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Research Article

Change and instability: A multilevel analysis of AIDS-related conversational networks among Malawian women

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Research Article

Change and instability: A multilevel analysis of AIDS-related conversational networks among Malawian women

Alexander A. Weinreb [1]

Abstract

This article examines changes in network structure using data on women's AIDS-related conversational networks from the 1998 and 2001 rounds of the Malawi Diffusion and Ideation Change project. The principal aims are to show that the structure of conversational networks can change significantly in relatively short periods and that multilevel analysis is an effective way to explore the scope of these types of changes. The article demonstrates that: (i) conversations about AIDS are increasingly occurring within and across all demographic groups in rural Malawi, (ii) AIDS-related conversational networks have therefore diversified, (iii) there is statistically significant village-level variance in characteristics of reported network partners, but it is a minimal source of total variance in such characteristics, and (iv) there is significant covariance between the estimated residuals associated with key predictors of size of the conversational networks.

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1. Introduction

This article has two aims. The first is to assert that analyses of social and conversational network effects on AIDS-related behavior should take into account temporal changes in the structure of conversational networks. The second is to show that multilevel analysis is an effective way to explore these types of changes (Note 1).

Underlying these aims are two key arguments. First, social interaction not only tends to be selective rather than random (Iacobucci, Neelamegham and Hopkins 1999; Kohler, Behrman and Watkins 2001), but the very factors that make it selective mean that there may be a substantial within-network correlation on both the observed socioeconomic characteristics of interactants, as well as on their less visible attributes such as attitudes (Snijders, Spreen and Zwaagstra 1995; van Duijn, van Busschbach and Snijders 1999). Second, this within-network correlation is more than an indicator of the clustering of normative patterns within the network. It also indexes a particular temporal dimension of networks, that is, that an inevitable outcome of micro-social ritual interaction, in particular repeated interactions, is the joint production of interactional norms and networks (e.g., Collins 1981; 1988).

The literature on temporal changes in social networks has dealt much less with the production of norms than with other types of changes (e.g., Bernard et al 1987; Bernard et al 1990; Feld 1997; Leik and Chalkley 1997; Morgan, Neal and Carder 1997; Ruan et al 1997; Suitor, Wellman and Morgan 1997; Brewer and Webster 2000). In particular, it has placed emphasis on the natural dynamism of networks, making crucial distinctions: (a) between changes in aggregate network composition/structure and the "inherent instability" (Leik and Chalkley 1997:64) of specific ties; and (b) between the inherent instability of specific ties and unreliability of measurement devices. These distinctions can be usefully applied to network analysis in sub-Saharan Africa. However, network approaches to AIDS-related research in sub-Saharan African contexts can also profit from a broader neo-Durkheimian approach that stresses the ritualized interactional processes which go into the production of norms as well as networks. For as I argue below, one of the principal consequences of the high levels of HIV/AIDS in sub-Saharan Africa is the fact that AIDS-related discourse has become more commonplace, diffusing across social groups and social boundaries, and therefore breaking down barriers to certain types of interaction. This has some bearing on both the specification of social network analysis, but also on the broader interpretation of observed distributions. Before addressing these issues more explicitly, some stage-setting is in order.

2. Background

As of 1999, HIV prevalence among adults aged 15-49 in Malawi was roughly 16.4 percent (UNAIDS 2002). Among the consequences of this high prevalence was an estimated three-fold increase in adult mortality within a decade (Doctor and Weinreb 2002) and considerable social and economic dislocations (e.g., Mtika 2001). Of greater relevance to the arguments pursued here, survey and qualitative data collected as part of the Malawi Diffusion and Ideational Change Project (MDICP) – described in greater detail below – imply that the high prevalence also appears to have affected more general patterns of interaction. Deaths are commonplace and are largely blamed on AIDS by family, friends and neighbors (Doctor and Weinreb 2003). AIDS increasingly features in general conversational interaction. And in general, in contrast to the earlier stages of the epidemic, AIDS is an increasingly legitimate subject for conversation.

This increased legitimacy should be reflected in two changes in general patterns of social interaction. First, there should be an increase in the number of people with whom a given individual has talked to or chatted about AIDS (Note 2). And second, the social characteristics of those who report having talked about AIDS, as well as those to whom they report having talked, should be increasingly diverse since the legitimacy of AIDS as a topic of conversation (a) extends across an increasing number of social groups; and (b) undermines prior conversation-related taboos, transforming AIDS from a sensitive topic about which there is limited "chatting," to an issue that can be discussed more casually, and with a wider array of interactants (Note 3).

Each of these patterns can either induce or otherwise become identified with one of the two types of meaningful temporal change in conversational and more general social networks: changes in aggregate network characteristics, and more general network instability. For example, if the legitimacy of AIDS as a topic of conversation is diffusing across social groups, then this may trigger increased social contact between types of people among whom there has traditionally been minimal interaction. This is the most significant type of network change because it signals structural rearrangements within and across social groups. In contrast, to the extent that an increase in the number of named network partners involves no significant change *in the social characteristics* of these new network partners, it merely reflects a level of instability that is inherent in all networks.

