Correlations

		GRDENFRI	EFFORT	INTELCON	COPERATI	GFRIEOTH
COPERATI	Pearson Correlation	.367*	.877**	.860**	1.000	.323*
	Sig. (2-tailed)	.011	.000	.000	.	.027
	N	47	47	47	47	47
GFRIEOTH	Pearson Correlation	.353*	.356*	.359*	.323*	1.000
	Sig. (2-tailed)	.015	.014	.013	.027	.
	N	47	47	47	47	47
GCOMMOTH	Pearson Correlation	.577**	.283	.298*	.255	.279
	Sig. (2-tailed)	.000	.054	.042	.084	.058
	N	47	47	47	47	47
SEX	Pearson Correlation	.185	.086	.022	.080	.114
	Sig. (2-tailed)	.212	.566	.886	.593	.447
	N	47	47	47	47	47

The Effects of the Social Network upon Academic Performance in Three Cohorts of an Undergraduate Degree.

Elaine Scott-Wedlock

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City University
Sir John Cass Business School
Faculty of Management

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Abstract

The Effects of the Social Network upon Performance in Three Cohorts of an Undergraduate Degree.

Social networks have been seen to have an effect upon the performance of both individuals and teams within organisations. This thesis aims to explore the effects of such social networks on the performance of individuals and groups in three cohorts of undergraduate students in management education.

Information on the social networks of the three cohorts was gathered with the use of a roster choice questionnaire. The questionnaire listed each member of the cohort and required the individual to identify with whom he / she is friends and with whom he / she communicates regarding academic related issues. This data was used to investigate the social networks of the three cohorts, the placing of individuals within these networks, and interactions within and amongst self-assigned project groups. Further information was gathered regarding the project groups in the form of a peer group assessment. The students were asked to rate the members of their group on a Likert scale in terms of effort within the group, intellectual contribution, and overall co-operation with the other members of their work group.

Within an educational context a student's performance is measured by their grades. The relationship between individual and group grades and the network and peer group assessment data was investigated.

Results indicate that there is significant correlation between students' grades and the degree to which they are sought out for communication in all three cohorts. In the second and third year cohorts there was also significant correlation between grades and the 'in degree' of friendship. In the third year cohort there was evidence of significant correlation between students' grades and their 'out degree' of communication.

These results have implications for both educators and students. Educators should make students aware of the effects of social networks and encourage students to participate in their social networks by promoting group work, applying team building exercises and supplying the facilities in which students can socialise. Students should attempt to socialise within their cohort, become involved in both the friendship and communication networks that are available.

Key Words
Social network analysis, education, performance, social capital, intellectual capital, peers, friendship network, communication networks, social support.

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Declaration

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Chapter One: The Study

1.1 Introduction

This chapter will begin by explaining the rationale behind this study. The aims of the research are then presented. The hypotheses will be outlined, providing the rationale behind each of the separate hypotheses. The chapter will then give an outline of how each of the ten chapters contributes to the thesis. A brief description of the appendices is then provided.

1.2 Rationale

Granovetter (1985) suggested that people are essentially social animals and that all of our actions are embedded within a context of the social system in which we operate. Man is not an island and cannot operate alone. People must interact with others even when attempting to achieve something that may appear to be solely individual, for example, the achievement of high academic performance by an individual on an undergraduate degree. This investigation came about through an interest in the old adage "it's not what you know, but who you know." I am interested in investigating this phenomenon fully. Can who you know really affect what you know? Can who you know and what you know be proven statistically to be significantly related?

A thorough review of the literature suggested that social networks affect many aspects of peoples' lives. Gaining employment is helped along by having such contacts as indicated in Granovetter's 1973 theory of weak ties. This 'weak tie' theory suggests that we are likely to gain useful information from friends of friends or those whom we are not directly related to. These weaker ties are often useful sources of information as they have access to different contacts and knowledge than those that we have more direct relationships with. It is also likely that people that we are more directly related to may have access to information that we already are aware of.

Once in employment such social networks can be linked with how well one performs, the ability to get things done and subsequent promotion with the organisation (Powell and Smith-Doer, 1994).

Working relationships also take place within the social context. Indeed, Ibarra and Andrews (1993) found that the attitudes of individuals towards their work are highly influenced by the attitudes of those around them.

Another aspect that has a great influence in the work place is stress. Research has shown that stress can have an impact upon individuals in terms of psychological well-being; health; morbidity; mental adjustment, work performance and academic performance.

Students can often find their degree studies particularly stressful. They may have moved away from home for the first time. They may find it difficult to adjust to their new environment, and to new ways of working. They may also find the actual work demands ominous and stressful. Students may find themselves in financial difficulties or have to hold down a part time job whilst studying. All of these factors mean that students may suffer from stress. Research has shown that social support can have a buffering effect upon stress (Mallinckrodt & Leong, 1992). Students with high centrality in a social support network are likely to have access to a high level of social support in times of stress. In turn research has indicated that reducing stress improves performance (Bowers, Weaver and Morgan, 1996).

Further research suggests that social support has a direct and constant effect upon a person's well-being. The very knowledge that one has someone to turn to if stress does arise provides a constant and direct effect. Indeed Mallinckrodt and Leong (1992) found that a lack of perceived social support can be an independent stressor in itself.

The social network provides social capital, which can be utilised as capital in much the same way as any other. Social support is a major form of social capital and the literature indicates that such support can go a long way to ease stress both within the workplace and equally within education (Mallinckrodt & Leong, 1992).

Although this social support can come from various sources such as family, community groups and clergy, Robbins & Tanck (1994) found that most students preferred to turn to a friend for social support. A friend who is also a student at University is likely to have an understanding of the problems that students face. They are likely to be facing similar problems themselves, and have a lot in common. A fellow student will be in a position to empathise and sympathise in a way that a family member or friend from outside of the university could not.

Further investigation into the field of social networks reveals that they not only provide an avenue of access and opportunity, and social support, but can also be used to disseminate knowledge and information (Grandori and Soda, 1995; Alter and Hage, 1993).

The field of higher education within a business school was chosen as a suitable population to investigate such phenomena. Not only may the students benefit from the social support at a highly stressful time, but also the dissemination of knowledge and information could be vital to the performance upon which the standard of degree is achieved. Much of the work on social networks has been carried out in an organisational context. The precursor to membership of such organisations i.e. business education, is thought to be a suitable place to start the investigation into whether the centrality of individuals in friendship and communication networks is related to their performance.

Baldwin, Bedell and Johnson (1997) investigated the effects of centrality in such networks of M.B.A (Masters of Business Administration) students in America. I feel that by looking at this form of interaction in undergraduate students, the focus of the study is on a more 'natural' group. M.B.A students must come to the program with previous business experience. Indeed all highly rated M.B.A programs require a minimum of three years business experience. They will be socialised into the act of networking, developing contacts whom they can later call upon for their own benefit. Undergraduate students are less likely to be pre-socialised in this way and so the aim is to investigate a less pre-meditated group. The study being carried out in a British university will also give a different cultural focus to the study.

Upon reflection of the available literature the first hypothesis to be explored in this study is that centrality in an undergraduate friendship network is positively associated with individual academic performance. This relationship is thought to be due to both the constant and the buffering effects of social support upon stress, and the subsequent links between reduced stress and increased performance. Hence the first hypothesis is as follows:

Hypothesis 1 – *Centrality in an undergraduate friendship network is positively associated with individual academic performance.*

The embeddedness of individuals within the social context in which they are operating is apparent not only in terms of obviously social relationships such as friendship and social support, but also in terms of communication. Social networks can be instrumental in providing access and opportunity, such as gaining employment. They can also be fundamental in getting things done once a person is in employment. Organisational research has shown the strength of weak ties in gaining employment (Granovetter (1973). The theory of structural holes has highlighted the power of brokerage that individuals may have if they occupy a bridging position within a network (Burt 1992). The reason weak ties can be exploited and structural holes can used as a form of brokerage, is due to the importance of the dissemination of knowledge and information.

The transfer of knowledge and information in an organisation is said to be highly reliant upon social interaction. Social networks then can provide access and opportunity and also facilitate the dissemination of knowledge and information. In turn research has shown that the ability to obtain access to knowledge and information through such networks is associated with increased performance at the individual and the group level (O'Reilly, 1977; O'Reilly and Roberts, 1977a, 1977b).

Within education, communication is partly about the dissemination of knowledge and information, it is also about learning, developing ideas and understanding. Networks of communication are advantageous to the reflective practise of learning. Carley and Hill (1999) said "the relationship to other people provides access and exposure to knowledge, which in turn impacts the individual who then updates his or her knowledge absorbed from the interaction with another person." Communicative relationships such as those investigated in this study provide access to knowledge and information. They also provide a facility to reflect upon one's own ideas, to develop and defend an argument before, for example, the idea is written down in an assignment or examination paper.

The sum total of the relationships that an individual has access to at any given time is referred to as social capital. Social capital is seen as resource in much the same way as money, tools and buildings. Research has shown that in particular social capital as a resource can provide important educational advantage for children and young adults (Coleman, 1990).

Baldwin, Bedell and Johnson (1997) found that centrality in communication networks was positively related to Master of Business Administration (M.B.A.) students' grades in America. This study is aimed at undergraduate business education in the U.K. M.B.A students are more likely to be pre-socialised into networking. They will have experienced the work place and understood the potential importance of developing and maintaining useful contacts. The undergraduates however have less experience, they are likely to be less calculated in developing their communication networks. By testing the hypothesis on undergraduate students I feel that a more 'raw, natural' group one that is less socialised into purposefully networking will also demonstrate that a persons centrality in a communication network is positively associated with academic performance.

The literature supports the view that social networks are key in terms of access and opportunity, the dissemination of knowledge and information. In turn this increased knowledge and information provides an increase in performance, as does the opportunity for reflective learning. The second hypothesis for this study then is that centrality in an undergraduate communication network is positively associated with individual academic performance:

> Hypothesis 2 – *Centrality in an undergraduate communication network is positively associated with academic performance.*

1.3 Aims

The aim of this study then is to investigate how centrality in friendship and communication networks is related to student's individual academic performance. The hypotheses will be tested and the correlation between centrality in friendship and communication networks and individual academic performance will be examined. This aim acts to address a particular gap in the literature.

There are relatively few studies that directly link network centrality with academic performance. The Baldwin, Bedell and Johnson study in 1997 was carried out with American with Masters of Business Administration (M.B.A.) students. No study has linked undergraduate students' network centrality with academic performance. Undergraduate students are a particularly interesting group because they have been less socialised than the M.B.A. students into actively networking. M.B.A. students have considerable business experience and so will be used to the process of gaining and utilising personal contacts. Undergraduate students are likely to be less socialised into actively networking and so a more 'natural' behaviour can be observed.

The aim is to investigate the social networks of this particular group of young people. Such an investigation has implications for both students and educators. The findings and conclusions of this study can help to inform the daily choices made by these two target groups. If students' position in friendship and communication networks are indeed significantly related to their academic performance, students and educators can utilise this phenomenon. In this way students and educators alike can utilise this phenomenon and gain further from the environment in which they are socially embedded.

In order to investigate further, the following hypotheses were developed.

1.4 Hypotheses

Each of the two main hypotheses was broken down into individual hypotheses. These individual hypotheses relate to different measures of centrality. The relationship between different measures of centrality and an individuals' academic performance were investigated because some of the measures relate to the actual number of relationships that an individual has while other measures indicate the individuals' position within the network as a whole. The definitions of these different measures are given below:

Measure	Definition
Degree	A direct count of the number of ties with other individuals
In- Degree	Number of ties directed at an individual.
Out- Degree	Number of ties directed out from an individual.
Closeness	The distance from one node (individual) to the others in the network. A maximally close node is one that is directly linked to all others.
In- Closeness	How close the other nodes are to the individual in terms of incoming relationships in a network with directed data.
Out -Closeness	How close the individual is to other nodes in the network in terms of out going relationships in a network with directed data.
Betweenness	The extent to which a point lies in between others, becoming a bridging relationship.

Table 1.1 – Definitions at a Glance – Centrality Measures

The in-degree is a simple count of how many ties are directed towards the individuals. The out-degree is a count of how many ties are directed from the individual. In figure 3.1 nodes A, B and C have the highest degree centrality scores, each with a score of five.

While degree centrality is a local measure of centrality, closeness is a global measure of centrality. Freeman (1979, 1980) proposed closeness as a measure of global centrality. Here centrality is expressed in terms of the distance from the other points in the graph. The path length between two points in a graph is the number of ties it takes to get from one node to another. A point is close globally in the graph if it lies at short distances from many other points in the graph. In figure 1.1, B would have the closest measure to all of the other points globally.

Freeman (1979) also proposed the betweenness measure of centrality. Betweenness investigates the extent to which a particular node lies between others in the graph. A node my have a low degree of points but could have a high betweenness score which would mean that they would still be very central. High betweenness centrality can indicate that the individual is in a position of brokerage as other individuals have to go through them in order to reach each other. They can act as an intermediary. In figure 1.1 for example points G and M lie between a great many pairs of points.

