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NON-LINEAR REGRESSION MODELLING OF TRADITIONAL AND BIOMEDICAL APPROACHES TO HIV/AIDS PREVENTION IN MALAWI

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Abstract

A recent study of the credibility of sources of information about AIDS prevention in Malawi, identified three orthogonal factors: Modernity, Traditionalism and Biomedicine. The purpose of the present study was to investigate the inter-relationship between these factors using innovative non-linear regression techniques. The sample comprised 175 undergraduate Malawian university students. At low levels of endorsement of Tradition (the splitting factor) there was a significant linear relationship between endorsements of Modernity (IV) and Biomedicine (DV). However, this relationship became progressively weaker as endorsement of Traditionalism increased, until at the highest level of Traditionalism there was no linear relationship between endorsements of Modernity and Biomedicine. These results indicate that the degree of Traditionalism moderates the normally linear relationship between endorsements of Modernity and Biomedicine, at least in the case of some AIDS prevention initiatives. We discuss the implications that the complex, non-linear, interaction of these variables has for the planning, provision and uptake of biomedical and traditional healing systems, regarding AIDS prevention in developing countries.

Key words: Cognitive tolerance, complexity theory, health care, AIDS prevention

Résumé

Une étude récente du degré de crédibilité des sources d'information en

matière de prévention du SIDA au Malawi, identifie trois facteurs orthogonaux: le Modernisme; le Traditionalisme; et la Biomédecine. Le but de l'étude présente est d'examiner la corrélation entre ces facteurs en utilisant des techniques de régression innovatrices et non-linéaires. Le sondage porte sur 175 étudiants Malawiens. Lorsque le degré d'adhésion à la Tradition (facteur de fission) est bas l'on peut noter une relation linéaire conséquente entre les adhésions au Modernisme (Variable Indépendante) et à la Biomédecine (Variable Dépendante). Cependant, cette relation s'affaiblit progressivement à mesure que l'adhésion au Traditionalisme s'accroît, jusqu'à disparaître complètement quant elle atteint le plus haut niveau de Traditionalisme. Ces résultats indiquent que le degré de Traditionalisme modère la relation - normalement linéaire - entre l'adhésion au Modernisme et à la Biomédecine, tout au moins dans le cas de certaines initiatives de prévention du SIDA. Il s'ensuit une discussion sur les implications que l'interaction complexe et non-linéaire de ces variables a sur le planning, l'approvisionnement et l'utilisation des systèmes curatifs biomédicaux et traditionnels, dans le cadre de la prévention du SIDA dans les pays en voie de développement.

Les mots cléfs: La tolérance cognitive, la théorie de complexité, les prestations en matière de santé, la prévention du SIDA

Introduction

In many societies there appears to be increasing choice in health services and providers. In many 'Western' countries, Eastern and traditional therapies constitute an increasing range of alternative treatments, to the dominant biomedical model, while in many 'developing' countries, biomedicine is seen as the 'modern' alternative to a plethora of extant traditional therapies and healers. We have previously described the ability to entertain more than one ontology of health and illness, as "cognitive tolerance" (MacLachlan and Carr, 1994a) and speculated that people entertain mixed-modal-models of health and illness, the world over. For instance, in many 'Western' countries, people may simultaneously pray for their cancer to be cured, receive chemotherapy and seek counselling. However, such an amalgam of spiritual, biomedical and psychological mediums may be more acceptable (or tolerable) to some people, than it would be to others. Those who experience cognitive dissonance (Festinger, 1957) between different belief systems may resolve their discomfort by opting for a single-modal-model regarding the mechanisms of health and illness.

In many 'developing' countries the development of biomedically orientated health systems has occurred parallel to, rather than in conjunction with, extant traditional healing systems. In essence, these different healing systems constitute two different knowledge bases, and the choice of which system to access, may be mediated by comparative knowledge concerning the two systems, cost, proximity, religion and other factors. However, even with similar knowledge of each system, for some the difference in approach may be easily reconciled, with patients attending both biomedical and traditional healers. Yet for others, the two approaches may appear contradictory and irreconcilable. In this latter case, 'cognitive dissonance' may motivate individuals to adopt one approach or the other, but not both. However, we envisage the propensity towards cognitive tolerance - the ability to entertain more than one ontology of health and illness - being distributed along a continuum, rather than being present or absent, in an all or none fashion (Carr, Mc Auliffe & MacLachlan, 1998).

