"Birds of a Feather": Homophilous Networks of Graduate Fellows across Academic Disciplines and Cultural Backgrounds

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Abstract

Sharing homophily in cultural background (nationalities) and academic disciplines may be said to grant a base for actors to closely interact, share information, advise, support, trust, and collaborate among themselves. However, this might not necessarily restrict forming ties along these lines with other actors from other nationalities and academic disciplines, as far as they work in the same academic environment. Using social network analysis, this paper examines homophilous networks (associating and bonding with similar others) and formation of ties across nationalities and academic disciplines among graduate fellows in Global Human Development PhD programme. The findings demonstrate existence of strong ties across nationalities and academic disciplines among actors in homophilous networks. This suggests persistence of other attributes necessary for the formation of ties and networks in addition to homophily in nationalities and academic disciplines. The paper urges for a need to undertake a broader study of this nature to encompass more attributes of the patterns of the relations between actors of the studied group or any other similar group.

Keywords: Homophily, social networks, ties, information, advice, support, trust

Introduction

People in a diverse academic environment who share cultural backgrounds and disciplines are increasingly seen as necessary for the robust social networks, significant for ties formation along lines of information, advice, support etc. Scholars such as Blau (1994) and Granovetter (1973) have argued that in many societies, people most easily associate with others like themselves, and that mutually beneficial cooperation occurs more readily among people of similar social identities, who are relatively equal and share common bonds including profession and ethnicity, among other things.

Interactions and relations act individually or in combination to create ties, characterised by content, direction and strength, and these ties are connection between social actors (Kehrwald, 2007:503). Also the ties are often characterized by emotional bonds of friendship, intimacy and reciprocity,

and they tend to endure over time (earning them the name 'strong ties' in social network theory) (Granovetter, 1973). People who are homogeneous in age, ethnicity, educational level, and status are much more likely to interact with each other than with people who are heterogeneous in these respects (Yuan and Gay, 2006). Empirical research has extensively shown these aspects, particularly in terms of gender (e.g. Ibarra, 1992; Leenders, 1996), cultural background (e.g. Mollica *et al.*, 2003) and education level (e.g. Marsden, 1987).

This paper examines homophilous networks (networks of actors who have a tendency to associate and bond with similar others) and formation of ties across academic disciplines and cultural backgrounds among graduate fellows in the Global Human Development (GHD) PhD Programme. This is a joint programme between the University College Dublin (UCD) and the University of Dar es Salaam (UDSM), aimed at pooling of the respective capacities of both universities to provide graduate research students and supervisors with what is necessary to conduct top class research in the field of development. The presence of social networks and ties among actors in this kind of partnership or collaboration is therefore guaranteed. The paper is restricted to PhD research fellows as it seeks to examine small-scale network along people who share fairly equal academic levels from different nationalities. To achieve objectivity, authors of this paper though were part of this group they were exempted from the study.

The contribution of this paper is to provide a detailed empirical analysis of social networks and ties formation across academic discipline and cultural backgrounds. This paper covers five sections, and is organised as follows; the subsequent section reviews related literature particularly on social networks and ties formation in small groups. In the same section, theoretical issues and hypotheses of the study are also stated. The third section explains the methodology and the type of data used while the fourth section presents the findings and discussion. The fifth section provides the conclusions.

In several circumstances homophilous ties are associated with some intensity, for example, if ties represent friendships; we expect some to be stronger than others and therefore affecting the flow of issues like information through a given tie. Much of the literature on network and ties formation to date has been restricted to the prevalence of situations where networks of relationships assume a role, which determines the outcome of the interaction. This draws interests in examining how network ties are formed and how structures of such ties matter.

Colleagues working in the same environment tend to have frequent opportunities of contact ranging from formal meetings to informal gatherings such as during parties, having a cup of coffee, lunch or dinner together. Altogether, this set of informal and formal contacts creates networks of relations and ties whose importance for group performance and intra-group dynamics has been increasingly recognized (Barrera and van de Bunt, 2009:709). Moreover, Burt (2005) states that informal conversations provide colleagues with opportunities to discuss personal issues as well as to gossip about other colleagues.

According to McPherson et al. (2001:415-416), people of different characteristics such as gender, race, ethnicity, age, class background, educational attainment, to mention but a few, appear to have

very different qualities, and that since people generally only have significant contact with others like themselves, any quality tends to become localized in socio-demographic space. The authors argue that by interacting only with others who are like ourselves, anything that we experience as a result of our position gets reinforced; it comes to typify "people like us." Situations that necessitate contacts between people who share certain qualities may grant a base of forming ties essential for flow of information, advice, support and trust, to name a few.

Network studies of academic communities have been focusing on scientific collaboration and works of scholars such as Newman (2001), Barabàsi et al. (2002), Moody (2004), Wagner and Leydesdorff (2005) and Leahey and Reikowsky (2008) have established an understanding of the structural determinants and patterns of collaboration. This suggests that such collaboration networks are random in nature, and they result from chance interactions among actors who share certain qualities in a specific context. It also advocates that scientific collaboration networks result from strategic behaviour of actors who are also responsible for maintaining internal structure and patterns of collaboration.

Network structures have also been argued to be responsible for the creation of social capital, along patterns of collaboration. Bourdieu and Wacquant (1992:119) define social capital as "the sum of the resources, actual or virtual, that accrue to an individual or group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition". Social capital is also defined by Coleman (1990:302) by its function. "It is not a single entity but a variety of different entities having two characteristics in common: They all consist of some aspect of a social structure, and they facilitate actions of individuals who are within the structure. Like other forms of capital, social capital is productive, making possible the achievement of certain ends that would not be attainable in its absence". In academic communities therefore we expect collaborative ties to be formed while guaranteeing individuals or group a competitive advantage in pursuing their ends, whereas better-connected people are receiving and enjoying high returns.

