SOCIAL INTERACTION, FERTILITY INTENTIONS AND MALE INVOLVEMENT IN FERTILITY DECLINE IN SUB- SAHARAN AFRICA: LONGITUDINAL EVIDENCE FROM GHANA[1]

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March 2008

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Paper for presentation at the 2008 annual meeting of the Population Association of America, New Orleans, April 17-19

[1] Support for data used in this research to the Policy Division of the Population Council from the National Institute of NIH/NICHD (R01-HD34524), the Mellon Foundation and the Hewlett Foundation are gratefully acknowledged

ABSTRACT

It is common in research on contemporary fertility transitions to account for social interaction effects on individual behavior. However, few studies estimate the impact of social interaction in forming fertility intentions. Yet, fertility decline requires both behavioral changes in contraceptive adoption and ideational changes in fertility intentions. Similarly, the role of men in fertility behavior has been widely acknowledged. This paper draws from previous literature to estimate the complementary effects of gendered social networks on changes in fertility intentions. We test a conceptual model that incorporates the complementary effects of discussions of matters of childbearing with men's and women's respective informal social network partners and the effects of spousal communication about family planning and spousal approval of family planning on couples' joint reproductive intentions. We account for unobserved fixed factors that might confound these relationships. In addition, we explore the mediating effects of joint fertility intentions in the relationship between social interaction and actual fertility. Our results show that discussions of childbearing issues in men's social networks significantly impacts on spouses' joint reproductive intentions both directly and indirectly through spousal communication about family planning and spousal approval of family planning , whilst women's discussions of childbearing in social networks, only affects spouses joint reproductive intentions indirectly. Lastly, we find that even though joint fertility intentions negatively mediate the relationship between discussions in networks and actual fertility, the relationship was not statistically significant. We offer interpretations of our results and their implications for research on social diffusion and population policy in sub-Saharan Africa.

INTRODUCTION

It is now common in research on contemporary fertility transitions to account for social interaction and diffusion effects on individual demographic behavior (Avogo and Agadjanian 2008; Bongaarts and Watkins 1996; Behrman, Kohler and Watkins 2002; Feyisetan et al. 2003; Mason 1997; Montgomery and Casterline 1998; Musalia 2005). Research on social diffusion considers individuals as not acting in isolation but in concert with others in their social groups. Thus, individual-level behavior is considered as embedded in social processes that influence behavior and facilitate the spread and evaluation of new information on reproductive choices and goals (Behrman et al. 2001, Bongaarts and Watkins 1996; Casterline et al. 2002; Musalia 2005; Kohler et al. 2001).

Studies on social interaction and diffusion in sub-Saharan Africa have been typically limited to modern contraceptive practice, which is considered innovative behavior in a region where fertility remains high but is slowly declining and modern contraceptive prevalence is until recently low. Few studies have attempted to estimate the impact of social interaction and diffusion effects in transmitting changes in the perception of the cost and value of children and in the formation of reproductive aspirations and behavior. Similarly, the mediating effects of fertility aspirations in the known relationship between social interaction and fertility outcomes remain largely unexplored. Yet, the mechanisms of the demographic transition theory require not only behavioral changes in contraceptive behavior but ideational changes in fertility preferences. At the same time, demographic research on fertility preferences in contemporary fertility transitions is largely focused on theoretical and empirical arguments on the role of fertility preferences in fertility decline (Feyisetan and Casterline

2000; Pritchett 1994) and the relationship between fertility preferences and subsequent reproductive behavior (Bongaarts 1992; Tan and Tay 1994; Thomson 1997). Thus, the prevailing literature on fertility preferences is oblivious of the role of social interaction and diffusion in transmitting fertility preferences and behavior.

Outside of diffusion and contraceptive behavior, the role of men in fertility and reproductive change in pronatalist societies has been widely acknowledged (Bankole 1995; Dodoo 1995a; Dodoo 1995b; DeRose and Ezeh 2000; DeRose et al. 2004; Dodoo and van Landewijk 1996; Ezeh 1993; Lesthaeghe 1989; Ngom 1997). This recognition has led demographers to redirect their attention to couples instead of women alone in studies on fertility in sub-Saharan Africa (Avogo and Agadjanian 2008; Bankole and Singh 1998; Takyi and Dodoo 2005). Following this recognition, numerous studies have found a positive relationship between spousal communication on family planning and approval of family planning on one hand and contraceptive use on the other (Agyeman et al. 1996; Bawah 2002; Dodoo 1998; Lasee and Becker 1996; Mbizvo and Adamchak 1992; Nyblade and Menken 1993; Salway 1994). Similarly, couples' studies have demonstrated the importance of joint reproductive preferences and contraceptive use (Bankole 1995; Dodoo 1998; Lightbourne 1985). However, none of these studies explores the impact of informal social interaction in men's and women's informal networks outside the marital household.

Based on these two bodies of literature (that on social interaction and fertility outcomes and that on the role of men in fertility changes), this paper uses data from panel surveys collected during a three year observation period in Southern Ghana to estimate social network effects on reproductive attitudes and behaviors. Specifically, the

paper test a novel conceptual model that incorporates the complementary effects of discussing matters of childbearing within men's and women's respective informal social networks and the effects of spousal communication about family planning and spousal approval of family planning on couples' joint reproductive intentions. In addition, the model explores the mediating effects of fertility intentions in the relationship between social interaction and subsequent fertility.

Unlike most previous studies on social interaction which rely mainly on women's social networks and cross-sectional data, the inclusion of men's networks in a marital dyad and the use of longitudinal data to explore the impact of social networks on changes in couples' fertility attitudes, aspirations and outcomes, while controlling for unobserved determinants of social networks, sets this study apart from most other previous analysis of social networks and reproductive behavior[2]. This allows this study to eliminate endogenous effects of social networks and to make a more substantive contribution to the establishment of causal relationships in social interaction and fertility analysis.

THEORETICAL FRAMEWORK AND CONCEPTUALISATION

The paper draws from and test diffusion effects through two familiar and fundamental mechanisms in the literature on social interaction – social learning and social influence. It is conceptualized that through social learning, women and men in their daily interactions with friends, neighbors and extended family are confronted with information

[2] Montgomery and Casterline 1993, Behrman et al. 2002 & Casterline et al. 2002 are very notable exceptions that control for the effects of unobserved characteristics in the association between social networks and contraceptive behavior. We do not know of any study that explores social diffusion effects on couple's fertility attitudes, aspirations and outcomes whiles controlling for unobserved fixed factors.

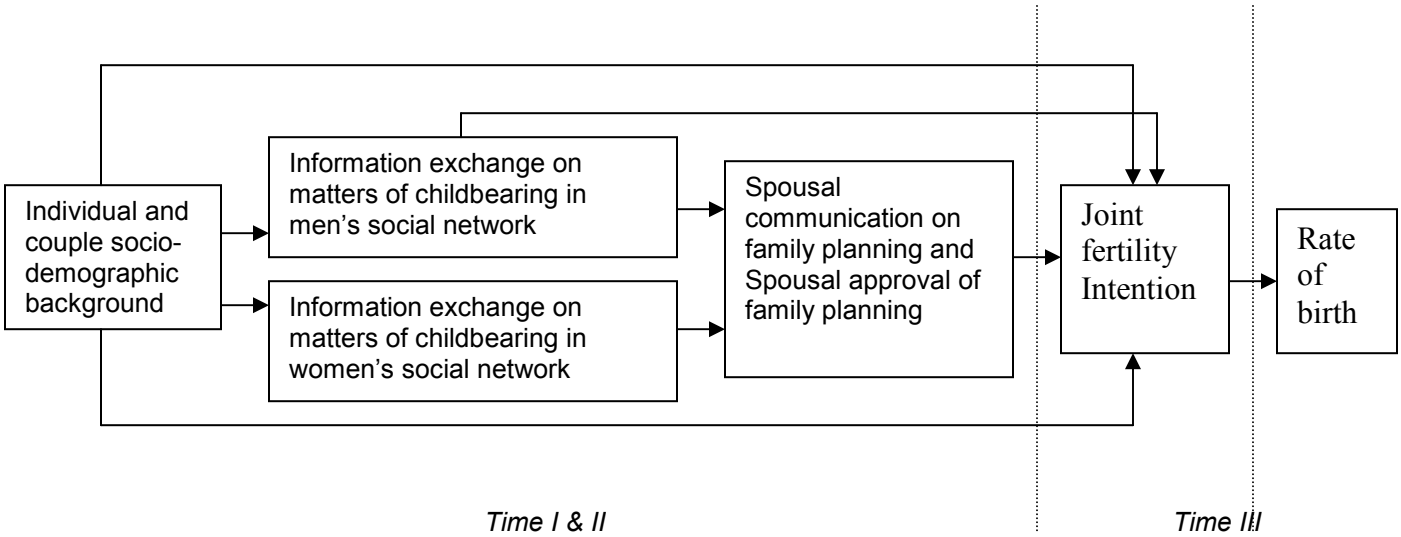
and ideas that evaluate the cost and benefits of having children. In Ghana, where the cost of educating children has recently risen, family size preferences and intentions are being reconfigured and people probe to clarify the potential cost and benefits of adopting smaller family sizes or to curtail fertility. On the other hand, social influence, points at the importance of authority, deference and social conformity pressures that exist in every society. This authority, which is usually geared towards the maintenance of existing social norms, constrains innovative behavior (such as antinatalist tendencies). As new and attractive ideas emerge about the cost and benefits of fewer children, this conservative constrain imposed by social influence disappears and personal networks become more diverse and heterogeneous (Montgomery et al 2001; Kohler et al. 2001). It is may be plausible that social networks particularly men's networks may start out as conservative and dismissive of the idea of curtailing childbearing. But as new ideas emerge about the benefits of having fewer children, these networks may spread information and help transmit ideals about smaller family sizes, thereby leading to the adjustment of couple's fertility intentions.

