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RESEARCH

Use of Loglinear Models to Assess Factors Influencing Concern for the Natural Environment

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ABSTRACT / Since it is necessary to isolate the most significant factors influencing personal concern for the environment, this paper utilizes loglinear models for identifying the interactions and interrelationships underlying multidimensional environmental survey data. A field study in Guyana conducted face-to-face interviews with 1600 citizens. Acquired categorical data were then subjected to loglinear modeling techniques to determine what significance the factors education, age, residential location, and gender have on personal concern for the environment. The loglinear models obtained from the five-dimensional contingency table suggest that there is a direct relationship between education and personal concern for the environment. Age has an interaction with education, and some influence on environmental concern, with younger respondents expressing higher concern for the environment than older respondents. Other results from the loglinear model demonstrate that residential location and the gender of the respondents do not have any statistically significant association with personal concern for the environment.

The complexity and interaction of the factors associated with personal concern for the environment demand that environmental managers utilize appropriate statistical procedures that will permit isolating the most significant factors influencing personal concern for the natural environment. This paper utilizes loglinear models to identify the interactions and interrelationships underlying categorical data on the various factors influencing personal concern for the environment. Although loglinear techniques are well established and have been proven to be useful in modeling categorical data, only a very limited number of researchers (for example, Valtonen and others 1994, González 1995, Badia and Prouzat 1996, Crook 1997, Dammer and Heyer 1997, Melville and Swain 1997) have applied loglinear modeling techniques to data from the broad spectrum of environmental and ecological studies. Justification for more extensive utilization of loglinear models in environmental research can be found in the literature, which shows the successful application of loglinear modeling techniques in several other disciplines, among them agriculture (Fanoriotu and Skuras 1991), fisheries (Labelle and others 1997, Crook 1999), forestry (Nemec 1992), applied geography (Wang and Unwin 1992, Cadwallader 1995, Lakhan and others 1995), psychology (Schneider-Rosen and Cicchetti 1991, Hintikka and others 1998), public health (Langford and Bentham 1997, Sheppard 1997, Tramarin and others 1997), sociology (Botev 1994, Jovanovic 1996, Lin and Xie 1998), social work (Combs-Orme 1992, Western 1996), reliability engineering (Lin and Hwang 1992), and transportation (Abdel-Aty and others 1998).

With loglinear analysis the interactions and interrelationships underlying categorical data can be highlighted. Essentially, categorical data are arranged in a contingency or frequency table. Each variable in the table has a number of categories. The major emphasis of loglinear analysis is to obtain a loglinear model that is linear in the logarithms of expected frequencies of a contingency table that adequately describes or "fits" the associations and interactions that exist in the original frequency table (Wrigley 1985). The objective is to choose a parsimonious model that adequately describes the data. Loglinear techniques are especially useful for frequency tables with more than three variables since the number of possible associations and interactions among the variables become very large (Gilbert 1981). An example of the utilization of loglinear techniques can be found in Lakhan and others (1995).

To demonstrate that loglinear models can facilitate the interpretation of the interactions and interrelationships underlying multidimensional environmental survey data this paper will subject categorical survey data from Guyana to loglinear modeling techniques. Before discussing the loglinear modeling procedures and results, the paper presents an account of the environmental situation in Guyana, provides some brief remarks on

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the factors influencing concern for the environment, and explains data acquisition methods.

The Environmental Situation in Guyana

Guyana, formerly British Guiana, is located on the northeast Atlantic coast of South America. The country has a population of nearly 900,000, and nearly 8000 species of flora and 1200 different species of vertebrates. Settled in the early 17th century by the Dutch, and later captured by the French, Guyana was finally ceded to the British in 1814 (Lakhan 1994). The expansion of settlements resulted in the indiscriminate exploitation of the country's resources (Odle 1976).