Monge and Contractor (2003) discuss how the theories of self-interest, mutual interest, social and resource exchange, contagion, balance, proximity, uncertainty reduction, co-evolution and homophily explain how ties can be created, maintained and dissolved in different contexts. While in social exchange theory for example, individuals are more likely to reciprocate friendship ties with those who have created ties with them at previous times, in balance theory individuals are more likely to create ties with friends of their friends. In theory of self-interest, individuals are less likely to create ties with those who have high attachment to the team since they feel well connected to the team and that those with high team attachment are less likely to create ties since they feel well connected.

In the contagion theory, individuals are more likely to have similar attachments to those members of the team with whom they have ties. In maintaining and dissolving the ties, Monge and Contractor (2003) use the social exchange theory to delineate that individuals are more likely to maintain reciprocated friendship ties with those who have previously created ties with them and that they are individuals are less likely to dissolve ties reciprocated friendship ties with those who have previously created ties with them. Though these theories have significant contribution in explaining ties formation, our interest is on individual similarities and dissimilarities based on certain traits and attributes.

As stated earlier, in this paper we focus on homophilous networks of small-scale group interactions on the basis of academic disciplines and nationalities (cultural backgrounds). In much more specific and in a streamlined stance, we recognise that as in scientific collaboration, networks are random by nature and circumstances of interactions inform ties formation. The discussion is restricted to ties necessary for close communication/interactions, flow and sharing of information, advice, support, trust and collaboration. As noted by McPherson et al. (2001:418), homophily in relationships that range from the closest ties and the strongest relationships of "discussing important matters" have been studied by Marsden (1987; 1988), while other researchers have studied various aspects of ties formation on "...friendship (Verbrugge 1977 & 1983) to the more circumscribed relationships of career support at work (Ibarra 1992 & 1995) to mere contact (Wellman 1996), "knowing about" someone (Hampton & Wellman, 2001) or appearing with them in a public place (Mayhew et al., 1995)...". In order to explore the intensities of homophilous ties, our study extends into how often actors interact among themselves.

Yuan and Gay (2006) note that previous research in this category has employed the theory of homophily to explore properties of social network relationships and ties formation, within and across distributed teams that belong to only one learning community. McPherson et al. (2001) and Monge and Contractor (2003) emphasise that homophily theory predicts that people are more likely to interact with individuals similar to themselves in respect to a variety of qualities and characteristics, as already highlighted. This proposes that, for people sharing similar traits the likelihood of interacting with dissimilar others is reduced, and it also shows, apart from unifying, homophily also divides a network. Differentiation or segregation between people is also related to network distance or network closeness, led by individuals' similarity or dissimilarity. There are tasks that involve new knowledge creation and therefore need diverse sources of information for successful intellectual exchange of new ideas. In such situations the capability of reaching out to dissimilar others is as important as reaching out to similar others, for people working in knowledge groups (Mollica et al., 2003).

We build on an approach by McPherson et al. (2001:422) especially on differentiating between *status homophily* and *value homophily* characteristics. In their approach, the authors stipulate that *status homophily* is based on the informal, formal, and ascribed status of an actor, and is derived from socio-demographic dimensions, such as gender, sex, age, race/ethnicity, or acquired characteristics such as religion, education, and behaviour patterns. *Value homophily* is based on values, beliefs, and attributes that include internal states shaping individual behaviour. We, however, focus only on cultural backgrounds (nationalities) and academic disciplines as socio-demographic dimensions resulting into *status homophily* although other aspects such as gender appear in the analysis. In terms of value homophily, we concentrate on attributes and try to link it with professional interests, especially on matters pertaining to preference to working together (collaboration) and trust.

In order to derive and operationalise the concept of homophily, we employ the concept of equivalence. According to Borgatti and Everett (1992), in the system, two individuals with identical relationships with other individuals in that system are said to be *structurally equivalent*. However, Mergel et al. (2007:3) state clearly that "...from a systems point of view, it is also possible for different actors to exhibit structural equivalence in completely isolated networks. For example, if two organizations or

individuals engage in exactly the same set of activities (out of a larger set of potential activities), they can be said to be *functionally equivalent* within the system because they are likely to fill equivalent roles..." Individuals with similar interests are said to be equivalent. Granted with information on how actors interact, it is easy to understand network analysis of structural equivalence. This argument has motivated this study to include the concept of equivalence in network analysis.

There is a general argument that in developing hypotheses about homophily and ties formation, one must take into consideration two kinds of causes for pair homophily. For example, Burt (1982:234) establishes that common norms may bring nodes with common attributes together, or the reverse. Additionally, common attributes and contact may lead to common norms, and this holds true for both individuals and collectivities. According to Feld and Carter (1998), the second cause of homophily is structural location. Two nodes may have the same attributes because both operate in the same arena, and the vice versa. Following our interest in six aspects; close interaction/communication, flow and sharing of information, advice, support, trust and preference to work together (collaboration), based on two socio-demographic dimensions (academic discipline and nationality or cultural background), we develop the following two hypotheses:

> **H1**: *People are more likely to closely interact, share information, advise, support, trust and collaborate when they share homophily in cultural backgrounds or nationalities.*

> **H2:** *People who share homophily in academic disciplines are more likely to closely interact, share information, advise, support, trust and collaborate.*

Methodology

This study uses a social network approach to examine social networks and ties formation across academic disciplines and cultural background. We conducted a social network analysis (SNA) of graduate fellows in the Global Human Development PhD Programme in 2010. The choice of this methodological approach followed its ability to provide a visualized graphic and analysis of both simple and complex human interaction. SNA is "the mapping and measuring of relationships and flows between people, groups, organizations, computers or other information/knowledge processing entities" (Krebs, 2002). The nodes in network are the people and groups while the links represent relationships or flows between the nodes. As noted by Wasserman and Faust (1994), rather than focusing on permanent attributes of people, objects or events, the social network perspective views characteristics of those people as arising out of relational process.

