competence, feelings of worthiness tied to available skills c. Relatedness, feelings of connection to family and community
Mental health	Depression, from the CES-D 20-point scale
Biometric	
Cortisol	a. Salivary, assessed in AM and PM (microg/l) b. Hair, 3cms of length (picog/mg hair)
DHEA	Hair, 3cms of length (picog/mg hair)

Table 2. Heat map of wellbeing correlations, full sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1. Log per capita expenditure		.896	.599	.74	.644	.411	.05	-.098	.065	.028	.297	-.02	.04	-.05	.065
2. Log per capita income			.679	.69	.609	.4	.059	-.101	.081	.071	.311	-.024	.052	-.057	.08
3. Log individual income				.476	.448	.326	.059	-.115	.124	.101	.344	-.141	.035	-.034	.051
4. Household wealth index					.613	.437	.047	-.139	.078	.082	.335	-.061	.026	-.073	.064
5. Subjective poverty						.512	.127	-.164	.128	.063	.331	-.101	.051	-.105	.104
6. Life satisfaction							.25	-.275	.252	.178	.371	-.257	.018	-.092	.067
7. Positive affect								-.664	.161	.164	.163	-.373	-.005	-.047	.021
8. Negative affect									-.211	-.149	-.2	.498	.002	.027	-.013
9. Autonomy										.457	.466	-.284	.035	-.009	.038
10. Relatedness											.524	-.276	.017	.031	-.001
11. Competence												-.313	-.039	-.048	-.01
12. Depression													.009	.007	.004
13. AM cortisol														.159	.843
14. PM cortisol															-.397
15. Cortisol gradient															

Table 3. Heat map of wellbeing correlations, by region

Lima

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1. Log per capita expenditure		.847	.477	.582	.312	.155	.059	-.087	.153	.131	.198	-.021	.088	.025	.074
2. Log per capita income			.58	.593	.324	.171	.06	-.084	.157	.172	.208	-.062	.109	.031	.092
3. Log individual income				.311	.202	.14	.004	-.059	.189	.208	.341	-.134	.071	.058	.042
4. Household wealth index					.379	.243	.032	-.074	.19	.203	.197	-.066	.071	.034	.053
5. Subjective poverty						.35	.151	-.143	.258	.241	.242	-.132	.056	-.041	.074
6. Life satisfaction							.29	-.267	.428	.258	.28	-.331	.05	-.018	.058
7. Positive affect								-.585	.221	.238	.176	-.355	.04	.072	.005
8. Negative affect									-.24	-.222	-.156	.572	.003	-.055	.029
9. Autonomy										.505	.546	-.346	.025	.008	.021
10. Relatedness											.581	-.321	.016	.065	-.015
11. Competence												-.36	-.061	.002	-.061
12. Depression													.021	-.028	.034
13. AM cortisol														.202	.884
14. PM cortisol															-.28
15. Cortisol gradient															

Sierra Central

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1. Log per capita expenditure		.761	.328	.349	.407	.1	-.057	.045	.027	-.084	.002	.104	.005	.027	-.012
2. Log per capita income			.505	.223	.352	.12	-.022	.016	.052	-.006	.078	.116	.011	-.012	.017
3. Log individual income				.109	.221	.124	.052	-.07	.091	.006	.116	-.12	-.005	-.023	.009
4. Household wealth index					.283	.132	-.037	-.085	-.002	-.025	.143	.028	-.031	-.06	.009
5. Subjective poverty						.308	.074	-.095	.073	-.082	.13	-.03	.061	-.074	.098
6. Life satisfaction							.211	-.239	.145	.135	.258	-.186	-.019	-.084	.033
7. Positive affect								-.716	.11	.1	.125	-.387	-.047	-.116	.028
8. Negative affect									-.195	-.095	-.187	.447	.004	.058	-.031
9. Autonomy										.406	.435	-.22	.047	-.023	.055
10. Relatedness											.515	-.227	.017	.007	.011
11. Competence												-.257	-.026	-.038	.
12. Depression													-.004	.024	-.018
13. AM cortisol														.13	.806
14. PM cortisol															-.483
15. Cortisol gradient															