We have previously reported a high degree of cognitive tolerance in studies of malaria, schistosomiasis, epilepsy and mental disorder in Malawi (see MacLachlan and Carr, 1994a, for a review). For instance, even though people in a rural community believed in a spiritual cause of malaria, the majority would seek a biomedical treatment for the disease (Ager, Carr, MacLachlan and Kaneka-Chilongo, 1996). Such findings may reflect a pluralistic and pragmatic integration of different ontologies (MacLachlan, 2001).

In a study of the credibility of different sources of information about AIDS/HIV prevention, biomedical doctors and nurses scored significantly higher than traditional healers, among a sample of Malawian university students (MacLachlan and Carr, 1994b). If belief in a biomedical ethos was felt to be inconsistent with belief in a traditional ethos, then we would have expected to find a significant negative correlation between these ratings (which were made on a four point Likert-type scale). In fact, we found no significant relationship between credibility ratings of doctors and nurses on the one hand, and traditional healers on the other hand. Individual's, who rated doctors and nurses as being highly credible sources of information regarding AIDS/HIV prevention, were no more likely to rate traditional healers as lacking credibility, than they were to rate them as being highly credible.

Our Factor Analysis of the ratings of these and other sources of information about HIV/AIDS prevention (see MacLachlan and Carr, 1994b), found that while doctors and nurses clustered together as one *'biomedical'* group factor, traditional healers were most strongly associated with friends, religious advisors and family. This may be characterised as a *'tradition'* factor. A third factor also emerged from our analysis, and included

newspapers, radio and government posters. Each of these media, being (in Malawi) relatively modern sources of information, may in combination constitute and index of orientation towards '*modernity*'.

The interplay between these three factors - biomedicine, traditionalism and modernity - is of considerable importance to health service planners. In most developing countries the relative scarcity of resources demands their optimal distribution. Where different models of health are coexistent, and consumers of health show a degree of tolerance towards different approaches, it may be very difficult to predict the demand for different sorts of health care. In most 'developing' countries (and in contrast to more industrialised ones) the biomedical sector is the alternative to mainstream traditional services. An 'easy' prediction would be that increasing acceptance of modernity will be associated with a preference for biomedical services. That is, that there is a linear relationship between the two. However, as we found no linear relationship between credibility ratings of traditional and biomedical practitioners, at least with regard to HIV/AIDS prevention, such an assumption is clearly not justified.

There may be no relationship between modernity and biomedicine, or it may be non-linear. If the latter were the case, then models of health care provision, based on the assumption of linearity, would be seriously flawed. In fact, there is some evidence to suggest that increasing 'modernisation' can result in a resurgence of traditional beliefs and practices (Jahoda, 1970). It is therefore important to explore the mathematical form of the relationship between endorsement of biomedicine, endorsement of modernity and endorsement of tradition. The present paper explores these relationships by re-analysing data from our previous research (MacLachlan and Carr, 1994b), this time utilising the recent and innovative mathematics of non-linear regression analysis (see Watters, Ball and Carr, 1996, for a review).

Method

Subjects

The sample comprised 175 first and second year social science students at the University of Malawi, ranging in age from 17-23 years. With 130 males (mean age = 21.24 years; SD = 1.52) and 45 females (mean age = 19.95 years; SD = 1.79) the gender ratio reflected the composition of the student population at, Chancellor College, University of Malawi, at the time. There was no significant difference between the age of males and females. Participants completed a questionnaire, having given informed consent, as part of their course work.

Materials & Procedure

In our original study participants were asked to use a four point scale (ranging from "not at all credible" to "highly credible") to rate the credibility of the following sources of information regarding the prevention of AIDS: traditional healers, medical doctors, nurses, psychologists, religious advisors, friends, family members, the radio, newspapers, and government posters. In addition to other statistics, participants' credibility ratings were factor analysed.

