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# A Longitudinal Analysis of Gendered Association Patterns: Homophily and Social Distance in the General Social Survey

**Matthew E. Brashears**
Department of Sociology, Cornell University, meb299@cornell.edu

## Abstract

How has the passage of time impacted the ego networks of males and females? I compare the homophily and social distances of males and females using the 1985 and 2004 GSS networks modules. The results indicate that change has been gradual and incremental rather than radical. In 2004 less social distance separates associates for women than for men, and males differentiate more among levels of education. The results suggest that macro-level structural changes have not been sufficient to produce similarly large changes in ego network composition.

## Keywords

General social survey, discussion relations, gender, social distance, homophily, longitudinal, ego networks

## Introduction

How have changing structural conditions impacted the composition of male and female ego networks? Existing scholarship argues that our social networks emerge largely from the structural constraints, opportunities, and settings that we experience in the course of our lives (e.g., Blau 1977; Feld 1981; McPherson, Smith-Lovin and Cook 2001). As a result, those who have different structural opportunities and constraints (e.g., different educational or occupational trajectories) should have networks of different compositions. These effects should extend beyond the individual level, aggregating to encompass entire demographic categories and producing characteristic patterns of association. A variety of studies have confirmed this insight, finding, for example, both that male and female networks differ in composition (Ibarra 1992; Marsden 1988), and that some of this difference can be attributed to structural inequalities (Moore 1990).

Recent decades have seen dramatic increases in the proportion of women who have achieved advanced educational credentials (Buchmann et al. 2006; Jacobs 1996) as well as success in the workplace (e.g., Carlson 1992; Cohen 2004). When coupled with burgeoning communications technologies that may help compensate for the traditional differences in male/female voluntary association participation (McPherson and Smith-Lovin 1982, 1986; Popielarz 1999), there is significant reason to believe that male and female networks should be growing more similar. This paper uses nationally representative data on ego networks to analyze differences in the association patterns of males and females, as well as to determine how association patterns have changed over a twenty-year period.

I begin with a discussion of association, evaluated both in terms of homophily, the well-known tendency for like to associate with like, and social distance, or the likelihood of association with various dissimilar categories. The study of association patterns in general is important because they reveal the nature of the underlying social structure (Blau 1977; Blau and Schwartz 1984) and changes in such patterns therefore reflect changes in the nature of that underlying structure. Additionally, association represents the day-to-day social environment that respondents navigate; to understand a person's experience of the social world, we must analyze their associations and not merely their structural location. Next, I introduce the data and correction factors employed in this analysis and describe the log-multiplicative models used to compare association patterns across years and sexes. Then, I describe my data and analytic techniques. Finally, I discuss the results and draw conclusions.

## Structure, Homophily, and Social Distance

Homophily, or the tendency to associate with those like oneself (Lazarsfeld and Merton 1954), is one of the most robust of all social science findings (e.g., McPherson et al. 2001; Smith et al. 2014). This tendency does not arise primarily from choice but rather from structural availability. We select our associates from among those with whom we come into contact and because those others often live, work, and recreate in particular places for the same reasons as ourselves (e.g., their wealth or education level), our selections are made from among a pool of others who are already like us. Much as a diner is forced to select a preference from a limited menu, we must select our friends and spouses from among the limited, and comparatively homogeneous, set of people with whom we come into contact. While homophily is a nearly universal finding, the strength of homophily is often unequal between dimensions (e.g., age or education) as well as between levels of the same dimension (e.g., high school degree versus college degree) (Marsden 1988). As such, both the cross-dimension and within-dimension differences in the strength of homophily provide useful information about the underlying structural forces that guide association. Likewise, changes in these forces should produce changes in the strength, and structure, of homophilous association between and within dimensions.

Structural constraints ensure that association occurs primarily between similar individuals, but those who are unlike oneself are not all equally dissimilar. For example, a person with a post-graduate degree is more likely to form a relationship with a college graduate than with a high school dropout- both persons are “dissimilar,” but the degree of dissimilarity is unequal. The likelihood of association between two dissimilar individuals can be thought of as their social distance, with those who are less likely to associate being located at greater social distances. Homophily reflects the tendency to associate with those like oneself, while social distance determines who one associates with when homogeneous others are unavailable. Social distance is also influenced by structure, with those who are at comparatively short social distances more likely to share foci (Feld 1981), and those at long social distances less likely. Changes in the underlying structure should therefore influence the likelihood of association with particular types of dissimilar others (i.e., social distance).

Homophily and social distance are closely related, but nevertheless are analytically distinct concepts. Groups that experience strong homophily could also be said to be at long social distances from all others, whereas those with weak homophily could be said to be at short social distances from all others. In either case, however, the landscape of social distance determines the types of dissimilar others with whom we associate, and therefore the kinds of bridging ties (Granovetter 1973) that are available. For example, college graduates and high school graduates might have equally strong tendencies towards homophily, but could still differ in their likelihood of connecting to those higher in the education structure, which would in turn shape their access to social capital. To develop a complete understanding of network composition, one must understand both the strength of homophily as well as the nature of social distance.

## Sex and Networks

Sex-based differences have long been observed in educational attainment (Ainsworth and Roscigno 2005; Beattie 2002; Buchmann et al. 2006; Jacobs 1996; Mickelson 2003), occupational attainment (Charles 2003; Cohen 2004; Correll 2001; Huffman and Cohen 2004; Reskin 1993) and income (Mandel and Semyonov 2005; Roth 2004). Research also indicates that sex-based differences can be observed in social networks, with the networks of females typically including more kin, as well as fewer non-kin (Marsden 1987), than male networks. Previous research suggests that these differences are partly or wholly the result of structure (e.g. the impact of educational attainment or child bearing practices) and, as a result, patterns of association can be used as indicators of differences in the structural forces operating on males and females (Ibarra 1992; Moore 1990). Similarly, some researchers (Smith-Lovin and McPherson 1993) have argued that gendered behavior in adulthood is partly or largely a result of differences in networks and socialization. Thus, comparing the networks of males and females provides both direct knowledge of the social environments of the sexes—something that can usually only be inferred from demographic variables—as well as information about the structural forces shaping these social environments.

The strength of homophily and the extent of social distance are not the same in all dimensions (e.g., education, race, etc.), or even for all levels of a given dimension (e.g., high school graduate, college graduate, etc.) but less is known about differences between males and females in homophily or social distance. Previous work has identified differences between men and women both in terms of homophily and social distance using the 1985 General Social Survey (GSS) networks data (Brashears 2008) but it is unknown how these differences have fared over time.

In recent decades the structural positions of males and females in American society have changed, with gaps in education and workforce participation narrowing considerably. For example, the General Social Survey indicates that from 1985 to 2004 the percentage of females with a BA degree or higher increased from 13.48% to 25.48%. The percentage of males with a BA degree or higher increased as well, from 21.95% to 31.10%, but this reflects only an additional 9.15% of males who achieved an advanced level of education. In contrast, an additional 12% of females achieved advanced degrees in 2004. Moreover, the academic performance, and graduation rates, of female students in high school and beyond have now clearly surpassed those of males (e.g., Buchmann et al. 2006). Labor force participation underwent a similar shift in the same period; whereas 19.55% of females were employed full time in 1985, 24.11% were so employed in 2004. Male full time employment remained stable during the same period, hardly varying from 29.65% to 29.59%.

Much as the telephone revolutionized connectivity, services such as e-mail and Facebook, among others, may lower the costs of maintaining large numbers of contacts (e.g., Hampton and Wellman 2003; Hampton et al. 2010; Rainie et al. 2006; But see also Tufekci and Brashears 2014). These technologies may be particularly important for women whose traditionally lower labor force participation rates as well as smaller, and less diverse, voluntary associations (e.g., McPherson and Smith-Lovin 1982, 1986) have impaired their ability to construct wide-ranging social networks. While males and females are not structurally equal, they appear to be living in converging worlds.

Recent research (McPherson et al. 2006, 2008; Smith et al. 2014) suggests that some convergence may already have occurred, finding both that males and females no longer differ in the number of non-kin alters contained in their networks, and that female networks do not favor kin alters to quite the extent that they used to. Indeed, the same research finds that in 2004 male and female networks contained the same proportions of kin, whereas in 1985 female networks contained a greater proportion of kin than did male networks. Additionally, research increasingly points to the conclusion that the networks of both males and females are growing smaller (Brashears 2011; Hampton et al. 2010; McPherson et al. 2006, 2008), though this finding remains controversial (Fischer 2009; McPherson et al. 2009; Paik and Sanchagrin 2013). Lastly, Smith et al. (2014) found that the proportion of cross-sex ties has increased from 1985 to 2004, suggesting greater overall integration of male and female social networks. Yet, Smith et al. also found that the increased tendency to select opposite sex alters is only observed for kin ties, and there primarily for spouses. Moreover, they found that the strength of homophily is strikingly stable from 1985 to 2004, suggesting that the structural differences described above may not have been sufficient to substantially alter male and female patterns of association. Further research is clearly required.