A brief social network questionnaire was designed to include, among others, socio-demographic questions and other questions seeking to draw out both network and actors' attribute information on how they closely interact or communicate in a group, how they share information, who they contact for advice, support, and questions related to trust and collaboration. All the questions allowed the actors to mention more than one fellow, and some questions required actors to mention how often, for example, they contact or interact with the named actor(s) so as to underscore the intensity of homophilous ties.

The Global Human Development PhD Programme is a small group of graduate fellows which in 2010 comprised 29 PhD research fellows of different nationalities in varied academic disciplines. They all undertook their studies at the University College Dublin in Ireland, where data for this paper were collected. We used the purposive sampling method since it aimed at collecting social network data in a small scale; therefore, it was easy to get a list of actors. Based on that list, we managed to physically meet and conduct semi-structured interviews with 14 PhD research fellows. The interviews ranged from 10 to 20 minutes. The rest of actors (except two who are the authors of this paper) were not reached for interviews as they were out of study area for research commitments and other reasons when this study was conducted. However, this study included them in the analysis because they were mentioned by their fellows during the interviews that they are sources or recipients of information, and advice, to mention but a few.

The UCINET 6.0 software was used for presentation and analysis of network data. In UCINET all data are described as matrices. The choice was based on the fact that this software has incorporated a diverse collection of network techniques. The techniques are diverse both in the sense of what they do (detect cohesive subgroups, measure centrality, and so on), and where they come from (having been developed by different individuals from different mathematical, methodological, and substantive points of view) (Borgatti et al., 2002: v). Different techniques such as cohesion, centrality, and structural equivalence were used to analyse social networks and ties formation among actors in this programme.

Description of the Participants

As already noted, the authors physically contacted 14 actors (summarised in the tables below) out of 29 PhD research fellows in the Global Human Development PhD Programme. These were from Ireland, Tanzania, China and Denmark. Other actors of different nationalities, who were not reached but were mentioned during the interviews, were from the USA and Poland. Thirteen actors shared homophily in academic disciplines such as Economics, Education, Engineering and Political Science. Only one actor was from Mathematics. Other academic disciplines that the rest of the mentioned actors pursue are Public Policy and Law.

To simplify the presentation of the findings, the actors were coded according to numbers followed by abbreviation of their nationalities and academic disciplines, whereas "I" represents Irish, "T" (Tanzanian), "C" (Chinese), "D" (Danish), "A" (American), "N" (Nigerian), "P" (Polish). The academic disciplines are abbreviated as follows "Pp" (Public policy), "Ec" (Economics), "En" (Engineering), "PSc" (Political Science), "Ed" (Education), "Lw" (Law), "Mt" (Mathematics) and "Geo" (Geography).

Table 1: *Nationalities of Interviewed Actors*

Nationality	Gender		Total
	Male	**Female**	
Irish	2	1	3
Tanzanian	7	1	8
Chinese	0	2	2
Danish	0	1	1

Table 2: *Academic Disciplines of Interviewed Actors*

Academic Discipline	Gender		Total
	Male	**Female**	
Economics	4	3	7
Education	1	1	2
Engineering	2	0	2
Political Science	1	1	2
Mathematics	1	0	1

Close Interaction/Communication among Actors

In terms of academic disciplines, there is the highest intensity of close interaction between actors who share Economics as their academic discipline. However, actor 18IPSc from Political Science interacts more with actors from Economics who are of Irish and Danish nationalities. Actor 14TPSc from Political Science seems to have many interaction ties from this actor to other actors from Education, Engineering, Mathematics and Economics who also share homophily in cultural background. Interestingly to note, actor 26CEc from Economics has outward ties with two actors from Public Policy.

When considering close interaction or communication across nationalities, the findings show that network of actors who share homophily in nationalities tend to closely interact. Actors from Tanzania, who formed a significant percentage of respondents in the sample, have a tendency to closely interact among themselves, although some of actors (for example actor 11TMt, 8TEc and 12TEc) normally interact closely with actors from other nationalities. The highest intensity of close interaction among Tanzanian actors is between actors 11TMt, 3TEd and 13TEd; 5TEn, 6TEn, 8TEc and 12TEc. Irish actors also tend to closely interact among themselves, although they also closely interact with a Danish actor. There is also a one-way interaction between two Chinese actors (26CEc and 7CEc). The network visualisation of these findings is summarised in Figure 1. Actors in the top left of the graph were not mentioned or contacted during interviews. These are considered to be 'isolates'.
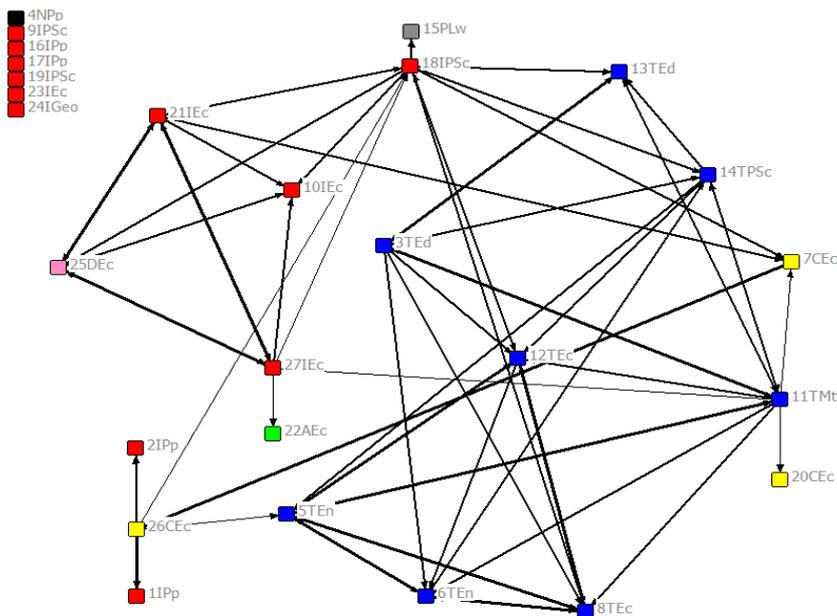
Figure 1: *Network of actors' close interaction across nationalities*