Unambiguous as these mechanisms may seem, this paper recognizes the multi-dimensionality of factors and actors that influence the reproductive intentions of marital partners (Agadjanian 2005) in fertility transitions in sub-Saharan Africa. For example, whilst it can be argued that reproductive intentions are largely predicated on economic factors, such as, the perception of the cost and benefits of rearing children, its influence is absorbed or dominated by ideational change processes, thereby, shifting the relationship between socio-economic factors and fertility behavior (Mason 1997). Thus, whereas economic considerations may play an earlier role in influencing fertility

intentions and preferences, diffusion processes largely enacted through social learning in gendered networks are primarily responsible for changes in fertility intentions and preferences. Whilst diffusion mechanisms (social learning and social influence) can manifest through other means such as impersonal sources (media, geographical mobility etc), we concentrate here on the effects of discussions on matters of childbearing in men's and women's informal social networks. Our focus, it may be argued, precludes the social influence component of this complex framework. We however, contend that the two mechanisms overlap; discussions of childbearing matters in informal social networks can both act to spread new ideas about the benefits and cost of smaller family sizes and at the same time contain a component of social influence that constrain or facilitate individual reproductive choices and behavior (Montgomery et al. 2001).

In figure 1, we present and conceptualize the specific analytic model for the observed relationships between discussions of childbearing matters in men's and women's networks, spousal communication about family planning and spousal approval of family planning and the formation of couples' joint fertility intentions.

Figure 1: Analytical model of the relationship between discussions on childbearing matters in gendered social networks and subsequent fertility attitudes and intentions



First, the model, (adopted from our previous investigation of gendered social networks and contraceptive use) assumes that social networks of women and men are gendered and rarely overlap (Agadjanian 2002; Avogo and Agadjanian 2008). Discussion of matters of childbearing with network partners (such as how to avoid pregnancy, ensure proper birth spacing and how to have the number of children that you want) at time I affects couple's subsequent fertility intentions at time III, by stimulating spousal communication on family planning issues and spousal approval of family planning. Whilst, discussions of childbearing matters with men's social network partners has both a direct influence on couple's decision to stop childbearing and indirectly works through spousal communication and spousal approval of family planning, that of women's discussions with network partners mainly operate through spousal communication about family planning and spousal approval of family planning to influence couples' fertility intentions.

Similar to most previous studies on fertility behavior, where the direction of the conceptualized relationship proceeds from background factors to individual attitudes then to fertility intentions and finally fertility behavior (Ajzen and Fishbein 1980), this study also conceptualizes that individual and couple background factors affects discussions of childbearing issues with social network partners and the selection of network partners, which in turn, affects spousal communication about family planning, spousal approval of family planning and couples' joint fertility intentions. There can also be a direct relationship between background factors and fertility attitudes and intentions. This link is depicted in figure 1. Similar patterns of the outlined relationship pertain for actual fertility, measured in this paper, as the rate of birth within a specified period of time. Couples' fertility intentions are expected to play a mediating role in the association between social network effects and fertility outcomes.

Specific Hypotheses

Based on the literature and the outlined conceptual and analytical model, we expect discussions on matters of childbearing within men's social networks to be have a significant positive impact on the likelihood of subsequent spousal communication regarding family planning, net of the effects of discussions within their wife's social networks and of individual and couples' socio-demographic factors. Similarly, we expect discussions on matters of childbearing within men's social networks to have a significant positive impact on spousal approval of family planning, net of the effect of discussions of matters of childbearing within their wife's social network and of other factors. In essence, we propose that men's social interaction within their personal informal

networks outside the marital household, acts as a catalyst to spousal communication about family planning and the cultivation of positive attitudes towards modern family planning practice.

We also expect discussions on matters of childbearing within men's social networks rather than with women's networks, to have a direct positive influence on the likelihood of subsequent agreement by couples to stop childbearing, net of socio-economic, cultural and demographic characteristics. At the same time, due to men's dominant pronatalist inclinations and their perceived power over childbearing decision-making in sub-Saharan Africa, we expect men's informal network participation to also work indirectly through spousal communication about family planning and spousal approval to influence couples' fertility aspirations. Whereas that of women's network participation will have only an indirect effect on couple's joint fertility preferences. Lastly, we expect that fertility intentions of couples will negatively mediate the relationship between gendered social interaction and the rate of birth, within a specified period of time, net of men's discussions of matters of childbearing in their personal network and that of their wife's discussions in networks.

DATA AND METHODS

Study Context

We use data specifically designed to measure social interaction and fertility control in Southern Ghana. The study covered six isolated and mainly rural[3] communities' spanning three contiguous administrative regions in southern Ghana. Contraceptive use within these rural communities, like the rest of rural Ghana, is low but is steadily

[3] One of the study communities is a peri-urban market settlement les than an hours drive form the nation's capital.

increasing[4]. Ghana as a whole is one of the few countries in sub-Saharan Africa to experience substantial gains in fertility transition. The total fertility rate (TFR) according to the Ghana Demographic and Health Survey (DHS) declined from 6.4 births per woman in 1988 to 4.4 births in 1998 and 2003, indicating a 2-child decline in fertility over the last 15 years but pointing to a seeming stagnation in fertility decline between 1998 and 2003. However, wide differences in fertility decline by place of residence remain, with rural women having 2.5 more births than their urban counterparts.

A key factor in the decline in fertility in Ghana is the early commitment of the government of Ghana to family planning program efforts going back to 1969, when Ghana adopted its first Population Policy with the aim of reducing population growth rates from 3% in 1969 to 1.7% in 2000 (Population Impact Project 1995). Later, in the 1980s, the Ghana Family Planning and Health Project was established with a renewed mandate to increase contraceptive prevalence and combat the spread of HIV and STDs (Miller et al. 1998). With these efforts, new modern methods of family planning became widely available in rural clinic locations. In our study settings for instance, majority of reproductive aged women had access to information about modern methods of family planning even though only one-quarter of them adopted a modern method (Montgomery et al 1998). At the same time, a large number of community organizations with the objective to improve the socio-economic conditions of their communities sprung up[5]. Information flow to and from these communities was enhanced not only through these organizations and home visits from family planning workers but by their exposure to the

[4] Contraceptive prevalence rate in rural areas in Ghana increased from 3.1% to 15% between the period 1988 and 2003.

[5] For a detailed profile of study communities including their local social structure and types of political, social and religious organizations see Agyeman et al 1996

influence of radio and to a lesser extent television. This setting set in motion interpersonal diffusion of knowledge about family planning and paved the way for informal social networks to interact and evaluate the advantages and disadvantages of having fewer children and to discern the desirability of deliberate control of fertility in marriage, within their local socio-economic and cultural contexts. These communities therefore serve as an ideal starting point to assess the impact of informal social interaction on fertility processes and outcomes.