Table 4. Heat map of wellbeing correlations, by gender

Male

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1. Log per capita expenditure		.892	.682	.745	.651	.416	.025	-.105	.067	.011	.362	-.076	-.001	-.036	.021
2. Log per capita income			.77	.687	.622	.406	.055	-.13	.084	.054	.375	-.082	.026	-.041	.049
3. Log individual income				.56	.497	.38	.046	-.104	.083	.081	.378	-.101	-.039	-.07	.006
4. Household wealth index					.602	.442	.065	-.17	.086	.088	.409	-.13	.002	-.083	.053
5. Subjective poverty						.517	.12	-.179	.137	.029	.362	-.114	-.003	-.133	.079
6. Life satisfaction							.249	-.29	.278	.181	.384	-.284	.017	-.117	.088
7. Positive affect								-.666	.167	.154	.133	-.366	-.021	-.076	.027
8. Negative affect									-.223	-.162	-.188	.486	-.032	.067	-.071
9. Autonomy										.454	.463	-.269	.059	-.031	.075
10. Relatedness											.473	-.276	.024	.064	-.017
11. Competence												-.298	-.013	-.063	.027
12. Depression													.023	.036	.
13. AM cortisol														.244	.801
14. PM cortisol															-.384
15. Cortisol gradient															

Female

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1. Log per capita expenditure		.9	.614	.724	.622	.398	.1	-.118	.095	.074	.255	-.026	.106	-.024	.107
2. Log per capita income			.694	.684	.579	.386	.077	-.086	.108	.121	.271	-.027	.098	-.034	.103
3. Log individual income				.466	.466	.301	.065	-.099	.142	.103	.278	-.101	.125	-.062	.14
4. Household wealth index					.619	.425	.03	-.12	.094	.092	.275	-.049	.063	-.009	.061
5. Subjective poverty						.501	.146	-.165	.138	.125	.326	-.142	.128	-.016	.123
6. Life satisfaction							.256	-.267	.228	.181	.373	-.271	.02	-.028	.03
7. Positive affect								-.662	.148	.175	.196	-.395	.018	-.007	.02
8. Negative affect									-.181	-.124	-.2	.513	.049	-.012	.049
9. Autonomy										.454	.461	-.287	.002	-.003	.003
10. Relatedness											.584	-.271	.007	-.05	.027
11. Competence												-.303	-.075	-.071	-.038
12. Depression													-.005	.045	-.024
13. AM cortisol														.003	.905
14. PM cortisol															-.423
15. Cortisol gradient															

Table 5. List of 22 well-being aspects and 11 dimensions included in trade-off game

Aspect (Spanish)	Aspect (English)	Dimension
1. Tener MAS personas a las que puede acudir cuando lo necesite.	A better support network	Financial security
2. Tener MAS seguridad financiera	More financial security	
3. Tener MAS libertad de decidir por sí mismo cómo vivir su vida	More freedom to decide how to live life	Autonomy
4. Tener MAS control sobre su vida	More control over life	
5. Sentir que tiene un papel MAS importante que desempeñar en la sociedad	A more important role in society	Competency
6. Sentir que es MAS competente en las actividades que le importan	More competent in activities you value	
7. Sentirse feliz MAS tiempo	More happiness	Positive affect
8. Sentir MENOS estrés en su vida	Less stress	
9. Sentir MAS satisfacción general con su vida	More satisfaction with life	Life satisfaction
10. Tener MAS actividades que valen la pena	More worthwhile activities	
11. Tener ingresos MAS altos que los ingresos de otras personas a su alrededor	More income than those around you	Relative status
12. Tener un estatus social MAS alto	Higher social status	
13. Tener MAS dinero para comprar cosas que son importantes para usted	More money to buy the things you find important	Material wellbeing
14. Tener un nivel de vida material MAS alto	A higher material level of living	
15. Sentir que tiene MAS posibilidad de vivir una vida larga	Increased longevity	Physcial health
16. Sentir MAS salud física	Better physical health	
17. Sentir MAS seguridad física	Better physical security	Physical security
18. Vivir en un lugar con MENOS violencia y delincuencia	Less violence and crime	
19. Tener MAS educación	More education	Public services
20. Tener MAS acceso asequible y confiable a electricidad, agua, y saneamiento	Better public services	
21. Tener MEJORES relaciones con familiares, amigos, o personas en su comunidad o vecindad	Better relations with family and friends	Relatedness
22. Tener MAS personas a su alrededor que piensan bien de usted y lo tratan con respeto	More people in community who treat you well	