Today, the citizens of Guyana are confronted with escalating environmental pollution problems that include the cumulative adverse effects of heavy metal contamination of soil and sediments, pesticide contamination, the poisoning of air and water resources, and highly polluting liquid and solid wastes. While some of the environmental pollution problems are localized, other areas have been declared national disasters. For example, in 1987 the entire country was placed on heightened medical alert in response to widespread thallium sulfate poisoning (Stabroek News 1987). This was largely the result of the Guyana Sugar Corporation's use of thallium as a rodenticide on sugar cane crops grown throughout Guyana. Although the World Health Organization recommended against the use of thallium in 1973, the Guyana Sugar Corporation, nevertheless, had enough thallium in storage to kill the entire population of Guyana (Singh 1988). Another example of massive environmental pollution occurred on 19 August 1995 when the wastewater pond of the Canadian-owned Omai Gold Mines broke and spilled more than 3 million m^3 of cyanide-laden wastes into two of Guyana's major rivers. On 22 August 1995 the President of Guyana declared a national environmental disaster because of the disastrous consequences of the cyanide spill on the aquatic resources, natural environment, and citizens of Guyana.

Given the fact that environmental pollution problems are now pervasive (Colchester 1997, Lakhan and others 1998) and impact all sectors of Guyana's society, a study was designed to determine the personal concern that the citizens of Guyana have for the natural environment which is becoming more polluted, and also to examine the factors influencing this concern. Before a questionnaire was designed to acquire data in Guyana, this research examined the literature in order to gain insights on some of the factors which have been found to be significant in influencing personal concern for the environment.

Factors Influencing Concern for the Environment

The theoretical and empirical bases of concern for the environment, namely personal concern for the environment, have been examined by several investigators (for example, Van Liere and Dunlap 1980, 1981, Morrison 1986). Without discussing the theory of concern for the environment, it is, nevertheless, worthwhile to mention that there is no consensus of opinion on the factors which influence it. Buttel (1975) claimed that concern for the environment is dictated by economic conditions and that during difficult economic times those who are more economically disadvantaged will disproportionately shift their priorities from environmental quality to economic well-being. Other researchers (for example, Grossman and Potter 1977, Morrison 1986) have, nevertheless, hypothesized that concern for the environment will diffuse throughout the public over the years, despite changing economic and environmental conditions. Several other factors have demonstrable links with personal concern for the environment. It is known from the literature that researchers have identified factors such as education (see Buttel and Flinn 1978, Fiallo and Jacobson 1994, Wall 1995, Arp and Kenny 1996), age (see Buttel 1979, Mohai and Twight 1987, Schahn and Holzer 1990, Fiallo and Jacobson 1994), residential location (see Hines and others 1975, Tremblay and Dunlap 1978, Lowe and others 1980), and gender (see McStay and Dunlap 1983, Arcury and others 1987, Blocker and Eckberg 1989, Stern and others 1993, Gbadegesin 1996), as being significant in influencing personal concern for the environment. Additional factors identified as governing personal concern for the environment have been found to be socioeconomic status, occupation, political affiliation and ethnicity (Hershey and Hill 1977–1978, Taylor 1989).

Data Acquisition

There is a paucity of information on the concern of Guyanese for the environment and the associated factors influencing this concern. Data were collected in the field from a representative sample of respondents from 36 communities throughout Guyana (Figure 1). The research selected communities in both the urban and rural regions of the country and also from communities that represent a broad range of social, economic and demographic characteristics. Previous field work conducted in Guyana by Lakhan and Stebelsky (1987) and Lakhan and others (1995), together with supplementary discussions and interviews with personnel fa-