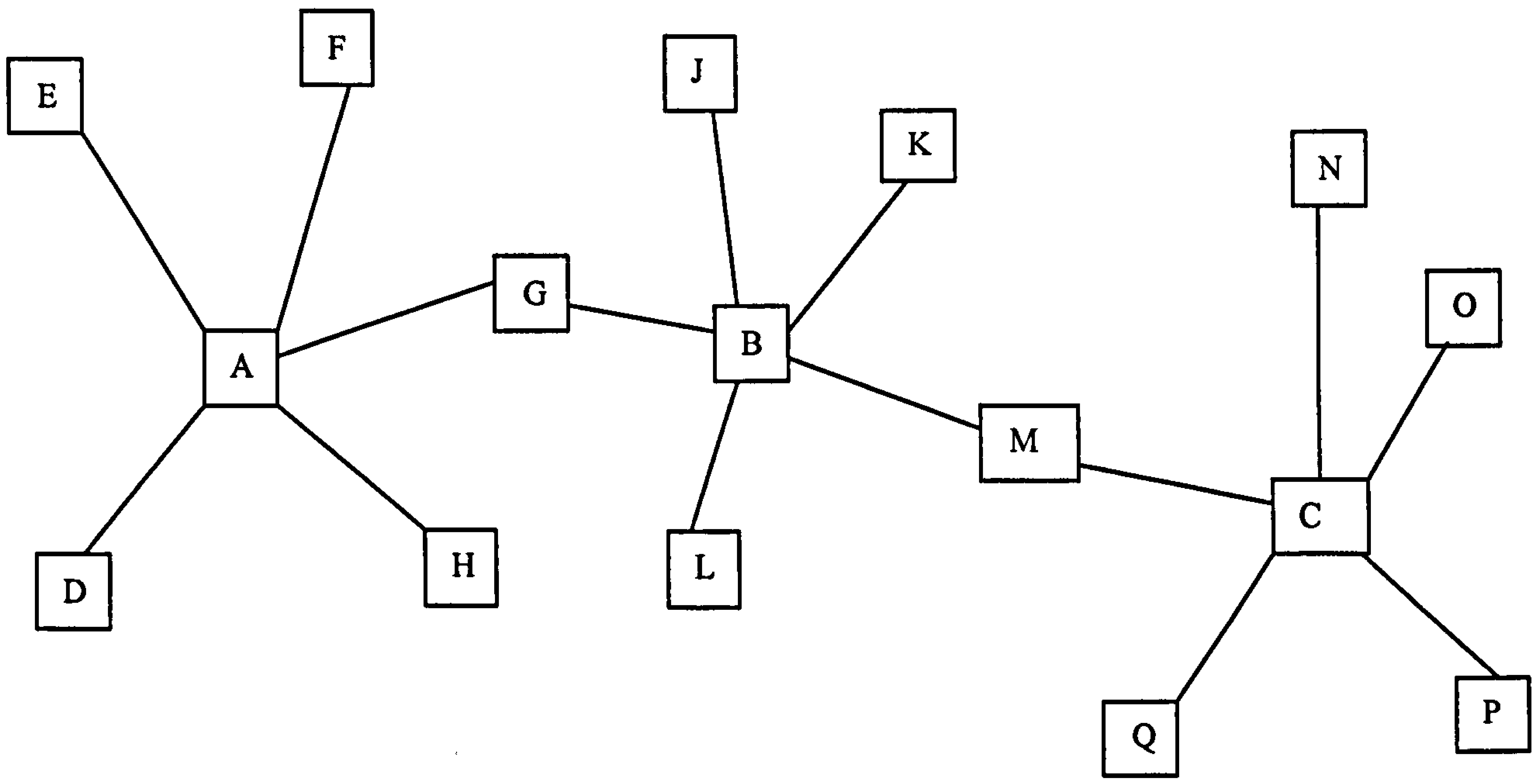

Figure 1.1 A Network Graph to Illustrate the Different Measures of Centrality Adapted from Scott (2000 p. 84)

1.4.1 Hypothesis 1(a)

In-degree centrality in an undergraduate friendship network is positively associated with academic performance.

In-degree centrality measures the actual number of in coming ties to the individual. In this case the ties are of friendship and so the in-degree of friendship is how many people cited an individual as a friend. I hypothesise that the positive association between the in-degree of friendship and academic performance will come about because this represents the actual number of friends within the cohort that the student can turn to for social support. The higher the number of in-coming friendship ties, the higher the number of friends that can provide both buffering and direct reduction of stress, leading to increased academic performance.

1.4.2 Hypothesis 1(b)

Out-degree centrality in an undergraduate friendship network is positively associated with academic performance.

The out-degree centrality measure relates to the actual number of ties going out from an individual. In this case it is the number of classmates that the students claims are his or her friend. I hypothesis that although the relationship will be stronger with the in-degree and performance than the out-degree, there will however be a positive association between the number of students claimed as a friend by the individual, and his or her academic performance. The reason for this is that the higher the number of friends that the student thinks they have, the higher their perceived network of social support. The out-degree in the friendship network acts as a direct on stress. The higher the out-degree of friendship, the higher the perceived amount of social support should it be needed. As mentioned previously, merely a perception of a lack of social support can be a stressor in itself. Therefore a higher perceived network of social support will lead to a reduction of stress and so ultimately, improved academic performance.

1.4.3 Hypothesis 1(c)

In-closeness centrality in an undergraduate friendship network is positively associated with academic performance.

Closeness centrality investigates the proximity of the individual to others globally in the network. . For example a student with a maximal closeness centrality would have a direct tie with every other student in the network. The higher the in-closeness score, the closer the incoming ties to the individual. Again this means that a student with a higher in-closeness centrality will have access to more social support, which again can have a buffering and a direct upon stress. In turn this reduction in stress will provide improved academic performance.

1.4.4 Hypothesis 1(d)

Out-closeness centrality in an undergraduate friendship network is positively associated with academic performance.

If a student is in close proximity in terms of friendship to many others in their out-going friendship ties, then they perceive themselves to have close friendship relationships. This means that they feel they have a good network of social support. This perception will have a direct effect upon their stress levels and sense of well-being. In turn their performance is likely to improve the higher their out-closeness of friendship score.

1.4.5 Hypothesis 1(e)

Betweenness centrality in an undergraduate friendship network is positively associated with academic performance.

Students with a high betweenness score in the friendship network are in a position of brokerage. They are a bridge between different people, or different sets of people. This means that they are in a position of power. It also means that they are likely to feel as though they are quite central. They will be the bridge that can bring people together and so this may help them to feel wanted and needed, as well as being in a position of power. In turn this feeling of centrality will have a positive affect on the student's academic performance.

1.4.6 Hypothesis 2 (a)

In-degree centrality in an undergraduate communication network is positively associated with academic performance.

If students seek out another for communication and advice about school related issues, it is likely that the person that they seek will have a reputation for being knowledgeable in the subject. At the same time if a person is being sought out for communication then they can also use the opportunity to formulate their own ideas. Reflection leads to greater learning. If students are sought out for communication they will need to describe and defend their ideas more than if they are not sought. This means that the more individuals seeking to communicate with a student, the more likely that student's knowledge and understanding is high in the first place. Also the more students are sought out for communication, the more they can take advantage of the opportunity to formulate and defend their arguments. In order to teach somebody else a given topic, one must first fully understand it one's self. Therefore a higher in-degree in a communication network is associated with higher academic performance.

1.4.7 Hypothesis 2 (b)

Out-degree centrality in an undergraduate communication network is positively associated with academic performance

If students have a high out-degree centrality in a communication network, they are actively seeking communication and advice regarding school-related topics. The higher the out-degree, the higher the actual number of people that they talk to about school related issues. The more people they talk to, the more they seek knowledge and information. Not only will the information that they gain by seeking communication help their academic performance, but also the fact that the communication allows students to reflect upon their thoughts, ideas arguments and knowledge will also have a positive affect upon their academic performance.

1.4.8 Hypothesis 2 (c)

In-closeness centrality in an undergraduate communication network is positively associated with academic performance.

Students with a high in-closeness centrality in the communication network are sought out directly by many of their fellow students. If students are seeking their advice then they must be very knowledgeable in the area. In turn students with a high in-closeness centrality can take the opportunity to discuss their ideas with those that seek their advice, strengthening their arguments and perhaps learning in order to help others. Being sought out in a communication network implies that a student is knowledgeable and the student in turn can use the opportunity to develop his or her own skills and knowledge base.

1.4.9 Hypothesis 2 (d)

Out-closeness centrality in an undergraduate communication network is positively associated with academic performance.

Students with a high out-closeness centrality in an undergraduate communication network are closer to the knowledge and information that its members can provide. Their proximity to the total knowledge that the group has to offer will put them in an advantageous position, and will improve their academic performance.

1.4.10 Hypothesis 2 (e)

Betweenness centrality in an undergraduate communication network is positively associated with academic performance.

Students with a high betweenness centrality in an undergraduate communication network, can, if they choose, act as brokers of information. They bridge the gap between different individuals and in order for someone to get information they must go through the person with a high betweenness score. This puts the person into a position of power. This access to knowledge and information not only means that the student can use this knowledge in order to achieve higher academic performance. In a competitive environment students could also use this brokerage position to their advantage. They could limit the access that other students have to knowledge and information. This could result in the student gaining relatively higher academic achievement than other students though to the detriment of others.

1.5 Thesis Plan

This thesis comprises ten chapters and four appendices. Each of these ten chapters will now be outlined in terms of the aims and objectives of each chapter and how it contributes to the research and to the thesis.

Chapter Two is a thorough review of the available literature. The chapter begins by reviewing literature regarding social systems and the social model of behaviour. Human beings are seen to be essentially social creatures whose behaviour is consistently embedded in the social system within which they operate. Such social systems can in turn provide social support, and the literature in this area is reviewed.

The effects of social support upon stress and ultimately performance are discussed. The way in which social support can provide both buffering and direct effects upon stress and performance is outlined.

The chapter goes on to discuss the literature regarding social networks. The effects of social networks upon organisations and the individual are discussed. The manner in which social networks can have an effect upon access to opportunities such as gaining employment is discussed as is the manner in which such networks facilitate the transfer of knowledge and information.

Such social networks build into a form of capital that individuals can utilise to their own advantage. The literature regarding how such social capital operates within the field of education is discussed. The literature regarding how social networks can effect performance in education is then reviewed.

Other predictors of performance such as previous academic performance and demographic, cognitive, and psychosocial variables are also discussed. Then follows discussion of how people learn from and with others. The literature regarding relationships and learning, peer learning and informal learning is reviewed.

Chapter Three builds on the literature review and outlines the rational for this study. A gap in the literature is identified and then the individual hypotheses are outlined, giving the rationale for each of the hypotheses individually.

Chapter Four outlines the methodology used in this study. It begins with a review of the historical development of social network analysis as a methodology in order to place the study in context. Methods of data collection are then discussed. The population is outlined as is the sample used for the study. The development of the two questionnaires and the way in which these questionnaires were tested and later administered is described. Preparation of the social network data is discussed along with the computer software that was used for this purpose. Finally, methods of data analysis are discussed and the process of correlation and multiple regression outlined.

Chapter Five consists of an analysis of the friendship and communication networks of the three undergraduate cohorts studied. Each of the networks can be seen as a graph using visualisation tools. The density of relationships within these graphs is discussed. The connectivity of the graph is also discussed, as is the presence of cliques and sub-groups and the degree to which the relationships are reciprocated. The amount to which the graphs are centralised around one particular point is also investigated and discussed. Finally a comparison is made between the networks evident in the three different cohorts.

In Chapter Six, the analysis is at the level of the group. Cohesion within and between project-based work-groups is investigated implicitly through the used of social network analysis. The density of friendship and communication relationships within and between the groups is analysed for each of the three cohorts studied and then a comparison is made between the different cohorts.

Chapter Seven then moves on to analyse network membership at the level of the individual. Three different centrality measures are used to analyse the networks, these measure are degree centrality, closeness centrality and betweenness centrality. These measures are applied to each individual within the study. The results are shown and a comparison is made between the mean centrality measures of each of the cohorts.

Chapter Eight outlines the findings of the study. Analysis at the network, group and individual level provides nodal properties that can be applied to each of the students taking part in the study. These variables are then out into a correlation analysis in order to find if there is any correlation between such variables and individual's academic performance. Variables that are significantly correlated with the students' end of year grade are outlined. Multiple regression models are then developed in order to ascertain how much of the variance in end of year grade can be explained by the centrality of the student in friendship and communication networks.

Chapter Nine provides the discussion of these findings. The relationship between various nodal properties and the students' end of year grade is discussed. These variables include previous academic performance, gender, peer assessment of effort, intellectual contribution and co-operation with work-group, group grade, density of friendship within and between work-groups and density of communication within and between work-groups.

Each of the hypotheses is then discussed in relation to the findings. Each of the hypotheses is either rejected or accepted.

The multiple regression models are then discussed; outlining how much variance in grade can be predicted by the centrality measures discussed.

The implication of the results for both educators and students are discussed. Finally chapter nine discusses the limitations of the study that are presented by both social network analysis as a methodology and by the sample used for the study.

Chapter Ten concludes the thesis. The novel contribution to knowledge that this thesis affords is outlined, as are hopes and suggestions for future research around the subject area of social networks and educational performance.

There are four appendices to this thesis, which are situated after the bibliography. These appendices show the following: Appendix 1: The social network questionnaire; Appendix 2: The peer group assessment questionnaire; Appendix 3: The full matrix of data collected for each of the cohorts; Appendix 4: The correlation matrix for each of the three cohorts.

Chapter Two: Methodology

2.1 Introduction

The objective of this chapter is to outline the methodology used in this study. This chapter contains details of the population and sample of this study and the response rates are reported. The process of getting clearance from the University Ethics Committee is described. The process of designing two questionnaires is described, as is the pre-test that was used to validate the questions that they contained. I then go on to describe how both of the questionnaires were administered. I describe the performance indictors that will be used to test the hypotheses and indicate how the anonymity of the subjects is upheld. I then go on to describe how the data was prepared and how visualisation tools were utilised. Finally, the process of testing the hypotheses is outlined in which correlation and regression analyses are performed using SPSS software.