Data

The data for this paper were collected in three of eight rounds in the 'Social Learning, Social Influence and Fertility Control' panel surveys of Southern Ghana. The surveys were designed and implemented by the University of Cape Coast in Ghana, with technical assistance from the Population Council. The sample universe of the surveys consisted of women aged 18 – 50 years selected regardless of their marital status along with their co-resident partners. It is thus feasible to access couple data to explore the relative influence of men's and women's social networks on fertility attitudes and outcomes. The eight rounds of data collection covered the period from 1998 -2004, however, we limit our analysis in this paper to data from rounds 1, 4 and 6, which were collected in 1998, 2000 and 2001, respectively and were focused on 'general' social networks[6]. We chose to concentrate on these networks in order to reduce the threat of bias associated with the selection of network partners based solely on reproductive behavior (Casterline et al 2002). However, other forms of bias associated with

[6] Other rounds of data collection focused on specific social networks such as family planning networks and AIDS networks.

endogeneity of social network effects remain. In the selected rounds, respondents were asked to name social network partners with whom they discuss important matters in their lives and whose opinions are important to them, other than their spouse. Thus, the name-generator was intended to capture socially important, confidant networks not specific to reproductive behavior and to emphasize outside-household contacts. Interviewers were instructed to record the number of names that the respondent mentioned and to probe further for additional names. However, detailed information on network characteristics and the content of discussions were obtained on as many as four network partners, only after they have been identified as holding opinions that are important to the respondent. For this analysis, the main predictor variables are drawn from responses to information exchanged in men's and women's social networks on matters of childbearing. The targeted question is framed as follows:

> "Have you and [name] ever discussed matters of childbearing, such as how to avoid pregnancy, how to ensure proper birth spacing, or how to have the number of children that you want?" (Name refers to at least four of the social network partners named by the respondent)

Based on previous findings that having at least one network partner who is a user significantly increases the odds of currently using a family planning method beyond additional network partners who are users (Behrman et al. 2002; Kohler et al. 2001), we limit the measurement of this variable to respondents who reported having at least one social network partner with whom they discuss matters of childbearing rather than the

size or fraction of network partners with whom the respondent discuss childbearing issues. Thus, this variable assumes the value of 1 if the respondent discussed matters of childbearing with at least one network partner and 0 if otherwise. Separate measures are constructed for men's and women's networks.

As depicted in our conceptual model, our main objective is to analyze social interaction effects on couple's fertility behavior and actual fertility, specifically; we concentrate on spousal communication about family planning matters, spousal approval of family planning, joint fertility intentions and actual fertility. Thus, four dependent outcomes are constructed. Spousal communication about family planning matters and spousal approval of family planning are both constructed as dyads by using reports on whether or not both spouses reported having discussed with each other about the means to space births or avoid pregnancy and whether or not both spouses approve or disapprove of couples using any means to space births or avoid pregnancy. Both dependent outcomes are operationalised as dichotomies. In keeping with previous 'couple' studies that highlight varying degrees of agreement and disagreement between couples on fertility preferences and its implications for population policies (Dodoo, 1993; Dodoo and van Landewijk, 1996), we construct joint fertility intentions by linking the responses of husbands on their fertility aspirations with those of their wives. A value of 1 is assigned if both marital partners report the desire not to have any more children and 0 if only one or none of the marital partners desire not to have any more children or otherwise. Thus fertility aspirations are modeled in terms of a husband and a wife agreeing to stop childbearing (neither wants more children) vs. any other form of agreement (both want more children) or disagreement (husband wants more wife wants

no more or vice versa). In this paper, fertility intentions are considered for only women who are at parity two or have more children and may be pregnant at the time of the survey[7]. Analyzing intentions after parity two allows us to adapt our findings to take into account high fertility in this setting and to account for the fact that most women who are at parity one will almost certainly go on to have subsequent births. The last outcome, actual fertility is the rate of birth between the baseline panel and the last follow-up panel under consideration (round six).

We include conventional individual and couple measures of likely determinants of fertility attitudes and aspirations as controls in our analysis. These include; the couple's number of living children at each survey (measured as a continuous variable), the type of marital union (monogamous vs. polygamous) and couples' religion (most couples reported a similar religion). Individual covariates include men and their spouse's ages (in groups) and women's education and men's occupation. Men's education and their wife(s)' occupation were excluded to reduce the threat of multicolinearity associated with these variables. We include the community from which a couple was sampled as a control in itself and as a proxy, partly for ethnicity and lineage type[8].

Due to exclusions imposed by the measurement of fertility aspirations on couples with at least two children and the fact that all couples must be interviewed in all three rounds and information must be available for all variables of interest, the final sample(s) drawn on for analysis in the first and second sections, consists of 509 and 378 married

[7] If respondents are pregnant at the time of the survey the question referred to their fertility intentions after the birth of the child they are expecting

[8] Five major ethnic groups are represented by the six communities sampled (Fante, Denkyira, Ga/Adangbe, Ewe and Ahanta), since lineage type is dependent on the ethnic composition (which is nearly homogeneous in all the communities), accounting for the community in our regression analysis, we believe, indirectly, accounts for both ethnicity and lineage type.

women and 470 and 360 matched male spouses respectively (some of the men were married to more than one woman). Table 1 presents a summary of the number of observations included in the sample(s) for the analysis. To reduce the threat of non-response bias and to maintain the integrity of the sample, efforts were made to track and interview persons lost to follow-up or new husbands or wives of individuals already in the sample. These interviews used a so called 'hybrid' questionnaire that blended items from the current and previous surveys. We introduce a dummy variable to identify these interviews in our regression analysis[9]. In all, our sample selection criteria results in a considerable sample loss. However, further analysis conducted revealed that, no significant differences can be observed between respondents who were interviewed in all rounds and those who could not be traced in round 4 and round six or were excluded due to the sample restrictions. It is thus plausible to assume that our sample selection is random and introduces no bias on our estimates.

Methods

As indicated previously, the sample for this analysis is based on marital partners, thus a husband-wife dyad rather than an individual as the unit of analysis is used. Since three of the four dependent outcomes of interest used in this analysis (spousal communication about family planning, spousal approval of family planning and joint fertility aspirations of couples) are binary dependent variables, logistic regression techniques are suitable. However, key to the objectives of this paper, is properly accounting for casual inferences of the impact of gendered social networks on

[9] Introducing a dummy variable to identify hybrid interviews serves as a control for any likely differences (changes in the order of questions, activism in probing etc) between the regular survey interviews and the so called 'hybrid' interviews

subsequent changes in fertility intentions (see Behrman, Kohler and Watkins 2002; Casterline et al. 2002; Aglobitse and Casterline 2007). This implies that standard logit estimates as used previously in studies on social networks and fertility may be inadequate to account for bias due to omitted or unobserved fixed factors such as network selection, prior contraceptive use or factors associated with the socio-economic context within which interactions occur. For instance, it is possible that couples who decided to stop childbearing were highly motivated to adopt a smaller family size, initiate discussions with their spouse on family planning or consider contraceptive use before they discussed their prior experiences on childbearing matters with their social network partners. Likewise, individuals who are averse to limiting their fertility and have never considered modern contraceptive use might not engage in discussions with their network partners on matters of childbearing. If these patterns persist over time, a potential exist for estimation bias and mistaken inference (Behrman et al. 2002; Casterline et al. 2002).

We include controls for these sources of bias by fitting fixed effects models in comparison with random effects models. Our random effects specifications, like previous studies on diffusion effects, assume that the selection of network partners is random and uncorrelated with individual characteristics of respondents (whether observed or unobserved), whilst the fixed effects models, assume that they are significantly correlated and adjusts for all fixed characteristics of respondents, in as far as, those characteristics do not change over the observation period (Allison 2005). Thus by including fixed effects estimates in the analysis, we focus on only changes in men's and women's social network on changes in fertility attitudes and aspirations. However,

for these estimates to be valid each couple in our sample must contribute at least two or more observations on the same dependent outcome used in the analysis, in addition, values of some of the social network and control variables used in the analysis must be different on at least two rounds of data (Allison 2005). These requirements make fixed effects models more stringent than random effects models but at the same time, constitute a source of their disadvantage, especially when a few observations are available for different individuals over time and it's expedient to make the best use of lesser amount of information for obtaining valid estimates of social network effects (Hsiao 2002). The trade-off however, is obtaining estimates that are relatively free of bias associated with unmeasured individual characteristics that may confound the association between social networks and the dependent outcomes. It is thus clear that the decision to treat network effects as random or fixed can be a difficult one to make as it has huge implications on the estimates of the parameters. To help us decide, we employ the classical Hausman specification test in STATA to determine whether statistically, there is a significant correlation between the unobserved person-specific random effects and our dependent outcomes. If we find no such correlation exist, the parsimonious random effects estimates will be our estimates of choice, if indeed a correlation exists, as we expect it to, our preferred estimates will be from the fixed effect models (SAS documentation; Yafee 2003).