## Data and Correction Factors

My data are taken from the General Social Survey (GSS), a multistage probability survey of non-institutionalized American adults administered every year or every other year since 1972. In 1985, and then again in 2004, the GSS included a social networks module intended to evaluate the interpersonal environment of the average American. This module included a name generator asking respondents to name up to five individuals with whom they had "discussed important matters" within the last six months.[1] Additional questions were then asked about each alter's age, race, sex, religion, and level of education.

Existing research suggests that the ego network data gathered by the GSS are reliable and linked to the provision of social support. Variations in the phrasing of the GSS name generator have few or no effects on the structure of the relationships that are elicited (Straits 2000). Elicited ties (i.e., relationships) are associated with multiple types of social support in which researchers are often interested (Brashears 2014; Ruan 1998) and variations in respondent interpretation of the question do not influence the structure of the networks captured (Bailey and Marsden 1999). In addition, Marin (2004) determined that the ties elicited by the GSS item are likely to be strong, close contacts who are tied to others in the respondent's network, and Burt (1997) found that the GSS item captured persons whom the respondent considered important, socialized with, and would rely on for advice. Thus, on the whole, the relationships assessed by the GSS "discusses important matters" item are likely to be close, important connections that provide the respondent with access to social and material resources. Uncertainty has emerged over the quality of the 2004 GSS data due to the finding (McPherson et al. 2006, 2008) that the number of persons who report being socially isolated (i.e., who report no important discussions in the past six months) has nearly tripled since 1985. This uncertainty has resulted in debate (Fischer 2009; McPherson et al. 2009) over whether this finding is legitimate or the result of an artifact. Fortunately for this project, I only examine those individuals who report one or more alters, thereby excluding those who are in the disputed "socially isolated" category. Thus, I use the portion of the 2004 GSS networks data about which we can be relatively confident (i.e., the non-socially isolated), and do not use those portions about which we are less certain. For basic statistics on these data, see McPherson et al. 2006, 2008 and Smith et al. 2014.

I focus on comparing male and female association along the dimensions of age and education. I select these dimensions because there are good reasons to expect that differences between the sexes, or over time, will be observed here. The convergence of male and female educational and occupational attainment may have made the pools of others from which males and females obtain their ties more similar, producing convergence in education homophily and social distance. Likewise, the growing male/female similarity in kin/non-kin network composition, in conjunction with the growing similarity in educational and occupational achievement, may have facilitated a similar convergence in age homophily and social distance. While information was also gathered on alter sex, race, and religion I do not analyze these data. In the case of sex, the small number of degrees of freedom, as well as my interest in comparing the association patterns of males and females, makes analysis uninformative.[2] In the case of race and religion, these are what Blau (1977) referred to as nominal parameters indicating difference in kind, whereas age and education are graduated parameters indicating differences in quantity. As a result, the social processes underlying each pair of characteristics, as well as their consequences (i.e., heterogeneity vs. inequality), are expected to differ. I additionally limit my analysis to non-kin and ignore the kin relations. Pragmatically, this is because kin relations are often heterophilous in certain respects (e.g., age, sex), thus making the estimation of common homophily and social distance parameters for kin and non-kin misleading. Theoretically, non-kin ties are acquired whereas kin ties are ascribed, and therefore non-kin relations are more sensitive to changes in the underlying structural conditions. Finally, non-kin relations signal the ease with which individuals could obtain social support that wouldn't otherwise be available from family. Given that we know from recent research that the numbers of kin and non-kin in male and female networks are growing more similar (McPherson et al. 2006, 2008), it is more useful for us to ask whether the nature of those non-kin relations is also changing.[3]

Respondents and alters are cross-classified by age and education into tables such that respondents comprise the rows and alters the columns (see Appendix A). Because the categories of age and education differ between respondents and alters, respondents are re-coded to match alter categories in the same fashion as previous research (Brashears 2008; Marsden 1988). An exception was made for education where all those in the "1-6 years," "7-9 years" and "10-12 years" categories were collapsed into a single "less than high school" category. While this differs from previous research, it is necessary due to the extremely low numbers of ties in each of the original educational levels contained in the 2004 data. The contingency tables (Appendix A) do not differentiate between alter sex because the strong sexual homophily among non-kin (e.g., Smith et al. 2014) would produce an additional pair of unacceptably sparse tables. The data were corrected using the appropriate GSS weights for each year (Davis et al. 2008: 2096-2111) to adjust for sampling effects. These weights were not used in earlier similar analyses (i.e., Brashears 2008; Marsden 1988) and thus my data and results do not precisely match theirs. However, the use of the correct survey weights will produce more accurate parameter estimates and are, in any case, indispensible due to differences in sampling procedures between the two GSS administrations. Finally, because each contingency table is a cross-classification of respondent and alter characteristics, an entry reflects a (perceived) tie between a respondent and an alter. Thus, the sum of the cells in each table gives the number of dyads contained in the data rather than the number of respondents. Some cells contain fractions of a dyad (i.e., decimal values) due to the influence of the survey weights. Because the cross-classification table is composed of dyads, respondents reporting no alters are not included in my analysis.

Obviously, because the GSS only gathered data from respondents, and not their alters, we cannot determine whether those alters would also have named the respondent as a discussion partner. Nevertheless, unreciprocated ties are observed in real social networks and thus a finding that group A directs more ties to group B than group B does to group A (i.e., group A is more likely to go to group B to discuss an important matter than the reverse) is entirely reasonable. Uneven tendencies for two groups to choose each other are regarded as a real phenomenon and not simply measurement error.

This analysis is based on respondent-alter dyads. Because the characteristics of a respondent influence the characteristics of the alter (e.g., through the influence of homophily), dyads that share a respondent are more homogeneous than a random selection of dyads drawn from the population. To correct for this lack of independence between the dyads I employ the single-moment adjustment[4] developed by Holt et al. (1980). The cell-by-cell design effects due to clustering (Kish 1965) are combined into a single correction factor, $\tau$, for each of the characteristics of interest (i.e., age and education). Briefly: $\tau = \Sigma(1-p_i)d_i/(s-1)$ where p is the proportion of observations in a cell, d is the design effect for a given cell, s is the number of cells in the table, and i is the cell in question. These correction factors (Age: 1.6794; Education: 1.6290), when used in conjunction with the GSS weights, provide the most accurate results, adjusting the fit of the models for both sampling effects and the clustering of dyads by respondent.[5] Other factors must be used when analyzing 1985 and 2004 separately and those given in the text are for models analyzing both the 1985 and 2004 data together.

## Models and Layer Effect Parameters

I conduct my analyses using the log-multiplicative family of models (see Agresti 2002; Powers and Xie 2000). While Smith et al. are correct in their observation that log-linear models are challenging to interpret (2014: 440), these models nevertheless offer several advantages. First, the log-multiplicative approach allows parameters accounting for homophily and social distance to be estimated simultaneously, and separately, while still controlling for demographic availability. Thus, we can distinguish the tendency to associate with one's own group from the tendencies to associate with particular dissimilar groups. Second, these models allow homophily to vary by the level of a given variable (e.g., by level of education), whereas regression-based approaches treat homophily as uniform throughout the dimension under study. Finally, log-multiplicative models are able to incorporate both linear and dramatically non-linear effects into the same model, and therefore do less violence to social reality in the process of fitting a model (e.g., McPherson 2004). Thus, these models represent a powerful and flexible technique that, while complex, is simpler than the available alternatives. The specific models used are special cases of Goodman's row and column effects model-II (Goodman 1979, 1985) adapted to four-dimensional data (i.e., respondent characteristic by alter characteristic by respondent sex by year). Goodman's RC model is appropriate for ordered data such as age and education, but I employ it to evaluate the ordered propensity to associate with particular others (i.e., social distance). Ronald Burt (1991) argued that a difference between two individuals (e.g., 32 versus 37 years of age) is only relevant to the extent that it produces social distinction. As a result, if two persons are separated in age by five years, but both ages produce the same life cycle effects, then the persons are socially the same age. Likewise, the row and column scores in my models do not reflect differences in the actual variables (e.g., five years) but an estimated difference in the social distance between those with certain characteristics. The row and column scores produce a gauge of social distinction and thus may not always agree with the ranks of the underlying variables.