2.2 Data Collection

2.2.1 Population

The target population of this study is undergraduate business education in the U.K. Increasingly there is a movement which purports that interaction between peers within an educational context can have a significant influence upon their achievement (Johnson & Johnson, 1993). A study was recently carried out measuring the social networks of master of business administration (M.B.A.) students in the U.S. investigating the links between network relationships and attitudinal and performance outcomes (Baldwin, Bedell and Johnson, 1997). This study aims to build upon the work by Baldwin, Bedell and Johnson by choosing the target population of undergraduate business education in Britain. This group are generally younger than M.B.A students and are less likely to be already socialised into the notion of networking. M.B.A. students already have considerable business experience and are likely to be familiar with utilising their network of friends and business associates to their personal benefit. An undergraduate group is less likely to have exploited this phenomenon and makes an interesting comparison to the M.B.A. students.

2.2.2 Sample

The sample consisted of 131 students at City University Business School, London, who were all registered full time on the undergraduate degree course in Management and Systems. The students were in three cohorts, split as follows:

Year 1: 47 Students

Year 2: 40 Students

Year 3: 44 Students.

Each cohort was treated as a discreet unit of analysis. Students were also split into self - assigned teams to carry out group work, these groups consisted of between 4 and 9 members, this meant that the relationships between group members and between groups themselves could also be investigated.

2.2.3 Ethics Committee

In order to carry out this study using students from City University, the whole study first had to be agreed by the Ethics Committee of the University. A proposal was submitted to the committee outlining the aims and objectives of the study along with the hypothesis, propositions, methods of data collection, an outline of what the data would be used for, the questionnaires, student permission memo and an outline of how the participants anonymity would be maintained. The following feedback was received from the Ethics Committee and accommodated into the study:

- When asking the student to participate in the study, it was emphasised that it was not compulsory to do so, and the decision not to take part in the study would in no way impact their academic achievement.
- The committee required further explanation as to what would happen statistically should a student decide not to participate. It was outlined that should a student decide not to participate they would be removed altogether from the study, so that no relationships in either direction would be recorded, eliminating the student as a node from the network investigation all together.
- A column entitled "Unknown" was added to the questionnaire enabling students to respond that they do know a particular student.

2.2.4 Response Rate

Students were asked to fill in a questionnaire regarding their choices of whom they are friends, and with whom they communicate on work related topics. They were also asked to fill out a peer group assessment questionnaire in which they would award marks to the members of their group work team. Only one student in the population chose not to participate in the study giving an overall response rate of 99.24% and a response rate per cohort of:

Year 1: 100%

Year 2: 100%

Year 3: 97.73%

Because the analysis examined relationships between individuals, the decision of one student not to take part resulted in eliminating one node from the social network analysis of cohort Year 3. In this way not only did she not respond, but also the responses directed towards her by other students were eliminated. This did not affect the analysis of the year 1 and 2 cohorts.

2.2.5 Questionnaires

Two questionnaires were administered to the students at the end of the second term of the academic year. This meant that all students had completed many course works both individually and as part of a group.

The advantage of using the questionnaire as the research tool was that this allowed direct sociometric choice data to be gathered. An alternative to the questionnaire would be simply to ask the student who they were friends with and whom they communicated with. The flaw in this approach however is that the student may forget to mention everybody. By listing the whole cohort and then asking the student to tick which of their peers they are friends with or communicate with, the likelihood of forgetting to mention someone is eradicated.

An alternative way to measure the network would be through examining the ego networks. To do this one would interview one person asking them with whom they are friends. Next the researcher would interview those friends and ask whom they were friends with and so on. The ego method was not deemed appropriate in this case. When investigating the correlation between friendship and communication networks and performance, the absence of a relationship is just as significant as the presence of one. By using the questionnaire one can discover just how prolific such relationships are amongst the entire group. For example one student in the Year 3 cohort chooses nobody as a friend and is chosen by nobody in return. If the ego network method was used this student would not have been included in the study, however it may be important to his academic performance that he has no friends, and with the use of the all inclusive questionnaire it was possible to investigate this.

2.2.6 The Social Network Questionnaire

The social network questionnaire consisted of a list of all students that were in the given cohort. This is the roster choice type of questionnaire, and consists of direct sociometric choice data. The students were asked to identify which of their peers they were friends with and which ones they communicated with about school related issues. The questions were adapted from those used by Baldwin, Bedell and Johnson (1997) in their study entitled "The Social Fabric of a Team – Bases M.B.A. Program: Network Effects on Student Satisfaction and Performance."

2.2.7 Pre-test

A pre-test of the social network questionnaire was carried out in order to ensure that the questions were easy to understand and that the instructions were easy to follow. A sample of ten students were identified for the pre-test. These students were enrolled full time on the first year of the undergraduate degree in Business Studies at City University Business School. This group is similar in terms of makeup to the Management and Systems degree group. They have the same entry requirements, the same type of mix of home, European and overseas students, the same type of male to female ratio and even share some classes with the Management and Systems group.

A list of the ten participating students was given to each individual. They were asked to put a tick by the name of any student that they were a) friends with, b) communicated with. The following definitions were given for the two categories:

a) Friendship – Which of the following students are good friends of yours, people who you see socially outside of classroom hours?
b) Communication - Which of the following individuals are important sources of school-related advice or whom you approach if you have a school-related problem?

It was explained to the students that the categories were not mutually exclusive and that they could tick both friendship and communication for a student and that ticking neither category meant that they had no particular relationship with that person. The pre-test group were left to fill out the questionnaire and were than asked to report upon how well they understood the definitions of friendship and communication and how well they understood the task.

The following responses were logged:

- Student BS1: "This was very easy to understand as all of the options were clearly defined. It didn't take long to fill out at all."
- Student BS2: "Clear and easy to follow."
- Student BS3: "It would be easier if it was all on one page, definitions were clear."
- Student BS4: "Some people are friends in University but you don't see them outside of school especially if you don't live in halls of residence, though you still talk about personal issues to them."
- Student BS5: "Are the categories mutually exclusive? Is the communication category merely an acquaintance?"
- Student BS6: "Is the communication only about school-related issues?"
- Student BS7: "Easy definitions, could be set out on one page."
- Student BS8: "Clear, fine."
- Student BS9: "Clear, ok definitions."
- Student BS10: "Clear definitions, no problem."

It appeared that the definition of friendship was not quite clear enough and so examples of the degree of friendship were added in order to make it more explicit. The definition of communication was also changed slightly in order to reflect that the student should tick the communication box to indicate where they communicate with others specifically regarding academic related issues.

In response to this feedback the definitions of friendship and communication were changed as follows:

a) Friendship: "Which of the following students are good friends of yours, people whom you see socially outside of classroom hours, e.g. you have coffee or lunch together between or after classes and discuss topics other than those which are University related."
b) Communication: "Which of the following individuals are important sources of school, coursework, examinations related advice and conversation, or whom you approach if you have a school-related problem."

The pre-test group also indicated that they would have found it easier if the definitions were on the same page as the questionnaire table in which they respond. Unfortunately this was not a change that would be feasible in the study. In order to accommodate this feedback, the definition sheet was not attached to the rest of the questionnaire when it was administered. In this way the respondent could keep the two sheets side by side and refer to the definition easily if necessary during the administration of the questionnaire.

The feedback from the pretest group also highlighted the need to emphasise that the two categories of friendship and communication were not mutually exclusive and indeed a student could choose to tick both categories for any given individual.

2.2.8 Administering the Social Network Questionnaire.

The social network questionnaire was administered towards the end of the second term. The researcher went into the classroom and explained how to fill in the questionnaire and went over the definitions of friendship and communication.

The instructions were given as follows:

"Please go down the list and put a tick next to the name of the students that you feel you a) are friends with, b) you communicate with. The categories are not mutually exclusive so that for example you can be a friend with someone and also communicate with them about University issues. Please do not let anyone else see your answers, as soon as you have completed this questionnaire please hand it in to the researcher."

The researcher remained on hand to answer any questions while the students filled in the questionnaire. Students were asked to be careful not to show their questionnaires to their class-mates as full and truthful responses were required. Administering the questionnaire to the group as a whole was useful in terms of getting everyone to respond, and fill out the questionnaire there and then. It also served as a visual stimulus to the students as they could look around the room and think about with whom they have any kind of relationship. Where students were not in class when the questionnaire was administered, the researcher followed up by contacting the students individually and administering the questionnaire on a one–to-one basis. There were pictures of all the cohort available should any student be unsure of another's identity. Where students asked to be reminded who another student was it always resulted in a tick in the 'unknown' category, as once reminded visually by the identity the student realised that they do not communicate or have a friendship with them.

2.2.9 The Peer group Assessment Questionnaire.

The peer group assessment questionnaire was administered in order to gain further nodal properties relating to the individuals within the work-groups. In this way it is possible to investigate the relationship between the effort, intellectual contribution and co-operation of the individual with the group and their individual end of year mark. This can be compared with an analysis of the relationship between the individual's centrality in friendship and communication networks and their academic performance.

The peer group assessment questionnaire has been used in the Department of Management Systems and Information for around ten years. It was developed as a means of fairly attributing grades in group work situations and assessing how much input each individual contributed to the assignment (Goldfinch and Summers, 1996). In the case of some group works in the department, the marks awarded to each other in the peer group assessment have been factored in to the final grade that the student receives for his or her group-based coursework. In the case of this study the peer group assessment marks did not affect the grades that the students would receive. It was made explicit to the students that the marks given in no way affected their coursework grade, and their choice of whether or not to participate in the study was entirely voluntary and non-participation would in no way affect their course work grade.

The students were asked to give each member of their team a mark between 0 and 6 for three categories:

1. Overall effort in the group.
2. Intellectual contribution to the group.
3. Co-operation with the group.

This type of response is known as a Likert scale where the respondent can choose their answer along a scale of extremity. The scale of 0 – 6 was explicitly defined as follows:

0 – No Contribution
1 – Very Poor
2 – Poor
3 – Average
4 – Good
5 – Very Good
6 – An Outstanding Contribution

Emphasis was placed upon using the entire scale in the following manner:

"Normally we would expect the ratings to be a 3 or 4, with some 1, 2 and 5 scores. The meaning of an award 6 to a fellow student should not be devalued. Please be willing to use a zero if necessary. For example, if you score a particular student zero for "co-operation within the group", it implies that the person never attended a group meeting."

2.2.10 Administering the Peer Group Assessment Questionnaire.

At the end of each group assignment, the groups give a presentation and submit a final written report. For each year group the final group-assignment in the second term was chosen as the one for which the peer group assessment would be administered. The researcher entered the classroom after the students had finished their assignment and explained how to fill out the questionnaire, remaining on hand to answer any queries that arose and collecting the questionnaires when complete. Any students that were not present at that session were followed up and the questionnaire was administered individually.

2.2.11 Performance Indicators

The measure of performance associated with the undergraduate degree is the grade achieved in course works and exams. The two grades used to measure performance in this study are the grade achieved in the group work assignment and the students' overall grade for the year. This is in line with the Baldwin, Bedell and Johnson (1997) who used the group work marks and overall yearly grade of M.B.A. students as a measure of their performance. In their study the M.B.A. students' GMAT (Graduate Management Aptitude Test) exam grades were used as a benchmark, similarly in this study the undergraduate students' A level or equivalent scores provided the benchmark. The 'A' level exam and its equivalent is considered by the University as a predictor of ability and aptitude. In order to gain entrance onto the Undergraduate degree in Management Systems and Information the students were required to gain a total of A level points or the equivalent in other internationally recognized qualification as follows:

Year 3 – 24 points
Year 2 – 24 points
Year 1 – 26 points.

The requirement is out of a possible total of 30 points (3 x grade A's). The entrance requirement was raised for the cohort that entered in 2000. When interviewed, the course director said that the raise in entry requirements was implemented "in order to raise the standards of aptitude and ability." Thus showing that the University uses the score as predictor for capability on the degree program.

2.2.12 Anonymity

The data collected was personal and sensitive data regarding individuals' choice of friends and with whom they communicate as well as the allocating of marks to their peers for contribution to group work. As such it was important that the confidentiality of such data was respected and that the anonymity of all participants was maintained. Once the questionnaires were collected, all individuals were randomly allocated an identification number. From this point onwards the students' identity is not used in the analysis.

2.3 Data Preparation

2.3.1 Social Network Data

The direct sociometric choice data obtained in the social network questionnaire was transferred into the form of binary data into a matrix. A matrix was set up listing each student symmetrically across the two axes.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
P1	*	0	0	0	0	0	0	0	0	0
P2	1	*	1	0	0	0	0	0	0	0
P3	0	1	*	0	0	0	0	0	0	0
P4	0	0	0	*	0	0	0	0	0	0
P5	0	0	1	0	*	0	0	0	0	0
P6	0	0	0	0	0	*	0	0	0	0
P7	0	0	0	0	0	0	*	1	1	1
P8	0	0	0	0	0	0	1	*	1	1
P9	0	0	0	0	0	0	1	1	*	1
P10	0	1	0	0	0	0	0	1	1	*

Fig. 2.1 A matrix representing the proliferation of friendship relationships amongst the pretest group.

Each questionnaire was then translated onto the matrix by going through each response and attributing a 1 where a relationship exists and a 0 where it does not. In this way in fig 2.1 for example, we can read that student P1 did not choose any of the others as a friend. Going down the column however we see that student P2 chose P1 and P3 as a friend in his response. This provides an asymmetrical matrix because not all relationships are likely to be reciprocal. The diagonal is taken up by *'s as these would represent the relationship with oneself and so the diagonal is ignored throughout the analysis. The matrix was entered directly into the spreadsheet editor of UCINET in order to facilitate further analysis.