Table 6. Well-being aspects ranked by relative likelihood of selection

Full sample		*Lima*		*Sierra Central*		*Male*		*Female*	
Aspect	Relative weight	Aspect	Relative weight	Aspect	Relative weight	Aspect	Relative weight	Aspect	Relative weight
Better physical health	0.85	Better physical health	0.89	Better physical health	0.81	Better physical health	0.86	Better physical health	0.85
More happiness	0.74	Less violence and crime	0.80	Better public services	0.80	More happiness	0.74	More happiness	0.75
Increased longevity	0.72	More happiness	0.70	More happiness	0.79	Better relations with family and friends	0.73	More satisfaction with life	0.71
More satisfaction with life	0.72	More satisfaction with life	0.70	Better relations with family and friends	0.77	Increased longevity	0.73	Increased longevity	0.71
Better relations with family and friends	0.71	Better physical security	0.69	Increased longevity	0.75	More satisfaction with life	0.72	Less stress	0.70
Less violence and crime	0.69	Increased longevity	0.69	More satisfaction with life	0.74	Less violence and crime	0.69	Better relations with family and friends	0.70
Less stress	0.67	Less stress	0.66	Less stress	0.68	Better physical security	0.66	Less violence and crime	0.69
Better physical security	0.66	Better relations with family and friends	0.66	More people in community who treat you well	0.67	More education	0.66	Better physical security	0.67
A better support network	0.62	More education	0.62	More money to buy the things you find important	0.64	Less stress	0.64	More worthwhile activities	0.62
More people in community who treat you well	0.61	More worthwhile activities	0.62	Better physical security	0.63	More financial security	0.63	A better support network	0.62
More worthwhile activities	0.61	A better support network	0.62	A better support network	0.62	More people in community who treat you well	0.62	More people in community who treat you well	0.61
More education	0.61	More competent in activities you value	0.58	More worthwhile activities	0.59	A better support network	0.62	More education	0.56
More financial security	0.58	More financial security	0.57	More financial security	0.59	More money to buy the things you find important	0.60	Better public services	0.56
Better public services	0.58	More people in community who treat you well	0.56	More education	0.59	Better public services	0.60	More competent in activities you value	0.55
More competent in activities you value	0.57	A more important role in society	0.51	Less violence and crime	0.58	More competent in activities you value	0.59	More money to buy the things you find important	0.54
More money to buy the things you find important	0.57	More freedom to decide how to live life	0.50	More competent in activities you value	0.55	More worthwhile activities	0.59	More financial security	0.53
More freedom to decide how to live life	0.49	More money to buy the things you find important	0.49	More freedom to decide how to live life	0.49	A more important role in society	0.55	More freedom to decide how to live life	0.48
A more important role in society	0.49	More control over life	0.47	More income than those around you	0.48	More freedom to decide how to live life	0.51	A more important role in society	0.44
More control over life	0.46	Better public services	0.37	A more important role in society	0.47	More control over life	0.48	More control over life	0.44
More income than those around you	0.41	More income than those around you	0.35	More control over life	0.45	More income than those around you	0.47	More income than those around you	0.36
A higher material level of living	0.31	A higher material level of living	0.26	A higher material level of living	0.36	A higher material level of living	0.35	A higher material level of living	0.27
Higher social status	0.20	Higher social status	0.15	Higher social status	0.25	Higher social status	0.25	Higher social status	0.15