With regard to cohesion, an overall density of close interaction across academic disciplines and nationalities is 0.1969 and a standard deviation of 0.6463. This means that, significantly actors in the network have low density of interaction in-ties compared to out-ties. The hybrid reciprocity is 0.3542, meaning that, of all pairs of actors that have any connection, 35% of the pairs have a reciprocated connection. Though somewhat low, this does seem to suggest indications of sub-groups horizontal connection among actors in this programme.

Sharing and Flow of Information among Actors

There are strong ties of information flow and sharing among Tanzanian actors compared to other actors from different nationalities, whereas, actor 11TMt leads with many out-ties in the sub-group. This indicates that sharing homophily in cultural background facilitates ties formation in sharing and flow of information. Reciprocated ties among actors in this subgroup seem to exist between 13TEd, 3TEd, 11TMt, 5TEn and 6TEn. Among these actors, it also shows that some of them share academic disciplines, something that might indicate the type of information flow or sharing is that necessary for knowledge within their own disciplines, although this may also be any other type of information sharing. There are also some ties of information flow and sharing across nationalities, especially between Tanzanian actors 8TEc and 12TEc and Danish actor 25DEc (all sharing Economics as their academic discipline), and also between actor 12TEc and 18IPSc.

Two Chinese actors, 7CEc and 26CEc seem to have information sharing ties with some Tanzanian and Irish actors who are not sharing homophily in academic disciplines. The reason behind this might be other attributes such as having desks in the same/close location, meeting during PhD's roundtables, informal gatherings, to mention just a few. The network of information flow and sharing is also characterised by a number of isolates, as shown in Figure 2 below.
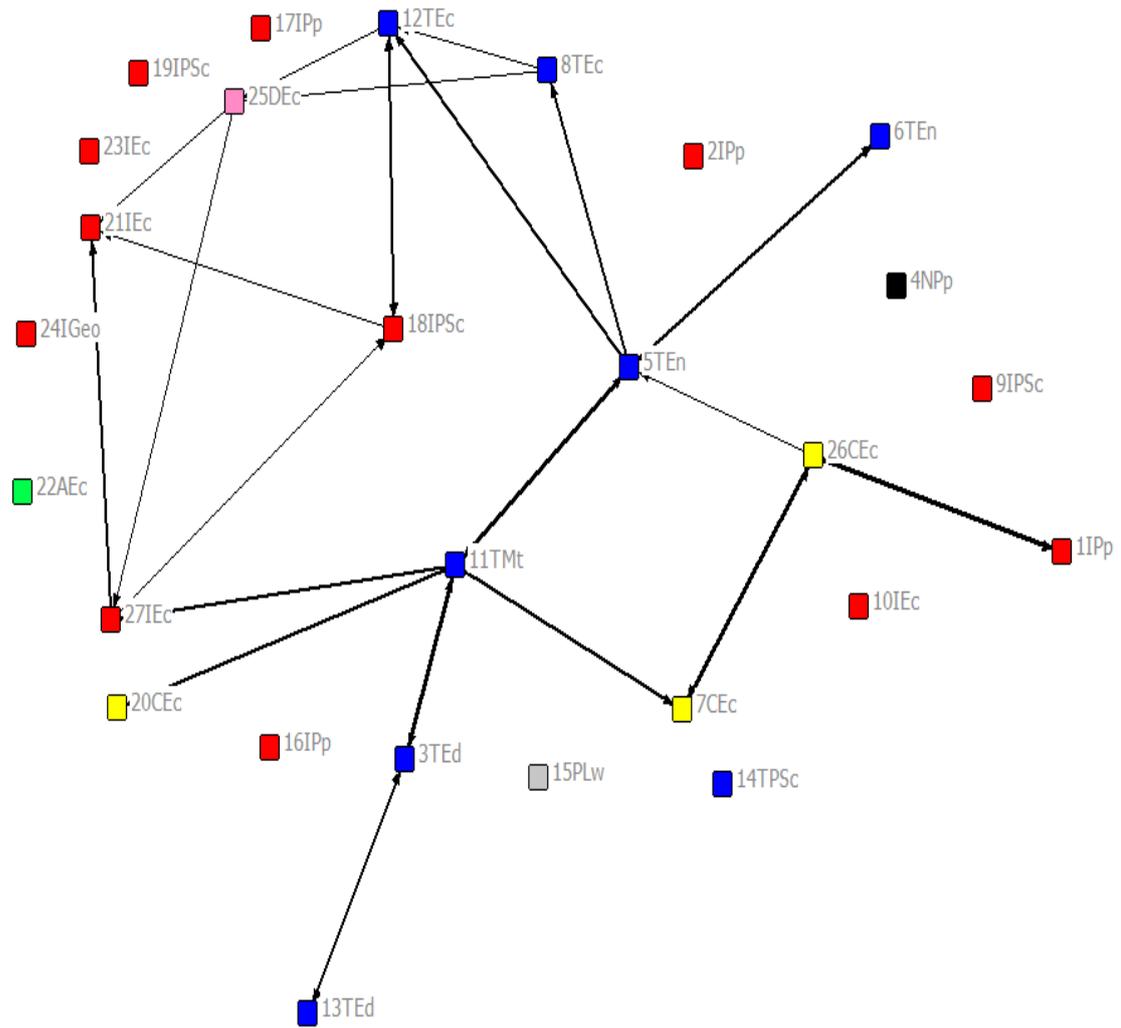
Figure 2: *Sharing and Flow of Information among Actors in a Network*