2.3.2 A Level Points Benchmarking

City University Business School has a high intake of international students and the Undergraduate Degree in Management and Systems is no different. In order to gain entrance on to the course the student must obtain 26 points (24 for the Year 3 and Year 2 cohort) at A level or equivalent. The University accepts many internationally recognised qualifications other than the 'A' level, but base the entry requirement at this level. In this way the admissions officer converts all of the other qualifications and sometimes experience in to points on the same scale as the 'A' level. With the help of the admissions officer, the researcher converted all entry qualifications into the same scale as the 'A' level (out of 30 possible points).

This variable was placed into the regression model as an independent variable along with the dependent variable and the other independent variables, in order to discover whether previous academic performance and entrance examination grades had an effect upon a student's performance in higher education.

2.3.3 UCINET 5

UCINET was developed by a group of network analysts at the University of California, Irvine (UCI). Those currently developing the software are Stephen Borgatti, Martin Everett and Linton Freeman. UCINET was first written in BASIC, then integrated into a DOS program and is now more accessible as a Windows program. The program contains algorithms to carry out the graph theoretical procedures, multi-dimensional scaling and positional analysis. UCINET can manipulate up to 500 points for procedures such as clique analysis and slightly fewer for more complex procedures such as multidimensional scaling.

Analysis of the cohesion, components, centrality, sub-groups, roles and positions within social networks can be carried out through the network menu in UCINET. The cohesion menu provides access to further analysis in terms of paths, distances and geodesics, while the properties menu gives access to the calculations of a networks' density. The centrality menu has various types of centrality including measures of degree, closeness and betweenness. The components menu can be used to detect simple components, k-cores and cyclic components. The sub-groups menu allows the researcher to detect n-cliques, n-clans and k-plexes. The tools menu provides multidimensional scaling. Cluster analysis, factor analysis and correspondence analysis.

The resultant output is displayed on screen as a series of numerical outputs, dendograms or clustering diagrams as appropriate. Understanding of the networks and resultant analytical data can be enhanced by the further use of data visualisation tools.

2.4 Data Visualisation in Social Networks

Visual images have been a vital tool in social network analysis in terms of understanding the structures of social networks and communicating these findings and insights to others (Freeman, 2000). Two types of visualisation have been used throughout social network analysis, the matrix and the point and line graph. A matrix contains columns and rows that represent the actors and inside the matrix numbers or symbols represent the relationships. The point and line graph represent the actors by points or nodes and the relationships by lines that join them. Throughout social network analysis, researchers look for patterns of close knit social groups or cliques, or they look at the social positions of actors within social groups, or indeed both. The use of these images stems from Morenos' work in the 1930's. When discussing the importance of the use of visualisation in networks he said "We have first to visualise... A process of charting has been devised by the sociometrists, the *sociogram,* which is more than merely a method of presentation. It is first of all a method of exploration. It makes possible the exploration of sociometric facts. The proper placement of every individual and of all interrelations of individuals can be shown on a sociogram. It is at present the only available scheme which makes *structural* analysis of a community possible." (Moreno 1934, pp95 – 96).

2.4.1 Pajek

In 1994 Batagelj and Mrvar released DRAW and ENERG the first in their series of network drawing tools. They went on to produce Pajek (Slovenian for spider) in 1996 which contains many algorithms for point location. The program also allows the user to move the points oneself as well as change labels, shapes and colours etc. Pajek can draw particularly large and complicated data sets in two and three dimensions. The program is used here to illustrate the social networks of friendship and communication within the three cohorts. By drawing the networks, one can immediately see who are the particularly popular students and which students are particularly unpopular.

2.5 Data Analysis and Hypothesis Testing

The hypotheses investigated whether there was any significant relationship between students' positions in friendship and communication networks and their performance on an undergraduate degree program. In order to test these hypotheses a correlation analysis was used to ascertain whether any the variables were significantly related. A regression analysis was then carried out in order to discover the amount of variation in academic performance that can be explained by the students' position in the friendship and communication networks along with other nodal variables.

2.5.1 Correlation and Regression

The correlation between all of the nodal variables for each cohort was investigated in order to examine the relationship between various measures of centrality and academic performance. By performing the correlation analyses the hypotheses are tested, indicating whether there is a statistically significant relationship between the students' academic performance and the different measures of centrality in friendship and communication networks as outlined in the individual hypotheses. The relationship between other nodal properties such as those relating to group membership and communication within and between groups. These attributes, though not directly related to testing the hypotheses help to give a fuller picture of the relationships within and between groups.

The correlation and regression analyses were performed using the statistical computer package SPSS. The following nodal properties were used in the analysis in order to test the hypotheses

- Group membership
- A level or equivalent points
- Group work grade
- In degree of communication
- Out degree of communication
- In degree of friendship
- Out degree of friendship
- Betweenness of communication
- Betweenness of friendship
- In closeness of communication
- Out closeness of communication
- In closeness of friendship

- Out closeness of friendship
- Group density of communication
- Group density of friendship
- Effort within group
- Intellectual contribution to group
- Co-operation with group members
- Group friendship with other groups
- Group Communication with other group

SPSS was then used to perform a multiple regression analysis upon the data for each of the three cohorts. For each cohort the dependent variable was set as the end of year grade and the variables listed above were set as the independent variables. Multiple regression is "a statistical technique that simultaneously develops a mathematical relationship between two or more independent variables and an interval scaled dependent variable." (Malhotra, 1993). This procedure will be used to determine whether the independent variables listed above can explain a significant variation in the dependent variable, the students' grade, i.e. whether a relationship actually exists. The procedure will also be able to determine how much of the variation in the individuals' grade (dependent variable) can be explained by the independent variables, i.e. the strength of the relationship. In this way multiple regression will be used to investigate whether a person's position in friendship and communication networks, and cohesion of relationship within and amongst project groups, can explain the variance in their individual end of year grade. As a relatively high number of variables were to be included in the model, a stepwise regression method was utilised. The purpose of a stepwise regression is to " select from a large number of predictor variables, a small subset of variables that account for most of the variation in the dependent or criterion variable. In this procedure, the predictor variables enter or are removed from the regression one at a time.... Forward inclusion is combined with the removal of predictors that no longer meet the specific criterion at each step." (Malhotra, 1993).

2.6 Summary

The object of this study was to discover how a student's networks of friendship and communication affect their performance in higher education. Social network analysis was found to the best methodology to discover the students' networks of relationships. The computer software UCINET is then suited to running algorthyms which give various measures of centrality which can then be used to create a regression model that can explain a proportion of the variance in the students' performance.

The target population for this study was undergraduate business education in the UK. The sample consisted of 131 students at City University Business School. All of the students were enrolled in an undergraduate degree course in Management and Systems Science. The students were in three cohorts which were split as follows: Year 1: 47 students; Year 2: 40 students; Year 3: 44 students. Each cohort was treated as a discreet unit of analysis. Within each cohort students were split into groups of four to nine students for project work. The City University Ethics Committee approved the methodology for this study and all surveys used.

A roster choice questionnaire was designed which contained the names of all of the students within a cohort. Students were asked to indicate which of the students they communicated with and which they were friends with. The definitions for friendship and communication were developed from those used in the study by Baldwin, Bedell and Johnson (1997). This questionnaire was pretested on a group of undergraduate Business Studies students at City University Business School, and alterations made accordingly. A peer group assessment questionnaire was also applied which had been used within the academic department for many years.

An overall response rate of 99.24% was achieved with the percentage being split between the three cohorts as follows: Year 1: 100%; Year 2: 100%; Year 3: 97.73% (only one student in the Year 3 cohort chose not to participate.

Performance indicators used were end of year grades that were benchmarked by A level or equivalent points.

Once all questionnaires were collected, the data was out into matrix format. Pajek software was then used as a visualisation tool to examine the networks. UCINET was used to run various algorythms in order to obtain centrality measures. These centrality measures along with the performance measures were then fed into a correlation model using SPSS software in order to test the hypotheses. A multiple regression model was developed using SPSS in order to examine how much of the variance in a student's performance (as measured by their end of year grade) can be explained by various centrality measures.

Chapter Three: Critical Literature Review

3.1 Introduction

The objective of this chapter is to review all of the literature that contributed to the formulation of the hypotheses for this study. The chapter will begin by examining and critically reviewing the literature regarding social systems and the social model of behaviour. It will go on to examine the literature that defines social support, reviewing the direct and buffering influences of social support, the effects that social support can have upon stress and health matters and ultimately its effects upon an individual's performance. The literature regarding social support in education is reviewed along with that of social support networks. The literature regarding social networks is then reviewed. This includes networks of access and opportunity and the way in which knowledge and information is transferred through networks. Social networks have been found to influence performance both in the organisational context and within the context of education and this literature is reviewed here. The historical development of Social Network Analysis as a methodology and theoretical framework is discussed.

Other performance predictors of education are also critically reviewed these include: previous academic performance; entrance examinations, demographic variables, cognitive variables, psychosocial variables, and attitudes towards working as part of a team. Finally in this chapter, a review of the literature regarding learning with and from others is undertaken. The way in which relationships effect learning is examined as is learning in groups, from peers and in an informal context.

3.2 Social Systems

3.2.1 Introduction

The following section highlights research into the social nature of human beings. People do not operate in isolation and particularly cannot do so in the setting of the work place or place of learning. The section shows how individuals are embedded within a system of social relationships, and how by acknowledging such a phenomenon one can begin to utilise the dynamics of social systems to ones advantage.

3.2.2 The Social Model of Behaviour

In his 1997 examination of "New Directions for Organization Theory", Jeffrey Pfeffer reviewed five different models of organisational behaviour: economic; retrospectively rational; moral, interpretive/cognitive and the social model of behaviour. People are social animals, everything that they do is embedded within the society in which they operate. The more traditional views of organisations have ignored the social aspect of relationships within and across the boundaries of organisations, in favour of purely economic reasoning or rational choice. The social model of behaviour however emphasises the embeddedness of behaviour within a social setting (Granovetter, 1985). Indeed Blau (1977 p.1) claimed that "The fundamental fact of social life is precisely that it is social – that human beings do not live in isolation but associate with other human beings... The study of social structure... centres attention on the distribution of people among different positions and their social associations." The social behavioural model of organisations stresses that all organisational behaviour is embedded in "concrete, ongoing systems of social relations" (Granovetter, 1985, p 487). In this way behaviour occurs in context to the system in which it is embedded. Behaviour is both embedded in the social system and also makes up part of that system. Granovetter said "one's behaviour is rarely explicable without reference to precious and persisting effects of interaction with others and the overall pattern of such interactions in groups." (1986, p 31). The social behaviour model emphasises the context of behaviour within a social environment with particular emphasis on the position of social actors within a social system (network), the relationships between the actors (type of network tie), and the causal explanations between social relations and resultant organisational outcomes.

In terms of social relationships shaping behaviour, many studies have shown that people's perceptions of the organisation in which they work, are very much influenced by the opinions of the people around them. For example White and Mitchell (1979), O'Reilly and Caldwell (1979) and Weiss and Shaw (1979) all conducted experiments in which it was shown that individuals took social cues from their co-workers which affected their perceptions and judgements of tasks that they were asked to carry out.

Ibarra and Andrews (1993) investigated work attitudes in an advertising firm and found a link between individual's attitudes, their formal work position, their position in informal networks and their attitudes towards the work they do and the firm that they work for. In short they found that people share the same attitudes with the people that they are close to in a communication network. This result is understandable as people are likely to communicate with people who have similar attitudes to themselves. In the work environment this is highly supportive of the social behaviour model in that individuals will communicate and share perceptions of the organisation and the work carried out therein according to the confines of the social system in which they are embedded. Attitudes and even adoption of different working practices are spread within and between organisations in a form of social contagion.

Drew Harris (2000) defined social systems as "any activity, assembly, or ongoing relationship that involves three or more people." This definition appears to be rather vague as it could relate to people in a theatre audience or people in a queue at the supermarket. However Harris went on to specify that the term could be more rigorously defined as 'sustainable social systems'. These would be "stable (i.e., have both long-term existence and minimal turnover in members), sustainable (i.e., do not require constant or substantial influx of exogenous resources), and effective (serve the needs and interests of substantially all of the participants in the social systems.)" Harris suggests this definition means that social systems operate at many levels such as "work teams, business, governmental organizations, towns, cities, states and nations." Indeed a university can be seen as a sustainable social system as can a business school, an academic department, a degree, a cohort and a project work team, all at different levels of resolution.

In contrast to the economic model, the social model of behaviour, does not emphasise individual characteristics, but rather focuses on the relationships between those individuals. For example, how a person finds a job in the first place, is affected by their network of weak ties (Granovetter, 1973). An individual's work attitude is affected by the attitudes of the people who share their work environment (Thomas and Griffin, 1983). More specifically it is affected by their position in a communication network (Ibarra and Andrews, 1993). The achievement of promotion is not only an indicator of a persons individual achievement, but also of their location in the social structure (Becker, 1964). A person's status is tied in with the organisation or other people that they are associated with (Podolny, 1993). Ultimately, at the organisational level, the survival and success of organisations is dependent upon the pattern of its ties with other organisations (Pfeffer and Salancik, 1978).

Within the field of education, Roy Edelfelt (1979) called for the adoption of the view of schools as social systems. He claimed that the school is more than merely a place focused on "learning subject matter – as an arrangement of students in class groups of 20 – 25 – as rule bound to preserve order – as pressured by the grades alone to cover certain content." Indeed Edelfelt emphasised the importance of the school as a social system and the intrinsic lessons learnt from operating within such a social system.