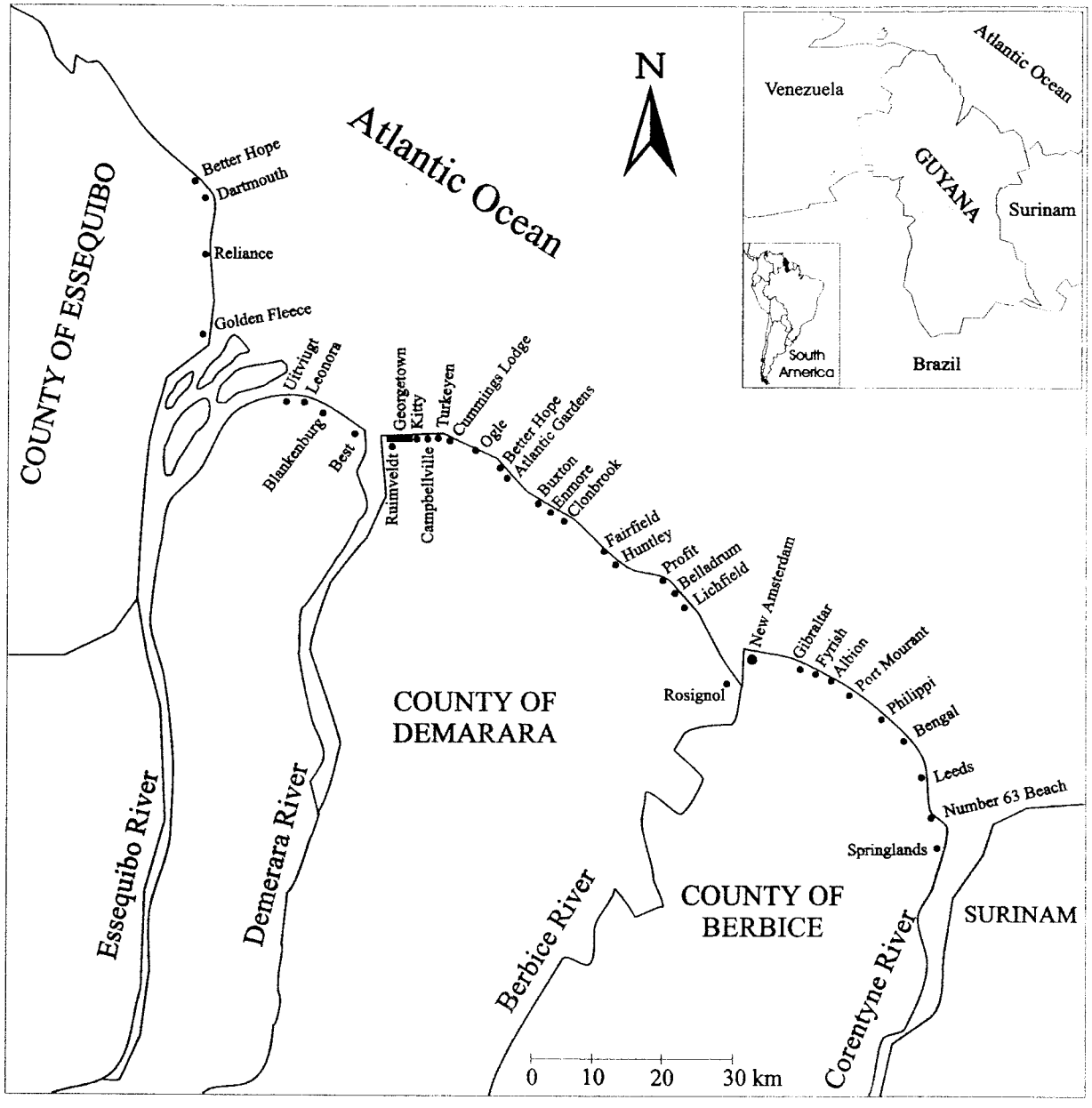

Figure 1. Sampling locations of respondents from communities in Guyana.

miliar with Guyana's environment, facilitated selection of the sample communities.

To balance time and cost, 1600 citizens were randomly selected from 36 coastal communities in Guyana (Figure 1). Those selected provide a representative cross-section of Guyana's population, with more than 90% of them residing in the coastal environment. During the months of February, June, July, and August of 1997, the senior author and three field research assistants conducted face-to-face interviews with each of the randomly chosen respondents. Nine hundred five samples were collected from the urbanized areas of Georgetown, Kitty, Ruimveldt, Campbellville, New Amsterdam, and Springlands; the remaining 695 samples were collected from nonurban communities.