1	2	3	4
OutDegree	InDegree	NrmOutDeg	NrmInDeg
------------	------------	------------	------------
11 11TMt 12.000	4.000	14.815	4.938
5 5TEn 8.000	6.000	9.877	7.407
26 26CEc 7.000	3.000	8.642	3.704
3 3TEd 4.000	4.000	4.938	4.938
27 27IEc 3.000	3.000	3.704	3.704
12 12TEc 3.000	4.000	3.704	4.938
7 7CEc 3.000	5.000	3.704	6.173
8 8TEc 2.000	2.000	2.469	2.469
6 6TEn 2.000	2.000	2.469	2.469
25 25DEc 2.000	2.000	2.469	2.469
18 18IPSc 2.000	3.000	2.469	3.704
13 13TEd 1.000	2.000	1.235	2.469
4 4NPp 0.000	0.000	0.000	0.000
2 2IPp 0.000	0.000	0.000	0.000
9 9IPSc 0.000	0.000	0.000	0.000
10 10IEc 0.000	0.000	0.000	0.000
17 17IPp 0.000	0.000	0.000	0.000
15 15PLw 0.000	0.000	0.000	0.000
16 16IPp 0.000	0.000	0.000	0.000
1 1IPp 0.000	3.000	0.000	3.704
21 21IEc 0.000	4.000	0.000	4.938
22 22AEc 0.000	0.000	0.000	0.000
23 23IEc 0.000	0.000	0.000	0.000
24 24IGeo 0.000	0.000	0.000	0.000
19 19IPSc 0.000	0.000	0.000	0.000
20 20CEc 0.000	2.000	0.000	2.469
14 14TPSc 0.000	0.000	0.000	0.000

DESCRIPTIVE STATISTICS

1	2	3	4
OutDegree	InDegree	NrmOutDeg	NrmInDeg
------------	------------	------------	------------
1 Mean 1.815	1.815	2.241	2.241
2 Std Dev 2.906	1.847	3.588	2.280
3 Sum 49.000	49.000	60.494	60.494
4 Variance 8.447	3.410	12.875	5.198
5 SSQ 317.000	181.000	483.158	275.873
6 MCSSQ 228.074	92.074	347.621	140.335
7 Euc Norm 17.804	13.454	21.981	16.609
8 Minimum 0.000	0.000	0.000	0.000
9 Maximum 12.000	6.000	14.815	7.407
10 N of Obs 27.000	27.000	27.000	27.000

Network Centralization (Outdegree) = 13.560%
Network Centralization (Indegree) = 5.572%

Output 1: *Freeman degree centrality and graph centralization of GHD actors' information network*

In terms of centrality, actors 11TMt, 5TEn and 26CEc have the greatest out-degrees compared to other actors in the group, and might be considered influential in sending out information. Actors 5TEn and 7CEc have the greatest in-degrees. As noted by Hanneman (2002) in a discussion of degree centrality using Freeman's approach, other actors share information with these named actors would seem to indicate a desire on the part of others to exert influence.

Advice among Actors

The findings indicate that ties necessary for advice are formed across nationalities in sub-groups (with an exception of only one sub-group) that can be considered to be independent entities. Tanzanian actors (11TMt, 3TEd and 13TEd) share advice ties among themselves, and not by any other in the group. The rest of Tanzanian actors share advice ties among themselves and with Irish and Danish actors through actor 12TEc. There is high intensity of ties between actors 14TPSc, 8TEc and 12TEc who seem to seek advice from among themselves more often and in a reciprocate way (for actors 8TEc and 12TEc). This suggests proximity of actors on the basis of collegiality.

Irish actors (21IEc, 27IEc and 10IEc) have ties necessary for advice with a Danish actor (25DEc). Following the fact that they have homophily in academic discipline, it is therefore, expected for these actors to form advice ties necessary for knowledge. Additionally, their ties in this category cut across gender as the Irish actors are all males, and the Danish actor is a female. Gender difference, therefore, is not a barrier in forming ties that are necessary for advice. Actor 18IPSc seems to act as a bridge between this sub-group and that of Tanzanian actors by giving and receiving advice to the same. There is also a unilateral tie formed between two Chinese actors (7CEc and 26CEc, who also tend to seek advice from an Irish actor 1IPp), as shown in Figure 3.
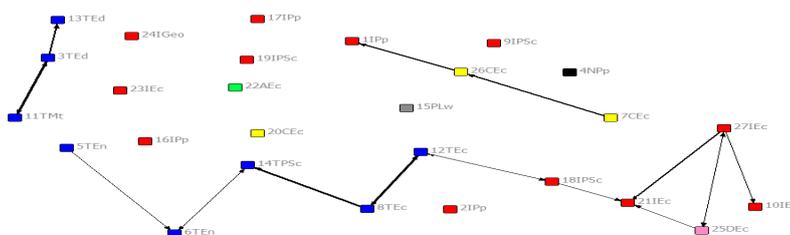

Figure 3: *Ties necessary for Advice among Actors*

With regard to closeness centrality measures for advice ties, actors 4NPp, 16IPp and 17IPp have the largest sum of geodesic distances from other actors (inFarness of 702) and to other actors with the same sum of geodesic distances. Actors 21IEc, 14TPSc, 6TEn, 12TEc and 10IEc have the greatest nearness compared to other actors in the network (the inCloseness of 4).