The social model of behaviour may also manifest itself in terms of providing help for the individuals that are embedded in the social system in the form of social support.

3.2.3. Summary

The social model of behaviour in organisations stresses the embeddedness of all people in relationships that make up a social system. All working patterns are made up of such relationships and as such the social aspect to organisational behaviour cannot be ignored. Research has shown that people's relationships at work can have a great effect upon many work related factors ranging from attitudes to work, opportunities for promotion and on a macro scale, the ties between organisations and industries. Ultimately all work organisations contain people, all of whom are embedded in a social system of relationship within the organisation and outside of it. Educational institutions are also social systems. The university is not simply a place to achieve good grades, it is also a place where people are embedded in social systems and people are socialised into the wider society. Such social relationships can also provide a form of social support that people can call upon in times of need.

3.3 Social Support.

3.3.1 Introduction

Since the 1970's, a substantial amount of research on the beneficial effects of social support has appeared in the social science literature. The research has indicated that not only is social support an integral part of day to day life in all social settings, but it can also have a vital and profound effect upon many aspects of life, from physical and mental health to work performance and adjustment to new surroundings and life changes (Berkman 1984); (Schaefer, Coyne & Lazarus, 1981); (Glaser & Tatum, 1999); (Kraimer & Wayne, 2001); (Cohen & Hoberman, 1983). Research has even indicated that individuals with few social contacts have higher mortality rates then those with more contacts, even independent of other factors such as age, sex, smoking, social class, obesity and alcohol use (Berkman, 1985, p244; Berkman & Syme, 1979 pp 190 – 192).

Indeed Albrecht and Burleston (1992, p149) claimed that "Social support matters: It is the cornerstone for the quality of human life." They went on to say that "perceiving that one has a reliable support system of kin, friends, and more distant associates has been found to reduce the risk of disease, enhance recovery from mental and physical illness, and reduce the possibility of abuse to self and others."

The nature of social support, its effects and who provides it has been an area of focus for research in the behavioural and social sciences (reviews by Berkman, 1984; Cohen and Syme, 1985; Coyne and Downey, 1991; Kessler, Price and Wortman, 1985). The attention on social support has been multidisciplinary, leading to various definitions and measures of social support. The following section will outline some definitions and taxonomies of social support. I will then go on to discuss research into different types of effects of social support, the effects that social support can have upon stress and performance, social support in the educational context and social support networks.

3.3.2 Definitions and Taxonomies

Leavy (1983, p.5) defined social support very broadly as "the availability of helping relationships and the quality of those relationships."

Cobb (1976) identified three distinct components of social support. These were referred to as information regarding whether one is (a) loved and cared for (succour, nurturance and affiliation); (b) valued and esteemed (recognition and respect) and (c) belonging to a group, or network of communication and mutual obligation. Here we begin to see the definition of social support split into categories. This trend is continued by many researchers who produced taxonomies of support (Barrera, Sandler & Ramsay, 1981;

Cohen & Hoberman 1983; Cutrona & Russel, 1987, 1990; Scaefer, Coyne & Lazarus, 1981). Most of these taxonomies distinguished between different types of support for instance, cognitive, informational and guidance, or emotional, tangible or material.

Cohen and Wills (1985) derived four primary types of social support from these many taxonomies: (a) affective support (this is often also known as esteem support or emotional support), this helps the individual to feel accepted and cared for by others; (b) informational support which provides advice and guidance when and where necessary; (c) instrumental support which is also known as tangible aid and is actual material assistance such as lending money or babysitting, and (d) social companionship, having other people to share interests, share leisure time and socialise with.

A distinction can also be drawn between qualitative and quantitative support (Thoits, 1982). Here Thoits breaks down social support into simpler categories than do Choen and Wills. Qualitative support is process orientated, it is emotional and refers to expressive values of social relationship, the depth of friendships etc. The quantitative aspect of support refers to the number of such relationships to which a person has access.

In this study the measures of communication and friendship indicate different qualitative levels of support. The communication pertains to support regarding school-related issues of coursework, examinations etc, while the friendship measure indicates a more emotional level of support. Both are forms of co-worker support in which a student can empathise with the situation of another student. The quantitative aspect of support is measured by counting the number of such relationships that a student has.

3.3.3 Direct and Buffering Effects

Research in the area of social support has followed two different models in the proposition of its beneficial effects. The buffering model suggests that social support may have an effect upon a person's well being only when they are under stress. In this model, the social support "kicks in" when a person is under stress, and is useful as a form of coping mechanism. The alternative model offers the direct effect hypothesis. In this model the social support available to a person has a direct and constant effect upon their well being regardless of whether or not other stressors are present at the time. Indeed the lack of social support or perceived lack of social support can be an independent stressor in itself. (Mallinckrodt & Leong, 1992).

House (1981) showed that empirical studies provide evidence for the direct effect hypothesis by a statistical main effect in the relationship between social support and stress symptoms. Alternatively, the buffering hypothesis is supported by statistical interaction between social support and levels of stress in predicting stress symptoms.

Controversy exists regarding whether the effect is direct or buffering and indeed regarding the direction of such an effect. Kahn and Byosiere (1992) reviewed twenty-two studies. They found that twenty of the studies reported a direct effect. Ten of the studies reported a buffering effect in the predicted direction and two of the studies reported a buffering effect in the opposite direction. One of the studies found neither a main nor a buffering effect. Kahn and Byosiere concluded, "social support is a demonstrably potent variable, that with only occasional exceptions has significant main effects, and that frequently has buffering effects as well" (p. 623). There is obvious confusion here as to exactly what the effect of social support, whether a direct effect or a buffering effect.

Cohen and Wills (1985) concluded that the occurrence of direct or buffering effects actually depends upon the way in which the social support is measured. Generally, evidence for the buffering effects is found when the study measures the availability of specific social support resources useful for coping with the particular demands of the particular stressor indicated. In this way the buffering effect is shown when it is investigated specifically whilst more general studies indicate the direct effect.

In particular a good deal of the research has investigated the moderating (buffering) effects of social support upon stress, and especially upon stress and burnout in the work place.

3.3.4 The Effects of Social Support on Stress and Performance.

In their review of the literature on occupational stress, Bowers, Weaver and Morgan (1996) identified social support as one of the major moderators of stress (and subsequently performance) in the work place. They found that men who had "high stress" jobs suffered from low social support while those with less stressful jobs reported a higher level of social support. This rather results in a "chicken and egg" scenario as perhaps men with stressful jobs do not have the time to seek out or to utilise the supportive relationships which would actually help to moderate the stress and turn their jobs into less stressful ones. Which came first: the lack of social support or the increase in stress? This is a typical example of a systemic relationship.

Similarly, Landsbergis et al (1992) found that a lack of social support had a negative impact upon job satisfaction where jobs had high demand and high decision latitude. They suggested that this would indicate that a co-operative work place would be far more beneficial than a competitive one.

Karasek's (1972) model of job demands–control hypothesises that there are two elements that make up the work environment: job demands and work control. This model says that job stress arises from these two aspects and the interaction of the two. By this he means that the stress at work comes about from a combination of what we have to do in the job and the control that we have over how and when etc. we do the work. Karasek and Theorell (1990) then went on to expand the jobs-control model to include social support. This model predicts that employees will be under the most strain when work stress is high and social support and work control is low. This model is also in line with the stress – buffering theory of social support. Indeed undergraduate students are in a position where work stress is high and control over the amount of work and what work they have to do is beyond their control. This leads undergraduate students to be under a great deal of stress and is likely to affect their performance.

Within stress research, studies have suggested that where employees face stressful life events or are under stress from learning new organisational roles, such psychological stress can lead to poor work performance (Bhagat, 1983; Latack, 1984; Motowidlo, Packard & Manning, 1986). Once again undergraduates tend to be undergoing a great deal of life changes as they undertake their degree programs, moving to new cities or countries, finding new independence and new modes of working.

Social support can moderate the effects of stress in the workplace, which in turn has an effect upon performance in the work place. Sargent and Terry (2000) found that where clerical workers had high levels of co-worker support, low levels of task control and high levels of work overload (high stress), their performance was higher than those with low levels of co-worker support. The situation of the clerical worker is not dissimilar to that of the undergraduate student who has a high workload, strict deadlines and relatively low task control.

Rafferty, Friend & Landsbergis (2001) found that co-worker support was associated with having "lower demands, lower emotional exhaustion and higher personal accomplishment." Thus social support from within the organisation enhanced their work performance. As research has shown that social support can have a direct or a buffering effect upon stress in the work place and hence an effect upon workers performance, does this mean that the same can apply to the work of a student?

Parker and McEvoy (1993) investigated the role of social support in acclimatisation for expatriate workers. They found that social support could help a person to adjust to a new country and a new working environment, hence again indirectly effecting their work performance. Perhaps social support can help students to acclimatise to their new environment within the university.

3.3.5 Social Support in Education

Students in higher education have a great deal of adjustment to deal with. It may be their first time away from their parent's home, or it may even be that they are living away from their home country for the first time. In this way they have adjustment outside of the work place to contend with. Almost certainly the student will have adjustments to make inside the workplace. The teaching process in higher education is likely to be one that the student will have to adjust to. They are treated as adults and have the choice to participate or not. Teaching includes the provision of lectures with large numbers of students attending; tutorials in which they must not only attend but participate; group works in which they must work as a team and guided and unguided self study for large assignments and examinations. It is likely that students will not have experienced this level of autonomy and these types of teaching methods in the past. It may take some time to come to terms with this different way of personal and academic life, which in turn may cause stress, consequently hindering performance. Social support can help to alleviate the stress caused by adjustment. Beard, Elmore & Lange (1982) commented that although some students can easily make the transition, many experience problems in adjustment which can lead to academic difficulty and hence poor performance.

Archer & Lamnin (1986) found that difficulties in adjustment can also lead to problems within the family, interpersonal difficulties within dormitory accommodation and other social situations. Lustman, Sowa & O'Hara (1984) found that such difficulties in adjustment could lead to a variety of psychosocial and physical symptoms.

Robbins, Lese and Herrick (1993) investigated how students adjust to university life. In particular they concentrated on the effect that social support has upon goal instability ("the inability to create or initiate age-appropriate purposes or objectives.") and how this affects adjustment to life at University. Students with high goal instability are confused about self and have difficulty in getting work done, or in initiating action. They found that low goal-directed individuals (those with high goal instability) benefited from socially supportive relationships, while those reporting high goal stability did not benefit from having relationships with someone who they could talk to. This effect however, was found to be on personal adjustment and not on academic adjustment. This indicates that the personality trait of goal stability has an effect upon whether social support is effective in assisting the transition into college life. Robbins et al (1993) offer the explanation that low goal-directed individuals may find it easier to as for advice and information regarding support on academic issues as this is more clear cut than the personal transition which involves new roles, boundaries and behaviours which have not yet been set or understood. It may be that as students settle into academic life they are able to get more out of their socially supportive relationships. As the years go on the stress will increase as the grades become more important and the goal in sight becomes closer. Social support can act as a buffer to this stress and in turn the less stress the better the performance.

This social support can come from various means but Robbins & Tanck (1994) found that students preferred to cope by talking to a friend. They reported that 95% of the students that they surveyed had at least once coped with a stressful situation by talking to a friend, 70% had coped by talking to a family member, 15% to a therapist and 7% to a member of the clergy. The large majority of students also claimed that talking to a close friend was the most helpful way of coping with stress. Robbins and Tanck also found that not only did the students turn most often to their peers but also they found this form of social support to be the most effective when utilised. They did not report exactly as to why students turn most often to their peers for support or indeed why this form of social support was found to be most effective. They did however note one student's comment that "Talking to someone who you know loves you and cares about you offers a great sense of comfort." Although we would expect that a family member would be best placed to be in such a position of love and support, it appears that the student also valued the shared experience of their peers, their proximity and empathy.

Carney-Crompton & Tan (2002) investigated the role of social support in the performance of non-traditional female university students[1]. They found that both the psychological and academic status of the female non-traditional students was unrelated to the quality and quantity of their social support systems. They found that the non-traditional students reported better academic performance despite having fewer sources of emotional and instrumental support. Their psychological functioning was also found to be unrelated to both types of social support. This finding was unusual however. Most of the research supports the theory that social support is either a buffer or a main effect in coping with stress and hence improving performance, in all types of student regardless of gender. Most studies report that non-traditional students who demonstrate greater satisfaction with their emotional and instrumental support relationships also report better psychological functioning than those who were less satisfied with such relationships (Leavitt, 1989; Mallinckrodt & Leong, 1992; Roehl & Okun, 1984). Rifenbary (1995) reported that the presence of emotional and instrumental social

[1] In this study non-traditional students are defined as those who do not go straight through compulsory schooling into University. They are mature students who choose to re-enter education later on in life.

support can have a positive effect upon the overall educational experience of the non-traditional student.

Wilcoxon, Wilcoxon & Tingle (1989) found that non-traditional female students who receive support from a similar group of women experienced better satisfaction with their course of study and higher academic performance.

Mallinckrodt & Leong (1992) surveyed students living in graduate housing regarding access to social support from within their academic programs and from their families, recent stressful life events and depression and anxiety as psychological symptoms of stress. They found that women reported significantly more stress, more symptoms of stress and less social support from both their academic departments and families than the men. In terms of the effects of social support on stress in these graduate students, men experienced direct effects of social support but no significant buffering effects. This means that regardless of the level of stress, men found social support to be generally beneficial, but when a particular life stress event occurred, the social support was not of particular use to them. Conversely, they found that for women, the buffering effects of social support seemed to be of most benefit (when a serious life-stress event occurs). This is the time when women tend to turn to their friends and family for support, using them to talk things through. Under such circumstances social support accounts for 40% of the variance in depression and 31% of the variance in anxiety in women.

