THE INFLUENCE OF ADAPTIVE POTENTIAL ON PROXIMATE MECHANISMS OF NATURAL SELECTION[1]

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ABSTRACT   This article tests a theory of overall adaptive potential at the individual and cultural level. Adaptive potential is measured by well-being conditions in each of three realms of human attention: efficacy and diversity in the biophysical realm, affiliation and autonomy in the interpersonal realm, and (provisionally) components of creativity in the symbolic realm. These conditions are assessed through the perspective of the self and the social and cultural surround among 131 individuals in a multicultural sample of Southern California college students. The theory is based on proximate mechanisms of natural selection and cultural transmission. This is largely an exploratory study. The categories measured gain their validity chiefly through the theoretical reasoning that gave rise to them (advanced in more detail in Colby, this same issue) and through the regression of the adaptive potential measure with measures of physical and psychological health.

INTRODUCTION

The empirical study described here is based on the following assumptions: Much of human behavior is guided by cognitive/affective organizations in the brain that are transmitted from one individual to another through cultural patterns. These neural organizations are referred to as schemata (hereafter, schemas) linked to values and goals that arise from genetically initiated and experientially (and culturally) shaped dispositions and as valenced schemas

cognitively distributed in a social group or society.[3]

Schemas represent the cognitive or ideational side of culture while observed cultural patterns represent the material phenomenological side. When Ward Goodenough used this distinction he went on to say that culture should be restricted to the ideational or cognitive side (Goodenough 1996). This limitation of culture to the cognitive side has characterized many studies in cognitive anthropology. In contrast, material culture, generally equated with artifacts and the built environment, has been neglected in social anthropology. But there is more to the phenomenological side than material objects. What is getting left out in current theorizing about culture is human behavior, sometimes to the point of explicit exclusion of behavior from definitions of culture. Any theory of cultural transmission must of necessity deal with behavior and the perception of behavior as part of the cultural equation.

It is thus critical that a theory of culture embrace both the ideational and the phenomenological side of human life, particularly if one is to base culture theory on natural and cultural selection and the coevolutionary interaction of the two. It is only through studies of human behavior that we can move toward an evolutionary science of culture and, as in the focus of this paper, it is only through behavior that we can understand a key part of that science, adaptive potential, the ability of humans to adapt to environmental change in both the natural and built world, particularly in today's world when its social and technical aspect is changing at such an accelerating pace.

John Searle takes both the ideational and the phenomenological aspects of human life into account by distinguishing "institutional facts" from "brute facts" (Searle 1995). In this paper we make a similar distinction by using the term, schema, for hypothesized units of cognitive processes relating to culture and the term, pattern, for the regularities of cultural features in the phenomenal world. That is, patterns in the phenomenal world are understood through schemas in the mind (including perceptual schemas). Read has proposed distinguishing between the logic of cultural constructs and the logic of the instantiation of abstract elements of those constructs to handle the issue of whether behavior (as opposed to artifacts) is part of culture (Read 2001). Similarly, our position on this is that any human behavior noticed and interpreted by an observer is cultural to the extent that the observer forms pattern-matching schemas for that behavior. Thus culture starts with perception. For present purposes we speak simply of schemas and patterns.

Cultural schemas have a somatic as well as an experiential basis and thus are subject to natural selection in two respects. First, they are linked broadly to genetic expression simply through the capacity for schemas of a particular type to be formed. We already know something about this through neurophysiological studies of language. Second, the human experience of life involves a continuous process of observing culturally patterned phenomena (in both behavior and material objects) and developing schemas to match or reconstruct those patterns through the selection of neurons and synaptic connections that deal with them over the growth and maturation of the individual (Edelman 1992). This second kind of selection in the internal bodily environment is an interactive process between the growth of neural networks and experience of both the internal (cellular) and the external environment. This generally is a matter

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3 Recently two sessions on the general subject of distributed cognition were held at the meetings of the Society for Anthropological Sciences in New Orleans which suggests a growing interest in this view of culture.

of form rather than content at specific levels. However in the theory tested here there is the postulation of a set of universal conditions which blur the line between form and content, just as universal elements of language (.e.g noun and verb concepts) relate to meaningful syntactic elements specific to particular languages. The empirical study here assumes the there are conditions of adaptive potential that have a genetically inherited component that resonates in different ways with specific (i.e. local) cultural conditions. Curiously, however, there has been little movement in psychological anthropology toward linking the universal results (i.e. capacities or predispositions) of this coevolutionary selection to specific individuals, or to how the specific content of cultural patterns or cultural institutions translates in terms of these universal conditions and facilitate the survival and success of individuals. As an analogy, the immune system is genetically based, but that basis does not inform us of the antibodies that are produced by the immune system. We thus are investigating conditions that are genetically initiated but that are shaped by experience; by the interactions of individual with the environment, both the cultural and natural environment. So also for general dispositions and specific cultural patterns.[4]

Natural selection is usually seen to operate over a time scale that spans many generations. Evolutionary anthropologists thus focus on time spans extending far back to the earliest hominids. In contrast, time scales common to problems and theories in psychological and cognitive anthropology are quite short. The divide between these two scales is exacerbated by the different methodologies, investigative interests, and theoretical approaches of those who work in these respective fields. If there is to be significant progress towards understanding cultural processes in either field the underlying somatic dynamics of these processes must be more extensively explored. A promising approach in such an endeavor is the study of how people deal with, and adapt to, stressors. Indeed this research assumes that a major function of culture is the forestalling and buffering of stressor events. The tests that we report support this interpretation of cultural functioning.

The core of human evolutionary progress from early hominid times up to the present relates to perceptions of well-being for the self, one's family, and one's group(s). These perceptions are shaped by local beliefs defining success tempered by individual responses to immediate situaltions. As Read suggests in a simulation model, there is an important distinction to make between normative or culturally appropriate behavior and the pragmatic exigencies (e.g. demographics) of individuals in a society (Read 1998).

Though ideas about success are enormously varied and complex from one individual and society to the next, we argue here that they all relate to a small number of underlying conditions of adaptive potential which combine genetic, epigenetic, and cultural factors in three realms of human attention and concern. By adaptive potential we mean a quantitative measure of a universal substratum of conditions that underlie both individual psychology and cultural patterning. The greater, more positive the quantitative measure of specifically defined adaptive potential conditions of individuals, groups, and institutions, the better their ability to promote physiological and psychological health among individuals and groups and ultimately to achieve

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[4]. Among psychologists an evolutionary view was pioneered by Campbell (1987). Since his work various versions of evolutionary psychology have been offered, varying somewhat in the degree to which nature or nurture is emphasized. In this initial stage of our study, and of current empirical findings in ethology and biology we remain agnostic about percentages or degrees of genetic versus cultural influence.

longevity and evolutionary success.