Support among Actors in the Programme

As in the ties necessary for advice, those related to support are formed across nationalities although there is a distinction between two subgroups (with actors 11TMt, 3TEd and 13TEd and that of

14TPSc and 6TEn) of Tanzanian actors who have support ties among themselves. There seem to exist strong reciprocate ties of support between actor 11TMt and 3Ted, and fairly strong reciprocate ties of support between actor 13TEd and 3TEd. This actor also seems to act as a bridge between actors 11TMt and 13TEd as she accepts and seeks support from both actors. Irish, Danish and Tanzanian actors (21IEc, 10IEc, 27IEc, 25DEc, 8TEc and 12TEc) also form another sub-group with ties necessary for support. The Chinese actor 7CEc seems to seek support from another Chinese actor 26CEc, who also seeks support from an Irish actor 1IPp, hence forming another sub-group. Two actors, one from Ireland and one from Tanzania, did not choose any one from the group by noting that mostly they seek support from the families, and that the question was very broad as it was not specific on what type of support.

We were also interested in attempting a cluster analysis in order to understand the structural equivalence in ties necessary for support. Our intention was to explore whether or not in this group there are actors who have similar patterns of support ties to other actors hence joined into a cluster. The findings show that actors 3TEd, 11TMt and 13TEd are most similar, therefore, forming a first cluster in support ties; a second cluster is formed by actors 7CEc, 1IPp and 26CEc; a third by actors 21IEc, 25DEc and 27IEc. The rest of actors in this network are distributed around more or less pairs that are not necessarily clusters. These findings are summarised in the Matrix and Dendogram figures below.

```
HIERARCHICAL CLUSTERING OF EQUIVALENCE
MATRIX

       1 1 1         2 1 1 2 1 1 2 1 2   2  1 1 2 2 2
 Level   3 1 3 4 6 2 4 5 9 3 7 8 0 5 6 4 9 2 7 1 6 8 2 0 1 5
7
------  - - - - - - - - - - - - - - - - - - - - - - - - - -
 0.000  . . . XXX
XXXXXXXXXXXXXXXXXXXXXXXXX . . . . . . . .
 1.000  . . . XXX
XXXXXXXXXXXXXXXXXXXXXXXXX . XXX . . .
. . .
 2.000  . XXX XXX
XXXXXXXXXXXXXXXXXXXXXXXXX . XXX
XXX . . . .
 2.236  . XXX XXX
XXXXXXXXXXXXXXXXXXXXXXXXX . XXX
XXX . XXX .
 2.434  . XXX XXX
XXXXXXXXXXXXXXXXXXXXXXXXX . XXX
XXX . XXXXX
 2.693  XXXXX XXX
XXXXXXXXXXXXXXXXXXXXXXXXX . XXX
XXX . XXXXX
13.795  XXXXX XXX
XXXXXXXXXXXXXXXXXXXXXXXXX XXXXX
XXX . XXXXX
26.000  XXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXX XXX . XXXXX
35.700  XXXXX XXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXX XXX . XXXXX
36.337  XXXXX XXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXX XXX XXXXXXX
46.027  XXXXX XXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXX XXXXXXXXXXX
55.088  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXX XXXXXXXXXXX
69.084  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXX
```

Output 2: *Hierarchical clustering of equivalence matrix*
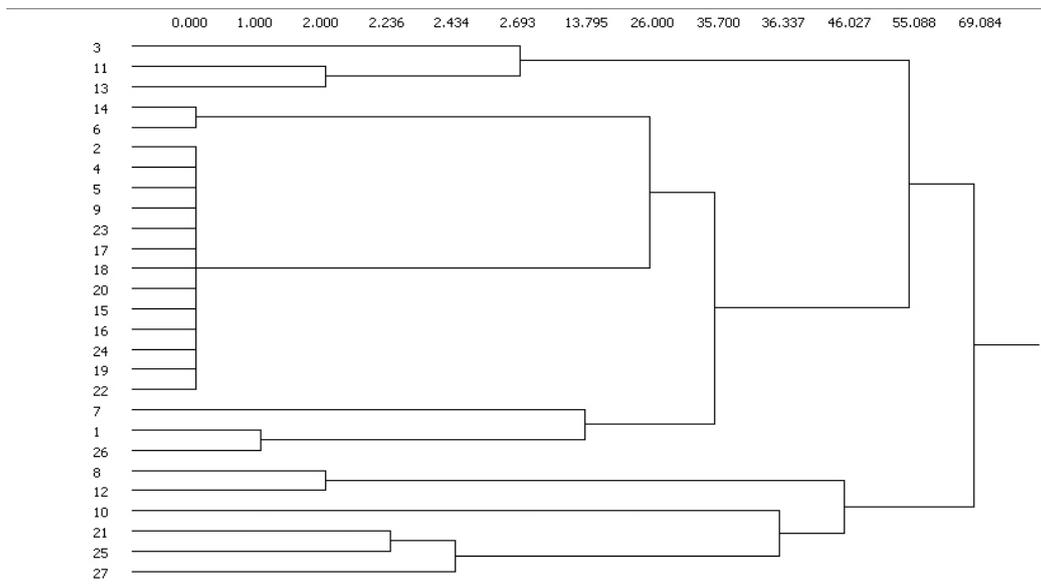
Output 3: *Dendogram of structural equivalence data*