The final equation we estimate can thus be specified in the following form:

$$Y_{it} = \beta_1 X_{it} + \beta_2 W_{ft} + \beta_3 V_{mt} + v_i + \varepsilon_{it}$$

Where Y_{it} is the probability that couple *i* report the desire to stop childbearing at

time t. β_1, β_2 , β_3 are vectors of co-efficients. X_{it} is a vector of a set of couple's socio-economic and demographic background factors at time t. W_{ft} is an indicator of discussion of matters of childbearing in women's social network at time t. V_{mt} is a an indicator of discussion of matters of childbearing in men's social network at time t. V_i is a vector of unobserved couple-specific fixed factors that determine a couple's desire to stop childbearing. ε_{it} is the random disturbance term assumed to be independent of the selection of network partners and of individual and couple characteristics at time t. i & t; i represents different couples in our analysis, and t refers to different measurements of the same variable for each couple or individuals at different points in time[10]

Finally, we use event-history analysis in the form of discrete-time hazard models to account for censoring in our analysis of the rate of birth to couples within the observation period. Marital couples are considered at risk of birth beginning from the year of interview of the baseline panel (1998) till the sixth survey in 2002. If no birth occurs by the time of the survey in 2001, the couple is censored. The unit of analysis is therefore person year and is assumed to have a linear effect[11]. However, to control for within couple clustering of births and to protect against deflated standard errors and potentially biased hypothesis test, we fit random effects logit models, which allows the intercept to vary randomly by marital partners[12] (Barber et al. 2000). We accomplish this by using XTLOGIT procedures in STATA. Our resulting discrete-time hazard model can thus be specified as:

$$\ln (P_{jt}/1 - P_{jt}) = \beta_{0j} + \boldsymbol{\beta}_1 X_{jt} + \boldsymbol{\beta}_2 \mathbf{T}_{jt}$$

[10] for brevity we do not subscript t for the different rounds of data, we also do not subscript X_{it} for time varying and time invariant variables

[11] Note that no adjustment is needed to account for multiple person-years contributed by each couple (Allison, 1982).

[12] A few couples had more than 1 birth within the risk period.

Where P_{jt} is the probability of having a birth for couple j in year t, β_{0j} is the intercept that varies randomly across couples, $\boldsymbol{\beta}_1$, $\boldsymbol{\beta}_2$ are vectors of coefficients, $\mathbf{X}_{jt}$ is a vector of covariates, $\mathbf{T}_{jt}$ is a specification for the baseline hazard.

Analytical Strategy

Results of this paper are presented starting with descriptive comparisons of men and women who reported discussing matters of childbearing in 1998 and those who did not report any such discussions. We then take advantage of the temporal order of events inherent in the longitudinal sample to test the hypothesis of the study in a series of model specifications that draw predictors from the baseline panel in 1998 and outcomes from the follow-up panel in 2001. At this stage, only random effects models that correct for the likely correlation between individuals who share resemblance in the same communities than individuals in different communities, are fitted, no fixed effects models are estimated at this stage.

Next, we utilize the full resources of our data in all three panels to fit random effects logits that adjust for the correlation in the likelihood scores of couples who contribute three observations each to the analysis. We compare these estimates to fixed effects estimates that are based on a subset of the random effects sample with at least one change in each of the dependent outcomes.

We conclude the presentation of results with discrete-time logistic models of the rate of birth for couples between the period 1998 and 2001, whilst adjusting for the mediating effects of fertility attitudes and aspirations in the association between men's

and women's social network effects and actual fertility. The paper concludes with a summary and discussion of major findings and their probable implications.

RESULTS

Bivariate Associations

Table 2 presents descriptive characteristics of men and women who discussed matters of childbearing with their personal network partners and those who did not. On the whole, men report higher levels of discussions than women - 54% vs. 47.7%. But this does not appear to have any significant impact on overall gender differences in social interaction by individual characteristics. Respondents who reported discussions were on the whole, slightly younger than those who did not report any discussions. However, men were older than women as reflected in the sample as a whole and as indicative of overall age differences between couples in marriage. There were no differences in the number of children alive between those who reported discussions and those who did not. This was so for both gender groups. Interestingly, schooling was only significantly associated with reporting discussions on matters of childbearing at the secondary or higher level, this was again true for both men and women. Even though respondents with no education reported higher levels of discussions than those with primary education, this relationship was not significant. On the whole, gender differences in educational attainment across educational categories are reflected in the results on table 2, with women more likely to be least educated than men. Christian men and women also showed higher levels of discussions in personal networks than Muslims or traditional and other religions, even though these differences were not statistically

significant using the chi-square statistic. Similarly, there were no significant differences in the levels of discussions between men and women in monogamous and polygamous marriages. Also, women and men in non-agricultural jobs report higher levels of discussions with their social network partners than those in agricultural jobs. The proportions are however, higher for women than for men. This finding could reflect the fact that in these settings women are more likely to report being traders and men more likely to be farmers.

There is a strong association between discussions in personal networks and spousal communication on family planning, with men reporting slightly higher levels of discussions than women. Virtually, no differences could be detected by gender in reporting discussions in social networks and whether couples approve of family planning. Lastly, only slight differences (49% by men - 44% by women) could be detected by gender between respondents who indicated they did not want any more children and discussing childbearing issues with social network partners. The differences however, were not significant.

On the whole, the bivariate patterns described above, highlight gender differences in social interaction and fertility attitudes and behavior. Importantly, the pattern identified suggests that men's social networks are as valuable a resource as women's social networks in exchanging information on childbearing issues. Thus our focus on men in a couple dyads seems particularly justifiable, given that men's interactions hold some implications for fertility attitudes and outcomes.

Table 2 about here

Discussion childbearing matters in social networks and subsequent spousal interaction on family planning

Multivariate results of random effects logit models predicting spousal communication about family planning in 2001 from discussion of childbearing matters in men's and women's networks in 1998 are presented on Table 3, in three models, each corresponding to our stated hypothesis. The baseline model tests the effects of men's discussions in networks only, then women's discussions in networks is added. In the final model, spouses' background characteristics are included. In all three models, we adjust for any likely differences from follow-up interviews of new husbands or new wife(s) of husbands already interviewed in previous surveys. The results are given as odds ratios, exponentiated from the log-odds of the logistic regression model. An odds ratio greater than unity indicates a positive effect on spousal communication about family planning for couples with at least two children, relative to the reference category and an odds ratio less than unity indicates a negative effect. Corresponding confidence intervals are indicated in parentheses.

It's clear from model I that the effect of men's discussions in networks is strong and statistically significant: discussions of matters of childbearing with social network partners in 1998 leads to a more than two-fold increase in the odds of subsequent spousal communication on childbearing matters relative to not discussing such matters. In model II, the effect not only remains statistically significant but is stronger than that of the effects of women's discussions in networks (odds ratio of 2.01 - 1.44), which is only marginally statistically significant at $p<.10$. The final model, which adjusts for spouses'

individual and shared background characteristics shows that the effects of men's discussions in networks increases in magnitude and remains highly significant, whilst that of women's discussions with network partners reduces and is no longer statistically significant. While it is not the intention of this paper to discuss the effects of control variables, we note that 'hybrid' interviews did not exert any influence on the spousal communication on family planning.

Table 3 about here

Overall, the random effects findings on spousal communication about family planning demonstrate that the effects of men's discussions in personal networks are stronger and independent of those of women's networks. This is in slight contrast from our previous findings based on a cross-sectional test of encouragement received from social network partners and spousal communication, which showed both effects as strong and largely independent of each other (Avogo and Agadjanian 2008).

We turn now to a similar test of hypothesis on spousal approval of family planning in 2001, using predictors on men's and women's discussions in networks in 1998 (results presented on Table 4). We find contrary effects from those observed on spousal communication in the previous table. Men's discussions of childbearing matters in personal networks are not statistically significant compared to women's discussions in networks. This is true for all three models presented. In the full model for instance, the odds of spousal approval of family planning for women with at least two children, who discussed childbearing issues in networks are 2.2 times that of those who did not. This

difference is highly significant and in contrast to the effects of men's discussions which are not only weaker but not statistically significant. This finding is inconsistent with the second hypothesis which posited that men's discussions in networks will have a positive effect on spousal approval of family planning, net of women's discussions in networks and of other factors. Perhaps, this finding is reflective of some traditional, pronatalist barriers on the overt expression of approval of family planning on the part of men in an environment were fertility is still high and majority of family planning use is female use. Finally, the specification of the random effect to account for any likely correlation from the community the couples were sampled contributed more to the variance explained in the spousal approval model (*p* ranges from 0.20 – 0.27) than that of the spousal communication model (*p* ranges from 0.02 – 0.05).

Table 4 about here

Discussion childbearing matters in social networks and subsequent spousal agreement to stop childbearing

Table 5 presents results of four random effects models predicting spousal agreement to stop childbearing in 2001 from discussions of childbearing issues in social networks and other characteristics in 1998. Model I, (the baseline model), test the effects of men's discussions in social networks. This model shows only a marginal statistical difference between men who discussed childbearing matters in networks and those who did not (odds ratio of 1.42), controlling for whether or not it was a 'hybrid' interview.

Table 5 about here

Model II adds the effects of women's discussion in networks. The model shows a similar weak effect from men's discussions in networks, as displayed in the previous model. However, women's discussion in networks is stronger and statistically significant at $p<.05$ - women's discussion of childbearing issues with social network partners leads to a 55% (1.55- 1=.55x100) increase in the odds of spousal agreement to stop childbearing, controlling for men's discussions and whether the interview was 'hybrid' -.