Carney-Crompton and Tan (2002) offer the hypothesis that their findings may have come about due to self-selection. These non-traditional female students are likely to be more self-sufficient, motivated and committed to achieving their goals. They are likely to have made a concerted effort to get back into education and will be determined to achieve to their fullest potential.

Kessler, Price and Wortman (1985) also found that the effects of social support differ for men and women. They found that social ties are more valued by women than by men and so the benefits of support may be stronger for women. But the benefits of social support can work two ways, being beneficial to both the person receiving support but also to the person who gives the support. Jung (1997) claimed that "the effects typically attributed to receiving support might be intermingled with the effects of providing support." Indeed many altruistic acts provide the instigator with a sense of well –being. It is this form of reciprocal social support that forms a support system or network, a number of relationships linking people into the same grouping.

3.3.6 Social Support Networks

Qualitative support is the amount of perceived support, the degree to which one feels supported. Quantitative support is the number of supportive relationships that one has. Tolsdorf (1976) explained the interaction between quantitative and qualitative support in terms of the support network: "An individual's expectations and beliefs help determine his behaviour, but they in turn are partially determined by the characteristics of the [social] network. Conversely, an individual's network is shaped and maintained by his use of it and by his attitude towards it. Thus the individual and the network are in constant interaction, both influencing and being influenced by the other ... Once established, network orientations [are] associated with the perceptions of stress, choice of coping style, proportion of multiple and kinship relationships and coping outcomes."

Pearson (1986) investigated the importance of social support networks in counselling. She found that helping clients to identify social support relationships and to establish networks of helpful relationships that could facilitate the coping process aided recovery greatly.

The social network can be an aid to coping in major stressful life events, but can also help in less stressful times. The effects of networks on various economic outcomes has been documented by research such as Granovetter (1974), Lin, Ensel & Vaughn, (1981) and Marsden and Hulbert, 1988). Hulbert (1991) went on to look at the effects of the network on non-economic outcomes and claimed that "Networks serve as a social resource which affects job satisfaction through social support."

Research from various fields has suggested that those who have dense networks exhibit greater well being and stability (Liem & Liem, 1978 p 151). Kadushin (1982) investigated the density of networks for Vietnam veterans and found that those veterans with dense networks were less likely to suffer from post-traumatic stress disorder whether or not they had actually been to battle. This indicates that the effects of a network of social support can be far- reaching and highly significant or even life changing for the individuals contained within those networks.

3.3.7 Summary

In summary, research has shown that stress can have an impact on psychological well being, health, morbidity, mental adjustment, work performance and academic performance etc. In turn social support can have an effect upon minimising the effects of stress. Two models are put forward for the effects of social support upon stress. The buffering model suggests that social support produces an effect only when a person is actually under stress as a form of coping mechanism. The direct effect model suggests that the social support available to an individual will act constantly to have a positive effect upon a person's well-being. I feel the direct effect to be more likely, friends and family help to alleviate the small everyday stresses that would probably mount into a larger problem without any form of social support.

Social support can be measured qualitatively (how much support is received), and quantitatively (how many people it is received from), and research on the density of networks has indicated that dense networks help people cope better with stress. Research also indicates that if people cope better with stress it is likely that their performance will be enhanced. Social support is shown to be beneficial in combating stress and so it has an indirect effect upon increased job performance.

Research has also shown that social capital can also help people to cope in times of high adjustment. Students often face a lot of adjustment in lifestyle and new ways of working and social support can help student to cope with this. Research has shown that students often turn to social support in times of high anxiety such as examinations and strict coursework deadlines. Socially supportive relationships build up and interact and can be seen as a network of social support. Social network analysis can be used to measure the density of networks and it is this methodology which will be utilised in this study in order to investigate the links between students friendship and communication networks and their performance on an undergraduate degree.

3.4 Social Networks

3.4.1 Introduction

The following section explores the research concerning social networks. Social networks have wide ranging effects from the individual level to that of the organisation and even industry wide. Social networks can provide access and opportunities, from getting a job, to getting promoted. Networks may also carry resources such as knowledge or information, and hence can be utilised to improve performance. The research on social capital is investigated with particular reference to social capital in education. Finally in this section the research into links between social networks and performance in education is investigated.

3.4.2 Networks, Organisations and the Individual

Since the 1950's approaches emphasising social networks have been taken in the fields of sociology, anthropology, psychology and molecular biology. In particular sociologists and anthropologists have examined the ways in which people are linked to each other and the consequences that such linkages have for society, or as Powell and Smith-Doerr (1994) said: "... how these bonds of affiliation serve as both a lubricant for getting things done and a glue that provides order and meaning to social life."

Social networks consist of the structural pattern of relationships (Freeman 1976). Social network analysis investigates the relationships between social entities such as individuals, teams or organisations. The approach then looks at the patterns of those relationships, the flow of information and resources and the implications of such patterns. Such patterns of relationships form a structure, and so social network analysis is also known as a structural approach. Relationships may be emotional, economical or even political, in fact any form of relational data.

Organisational theorists have applied the network concept at different levels of resolution ranging from the individual level to networks of international corporations. Applications of social network analysis range from investigations into informal friendship ties amongst individuals; the shadow network or informal replacement of the formal organisational channels of communication; departmental networking; organisational networks and strategic alliances; social differentiation and networks of social influence; up to the highest level of resolution: network clusters of regionally and industry based organisation types. (Laumann et al, 1978; Shaw, 1997; Roethlisberger and Dickson, 1939; Friedkin, 1998; Powell, 1993 etc.)

Indeed many authors go so far as hailing the network approach to organisation as the ideal form of organising for the current economic and social climate. Nohria (1992 p2) claimed that "If the old model of organisation was the large hierarchical firm, the model of organisation that is considered characteristic of the New Competition is a network, of lateral and horizontal linkages within and among firms."

Not only are new firms taking this perspective, but also Mills (1990), found that many large established firms are adapting and restructuring their internal forms of organising along network principles.

Mueller (1986) claimed the "...concept of human networks and the process of social networking are prime components for a properly balanced organisational system in these turbulent and exciting times. Formal recognition and use of human networks is limited and somewhat unacceptable in the traditional hierarchical and structured makeup of most of our institutions. However, the good news is that networks and networking can cohabit with hierarchy and bureaucracy. Effectiveness and action-timing can often be enhanced with proper empowerment of the human networks which already exist in all organisations. One way to get things done quicker and better, given the barriers and complexities in our political, economic, education, social, and technological institutions, is to "think networks", i.e., identify and encourage them where appropriate."

Indeed Carley and Hill (1999) said that "A common conception of structure is in terms of the set of linkages among personnel; e.g., the authority network, the communication network, and advice network, the friendship network are all part and parcel of the structure of the organisation." The connections amongst social networks are likely to influence behaviour in the individual, and in groups (McPherson, 1983), as well acting to facilitate and to constrain change in organisations (Granovetter, 1985). Carley and Hill (1999), go on to say that "individual agency emerges from, is constrained by, and is enabled by structure." Hence the position that they hold within the structure, whom they know and what they know gives them the advantage or the restriction to get on within that organisation and beyond.

The concept of people organising themselves through a process of networking links in with the idea of self-organisation and emergence. Through a process of human networking, individuals are empowered to self-organise into working teams that are more efficient than those that are artificially created. The emergent output is more than the sum of the parts and may authors such as Stacey (1996) claim that networks should be encouraged as a means of making an organisation more flexible and to enable it to react and adapt more quickly. Wheately (1992) also says that organisations, like the natural world, can benefit through enabling networks to form and through utilising self-organisation, the emergent outcomes tend towards order and so a solution will emerge that fits the given problem at that time. Hence if the networks that emerge naturally are empowered, this can be utilised as a way of organising. A form of organising which Wheately feels is the natural and most efficient configuration. Within this study of social networks in an n undergraduate degree program the students worked in teams on project work. The project teams in this study were self-organised; perhaps this process of self-organisation allowed the students to perform to a higher standard than if they were allocated group membership.

Nonaka & Takeuchi (1995) also emphasised the importance of self-organisation in what is referred to as the knowledge creating company. They claimed that organisations that are successful in creating information are in fact ones that allow a maximum of self-organisation in order to form information out of chaos.

They reiterate the importance of self-organisation through human networking and espousing the network approach as ultimately the foremost organisational form.

So what exactly is a network? Mueller (1986, p 155), describes networks as "... informal systems where dissonance is encouraged and consensus a common goal. The nature of networks is that they are short-lived, self-camouflaging, and a-disciplinary. They are invisible, uncountable, unpollable, and may be active or inactive. In practical terms, networks nurture spontaneous feedback via telephone, mail, meetings, computers or a shout across the room."

Another definition comes from Friedkin (1998, p3): "A social network exists in a population of actors whenever we can say that "actor *i* is related to actor *j*" or that actor *i* is not related to actor *j* for each ordered pair of actors. Thus networks of kinship, friendship, advice seeking, and discussion (among other relations) may be defined."

The emphasis on the informal can regularly be seen in network literature. The first look at the informal organisation in organisation theory stems back to the 1930's when Roethlisberger and Dickson (1939) carried out the famous Hawthorne Studies. They found that the informal relationships between workers somewhat undermined the formal chain of authority and was a hindrance to productivity.

Others also stressed the role of the informal network as an antidote to the formal organisation. Indeed Roy (1954) and Dalton (1959) thought that informal social networks could be a means of subverting management dictates.

But other researchers did not view informal networks as negative, subversive activities, but rather, they took the view that networks could be used to bridge gaps and form relationships between different departments and overcome formal organisational routines which may have become too stuffy and constricting. Thus enabling enhanced organisational performance (Barnard, 1938; Kanter, 1983). In fact it is likely that the effects of informal networks can be positive or negative, depending on the intentions of the members of those networks.

Mintzberg (1979) also talked of the potential benefits of informal social networks. He emphasised that the organisation is made up entirely of such networks. Even the most bureaucratic of operations often requires the social network in order to "grease the cogs" (Powell and Smith-Doerr, 1994). Indeed Mintzberg claimed that it is often the more bureaucratic of organisations that may heavily rely upon friendship networks, co-operation between departments through personal contacts, and even a certain amount of rule bending or breaking for friends. The formal and the informal are then seen as interdependent.

Powell and Smith-Doerr (1994) reiterated the point that "The interplay between formal and informal structures – the chain of authority represented in the organisation chart versus the soft underbelly of friendship cliques and tacit workplace norms – is a recurring theme in organisation studies... Running through this work are the shared insights that informal relationships are at the centre of political life in organisations; that formal organizations are essentially patterns of recurring linkages among persons and that organizations are built on a complex mixture of authority, friendship and loyalty."

Shaw (1997), emphasised the role of the informal side of the organisation, calling it the "shadow organization", to reflect what is actually going on behind the formal front. She suggests "order emerges for free without any central or governing control or intention when the network is operating at "the edge of chaos conditions."

Ibarra (1992) also talked of emergent relationships in the informal network. "An emergent network ... involves informal, discretionary patterns of interaction where the content of the relationship may be work related, social, or a combination of both." The role of the individual and the social aspects of such relationships are thus accentuated. Nohria (1992 p4) says that "All organizations are in important respects social networks and need to be addressed and analyzed as such."

The role of networking in the organisation then is not only informal, but in being so, it is also social. Laumann et al (1978, p458) described a social network as "a set of nodes (e.g., persons, organizations) linked by a set of relationships (e.g., friendship, transfer of funds, overlapping membership) of a specified type." Indeed when Powell (1985) investigated the professional and social activities of editors in academic publishing houses, he found that there were no boundaries between work and social life. At all times these editors were found to be acting in such a way as to enhance the welfare of their organisation. Powell found that friendship, reputation, and business was virtually indistinguishably meshed together.

Powell and Smith-Doerr (1994) explained that social roles do not exist independently but by definition "exist only in relation to one or more complementary roles with which it regularly interacts. A role then, is not merely a label for a set of activities that an individual routinely performs; it also indicates the points of contact with other people occupying different positions. Thus knowledge of a person's network ties facilitates prediction of similarities between attitudes and behaviors (Emerson, 1972; Marsden and Friedkin, 1993)."

The informal and the social then are tightly coupled with the formal organisation. But what is the role of the individual? It is the actions of individuals that make up the whole that is the social or informal network. What is it that motivates an individual to act in this way, to take on a particular social role? It may be that they are actively networking in order to further their career i.e. to gain a network of access and opportunity. They may also be transferring or seeking knowledge or information, or they may simply be acting out of friendship and a shared goal.

3.4.3 Networks of Access and Opportunity

The concept of networking has become more and more familiar in the work place. To be an expert "reticulist"[2] (Mueller, 1986 p14) is the key to getting ahead in many organisations and industries. Some industries in particular "rely to a certain extent, on stable and enduring personal networks based on loyalties and friendships cemented over time. In sum, formal and informal organization are inextricably linked." (Powell and Smith-Doerr, 1994). Industries such as these include the film industry (Faulkner and Anderson, 1987); architecture (Blau, 1984), book publishing (Coser, Kadushin and Powell, 1992), and the diamond industry (Ben-Porath, 1980), all industries which it can be noted are particularly project based.