One of the key problems in identifying whether such phenomena actually occur stems from the possible effects of the within-network correlation described above. This correlation affects the way that the changes map themselves across social space and time. The temporal dimension is the more important one here. The problem is this: interactional norms in one time period, as mentioned above, tend to be highly correlated with norms in the next time period. This is because individual members of networks, in

which the norms are reproduced, are inevitably bound together by some level of allegiance to the existing norms, since without that allegiance, there could not have been an interaction that was emotionally productive enough to generate the repeated interactions (Collins 1981).

This temporal dimension poses a problem for the interpretation of change in a network since it suggests that network-specific variation in interactional norms at a single point time, as well as variation in the trajectory and speed of change in these norms over time, independently affects the structure of an individual's social network over and above an individual's own preferences. Put another way: there is always some element of path dependence in issues of network selectivity, and the path is a complicated loop that links individuals' preferences *and* preferences of other members of the network.

An illustration may clarify this a little more. Assume two social networks whose micro-level interactional norms vary in their level of openness to outsiders. It is reasonable to assume that these initial differences in interactional tastes translate into differential trajectories of network change and instability in successive time periods. For example, members of the more open network may be more likely to talk to or befriend people unlike themselves. Over time this accentuates the diversity of their network.

To accurately describe AIDS-related effects on the structure of conversational networks, including effects on temporal changes in that structure, we need to begin with a similar assumption about heterogeneity in interactional norms across both individuals and networks. Following from this, we should also expect network-specific measures to generate non-uniform distributions in residuals across the whole sample. This is because residuals will contain significantly different levels of variance at differing values of the explanatory variable, implying that there is more to the relationship between the two variables than what is captured in a fixed part of the model. Differential interpretation of AIDS-related variables across sub-Saharan African contexts, for example, or across individuals, could lead to either differences in estimated relations among observed variables in different settings, or at least to significant variation in an established analytic relationship.

The remainder of this article is devoted to highlighting these issues empirically, and in so doing, to demonstrate the leverage that two relatively simple multilevel analytic methods can wield. The first method involves the partitioning of the variance on key network-specific variables at multiple analytic levels. This allows us to identify the levels at which aggregate network change or instability is occurring, and the extent to which there is clustering of characteristics within groups of individuals. The second method involves the specification of "complex variation" – that is, the estimation of

different variance values and structures across groups of individuals – within the context of regression models.

3. Data

I use AIDS-related conversational network data from the 1998 and 2001 rounds of the Malawi Diffusion and Ideation Change Project (MDICP). This is an ongoing longitudinal research project with fieldsites in rural areas in each of Malawi's three regions: Balaka District in Southern Region, Mchinji District in Central Region, and Rumphi District in Northern Region.

The MDICP sample was drawn the week prior to the first round of data collection in 1998. A cluster sampling strategy was employed. In the first step, villages were randomly selected within purposively chosen census enumeration areas in each of the three areas. In the second step, lists were made of all ever-married women under roughly age 50 considered by village informants to be either *de jure* or *de facto* residents of these areas. Finally, a proportion of these women were selected, yielding a total sample of 1,856 women. 1,541 women of these were successfully interviewed in 1998 and 1,587 in 2001 (Watkins et al. 2003).

In addition to asking all respondents background questions about themselves and about their attitudes to AIDS and sexual behavior, the MDICP research instruments employed name generators to collect data on issue-specific conversational networks. That is, at two points in the questionnaire, respondents were asked for the names (real or fictitious) of up to four individuals with whom they had "chatted" about (a) family planning and (b) AIDS. In each case, information was collected about the educational level, age and gender of the named network partners, information about their geographic and familial proximity to the respondent, the duration and degree of the relationship between the respondent and network partner, and the frequency of contact (Note 4).

Prior to this analysis, the data were restructured in two ways. First, the sample was restricted to the 1,210 women with whom completed interviews were conducted in both the 1998 and 2001 rounds. Second, to facilitate multilevel analysis, the data were reshaped in order to nest each named network partner within a given respondent's data. This process yielded data on 3,350 and 3,518 conversational network partners in Malawi 1 and Malawi 2 respectively, an average of 2.9 network partners per respondent over the two rounds.

4. Analysis

Analysis is divided into two main sections. The first, incorporating two sub-sections, is devoted to the diversification issue. I assess the extent to which the characteristics of conversational network partners changed during the three-year intersurvey period, and the extent to which there is increasing diversity in the number of respondents with active AIDS-related networks. As argued above, these are important questions because they deal with possible structural rearrangements in local patterns of interaction.

The second section, again organized in two subsections, is devoted to the issue of network size. Initially I build on the diversification issue, exploring variation in network size across social groups. Final specifications, however, identify complex variation among the residuals, allowing me to highlight some of the heterogeneity among significant predictors, discussed above.