Cognizant of Guyana's environment and the relevant literature, the survey questionnaire concentrated on how the factors education, age, residential location, and gender influence personal concern for the environment. Educational attainment was categorized into

three groups: 5–9.99 years, 10–14.99 years, and 15 or more years. Based on the demographic composition of Guyana's population, the age of the respondents was grouped into four categories: 18–30 years, 31–43 years, 44–56 years, and 57 years and older. Gender was either male or female, and the residential location of respondents was classified as either urban or rural. Other questions identified the respondents' occupation, ethnicity, and their awareness of environmental pollution problems in the natural environment.

Wording of responses to various questions was simplified in order to accommodate those who did not obtain a secondary-school education. For example, to obtain a response on personal concern for the natural environment, the interviewer asked each respondent: "Generally speaking, would you say that the natural environment (for example, air, land, soil, water, etc.) is becoming more polluted?" If the respondent answered "yes" the next question asked was: "Are you personally concerned that the natural environment is becoming more polluted?" (Respondent was asked to answer either yes or no). If respondent answered "yes" the question that followed was: "Would you say that you are very highly concerned, have a fair amount of concern or very little concern that the natural environment is becoming more polluted?"

Methodology

All collected data were coded, tabulated, and analyzed with loglinear techniques. To explain the utilization of loglinear techniques, this methodology section will provide some brief remarks on loglinear models, discuss the application of loglinear modeling techniques, and then explain the selection and testing of loglinear models.

Loglinear Models

The mathematics relating to loglinear models can be found in several studies (for example, Bishop and others 1975, Kennedy 1983, Fox 1984, Agresti 1984) and as such will not be presented here. Loglinear models can be classified as nonstandard or conventional. Nonstandard models require specification of a set of hypotheses concerning the structure of the data (see Magidson and others 1981, Breen 1984, Rindskopf 1990). Nonstandard loglinear models are not hierarchical, and therefore do not consider the main effects and interactions used in conventional loglinear models. Conventional loglinear models can be broken down into saturated models and unsaturated models. A saturated loglinear model fits the original frequency table exactly (Bishop and others 1975, Reynolds 1977, Goodman 1984). Unsaturated loglinear models are also referred to as hierarchical loglinear models (Fienberg 1977, Dillon and Goldstein 1984, Fingleton 1984, Wrigley 1985, Freeman 1987, Agresti 1990, Hagenaars 1990). Unsaturated loglinear models were used in this study because once a higher order effect is included in the model, all its lower order effects are automatically included.

Application of Loglinear Modeling Techniques

The data from the questionnaires were summarized in a five-dimensional frequency table, cross-classifying the dependent variable, personal concern for the environment (C), with the independent variables educational attainment (E), age (A), residential location (L), and gender (G). For the purposes of this paper, each variable in the frequency table, for example, C, is termed a main effect. The corresponding notation in the loglinear model is [C]. Interaction or association between two variables in the frequency table, such as C and E, is denoted as CE with the corresponding notation [CE] in the loglinear model. By the definition of hierarchical loglinear models, the term [CE] contains the two lower order main effects, C and E. Similarly, interaction among three variables, C, E, and A in the frequency table is denoted as CEA, with the corresponding notation [CEA] in the loglinear model. Again, by definition, the lower order main effects C, E, and A, and the lower order two-term interactions CE, CA, and EA are contained in the higher order term [CEA]. Various loglinear models can be fitted to the data. The final loglinear model that is selected need not contain all possible interactions in the frequency table since the purpose of loglinear analysis is to find the simplest model that adequately describes the data.

As a rule the greater the number of variables in the frequency table, the larger the number of possible loglinear models that can be constructed. For the five-dimensional table there are 31 possible terms that can be included in a loglinear model in various combinations. Owing to the large number of possible loglinear models that can be constructed from the five-dimensional frequency table, methods have been developed to investigate loglinear models in a systematic manner to limit the number of models to be evaluated. This paper uses K factors (see StatSoft, Inc. 1995) to introduce the nature of the loglinear models to be tested. In Table 1, K factors have been produced using the Loglinear Module in the computer software program Statistica for Windows (StatSoft, Inc. 1995). The K factor relates to the number of interactions in the frequency table.