Model III adds spouses' individual and shared background characteristics, this reduces the strength of the effects of men's discussions in networks further and does not test as significant. The effect of women's discussions in networks on the other hand, increases slightly and remains statistically significant, suggesting that the female network effect is independent of the male effect and of individual and spouses' shared demographic factors. It is worth noting that in this model, wife's education positively influences spousal agreement not to have more children. This is consistent with studies in most developing countries that find a strong association between women's schooling and fertility outcomes (Diamond et al 1999; Jejeebhoy 1995).

The final model (model VI), adds spousal communication about family planning and joint spousal approval of family planning to the model. Whilst the effect of women's discussions in networks does not disappear completely, it is no longer statistically significant. Like in the previous model, the effect of men's discussions in networks does not test as statistically significant. Spousal communication about family planning however, shows strong statistical significant effects: the odds of both spouses agreeing

to stop childbearing are more than twice as high among spouses who communicated about family planning, relative to those who did not. There are no statistical significant differences of joint spousal approval of family planning on spousal agreement to stop childbearing. The results shown on this model suggests that the effects of women's discussions in networks operate indirectly through spousal communication on family planning. Stated differently, spousal communication mediates the relationship between discussions in women's networks and agreement by spouses to stop childbearing. The specification of the random effect for the community sampled, contributed only .058 of the variance explained by these models.

In summary, our random effects estimates that take advantage of the temporal order of events, indicate that (1) men's and women's discussions in networks are significantly associated with subsequent spousal communication about family planning; (2) only women's discussions in networks are significantly associated with subsequent spousal approval of family planning; (3) men's discussions in networks are not significantly associated with spousal agreement to stop childbearing, only women's discussions in networks work indirectly through spousal communication about family planning to influence spousal agreement to stop childbearing. In the next section, we repeat the tests of these hypotheses but account for important biases that may be implied in our random effects estimates and may confound the estimated impact of social interaction on our outcomes of interests.

Table 6 about here

Random and fixed effects estimates of discussion of childbearing matters in social networks and spousal interaction on family planning

On table 7, random and fixed effects logit estimates that focus on changes in spousal communication and approval of family planning, using couples who contributed three observations, 1 each in round 1, 4 and 6 are presented (a total of 378 couples were included, see Table 6 for summary statistics of couples included in this section). As indicated previously, the fixed effects estimates use only a subset of this sample; that is, couples who changed their response on spousal communication or approval of family planning, at least once during the observation period (this yielded 159 and 55 couples respectively). Couples who did not change their response on the dependent or independent outcomes of interest were deleted. Our results on Table 7 are limited to full models, as used in the previous section.

The first set of random effects estimates on Table 7, show that both men's and women's discussions in networks significantly increase the odds of spousal communication. For men who discuss childbearing matters in networks, their odds increase 1.50 times compared to those who do not hold such discussions. That of women increases 1.76 times compared to women who do not report any discussions. However, the fixed effects estimates displayed in the adjacent column, indicates that neither of these effects are statically significant. To help us decide our preferred estimates, we employed the Hausman specification test to test the underlying

assumption for fitting fixed or random effects estimators. The test reveals a highly significant correlation between the unobserved person-specific random effects and the regressors (see Table 10). This shows that for spousal communication, our random effects models are inconsistently specified, thus leading us to the conclusion that men and women's discussions in social networks contrary to both random models, do not significantly predict spousal communication about family planning.

Table 7 about here

The second set of random models on Table 7 dealing with spousal approval of family planning shows that men's discussions in networks, as seen in the previous section, are not a significant predictor of spousal approval of family planning. However, the effects of women's discussions in networks are positive and statistically significant. The fixed effects estimates on this model also indicate the same findings. The Hausman test shows no correlation between the person-specific random effects and the regressors (see table 10). This leads us to the conclusion that our random effects estimates that indicate that women's rather than men's discussion in networks significantly predict spousal approval of family planning, should be upheld. It's however, remarkable that both random and fixed effects estimates yield the same findings.

A random and fixed effect estimates of discussion of childbearing matters in social networks and spousal agreement to stop childbearing.

Table 8 displays two pairs of random and fixed effects model specifications. The first pair in addition to testing the effects of men's and women's discussions in networks

controls for individual and couple socio-economic and background factors. The second pair shows results of the comprehensive model that includes the effects of spousal communication about family planning and spousal approval of family planning. The first set of random effects estimates demonstrates that men who discuss childbearing matters in networks are significantly more likely to agree with their spouse not to have any more children. The model also indicates similar positive effects for women's discussions in networks, although this effect is only marginally significant at $p<.10$. In the comprehensive random model (model II, first column), the effects of women's discussions in networks are no longer significant, whilst the effects of men's discussions in networks reduce in strength, they are nonetheless, still statistically significant ($p<.05$). Consistent with our previous random effects tests, spousal communication on family planning is a significant mediator of spousal agreement not to have any more children. Thus, whereas women's discussions in networks influence joint spousal agreement to curtail childbearing only through spousal communication, that of men's networks has both a direct and indirect effect. Men's discussions in networks are therefore independent of both women's discussions in networks and of spousal communication about family planning. As hypothesized, the effects of spousal approval of family planning are also positive but only marginally significant ($p<.10$). Thereby also indicating that women's discussions in networks operate indirectly through spousal approval of family planning.

Table 8 about here

Turning to the fixed effects estimates on table 8, the first pair of fixed effects logits on model 1, shows similar positive and statistically significant effects of men's discussions in networks. Whilst the effects of women's discussions in networks are positive, they are not statistically significant. Similarly, the fixed effects estimates of the comprehensive model also show statistically significant effects of men's discussion in networks and insignificant effects of women's discussions in networks. Spousal communication about family planning and spousal approval of family planning do not test as significant. The Hausman test on both pairs of random and fixed effects estimates demonstrates that there is no significant correlation between the person-specific random effects and the regressors. This demonstrates that our random effects models are consistently estimated and are a valid and parsimonious representation of the impact of informal discussions in networks and joint fertility intentions. We therefore reach consensus, based on the results of the two types of random effects tests –that which incorporates the temporal order of events and that which uses three observations per couple- that the effects of women's discussions in networks on spousal agreement to stop childbearing operate mainly through spousal communication.

However, two important inconsistencies are produced by the two types of random effects models: the effects of men's discussions in networks on spousal agreement to stop childbearing are not statistically significant in the first test of random effects, whilst, in the second test, the effects are substantial, positive and statistically significant. Similarly, although the first test of random models indicate that spousal approval of family do not significantly mediate the relationship between discussions in networks and spousal agreement to stop childbearing, that of the second set of random

models, indicate that spousal approval has marginally significant effects on spousal agreement to stop childbearing.

We are inclined to choose the results of the second random effects tests as our preferred estimates based on the express objectives of this study. Repeated observations of more cross-sections, as embedded in our second random effects test, gives us the leverage to make more valid conclusions on the dynamics of change in fertility attitudes and behavior with short time cross-sectional series (as measured in 1998, 2000 and 2001 in the second tests) than with fewer time series (as measured in 1998 and 2001 in the first tests) (Yafee 2003). Thus, for the overall purpose of this paper and to adequately contribute to more confident causal inferences regarding the impact of social networks on fertility processes, we conclude, based on the second random effects models, that net of other factors, men's discussions in social networks has a positive, substantial and significant effect on spousal agreement to stop childbearing. Similarly, spousal approval of family mediates the relationship between discussions in networks and spousal agreement to stop childbearing, although this relationship is only marginally significant.

To summarize, the overall results of the second part of our analysis that fit random and fixed effects estimates based on couples who contributed three observations to our sample, suggest that (1) neither men's nor women's discussions in networks significantly predict spousal communication about family planning. (2) only women's discussions in networks significantly predict spousal approval of family planning (3) whereas men's discussions in social networks have substantial and statistically significant direct and indirect effects on spousal agreement to stop

childbearing, that of the effects of women's discussions in networks only operate through spousal communication about family planning.

Discussion of childbearing matters in social networks and the rate of birth

The results of the discrete-time hazard models are presented in table 9. A similar analytical strategy, as used in previous sections, is adopted for hypothesis test on this table, however, we interpret the odds ratios exponentiated from the log-odds, as rates. This is possible because in this sample, the odds closely approximate the rates, since the probability of birth to a couple within the interval (1 year) is small. Model I (the baseline model), displays the main effects of men's discussions of childbearing matters in networks and men's baseline hazard, which is parameterized as linear. The model shows men's discussions in networks are associated with significantly lower rates of birth in any given year between 1998 and 2001. Men who discuss childbearing issues in networks give birth at a rate that is 19% lower (0.81-1.0=19%) than men who do not discuss childbearing in their networks. In model II, which adds wife's discussions in networks and their baseline hazards, the strength of the rate of birth for men who discussed childbearing in their networks increases (0.78-1.0=22%) and remains statistically significant? That of their wife's is negative but not statistically significant. The inclusion of individual and couple background factors in model 3, maintained the strength and statistical significance of the negative association between men's discussions in networks and the rate of birth. Similar to model I and II, the odds of birth for women who discuss in networks is negative but remains not statistically significant. In the final model (Model IV), we included spousal approval, spousal communication

about family planning and joint fertility intentions of couples as specified in our conceptual framework. We also added the community from which couples were sampled. This reduced the strength of the rate of birth for men who discussed childbearing in networks (18%) and its statistical significance were marginal (p<.10). The rate of birth of wives who discussed childbearing in networks was not statistically significant.