4.1 Diversification

4.1.1 Diversification of conversational network partners' characteristics

I explore the diversification of conversational network partners' characteristics using (a) comparisons of univariate distributions across the two rounds of the survey, and (b) "variance components" (VC) models. In each case I assess the diversification in relation to three reported characteristics of the network partners: their relationship to the respondent, the level of intimacy in the relationship, and residential proximity.

The comparison of univariate distributions in the characteristics of these conversational network partners over the 3-year period for the 1,210 women is presented in Table 1. On all dimensions other than network homophily – 94 and 95 percent of women's AIDS network partners in Malawi 1 and Malawi 2 respectively are other women – there is some change. In particular, a larger proportion of AIDS-related conversations reported in 2001 were with village-based friends about whom basic information, in this case schooling, is known.

VC models, the simplest type of multilevel models, yield more information. The models specified here partition the variance in conversational network partners' characteristics at three levels: between villages (n=54), individuals (n=1,210) and the named network partners (n=3,350 and 3,518, respectively). They do this by estimating an intercept and residual variance for a specified dependent variable, in this case a network partner characteristic, as in:

$$y_{ijk} = \beta x + v_k + u_{jk} + e_{ijk} \quad (1)$$

where y is the dependent variable, *x* the intercept, *e, u and v* residuals, and subscripts i, j, and k index the network-partner, individual, and village respectively.

Table 1: *Bivariate tabulations of selected women's network partner (NWP) characteristics in Malawi 1 and Malawi 2* [1]

	1998 (N=3,350)	2001 (N=3,518)
Percentage of network partners by gender:		
- female	93.9	94.7
- male	6.1	5.3
Percentage of network partners by relationship to respondent:		
- friends	31.6	40.5
- sister-in-law/sister-in-marriage	17.2	18.3
- distant female relatives	16.2	11.4
- acquaintance/workmate	13.2	10.6
- other[2]	21.8	19.2
Percentage of network partners live in:		
- same HH	0.90	1.4
- same compound	12.9	14.8
- same village	43.3	48.6
- same district	35.5	33.0
- same region	2.1	0.7
- other region	1.2	0.2
- elsewhere (outside Malawi)	4.3	1.4
Percentage of network partners who R claims are:		
- confidants	27.6	26.6
- friends	52.6	58.7
- acquaintances	15.3	12.5
- met once or twice only	4.4	2.3
Percentage of network partners who have:		
- no schooling	25.7	29.7
- some primary schooling	37.2	36.4
- completed primary schooling	17.5	19.0
- some secondary or more	6.8	8.7
- R does not know NWP's schooling	12.8	6.3

Notes: [1] Categories within columns may not sum to 100.0 due to rounding. [2] Refers to all male relatives, mothers and mothers-in-law, medical staff and "other."

Table 2 presents the proportion of variance at these three levels over the two rounds of data collection. Each of the three network characteristics is transformed into a binomial variable: kin *versus* non-kin; confidant *versus* friend, acquaintance, or relationship in passing; and lives in the same village as the respondent *versus* lives elsewhere. Consequently, the VC model is specified with logit distributions.

Table 2: *Estimated intercept and residuals (standard errors) in variance components models comparing characteristics of AIDS network partners named by the 1,210 women interviewed in 1998 and 2001.*

	Network partner characteristics:					
	kin		confidant		lives in same compound or village	
	1998	2001	1998	2001	1998	2001
Intercept – β_0	.091	-.109	-1.00	-1.01	-.274	-.075
	(.080)	(.067)	(.075)**	(.055)**	(.080)**	(.058)
Residual variance at level of:						
- *villages* – v_k	.186	.230	.101	.000	.184	.078
	(.076)*	(.074)**	(.063)	(.000)	(.077)*	(.053)
- *individuals* – u_{jk}	2.35	1.73	2.57	1.99	2.36	1.95
	(.134)**	(.114)**	(.157)**	(.132)**	(.135)**	(.123)**
- *network partners* – e_{ijk}	.371	.508	.502	.608	.385	.496
	(.010)**	(.014)**	(.014)**	(.017)**	(.011)**	(.014)**
Proportion of total variance (v_k + u_{jk} + e_{ijk}) between:						
- *villages*	0.06	0.09	0.03	0.00	0.06	0.03
- *individual respondents*	0.81	0.70	0.81	0.77	0.81	0.77
- *network partners*	0.13	0.21	0.16	0.23	0.13	0.20

Notes: ** statistically significant at the 1% level; * significant at the 5% level.

Results are consistent with expectations. While in both 1998 and 2001 the bulk of variance in conversational network partners' characteristics is at the individual level (the proportions range from 0.81-0.91 in 1998 to 0.70-0.87 in 2001), there are systematic differences between the two rounds. In absolute terms, there is a reduction in the total variance of these network characteristics across all three variables between 1998-2001. This is mainly brought about by attenuated variance at the individual level (there is also a reduction at the village-level in relation to the locality of the network

partner). In contrast, variance among network partners increases on all three characteristics.