Table 1. Results of fitting all K-factor interactions. Simultaneous tests where all K-factor interactions are simultaneously zero[a]

K factor	Degrees of Freedom	Max. Likelihood (χ^2)	Probability (P)	Pearson (χ^2)	Probability (P)
1	9	696.8879	0.000000	566.0361	0.000000
2	31	134.3365	0.000000	155.6839	0.000000
3	51	63.8313	0.107338	65.8832	0.078710
4	40	31.3895	0.832857	31.1345	0.841128
5	12	5.5266	0.938027	5.4917	0.939495

[a]Source: Output from Statistica for Windows Loglinear Module (StatSoft, Inc. 1995).

Table 2. Tests of marginal and partial association of loglinear models specifying the interrelationships between personal concern for environment (C), educational attainment (E), gender (G), residential location (L), and age (A)[a]

	Degrees of freedom	Partial association		Marginal association	
		χ^2	P	χ^2	P
(1) [C]	2	19.2699	0.000066	19.2699	0.000001
(2) [E]	2	609.7607	0.000000	609.7607	0.000000
(3) [G]	1	22.5603	0.000002	22.5603	0.000000
(4) [L]	1	26.4451	0.000000	26.4451	0.000000
(5) [A]	3	18.8517	0.000294	18.8517	0.000294
(6) [CE]	4	48.2301	0.000000	52.1537	0.000000
(7) [CG]	2	0.3983	0.819447	0.2677	0.874722
(8) [CL]	2	0.0241	0.988014	0.4171	0.811756
(9) [CA]	6	11.8624	0.065144	15.5700	0.016276
(10) [EG]	2	1.2071	0.546869	0.7796	0.677205
(11) [EL]	2	16.8711	0.000217	18.0039	0.000123
(12) [EA]	6	35.9039	0.000003	40.2750	0.000000
(13) [GL]	1	0.3188	0.572310	0.1647	0.684893
(14) [GA]	3	5.1431	0.161636	4.7704	0.189421
(15) [LA]	3	5.7196	0.126099	6.6293	0.084723
(16) [CEG]	4	0.7675	0.942752	0.6460	0.957820
(17) [CEL]	4	4.2364	0.374981	4.9091	0.296777
(18) [CEA]	12	10.7024	0.554591	11.8366	0.458921
(19) [CGL]	2	0.0015	0.999268	0.0891	0.956452
(20) [CGA]	6	5.7346	0.453580	6.0177	0.421231
(21) [CLA]	6	12.8110	0.046167	14.1371	0.028166
(22) [EGL]	2	5.3920	0.067491	5.5929	0.061040
(23) [EGA]	6	2.7240	0.842598	3.5757	0.733863
(24) [ELA]	6	13.0117	0.042879	14.4872	0.024665
(25) [GLA]	3	4.6695	0.197683	4.9918	0.172424
(26) [CEGL]	4	3.8969	0.420149	2.7229	0.605219
(27) [CEGA]	12	7.0967	0.851138	7.4745	0.824713
(28) [CELA]	12	8.7108	0.727397	6.6638	0.878988
(29) [CGLA]	6	6.5073	0.368848	7.8444	0.249765
(30) [EGLA]	6	6.3171	0.388647	6.5920	0.360259

[a]Source: Output from Statistica for Windows Loglinear Module (StatSoft, Inc. 1995).