The basic log-multiplicative model I employ is given in equation 1:

$$\log F_{ijkl} = \lambda + \lambda_i^R + \lambda_j^A + \lambda_k^Y + \lambda_l^S + \lambda_{ik}^{RY} + \lambda_{jk}^{AY} + \lambda_{kl}^{YS} + \phi_k\sigma_i\nu_j + \phi_l\sigma_i\nu_j + \phi_k\delta + \phi_l\delta \qquad (1)$$

In equation 1, $\lambda$ is the effect of table size, while $\lambda_i^R$, $\lambda_j^A$, $\lambda_k^Y$ and $\lambda_l^S$ account for the main effects of the rows (respondents), columns (alters), first layers (years) and second layers (sex) respectively. $\lambda_{ik}^{RY}$, $\lambda_{jk}^{AY}$ and $\lambda_{kl}^{YS}$ are two-way associations between respondents and years, alters and years, and years and sex. This allows for differences in the number of male and female respondents in each row, differences in male and female tendencies to develop ties, and changing numbers of male and female ties over time, to be accounted for. These effects also control for the impact of consolidated parameters (Blau 1977).

$\sigma_i$ reflects the category scores attached to particular rows in the contingency table while $\nu_j$ reflects the category scores for columns. Collectively, the product of sigma and upsilon define a row-column association that is the result of a linear relationship between the category scores of the rows and columns. Put more simply, the RC model iteratively determines the set of category scores that are most likely to produce the observed data given a linear relationship between the rows and columns. Substantively, the row-column association captures the proximity of particular age or education groups to each other in terms of social distance. This model can be estimated either in a heterogeneous form, where $\sigma_i \neq \nu_j$ or a homogeneous form where $\sigma_i = \nu_j$. A homogeneous form is equivalent to a model of social space that is unidimensional (i.e., age or education categories occupy points on a line) while a heterogeneous form is equivalent to a model of social space that is bidimensional (i.e., age or education categories occupy points on a surface). In all cases delta contains additional parameters accounting for the diagonal cells (i.e., cells for which i=j). These cells, containing ties between respondents and alters who share the same characteristics (e.g., both <30 years of age), must be modeled separately so that the impact of homophily does not swamp the influence of social distance. Additionally, these parameters are estimated net of the social distances captured by the row-column association. Thus, positive parameters for homophily indicate a greater tendency towards associating with similar others than we would expect based on social distance alone, whereas negative parameters indicate a lesser tendency. These cells are modeled (Marsden 1988) using either constant inbreeding, where tendencies towards homophily are the same for all row/column diagonal combinations (e.g. $\delta_{ij} = \delta_{ij}' = \delta_{ij}''$), or using differential inbreeding, where each row/column diagonal combination possesses its own tendency towards homophily (e.g. $\delta_{ij} \neq \delta_{ij}\, j' \neq \delta_{ij}''$).[6] With constant inbreeding homophilous association is favored to the same extent across the range of a characteristic (e.g. education) while in differential inbreeding homophilous association is favored to a different degree across this range (e.g., homophily is stronger for college graduates than high school graduates).

Finally, both the row column association ($\sigma_i\nu_j$) and the diagonal specification ($\delta$) are paired with an index of association ($\phi$) that determines how these specifications are constrained across year ($\phi_k$) or sex ($\phi_l$). In a constrained specification the association between row and column is held to be equal for all years and/or sexes (e.g., $\phi_k = \phi_k'$). A constrained specification indicates no difference by layer (i.e., year or sex) in the association between respondent and alter characteristics (i.e., $\sigma_{ik}=\sigma_{ik}'$ and $\nu_{jk}=\nu_{jk}'$). In an unconstrained specification the association between row and column is permitted to vary freely for all years and/or sexes (e.g., $\phi_l \neq \phi_l'$). An unconstrained specification indicates that the association between respondent and alter characteristics in one layer (i.e., year or sex) is entirely different from the association in the second layer (i.e., $\sigma_{il} \neq \sigma_{il}'$ and/or $\nu_{jl} \neq \nu_{jl}'$). Finally, the proportional specification is simply Yu Xie's (1992) log-multiplicative layer-effect model in which the pattern of association between rows and columns is held constant across layers but the strength of the association varies (e.g., $\sigma_{ik} / \sigma_{i'k}' = \phi_k\sigma_{ik}' / \phi_k\sigma_{i'k}'$). The proportional specification indicates a general expansion (i.e., "stretching") or contraction of social distance without the relative positions of social categories changing. One layer is arbitrarily selected as a "reference layer" and its phi parameter is fixed at one; the phi parameters for all other layers are determined relative to this reference layer. In my results all phi parameters generated by the proportional specification are normalized so that the sum of their squares is equal to one.

I employ a two-stage model fitting procedure in order to keep the presentation of results manageable. This research is primarily concerned with how the association between respondent and alter characteristics differs by sex and year. Additionally, I model the diagonal cells, recording homophily, and the off-diagonal cells, recording social distance, with separate parameters. There are, therefore, four separate layer comparisons (i.e., homophily by sex, homophily by year, social distance by sex, social distance by year) each of which can employ one of three different layer specifications (i.e., constrained, unconstrained or proportional). Thus, there are $3 \wedge 4$ or eighty-one possible combinations of layer specifications. Additionally, as the Goodman RC-II model can be specified either in a homogeneous form or a heterogeneous form (described above), and since I examine both age and education, there are approximately 324 models to be fit. In the first stage I estimate a series of models containing either a constant inbreeding or a differential inbreeding diagonal specification without a social distance term. This is necessary in order to determine the correct specification for homophily. These models are then tested with the available layer specifications to find the preferred model in each category. These two preferred models are then tested against each other to determine whether differential or constant inbreeding is preferred overall. The preferred of these two is then used in stage two, where social distance is added using both the homogeneous and heterogeneous versions of the Goodman RC-II model.[7] As the diagonal parameters in these models describe deviations from what would otherwise be expected based on marginal and category scores (i.e., homophily over and above that predicted by the linear association between row and column scores), it is necessary to refit the diagonal layer specifications for year and sex at this time. Finally, a preferred homogeneous RC model and a preferred heterogeneous RC model are selected and tested against each other to identify the final preferred model. While I limit my attention in the results section to my final preferred models, the complete model fitting narrative is available in Appendix B along with the relevant tables. The remaining models not included in this narrative are available upon request.

## Analytic Method

As separate phis are applied to both the comparison by year and the comparison by sex, and there are three phi specifications employed, there are nine possible combinations of phi specifications. These nine combinations are listed in Table 1 with descriptive labels.

Table 1. Phi Combinations

| | | **Year** | | | |
|---|---|---|---|---|---|
| | **Layer Effect** | **Constrained** | **Proportional** | **Unconstrained** | **Marginal Summary** |
| **Sex** | **Constrained** | Constant Equality | Evolving Equality | Reorganized Equality | M/F are the same |
| | **Proportional** | Constant Similarity | Weakening/Strengthening Similarity | Reorganized Similarity | M/F are similar |
| | **Unconstrained** | Constant Difference | Evolving Difference | Reorganized Difference | M/F are very different |
| | **Marginal Summary** | No change from 1985 to 2004 | Convergence/Divergence from 1985 to 2004 | Radical change from 1985 to 2004 | |

If the sex specification is constrained (Table 1, row 1) we would conclude that males and females do not differ from each other. If the sex specification is proportional (Table 1, row 2) we would conclude that males and females exhibit similar patterns of association but that the strength of these patterns differs (e.g., males and females associate with the same dissimilar category most often, but this association occurs at different frequencies). Finally, if the sex specification is unconstrained (Table 1, row 3) it means that males and females are entirely different from one another (e.g., consider different dissimilar others to be at shorter social distances).

Similarly, if the year specification is constrained (Table 1, column 1) we would conclude that there has been no change from 1985 to 2004. If the year specification is proportional (Table 1, column

2) we would conclude that the patterns of association in 2004 are similar to those in 1985, but that the strength of these patterns differs (e.g., individuals associate most often with the same dissimilar category in 2004 as in 1985, but the frequency of this association has changed). Finally, if the year specification is unconstrained (Table 1, column 3) we would conclude that association in 2004 is entirely different from association in 1985 (e.g., the closest dissimilar other has changed from 1985 to 2004).