Adaptive potential underlies specific cultural differences and local ideas about what constitutes success. The degree to which local ideas of success – folk success (as opposed to a theoretical evolutionary success through natural and cultural selection) match or support the substratum conditions of adaptive potential and guide behavior should be predictive of well-being and health within individuals of the local group. Individuals in all societies must enjoy high levels of adaptive potential if they are to live physically and mentally healthy lives. In addition to local adaptation to the social and natural environment, adaptive potential includes the ability to respond successfully to events and situations that depart from the usual routine of one's experience in life. It means having the resilience to deal successfully with any events and situations that can be stressful, harmful, or dangerous to life.

These conditions of adaptive potential can be described at a general level as control or ecological adaptivity in the biophysical realm, altruism in the interpersonal realm, and creativity in the symbolic realm. In the study described here the focus is actually on the more specific and measurable subcomponents of these three conditions: efficacy and diversity in the biophysical realm, affiliation and autonomy in the interpersonal realm, and (provisionally) meaningfulness and coherence in the symbolic realm. Other components of the symbolic realm tested in earlier work, imagination and metaknowledge (hypothesized components of creativity) were not measured in this study (to avoid an overly long questionnaire for our respondents) which, at least for the symbolic realm is still in a very exploratory stage.

ADAPTIVE POTENTIAL AND STRESS

The distal or final determination of each individual's part in the evolutionary scheme as a carrier of alleles is how successful that individual has been in having progeny, and in turn, how successful the progeny have been in reaching adulthood and reproducing. Whether those progeny survive long enough to reproduce depends also on what we call proximal effects – how nurturing parents are; how successful they are in providing food for their young children; how wise they are in insuring that their children learn to be effective; and how helpful they are for their grandchildren. In this last respect, human longevity provides a distinct advantage, more so than for other animals because of the synergistic effect of culture. In this regard ideas of success and of stress management can enhance reproductive success in varying degrees depending on local culturally guided ideas about what constitutes success. In spite of local differences, however, the ultimate success of individuals and groups depends on how these local ideas of success and their realization facilitate high levels of the underlying substratum universal in all societies, the conditions of adaptive potential.

WELL-BEING AND BIOCULTURAL SUCCESS

In the present study health, both physical and psychological, is a lower-level, measurable, and proximal, evolutionary variable. This contrasts with the distal variables of death and reproductive success that are defining criteria in theories of natural selection. In both proximal and distal views, the potential for adaptivity is key.

In biological and medical anthropology adaptivity has been studied in terms of specific

interactions among biological, ecological, and cultural variables involving the relation between diseases on the one hand, and diet, location, social characteristics and stress on the other (Aldwin 2000; Rubel 1984). In our theory which includes cultural selection (or preferably, cultural transmission) health serves as our outcome or dependent variable standing in for the higher level, more distal concept of biocultural success.

While adaptivity is restricted in these microviews to circumstance bound in space and time, we examine adaptive potential over a broader range as a generalized characteristic whether spanning a short time period or extending over a longer period in the life cycle. If these periods are specified in a study we have a longitudinal study. In the present study, however, we use a cross-sectional study but assume that the adaptive potential measured is a somewhat varying but essentially long-enduring characteristic of the individuals studied in their particular situations or "surrounds" both social and material.

CULTURAL PATHOLOGY AND CULTURE THEORY

The adaptivity, or maladaptivity of persons or cultural groups is still treated in what is largely a post hoc fashion by ethnographers. In the received view of culture we are locked into a problem Freud referred to many years ago. It was not possible, he thought, to determine whether entire civilizations might be pathological because cultural theory lacked anything comparable to a psychological concept of normality (Freud 1961). In the received view of culture, which is generally relativistic, there is no way to make such determinations. Judgments of cultural pathology thus must reject the relativistic component of the received view (Edgerton 1992).

The approach we take here seeks escape from the Freudian impasse in two ways. First, we reject the received theory of culture as a relativistic entity with boundaries that take determiners like "a" and "the" in favor of a schema/pattern tandem approach in which people engage with their world through mental schemas and observed patterns.

Second, our measures were derived from evolutionary principles both of natural selection and of culture transmission. These criteria suggest ways in which theories of adaptivity, well-being and cultural pathology might be tested directly with individual members of any social population or sample, however it may be defined. We do not mean to minimize translation problems, only to emphasize the theoretical point of a universal theory with local measurement translations.

Our theory can be conceptualized at different levels of generality. At the highest level it states simply that among individuals and groups the higher the adaptive potential the higher the well-being. Conversely, the lower the adaptive potential, the greater the psychocultural pathology. In the study we describe here, we focus on two components of well-being, physical and psychological health. This allows us to use outcome, or dependent, variable measures in questionnaire form. At the same time, one can use picture (Thematic Apperception) tests and open-ended questions in a more traditional psychological and anthropological manner to maintain a form of contextual relations for the content analysis of verbal productions to assist in further interpretations of the questionnaire results. We emphasize that a major part of this study is exploratory.

THE STUDY

While over half the individuals of the sample in the present study do not have English as their first language, the study was conducted in English at an American university. The use of literate and educated respondents during the early development of the theoretical program has facilitated a more rapid exploration of different aspects of the theory.

The adaptive potential measure we used is not simply a measure of a single person's general adaptability to an unspecified cultural ambience and ecological circumstance. It also reflects our respondents' perception of the specific conditions of the surrounding biophysical, social, and symbolic realms in which they are located.

Thus by adaptive potential, it should be clear by now that we do not mean adaptation to "a culture." Measuring adaptive potential, as we conceptualize it, is not, for example, to distinguish native born persons as being 100 percent adapted to their culture as opposed to foreign born persons who are seen to be some degree less than 100 percent adapted. Culture is so amorphous, varied and differently represented in the minds of even native-born individuals (Schwartz 1978; Schwartz 1989) that it is meaningless to quantify adaptation to "a culture."

What we mean by adaptive potential is the ability to change or adapt in response to changes in the environment, both natural and social. A major part of adaptive potential involves an individual's own internalized cultural system, basically a system of systems, from language, to world view and to goal structures and the emotional system these goal structures involve. Adaptive potential arises from a tandem interaction between cultural systems in the minds of individuals and cultural systems as externally observed and usually institutionalized cultural patterns (Colby 1981; Romney and Moore 2001).

In short, our usage of adaptive potential is the ability to adapt to situation and circumstance over the life-time of individuals. We do not mean changes in the allelic structure of a population. While our usage of adaptive potential could include non-genetic adaptive potential in a purely physiological sense, such as acclimatization to high altitudes, (where large lungs are a response to oxygen thin atmosphere, a phenotypic plasticity) we focus here on predispositions and habits of thought and action that result from cultural interaction. We see all individuals, regardless of place of birth, as having higher or lower levels of adaptivity to their particular circumstances.

