Neighbors, Social Interactions, and Learning HIV Results

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Abstract

How do neighbors positively or negatively influence individuals living in rural Malawi to attend VCT centers to learn their HIV results? Using GIS data of location of homes and distance to other neighbors, we measure the social network effects of neighbors' VCT attendance on individuals own attendance. This paper utilizes a randomized experiment that encouraged individuals and their neighbors to learn their HIV results. Using the fact that neighbors randomly received monetary incentives of varying amounts to learn their HIV status, the results in this paper indicate positive effects of neighbors attending VCT clinics on others living nearby. We find differential effects by religious networks as well as by initial level of social interaction.

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1. Introduction

Social networks can have both a positive and negative influence on medical and health care decisions as well as the use of health-promoting services. For example, networks can positively influence individuals to seek cancer screening (Suarez 1994), recruit and influence friends to use contraception (Speizer, Tambashe et al. 2001), utilize health services (Deri 2005), receive a flu vaccination (Rao et al. 2006) or influence family planning choices or sexual behavior (Casterline 2001; Kincaid 2000; Kohler et al. 2001; Montgomery and Casterline 1996; Morris and Kretzschmar, 1997; Valente et al. 1997; Helleringer and Kohler 2005; Behrman et al. 2006; Campbell et al. 2002, Munshi 2000). Networks may also have a negative effect on health behavior. Miguel and Kremer (2006) find that social learning about de-worming drugs in Kenya may have actually lowered subsequent purchases: increased number of peers using de-worming drugs lowered others' infection risk and thus lowered the benefit of purchasing such drugs.[3]

This paper evaluates the impact of social networks on the decision to learn HIV results after being tested. There is abundant evidence, mainly qualitative or anecdotal, that people are afraid of learning their HIV results. This could be due to the fact that individuals often overestimate the risk that they face and expect to receive an HIV-positive diagnosis (Anglewicz and Kohler 2005; Bignami Van-Assche, Anglewicz et al. 2005). It is theoretically ambiguous whether the strategic complementarities of others' attendance at VCT centers are positive or negative. They may be positive if, for example, neighbors provide additional emotional support that reduces psychological costs, or if there are economies of scale of travel costs. Alternatively, they may be negative if increased numbers of neighbors observing attendance at the VCT center results in higher psychological costs (i.e. due to stigma). It is often suggested by policy makers that one important barrier to testing and learning results is social stigma and a great deal of financial and human resources have been devoted to de-stigmatization and HIV testing awareness campaigns. (See HITS-2000 Investigators, 2004; Mugusi et al. 2002; Ginwalla 2002; Baggaley 1998; Hutchinson 2004; Ford 2004; Coulibaly 1998; Kalichman 2003; and Wolff 2005).However, there

[3] Within the fields of education and crime there is a wider literature on the effects of social networks, see for example Sacerdote (2000), Figlio (2003), Angrist and Lang (2002), Evans, Oates, and Schwab (1992), Gaviria and Raphael (2001), Hoxby (2000), Zimmerman (2002).

has been surprisingly little rigorous research quantifying or identifying these claimed negative social network effects on seeking HIV results. For this reason, it is important to understand how social interactions affect individuals' motivation to learn their HIV results.

Measuring the extent to which social networks affect decision making is challenging because social group formation is usually endogenous, complicating causal interpretation: that is, if belonging to a social group is a matter of deliberate choice, it is difficult to assign causality to the impact of the group itself (Manski 1993). In addition, individuals may make simultaneous contemporary decisions making it difficult to determine the causal behavior; this is often called the reflection problem. A few studies have utilized natural or field experiments in which social groups were randomly assigned (e.g. dorm room assignments, see Kremer et al; Rao et al. 2006; Sacerdote 2001; Zimmerman 2003; or random allocation of de-worming medicine, see Miguel and Kremer 2006). Other strategies have used natural experiments or constructed instrumental variables to instrument for endogenous peer behavior (Figlio 2003). This paper adds to this literature by analyzing an experiment that randomized the allocation of monetary incentives to multiple individuals in the same village in rural Malawi to learn their HIV results after being tested. The monetary incentives serve as exogenous instruments for multiple individuals living in the same communities to learn their HIV results, thereby permitting a causal analysis of the effects of social networks.

In this paper, we examine several aspects of social networks and the decision to learn HIV results. First, we measure the effects of neighbors living within close geographic proximity on an individual learning her HIV results. We find large effects of neighbors living within 0.5 kilometers: a 10 percent increase of neighbors attending the VCT (approximately 9 additional neighbors) increases the probability of obtaining HIV results by 1.7 percentage points. These effects are similar among men and women.

Second, we examine how members of the same and different religious group affect one another. Using detailed data of church and mosque membership, we find that both religious affiliation (e.g., Christian or Muslim) and church/mosque attendance at a specific place of worship matters for the size of the network effects on learning HIV results. In general, among Christians, there are larger effects of community members belonging to a different church obtaining their HIV results than the effects of community members belonging to the same church obtaining their HIV results. However, among Muslims, the opposite is true: there are larger effects of community members belonging to the same mosque obtaining their HIV results than those effects of community members belonging to different mosques attending the VCT.

Intensity of social interactions within a community also is important, but only for women. For women, the frequency of social interactions within the village as measured by attendance to community events (for example, weddings and political meetings), has important effects on increasing the size of the peer effect for obtaining HIV results. There is no effect of frequency of social interactions within the village on the peer effects among men. In all we find positive social network effects on the decision to learn HIV results in communities in Malawi.