Any combination of specifications appearing in row one of table one would indicate that males and females did not differ from one another in a specific manner (i.e., homophily or social distance) for a particular variable (i.e., age or education) in either year. Likewise, any combination of specifications appearing in column one of table one would indicate that the association patterns of males and females have not changed from 1985 to 2004. The remaining four combinations represent varying degrees of change. If a proportional specification for sex is combined with a proportional specification for year, then we observe a case of "weakening/strengthening similarity," meaning both that males and females have similar patterns of association and that association has remained similar over time. If a proportional specification for sex is combined with an unconstrained specification for year, then males and females remain similar to each other in each year, but the pattern in each year is decidedly different. If an unconstrained specification for sex is combined with a proportional specification for year, then males and females have very different patterns of association in each year, but these patterns have been altered in a consistent way over time. This would suggest that the structural features that have changed between 1985 and 2004 are impacting male and female association equally, but that other forces that have not changed are preserving male/female distinctiveness. Finally, if both specifications are unconstrained it indicates that males and females are profoundly different from each other and that the structure of association in 2004 is markedly different from that in 1985.

## Results

### *Age:*

The preferred specification for age ($L^2$= 64.028, df= 53) is a heterogeneous RC model, meaning that categories that do the choosing (rows) and are chosen (columns) are not equally spaced, or in other words, that the social effects of age are not unidimensional. The layer effect specifications on the diagonal terms indicate that while there have been changes in the strength of homophily between 1985 and 2004 (i.e., a proportional layer effect), there do not appear to be differences by sex (i.e., a constrained layer effect). In contrast, the social distance terms differ in strength both over time and by sex (i.e., a proportional layer effect). Thus, males and females have similar, but statistically different, tendencies to associate with those whose ages are unlike their own and these tendencies have shifted during the previous twenty years. These combinations of specifications are consistent with "evolving equality" for homophily, and "evolving similarity" for social distance.

Table 2. Model Statistics: Preferred Age Model

| Diagonal | | | | | |
|---|---|---|---|---|---|
| | 1985 | 2004 | Male/Female | | |
| <30 | 2.316 | 2.917 | 0.413 | | |
| 30-39 | 0.647 | 0.815 | -1.118 | | |
| 40-49 | -2.575 | -3.244 | 3.560 | | |
| 50-59 | 0.864 | 1.089 | -1.437 | | |
| 60 or over | 1.675 | 2.110 | 1.359 | | |
| Phi | 0.622 | 0.783 | | | |
| Row and Column Scores | | | | | |
| Year | | | | | |
| 1985 | | | | | |
| | <30 | 30-39 | 40-49 | 50-59 | 60 or over |
| Row | -0.454 | -0.498 | -0.085 | 0.488 | 0.549 |
| Column | -0.565 | -0.474 | 0.275 | 0.593 | 0.172 |
| Phi | 0.649 | | | | |
| 2004 | | | | | |
| | <30 | 30-39 | 40-49 | 50-59 | 60 or over |
| Row | -0.376 | -0.412 | -0.071 | 0.404 | 0.454 |
| Column | -0.467 | -0.392 | 0.227 | 0.490 | 0.142 |
| Phi | 0.761 | | | | |
| Sex | | | | | |
| Male | | | | | |
| | <30 | 30-39 | 40-49 | 50-59 | 60 or over |
| Row | -0.194 | -0.658 | 0.150 | 0.712 | -0.011 |
| Column | -0.194 | -0.334 | -0.444 | 0.187 | 0.786 |
| Phi | 0.335 | | | | |
| Female | | | | | |
| | <30 | 30-39 | 40-49 | 50-59 | 60 or over |
| Row | -0.107 | -0.362 | 0.083 | 0.392 | -0.006 |
| Column | -0.107 | -0.184 | -0.244 | 0.103 | 0.433 |
| Phi | 0.942 | | | | |

Diagonal, row, and column scores are provided in Table 2 for additional detail along with the phi statistics for the proportional layer effects. To simplify interpretation, the diagonal scores for 1985 and 2004 are illustrated in Figure 1. In this representation males and females have been collapsed due to the observed lack of difference in their homophily parameters. These parameters are estimated net of the social distance effects and therefore a positive value indicates more homophily than would be expected based on the category's positioning in social space, while a negative parameter indicates less homophily than would be expected (e.g., 40-49 year olds are less homophilious than expected). A negative value on this graph does not, however, mean that homophily is not present for this category in absolute terms. With the exception of those in the middle of the age distribution, the pattern shows greater than expected preferences for association with those of the same age and that the overall pattern has increased significantly in strength over time. This suggests that while males and females have been, and remain, equal in their tendency to associate with similar-age others, these tendencies have grown even more pronounced over twenty years. Put differently, age is even more salient a determinant of association in 2004 than it was in 1985.

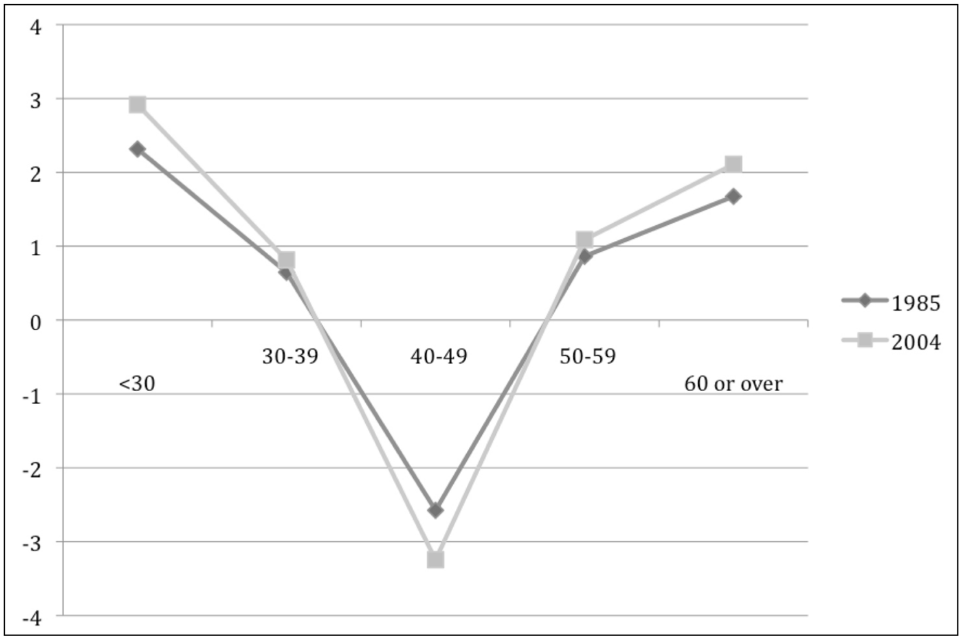


Figure 1. Homophily Parameters: Preferred Age Model (Collapsing sexes)

Representing the four-way association between row (sigma) and column (upsilon) scores (i.e., social distance) is a more difficult problem. Given that only the differences between the scores convey useful information (i.e., their specific values are irrelevant), I take the row and column scores as a set of coordinates in social space and produce matrices of Euclidian distances[8] for males and females in 1985 and 2004. The associated figures provide a direct representation of the amount of social distance separating various levels of age, controlling for marginal effects and homophily. The greater the social distance between two categories, the lower the likelihood of association between them. For each column in these figures height above the zero line indicates social distance. Thus, in Figure 2, examining male social distance in 1985, those who are less than thirty years old (column 1) are least socially distant from those 30-39, followed by 40-49 years olds, those 60 and older, and finally 50-59 year olds, in that order. Similarly, those aged 50-59 (column 4) are equally close to those 40-49 years old and those 60 and older, followed by those under thirty and finally those aged 30-39. Thus, by reading upwards in a column it is possible to determine to which other categories a person is socially proximate.