In the present treatment of this data, factor scores were computed on the three factors derived by MacLachlan and Carr (1994b). Because the factor solution was orthogonal, the factors were linearly unrelated to each other. Although orthogonal factor sets represent statistically independent features, which may assist in the search for latent structures, their eigenvalue sets may not reflect the underlying mathematical properties of these latent values (particularly if the relationship between latent variables is non-linear). Although it is possible to analyse non-linear models using orthogonal factor sets, it is not then possible to compute linear models from the factor data for comparative purposes (i.e., to determine whether a linear or non-linear model is best) because the factor data are orthogonalised.

To overcome this difficulty we used non-orthogonal basis variables using an unweighted mean method. This involves computing a composite score for each case, corresponding to each of the factors extracted using PCA, by using the factor on which each variable has the greatest loading, as the criterion for inclusion. For example, a 'modernity' score is computed by taking the mean of variables corresponding to government posters, newspapers and radio, and forming a composite score.

Unweighted and non-orthogonal composite variables were computed for 169 cases (missing data excluded). Scores for 'modernity' and 'biomedicine' were further divided on the basis of the corresponding 'tradition' score: for low, moderate and high values of 'tradition'. The 'tradition' factor was therefore used as a so-called "splitting factor" to examine the effect of different levels of tradition on the relationship between degree of modernity (IV) and degree of biomedicine (DV).

Results

Linear Regression was performed between Modernity (x) and Biomedicine (y) for three levels of Tradition (low, moderate and high). It was found that the low Tradition group had the best linear fit (R=0.56), which was more than twice as linear as the moderate Tradition group (R=0.24), and

more than six times as linear as the high Tradition group (R=0.09). Regression equations and significance levels for variables, and constants in each equation, are shown in Figure 1. Regression fits are shown in Figure 2, for each of the three levels of the Tradition factor.

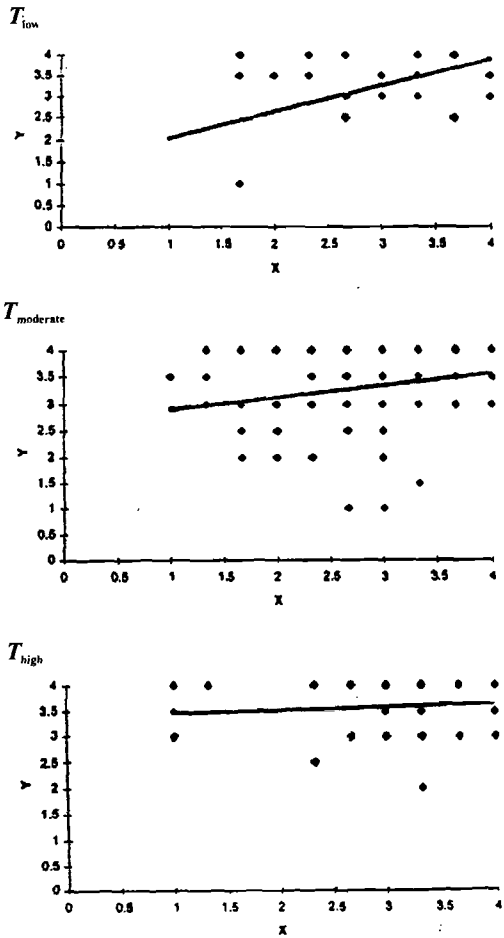
Intercept values made no significant contribution to the regression equation for the low Tradition group, but were significant for the moderate and high Tradition groups. Conversely, the independent variable (Modernity) made significant contributions to the regression equation for low and moderate Tradition groups, but not for the high tradition group. This indicates that levels of endorsement of traditional sources of information about HIV/AIDS prevention, moderates the normally linear relationship between endorsement of modern media sources and biomedical sources, with a transition occurring at moderate levels of tradition, and with linearity almost non-existent at high levels. In combination, these results strongly suggest that the relationship between modernity and biomedicine in the present sample is far from smooth and linear.