Networks of access are the key to getting into an organisation in the first place. Granovetter (1973, 1974), espoused the "strength of weak ties". He argued that an individual is far more likely to learn of a job opening through a weak tie than a strong one. He describes a weak tie as being a person with whom one is acquainted, but travels within different circles and a strong tie is a person that one is much more closely in contact with and who associates with the same people as you do. Indeed close friends, he claims, would have access to the same information as you do and so may not prove to be as useful in terms of supplying new contacts and information. Montgomery (1991)

[2] A reticulist is a person who purposefully attempts to network – to meet people that may be useful in some way, and to take advantage of personal contacts for personal gain.

and Granovetter (1986) both found through extensive surveys that as many as half of all jobs are found through personal referrals.

Debate also surrounds the notion that it is not only who you know, but also who you are yourself, that will influence the ability to develop and utilise these "weak ties". Campbell, Marsden & Hurlbert (1986) argued that these types of networks are not distributed evenly in society. The more educated a person is, the larger the network they belong to, and the more likely they are to be included in discussions with people who are, or who have the potential to be, useful weak ties. Those with a higher socio-economic status have more opportunities to form such ties with influential people both in a social and professional setting. (Marsden, 1987). This process comes full circle, as Granovetter found in 1974; people are more likely to secure jobs when they have a large network, the positions that they secure are then likely to be of a higher status and with better pay.

Whether one finds employment through a contact is also likely to be somewhat dependent on the size of the organisation. DiMaggio and Powell (1983) found that in smaller companies it is most likely that a new employee will have had some previous contact with the organisation and may also know the employer. Larger firms on the other hand are more likely to use channels that they have previously utilised such as university alumni networks.

Once an individual has entered an organisation, they then have to learn the ropes and find out the best ways to get things done. If an individual has entered the organisation through network contacts then he/she will already have informal relations in the work place that they can turn to for help. Granovetter (1986) argues that the common background that comes with having entered the firm through a contact not only makes the working environment smoother, it also means that individuals are likely to stay longer in the organisation and so reducing staff turnover. In the case of the undergraduate degree that was the focus of this study, some of the students had been recommended to take the course by peers, friends or relatives. This form of recommendation may help the student to settle in more quickly as they have access to advice and guidance regarding the work and the norms of behaviour to be expected.

So, it is more likely that an individual will gain entry to an organisation through network contacts, and once there, they are more likely to fit in, to learn about how the organisation works and their position within it. Another aspect in which such a network can be highly influential is when the individual needs to "mobilize resources to get things done." (Powell and Smith-Doerr, 1994) claim that network size and diversity are central to a person's ability to do so. They said "someone with a small set of overlapping, hence redundant ties is at a disadvantage when competing with someone with a large set of diverse ties. Diverse ties provide ready access to information on opportunities and threats. The ability to tap into rich stores of information makes it easier to generate support for one's agenda as well as block those whom one opposes." A student with a larger, more diverse network may be able to turn to many different people for advice about coursework or examinations, and may have more social support in terms of both emotional and practical assistance.

Boissevian (1974) also stresses the importance of brokers in this situation. Weak ties that are in strategic positions can be seen as brokers who bridge separate social worlds, allowing access to new information, and of course, yet more contacts with whom to forge a relationship. Powell (1993) and Rogers and Larsen (1984) found that this was particularly the case in, for example, the biotechnology field. Also prominent in high technology fields where venture capital and law firms act as brokers to bring together contacts that have either the money, or the research skills, as well as providing managerial and legal services once the relationship has been formed. By 'pulling strings' in this way the brokers can form alliances between complementary parties allowing the individual to achieve further progress in the organisational world. "Networks are the lines of communications, the alternative express highways that people use to get things done. In crisis and in opportunity, the word spreads quickly through these people-power lines." (Lipnack and Stamps, 1982).

Networks not only provide such contacts; they also provide the lines of communication. In order for those lines of communication to be useful, then the content and quality of the information carried is vital if the networking process is to reach its full potential. Burt (1992) indicates that in fact the key informational benefits of networks are the access, timings and referrals that they provide.

Carley and Hill (1999), takes this further by saying that the knowledge network "is the set of linkages between individuals and information, between "the who" and "the what". Logically there is another network of importance – the information network. The information network is the set of linkages among information" This would include mental models, frames, schemas etc. They say, "The important thing here, is that even as "the whos" can be related, so can "the whats."

It is not only the content of the information that is vital, but also what the individual does with that information. "The who is capable of knowing at least some of "the what" and is capable of taking action. Such actions might include storing, retrieving, manipulating, combining, creating, communicating the information or taking actions based on the information known." (Carley and Hill, 1999).

Indeed Carley and Hill (1999), widened the boundaries of the importance of what you know and who you know, by saying that: "This provides grounding for talking about the information that the agents have as including not just the "what", but also their perceptions of who knows who knows who (the cognitive social structure – Krackhardt, 1987) and who knows who knows what (the transactive memory Wegner; 1987, 1995). This is important when people make choices regarding whom they seek advice and communication or friendship from. For example student A will seek advice from student B regarding a certain coursework because he thinks she is knowledgeable, or perhaps because he thinks she will know someone who can help them.

3.4.4 Networks and the Transfer of Knowledge and Information

The process of knowledge transfer in organisations is said to be highly dependent on social interaction across organisational boundaries by members of a variety of external networks (Grandori and Soda, 1995, Alter and Hage, 1993, Tushman and Scanlan, 1981). Such networks include relationships between different types of organisation such as educational institutions, customers and suppliers, as well as professional associations that bring together members of the same field that work in separate organisations. This type of social interaction provides a forum for discussion, enabling the transfer of information. Indeed Tushman and Scanlan (1981), go further by saying that boundary spanning individuals act as a type of "technological gatekeeper." They are the individuals that belong to the professional associations and have the ability to understand information regarding technical innovations and choose whether to bring the information into the organisation.

The information, which is traded, plays a large part in a person's willingness to partake in trade-offs in the future. Schrader (1992 pp154 – 155) reported that 61 percent of 294 respondents considered colleagues in other firms to be very important sources of information. Indeed 19 per cent of his sample made up of engineers and mid-level managers were asked for information even by direct competitors in abundance of ten times a year.

Von Hippel (1988) found that the type of information traded in the specialised steel industry was inclined to be pertaining to such improvements as pollution control and labour saving, while more potentially monopolistic information such as key technical product advances would be likely to be closely guarded. Both Schrader and Von Hippel emphasise the importance of company benefit rather than personal benefit in this form of information trade-off. The influence of friendship and professional reputation is played down in these studies in favour of purely economic consideration for the organisation. The data did show however, that the act of information sharing is reciprocated.

Reciprocity and trust are closely linked. One is unlikely to give away information unless one feels that the favour will at some point be returned. Reciprocity is a vital variable in the recipe of information networks. Indeed Burt (1992 p13) argues that the choice of network contact is guided by "a matter of trust, of confidence in the information passed and the care with which contacts look out for your interests." He talks of actors being "connected to, trusting of, obligated to and dependent on" certain other individuals. This would indicate that individuals are not purely acting out of the economic interests of the organisation as claimed by Schrader and Von Hippel, but rather it is a more selfish act, a game of "you scratch my back and I'll scratch yours." Friendship, professional reputation, status, and kudos are all inextricably linked in the development and sustainability of network contacts.

Granovetter (1985) also suggests that, relationships must be built up gradually. That we most trust those informants that we have had dealings with before, and whose information has already proven to be reliable and useful. Galaskiewicz (1979 p16) particularly emphasised the role of the individuals creating network contacts out of self-interest. "... purposive action of social actors who seek to realize their self-interests, and depending on their abilities and interest, will negotiate routinized patterns or relationships that enhance those interests."

According to Carley and Hill (1999), building up a network relationship not only is dependent on the notion of trust and reciprocity, but also that the individual will be able to return that help within a certain threshold of time. They related this to structural learning in an organisation so that it might be based on future expectations rather than purely historical analysis: "Structural learning occurs when changes occur in the social network. Structural learning results in the adding and dropping of agents (individual representatives of the organization or the organization as a single entity) or choosing to continue or discontinue relations with those agents. An interesting aspect of structural learning is that it is often based on expectations about the future, and not just on direct historical experience ... For example, an organization may chose to establish a relationship (selling, vending, acquisition, etc.) based on the forecasted profitability of the firm in question."

The information that is shared then can be seen as two types. There is information regarding access and opportunity within an organisation and its competitors (the how to get in and how to get things done once you do). There is also the more technical information which may be used as a form of trading power or brokerage to make, utilise and maintain contact relationships which may in turn be reciprocated with technical information or information for access and opportunity. Individuals may trade technical information as a means of improving their professional reputation and status, such as in the field of biotechnology (Powell, 1993). The organisation will however, regardless of the originally unrelated motivation for trading such information, be able to benefit from what may be learned through such a process. In this way an organisation may benefit from the efforts of an individual who is networking for personal development or future anticipated career advancement, and who trades in information that will improve performance of the organisation regardless of original individual intention. We can see that it may be possible that the global outcome of individual choices may be more than the sum of those actions. Powell and Smith-Doerr (1994), talked of how "the movement of key personnel across organizations and the presence of professional associations further contributes to the diffusion of standard solutions to organizational problems." So, while individuals are networking in professional associations, the organisation benefits from information that is passed as a type of by-product to the networking process. Indeed as Krackhardt and Carley (1998) say "Networks of ties link not just people, but people, knowledge, resources, tasks etc", so that when people meet they do not simply connect themselves, they connect two strands of knowledge which has the potential to then overlap, bridging the gaps in each of the individuals personal knowledge.

These non-linear linkages between different types of networks can effect performance. "Change in the information network will interact with changes in the other networks to affect overall organizational performance." (Carley and Hill, 1999). In terms of the undergraduate cohorts in this study, the networking behaviour and patterns of communication and friendship networks of individuals may have a direct or an indirect effect upon their performance.

These networks are not static, but rather "Networks are constantly being socially constructed, reproduced, and altered as the result of the actions of actors." (Nohria, 1992). Indeed Carley and Hill (1999), say that "Consequently, dramatically different behavior (at both the individual and the organizational level) can result from seemingly innocuous changes in the underlying social knowledge networks, and so changes in the underlying structure and culture of the organization. Such changes are ubiquitous. However, continual change does not imply that we cannot predict the behavior of the organizational system. If we are to understand and predict organizational behavior then we will need to understand "the who" – social relationships – and "the what" – knowledge - which result in learning." Indeed it is likely that over the course of three years of study, friendship and communication patterns will change considerably. This will alter who has access to individuals both in terms of social support and in terms of help with particular subjects etc.

There are in fact many different types of network that combine to make up what Carley and Hill (1999) call the meta-network. For example the authority networks, the communication, friendship or power networks. "Networks of ties link not just people, but people, knowledge, resources etc." (Krackhardt and Carley, 1998). The emphasis in this study is on both the friendship and the communication networks within the cohort of university students. Carley and Hill (1999) said that: "Organizational theorists are very familiar with the network by linking people to people – the social network. The communication network, the authority network, and the friendship network, are popular examples of variations on this theme. The point here is that such networks link people to people. The relationship to other people provides access and exposure to knowledge, which in turn impacts the individual who then updates his or her knowledge absorbed from interaction with another person." Since such relationships provide exposure to knowledge and information it is logical to conclude that in a knowledge intensive environment such as an undergraduate degree, those with more access to such information are likely to perform better in knowledge related tasks such as coursework and examinations than those without such access.

Carley and Hill (1999) go on to say that although the social networks and knowledge networks are highly interactive, they are still separate subsystems of the same network. Thus the friendship and communication networks of the cohorts in this study have been measured separately in order to discover which type network particularly influences the student's performance.

The information can in some way be passed to an organisation as a form of by product of the individuals wishing to advance their own career, The information will be exchanged which may or may not be of benefit to the organisation. As Carley and Hill (1999) espouse: "Relationships among individuals are important as they facilitate individual access to knowledge and serve as a form of organizational knowledge." Hence we can see that what is in part the knowledge of the individual, also constitutes one section of the overall knowledge of the firm, so that "Organizations are composed of intelligent adaptive agents constrained and enabled by their positions in networks linking agents and knowledge. Consequently, organizations are themselves synthetic agents in which knowledge and learning reside in the minds of the participant agents and in the connections among them." The transfer of knowledge may be made purposefully but it is not purposefully gained by the organisation, rather the knowledge held by each individual contributes to the intellectual capital of the firm or work group.

Networks then are as much about process as they are about structure. In fact the network is simply an over all term used to describe the many relationships of which a system composed. The network does not stand alone but is created out of individual actions, which in turn are motivated by individual intentions. Hence it can be seen that individual intentions may have the global consequences of producing an identifiable network. This may in turn produce the global outcome of improved individual, organisational or group performance as a result of the trading of information in order to achieve those original individual goals.

3.4.5 Networks and Performance.

Since the Hawthorne experiments in the 1930's (Roethlisberger and Dickson 1939), researchers have been interested in the effects that social networks have upon performance both at the individual and work-group level. Management theory in particular has increasingly adopted the view that the embeddedness of individuals in social networks may be crucial in explaining organisational outcomes (Granovetter 1985). The structural properties of a social network created through the presence or indeed absence of relationships has been used to explain organisational advantage both in terms of organisational assimilation (Sparrowe and Liden, 1997) and promotions (Burt, 1992).