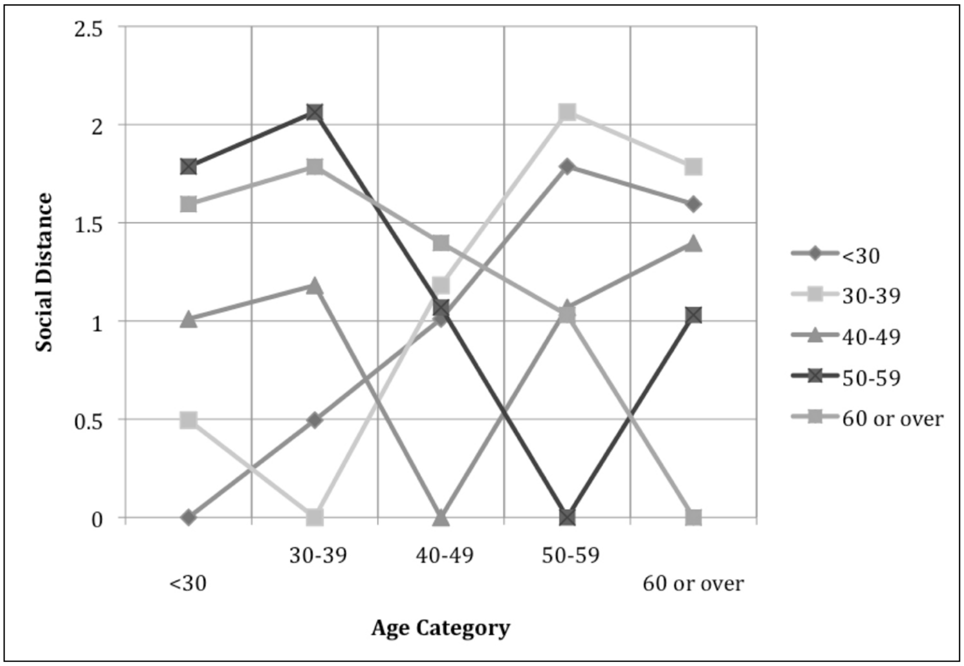


Figure 2. 1985 Male Social Distance—Age

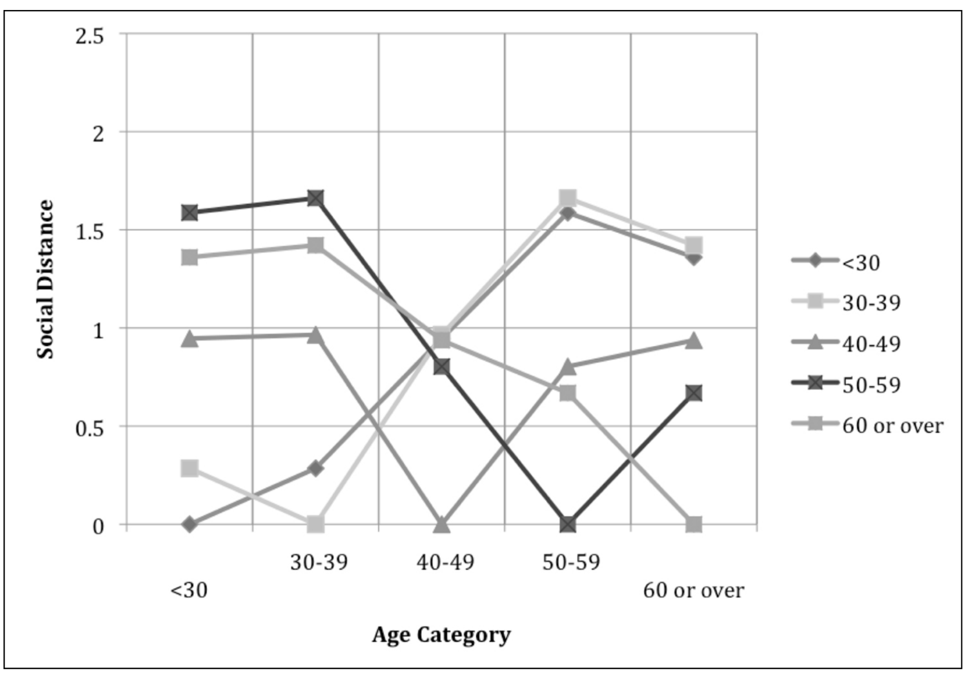


Figure 3. 1985 Female Social Distance—Age

Using figures 2-5, it is immediately apparent that in all years, for both males and females, those aged 30-39, and those younger than thirty, are relatively socially close (i.e., likely to choose one another) and, likewise, removed from those of other ages. Those aged 50-59 and 60 or above are also somewhat close to each other. Finally, those aged between 40 and 49 are at a similar social distance from (i.e., equally like to choose and be chosen by) all other age groups. The phi parameters indicate that social distance has generally decreased[9] by approximately 17.3% from 1985 to 2004 and that overall social distance is roughly 65% greater for males than females. Put differently, there appears to be less distinction made between the various age categories in 2004 than in 1985 and females appear to distinguish less between various ages in all years than do males. In combination with the homophily parameters, it appears that those aged 40-49, and particularly females of those ages, play an important role in linking the upper and lower ends of the age spectrum, serving as intergenerational bridges.

Critically, while males and females are not identical in terms of social distance in the age dimension, the overall decrease in age social distance from 1985 to 2004, coupled with the proportional specification for sex, indicates that male and female social distance is more alike in 2004 than in 1985. Put differently, if the pattern of preferences among dissimilar alters is the same, and social distance decreases, then the frequency with which males and females associate with those dissimilar others must become more equal. In combination with the results for age homophily, it appears that in 2004 both males and females tend to associate with those of the same age more strongly, but differentiate less between those of other ages when associating with dissimilar others.

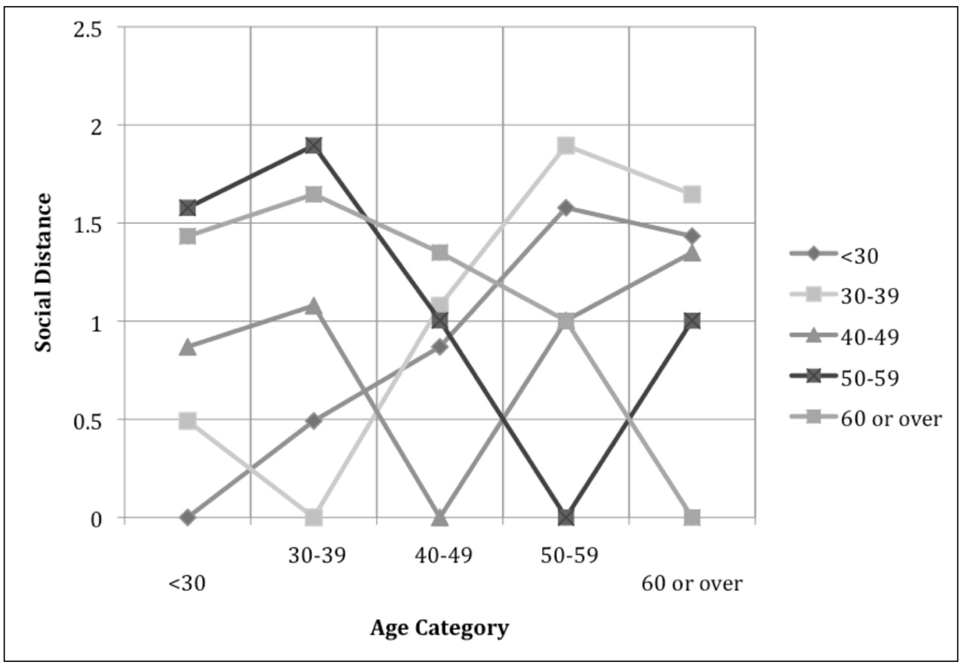


Figure 4. 2004 Male Social Distance—Age

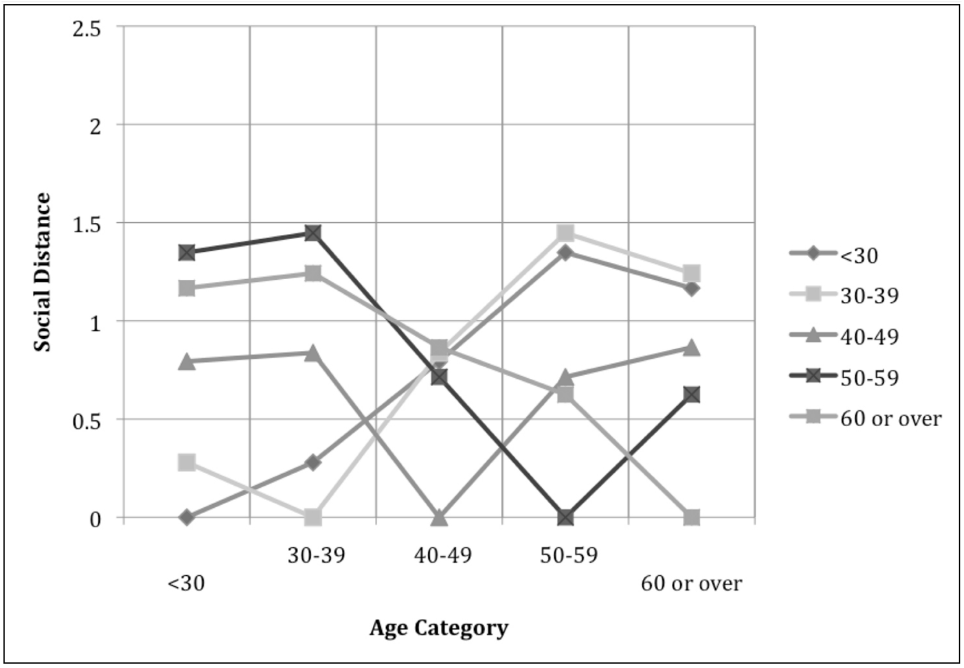


Figure 5. 2004 Female Social Distance—Age

### *Education:*

The preferred specification for education ($L^2$= 97.790, df= 79) is, again, a heterogeneous RC model, indicating that social distance is once more better represented by a bidimensional, rather than a unidimensional, space. The diagonal is constrained by year, indicating that homophily has not changed markedly from 1985 to 2004, but is proportional by sex, indicating that males and females differ in the strength of their educational homophily in both 1985 and 2004, though they do not differ in the pattern of homophily. Social distance, in contrast, is proportional by year, appearing to have changed in strength over the past twenty years, and is unconstrained by sex, suggesting that males and females differ both in strength and in pattern from one another. In other words, males and females have entirely different sets of social distances separating each level of education, but these patterns have been similarly influenced by the passage of time.