Table 9 about here

Spousal approval and spousal communication about family planning were also not statistically significant. Spousal agreement to stop childbearing, which was hypothesed to negatively mediate the relationship between discussions in social networks and actual fertility is also not statistically significant but has a negative effect on actual fertility. Thus, table 9 produces partially support of our last hypothesis by demonstrating clearly, that men's discussions in informal networks and not women's discussion with their partners, affects actual fertility and that when spouses agree to stop childbearing, it has a negative, albeit not a significant effect on rate of subsequent birth. These findings, again, may hint at some power dynamics in childbearing decisions within marriage. Men who interact on childbearing issues in informal social networks outside the marital household, may be more amiable to the idea of postponing or curtailing fertility, whereas in the case of women, discussions with their network partners could affect other fertility behaviors, such as modern contraceptive use, but not so much

on the decision to delay or curtail birth since much of this decision is contingent on men's roles in the marital bond.

DISCUSSION AND CONCLUSION

Following from the proliferation of studies in the last two decades that incorporate diffusion effects into research on fertility transitions in developing countries, this paper undertook to ascertain the relationship between discussing childbearing matters in personal social networks and fertility attitudes, aspirations and outcomes. We proposed a novel conceptual model that bridges the gap in literature between analysis on social interaction and contraceptive use and studies on the role of men in reproductive changes, by examining the gendered and complimentary role of social interaction on fertility processes (such as, spousal communication about family planning, spousal approval of family planning and joint reproductive intentions of couples) and outcomes (as in actual fertility).

Central to the objectives of this paper, were attempts to contribute to more confident causal inferences on the effects of social networks on fertility processes, by removing the effects of any unobserved factors that affect both fertility and social networks. The availability of longitudinal data, specially designed to measure the impact of social interaction on fertility behavior in Southern Ghana and the use of statistical methods that effectively test and control for endogeneity, allowed us to propose and rigorously test hypothesis related to social interaction and fertility processes and outcomes. Our first and second hypothesis were all based on the assumptions that discussions of childbearing matters in husbands' and wife(s)' social networks will affect

spousal communication about family and spousal approval of family planning, independent of each other and of the background characteristics of partners. The third and fourth hypothesis rested on the assumption that discussions of childbearing issues in men's social networks directly and indirectly influences spousal agreement to stop childbearing by stimulation spousal communication on family planning and spousal approval of family planning, whilst women's discussions in networks affects spousal agreement to stop childbearing only indirectly through spousal communication about family planning and spousal approval of family planning. Our last hypothesis, was premised on the assumption that spousal agreement to stop childbearing will negatively mediate the relationship between discussions in men's and women's networks and the rate of birth, net of men's and their wife's' discussions with network partners.

Our empirical findings however, suggested three important modifications to our conceptual model and hypothesis. First, contrary to our first hypothesis, neither men's nor women's discussions on childbearing issues with social network partners has a significant effect on spousal communication about family planning, when we control for unobserved factors that proved significant in determining both social networks and spousal communication. A second correction suggested by our findings and related to our second hypothesis is that, only women's discussions with network partners has substantial and significant effects on spousal approval of family planning, net of even unobserved factors that may confound this relationship (although, our statistical test showed no significant confounders between social interaction and spousal approval of family planning). Thus our second hypothesis was only partially supported. Our third and fourth hypotheses were all fully supported, thereby hinting at gender roles in

reproductive decision making. Informal social interactions by men, who are assumed to have substantial decision-making powers in childbearing, influence spousal agreement to curtail childbearing directly and indirectly through spousal communication on family planning and spousal approval of family planning, whereas, women, with relatively less control over childbearing, only influence spousal agreement to curtail childbearing indirectly, if they participate in communications about family planning and share approval of the practice of family planning with their husbands. The third and final correction to our conceptual model produced by our empirical findings is that spousal agreement to stop childbearing does not significantly mediate the relationship between informal interactions in networks and fertility outcomes. However, the negative direction of this relationship is reassuring indeed. Integral to this correction, is the finding that men's rather than women's informal discussions in networks are significant predictors of actual fertility. This is consistent with our prior finding that women's discussions with network partners are not direct significant predictors of spousal agreement to stop childbearing.

Our results are by no means an exhaustive proof of the theoretical framework encompassed in social learning and social influence. Indeed, social influence is only indirectly reflected when informal social networks exchange information on childbearing. Nonetheless, our study adds to previous studies that show that social diffusion effects work mainly through social learning (Behrman et al., 2002; Bongaarts and Watkins, 1996; Kohler et al., 2001; Montgomery and Casterline 1996). Another essential contribution of our findings is to the ongoing debate about the role of men in reproductive and fertility changes in sub-Saharan Africa. Evidence, gathered in this

paper, from the influence of men's discussions with social network partners on fertility processes and outcomes, reinforce earlier research that highlights gender dynamics in reproductive decision-making (DeRose et al. 2002; DeRose and Ezeh 2005). Yet the re-consideration of the role of spousal communication about family planning, spousal approval of family planning and joint fertility intentions are particularly valuable. As demonstrated, women's discussion of childbearing matters with their respective social network partners is translated to a higher likelihood of joint fertility intentions, mainly by stimulating communication on family planning and sharing approval of family planning with their spouses. Likewise, apart from the direct effect men's discussions of childbearing issues have on spousal agreement to stop childbearing, indirect effects also accrue through spousal communication about family planning and spousal approval of family planning. Similarly, although not statistically significant, the findings show that joint fertility intentions negatively influence the rate of birth.

Finally, even though fertility decline is already underway in much of sub-Saharan Africa, the slow pace of this decline is of concern to most demographers and policy makers (Bongaarts 2006; Moultrie et al. 2008). The results of the present study, like in previous research on social interaction and contraceptive use (Agadjanian and Avogo, 2008), suggests, that reproductive health interventions in sub-Saharan Africa should pay more attention to gendered social interactions and its effects on fertility processes and outcomes. In particular, whatever mechanisms that are adapted to stimulate men's and women's informal social interactions in peer networks, should aim at galvanizing spousal communication and spousal approval among marital partners about family planning.

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Table 1. Number of married women and men with atleast two children included from each round of the Southern Ghana Diffusion Study

Survey Round	Number of Women	Number of Men	Number of Couples
Round 1	624	607	437
Round 4	674	600	499
Round 6	731	597	532
Cases in round 1 and 6 (with nonmissing data)	557	502	544 (509)
Cases in round 1, 4 & 6 (with nonmissing data)**	554	591	420(378)**

* Only couples with non-missing information on all variables of interest are included in subsequent regressions

**Total number of couples in all three rounds is further reduced by birth history calendar dates measured at round 7 (thus these couples are in rounds 1, 4, 6, 7)

Table 2. Characteristics of men and women with atleast two children who discussed and did not discuss matters of childbearing (MoCB) with their social network partners, 1998 (Round 1)

	Men			Women		
Characteristics	All men	Discussed MoCB	Did not discuss MoCB	All women	Discussed MoCB	Did not discuss MoCB
Mean age (SD)	40.8	40.1	41.6	33.35	32.7	33.9
	(11.12)	(11.8)	(10.5)	(7.6)	(7.2)	(7.9)
Number of living children (mean)	4.5	4.7	4.1	4.9	4.9	5.1
	(3.4)	(3.4)	(3.4)	(2.5)	(2.4)	(2.5)
Education						
No Education	25.3	22.2	28.9	42.6	36.6	48.1
Primary Education	18.5	17.1	20.2	26.2	25.5	26.7
Secondary Plus	54.5	58.7	49.5	31.1	37.5	25.2
Religion						
Christianity	65.7	65.9	65.6	68.4	67.9	68.8
Moslem	22.6	24.2	20.6	23.4	24.7	22.2
Tranditional/other	11.7	9.9	13.8	1.0	0.8	1.1
Type of Union						
Monogamous	78.9	76.2	82.1	72.3	73.7	71.1
Polygamous	21.1	23.8	17.9	27.7	26.3	29.0
Occupation						
Agricultural	60.9	58.3	63.7	29.7	26.8	32.3
Non-agricultural	37.0	38.9	34.9	65.2	69.1	61.7
Not working	2.1	2.8	1.4	5.1	4.1	6.0
Spousal discussion of family planning	81.7	86.5	76.2	71.0	82.3	60.5
Spousal approval of family planning	92.7	94.8	90.3	93.5	95.1	92.1
Want no more children	42.8	49.2	35.3	41.5	44.0	39.1
Percent	100	53.6	46.4	100	47.7	52.3
Total	470	252	218	509	242	266