Selecting and Testing Loglinear Models

Partial and marginal association tests and backward elimination procedures are normally used for selecting loglinear models to be tested. The procedures of marginal and partial association are described in Dillon and Goldstein (1984) and are used to choose and examine a subset of models from the five-dimensional table. Table 2 provides a summary of results from the marginal and partial association tests. In brief, the partial association tests are done using the full five-variable frequency table. To test the five main effects, C, E, G, L, and A, the base loglinear model of [C][E][G][L][A] is used. All five main effects are included in the base model, which is fitted to the original frequency table

Table 3. Model selection using both partial and marginal association tests[a]

Both partial and marginal tests are significant	Both partial and marginal tests are not significant		One test significant, one test insignificant
Include	Exclude		Reserve judgment
[C] [E] [G] [L] [A] [CE] [EL] [EA] [CLA] [ELA]	[CG] [CL] [EG] [GL] [GA] [LA] [CEG] [CEL] [CEA] [CGL] [CGA] [EGL] [EGA] [GLA] [CEGL] [CEGA] [CELA] [CGLA] [EGLA]		[CA]
Test	χ^2	*df*	*P*
Model 1: [CE][EL][EA][G]	124.6893	122	0.4156787
Model 2: [CE][EL][EA][G][CA]	112.8995		0.5641043
Model 3: [CLA][ELA][CE][G]	126.7640		0.0564010

[a]C = personal concern for the environment; E = educational attainment; A = age; L = residential location; G = gender.

and its level of significance is noted. Models are then fitted that omit each main effect in succession. For example, to test the main effect C, the loglinear model [E][G][L][A] is fitted to the frequency table and its significance level is noted. The significance of the main effect C is then determined by finding the difference between the χ^2 values and the degrees of freedom of the base model that includes the effect C and the model that excludes the effect C. Using a significance level of 0.05, it can be observed from Table 2 that all five main effects are significant. In a similar manner, all two-way, three-way, and four-way interaction terms are tested by using base models that include all possible two-way, three-way, and four-way interaction terms and omitting each of the respective interaction terms in sequence.

The marginal association tests are also done in stages using the corresponding marginal tables from the five-dimensional frequency table. The results of the marginal association tests are summarized in Table 2. Each of the 30 effects in Table 2 can be classified using the significance levels as follows: (1) both the partial and marginal tests are significant, (2) both the partial and marginal tests are insignificant, and (3) only one of the partial or marginal tests is significant. Using a significance level of 0.05, the results are summarized in Table 3.

Using the partial and marginal association tests, three loglinear models are constructed and tested using the Loglinear Module in the Statistica for Windows (StatSoft Inc. 1995) program. Based on the guidelines for model selection (see Knoke and Burke 1980), it is evident that model 1 is the most appropriate to describe the interactions in the five-dimensional table.

The procedure of backward elimination is described by Dillon and Goldstein (1984) and used by the Statistica Loglinear Module (StatSoft Inc. 1995) to automatically select the best model for a given frequency table. The backward elimination procedure considered a total of 55 loglinear models. The best model selected is the loglinear model [CE] [EL] [EA] [G], which is the same as model 1 in Table 3. Therefore, using the procedure of backward elimination and partial and marginal association tests, the final choice of loglinear model is [CE][EL][EA][G] with χ^2 equal to 124.6893, degrees of freedom equal to 122, and a *P* value of 0.4156787.

Discussion of Results

The results of the loglinear modeling permit an assessment of the factors that influence personal concern for the environment. Based on the model [CE][EL][EA][G] that best describes the five-dimensional table, it is clear that the major factor influencing personal concern for the environment is education. This is shown in the loglinear model by the term [CE], which indicates an interaction between the factors personal concern for the environment (C) and educational attainment (E). The remaining three terms, [EL][EA][G], in the loglinear model do not contain the factor personal concern. This would indicate that age, residential location, and gender do not have a strong influence in terms of interacting with personal concern for the environment in the loglinear model. The finding that education is the most significant factor in influencing personal concern for the environment is similar to those obtained by investigators in other countries (for example, Buttel and Flinn 1978, McStay and Dunlap 1983, Fiallo and Jacobson 1994, Wall 1995, Arp and Kenny 1996). Buttel and Flinn (1978) analyzed environmental awareness in Wisconsin and found that

those with a postgraduate education were more concerned for the environment than those with less education. The study by McStay and Dunlap (1983) also emphasized that the well-educated are more concerned about the environment. The research by Fiallo and Jacobson (1994) reported that acceptance of environmental protection and conservation initiatives in Ecuador increased in those sectors of the country's population with more education. In addition, Wall's (1995) study of citizens' concern for the environment in Edmonton, Alberta, Canada, also concluded that higher levels of education contributed to greater concerns for the environment. Another investigation supporting the results obtained from Guyana is that of Arp and Kenny (1996), who reported a strong relationship between high levels of formal education and high concern for the environment in the communities of Alsen and Homer, Louisiana, USA.