These divergent trajectories in the distribution of variance imply the following. First, village-level differences in types of AIDS-related conversational network partners appear to be shrinking in terms of variance estimates. In the 1998 data, there was no significant village-level difference in whether these AIDS-related conversational network partner were considered a "confidant" as opposed to a "friend," "acquaintance," or "met only once" (Note 5), but there were still significant differences in the network partners' residential proximity to the respondent, and in whether they were kin as opposed to non-kin. By 2001, only variance in the latter remained significant. Similarly, the variance contributions of villages with respect to conversational network partner characteristics increases only on the kin *versus* non-kin dimension.

Second, on all three measures, there has been a statistically significant reduction in variance at the individual level, implying that over and above the convergence at the village-level, there is increasing homogenization of network characteristics among individuals. In other words, individuals are diversifying their AIDS-related conversational network; their idiosyncratic preferences are less important determinants of network partner selection *vis-a-vis* AIDS than they were.

This directly ties into the third implication of these results: that at the level of the network partner, there is increasing heterogeneity. The diversification of the network pool at the individual level means that those conversational network partners mentioned in 2001 are a more diverse group than those mentioned in 1998, even though they are nominated by the same set of individuals.

4.1.2 Diversification among respondents who claim to have network partners

One limitation of this diversification argument is related to the possible selection bias in the network partners named in 1998 and 2001. We have no way of telling from Table 1, for example, how much selection bias affected the 1998 estimates that are used as a baseline here. To provide further support for the diversification argument it is useful to check whether there is also an apparent diversification in the characteristics of respondents who report AIDS-related network partners. Respondents, after all, more systematically reflect the characteristics of the general population since they, in contrast to their network partners, were randomly sampled from it.

Again, I begin by looking at changes in univariate distributions. The survey questionnaire's key name generator was: "How many people have you chatted with about AIDS (other than your husband or partner)?" In response to this question, women

claimed an average of 4.3 and 5.8 people in 1998 and 2001 respectively. Part of this increase in the number of reported conversational network partners stems from a decrease in the number of zero-responses, that is, in the number of women who replied that they had not talked to anyone about AIDS. Of the 1,210 women, 192 reported zero network partners in 1998, and 59 in 2001. But part of the increase in reported number of conversational network partners also stems from an increase among those who had reported *at least one* such network partner (it increased from 5.3 people in 1998 to 6.1 people in 2001). Either way, within the same pool of respondents, there appears to have been an increase in the number of conversations about AIDS.

Table 3: *Characteristics of MDICP women interviewed in both 1998 and 2001 (N=1,210)*

	1998	2001
Background		
Age	31.2	34.3
Years of schooling	3.7	3.8
Currently married (%)	88.6	89.3
Geographic mobility		
Been to own region's capital city[1] (%)	44.7	50.8
Been to neighboring region's capital city (%)	13.9	17.5
Been to all three region's capital cities (%)	3.5	4.4
Wealth		
Ownership of HH goods[2]	2.8	3.1
House materials[3]	0.27	0.37
Units of livestock[4]	136.1	118.2

Notes: [1]Regional capitals refer to Blantyre in Southern Region, Lilongwe in Central Region, and Mzuzu in Northern Region; [2]0-6 additive scale combining ownership of bed & mattress, radio (with 2 points if it is currently working), bicycle, lamp, and pit latrine; [3]0-2 scale combining metal/tile roof and fired brick walls; [4]Based on relative prices of livestock in Malawi in 1999, a chicken is defined as 1 unit of livestock, a goat/pig as 15 units, and a cow as 150 units.

Are there signs that the respondent pool has greater diversity in 2001 than in 1998? Changes in univariate characteristics, shown in Table 3, imply a qualified "yes," since among the 1,210 women respondents, there is general stability in background characteristics but some change in mobility and wealth across the 3-year intersurvey period. Specifically, the increase in mean age corresponds to the duration of the intersurvey period, and years of schooling and the percentage currently married are very similar (though there is some flux in the latter since a small proportion of these women were widowed, separated or divorced within the 3-year intersurvey period, but they also remarried and remained in the sampled areas). In contrast, a larger number of these

women had claimed to have visited either their own regional capital, the capital of the neighboring capital, or the capitals of all three regions (Note 6). Similarly, while there appear to have been increases in ownership of consumer goods within households, and of the accumulation of more resilient and expensive housing materials, there has also been a reduction in agricultural wealth, at least as measured by livestock holdings (Note 7).

Multilevel analysis begins, once again, with a simple VC model. This differs from model (1) in a number of ways. First, because of the long right tail in the number of people reported in response to the name generator question, the actual analysis is conducted on a log transformation of this variable that more closely approximates normality. Second, women who reported zero-networks were assigned 0.1 network partners (since the log transformation of zero is not identifiable). Third, because we now include individual respondents who reported no conversations about AIDS, a two-level model is specified with random variation between villages and between individuals. This is equivalent to dropping the estimate of network-specific variance e_{ijk} from equation (1), as in:

$$y_{jk} = \beta x + v_k + u_{jk} \qquad (2)$$

where all terms are as described in (1) above. Finally, the model is estimated using a Generalised Least Squares specification rather than logit (Goldstein 1995: Chapter 2).