Note: numbers in parentheses are standard deviations

Table 3. Odds ratios and confidence intervals of random effect logit regression predicting spousal communication on family planning in 2001 from discussion of matters of childbearing with social network partners in 1998 (for couples with atleast two children)

	Model I		Model II		Model III	
Predictors	OR	CI	OR	CI	OR	CI
Men's discussion of matters of childbearing (MoCB) with social network partners						
Discussed MoCB	2.04	** [1.4 2.10]	2.01	** [1.40 2.92]	2.10	** [1.41 3.13]
Did not discuss (Ref.)						
Women's discussion of matters of childbearing (MoCB) with social network partners						
Discussed MoCB			1.44	+ [0.91 2.09]	1.25	[0.84 1.85]
Did not discuss (Ref.)						
Men's control variables						
Age group						
19-29					3.38	* [1.46 7.81]
39-39					2.10	* [1.29 3.44]
40+ (Ref.)						
Occupation						
Agricultural					1.11	[0.73 1.70]
Non-agricultural (Ref.)						
Women's control variables						
Age group						
16-26					2.49	* [1.18 5.24]
26-35					2.48	** [1.49 4.14]
36+ (Ref.)						
Education						
None (Ref.)						
Primary					1.36	[0.85 2.20]
Secondary plus					2.06	* [1.26 3.38]
Couples control variables						
Type of marriage						
Polygamous					1.13	[0.73 1.77]
Monogamous (Ref.)						
Number of living children					1.09	+ [0.99 1.21]
Religion						
Christian					1.72	* [1.08 2.73]
Muslim/other (Ref.)						
Hybrid interview	0.86	[0.49 1.51]	0.79	[0.45 1.40]	0.73	[0.40 1.34]
Variance (p)	0.02		0.03		0.05	
Log-likelihood	-341.95		-340.05		-309.78	
N	509		509		509	

** p<.01, *p<.05, + p<.10

(Ref.) - reference category

Table 4. Odds ratios and confidence intervals of random effect logit regression predicting spousal approval of family planning in 2001 from discussion of matters of childbearing with social network partners in 1998 (for couples with atleast two children)

	Model I		Model II		Model III	
Predictors	OR	CI	OR	CI	OR	CI
Men's discussion of matters of childbearing (MoCB) with social network						
Discussed MoCB	1.57	[0.84 2.94]	1.49	[0.79 2.82]	1.64	[0.83 3.23]
Did not discuss (Ref.)						
Women's discussion of matters of childbearing (MoCB) with social network						
Discussed MoCB			2.18 *	[1.14 4.16]	2.20 *	[1.13 4.29]
Did not discuss (Ref.)						
Men's control variables						
Age group						
19-29					8.03 *	[1.41 45.9]
39-39					2.49 *	[1.08 5.71]
40+ (Ref.)						
Occupation						
Agricultural					0.89	[0.42 1.87]
Non-agricultural (Ref.)						
Women's control variables						
Age group						
16-25					0.37 +	[0.12 1.16]
26-35					1.07	[0.48 2.38]
36+ (Ref.)						
Education						
None (Ref.)						
Primary					1.13	[0.50 2.52]
Secondary plus					1.01	[0.45 2.24]
Couples control variables						
Type of marriage						
Polygamous					1.14	[0.55 2.35]
Monogamous (Ref.)						
Number of living children					0.95	[0.82 3.10]
Religion						
Christian					1.86	[0.75 4.63]
Muslim/other (Ref.)						
Hybrid interview	0.34 *	[0.13 0.97]	0.29 *	[0.11 0.76]	0.27 *	[0.01 0.72]
Variance (p)	0.27		0.27		0.20	
Log-likelihood	-155.84		-152.9		-145.36	
N	509		509		509	

** p<.01, *p<.05, + p<.10

(Ref.) - reference category

Table 5. Odds ratios and confidence intervals of random effect logit regression predicting spousal agreement not to have any more children in 2001 from discussion of matters of childbearing with social network partners in 1998 (for couples with atleast two children)

	Model I		Model II		Model III		Model IV	
Predictors	OR	CI	OR	CI	OR	CI	OR	CI
Men's discussion of matters of childbearing (MoCB) with social network partners								
Discussed MoCB	1.42 +	[0.96 2.09]	1.41 +	[0.96 2.07]	1.39	[0.91 2.13]	1.27	[0.83 1.96]
Did not discuss (Ref.)								
Men's control variables								
Age group								
19-29					0.56	[0.23 1.37]	0.51	[0.21 1.27]
30-39					0.75	[0.45 1.25]	0.72	[0.43 1.22]
40+ (Ref.)								
Occupation								
Agricultural					0.65 +	[0.41 1.03]	0.67 +	[0.42 1.08]
Non-agricultural (Ref.)								
Women's discussion of matters of childbearing (MoCB) with social network partners								
Discussed MoCB			1.55 *	[1.06 2.3]	1.58 *	[1.03 2.41]	1.36	[0.88 2.12]
Did not discuss (Ref.)								
Women's control variables								
Age group								
16-25					0.77	[0.34 1.74]	0.71	[0.31 1.64]
26-35					1.11	[0.66 1.87]	1.01	[0.59 1.73]
36+ (Ref.)								
Education								
None (Ref.)								
Primary					2.18 *	[1.29 3.67]	2.14 *	[1.26 3.63]
Secondary plus					2.20 *	[1.30 3.75]	2.14 *	[1.25 3.66]
Couples control variables								
Type of marriage								
Polygamous					1.25	[0.77 2.00]	1.30	[0.80 2.11]
Monogamous (Ref.)								
Number of living children					1.38 **	[1.25 1.55]	1.37 **	[1.23 1.53]
Religion								
Christian					1.21	[0.68 2.14]	1.21	[0.67 2.18]
Muslim/other (Ref.)								
Spousal approval of family planning							0.78	[0.40 1.51]
Spousal communication on family planning							2.25 *	[1.41 3.60]
Hybrid interview	0.54 *	[0.30 0.97]	0.46 *	[0.27 0.88]	0.46 *	[0.23 0.91]	0.48 *	[0.24 0.96]
Variance (ρ)	0.03		0.04		0.05		0.57	
Log-likelihood	-339.33		-336.7		-290.6		-284.64	
N	509		509		509		509	

** p<.01, *p<.05, + p<.10

(Ref.) - reference category

Table 6. Summary statistics of couples with atleast two children in all three rounds (1, 4, 6) of Southern Ghana Diffusion Study

	Men			Women		
Characteristics	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3
Age	41.08	43.37	44.15	33.47	36.40	37.15
	(10.5)	(10.3)	(5.6)	(7.5)	(7.57)	(7.60)
Number of living children	4.15	5.03	5.63	4.33	4.46	4.8
	(3.0)	(3.02)	(2.90)	(1.95)	(1.93)	(1.86)
Education*						
Has no education	23.8	23.8	23.8	44.7	44.7	44.7
Has primary education	19.6	19.6	19.6	26.7	26.7	26.7
Has secondary education	54.5	54.5	54.5	28.6	28.6	28.6
Religion*						
Christianity	67.2	67.2	67.2	70.9	70.9	70.9
Moslem	21.2	21.2	21.2	19.8	19.8	19.8
Tranditional/other	11.6	11.6	11.6	9.3	9.3	9.3
Occupation*						
Agricultural	63.5	63.5	63.5	30.4	30.4	50.1
Non-agricultural	34.7	34.7	34.7	63.5	63.5	47.0
Not working	1.9	1.9	1.9	6.1	6.1	2.9
Type of Union						
Monogamous	84.7	84.7	84.7	83.6	83.6	85.2
Polygamous	15.3	15.3	15.3	16.4	16.4	14.8
Discuss matters of childbearing (MoCB) in social network	51.1	77.63	80.11	44.0	73.5	74.7
Discuss family planning with spouse	81.5	75.93	74.6	72.7	63.5	60.1
Approves of family planning	93.1	97.61	95.5	94.7	93.9	92.9
Want no more children	43.7	59.26	57.94	42.6	51.6	55.0
N	378	378	378	378	378	378

Note: Standard deviations indicated in parantheses

Education, religion and occupation are as measured only in round 1 because of decisions by investigators not to repeat certain questionnaire items in all rounds

Table 7. Odds ratios and confidence intervals of random and fixed-effects logit regression of spousal communication on family planning and spousal approval of family planning for couples with atleast two children (outcomes measured at round 1, 4, 6) (Full Models Only)