2. Experiment and Data

2.1 Survey and Experimental Design

The Malawi Diffusion and Ideational Change Project (MDICP) is conducted in rural Malawi and is a collaborative project between the University of Pennsylvania and the Malawi College of Medicine. It is an on-going study of men and women randomly selected from 125 villages in the districts of Rumphi, Mchinji, and Balaka, located in the north, central, and southern regions respectively. Approximately one in four households in each village were randomly selected to participate, and ever-married women and their husbands from these households were interviewed in 1998, 2001, 2004, and 2006. In 2004, an additional sample of adolescents (ages 15-24) residing in the original villages was added to the sample. In addition, in 2004, all of those who participated in the survey were offered free tests for HIV and three other sexually transmitted infections, in their homes. The test results were available to respondents approximately 2 months after they were taken due to processing time at the laboratory. This paper uses the survey data and HIV data collected in 2004.

Across the three districts, 2894 respondents accepted a test for at least one sexually transmitted disease. The HIV prevalence rate was 6.4 percent (7.5 percent rates for females, 5.5 percent for males). The level of HIV infections in the MDICP sample is considerably lower than national prevalence rates, a typical finding when prevalence data from antenatal clinics are compared with prevalence data from a cross-sectional population-based study (Mishra 2006; Boerma 2003; Garcia-Calleja 2006). In our longitudinal data, downward biases may also result from death and migration (discussed below), as well as the fact that the data includes the additional sample of unmarried respondents and married adolescents (the prevalence in the adolescent sample is 1.7%).

The experimental design involved offering monetary incentives to encourage respondents to obtain their HIV test results. After taking the test samples, nurses gave each respondent a voucher redeemable upon obtaining their HIV results. Voucher amounts were randomized by letting each respondent draw a token indicating a monetary amount out of a bag. Vouchers ranged between one and three dollars; the average total voucher amount was 104 kwacha (or approximately one dollar), worth approximately a day's wage. The distribution of vouchers was carefully monitored to ensure that each nurse followed the rules of randomization. Overall, 20 percent of respondents received no monetary incentive.

Two to four months after collecting samples, test results became available and temporary counseling centers consisting of small portable tents were placed randomly throughout the districts, stratified by village. Based on their geo-spatial (GPS) coordinates, respondents' households in villages were grouped into zones, and within each zone a tent location was randomly selected. There were 16 different VCT zones across all three districts with an average of 177 people in each VCT zone. The average distance to a center was short, approximately 2 km, and over 95 percent of those tested lived within five kilometers. The VCT zones are relatively heterogenous – while on average approximately 46 percent of the sample is male, this varies from 39 – 53 percent across zones. The religious composition also varies across and within in zones. For example, although 22 percent of the sample is Muslim some zones have no Muslim representation and others are 75 percent Muslim.

Respondents were personally informed of the time and location of their assigned center (open Monday through Saturday from eight in the morning until seven in the evening) and centers were operational for approximately one week. Respondents were allowed to attend any of the VCT centers but were only informed of the location and time of their assigned center (less than six percent of respondents went to a different center than the one to which they were assigned). Couples were not informed of their results together, and results were verbally told to each respondent. Respondents could only redeem their voucher after they heard their results.

2.2 Data

The sample used for analysis in this paper consists of those individuals who accepted an HIV test in 2004. These data and the experimental design are discussed extensively in Thornton (2007), however, it is worth briefly mentioning a few key issues. First, although the original sample in 1998 was randomly drawn, sample attrition across waves of data collection affects the degree to which this sample is representative. The primary reason for attrition across all waves of data is temporary and permanent migration (Obare 2007); in 2004, 18 percent of those interviewed in 2001 were away or had moved, which is comparable to the attrition rates of other longitudinal studies in Africa (Chapoto and Jayne 2005; Maluccio 2000; Van-Asche, Reniers and Weinreb, 2003, Anglewicz et al 2007,). Sample attrition from the panel means there are disproportionately fewer mobile and sick individuals, thus potentially affecting the external validity of the study. However, these data in both the MDICP sample as well as the sub-sample we use for analysis are similar to those found in a recent population based survey in Malawi along all basic demographic characteristics (not shown, MDHS 2004).

Test refusals may also be a source threat to external validity: 9 percent of those approached refused to be tested for HIV. However, in comparison to the DHS Malawi (2004), this is a relatively low refusal rate, which may be due to the use of saliva rather than blood (as in the MDHS) or that respondents were not required to learn their results at the time of testing (the MDHS did not offer results). Other analysis the MDICP data suggested that there was limited selected refusal based on observable characteristics (Onyango 2007). 18 percent of respondents reported having a previous test for HIV, although only half of these individuals reported actually having received the results. Those who had a previous test were six percentage points more likely to accept a test from the MDICP nurses (not shown). However, those who reported previously *learning* their results were *less* likely to accept a test than those who reported previously not learning their results. Not all spouses of respondents were offered a test: men who divorced or were widowers as well as spouses of the newly sampled adolescents were ineligible for testing.