The hypothesis we actually test, then, is as follows: For any individual, the higher the level of adaptive potential the lower the frequency of symptoms of physical and psychological illness.[5]

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[5] Adaptive potential measures of individuals belonging to some theoretically distinguished group or network characterized by specified cultural or social characteristics can be summated for group assessment as well as for individual assessment. It must be emphasized, however, that assessing the adaptive potential of an individual, unlike most personality assessments, must also include an assessment of that individual's social surround, whether it be the individual's own perception, or some other source such as the observational opinions of informed judges.

THE RESEARCH SAMPLE

The research sample consisted of 131 undergraduates at the University of California, Irvine, a campus of rich ethnic diversity.   Of these only 57 listed English as their first language. Of the remaining 74 respondents, 64 were foreign born. Outside the United States, the most frequent country of birth was Vietnam (13) followed by Korea (12), Latin America and Spain (8), Taiwan and Hong Kong (7) and the Philippines (6). 91 respondents were female; 40 were male. 119 respondents were between 18 and 22. There were four 17 year-olds and 10 respondents between 23 and 29. In addition, there was one 31 year-old and one 45 year-old participant.

Students in undergraduate classes are routinely recruited to participate in university sponsored projects. Many students seek out participation in these experiments because they receive extra credit in their respective classes. However they are not required to participate. After review of the human subjects committee, sign-up sheets were posted to recruit the sample. The project was introduced as a study of health and stress in the emerging field of behavioral medicine and psychoneuroimmunology. The latter refers to a previous and still largely unpublished project where adaptive potential was examined in reference to immunological variables (Colby, et al. 1985; Milanesi 1991; Milanesi, et al. 1994; Mishra, et al. 1991). Student participants were given the opportunity to ask questions prior to the distribution of the questionnaires. Anonymity was maintained by having students make up their own ID code. Participants were asked to complete three questionnaires, as well as to respond in writing to three open-ended questions, all described below.

DESCRIPTION OF THE INSTRUMENTS AND VARIABLES

The Adaptive Potential Scales

There are three main categories or realms in which adaptive potential is most applicable: the biophysical (or material) realm, the interpersonal realm of social interaction, and the symbolic realm. The original rationale for these three realms and their subcategories are discussed in earlier publications (Colby 1981; Colby 1987 and Colby, this issue of MACT). In this study seven variables cover these three basic categories.

The biophysical realm is represented by variables that measure efficacy and diversity. Efficacy concerns the ability of a person or group to engage successfully in tasks of daily living -- be it food preparation, job performance or other activities. Diversity is a measure of first, the repertoire of culture patterns relating to the physical or biophysical realm that are available to an individual or group; and second, receptivity toward new culture patterns, whether imported or locally developed. When both efficacy and diversity are high there is presumed to be a synergistic support for general adaptivity and control in the biophysical realm.

The interpersonal realm is represented by two variables, affiliation and autonomy. Affiliation measures the degree of affection given and received by an individual and includes items that measure a perceived altruistic social environment (or its lack). Autonomy includes items that measure the autonomy allowed or desired for others, (i.e. tolerance) as well as items

characterizing autonomy for the self. When both types of autonomy are high there is presumed to be a synergistic effect with affiliation. Together affiliation and autonomy support altruistic behavior.

Determining measures for adaptive potential in the symbolic realm is still in an experimental stage. The three categories explored in the current study are creativity, meaningfulness, and coherence. In an earlier study (Colby 1987) creativity was measured in terms of two subcategories, imagination and metaknowledge, the latter focusing on reality control and the ascertaining of truth. The rationale for categories in the symbolic realm has been based on interpretations of evolutionary theory as it relates to symbolic behavior. Recent studies have highlighted the rapid increase of the prefrontal cortex as marking a uniquely human evolutionary development (Damasio 1999; Deacon 1997) suggesting that the adaptive potential variables in the symbolic realm should include variables relating to goal orchestration, a primary function of the prefrontal cortex. Meaningfulness and coherence building are key components of goal orchestration and are required processes in creative symbolic behavior, particularly language. This aspect of the report is thus provisional. Generally, then, though we use an anxiety scale widely used in psychology for one of our variables, our theoretical approach, we think, is uniquely anthropological.

What follows are some examples of particular questionnaire items from each of the adaptive potential scales. The scales run through seven points starting from the negative side with "strongly," "moderately," and "slightly disagree" to "neutral" and then to "slightly," "moderately," and "strongly agree" on the positive side. The examples below include both pro-trait and con-trait items. That is, questions in which an "agree" answer indicates a positive value for the variable are balanced, with questions in which an "agree" answer indicates a negative value.

The adaptive potential questionnaire consists of 83 items[6] The items were summed in each subcomponent for a final adaptive potential measure with an arbitrary weighting of 27 items for the biophysical realm, 38 for the interpersonal realm, and 18 for the symbolic realm. This weighting it not theoretically determined but simply reflects the success of earlier exploratory studies which yielded different numbers of items that best represented the conditions of adaptive potential determined in the first theoretical formulation. That is, though the theory's rationale and initial postulation of adaptive potential conditions derived from a superordinate evolutionary base that encompassed both natural selection and cultural selection (see Colby, this issue) the selection and testing of individual items thought to best represent these conditions has been a bottom up approach. This is an eminently anthropological approach represented in one of its aspects as the "emic" quest. This bottoms up approach is characteristic of a general propensity among anthropologists who seek ways in which the data speak to the ethnographer rather than let preconceived categories prejudice ethnography. Conceivably future studies might even lead to a reformulation of the superordinate evolutionary theory, not, certainly the more specific processes of natural selection, but rather for the more complex and still uncertain approaches to the theory of cultural selection or perhaps better phrased, of cultural

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[6] . In addition to the 83 AP items were 31 sicknesses or symptoms in the SickStressTot measure. A conservative approach was taken to missing answers by excluding from the analysis any cases that omitted one or more answers.

transmission.   Thus in our two-phased approach of test and exploration, we might use standardized (z-scores) measures in lieu of raw scores for some purposes to reflect a balanced weighting of the test categories but for the most part we use raw scores which better reflect the validity of our measures in this still quite early stage of development in the theoretical program. In each new study we distinguish between items that have been used in prior studies (test items) and new items as exploratory items (not used in test results, but used in subsequent exploratory analysis for further development of the theory and the measuring instrument. At this time, theory for the interpersonal realm has been most developed and we thus are more confident in the validity of these measures than in the measures for the other two realms.   Table one below shows examples of items used in the questionnaire for this study.