The results of two VC models are presented in Table 4. They add to the information implied by the changes in univariate statistics. The bulk of the variance in the number of AIDS-related conversational interactants is at the individual level, though as shown in Table 2, here too there is a large reduction in individual variance between 1998 and 2001, suggesting that the pool of individuals who had participated in AIDS-related discussions by 2001 (and who reported that participation) is more diverse than the equivalent pool in 1998.

Table 4: *Variance components model of (log) network size among the 1,210 women interviewed in 1998 and 2001, by year of data collection*

	Malawi 1	Malawi 2
Intercept	.786 (.063)**	1.455 (.043)**
Residual at level of:		
- *villages* – v_{1j}	.124 (.048)*	.139 (.033)**
- *individuals* – u_{1ij}	2.167 (.091)**	.936 (.041)**
-2*log(likelihood)	4,412.65	3,462.95

Notes: ** statistically significant at the 1% level; * significant at the 5% level.

In addition, however, Table 4 also points to an aggregate transition in the structure of networks insofar as village-level variance in the number of reported interactants remains stable and significant over the two measurement periods. In other words, there is some level of clustering in conversational intensity. Women with larger AIDS-related conversational networks live amongst each other. This makes sense intuitively. It also underscores the reliability of the MDICP's name generator across respondents.

4.2 Network size

4.2.1 Covariates of network size with simple variation

Increased diversity among respondents who report having conversations about AIDS also raises questions about covariates. In particular, what is that heightened diversity related to? I now specify two models that attempt to identify the covariates of the size of respondents' conversational networks. The first adds explanatory variables to the fixed part of model (2) but leaves the random part unchanged, distinguishing only between the level-specific random terms associated with the intercept. Thus,

$$y_{jk} = \beta_0 + \beta Z_j + v_k + u_{jk} \quad (3)$$

where Z refers to a vector of explanatory variables, and all other terms are as described above.

In initial iterations of the models, three categories of explanatory variables were specified. The first refers to standard demographic and socioeconomic characteristics such as age, years of schooling, and measures of economic status. The latter includes additive measures of household ownership of consumer items, measures of income, measures of agricultural wealth and land-holdings, and of the types of materials from which the respondent's house is constructed. Measures of economic wealth and heterogeneity in wealth were also specified at the village-level.

The second category of explanatory variables includes variables that are reasonably thought to be more directly related to exposure to conversations about AIDS through increasing contacts beyond local networks. These include past residence or recent stays in a city, number of marriages, interethnic marriage (a possible indicator of an individual's taste for contact with people unlike themselves), and measures of ethnic heterogeneity at the village-level (under the hypothesis that these types of differences can lower the likelihood of having conversations about a relatively sensitive topic).

Finally, the third category of explanatory variables includes those related to exposure to the consequences of AIDS. This category includes variables that index the

estimated number of local people the respondent guesses have died from AIDS, the number of relatives said to have died from AIDS, and the number of funerals the respondent has reportedly attended in last 12 months.

Table 5: *Covariates of (log) network size (and standard errors) among 1,210 women interviewed in 2001 who had previously been interviewed in 1998.*

	(1)	(2)
Fixed part of model:		
Intercept	.865 (.080)**	.873 (.081)**
Years of schooling	.017 (.010)	.019 (.009)*
Ownership of HH goods[1]	.066 (.017)**	.060 (.017)**
Number in the area died from AIDS	.019 (.004)**	.020 (.004)**
Number of relatives said to have died from AIDS	.043 (.017)**	.045 (.015)**
Funerals attended in last 12 months	.025 (.009)**	.025 (.008)**
Random terms associated with intercept:		
v_{1j} – Villages	.100 (.027)**	.095 (.025)**
u_{1ij} – Individual	.893 (.039)**	1.519 (.137)**
Random terms that vary across individuals in relation to:		
u_{4ij} – Number in the area died from AIDS		.0011 (.0004)**
u_{6ij} – Funerals attended in last 12 months		.0013 (.0015)
Covariance between individual-level random terms		
$\sigma_{u41} - u_{1ij}/u_{4ij}$		-.039 (.007)**
$\sigma_{u61} - u_{1ij}/u_{6ij}$		-.048 (.017)**
$\sigma_{u46} - u_{4ij}/u_{6ij}$		.0032 (.0007)**
-2*log(likelihood)	3,385.75	3,356.23

Notes: [1]HH goods refers to a 0-6 additive scale combining ownership of bed & mattress, radio (2 points if it currently works), bicycle, lamp, and pit latrine. ** statistically significant at the 1% level; * significant at the 5% level.