Table 1. Regression equations for analysis of the relationship between Modernity and Modern Medicine at three levels of Tradition (T^{low}, $T^{moderate}$ & T^{high})

Tradition Level	**Equation**	**R**	**T-test**
T low	$y = 0.5\,b + 1.05\,x$	0.56	*y:* $t(20) = 3.03$**
			b: $t(20) = 2.00$
T moderate	$y = 1.79\,b + 0.25\,x$	0.24	*y:* $t(113) = 2.57$*
			b: $t(113) = 6.00$**
T high	$y = 2.52\,b + 0.16\,x$	0.09	*y:* $t(33) = 0.52$
			b: $t(33) = 2.25$*

*p<.05,**p<.01

Figure 1: Regression fits for each of the three groups of Tradition (T_{low}, $T_{moderate}$ and T_{high}), with the predicted relationship between modernity (x) and modern medicine (y) becoming progressively nonlinear with increasing tradition.



Discussion

We have explored the relationship between 3 orthogonal factors (originally derived by Principle Components Analysis) using non-linear regression techniques. Whether individual's scored low, moderate or high, on the Tradition factor, influenced the extent to which endorsement of 'biomedical' and 'modern' sources of information about HIV/AIDS were linearly related. For high levels of endorsement of the Tradition factor, there was no linear relationship between endorsements of Modernity and Biomedicine, while at lower levels of endorsement of Tradition, there was a progressively stronger linear relationship between Modernity and Biomedicine.

In practical terms these results suggest that it will be most difficult to predict the sort of health services people will seek help from, when they strongly endorse traditional community sources of health promotion information. This is so, regardless of how strongly they also endorse the value of biomedical personnel, and modern sources of information, such as posters, newspapers and the radio. Consequently within such a sample simply surveying peoples' view on biomedical services would not be sufficient to know whether they would be given credence. Such an apparently obvious deduction can in fact only be made in the context of information about attitudes towards traditional sources of information about the same issue. This implies that health service planners must take into account not only attitudes towards new biomedical facilities they may wish to introduce, but also attitudes towards the extant traditional resources, if they are to accurately predict the demand for their health services. We would expect the high endorsement of traditional values to coincide with the availability of biomedical services when, for instance, there is rapid migration from rural to urban areas of developing countries, or where biomedical services are being introduced to more remote areas with a more traditional outlook. As the therapeutic value of culture, as a medium of treatment in its own right, is becoming increasingly recognised (see, for example, Brady, 1995; MacLachlan, 1997), it is important that the potential benefits of introducing biomedical services are not negated by challenges to cultural identity which undermine the potency of traditional healing systems.

While the findings in this study may well reflect contextual factors (concerning Malawi and the topic of HIV/AIDS) as well as the nature of our sample (undergraduate students), it is the dynamic nature of the emergent relationships which we believe to be most noteworthy. Pluralism is obviously not confined to Africa and is being recognised as an increasingly important resource in Europe (e.g. Vincent & Furnham, 1996), the USA (e.g. Berkow & Page, 2001) and Asia (e.g. Bishop & Wong, 2001).

"Catastrophes" are one family of mathematical models which describe exactly the scenario presented here: a normally linear relationship becomes increasingly non-linear due to the moderating influence of a third "splitting factor", which gives rise to local instabilities (see Arnold, 1986, for a review). Although such models provide excellent metaphors for the dynamics described in this paper, the fitting of arbitrary n-parameter non-linear regression models has been criticised in the literature (Cobb et al, 1983), which is why we chose to demonstrate a reduction in linearity rather than increasing non-linearity per se. We are continuing to develop appropriate regression techniques for analysing models of the kind developed in this paper and believe that they may prove very useful to the planning of health services in our increasingly pluralistic societies, and in particular, in developing countries.

Finally, while we have already alluded to contextual particularities within this research, it is also important to acknowledge that, as with any application of multivariate statistics, subjective interpretations play an important part. So, for instance, our interpretation of the three originally derived factors reflecting what we claimed them to reflect (modernity, traditionalism and biomedicine) may be contested. Other labels, for instance, focusing more concretely on different modes of media, could be suggested. However, while the meanings attributed to these factors are important, the dynamic relationships between them endure, whatever interpretation is given to the factors. We would however acknowledge that the meaning given to factors would also influence the choice of 'splitting factor' in a subsequent analysis, to our own. We would therefore call for more research that would help to establish the representativeness and generalisability of the present findings.

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