Although there is a relationship between high concern for the environment and high educational attainment, the questionnaire data, nevertheless, reveal that only 52.7% of the most educated (15+ years) respondents show a high personal concern for the environment in Guyana. With declines in education levels there are corresponding reductions in the percentage of respondents who are highly concerned for the environment. An explanation as to why more Guyanese are not highly concerned for the environment can be attributed to the fact that the country has never had a history of environmental education or involvement and promotion of environmental awareness. Environmental degradation and constraints to environmental protection in Guyana prevailed not only during the colonial period but were also exacerbated when the country attained its independence from Great Britain in 1966, after 152 years of colonial rule. Although personal concerns for the environment were at the forefront of opinion polls at the time (Baden and Stroup 1990), the development and state planners of a postcolonial Guyana ignored, deliberately or otherwise, the sustainability debate and planning strategies of the 1970s and 1980s (Lakhan and others 1988). They never fostered or promoted environmental education. An examination of the education curriculum reveals a paucity of environmental education courses at the primary, secondary, and college levels. Only in 1993 did the University of Guyana initiate its first degree program in environmental studies. Field investigations have also determined that there are no community or government outreach programs to promote environmental education in the country. With a lack of environmental education programs, especially at the pre-university level, together with less than five inadequately funded nongovernmental organizations currently interested in environmental issues, the public has minimal involvement in environmental matters. Hence, without an entrenched environmental education program, it is not surprising that at all levels of educational attainment there is not very high personal concern for the environment.

The weak environmental education traditions of the country also contribute to the low personal concern for the environment by respondents of all ages. Figure 2 illustrates that irrespective of age, concern for the environment is not high. Less than 40% of the respondents in all age categories show a high personal concern for the environment. The age group between 18 and 30 years has the highest percentage (38.9%) of respondents who are highly concerned for the environment, while the category of oldest respondents (57 years and older) has the lowest percentage (27.6%). The finding that younger respondents have a higher personal concern for the environment is in agreement with those of several investigators (for example, Tognacci and others 1972, Mohai and Twight 1987, Adeola 1994). In a study of residents from Boulder, Colorado, USA, Tognacci and others (1972) concluded that younger residents were more concerned for the environment. Mohai and Twight (1987) used the results from a national stratified sample survey of 7010 residents in the United States and found age as the variable that strongly influenced concern for the environment, with younger residents having the highest concern for the environment. The results from Adeola's (1994) study done in East Baton Rouge, Louisiana, USA, also revealed that younger respondents were more concerned for the environment. The results from Guyana showing that younger residents have more concern for the environment than older residents can be explained by the fact that only in the past decade environmental issues and problems became a concern for Guyana's citizens and administrators.

From the loglinear results, it is clear that there is no statistically significant interaction between residential location and personal concern for the environment. The lack of distinct spatial differences in personal concern for the environment demonstrate that the urban and rural residents have the same concern for the environment. Since both urban and rural residents are provided with the same primary and secondary school education by the government, they obtain and have similar levels of exposure to environmental problems and issues. In addition, printed and audio visual media, which are likely to provide information on environmental issues, do not vary in urban and rural areas.