Results of the final models with simple variation are presented in the first column of Table 5. There are two contrasting sets of results. First, there is a relative dearth of relationships between respondents' background characteristics and the number of AIDS-related conversational network partners they report. For example, there is no observed relationship whatsoever between the number of reported network partners and the second category of explanatory variables: those that index contacts beyond local networks. Similarly, the only consistently significant relationship between the number of reported network partners and background characteristics was with an additive measure of ownership of consumer items. Age had no effect on likelihood of reporting

conversations (in either linear or exponential forms), and even the positive effect of schooling is conditional on controls introduced in model 2 (discussed below).

In contrast, there are strong relationships between reported exposure to the consequences of AIDS and the number of reported conversational network partners.

These results suggest that factors which are specific to AIDS are much more likely to trigger AIDS-related conversations than, say, more general social characteristics. This too is consistent with the diversification story described above, since in combination with the increasing impact of AIDS-related mortality, it suggests that the diffusion of AIDS through the population in itself increases its legitimacy as a topic for conversation. Taboos about AIDS-related conversations, in other words, may also be a casualty of high rates of HIV/AIDS, even where, in the initial stages of the pandemic, they hindered public-health messages and informal conversations.

4.2.2 Covariates of network size with complex variation

Fitting a VC model with complex variation in the estimated residuals allows us to check whether the positive relationship between exposure to AIDS and the reported number of AIDS-related conversational network partners is true across all individuals and communities. Complex variation, in this case, refers to the differentiation between general residuals associated with the intercept and residuals specific to parameters in the fixed part of the model. The latter is associated with a single fixed parameter and can be specified at either the village or individual level, as in:

$$\beta_{1jk} = \beta_1 + v_{1k} + u_{1jk} \tag{4}$$

Identifying complex variation is useful because it allows us to explore whether the residual contains significantly different levels of variance at differing values of the explanatory variable, implying that there is more to the relationship between the two variables than that which is captured in the fixed part of the model. In this case, for example, it seems plausible to suggest that the number of funerals that the respondent has attended could have differential effects on one's willingness to talk to others about AIDS (or to provide such information to interviewers). It is also possible that this difference might vary across villages or other types of networks. Similar arguments could be constructed about each of the variables used in model 1 in Table 5.

Model 2 in Table 5 presents results of a specification with complex residual variation. A number of iterations were attempted in which each of the variables in the fixed part of the model were specified as random at both the village- and individual-level. None varied randomly at the village level. Two varied randomly at the

individual level and contributed to the model's explanatory power: the number of local deaths from AIDS, and the number of funerals that the respondent has attended. While the fixed part of the model depicted in column (2) of Table 5 is therefore identical to column (1) in terms of overall structure, and very similar in terms of the size of estimated effects, the random part contains two extra residual terms that vary across individuals in relation to the fixed coefficients (u_{2jk} and u_{3jk}), as well as three covariance terms that measure the relationship between these two and the general intercept-related residual u_{1jk}.(Note 8). Substituting equation (4) into (3) yields the complete model estimated in column (2) in Table 5:

$$y_{jk} = \beta_0 + \beta Z_j + \beta_2 + \beta_3 + v_{0k} + (u_{1jk} + u_{2jk} + u_{3jk}) \quad (5)$$

where subscripts 2 and 3 index estimates specific to two fixed/random parameters, and all other terms are as described above.

This specification significantly improves model fit, as judged by the 30-point reduction in the log-likelihood statistic. It shows that although the number of AIDS network partners is positively associated with the reported number of AIDS deaths in the area, there is significant variability in this relationship across individuals. There are also distinct patterns of covariance with the residual of the reported number of attended funerals in the last 12 months, signaling a non-uniform distribution of total variance.

To make it easier to see this, these relationships, in particular the covariance between the two random terms associated with fixed coefficients, u_{2ij} and u_{3ij}, are demonstrated graphically in Figure 1. That is, Figure 1 graphs the predicted variances of the sum of random variables – the equation from which that sum is estimated is specified in footnote 8 – over a range of values of the two coefficients which have both fixed and random terms (x_{2jk} and x_{3jk}), and over the mean values of the other parameters. The predicted values are derived from the model presented in column (2) of Table 5.

Figure 1 shows that the variance of the sum of random variables is greatest at the extreme low and high values of predictor variables, especially the latter. It also demonstrates the negative covariance between the two sets of residuals. For example, it shows that the variance in the sum of random variables is partly contingent on the interaction between the number of funerals a respondent has attended, and the number of people they claim have died of AIDS. Thus, for those individuals who claim to have been to many funerals, the variance climbs with a slight exponential curve in proportion to the number of people they report have died of AIDS. For those who claim to have been to no funerals, in contrast, the variance of the sum of random variables falls in proportion to the number of reported AIDS deaths.