The main sample for this paper consists of those who accepted an HIV test in 2004 and had basic covariates of HIV positive or negative results (not including those tested as indeterminate), age, and village ID. This results in 2825 total observations. The sample is 46 percent male with an average age of 33; 71 percent of the respondents were married at the time of the survey interview; and the average number of years of education was 3.3. There are large differences in ethnicity and religion across the three districts: the Chewas in Mchinji and the Tumbukas in Rumphi are primarily Christian, and the Yaos in Balaka practice Islam. The majority of the respondents are subsistence farmers producing primarily for home consumption, although some grow cash crops. The majority of the respondents, 76 percent, had been sexually active in the past year.

At the time of the survey, GPS coordinates were recorded at each respondent's house. Of the sample of tested respondents, 92 percent had GPS coordinates. Using the sample that had these location coordinates, we can identify non-spousal non-resident neighbors living within various kilometer radii bands of each respondent who tested for HIV. On average, there were 31 neighbors in the first 0.2 kilometer band that tested for HIV, 38 in the second 0.2 kilometer band, and 43 in the third 0.2 kilometer band. Although we are able to identify spousal relationships, we cannot distinguish other types of relationships between the respondent and his/her neighbors in the data.

An additional set of information that allows for measuring social networks is the religious membership of each respondent. Each respondent was asked about his or her religious affiliation as well as his or her specific place of worship. These data were coded to match individuals to their exact church or mosque. There were a total of 339 different churches or mosques identified, with an average of 20 different congregations in each VCT zone. These congregations are used to link respondents to social network groups. Approximately 10 percent of the respondents had no data about their place of worship, either because they had no place of worship or they did not respond to the question (treatment of missing data is discussed below).

3. Estimation Strategy and Results

3.1 Estimation Strategy

The difficulties of identifying and measuring social network effects was first outlined by Manski (1993) who differentiated endogenous peer effects from exogenous peer effects. In this paper, the endogenous peer effect is the effect of neighbors obtaining their HIV results on others obtaining HIV results. The exogenous peer effect is the effect of neighbors' background characteristics (such as attitude toward HIV or education) on others obtaining HIV results. Identification is further complicated by correlated effects – that individuals have self-selected into peer or network groups based on similar characteristics. Disentangling these various effects is one of the biggest challenges in the social networks literature and previous strategies have either utilized natural experiments that randomly assign peer groups or instruments for peer behavior. To estimate the effect of neighbors learning HIV results, we utilize the latter strategy, where exogenous incentives to learn HIV status are instruments for neighbors learning HIV results. Because neighbors randomly received different levels of financial incentives to learn their HIV results, we control for the potential selectivity of peer groups.

Our main specification estimating the effect of neighbors' VCT attendance on an individual's own VCT attendance is:

$$GotResults_{ij} = \alpha + \beta \% NeighborsGot_{ij} + X'_{ij}\mu + \varepsilon_{ij} \qquad (1)$$

where *GotResults* is an indicator whether individual `*i*' in village `*j*' attended the VCT center. The main independent variable, *NeighborsGot* is equal to the fraction of tested neighbors who attended the VCT center. In our preferred specification this variable refers to the neighbors who are living within 500 meters of the individual, approximately 91 neighbors.[4] In other specifications, the reference group of neighbors or peers may refer to subgroups such as females and males living within 500 meters of the respondent, and individuals belonging to the same church/mosque who live within 500 meters of the respondent. We also present results for neighbors who live within 0.2 kilometer radii bands from the respondent household.

Each specification also includes demographic controls such as HIV status, age, age-squared, gender, years of education, number of assets, and district fixed effects. We cluster our standard errors by village. In addition, we include in each specification a control for the total number of neighbors in the reference groups. This controls for differential effects of social networks for larger and smaller groups.

Because the percent of neighbors attending the VCT is endogenous (and may also be affected by the respondent herself), we use an instrumental variables strategy to identify the causal effect of neighbors attending the VCT center, relying on the fact that neighbors received different values of monetary incentive and these incentives had a strong influence their the decision to attend the HIV results center. We instrument *%NeighborsGot* by a spline function of the percent of neighbors randomly assigned the various incentive amounts within the reference group; in the main specification, the reference group are those living within 0.5 kilometers. In particular, the first stage is:

(2) $\%NeighborsGot_{ij} = \alpha + \beta_1 \%10-50_{ij} + \beta_2 \%50-100_{ij} + \beta_3 \%100-200_{ij} + \beta_4 \%200-300_{ij} + X'_{ij}\mu + \varepsilon_{ij}$

In this specification, the omitted category is the percent of neighbors within the reference group receiving zero incentive. The percent of neighbors receiving each of the other specified values (in Kwacha) are included as the instruments.

There is a large effect of the percent of neighbors receiving various amounts of incentives on the percent of neighbors attending the VCT center. Appendix A shows the first stage estimate for the neighbors residing within 500 meters of each respondent, indicating the large effects of percent of

[4] Recall that in 1998 approximately one in four households were randomly sampled and it is reasonable to expect that the households that tested for HIV are evenly distributed with density roughly proportional to all the households within the sample villages.

neighbors receiving incentives on the percent of neighbors obtaining HIV results. The F-statistic for the pooled male and female regression is 270 (Column 1).

The main assumption for our identification strategy is that neighbors' incentives do not have a direct effect on others' attending the HIV results centers. Because the vouchers were given in the privacy of each respondent's home, this is a reasonable assumption. It is plausible that this assumption may be violated for those living within the same household due to pooling of household income therefore we exclude all spouses and co-residents from the network analysis and only focus on non-spousal neighbors.