Table 3. Model Statistics: Preferred Education Model

| | | | | | | |
|---|---|---|---|---|---|---|
| Diagonal | | | | | | |
| | Males | Females | 1985/2004 | | | |
| Less than H.S. | -0.701 | -1.281 | 3.073 | | | |
| H.S. Grad | 0.026 | 0.047 | 2.531 | | | |
| Some Coll. | -0.065 | -0.118 | 0.271 | | | |
| Assoc. Deg. | 0.515 | 0.940 | -0.610 | | | |
| Bach. Deg. | 0.144 | 0.263 | 0.290 | | | |
| Grad Deg. | -1.562 | -2.854 | 2.660 | | | |
| Phi | 0.333 | 0.943 | | | | |
| Row and Column Scores | | | | | | |
| Year | | | | | | |
| 1985 | | | | | | |
| | Less than H.S. | H.S. Grad | Some Coll. | Assoc. Deg. | Bach. Deg. | Grad Deg. |
| Row | -0.338 | 0.852 | 0.044 | -0.332 | -0.0066 | -0.2185 |
| Column | 0.424 | -0.852 | 0.186 | -0.082 | 0.174 | 0.150 |
| Phi | 0.547 | | | | | |
| 2004 | | | | | | |
| | Less than H.S. | H.S. Grad | Some Coll. | Assoc. Deg. | Bach. Deg. | Grad Deg. |
| Row | -0.159 | 0.399 | 0.021 | -0.156 | -0.003 | -0.102 |
| Column | 0.199 | -0.3996 | 0.087 | -0.038 | 0.081 | 0.070 |
| Phi | 0.837 | | | | | |
| Sex | | | | | | |
| Males | | | | | | |
| | Less than H.S. | H.S. Grad | Some Coll. | Assoc. Deg. | Bach. Deg. | Grad Deg. |
| Row | 0.184 | 0.309 | 0.245 | 0.354 | -0.335 | -0.757 |
| Column | -0.793 | -0.027 | -0.073 | 0.041 | 0.410 | 0.442 |
| Females | | | | | | |
| | Less than H.S. | H.S. Grad | Some Coll. | Assoc. Deg. | Bach. Deg. | Grad Deg. |
| Row | -0.408 | -0.2222 | -0.241 | -0.035 | 0.057 | 0.849 |
| Column | -0.696 | -0.151 | -0.033 | 0.020 | 0.184 | 0.676 |

To provide greater detail the parameters generated by this model are provided in Table 3. For simpler interpretation the homophily parameters are illustrated in Figure 6. As with age, the homophily parameters are estimated net of the effect of social distance. Thus, negative values indicate less homophily than would be anticipated net of social distance while positive values indicate more. As the model reveals no changes over time, the years are collapsed in this figure. The results reveal that homophily is relatively weak for those with less than a high school education and those with a graduate degree. In contrast, homophily is relatively strong- either as strong as predicted or greater- for the remaining education categories. While this pattern of homophilous association is constant across both males and females, it appears that it is approximately 83% stronger for females (i.e., tendency towards homophily, net of other parameters, is 83% greater). Thus, education appears to be a more salient determinant of association for women than for men.

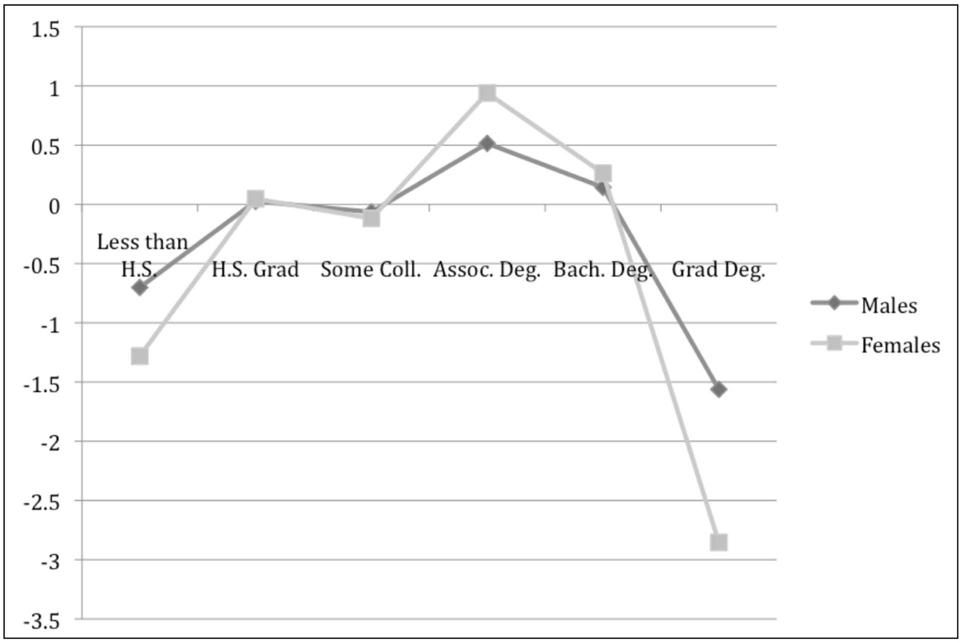


Figure 6. Homophily Parameters: Preferred Education Model (Collapsing sexes)

Turning to social distance, I once again translate the row and column scores into a set of Euclidian distances that capture the social distances between categories. In 1985 for males (Fig. 7) it appears that those with a bachelor's degree and those with a graduate degree form a "cluster," or are each other's closest neighbors at a relatively short remove (i.e., less than 0.5 units apart). Likewise, those with some college or an associate's degree form a second cluster. Thus, within each of these clusters, members are more likely to select each other for heterophilous association than any of the other categories. Those with less than a high school education and those with only a high school diploma, however, are relatively distant from all other categories and both regard those with some college as their closest social neighbors (i.e., most likely associates). As with the age graphs, a middle category—in this case "some college"—is least socially distant on average from all other categories. For females in the same year (Fig. 8) the story is similar. Those with less than a high school education or only a high school degree are relatively isolated and both count those with some college as their nearest neighbors. Those with some college or an associate's degree still form a cluster, however in this case those with a bachelor's degree are also included. Finally, those with a graduate degree are relatively isolated. Isolated, in this context, does not mean that individuals lack contacts but rather that they may find it difficult to develop ties with those outside their own group. Much as the residents of a remote island can be "isolated" from those on the mainland despite their frequent contact with other islanders, those who belong to a remote social group may be isolated from the remainder of social space. Thus, for females in 1985 it appears that relatively little social distinction is made between those with some college, an associate's degree, or a bachelor's degree. As with males, those with some college are closest on average to all other educational categories.