Condition	Item Examples
Efficacy (21)	People believe that you are very good at your job or whatever tasks you are engaged in. (P) These days you find you are performing at your best and can achieve what you want with very few difficulties. (P)
Diversity (6)	Variety in your studies and work is stressful. (C) You feel more comfortable specializing in just one task or subject. (C)
Autonomy (18)	You practically never need strong guidance and advice. (P) If you are too flexible with others they'll take advantage of you. (C)
Affiliation (20)	The people you love have a caring intimate way of relating to you. (P) The people you are in contact with most of the time are selfish. (C)
Creativity (6)	You have no opportunity to satisfy your need for creativity. (C)
Meaningfulness (5)	You often have a chance to do things that give you a feeling of enthusiasm for being alive. (F)
Coherence (7)	Some of your most important life goals are in conflict with other goals or ideas that you value. (C) Everything in your life is well-ordered and harmonious. (P)

Table 1 *Showing selected items of the Adaptive Potential scale used in this study.*

Illnesses and Symptoms

The first dependent variable used in this study is a measure of health based on an inventory of the sicknesses and symptoms experienced by the individual. The health inventory consisted of 31 common medical problems selected from measures used by Belloc, Breslow, and Hochstim (1971) and Belloc and Breslow (1972) for an adult population. Among the items were high blood pressure, asthma, and frequent headaches. One new item, depression, was added. The list of symptoms was originally used on an elderly population (Colby, et al. 1985) and was employed with the UCI student sample as a means of comparison (subsequently we have used the Cornell Medical Index which we consider to be more appropriate for a general population, including students). The list was presented to the respondents in an attempt to

assess perceived stress of the symptoms in the following words: Please circle 'yes' for each condition that you have had in the past six months (from September 1994). Indicate how stressful the problem was during the worst time for each problem on a scale from 1 to 5.

If respondents had one of the listed problems in the past six months they were to circle yes and score whether the problem was stressful on a scale of 1 to 5, "Not at all," "A little," "Somewhat," "Very," and "Extremely." The three most frequently checked items were "depression," "getting very tired in a short time," and "frequent headaches." Four items were not checked by any student: "stroke", "epilepsy" "cancer" and "chronic liver trouble." The summation of the symptoms and illnesses along with perceived stress is given the variable name, SickStressTot.

Taylor Manifest Anxiety Short Form

A second dependent variable is an anxiety scale as a measure of psychological health and as an indicator of stress. Taylor's personality test for the measurement of anxiety has been widely used in psychology (Taylor 1953). The test items were originally taken from the Minnesota Multiphasic Personality Inventory (MMPI) an instrument designed to cover the main symptoms and types of behavior disorder. The Taylor Manifest Anxiety Scale was validated in several studies that examined correlations between anxiety scores and clinical ratings of anxiety by psychiatrists (Taylor 1956). This test is in a true/false format.

In our study of college students we used a later, unidimensional short form of Taylor's Manifest Anxiety Scale (Hicks, et al. 1980). This shorter scale was constructed after finding that a number of factor-analytic studies of the items in the original scale revealed the presence of more than a single factor. The short form of the scale has the advantage of being only twenty items long (as opposed to the original fifty items). They were selected from among the original items on the basis of their heavy loadings on the main manifest anxiety scale factor and low loadings on the other factors. The score is obtained by summing the number of items marked as true.

Open-ended questions

Three open-ended questions were an important part of the study for two reasons. (1) In an anthropological study such as this that involves quantitative measures and large numbers of respondents, we required some form of deeper information to add context to the quantitative results. (2) This study is part of an ongoing theoretical program. Further development of the theory requires going beyond questionnaire items to the context of analysis of texts produced by each respondent to further explore the variables and the variable space (conceptual areas overlapping in semantic content with the variable being measured). These questions were thus useful to interpret the results as we do here for some unusual cases, and also for further study and development of the theory not reported here.

For these reasons we chose two of the standard Murray TAT pictures; picture 1 depicting a ship captain talking with a man; and picture 4, a lab scene with two women (Smith 1992: 633 and 636). The pictures were printed directly on the questionnaires. One last question was open-ended: "Finally, are there any major life events, problems, or situations that

are affecting you (positively or negatively) now or over the last few weeks? If so please describe them in the space below:"

FINDINGS

We measured the amount of time our informants spent in an English speaking country and noted their country of birth. While native born students had a slight edge (standardized z-scores in Adaptive Potential were slightly above the 0 mean at 0.255 for US-born and slightly below at -0.189 for foreign-born students) the difference was not statistically significant. There were 22 countries represented in the sample but only Vietnam, Korea and the Philippines were large enough for any meaningful comparisons and for these groupings there were no significant differences in adaptive potential. On the possibility that the Adaptive Potential score was related to command of English we looked at the variable indicating age of learning English on the assumption that the later the age at which English was learned, the less competent would our respondents be in the language and the underlying presuppositions of general California cultural patterns. All foreign-born students already had to have passed a TOEFL test of English competence before admittance to the University. No significant differences in adaptive potential were found to exist above this standard level of competence.

This and prior analyses have proceeded in two phases, a testing phase, in which the original theory of the adaptive potential (APtot) and sickness (SickStressTot) relation is tested, and an exploratory phase in which the most successful items (as judged by their individual correlations with the dependent variable, SickStressTot) are analyzed to develop a better conceptual definition and refinement of our measures. The exploratory phase includes an admittedly very speculative analysis of the open-ended questions in individuals identified as having a key position (for or against the theory) in the distribution of cases (see figure 1 below).
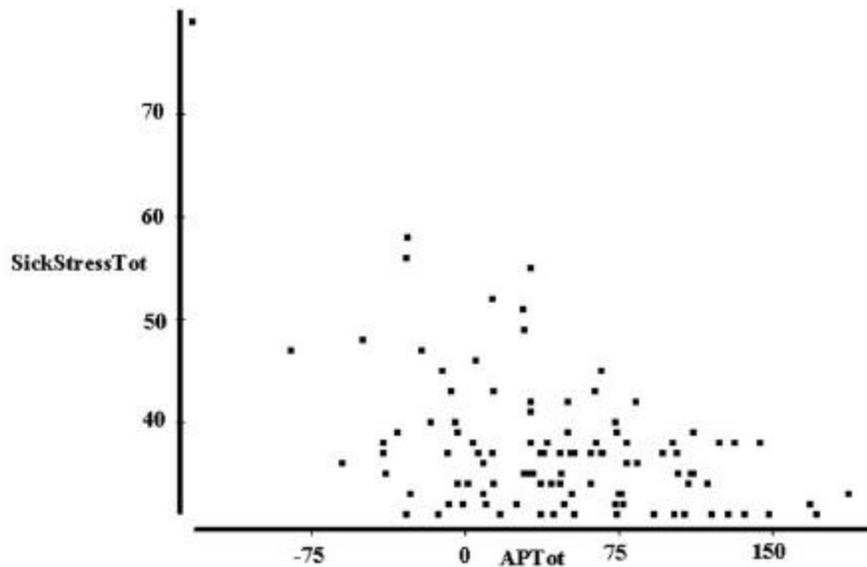

Figure 1: Showing a scatergram of cases plotted against symptoms and their perceived stress (SickStressTot) and Adaptive Potential scores (Aptot).