It is important to note that those receiving varying incentives amounts had generally balanced baseline characteristics. Table 2 presents OLS regressions of baseline demographic data on having a positive-valued voucher, the amount of the voucher, and living over 1.5 kilometers from the VCT center. For most instances, there are no significant correlations between incentive amount and demographic data, although in some cases there are statistically significant differences. For example, those receiving positive incentive amounts were approximately 2 years older and were 5 percentage points more likely to be sexually active. However, these differences are not large in magnitude; the fact that the data is generally balanced on observables reassures us that the randomization occurred correctly and that the randomization is likely to have created balanced groups on unobservables.

Another important consideration is that in some specifications, some individuals will have no neighbors in their network. For example, when estimating the impact of peers living within 0.5 kilometers of an individual, there may be some individuals who have no neighbors living within that proximity. In that case, instead of coding those individuals with missing neighbors attendance (because they had no neighbors in that group), those individual's neighbor's VCT attendance is coded as zero percent attendance. This is due to the fact that if there are no neighbors in the individuals' reference group, there will be no effect of those missing neighbors' VCT attendance on own attendance.

3.2 Results

We first illustrate graphically the impact of an increasing proportion of neighbors living within 0.5 kilometers attending the VCT center on an individual's own likelihood of attending the VCT center using a locally weighted Fan non-parametric regression. Figure 1 graphs the relationship between neighbors VCT attendance and own likelihood of attendance. There appears to be a linearly increasing relationship between neighbors' attendance and own attendance. However, this graph only illustrates the impact without instrumenting with the exogenous incentives.

Table 3 presents the OLS and IV estimates of the effect of neighbors living within 0.5 kilometers' attendance on respondents' own attendance at the HIV results centers. Columns 1-3 presents the OLS estimates of the effect of neighbors' attendance on respondents' VCT attendance. The coefficients are all positive and significant, of approximately the same magnitude. The IV estimates are slightly larger than the OLS estimates: the OLS coefficient for women is 0.111 while the IV coefficient is 0.146 (Columns 2 and 5). For the men, the OLS coefficient is 0.123 and the IV is 0.118 (Columns 3 and 6). This may suggest that without controlling for selection due to omitted variables, network analysis would underestimate the true peer effects for women.

Column 4 presents the pooled IV results for men and women. The coefficient implies that increasing the proportion of one's neighbors that attend the VCT center by 10 percent increases the respondents' probability of attending by 1.34 percentage points. The results are similar for men and for women; 1.46 percentage points for women and 1.18 percentage points for men (Columns 2 and 3).

These results are similar to other findings of peer effects. For example, Sacerdote (2000) found a point estimate of 0.131 of the effect of mean fraternity membership on a dorm floor in college on the likelihood of being in a fraternity. Rao et. al. (2007) found slightly larger effects of students' flu vaccine decisions on their friends with a point estimate of 0.82.

In addition to potential gender differences in the response to neighbors attending the VCT centers, there may be differential responses to neighbors of different genders (Moore 1990; for Malawi, see Anglewicz and Kohler 2007; Gerland 2005). For example, it may be that men and women only respond to those of the same gender, because same-sex neighbors may have the most influential social networks. To test this, we separate neighbors living within 0.5 kilometers into gender subgroups: female neighbors living within 0.5 kilometers of each respondent and male neighbors living within 0.5 kilometers of each respondent; we then estimate the separate effects of male and female neighbors' VCT attendance on respondents learning their HIV results. Each independent variable – percent of females obtaining results and percent of males obtaining results – are instrumented with the percent of females receiving various incentive amounts and the percent of males receiving the various incentive amounts. Columns 7 through 9 indicate that the most influential neighbors are females, although the coefficient is not statistically significant. The stronger effect of female neighbors holds for both males and females (Columns 8 and 9).

There is an extensive literature that suggests that peers tend to be concentrated within a close geographical proximity of the individual (Conley and Udry 2000). We choose 500 meters as our main specification; however, we test alternative specifications to examine neighbors living within a closer proximity. We examine the impact of neighbors' living within the 0.2 kilometer radii bands, from .2 meters to 1.0 kilometer.[5] The percent of neighbors living within each band is instrumented with the percent of the neighbors within that band receiving various amounts of incentives. The IV estimates are presented in Table 3 (Columns 10 – 12). These results indicate that the peer effect is concentrated in the first band – that is the neighbors within a 200m radius band have a larger impact in influencing the respondent's decision to attend the VCT center relative to neighbors residing further away. The positive spillovers are present for both men and women and suggest that on average those with an additional 10 percent (approximately an additional 3 individuals) of their closest neighbors attending the VCT center are 1.10 percentage points more likely to attend the VCT. As a robustness check of these estimates, neighbor bands were drawn at further distances as a proxy: starting from 1 kilometer away from the

[5] Miguel and Kremer (2004) measure externalities using similar methodology. The correlation between average neighbors' and own distance to centers is 0.22, 0.18, 0.30 and between neighbors' incentives and own incentives is 0.02, 0.03, and 0.04 for radius bands of 0.2, 0.4, and 0.6 respectively. Because neighbors' distance may not satisfy the exclusion restrictions for the IV specification, we do not include average neighbors' distance as an instrument.

individual. Those results indicated no significant effects of neighbors living further away on own attendance (not shown). Other specifications were also tested, for example, widening the bands to 100m and 300m bands which are generally consistent with the main results presented here – individuals living in close proximity have the largest positive impact on the respondent (not shown).