Table 7. Well-being dimensions ranked by relative likelihood of selection

Full sample		*Lima*		*Sierra Central*		*Male*		*Female*	
Dimension	Relative weight	Dimension	Relative weight	Dimension	Relative weight	Dimension	Relative weight	Dimension	Relative weight
Physcial health	0.80	Physcial health	0.81	Physcial health	0.79	Physcial health	0.78	Physcial health	0.82
Positive affect	0.73	Physical security	0.77	Positive affect	0.75	Positive affect	0.68	Positive affect	0.77
Physical security	0.69	Positive affect	0.70	Relatedness	0.73	Physical security	0.66	Physical security	0.72
Relatedness	0.68	Life satisfaction	0.68	Public services	0.70	Relatedness	0.66	Life satisfaction	0.71
Life satisfaction	0.68	Relatedness	0.63	Life satisfaction	0.68	Life satisfaction	0.64	Relatedness	0.69
Financial security	0.62	Financial security	0.62	Financial security	0.62	Public services	0.62	Financial security	0.62
Public services	0.61	Competency	0.57	Physical security	0.61	Financial security	0.62	Public services	0.60
Competency	0.55	Public services	0.52	Competency	0.52	Competency	0.56	Competency	0.53
Autonomy	0.49	Autonomy	0.50	Material wellbeing	0.51	Autonomy	0.49	Autonomy	0.50
Material wellbeing	0.46	Material wellbeing	0.40	Autonomy	0.48	Material wellbeing	0.47	Material wellbeing	0.44
Relative status	0.32	Relative status	0.27	Relative status	0.38	Relative status	0.35	Relative status	0.30

Annex I. Stress and wellbeing, an overview

Physiological responses to stress

There is general consensus that stress produces psychological, physiological, and behavioral reactions (Starcke and Brand 2012). Stress "occurs whenever a demand exceeds the regulatory capacity of an organism, particularly in situations that are unpredictable and uncontrollable" (Dickerson and Kemeny 2004; Koolhaas et al. 2011). Three bio-physical systems are involved in the response to stress, including both physiological and endocrine reactions: the sympathetic-adrenal-medullary system (SAM-system, Cannon 1914); the hypothalamic-pituitary-adrenal axis (HPA-axis, Selye 1956); and the immune system.

The neural reaction of the SAM system occurs immediately after the exposure to the stress inducing factor and is the primary physiological response to acute stressors. It produces symptoms such as increased heart rate, pulse, blood pressure and electrodermal activity, and disappears approximately 10 minutes after cessation of the stressor (Het et al. 2009, Kirschbaum et al. 1993). There are several biomarkers associated with the SAM system which can be measured in urine, plasma, or cerebrospinal fluid samples. Among these, the salivary enzyme alpha-amylase (sAA) is being increasingly used due to its minimally invasive collection method (Piazza et al. 2010).

The HPA-axis reacts more slowly, and it leads to the release of glucocorticoids from the adrenal cortex. The primary glucocorticoid in humans is cortisol, which peaks approximately 21 to 40 minutes after the onset of the stressor. Cortisol elevation can persist up to 60 minutes after the cessation of the stressor in cases where the cortisol peak was high, but goes back to normal levels after 41-60 minutes otherwise (Dickerson and Kemeny 2004). Once again, several biomarkers of the HPA axis have been identified, though the ease of salivary collection together with its predictable diurnal pattern have made cortisol a preferred candidate in field studies (Piazza et al. 2010).

Finally, the reaction of the immune system protects the body from internal and external threats. Among the biomarkers associated with the functioning of the immune system there is epithelial barriers, NK cells, and C-reactive protein (Piazza et al. 2010). The development of dried blood spot (DBS) technology allows for field measurement of many biological measures that were once only possible in a lab setting, such as is the case of C-reactive protein (National Research Council 2007).

While the stress response is beneficial in the short term, as it allows the individual to adapt (allostasis), the activation for long periods of time may generate allostatic load or wearing down of the system (McEwen 1998). This allostatic load can be classified into different types: it occurs when the individual is repeatedly exposed to novel stressors – i.e. the body reacts normally to stress but is exposed to it multiple times; when the individual fails to adapt to the same stressor; when the stress response lasts longer than it should (no recovery); and when the individual fails to respond adequately to the stressor, in which case the body compensates by the over-reaction of other mediators (McEwen 2000). The measurement of allostatic load follows a multivariate approach, where a number of biomarkers are combined into a single index. The exact way the index is calculated varies with each study, but one common approach consists of adding up individual scores when they lie at the extremes (Piazza et al 2010). Recently, it has been suggested that the collection of hair cortisol can also serve as a good biomarker for chronic stress (Russell et al. 2012).