Trust among Actors

Trust was considered an essential category for ties formation among actors in the programme. Our findings are in line with argument by with Tanis and Postmes (2005). These authors indicate that trust includes both "trustworthiness" and "trusting behaviour" and trustworthiness is a precondition of trusting behaviour in most cases and is a subjective construct, which varies from one participant to another. Our findings therefore show that ties necessary for trust normally cut across nationalities and academic disciplines, thus therefore conforming to the two homophily hypotheses stated earlier in this paper. Although there are also ties among actors within nationalities, some actors (for example 18IPSc and 25Dec) seem to act as bridges by connecting trusting ties among actors from other nationalities. There is also presence of trusting ties between Chinese actors whereas one actor (26CEc) has also a tie with an Irish actor (1IPp). The figure below shows trusting ties among actors in the programme.
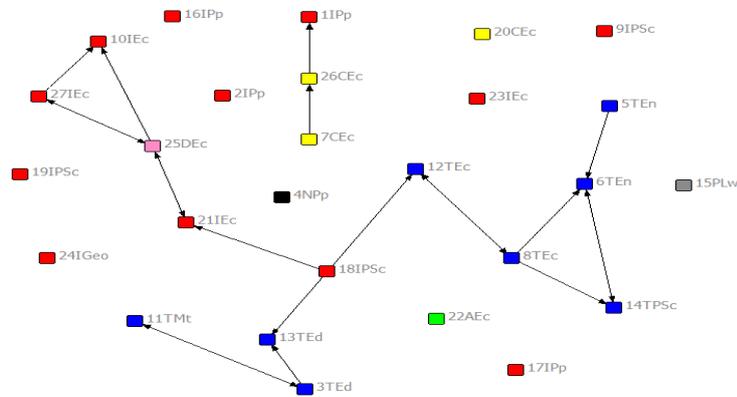

Figure 4: *Ties necessary for trust*

There is no any maximal complete sub-graph present in these data, and this means that this network does not have any clique. Since there is presence of isolates in this network, the analysis indicates that there are a total of 13 components, as shown in Output 4 below.

```
Kind of Components: WEAK
13 components found.
Component Sizes

   Component      Nodes  Proportion
---------- ----------- -----------
           1         3     0.111
           2         1     0.037
           3        13     0.481
           4         1     0.037
           5         1     0.037
           6         1     0.037
           7         1     0.037
           8         1     0.037
           9         1     0.037
          10         1     0.037
          11         1     0.037
          12         1     0.037
          13         1     0.037

  NODE     COMPONENT
  1IPp        1
  2IPp        2
  3TEd        3
  4NPp        4
  5TEn        3
  6TEn        3
  7CEc        1
  8TEc        3
  9IPSc       5
 10IEc        3
 11TMt        3
 12TEc        3
 13TEd        3
 14TPSc       3
 15PLw        6
 16IPp        7
 17IPp        8
 18IPSc       3
 19IPSc       9
 20CEc       10
 21IEc        3
 22AEc       11
 23IEc       12
 24IGeo      13
 25DEc        3
 26CEc        1
 27IEc        3
Components with 3 or more members:
  1:  1IPp 7CEc 26CEc
  2:  3TEd 5TEn 6TEn 8TEc 10IEc 11TMt 12TEc 13TEd 14TPSc 18IPSc 21IEc 25DEc 27IEc

Component size heterogeneity: 0.741
Normalized heterogeneity: 0.769
Entropy: 1.939
Normalized entropy: 0.588
Fragmentation: 0.769 (prop. of nodes that cannot reach each other)
```

Output 4: *Actors' components*

Collaborative Ties among Actors

Collaborative ties in the network of actors suggest preference for these actors to work together across nationalities and academic disciplines. Although there is a tendency for actors to prefer to work together along their academic disciplines or nationalities, yet some actors from different nationalities seem to have established collaborative ties with others in the network who do not necessarily share cultural background/nationalities with them. An Irish actor 18IPSc, has collaborative ties with the Tanzanian actor 8TEc and the Polish actor 15PLw (notwithstanding they do not share same academic disciplines). This actor also has collaborative ties with another Irish actor 21IEc, although they don't share the same academic discipline.

To this end, findings suggest that actors prefer to establish collaborative ties to encourage working in a multidisciplinary way in order to allow the exchange of necessary knowledge to be used in their disciplines for effective functioning and successful completion of their goals. In other words, actors prefer to work with others from different academic disciplines so as to gain practical aspects of various applications (for instance statistics) that they might not be well familiar with, hence helping them in research tasks. Figure 5 summarises these findings.
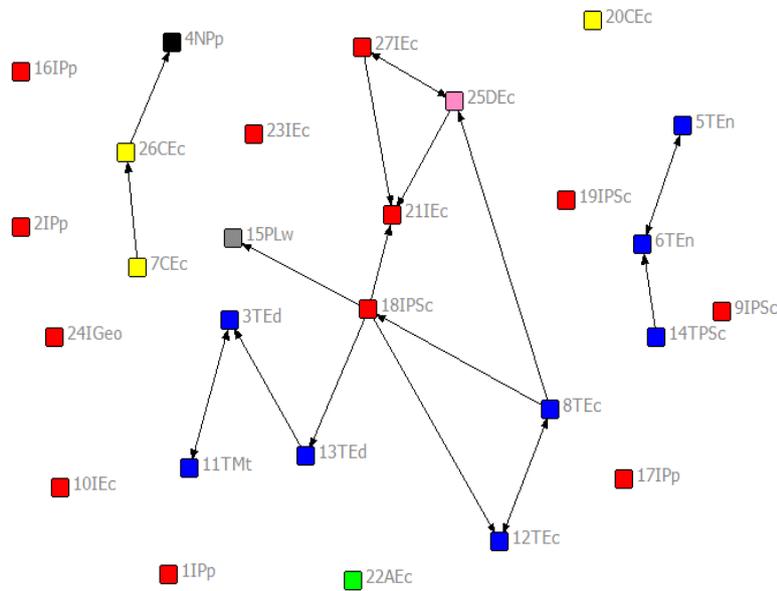

Figure 5: *Collaborative ties among actors*

Actors with similarities in character-mapped graphic of clustering of collaboration are 8TEc, 12TEc and 18IPSc who form a first cluster; 5TEn, 6TEn and 14TPSc who form a second cluster; 7CEc, 4NPp and 26CEc who form a third cluster); 3TEd, 11TMt and 13TEd (a fourth cluster) and 21IEc, 25DEc and 27IEc. These actors can be regarded as structural equivalences in the network as they appear to have identical collaborative ties to all other cases.