In our initial regression the raw score APtot with its heavier weighting in the biophysical and interpersonal realms had an R of -.46 (p < 0.0001) thus supporting the theory. Adding Gender and US-birth does not significantly reduce the adjusted power of the adaptive Potential measure (i.e. from – .46 to -.45). The overall result is reported in Table 2 below as R squared, representing the percentage of variance explained by the relationship (21.6%).

```
Dependent variable is:                      SickStressTot
No Selector
131 total cases of which 26 are missing
R squared = 22.3%    R squared (adjusted) = 21.6%
s =  6.270  with  105 - 2 = 103  degrees of freedom
```

Source	Sum of Squares	df	Mean Square	F-ratio
Regression	1162.60	1	1162.60	29.6
Residual	4049.64	103	39.3169	

Variable	Coefficient	s.e. of Coeff	t-ratio	prob
Constant	40.1502	0.7817	51.4	≤ 0.0001
APtot	-0.058614	0.0108	-5.44	≤ 0.0001

Table 2: *Showing a regression analysis of sickness and Adaptive Potential*

If we return to the scattergram (Figure 1) it can be noted that there is clearly one distant outlier with an unusually high number of symptoms and a very low score on adaptive potential. How important is that one individual in the test? Removing this individual, ML711 yields the following regression results (Table 3 below):

```
Dependent variable is:                      SickStressTot
cases selected according to                 ML711excluded
131 total cases of which 27 are missing
R squared = 14.4%    R squared (adjusted) = 13.5%
s =  5.400  with  104 - 2 = 102  degrees of freedom
```

Source	Sum of Squares	df	Mean Square	F-ratio
Regression	499.642	1	499.642	17.1
Residual	2974.19	102	29.1588	

Variable	Coefficient	s.e. of Coeff	t-ratio	prob
Constant	38.9976	0.6995	55.8	≤ 0.0001
APtot	-0.040384	0.0098	-4.14	≤ 0.0001

Table 3: *Regression of stress of sickness symptoms (SickStressTot) and Adaptive Potential scores with outlier ML711 removed.*

We see in this table that the extreme outlier ML711 does not make or break the test

results.   At this point we can look at the probability plot of leverages to look for other influential cases (Figure 2 below).
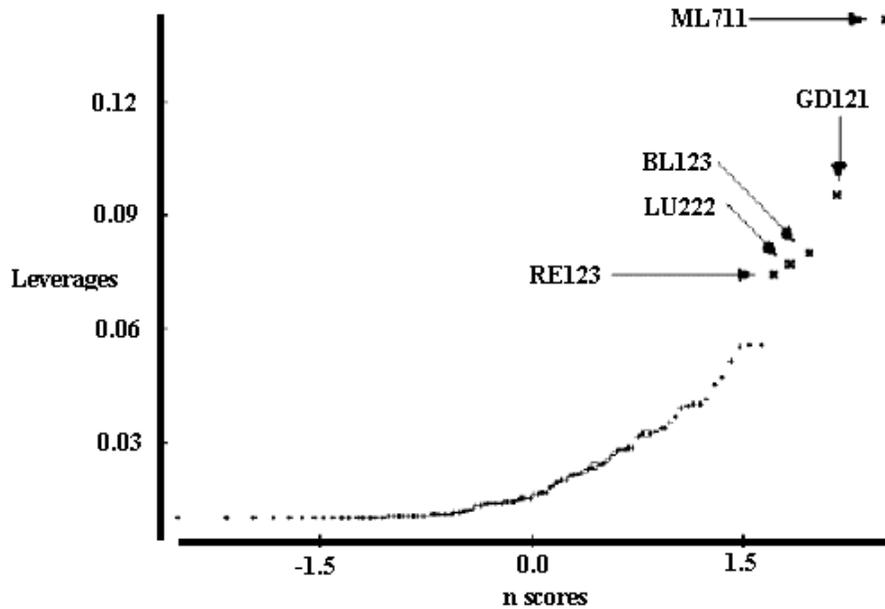

Figure 2: *Showing leverages for each case, indicating their relative influence on the regression analysis.*

In addition to the ML711 outlier, there are four other strongly influential cases indicated by x's (Figure 2). To continue in this conservative approach, we remove the five most influential cases and test the theory with the remainder of the cases. When this is done the hypothesis is still supported at a significant level, though of course to the substantially lesser degree as shown in Table 4:

```
Dependent variable is:              SickStressTot
cases selected according to          Minus 5 greatest leverage cases
131 total cases of which 31 are missing
R squared = 10.5%    R squared (adjusted) = 9.6%
s = 5.485 with 100 - 2 = 98 degrees of freedom
```

Source	Sum of Squares	df	Mean Square	F-ratio
Regression	347.208	1	347.208	11.5
Residual	2948.23	98	30.0840	

Variable	Coefficient	s.e. of Coeff	t-ratio	prob
Constant	38.8503	0.7405	52.5	≤ 0.0001
APtot	-0.038146	0.0112	-3.40	0.0010

Table 4: *Showing the regresson of stress of sickness symptoms (SickStressTot) and Adaptive Potential scores after the five most influential cases have been removed from the analysis.*