Decision making from a neurobiological perspective

Starke and Brand (2012) present a comprehensive review of the theoretical approaches to decision-making and its neurobiological correlates. Understanding the decision-making process is a challenge, and the psychological literature has proposed multiple models to explain this process. An integrative approach has been proposed by Epstein et al. (1996), which poses that humans make both strategic and intuitive decisions. Therefore, according to this dual process theory, the decision process involves two systems: the rational-analytical system, which involves controlled and rule-governed information processing; and the intuitive-experiential system, which involves a fast, associative, emotional information processing. Depending on the situation, one or both of these systems operates with different intensities. When uncertainty is very high (i.e. an unknown probability distribution of the events), the intuitive system plays a more prominent role. Under risky settings, the rational system dominates. In intermediate situations, or situation that involve a moral dilemma or some type of conflict between emotion and reason, the two systems interact: there is a first response by the intuitive system, followed by calculated thought. Some of the specific decision-making mechanisms identified include: strategy application, adjustment from automatic responses, feedback processing, and reward and punishment sensitivity. In most situations more than one of these mechanisms interact.

Functional magnetic resonance imaging (fMRI) has been used in recent years to identify the neurobiological correlates of decision-making. While this is a complex process that involves multiple regions of the brain, some correlates and functions have been identified. For example, executive functioning and working memory rely on the dorsolateral prefrontal cortex (Jonides et al. 1997, Lie et al. 2006); the emotional-intuitive system relies on the limbic and basal ganglia regions (Vorhold 2008); editing operations and inhibition of fast automatic responses relies on the prefrontal regions (Vorhold 2008); reward processing heavily involves the striatum (Delgado 2007).

Stress, decision making and well-being

There is ample overlap in the regions of the brain that are involved in the decision-making processes above and the regions of the brain that react to stress, due to the presence of receptors for stress hormones in these same regions. Using fMRI, metabolic reactions have been identified in the prefrontal, limbic, basal ganglia and other regions (Dedovic et al. 2009, Pruessner et al. 2010). This overlap is key since it suggests that the physiological aspects of decision-making are potentially vulnerable to stress responses.

For example, Starcke and Brand (2012) present a comprehensive review of studies that look at the impact of stress on decision-making, where decisions are restricted to those that involve the choice among at least two alternatives. The evidence suggests that stress affects different decision-making mechanisms, including the dysfunctional use of strategy decision-making, insufficient adjustment from the automatic response, altered feedback processing, and altered reward and punishment sensitivity. Whether the impact leads to advantageous or worse outcomes depends on the situation.

The medical literature identifies stress as a key factor in explaining the well-established SES gradient in health status (Adler et al. 1993; McEwen 2000). While the physiological stress response has protective effects in the short-term, repeated or prolonged exposure to stressors can have damaging effects (McEwen, 1998). This cumulative cost or wearing down of the bodily systems, defined as ‘allostatic load’, also follows a strong SES gradient, and has been found to predict increases in risk for incident cardiovascular disease, risk for decline in physical and cognitive function, and risk for mortality (Seeman et al. 1997; Sapolsky 1996).

Cortisol, in particular, has been proposed as a key major mediator of stress, and increasing levels have been found to affect working memory (Schoofs et al. 2008 and Wolf 2009), executive functioning (McCormick et al. 2007), feedback learning (Petzold et al. 2010), perception and attention (Broadbent 1971); and operant conditioning (Schwabe and Wolf 2009). There is also a well-identified gradient of cortisol levels with respect to social markers of status and income. For example, one study finds significantly higher cortisol levels amongst British civil servants with lower socio-economic status, even 30 minutes after awakening in the morning (Kunz-Ebrecht et al. (2004)). The stress response is also higher among subjects with relatively little control and autonomy (Dickerson and Kemeny, 2004) and, since autonomy is often seen as an important dimension of SWB and itself exhibits a clear gradient with respect to economic resources, the inter-relation between SWB, money-metric utility, and physical markers of stress is appears to be strong. Finally, recent cross-disciplinary research has also explore the role that stress plays in causing sub-optimal decision–making and shows that stress is a key enforcer of poverty status (see Haushofer and Fehr (2014), and Mani et al. (2013) for reviews).

References