In these estimates of the effects of neighbors, we cannot determine the composition of the close networks – only that individuals who live in close geographically proximity have the largest effects. In particular, we cannot rule out the possibility that these positive spillovers are driven by the fact that family members reside close to one another and influence one another's behavior. We can, however, rule out that this is not driven by individuals residing in the same household as the respondent and their spouse(s) because spouses have been excluded from the analysis. In addition, although we instrument the percent of the neighbors attending the VCT center with exogenously assigned incentives, we are unable to determine if the positive peer effects are due to the neighbors themselves, or due to correlated characteristics where individuals endogenously selected neighbors or places to live.

In the remainder of the paper we consider alternative definitions of peer network, in addition to those of geographic proximity and gender. In order to ensure sufficient variation in the network measure and to account for the important of geographical proximity in peer effects, our preferred specification (presented in Table 3, Columns 4 – 6) limits the peers to those residing within 0.5 kilometers from the respondent – approximately 90 neighbors, or 50 percent of the VCT zone..

Religious Affiliation

Geographic proximity may not capture some of the more intricate networks occurring in rural Malawian villages. Networks may form through community organizations (such as clubs or community groups), or through participation in local activities (such as farming or going to market). Unfortunately, detailed network data on exact friendships are unavailable for these data. However, we have detailed information on one potential network – religious membership. Individuals were asked which religious organization they belonged to. Religious affiliation has been broadly categorized into Christian (Church of Central Africa Presbyterian (CCAP), Catholic, Other Christian Baptist, Anglican, Pentecostal, 7th Day Adventist, and Indigenous Christian, and Muslim (Quadriya and Sukuti). Specific church membership includes individuals who attend the same congregation (either church or mosque); this was matched through the identification of the name of the congregation, and the name of the pastor or imam. Out of all of those with a religious affiliation, 89 percent of respondents reported attending a religious service (either church or mosque) in the past month, with 63 percent attending in the past week. This indicates the potential importance of religion. Moreover, actual affiliation may represent a more permanent social network: only 12.8 percent reported attending a different congregation in the past year.

Table 4 presents the IV estimates of the effect of neighbors' VCT attendance among those living within 0.5 kilometers by religious affiliation and church/mosque membership. Each independent variable of the percent of neighbors attending the VCT is instrumented with the percent of those individuals receiving various incentive amounts (equation 2). The pooled regression including all religions includes a religious denomination fixed effects (Christian or Muslim).

Columns 1-3 presents the IV results of the impact of neighbors VCT attendance belonging to the same or different church/mosque on own VCT attendance for the pooled male and female sample. Both coefficients of the effect of the percent of neighbors in the same and other church/mosque attending the VCT are positive. Importantly, there are dramatically different effects of social networks among Christians and Muslims. Among the Christian denominations, there is a larger effect of neighbors belonging to other churches attending the VCT than the effect of neighbors belonging to the same church (Columns 2 and 3). This effect is especially large among women. This effect is also consistent across various Christian denominations (CCAP, Catholic, and other Christian groups; not shown). However, among Muslims, the effect is reverse, where the peer effects are stronger from neighbors belonging to the same mosque, rather than the effects from neighbors belonging to a different mosque.

Religious organizations have been both faulted and credited with their responses to the HIV/AIDS epidemic. The responses of religious leaders has varied and there are examples of both positive and negative effects of religious groups on levels of stigma, adoption of safe sexual behavior, and community support. The strong positive effects of neighbors belonging to different churches among female Christians, and especially the lack of a positive effect of within church neighbor among this group may suggest that there is more social pressure or potentially stigma among Christian females to attend the VCT with their close religious network partners. On the other hand, the strong positive spillover effects for both men and women Muslims among same-mosque network partners may suggest that there is a supportive effect of the religious community.

Social Intensity

In addition to comparing networks of differing types (ie., geographical and religious networks), we also explore how individuals with differing levels of social interactions respond differentially to neighbors' VCT attendance. We construct a "social intensity" index that measures the number of times that an individual attends social events. In particular, this index is an average of the number of times an individual reported attending a wedding, funeral, beer hall, market, dance, HIV/AIDS meeting, or political rally. The index ranges from zero to just over 15 with an average of 1.42 where a higher level indicates more social interaction within the community. We might expect that this social intensity index would be in important mediating factor for the effects of neighbors on own VCT attendance. Table 5 presents the main specification of the impact of neighbors VCT attendance that includes interactions with social intensity. There are striking differential results by gender: for women, controlling for social intensity and the interaction of social intensity of the percent of neighbors attending the results center, there is no direct effect of neighbors per se. The peer effect operates entirely through social intensity (Column 2). That is to say, those with more social interaction (as measured by number of times participating in outside groups), the more neighbors VCT attendance has an impact on own VCT attendance. Among women who have no outside community group participation, neighbors have no impact on women's VCT attendance. This result has important implications for programs targeting women's health utilization. Perhaps increasing overall women's mobility and empowerment may increase peer effects and increase the effectiveness of social programs. On the other hand, for men, social intensity has no impact on the network effects on VCT attendance: the interaction term is essentially zero (Column 3).