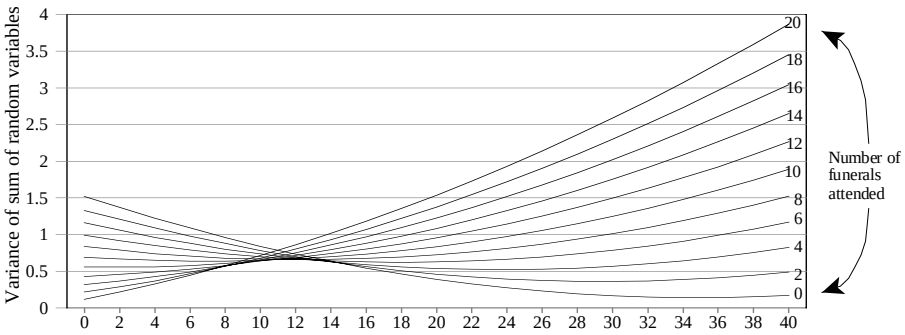

Figure 1: *Predicted variance of sum of random variables by reported number of AIDS deaths in the area, and the reported number of funerals respondents had attended (estimates derived from model 2 in Table 5).*

5. Conclusion

The key premise underlying a networks approach to the analysis of AIDS-related behavior is the following: people with whom a given individual interacts can influence that individual's own AIDS-related decisions, and therefore his/her subsequent likelihood of infection. Using data on conversational networks – a subset of more general social networks – this article has attempted to focus attention on two aspects of networks that have not yet received much in the way of empirical attention. First is the idea that networks change, and may be more likely to change in times of rapid social dislocations since the interactional norms which underlie them are also more likely to be changing. Second is the idea that in common with other types of social change, changes in network structure or composition may be at least partly correlated within a group.

A number of empirical observations have emerged during the analysis. The first is that conversations about AIDS are increasingly occurring within all demographic groups in rural Malawi. For example, the number of reported conversations covaries much less with standard demographic characteristics such as age and socioeconomic status than with personal exposure to the consequences of AIDS. Similarly, a reduction in individual-level variance between the two survey waves among those who reported

AIDS-related conversational network partners suggests that the pool of individuals who had participated in AIDS-related discussions by 2001 (and who reported that participation) is more diverse than the equivalent pool in 1998.

The second empirical observation is that AIDS-related conversational networks have diversified, which is also consistent with this diminished importance of social group markers. Specifically, respondents reported more conversations with people unlike themselves, in particular friends over kin, in 2001 than in 1998. This may be important since it points to aggregate changes in interactional norms that are consistent with the forecasts of social theorists, as discussed briefly in note 3.

Third, the methods used here have also allowed me to identify the level at which some of these changes are occurring, in particular the level of clustering of these phenomena. This group of observations is, in certain ways, the most surprising since it shows that village-level variance in the number and characteristics of AIDS-related conversational network partners is consistently a negligible proportion of the total variance, even though it is for the most part statistically significant. Similarly, there is no significant complex variation at the village level.

This relative lack of village effects is disappointing from one perspective. Yet on the other it is consistent with contemporary skepticism about the extent to which communities can be accurately depicted as physically bounded (e.g., Cohen 1985). For like prior research on the relative strength of villages and conversational networks in the estimation of family planning program effects (Kohler, Behrman and Watkins 2000), the results described here imply that when attention is on interactional phenomena, definitions of community that stem from constructivist and network approaches may be more valid than standard definitions that employ geographic markers to distinguish between communities. People and information flow across boundaries in the course of daily life. Their social contacts are not restricted by village markers.

Many questions remain. Are these changes in conversational network structure among women restricted to conversations about AIDS, or are they more general? Has the pace of changes in either AIDS-related or general social networks accelerated in recent years? Is AIDS the main cause? If there is more generalized change, what will interaction in rural Africa look like when this round of changes in network structure begins to slow? More specific to AIDS: what effect will the more diverse set of network partners have on subsequent AIDS-related behavior? And are these apparent changes specific to women, or would we also identify them if we replicated the analysis on men's data? Finally, and more generally yet: Does village-level variance on other constructs used in AIDS research in general, and in sub-Saharan Africa in particular, contribute as little to the total variance as the network measures explored here? Is it possible to collect non-conversational "true" social network data that allow us to model

within-network correlations more effectively than is presently possible with the limited conversational network data?

A single positive policy-relevant tidbit may also be gleaned from the results presented here. The rural residents represented in these data appear to feel more comfortable talking or chatting about AIDS, irrespective of their age and largely irrespective of their educational status, than they did a few years ago. If this willingness to talk is an early marker of attempts to minimize infection then this is in itself good news. If the networks are new, broad and diffuse, then it is even better so. For conversational networks are networks along which new information, which we hope in this case will include protective information, will likely pass. The newer, broader and more diffuse those networks are, the more rapid the spread of that information.

6. Acknowledgements

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Notes

1. Although these have also been referred to as "hierarchical linear models," I prefer the nominally simpler and less restrictive "multilevel" label.

2. It is worth noting that on a certain level, there may be an inverse relationship between the cultural importance of a given topic and the frequency with which it is communicated verbally. It is, in a classical sense, "taboo." With the exception of reluctance to admit HIV status, AIDS in Malawi, at this stage of the epidemic, does not appear to be in this category. Its day-to-day visibility in the media, in public-health campaigns, in school curricula, in local meetings, in the frequent funerals of working-aged adults, and so on, have all induced increasingly public discussion, and increasingly public references. Much of this has emerged MDICP qualitative data, especially in semi-structured interviews and diaries.