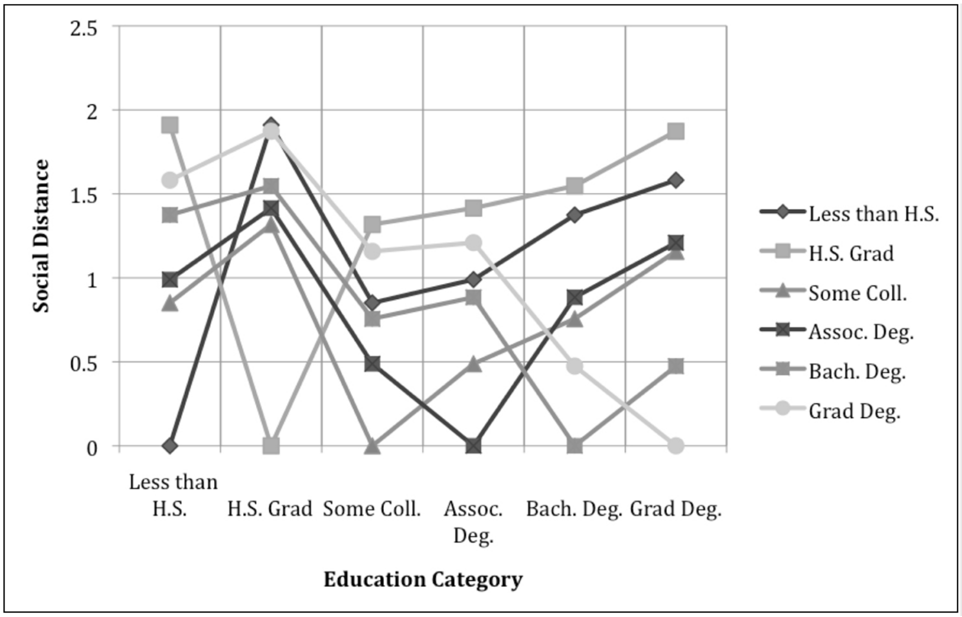


Figure 7. 1985 Male Social Distance—Education

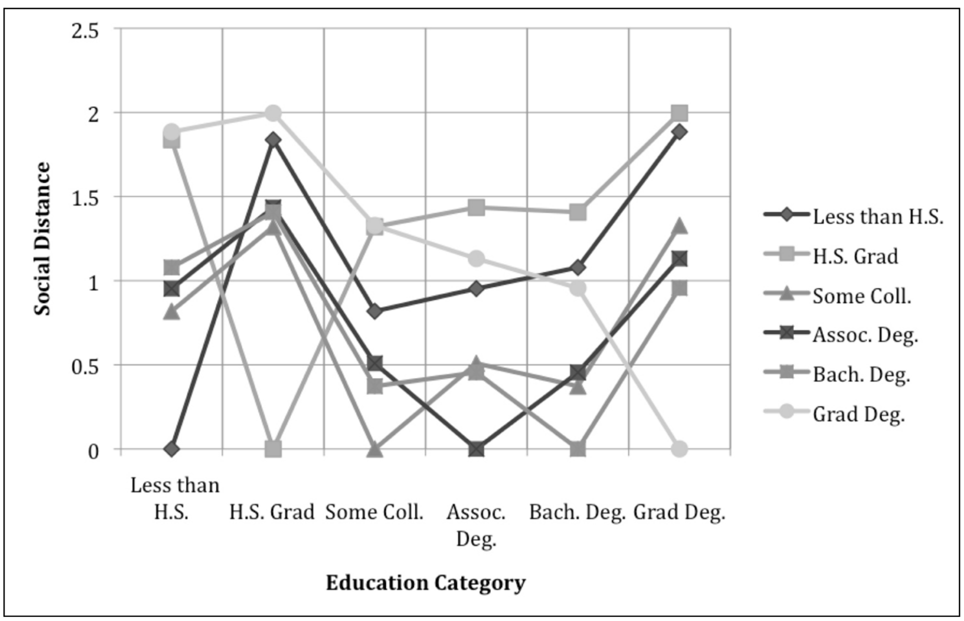


Figure 8. 1985 Female Social Distance—Education

In 2004 the social distance separating educational categories decreased by approximately 53% relative to 1985 (i.e., fewer distinctions are made between dissimilar others). For males (Fig. 9) the same clusters appear linking those with bachelor's degrees to those with graduate degrees, and those with associate's degrees to those with some college. Individuals with a high school diploma or less remain relative isolates (i.e., unlikely to choose/be chosen by those outside their own group) and are still closer to those with some college than any other group. For females (Fig. 10) the same cluster of those with some college, associate's degrees, or a bachelor's degree remains while those with a graduate degree as well as those with a high school diploma or less, all remain comparatively isolated. Moreover, while the social distance separating categories has decreased for females as well as males, these changes have been less pronounced at the upper extreme of education than in the middle categories. Specifically, while the middle categories of education have grown closer together and moved closer to the lower categories, those with a graduate degree are no closer to others in 2004 than they were in 1985. Finally, for both males and females the patterning of social distance in 2004 more closely resembles a flattened v-shape than in 1985. That is to say that in 2004 the social distance between two categories increases relatively smoothly as the educational difference between them increases, producing a v-shaped line from each zero point. In 1985, this pattern was considerably more uneven. Thus, in 2004 the difference in amount of education between the respondent and alter more closely reflects the socially relevant distinctions between these categories than was the case in 1985.

The amount of social distance separating various categories has decreased substantially from 1985 to 2004. This has the unavoidable result of make the frequencies with which males and females interact with dissimilar categories more alike. Nevertheless, considerable differences remain. In combination with the homophily parameters, it is safe to conclude that while the passage of time has influenced male and female association similarly, the sexes are not markedly more similar in their patterns of association in 2004 than they were in 1985.

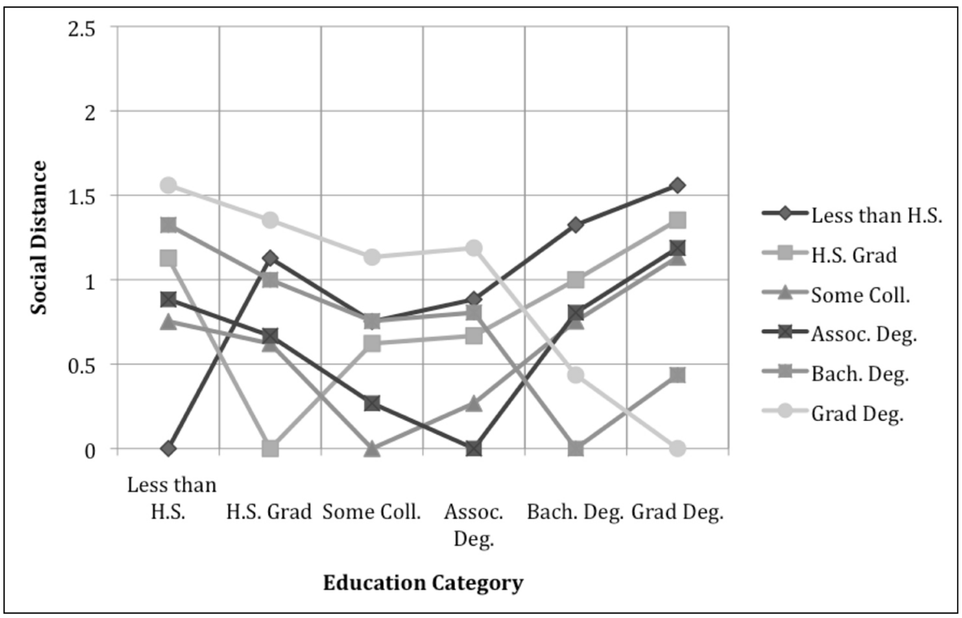


Figure 9. 2004 Male Social Distance—Education

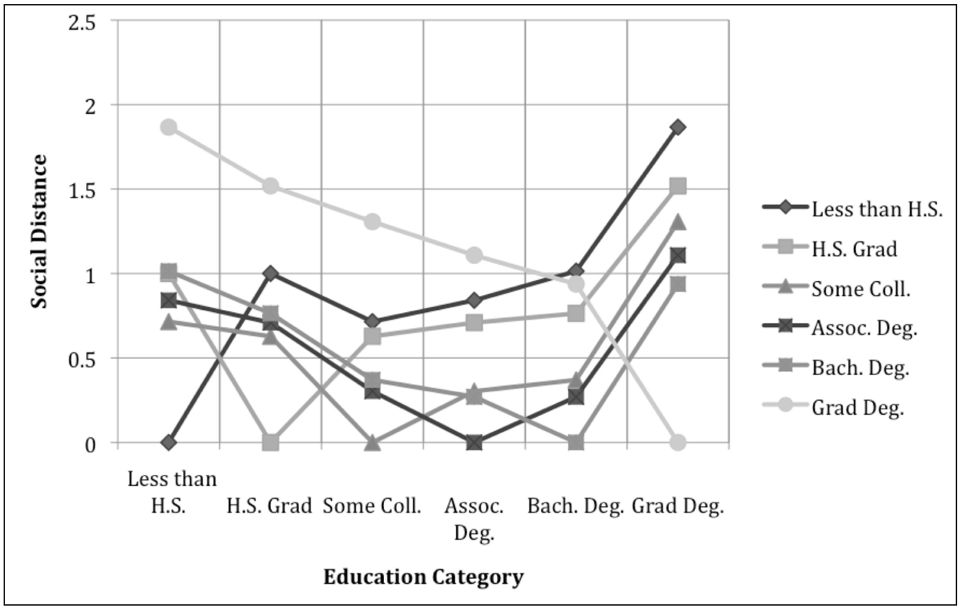


Figure 10. 2004 Female Social Distance—Education

## Discussion and Conclusion

This paper has examined the tendencies towards homophily and social distance for males and females in both 1985 and 2004, thus shedding light on the nature of the social worlds of both sexes and, by implication, on the social structure that creates these worlds.