Individual vs. Group Targeting

The fact that individuals were given incentives to attend the VCT clinic not only allows for instrumenting neighborhood behavior, but also allows for quantifying the effects of various types of program targeting for increasing health utilization or learning HIV results. For example, offering individuals any positive incentive increased the likelihood of obtaining results by almost 36 percentage points (Table 6). Among those who received some positive valued incentive, receiving an additional ten cents of monetary incentive increased the likelihood of obtaining results by 12 percentage points.

The social network effects can be similarly quantified: among those receiving no monetary incentive, a 10 percent increase of neighbors attending the results centers increases the likelihood of attending by 2.1 percentage points. The network effect is significantly larger among those who received no monetary incentive than those who received some monetary incentive. While it is impossible to extend the empirical results of this study in which 80 percent of those testing within communities obtained a monetary incentive to a program in which fewer individuals receive incentives, these findings do suggest that there are diminishing network effects among those offered financial incentives. This suggests that offering all incentives may not be the optimal targeting policy. On the other hand, offering a few people monetary incentives will have large effects on others through the network effects. This is similar to the findings in Duflo and Saez (2003) who find large spillover effects in treating some individuals with just information about a benefits fair.

4. Conclusion

Understanding why people choose to learn their HIV results is important both theoretically for social scientists and for public policy. In the past several years, governments, NGO's, as well as academics, have emphasized the importance of voluntary testing and counseling (VCT) as a strategy for treating

HIV-positive individuals (Ainsworth and Oliver 1997). In addition, other health programs target visits to clinics or other community health events such as vaccination days or baby weighing days.

This paper shows social network effects of neighbors VCT attendance on others' VCT attendance. These effects are strongest among closest neighbors living within 200 meters or approximately the 30 closest households. In addition, there are strong effects of religious affiliation and membership. Social intensity is important for women, although not for men.

Individuals make decisions related to their health based on information, costs, benefits, as well as their social networks. The largest determinants of obtaining HIV results in this study was due to financial incentives; however, it may not always be feasible to subsidize HIV testing, or other health programs for that matter. In that case, treating some key individuals in communities and allowing those individuals to be catalysts for others may be the most optimal way of increasing health utilization. Who these key individuals are, for example, first movers in the decision to learn HIV results in this study, is the subject of future research.

Figure 1: Proportion of Neighbors within 0.5 km attending the VCT center

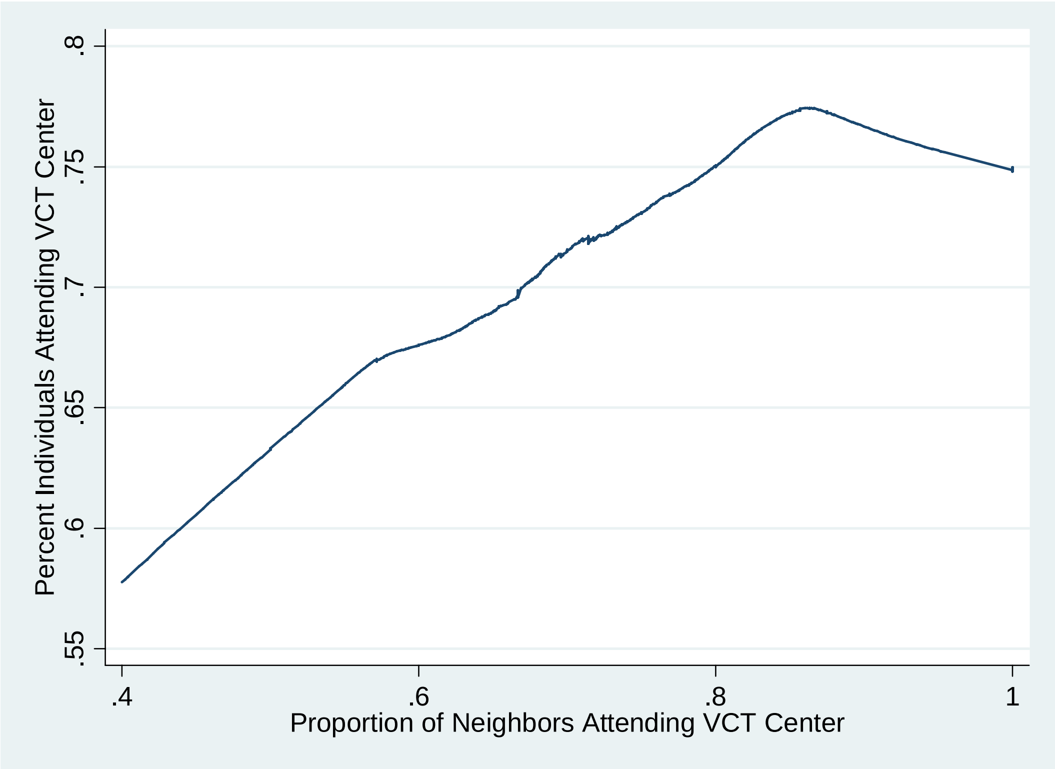

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Table 1: Summary Sample Sizes and Characteristics

Panel A: Sample Sizes		Obs		
	Offered HIV test in 2004	3185		
	Accepted HIV test in 2004	2894		
	Main Sample	2825		