An Irish actor 18IPSc has the greatest out-degrees followed by Tanzanian actor 8TEc and they might be regarded as the most influential (though as Hanneman (2002) states, it might matter whom they collaborate with, this measure does not take that into account). When examining in-degrees, the Irish actor 21IEc has the greatest showing that other actors prefer much to collaborate with him hence denoting potential skills in collaboration. On the average, actors have a degree of 0.741, which is quite small. In the network, the percentage of network centralization out-degree is higher (13.018) compared to that of in-degree (9.024) and that there is more variability across actors in out-degree than in-degree (variances and standard deviations). As noted by Hanneman (ibid.) "the range and variability of degree (and other network properties) can be quite important, because it describes whether the population (group) is homogeneous or heterogeneous in structural positions. One could examine whether the variability is high or low, relative to the typical scores by calculating the coefficient of variation (standard deviation divided by mean, times 100) for in-degree and out-degree". The output below summarises these findings.

	1 OutDegree	2 InDegree	3 NrmOutDeg	4 NrmInDeg
18 18IPSc	4.000	1.000	15.385	3.846
8 8TEc	3.000	1.000	11.538	3.846
27 27IEc	2.000	1.000	7.692	3.846
25 25DEc	2.000	2.000	7.692	7.692
7 7CEc	1.000	0.000	3.846	0.000
3 3TEd	1.000	2.000	3.846	7.692
13 13TEd	1.000	1.000	3.846	3.846
14 14TPSc	1.000	0.000	3.846	0.000
6 6TEn	1.000	2.000	3.846	7.692
12 12TEc	1.000	2.000	3.846	7.692
11 11TMt	1.000	1.000	3.846	3.846
5 5TEn	1.000	1.000	3.846	3.846
26 26CEc	1.000	1.000	3.846	3.846
4 4NPp	0.000	1.000	0.000	3.846
9 9IPSc	0.000	0.000	0.000	0.000
10 10IEc	0.000	0.000	0.000	0.000
17 17IPp	0.000	0.000	0.000	0.000
15 15PLw	0.000	1.000	0.000	3.846
16 16IPp	0.000	0.000	0.000	0.000
2 2IPp	0.000	0.000	0.000	0.000
21 21IEc	0.000	3.000	0.000	11.538
22 22AEc	0.000	0.000	0.000	0.000
23 23IEc	0.000	0.000	0.000	0.000
24 24IGeo	0.000	0.000	0.000	0.000
19 19IPSc	0.000	0.000	0.000	0.000
20 20CEc	0.000	0.000	0.000	0.000
1 1IPp	0.000	0.000	0.000	0.000

DESCRIPTIVE STATISTICS

	1 OutDegree	2 InDegree	3 NrmOutDeg	4 NrmInDeg
1 Mean	0.741	0.741	2.849	2.849
2 Std Dev	1.003	0.843	3.859	3.242
3 Sum	20.000	20.000	76.923	76.923
4 Variance	1.007	0.711	14.894	10.511
5 SSQ	42.000	34.000	621.302	502.959
6 MCSSQ	27.185	19.185	402.148	283.805
7 Euc Norm	6.481	5.831	24.926	22.427
8 Minimum	0.000	0.000	0.000	0.000
9 Maximum	4.000	3.000	15.385	11.538
10 N of Obs	27.000	27.000	27.000	27.000

Network Centralization (Outdegree) = 13.018%
Network Centralization (Indegree) = 9.024%

Output 5: *Freeman's degree centrality measures*

Conclusion

This paper aimed at examining the homophilous networks and formation of ties across academic disciplines and cultural backgrounds among graduate fellows in the Global Human Development PhD Programme. Motivated by homophilous relationships among actors in this small-scale group, the paper is based on the findings accrued from a small social network data collection among research fellows in the group. The literature related to social networks and the formation of ties was reviewed and a theoretical foundation of homophilous relationships was drawn there from. The study used social network analysis, and in the process, it included various SNA to analyse the data and operationalise the research hypotheses.

The paper concludes that although sharing homophily in cultural background (nationalities) and academic disciplines may grant a base for actors to closely interact*,* share information, advice, support, trust and collaborate among themselves, it might not necessarily restrict forming ties along these lines with other actors from other nationalities and academic disciplines, as far as they work in the same academic environment. The findings have shown the existence of strong ties across nationalities and academic disciplines among actors in the Global Human Development PhD programme. This suggests persistence of other attributes necessary for ties formation and social networks in addition to homophily in nationalities and academic disciplines. Working in the same or in close buildings, living in the same or close accommodations, formal meetings during PhD roundtables or conferences, informal gathering and others are attributes that create necessary conditions for ties formation among these actors.

In order for the actors to effectively function and successfully accomplish various goals, it has been seen that ties and social networks are therefore necessary. Maintaining them may also guarantee social capital among actors. The study of ties formation and social networks is therefore central to understanding the patterns of the relations between social actors together with their performance and behaviours. This also urges for a need to undertake a broader study of this nature, which will encompass more attributes of the patterns of the relations between actors of the studied group or any other similar group.

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