In this study, then, the theory survives a draconian elimination of cases but the correlation is certainly not robust. On the other hand, one should consider all the factors that are likely to go into this variance. In the phenomena we are investigating one should expect a substantial amount of the variance to have a genetic or phenotypical origin that is beyond our ability to measure. We do not subscribe to a blank slate view attributing a very large preponderance of adaptive potential to purely cultural or historical experience. Clearly there are predispositions with genetic or very early developmental origin that relate to physical and mental health. There is currently no way we can separate the cultural and experiential factors from the genetic ones. Even were we to have DNA samples from the respondents at the present stage of research in gene-related health factors there is not much we could do. So we are agnostic about what the true weighting of genetic versus cultural factors might turn out to be, if indeed it ever could be determined even as a range of variability. Most likely it is a highly variable ratio in itself from one individual, domain of activity and cultural setting to another. Further, with the removal of the five most influential cases we still are in the range of published studies of life events, social support, and other factors shown to relate to health in the field of health psychology. Most studies in this area that relate questionnaire results to sickness are not robust, typically they are correlations in the low .30's (The much celebrated Holmes and Rahe Life Event Studies were in this low range) or 9% of the variance. That's where we are with the five most influential cases removed and with an adaptive potential questionnaire that is still under development.   Indeed there is much ahead of us in further development of the measuring instrument and the theory, including factor analyses, reliability measures and other matters typical of a more mature stage in scale development.
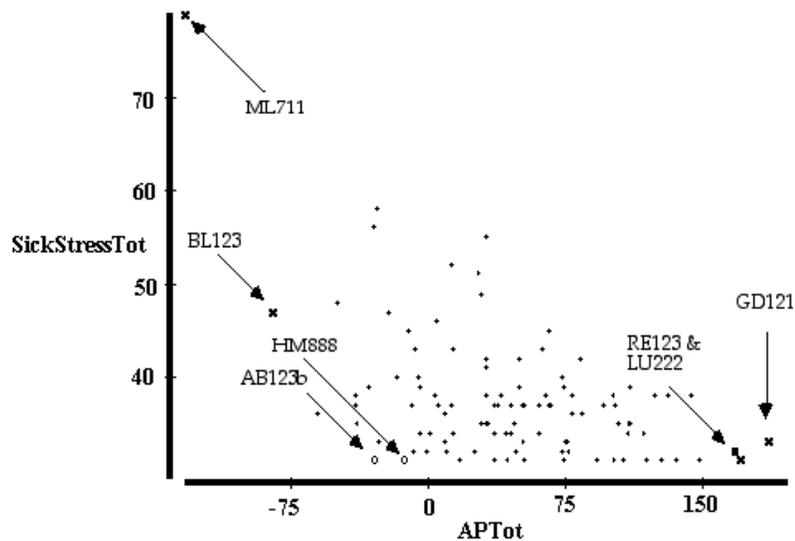

Figure 3: *Showing the scattergram of all (complete) cases plotted with SickStressTot against Aptot.   The five most influential cases supporting the hypothesis being tested are marked x. The two cases most opposing the hypothesis are marked as o.*

It is at this point that we go beyond the numbers. Perhaps this is one of the areas that are eminently anthropological in approach where the detailed analysis of individuals and their circumstances give some substance and meaning to the numbers. At the same time, this is the most frankly speculative aspect of the exploratory phase of our analysis. In figure three (below) where adaptive potential scores are plotted against sickness stress scores the five most influential cases supporting the hypothesis are shown as x's and the two cases most contradictory to the hypothesis are shown as o's.

Of the five most influential cases two (ML711 and BL123), are very low in adaptive potential and high in sickness cases as predicted. The other three are exhibit high adaptive potential and low sickness, again as predicted. This exploratory analysis, is to some an ethnographic approach, albeit limited to the three open-ended questions rather than to an interview or site visit. Just as an ethnographer in the field is likely to single out unusual informants rather than choose randomly selected individuals to interview, we single out what look like key cases for and against the theory to gain greater depth in a more discursive aspect of theoretical development. Thus a discussion of individuals that occupy spaces around the edges of Figure 2 can be useful in assessing the viability of our adaptive potential theory as currently outlined. In the discussion that follows each case is referenced by its five digit identifier. To protect the participants in the study, national or geographic provenance is deleted since we found no significant differences in the few ethnographic groups large enough to look for differences relevant to the study. However the identifiers are kept. The investigators have no records linking the identifier number (made up by the respondents at the time of the test) with individual names.

TEXT ANALYSES OF CASES

Low Adaptive Potential, High Sickness: Case ML711

The respondent is a 21- year-old woman.   She marked high levels of stress ("Very" or "Extremely stressful") for 12 items and in addition listed: "hemorrhoids, constipation, yeast infection and angina" for the write-in questions at the end of the sickness list.   Both of her TAT stories had medical themes. The lab story was described as two physicians testing for blood samples for several diseases, one of the physicians is concerned about the results for her patient.

The ship captain story begins by identifying one of the characters as a ship captain who is later converted to a doctor prescribing an "anecdote" (sic) for motion-sickness. Is this Freudian slip (anecdote for antidote) indicative of anything? Might this student have been raised in an environment that provided psychic income for stories of illness or might the student have been responding to her perception of the experimental task and design? Analyses of other cases, particularly the open-ended questions, many of which were quite frank and confidential, suggest that the students generally were indeed serious in their responses.

ML711's open-ended life event description is minimal in comparison to most others: "debating about grad school; setting a date for my wedding."   We also note that her anxiety score was 19, the highest in the sample (see the later section). In another question she considered her physical condition to be +1, "all right," on a 7-point scale running from -3

through 0 to +3.

In answer to the question, "How many times have you seen a doctor about your health between now and the beginning of last September?" The respondent answered 2. (Median for the sample is 1, Mean 1.43, Standard Deviation 1.54). To the question, "How many times in the last (fall) quarter or this (winter) quarter have you missed a class because you felt bad or stayed home sick?" The answer was 4 (Median is 2, Mean 2.88 and Standard Deviation is 7.54).

By removing this unusually leveraged case the t-ratio reduces from -5.44 to -4.14 but remains statistically significant (p <0.0001).1 Throwing out the most supportive case for a theory to see how the theory holds up is useful in assessing the theory as stated. To understand the inner workings of the variables involved, though, would seem to require giving special attention to the exploratory analysis of such cases. Paradoxically, however, while this case strongly supports our theory, the preoccupation with health and the high anxiety may have prevented the emergence of material in the two stories that might throw light on underlying dynamics among the theoretical variables or on relevant processes not yet recognized by the theory. What can we learn from other cases around the edges of the distribution?

Low Adaptive Potential, High Sickness: Case BL123:

This respondent is a male. His ship captain story describes a KGB agent emigrating to the United States as a spy. The agent is caught by the captain for carrying a weapon.

His lab story describes a lab assistant who is jealous of her supervisor and falsifies the research to discredit her so the assistant can take her job. The jealous assistant accidentally makes a discovery that renders nuclear weapons obsolete. "The assistant takes the credit for getting rid of weapons by making them obsolete."

In reporting life events in the last open ended question this respondent mentions a date who left him for his friend. This friend had once driven into a tree and was suspected of being suicidal. The student lists unhappiness with his schooling and worry about college admissions. He says he has "clinical depression" and that "most events in my life affect me in a negative manner."

The negativity in all three open-ended writings is consistent with his low adaptive potential and high sickness score. We assume it likely, when he says he has "clinical depression" that he has, in fact been diagnosed by a health professional. He missed class three times because of feeling bad or sick. Concern over weapons and destruction, truth, duplicity, rejection and recognition suggest impairment of affiliative bonds and lack of trust in the social realm as the most overriding element with this respondent. Trust bridges the affiliation component of the symbolic realm and the truth (metascience or verification) component (which we did not measure in this study) in the symbolic realm. In this case we find intuitive support as well as statistical support for the theory.