As with residential location, there is also no statisti-

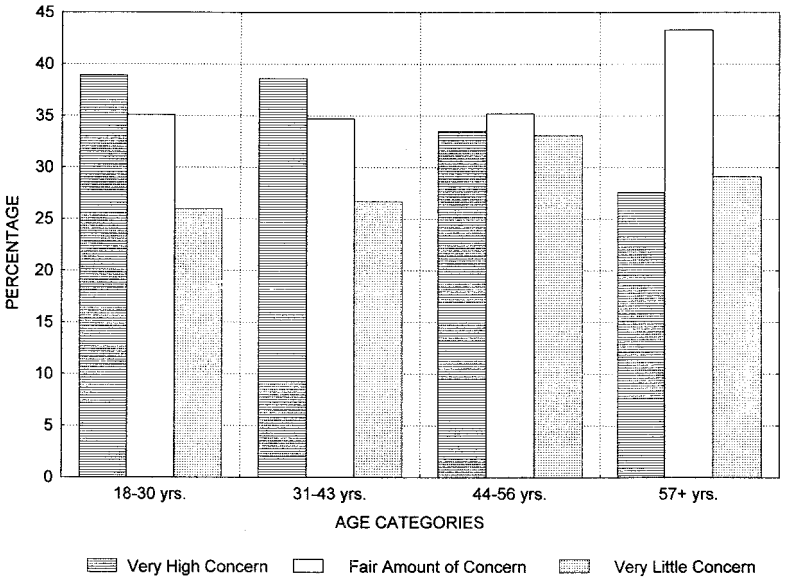

Figure 2. Personal concern for the natural environment and relationship to age.

cally significant interaction between gender and personal concern for the environment. The loglinear model results showing that men and women in Guyana express the same concern for the environment differ from those reported in previous studies. The study by Stern and others (1993) stated that men tend to emphasize scientific and technological concerns rather than concerns for the environment, while Davidson and Freudenburg (1996) claimed that men are more likely to show more concern about the economy than about environmental problems. Other investigators (for example, Arcury and others 1987, Gbadegesin 1996) reported that women, because of the strength of their socialization to the roles of mother and nurturers, will be more concerned and more aware of others and the environment. Gbadegesin's (1996) claim that women, especially those in developing countries, tend to conserve and improve the state of the environment more than men do is not supported by the results from Guyana, a developing country.

Conclusion

It is essential to understand the dynamics of personal concern for the environment (Schahn and Holzer 1990) because the factors that have strong demonstrable links with personal concern for the environment must be isolated. While the data used in this paper are from Guyana, it is important for environmental researchers to acquire additional data from other countries where concerns for the environment are not documented. Loglinear modeling and other techniques could then be utilized to identify existing and emerging factors that influence personal concern for the environment. As demonstrated in this paper, loglinear modeling techniques are very appropriate for identifying the most significant from among a multitude of factors that can affect personal concern for the environment. By utilizing the loglinear modeling approach, this paper determined that the factors residential location and gender do not have a statistically significant interaction with citizens' personal concern for the environment. This observation does not support the work of other investigators who reported that residential location (for example, Hines and others 1975, Tremblay and Dunlap 1978, Lowe and others 1980) and gender (Arcury and others 1987, Stern and others 1993, Davidson and Freudenburg 1996, Gbadegesin 1996) have an influence on personal concern for the environment.

The results emphasizing the importance of age are in agreement with those of other researchers (for example, Tognacci and others 1972, Mohai and Twight 1987, Adeola 1994), who found that younger people have higher concern for the environment. The loglinear models also substantiate the work of other investigators (for example, Buttel and Flinn 1978, Fiallo and Jacobson 1994, Wall 1995), who found that education is a significant factor influencing personal concern for the environment.

The loglinear model result highlighting that education is the most significant factor influencing personal concern for the environment is important for policy planners, environmental managers, and all others who are committed to protect the environment, not only in Guyana, but also in all countries where the natural environment is being degraded and polluted. While

environmental awareness and concern for the environment vary globally (see Dunlap and others 1993, Bloom 1995), it must be emphasized that raising environmental concern can be accomplished through effective education. With sound and systematic environmental education UNESCO (1994, p. 2) emphasized that people will "develop the understanding, knowledge, skills and motivation leading to the acquisition of attitudes, values and mentalities which are necessary to deal effectively with environmental issues and problems." Hence, it will be beneficial for Guyana and other countries confronted with escalating environmental pollution problems to develop, implement, and actively promote functional environmental education strategies which will be crucial for the protection of the natural environment.

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