Panel B: Baseline Characteristics		(1) Obs	(2) Mean	(3) SD
Demographics:	Male	2825	0.463	0.499
	Age	2825	33.396	13.650
	Married	2819	0.711	0.453
	Hiv Status	2825	0.058	0.252
	Had sex in the last 12 months	2816	0.761	0.426
	Distance from VCT	2825	2.015	1.268
	Education	2825	3.266	3.698
	Assets	2825	4.835	2.624
Tribe:	Chewa	2825	0.245	0.430
	Tumbuka	2825	0.288	0.453
	Yao	2825	0.245	0.430
	Other	2825	0.021	0.142
Religion:	Catholic	2825	0.143	0.350
	CCAP	2825	0.160	0.366
	Other Christian	2825	0.218	0.413
	Muslim	2825	0.220	0.414
	Other	2825	0.033	0.178
Incentives:	Received a non-zero incentive	2825	0.780	0.414
	Amount of incentive (Kwacha	2825	104.490	95.320
	Respondent got results	2825	0.691	0.462
	Number of Neighbors in band 0 - 0.2 km	2825	31.457	32.413
	Number of Neighbors in band 0.2 - 0.4 km	2825	38.274	40.354
	Number of Neighbors in band 0.4 - 0.6 km	2825	43.304	42.246
	Number of Neighbors in band 0 - 0.5 km	2825	90.608	77.604

Notes:
The main sample consists of those who accepted an HIV test, did not test as indeterminant, and who had basic co-variates.

Table 2: Baseline Characteristics by Incentives

Women

	Age	Married	HIV status	Had sex in last 12 months	Chewa	Tumbuka	Yao	Other	Catholic	CCAP	Christian	Muslim	Other
Any Incentive	1.573*	0.014	-0.004	0.054*	0.031	0.038	-0.042*	-0.005	-0.016	-0.012	0.019	-0.007	0.007
	[0.802]	[0.027]	[0.021]	[0.033]	[0.054]	[0.024]	[0.023]	[0.020]	[0.011]	[0.027]	[0.026]	[0.035]	[0.032]
Amount of Incentive	-0.187	-0.044**	0.005	-0.056***	-0.044	-0.015	0.022*	0.001	0.005	-0.006	-0.014	0.008	0.02
	[0.414]	[0.018]	[0.011]	[0.020]	[0.027]	[0.013]	[0.013]	[0.010]	[0.006]	[0.015]	[0.015]	[0.019]	[0.017]
Over 1.5 km	-0.351	-0.017	-0.029*	0.007	1.447***	0.021	-0.019	0.006	-0.009	-0.005	0.006	-0.067	0.008
	[0.707]	[0.025]	[0.017]	[0.022]	[0.106]	[0.038]	[0.025]	[0.019]	[0.011]	[0.030]	[0.043]	[0.047]	[0.033]
Observations	1517	1517	1517	1517	1517	1517	1517	1517	1517	1517	1517	1517	1517
R-squared	0.17	0.28	0.02	0.18	0.71	0.57	0.55	0.79	0.01	0.19	0.51	0.04	0.09

Men

	Age	Married	HIV status	Had sex in last 12 months	Chewa	Tumbuka	Yao	Other	Catholic	CCAP	Christian	Muslim	Other
Any Incentive	1.701*	-0.013	-0.009	-0.014	0.03	-0.038	0.023	-0.01	0.022*	0.001	-0.006	-0.03	0.042
	[0.986]	[0.022]	[0.025]	[0.030]	[0.078]	[0.029]	[0.026]	[0.020]	[0.011]	[0.032]	[0.029]	[0.032]	[0.034]
Amount of Incentive	-0.561	0.007	-0.008	-0.019	-0.058	0.029*	0.001	-0.008	-0.01	0.025	0.017	-0.005	-0.035*
	[0.524]	[0.013]	[0.013]	[0.018]	[0.049]	[0.017]	[0.017]	[0.011]	[0.009]	[0.017]	[0.018]	[0.016]	[0.019]
Over 1.5 km	-0.027	-0.004	-0.035***	0.012	1.432***	0.033	0.001	-0.026	-0.007	-0.002	0.015	-0.068*	0.019
	[0.788]	[0.017]	[0.012]	[0.023]	[0.111]	[0.039]	[0.024]	[0.031]	[0.011]	[0.028]	[0.038]	[0.039]	[0.029]
Observations	1308	1305	1308	1302	1308	1308	1308	1308	1308	1308	1308	1308	1308
R-squared	0.4	0.67	0.04	0.33	0.7	0.49	0.5	0.68	0.02	0.13	0.45	0.05	0.11

Notes:

Notes: Each column represents an OLS regression

Standard errors are clustered by village.

Each column also includes control variables including age, age-squared, a simulated average distance from the HIV results centers term , HIV results, and district fixed effects.

Table 3: Impact of Neighbor's Attendance on Own Attendance: Gender

	OLS			IV						IV		
Proportion of group attending VCT	All (1)	Females (2)	Males (3)	All (4)	Females (5)	Males (6)	All (7)	Females (8)	Males (9)	All (10)	Females (11)	Males (12)
Neighbors within 0-0.5km	0.116***	0.111**	0.123***	0.134***	0.146***	0.118**						
	[0.030]	[0.043]	[0.044]	[0.036]	[0.045]	[0.057]						
Female Neighbors within 0-0.5km							0.021	0.184	-0.215			
							[0.141]	[0.163]	[0.209]			
Male Neighbors within 0-0.5km							0.054	0.04	0.126			
							[0.156]	[0.177]	[0.221]			
Neighbors within 0-0.2km										0.110***	0.114***	0.117**
										[0.032]	[0.043]	[0.053]
Neighbors within 0.2-0.4km										0.034	0.04	0.017
										[0.040]	[0.052]	[0.058]
Neighbors within 0.4-0.6km										0.007	0.022	0
										[0.048]	[0.057]	[0.067]
Neighbors within 0.6-0.8km										0.225**	0.38	0.127
										[0.110]	[0.255]	[0.147]
Neighbors within 0.8-1.0km										-0.256	-0.222	-0.54
										[0.233]	[0.215]	[0.680]
Observations	2825	1517	1308	2825	1517	1308	2825	1517	1308	2825	1517	1308
R-squared	0.22	0.22	0.23	0.22	0.22	0.23	0.22	0.22	0.23	0.22	0.22	0.23