The primary finding of this research is that homophily and social distance are comparatively stable phenomena, even in the midst of large macro-level structural changes. The pattern of homophily did not vary over time for either age or education, although it varied in strength for age. Similarly, the pattern of homophily did not vary between males and females, although it did vary in strength for education. In sum, then, despite the changing landscape of American education, heightened female participation in many occupations, decreasing network sizes, and the increased adoption of communications technologies, homophilous association appears to be remarkably stable and robust for both males and females. The fact that significant structural change has produced very little change in the tendency to associate with similar others is intriguing. Moreover, Smith et al. (2014) also found, without distinguishing by sex, that homophily was a remarkably stable phenomenon over time, confirming the general thrust of the current work. In combination, this suggests that structural changes may not translate as quickly, or directly, into association as has previously been thought.

A similar pattern of results was observed for social distance. For age, males and females differed from each other only in strength, rather than in their pattern, of association with dissimilar others. While my analyses were carried out only on non-kin ties it may be that this finding is partly driven by the traditional role of women as “kin keepers” (Moore 1990). Intergenerational ties with kin provide the opportunity for women to enter social foci that contain others of very different ages. For example, a greater tendency for females to maintain ties with adult children or aging parents may make it more likely that they will discuss important matters with the friends of those children or parents. A kin tie thus becomes a focus for association around which ties to non-kin can develop; therefore, even though I excluded kin alters from my analysis, the greater number of kin alters reported by females (McPherson et al. 2006, 2008) serves as an avenue through which non-kin alters of substantially different ages may be obtained. If the male and female disparity in number of kin alters continues to shrink we should expect male and female age social distance to become more similar. The clustering in age observed for those aged thirty-nine or less, and the relative lack of clustering for those who are forty and above, likely reflects life cycle differences. Those aged thirty-nine or less are disproportionately likely to still be single as well as occupationally and geographically unstable (Schlottman and Herzog 1984) or to have young children. The amount of social distance that separates age categories appears to be decreasing over time, however, suggesting that longer work lives and healthier living into late adulthood may be reducing lifestyle distinctions throughout the life course. In other words, the difference in the lifestyle of a forty year old and a sixty year old may be less in 2004 than it was in 1985, though by no means have these differences gone away. In total, the social distance results suggest that at least in this respect male and female association is growing more similar. In combination, the intensification of the homophily parameters in conjunction with a general decrease in social distance in the age dimension suggests that age remains an important source of social differentiation, but that in 2004 when same-age alters are unavailable, both men and women made fewer distinctions between those of dissimilar age. These results are broadly consistent with those of Smith et al. (2014). While their methods did not separate homophily and social distance, they found a general increase in the salience of age. This is precisely what we would expect if homophily has generally increased in strength, while social distance has generally decreased.

For education the story is somewhat more complex. While there has been no change in homophily over time, males and females do differ somewhat from each other. Women with graduate degrees appear to be less homophilous than similarly educated men, possibly due to demographic lag. While the increase in the percentage of females with a BA degree or better has been substantial, there are still more males in the population with these degrees. Additionally, the possibility that women may be more likely to leave the labor force due to childbearing and the segregation of women into particular occupations and sub-fields, may help to ensure that highly educated men remain the numerical majority locally, even if at a population level they become a minority. Thus, for now, highly educated women may often be forced to choose between associates who are homophilous on education and associates who are homophilous on sex to a degree not otherwise captured by the model parameters. Specifically, such an effect would not be controlled for by my models' marginal parameters, which only measure the availability of certain types of ties at the population level, and are unable to model these more micro-level effects. Regardless, however, it appears that the differences between males and females in terms of homophily have remained constant over time.

In terms of social distance, women with more than a high school degree but less than a graduate degree appear to be relatively indistinguishable from each other while among men the earning of a four-year degree entails detectable social distinction. In the past twenty years this pattern has persisted, with decreasing social distance being felt primarily in the middle of the education distribution for both males and females. The implication is that, socially speaking, fewer distinctions are being drawn between those that have less than a bachelor's degree for males, and those with less than a graduate degree for females. This shift in social distance is partly consistent with concerns about the devaluation of high school and even college degrees (Van der Ploeg 1994) as the social impacts of these degrees appear to be diminishing. Additionally, while the amount of social distance separating categories of education has been decreasing for both sexes, males and females nevertheless view different categories of other as being at shorter social distances. More concretely, while the social worlds of men and women are more similar in 2004 than they were in 1985, it cannot be said that males and females are living in the same world. Again, these results are consistent with Smith et al. (2014), who found very limited changes in education over time, though they did not distinguish between homophily effects and social distance effects.

While structure is unarguably important to understanding the lives of men and women, the structural changes that have occurred to date have exerted only a limited effect on the dimensions under study. Additionally, it appears that whatever changes have occurred over twenty years have had a greater impact on social distance than on homophily. Or, in other words, in 2004 all types of dissimilar others are regarded as more alike, even as the tendency towards association with similar others remains relatively unchanged or is intensified. This implies that one or more structural forces exist that both have not converged to the same extent as education and employment and which are even stronger determinants of the structure of male and female networks. Identifying such factors would add to our ability to model the composition of social networks as well as to understand the advantages and disadvantages faced by men and women in using their networks for material or social advantage.

It should be noted that all of these network data are based on discussion partners and do not necessarily represent the most important alters in other domains. At the same time, however, discussions can serve a wide variety of purposes, from developing mutual trust and appreciation, to acquiring important information, to attempts to subtly influence an alter. Likewise, it is known that this name generator captures strong tie regions of a respondent's network (Marin 2004; Ruan 1998). As such, these data should be viewed as a snapshot of an important network region. While I would not claim that my results apply to all types of relations, their applicability to these alters suggests that the core, important regions of male and female social networks are different and show few signs of becoming more similar.

This research is a step towards understanding homophily and social distance differences for males and females as well as how networks are changing over time. Much work remains to be done, however. While this research has identified differences between males and females in terms of both age and education, it is possible to also search for similar differences among the nominal parameters (Blau 1977) of race and religion. Additional work will need to be undertaken in order to ascertain precisely why networks change over time, how these causes impact males and females differently, and to link these changes to the powerful effects of social structure. Nevertheless, these results make it clear that sex-based non-kin network differences remain alive and well in the early twenty-first century.

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[1] The text of the name generator was: "From time to time, most people discuss *important matters* with other people. Looking back over the last six months—who are the *people* with whom you discussed matters important to you? Just tell me their first names or initials." If fewer than five names were given, respondents were probed with the question "Anyone else?"

[2] Results of such an analysis (not included) initially suggested that sexual heterophily (i.e., cross-sex ties) increased from 1985 to 2004. This apparent increase is explained by a relatively greater loss of non-kin ties than kin ties during the same period. Sexual homophily is still overwhelmingly common among non-kin. Similar results were obtained by Smith et al. (2014).

[3] For an analysis of changing homophily among both kin and non-kin without distinction by sex, see Smith et al. 2014.

[4] Particular thanks to Dr. Dan Ao for this approach.

[5] The correction factors penalize more complex models relative to simpler ones and therefore I take the conservative path by employing them.

[6] The practice of blocking the diagonal in mobility research predates the work by Marsden (e.g. Goodman's "quasi-perfect mobility" model). I cite Marsden's work as it is also a network study and I find it useful to employ his terminology.

[7] The preferred diagonal model is also compared to the preferred homogeneous RC model to determine whether or not social distance is relevant to observed association.

[8] Calculated as $d = \sqrt{((\sigma_{ki}-\sigma_{ki'})^2+(\nu_{kj}-\nu_{kj'})^2+(\sigma_{li}-\sigma_{lj'})^2+(\nu_{lj}-\nu_{lj'})^2)}$

[9] Percentage differences determined by subtracting the phi parameter for one category (e.g., female) from the phi parameter for the second category (e.g., male) and dividing the result by the first phi.