	Spousal communication on family planning						Spousal approval of family planning					
	Random Effects Logits			Fixed Effects Logits			Random Effects Logits			Fixed Effects Logits		
Predictors	OR		CI	OR		CI	OR		CI	OR		CI
Men's discussion of matters of childbearing (MoCB) with social network partners												
Discussed MoCB	1.50	*	[1.02 2.22]	0.93	[0.57	1.51]	1.61	[0.88	2.96]	1.68	[0.11	0.12]
Did not discuss (Ref.)												
Women's discussion of matters of childbearing (MoCB) with social network partners												
Discussed MoCB	1.76	*	[1.21 2.55]	1.09	[0.69	1.70]	1.87	* [1.03	3.40]	1.71	* [0.27	1.56]
Did not discuss (Ref.)												
Men's control variables												
Age group												
19-29	1.49		[0.56 3.97]				0.64	[0.13	3.15]			
39-39	1.98	*	[1.20 3.28]				1.39	[0.62	3.12]			
40+ (Ref.)												
Occupation												
Agricultural	0.78		[0.47 1.30]				0.89	[0.41	1.92]			
Non-agricultural (Ref.)												
Women's control variables												
Age group												
16-25	4.68	**	[1.98 11.03]				2.61	[0.62	10.96]			
26-35	3.88	**	[2.34 6.42]				2.05	+ [0.93	4.51]			
36+ (Ref.)												
Education												
None (Ref.)												
Primary	1.03		[0.60 1.76]				0.96	[0.43	2.17]			
Secondary plus	1.40	*	[0.82 2.40]				2.30	+ [0.96	5.48]			
Couples control variables												
Type of marriage												
Polygamous	0.90	+	[0.52 1.57]	0.60	[0.20	1.79]	1.18	[0.49	2.82]	1.05	[3.35	1.76]
Monogamous (Ref.)												
Number of living children	1.32	**	[1.16 1.50]	1.08	[0.69	1.71]	1.05	[0.87	1.27]	0.67	[0.23	0.46]
Religion												
Christian	1.17		[0.65 2.10]				0.60	[0.25	1.48]			
Muslim/other (Ref.)												
Community												
Village 1 (Ref.)												
Village 2	0.56		[0.24 1.32]				1.09	[0.25	4.65]			
Village 3	0.41	*	[0.18 0.91]				0.57	[0.18	1.85]			
Village 4	0.78		[0.39 1.56]				2.77	[0.79	9.70]			
Village 5	0.38	*	[0.19 0.76]				0.57	[0.20	1.60]			
Village 6	0.75		[0.34 1.64]				0.22	* [0.07	0.70]			
Variance (p)	0.36						0.42					
Log-likelihood	-615.26			-168.84			-261.97			-55.64		
N	378			159			378			55		

** p<.01, *p<.05, + p<.10

(Ref.) - reference category

Table 8. Odds ratios and confidence intervals of random and fixed-effects logit regression of spousal agreement not to have any more children (for couple's with atleast two children) (outcome measured at round 1, 4, 6)

	Model I				Model II			
	Random Effects Logits		Fixed Effects Logits		Random Effects Logits		Fixed Effects Logits	
Predictors	OR	CI	OR	CI	OR	CI	OR	CI
Men's discussion of matters of childbearing (MoCB) with social network partners								
Discussed MoCB	1.74 *	[1.12 2.74]	1.91 *	[1.09 3.35]	1.60 *	[1.03 2.50]	1.89 *	[1.05 3.32]
Did not discuss (Ref.)								
Men's control variables								
Age group								
19-29	0.48	[0.14 1.66]			0.46	[0.14 1.53]		
39-39	0.86	[0.50 1.48]			0.79	[0.47 1.34]		
40+ (Ref.)								
Occupation								
Agricultural	0.66	[0.38 1.14]			0.68	[0.39 1.15]		
Non-agricultural (Ref.)								
Women's discussion of matters of childbearing (MoCB) with social network partners								
Discussed MoCB	1.53 +	[0.99 2.35]	1.24	[0.74 2.10]	1.43	[0.93 2.19]	1.21	[0.72 2.05]
Did not discuss (Ref.)								
Women's control variables								
Age group								
16-25	0.51 **	[0.18 1.45]			0.44	[0.16 1.23]		
26-35	0.69 **	[0.41 1.16]			0.58 *	[0.34 0.98]		
36+ (Ref.)								
Education								
None (Ref.)								
Primary	2.04 *	[1.12 3.72]			2.03 *	[0.34 0.98]		
Secondary plus	2.85 **	[1.54 5.28]			2.74 *	[1.13 3.63]		
Couples control variables								
Type of marriage								
Polygamous	1.69 +	[0.93 3.06]	1.06	[0.41 2.74]	1.71 +	[1.51 4.97]	1.08	[0.42 2.78]
Monogamous (Ref.)								
Number of living children	2.26 **	[1.91 2.68]	3.11 *	[1.85 5.24]	2.18 **	[0.96 3.05]	3.20 *	[1.93 5.54]
Religion								
Christian	1.02	[0.53 1.98]			1.04	[1.85 2.57]		
Muslim/other (Ref.)								
Spousal approval of family planning					1.97 +	[0.55 1.90]	2.18	[0.76 6.30]
Spousal communication on family planning					2.07 **	[0.88 4.40]	1.19	[0.69 2.07]
Community								
Village 1 (Ref.)								
Village 2	0.31 *	[0.12 0.78]			0.33 *	[1.35 3.19]		
Village 3	0.70	[0.29 1.71]			0.79	[0.14 0.82]		
Village 4	0.40 *	[0.19 0.87]			0.42 *	[0.33 1.89]		
Village 5	0.53	[0.24 1.14]			0.61	[o.20 0.87]		
Village 6	0.24 *	[0.09 0.61]			0.28 *	[0.29 1.29]		
Variance (p)	0.36				0.36			
Log-likelihood	-517.72		168.34		-517.72		167.28	
N	378		166		378		166	

** p<.01, *p<.05, + p<.10

(Ref.) - reference category

Table 9. Odds ratios and confidence intervals of discrete-time hazard models of the effects of discussion of matters of childbearing with social network partners on the probability of birth (1998 - 2002)

Predictors	Model I			Model II			Model III			Model IV		
	OR		CI	OR		CI	OR		CI	OR		CI
Men's discussion of matters of childbearing (MoCB) with social network partners												
Discussed MoCB	0.81	*	[0.68 0.80]	0.78	*	[0.65 0.95]	0.79	*	[0.65 0.96]	0.82	+	[0.67 1.00]
Did not discuss (Ref.)												
Men's control variables												
Age (years)	0.95	**	[0.95 0.96]	0.99		[0.98 1.01]	0.98	*	[0.97 0.99]	0.98	*	[0.97 0.10]
Occupation												
Agricultural							0.91		[0.74 1.11]	0.95		[0.76 1.18]
Non-agricultural (Ref.)												
Women's discussion of matters of childbearing (MoCB) with social network partners												
Discussed MoCB				0.97		[0.80 1.17]	0.96		[0.79 1.17]	0.96		[0.78 1.17]
Did not discuss (Ref.)												
Women's control variables												
Age (years)				0.93	**	[0.91 0.94]	0.88	**	[0.87 0.90]	0.89	**	[0.87 0.91]
Education												
None (Ref.)												
Primary							1.11		[0.87 1.41]	1.15		[0.90 1.46]
Secondary plus							1.06		[0.86 1.31]	1.05		[0.84 1.30]
Couples control variables												
Type of marriage												
Polygamous							0.95		[0.75 1.22]	0.97		[0.76 1.25]
Monogamous (Ref.)												
Children ever born							1.38	**	[1.30 1.47]	1.38	**	[1.30 1.47]
Religion												
Christian							1.13		[0.91 1.41]	1.15		[0.87 1.52]
Muslim/other (Ref.)												
Spousal approval of family planning										1.20		[0.85 1.67]
Spousal communication on family planning										1.11		[0.89 1.39]
Spousal agreement to stop childbearing										0.88		[0.67 1.15]
Community												
Village 1 (Ref.)												
Village 2										1.11		[0.78 1.60]
Village 3										1.25		[0.86 1.82]
Village 4										1.04		[0.72 1.49]
Village 5										1.37	+	[0.99 1.91]
Village 6										1.21		[0.84 1.74]
Log-likelihood	-1485.36			-1453.7			-1391.9			-1387.33		
Variance (p)	$3.4x10^{-8}$			$3.4x10^{-8}$			$3.4x10^{-8}$			$3.4x10^{-8}$		
Person-years	3590			3590			3590			3590		

** p<.01, *p<.05, + p<.10
(Ref.) - reference category

Table 10. Chi-square value and corresponding p-values from Hausman specification tests of whether fixed or random effects models should be used on Table 7 & 8

Model	Chi-square	*p* -value
Spousal communication	46.26	(0.0000)
Spousal approval	1.63	(0.8038)
Spousal agreement to stop childbearing	4.13	(0.3892)

* The Hausman test for whether there is a significant correlation between the unobserved person-specific random effects and the regressors. If there is no correlation, random effects are the prefered estimates, if there is a correlation fixed effects should be used