High Adaptive Potential, Low Sickness: Case GD121

Another respondent whose statistics give strong support to the theory is this female. Her ship captain story describes a conversation between the captain and a private investigator

about missing evidence. The captain describes the events that led to the problem on his last trip.

In her laboratory story the two experimenters are very interested in learning what the outcome of their experiment will be. One of the women is learning about procedures from the other. Both stories describe cooperation between the two protagonists who are trying to solve a problem or conduct an experiment.

In her life events answer the respondent says she has no difficulties other than getting adjusted to a quarter system of courses. On the positive side she says she is "doing very well in volleyball which helps to raise my attitude on life." She has seen a doctor twice and missed class once because of feeling bad or sick.

The positive attitude about her life in the social and biophysical realms is consistent with high adaptive potential. Here the affiliation component takes the form of working together toward a common goal. Learning about procedures exemplifies the efficacy component. These areas in the student's life appear to be problem free in her written responses.

High Adaptive Potential, Low Sickness:Case LU222

Strong statistical support to the theory as tested comes from another female. Her ship captain story is short. A would-be passenger has just missed the boat and "is being told by the boat guy that he is too late."

Her lab story interprets the two women to be students in a microbiology class: "The woman who is measuring one of the microbe materials is getting frustrated because she can't seem to get the micropipette to work correctly. And her lab partner is furthering her state of frustration due to the fact that she is not offering to help and is just observing with her hands in her pockets." This suggests a focus on problems in the external environment that relate to the efficacy and affiliative components of adaptive potential which run counter to her statistical position of high AP and low sickness.

If there is indeed conflict in areas of the biophysical realm, it may be compensated for by high success in the interpersonal realm as indicated by the following general note regarding positive and negative events: "Positive-- 1. I got chosen to be a ... staffer (yeah)!!! 2. I got initiated into my sorority. 3. My little sister (who I love and am very close to!) got her acceptance letter to (this university) for fall. Stressful-- 1. Final interview (stage 3) for {deleted} position. 2. Date with boy that I adore." Here the life events description indicates positive social successes including the advance to stage 3 in her application for a particular position of importance.   While she indicates some concern regarding future interpersonal success, that may suggest nothing more than a heightened concern that is functional for attaining that goal. Since adaptive potential theory goes beyond the individual to the individual's material and social surroundings, the portrayal of an unhelpful lab partner may be relevant.   Being late for an appointment bridges the area of efficacy in the biophysical (material) realm and affiliation in the interpersonal realm. This respondent has not visited a doctor nor has she missed class for health reasons.

High Adaptive Potential, Low Sickness: Case RE123

This female was born in {one country} with a family background in {another}. All three of her texts show a strong concern with relationships, and the positive qualities (intelligent and kind) of the woman - the first between a woman and her coworkers, the second between the Captain and his date, and the third about the respondent's recent boyfriend who is a cut above all previous ones.

The student appears to attribute to her new boyfriend and the captain in her story those qualities she values in herself. The captain story: "Captain Stubing checks himself out in the mirror before leaving for his hot date with Maria. He feels extremely excited and cannot wait to see the woman he has been waiting for all of his life. Unlike most women he has been meeting, Maria is kind, real, and has a passion for life. She is beautiful, yet not conceited and also is looking forward to seeing the captain once again."

The Lab story: "a doctor, must often prove herself to her co-workers even though she, too, has pursued her medical education in the US. However, after others realize her intelligence as well as her genuine kindness, they often rid themselves of their preconceptions. Everyone begins to see {her} as an excellent physician and scientist, but it is unfortunate that they questioned her initially."

In the life events questions this respondent writes: "After many relationships, I have often felt unsatisfied with the men I had been meeting. I pretty much "gave up" looking and decided the right relationship will come along when the time is right. After being single and a "player" for two years, I have just met a very beautiful man and friends have noticed a "glow" on my face. No, I didn't need him to "make" me happy, but he gives me something to look forward to and allows me to express all the love I have inside!"

The overriding concern and positive attitude about matters of affiliation are quite evident in these stories. This respondent's standards of personal qualities for herself and her boyfriend suggest both high affiliation and autonomy and thus is consistent with a high score in adaptive potential. She has not seen a doctor in the stated period and has missed one class because of illness.

Non-Supporting Cases: Case HM888

Now we examine some cases from the non-supportive edges of the distribution. Case HM888 is male student. His low adaptive potential score would indicate a high sickness score, but he lists no sicknesses.

His TATs are mixed, the first story is about a general emphasizing careful preparation for war but a ship captain who is carefree and doesn't worry.

In the lab scene two women have discovered a special cure for an unknown disease. They are optimistic about their discoveries and hope that this formula would help save lives. Their main concern now is the availability of the cure, and the uncertainty about their discovery.

The life events description reflects the theme of the first story and is mixed regarding the respondents own feelings: "Yes, there are some (life difficulties); however the one that comes to mind at this moment is getting through all of my classes. Coping with the stress about classes and worry, are so stressful; that there are days when I have thought about suicide. Moreover

there are days that I can see blue sky and heard the birds sing. In other word, life is good. But the motto to live by now is life is short, plan."

This respondent did not answer the question about seeing a doctor or missing classes. However the thought of suicide does suggest pathology and thus on an intuitive basis would give more support to the theory than his distributional position would indicate. On the other hand, there is nothing in the TAT stories that would suggest low adaptive potential. Since all respondents were anonymous there was no possibility of a follow-up interview to get more details.

Non-Supporting Cases: Case AB123b

This female student also has low adaptive potential and a low sickness score which runs against the theory. In her first story she visualizes an airport scene. A minor malfunction of an aircraft may lead to a cancelled flight. The copilot is wondering how passengers will feel about it. He feels bad for them but feels happy for himself so he can return to his wife. His marriage has suffered from his job.

In the lab scene two students are involved in an experiment. "This chem lab student named Beth is demonstrating to Sue how to do an experiment. Sue, who is Beth's lab partner, isn't sure if she can do it. In fact, she's not even sure if she wants to be in Chem lab. Both her parents are doctors, which is what Sue wanted to be at first. But, now she's having second doubts. Chemistry seems too difficult for her and she's wondering how she can tell her parents about changing her major." This student has not seen a doctor nor missed a class.

The material here suggests there may be instances of conflict between goals in the material world and goals of affiliative relationships where the student's life goals are in conflict with the wishes of others, namely parents and spouse. There is no answer to the life events question. These results would corroborate the lower score in adaptive potential but there is no inverse relationship between the low adaptive potential score and illness symptoms.