3. To the extent that our concern is with primary causes of such transitions, it is important to recognize that these AIDS-related effects may also be an outcome of more general changes associated with modernization, economic dislocations, flawed governance, and so on. For example, social theorists have long described the interactional transition that accompanies modernization: that on both the individual and communal level there is a diversification of one's key social network leading especially to a partial substitution of kin by friends and co-workers. Although this substitution may be partly the result of increased social and geographic mobility – which increases the pool of prospective conversational interactants – it is also embedded in an increased openness to outsiders, and to the outside (Durkheim [1924] 1964, Douglas 1970, Giddens 1990). In addition, there may also be some interaction between AIDS and these more general changes. Mtika (2001) and Weinreb (2002), for example, report Malawian informants' attempts to diversify their support networks to include non-kin in order to avoid total reliance on family networks, considered somewhat less reliable as AIDS-related demands grow.

4. There is a considerable literature on the relative strengths and weaknesses of different types of name generators, and of the different types of network data that these methods spawn (e.g., Bernard et al 1987; Bernard et al 1990; Marsden 1990; Bailey and Marsden 1999; Hlebec and Fergiloj 2001). The MDICP name generator is intended to collect data on "conversational networks." This is based on the assumption that individuals may choose conversational network partners from a larger pool of possible friends and acquaintances on the basis of expectations about their response to certain issues. Initially, this focus on conversations rather than more general social networks appears problematic since it raises questions about

(a) network selectivity and (b) about the extent to which these conversational networks can be considered an indicator of true social networks.

Two factors suggest that there is little to worry about, at least with respect to the AIDS network. The first stems from a comparison with the family planning network. A high level of overlap in personnel or social characteristics between independently collected networks signals, at most, some "instability" between two networks, but not meaningful differences, because the same type of people predominate in both networks (e.g., Brewer and Webster 2000). There is considerable overlap between people mentioned in the AIDS and family planning network, and in their characteristics. This has been reviewed in relation to parallel Kenyan data by Watkins and Warriner (1999). But the overlap is as pronounced in the Malawi 2 data. Not only do 30 percent of named network partners appear in both family planning and AIDS networks, but the remaining 70 percent are very similar in their outward characteristics: 32 percent in both networks have no formal education; 43 and 41 percent, respectively, are friends rather than family; and 98 and 94 percent are women. The only substantial difference in background characteristics between the two networks is in the closeness of the relationship. Specifically, 35 percent of family planning network partners are "confidants," in contrast to 20 percent of AIDS network partners. Yet even this difference is consistent with prior assertions about the increased legitimacy of AIDS as a topic for even casual conversation with non-confidants (unlike a conversation about family planning).

The second factor is empirical. The name generator used in the MDICP was previously used in a parallel study in Kenya, and analytic results from that project are consistent with general social network theory (e.g., Kohler, Behrman and Watkins 2001), implying that network data collected with a conversation-focused name generator behave in the same way as more general network data.

5. There were also no significant village-level differences when other constructions were attempted (e.g., "confidants"/"friends" *versus* "acquaintances"/ "met only once").

6. Note the apparent contrast between the greater worldliness of respondents in 2001 – insofar as this is indexed by the increase in the proportion who had visited their own region's capital city, and the neighboring region's capital city – and the increasingly local nature of their AIDS-related networks depicted in Table 1.

7. These developments, within a relatively short 3-year span, signal the speed of ongoing social and economic transformations in Malawi. They are consistent with informants' reports that consumer goods are cheaper now than they were a few years ago (and South African Development Community [SADC] plans to rid trade

between member countries of tariffs altogether will likely further reduce the prices). They also suggest that demand for consumer goods is becoming less sensitive to price: thus the apparent substitution of consumer items for more traditional types of agricultural wealth, even among these rural agricultural women. It is also worth noting that although survival to Malawi 2 means that this sample does not directly measure the effects of AIDS mortality, these reported changes in wealth are not consistent with the darker predictions of AIDS-related effects on aggregate poverty levels.

8. The full measure of individual-level variation in the model portrayed in column (2) is therefore: $\text{var}(u_{1jk}x_1 + u_{2jk}x_1 + u_{3jk}x_1) = \sigma^2_{u1}x_1^2 + 2\sigma_{u12}x_1 x_{2jk}^2 + \sigma^2_{u2}x_2^2 + 2\sigma_{u13}x_1 x_{3jk}^2 + 2\sigma_{u23}x_2 x_{3jk}^2 + \sigma^2_{u3}x_3^2$. Note that although the random term on "number of funerals" (u_{3ij}) is not statistically significant on its own, it is statistically significant in its covariance with both the random term associated with the intercept ($ó_{u31} - u_{1jk}/u_{3jk}$) and with the random term associated with "Number in the area died from AIDS" ($ó_{u23} - u_{2jk}/u_{3jk}$).

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