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Columns representing an IV regression in include instruments for the percent of neighbors: percent of neighbors having various amounts of incentive .
Standard errors are clustered by village.
Each column also includes control variables including age, age, squared, HIV status, education, number of assets, and and district fixed effects.

Table 4: Impact of Neighbor's Attendance on Own Attendance: Religion

	All			Female			Male		
	All	Christian	Muslim	All	Christian	Muslim	All	Christian	Muslim
	(1)	(2)	(3)	(5)	(6)	(7)	(9)	(10)	(11)
% in same church	0.048	0.041	0.149**	0.036	0.036	0.143	0.068	0.061	0.124*
	[0.029]	[0.039]	[0.063]	[0.039]	[0.049]	[0.094]	[0.043]	[0.061]	[0.072]
% in other church	0.104***	0.147***	-0.063	0.127***	0.189***	-0.143	0.07	0.08	0.056
	[0.036]	[0.047]	[0.074]	[0.045]	[0.056]	[0.094]	[0.060]	[0.079]	[0.142]
Christian	-0.007			0.027			-0.034		
	[0.025]			[0.040]			[0.034]		
Other Religion	-0.002			0.016			-0.017		
	[0.120]			[0.185]			[0.135]		
Observations	2825	1862	621	1517	1051	344	1308	811	277
R-squared	0.23	0.22	0.26	0.23	0.23	0.29	0.23	0.24	0.27

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Columns representing an IV regression in include instruments for the percent of neighbors: percent of neighbors having various amounts of incentive .

Standard errors are clustered by village.

Each column also includes control variables including age, age, squared, HIV status, education, number of assets, and and district fixed effects.

Table 5: Interactions with Intensity of Social Networks/Engagement

	All	Females	Males
	(1)	(2)	(3)
% within 0-0.5km	0.106*	-0.012	0.178*
	[0.058]	[0.066]	[0.091]
% within 0-0.5km * Social Intensity	0.042	0.165***	-0.018
	[0.027]	[0.048]	[0.034]
Social Intensity	-0.019	-0.091***	0.017
	[0.019]	[0.032]	[0.023]
Observations	2603	1444	1159
R-squared	0.22	0.22	0.23

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Columns representing an IV regression in include instruments for the percent of neighbors: percent of neighbors having various amounts of incentive .
Standard errors are clustered by village.
Each column also includes control variables including age, age, squared, HIV status, education, number of assets, and and district fixed effects.

Table 6: Impact of Neighbor's Attendance on Own Attendance: Own Incentive

	All (with additional controls)		
	All	Females	Males
	(1)	(2)	(3)
% within 0-0.5km	0.207***	0.264***	0.145
	[0.061]	[0.073]	[0.093]
Any Incentive	0.355***	0.391***	0.327***
	[0.045]	[0.055]	[0.072]
Any Incentive * % within 0-0.5km band	-0.291***	-0.171*	-0.045
	[0.092]	[0.090]	[0.103]
Amount of incentive	0.125***	0.131***	0.119***
	[0.016]	[0.020]	[0.022]
Observations	2825	1517	1308
R-squared	0.23	0.23	0.23

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Columns representing an IV regression in include instruments for the percent of neighbors: percent of neighbors having various amounts of incentive . Standard errors are clustered by village.

Each column also includes control variables including age, age, squared, HIV status, education, number of assets, and and district fixed effects.

Appendix A: First Stage

Proportion of Neighbors within 0.5 km band attending VCT	All (1)	Females (2)	Males (3)
% of Neighbors with 10 - 50 kwacha incentive	0.734***	0.725***	0.738***
	[0.042]	[0.049]	[0.047]
% of Neighbors with 50 - 100 kwacha incentive	0.799***	0.774***	0.826***
	[0.057]	[0.058]	[0.066]
% of Neighbors with 100 - 200 kwacha incentive	0.936***	0.954***	0.911***
	[0.038]	[0.041]	[0.048]
% of Neighbors with 200 - 300 kwacha incentive	0.694***	0.699***	0.685***
	[0.067]	[0.076]	[0.076]
Any Incentive	0.01	0.003	0.021
	[0.010]	[0.013]	[0.015]
Amount of Incentive	-0.007	-0.003	-0.013*
	[0.005]	[0.007]	[0.008]
Observations	2825	1517	1308
R-squared	0.74	0.72	0.76
F-test Statistic	270.02	200.37	277.9

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Notes: Columns representing an IV regression in include instruments for the percent of neighbors: percent of neighbors having various amounts of incentive .
Standard errors are clustered by village.
Each column also includes control variables including age, age, squared, HIV status,