ANXIETY AND ADAPTIVE POTENTIAL

In addition to the correlation of AP with physical health, we wanted to test for general sense of well-being through low scores on a measure of anxiety. There are important differences between the two, however. The AP scales were first developed to match variables indicated by theory whereas anxiety scales are typically developed clinically. Further, an important conceptual difference between the AP Scale and the Taylor Manifest Anxiety Scale is that adaptive potential involves abilities, attitudes, values and dispositions of the individual as well as reflect the individual's cultural, social and material environment as perceived by the individual, all of which, in turn, can contribute to psychosomatic processes. Anxiety scales, on the other hand, are restricted to the mental consequences of stressors, particularly habitual stress reactions.

There is also a difference in how data points are scattered when adaptive potential is mapped against anxiety in Figure 3 and the scattergram of adaptive potential with sickness in Figure 2. The first is contained by a stretched-out ellipse while the second is in the form of a wedge.

To explain this distribution, and as a general speculation, we posit an adaptive potential--defense mechanism relationship: With lower adaptive potential people are less successful (in a very broad biological and cultural sense) and more prone to feelings of inadequacy and anxiety. These feelings may be relieved with ego-protective defenses identified early on in psychoanalytical approaches but that extend to include cultural defense mechanisms: ideological defenses such as ethnocentricity, collective biases, racism, authoritarian explanatory attitudes ,and obsessive rituals. Thus the wedge-shaped distribution (rather than a more closely linear shape around the regression line) in the scattergram of APtot with illness (figure 2 previously shown above) shows a greater spread of illness indicators at the low APtot end. One hypothesis that would account for such a spread is that at the low end cultural and individual defense mechanisms act to compensate for low adaptive potential by lessening stress and consequent poor health through collective projection, spurious reality construal and other common defenses expressed in cultural patterns. If this linkage of individual defense mechanisms to institutionalized cultural defense mechanisms are borne out (being investigated in new studies) it would open up a new and so far little explored area of cultural analysis with special relevance to current social concern with the survival of seemingly dysfunctional (fundamentalist authoritarian) religious ideology.
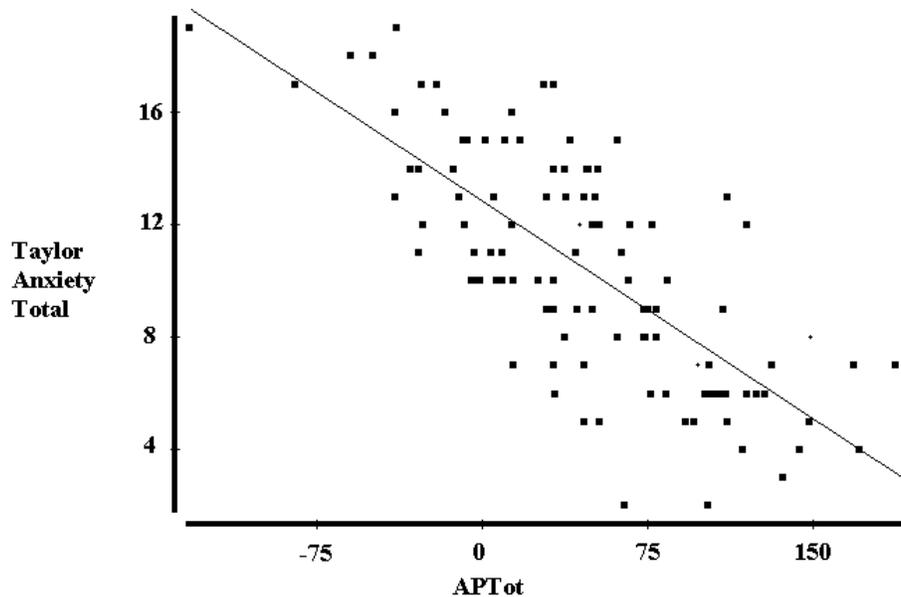

Figure 4: *Scattergram of standardized scores for Adaptive Potential (zzAptot) plotted against standardized scores for the Taylor Anxiety Scale (zTaylorAnxiety) with regression line drawn.*

```
Dependent variable is:                    Taylor Anxiety Total
cases selected according to               ML711excluded
131 total cases of which 27 are missing
R squared = 51.3%    R squared (adjusted) = 50.8%
s = 2.822  with  104 - 2 = 102  degrees of freedom
```

Source	Sum of Squares	df	Mean Square	F-ratio
Regression	856.374	1	856.374	108
Residual	812.462	102	7.96532	

Variable	Coefficient	s.e. of Coeff	t-ratio	prob
Constant	12.8710	0.3656	35.2	≤ 0.0001
APtot	-0.052870	0.0051	-10.4	≤ 0.0001

Table: 5 Showing the relationship in a regression analysis between AP and the Taylor Manifest Anxiety Scale with the most leveraged case, ML711 excluded. It shows that adaptive potential and anxiety are negatively related accounting for 50.8% of the variance.

As table 6 shows when the Taylor Anxiety measure is brought into the regression equation of APtot on SickStressTot, the explanatory power of APTot drops dramatically to just barely maintaining statistical significance at the .05 level, reflecting how closely the two are correlated, yet the contents of both scales are quite different and derived in entirely different ways.

```
Dependent variable is:                    SickStressTot
cases selected according to               ML711excluded
131 total cases of which 27 are missing
R squared = 15.7%    R squared (adjusted) = 14.0%
s = 5.385  with  104 - 3 = 101  degrees of freedom
```

Source	Sum of Squares	df	Mean Square	F-ratio
Regression	545.269	2	272.635	9.40
Residual	2928.57	101	28.9957	

Variable	Coefficient	s.e. of Coeff	t-ratio	prob
Constant	35.9474	2.530	14.2	≤ 0.0001
APtot	-0.027855	0.0139	-2.00	0.0484
Taylor An...	0.236981	0.1889	1.25	0.2126

Table 6: Showing APtot and the Taylor Anxiety Scale in a stepwise regression on SickStressTot.

CONCLUSION

In the sample studied here we report two main findings resulting from tests of two hypotheses suggested by adaptive potential theory. The first hypothesis is that adaptive

potential and physical illness (as measured by symptoms) and the perceived stress associated with that illness are negatively related. The second is that adaptive potential and psychological illness (as represented by the Taylor Manifest Anxiety Scale) are also negatively related. We found both to be supported.

We have shown that there is not only an inverse relationship between adaptive potential, a measure that covers psychological, sociological and cultural aspects of life adjustment on the one hand, and physical health on the other; but also between adaptive potential and anxiety, a more purely psychological measure. Since the content of these two scales are quite different and are based on very different theoretical origins (a theory of natural and cultural selection versus clinical description) they give some support to each other as independent measures of universal proximate indicators of health, longevity, and well-being. We see these results as constituting a useful base for a pattern/schema view of culture and biocultural selection (natural selection, cultural transmission and coevolution) where adaptive potential arises out of interaction between universal human bodily needs, dispositions, and processes and local cultural and behavioral manifestations. Much of this study is exploratory in nature and is part of an ongoing research program.

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