This principle of brokerage in network theory suggests that bridge building relationships provide people with a competitive advantage. Where people have indirect relationships between disconnected groups, they receive a disproportionate flow of resources. This theory of brokerage is the underlying principle of the structural hole theory of social capital. The structural hole theory comes from a medley of economic notions such as monopoly and oligopoly producing competitive advantage; sociological research on the autonomy created by having conflicting affiliations, (Simmel, 1922 and Merton, 1957); and further sociological research from the 1970's such as Granovetter's (1973) work on the strength of weak ties; Freeman's (1977) work on betweenness centrality; Cook and Emerson's (1978) investigation into the benefits of having exclusive exchange partnerships and Burt's (1992) research into how network complexity creates structural autonomy. The main premise of the structural holes theory is that where the division of labour has created specialisation people and organisations tend to concentrate on the immediate tasks without paying much attention to the tasks going on around them. Such division of labour leads to people becoming disconnected. This means that structural holes form as people and functional groups are not aware of what people around them are doing, and hence unaware of the benefits that the people around them could offer to the task that they are performing. For example by concentrating purely on a task in hand such as creating a computing program, one may not be aware that the person sitting next to you who may have knowledge of the programming even though it is not part of their job. By focusing on their own activities through the process of specialisation, people do not have the time to find out what other people are doing or what they know, thus providing holes in the sum total of social and intellectual capital as the information cannot flow. Those individuals that are connected to different groups then may be able to see where collaboration would be effective and who might have particular knowledge to contribute to a particular task, hence bridging the gap. Research has indicated that individuals who have networks that are rich in structural holes in the organisational setting receive higher evaluations (Rosenthal, 1997; Krackhardt and Stern, 1988 and Burt et al 1998). They also receive higher compensation (Burt, 1997, Bielby and Bielby, 1999), and gain promotion earlier (Burt, 1992; Gabbay, 1997; Podolny and Baron, 1997).

The structural property that the literature most often links with subsequent outcomes is centrality (the degree to which an individual is connected to others). Brass (1984) linked centrality with power, Ibarra (1993) linked centrality with innovation and Friedkin (1993) linked it with having influence in decision making.

There have, however, been relatively few studies directly linking centrality in social networks to individual and group performance at work. Brass (1981) examined the way in which employee's positions in networks of work-flow related to job characteristic and indirectly to job performance. Brass (1984) and Ibarra (1993) found that individuals who have high centrality in the work place have access to more resources, this may have subsequent implications for improved performance. Resources that are exchanged through informal networks include advice regarding how best to carry out work tasks, and strategic information. Central individuals have access to more people and hence access to more resources, being less dependent on any single individual for information (Cook and Emerson, 1978). Such centrality may not only mean access to resources, but may also indicate control over access to resources. Central individuals can act as gate keepers to other individuals with information. This structural property of a person's position in a network may explain why some people out-perform others in the work place. This advantageous position allows access to people who otherwise would be disconnected from each other. These individuals act as go-betweens and so they bridge the gap, or "structural holes" between disconnected people, allowing information and resources to flow around the organisation. This may in turn lead these individuals to gain from faster promotion, enhanced rewards and higher performance. (Burt, 1992). It is not just the size of the network that matters. Burt went on to say that developing a large number of contacts may not be as helpful as developing an advantageous position in a smaller network. A central position in a very small clique however may not be as advantageous. In a clique the same information will go round and round so that information that circulates within a highly connected group (clique), becomes redundant. Better to bridge the gaps between cliques and belong to many different small groups thus providing both access to more information and more control over how it is spread. The research in how information spreads within and between such cliques comes not only from the field of organisational research but also that of small group research (Burt, Jannotta and Mahoney 1998). In small group research experiments showed that where people have exclusive relations to others who would otherwise not be connected, they gain a greater amount of resources (Cook and Emerson, 1978; Cook et al, 1983). This type of boundary spanning in known as betweenness centrality. Brass (1984) found that those with a high betweenness centrality in informal communication networks not only had greater access to information, but they also appear to have utilised this information because they showed greater social influence and had a higher likelihood of being promoted. Rosenthal (1997) also looked at the effect of social networks on team performance. She investigated the effects of network constraint upon team performance, defining constraint as " a qualitative measure describing the pattern of connections between contact in a personal network. Constraint measures the extent to which relations in a person's network lead directly or indirectly to one contact. A clique, in which there is a high degree of overlap between contacts, is an illustration of a highly constrained network." Rosenthal found that there was a negative association between network constraint and team performance. This means that it is not enough simply to have a highly connected network within a team. The team also needs to be linked to the outside in order to benefit from further ideas and information / resources. If the network is constrained, the information flowing within the network will eventually become redundant.

Those with a central position in a network can also choose whom to go to for information and have more choice in whom to consult. Such networks of information can be seen as advice networks, people share resources such as guidance, information and assistance. Baldwin, Bedell and Johnson (1997) found that people who are central in the advice network, over time, pick up a lot of knowledge regarding solutions to task-related problems. Thus centrality in an advice network can indirectly affect job performance. As a person becomes more central and in turn more knowledgeable, they will then be sought out for further advice, gaining advantage in the knowledge seeking process (Cook and Emerson, 1978). It would appear then that their centrality and knowledge increases exponentially.

The ability to obtain information has been found to be directly related to job performance both at the individual and the group level (O'Reilly, 1977; O'Reilly and Roberts, 1977a, 1977b). Indeed the effects are felt far past the group level and up to the organisational level as information flows through the members connecting the whole system and working towards the goals of the organisation.

Sparrowe, Liden and Kraimer (2001) found that centrality in an advice network was positively related to individual performance, both in–role (tasks that workers are contracted to perform) and extra-role (tasks which workers perform that are above and beyond their expected duties).

Podolny and Baron (1997) found that informal networks in the workplace also transmit social norms and values, disseminating forms of social identity in the organisation. In the same way that an individual's position in a social network is thought to influence their job performance, so too density of relations within a group affects group performance. Molm (1994) found that where there is a great deal of communication between members of a work group, there is greater sharing of information, more co-operation and shared expectations. Molm also found that more dense advice networks within groups lead to mutual interdependence which in turn leads to co-operation, consequently enhancing job performance in groups. The more members of the group that are involved in sharing information, then the less the likelihood of there being redundant pieces of information. The more they talk the more they share and the better the group is likely to perform. Larson, Christensen, Franz and Abott (1998) found that the quantity of information shared is related to the quality of the group discussions. Such exchanges within the group will also serve to make group members aware of each other's roles in the group as well as serving to spread group norms and values etc. As group members become more familiar with each others' roles, their task behaviour becomes clearer, thus everyone is able to more quickly locate who knows how to do what, there is increased visibility and accountability and so enhancing group performance (Wegner, 1995). Sparrowe et al (2001) however found that centralisation at the group level was negatively associated with group performance. This finding was in line with Shaw's (1964) work on group structures which found that although centralisation was related to increased individual performance, it related to increased group performance only for simple tasks. Molm (1994) claimed that in fact the group performance was more than the sum of each of the individual's performance, which appears to have been shown in the previous two studies. This is because when working in a group situation there is an opportunity for reflection that is not apparent in solo work. Individuals can use the group to 'bounce ideas off each other'. They will need to defend their arguments in a group situation and so strengthening their ideas and standpoints.

Other authors have made the link between social networks and performance at the organisational level. In particular, literature on organisational design has suggested that it is the structural properties of groups that underly organisations that actually have an effect on organisational performance rather than the design per say. Tichy, Tushman, and Fombrun (1979) suggested that macro level organisational design characteristics do not influence group or organisational performance directly, but rather it is moderated by the impact that it has upon flows of communication and information etc. Organisational design has a direct impact upon the way in which information flows throughout the firm which in turn creates formal and informal structures which in turn affect performance. Research has suggested that mechanistic organisational design, for example, is characterised by low centrality, a lower number of clusters and lower density of relationships. Organically designed forms however tend towards a greater level of connectivity, greater reciprocity of relationships and fewer isolated individuals (Payne & Pheysey, 1971; Tichy & Fombrun, 1979; Tichy et al, 1979, Tushman, 1979).

Mehra, Kilduff and Brass (2001) also found that high centrality related to high individual job performance. In addition they related this phenomenon to the personality of those who are likely to become highly central. They found that people who were high self -monitors[3] were likely to occupy positions of high betweenness centrality. No doubt those with personalities that find it easy to be more adaptable in social situations find it easier to bridge the gap between different groups of people. He found that people who were high self-monitors were likely to be highly central and in turn people who were highly central were likely to achieve a higher level of job performance.

National culture may have an effect upon how social networks evolve. Burt et al (2000) found that while social networks were found to be equally important in French as in American business, the networks evolved differently and for different reasons and the act of networking was perceived differently.

One of the most important factors for managers is that research has shown that social networks can affect performance in terms of profitability. Krackhardt (1994) and Krackhardt and Hanson (1993) conducted a study of the social networks of twenty-four local branches of a large American high street bank. They found that where there was little hierarchy in the channels of communication and informal networks were allowed to flourish. This informal two way conversation between colleagues at all levels led to these non-hierarchical branches being 70% more profitable than the branches which kept to more formal, hierarchical forms of one-way communication. Robbins, Pattison and Langan-Fox (1995) came up with similar results when they investigated fifteen local branches of a retail bank in Melbourne, Australia. They found that where there was evidence of informal networks of friendship and communication, sales performance was increased. They concluded that positive informal relationships amongst peers and

[3] Self – monitoring: a personality trait. Individuals who are high self – monitors will assess social situations and act differently according to how they perceive they should in that given situation.

between managers and subordinates resulted in producing enthusiastic members of staff who would be influenced and motivated to make more of an effort to sell products.

Performance of an organisation can also be measured by how long it survives. Research has found that success of entrepreneurial start-ups depends (amongst other things) on the proliferation of the entrepreneur's social networks. Family and friends can help an entrepreneur in terms of financial assistance, emotional support, information regarding business ideas, potential employees, suppliers, customers, business opportunities. (Bruderl and Priesendorfer, 1997; Flap et al, 1998). Weaker ties, colleagues and regular customers may also be an invaluable source of information. The social network at the community level can also have a positive effect upon the performance of start-up businesses. Flap et al (1997) proposed that the bounded network of ethnicity and extended family contributes to the success of ethnic entrepreneurial start-ups.

Lazega (1998) also found that advice networks had an effect upon performance. He found that in a law firm, lawyers who where actively sought out to give advice to colleagues earned more money for the law firm for which they worked. This may however be a case of the opposite cause and effects whereby lawyers seek out their more able colleagues to give them advice, colleagues that in turn make more of money for the firm. Indeed other studies have shown that it may be the good performance of an individual or organisation that in fact effects the social network rather than the other way around. For example Bass (1990, p667) found that where work groups are successful they have more of a tendency to socialise together. Similarly, Blau and Alba (1982) found that where a company or department within a firm has more prestige and is perceived to be high performing, the informal, social network power of its managers is increased.

As social networks can influence the performance of individuals and teams, so social network analysis can be used as a tool to diagnose areas of the social network that may need attention. In their paper entitled "Making Invisible Work Visible: Using Social Network Analysis to Support Strategic Collaboration" Cross, Borgatti and Parker (2002) found that by identifying individuals who are highly central in a network, they in

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Individuals with low self-monitoring are much less adaptable and are likely to be the same regardless of the situation.

turn identify those with the most control over information or decision making. This knowledge of the informal network can be utilised by management as they can reallocate informational domains or decision making processes to make the group as a whole more effective. Also where an investigation into the social network reveals subgroups, or fragmentation between hierarchical or functional boundaries, efforts can be taken to instigate discussion between disparate groups. By identifying patterns of actual behaviour, one can begin to work towards directing the flow of information in the way you require it, promoting collaboration across functions and ultimately strategic benefit. By raising awareness of social networks, Cross et al found that individuals would concentrate more on improving their own connectivity, by doing so benefits are produced not only for the organisation but also the individual's opportunities increase and it becomes easier for them to get things done in the work place. Cross et al do however warn of the dangers of taking over-correcting measures. They suggested to one organisation that their research scientists might work more efficiently if they interacted across geographical boundaries. As a result the organisation put into place many interventions that would ensure that such cross-geographical work ensued. After these interventions had been in place for some time another social network analysis was performed which found that while the cross-geographical interaction had been increased, this was in fact to the detriment of relationships within geographical locations. They found that people within the same functional units and in the same building were no longer well connected because they were too busy collaborating with researchers in different locations. Hence a balanced approach is required as well as one which monitors the shifting social networks across time, as they continuously evolve.

3.4.6 Social Capital and Education

The total of relationships that a person has access to at any given time can be a resource to them in just the same way as other resources such as money and tools and buildings are seen as resources. The term social capital was first used by Loury (1977, 1987). Loury used the term to describe the set of resources that are evident within families and communities and which can be useful for the cognitive development of children and adolescents. Such resources can provide a child with an important educational advantage just as access to book would be an advantage to their education. The theory of Social Capital was introduced into economic theory by Loury as a form of antidote to the prevailing economic theory that people acted as individuals in a type of isolation where their actions were not influenced by other. This form of individualistic theory had been prevalent in economics from political thinkers in the seventeenth and eighteenth centuries, from Adam Smith's invisible hand and beyond.

Ben-Porath (1980) also advocated the social capital approach again within the field of economics, he developed the notion of the F-connection in exchange systems. The F in F-connection refers to family, friends and firms. The F-connection draws together theories from anthropology, sociology and economics and states the importance of family, friends and firms within the exchange process. People do not act in isolation, all things being equal, because all things are not equal. Even within the most obviously economic exchanges, for example on the stock market at the Chicago Mercantile Exchange, Baker (1983) showed how the social relationships amongst floor traders greatly affected the way in which they traded. Indeed Granovetter (1985) refers to this way of ignoring the relationships that are effective in economic exchanges as the "undersocialized concept of man." He claimed that all economic actions are embedded in a network of social relations, and they cannot be separated from such patterns that have always been present within and around economic transactions.

Such social resources or social capital can be an aid in allowing a person to achieve their goals. Lin, Ensel and Vaughn (1981) and later Lin (1982, 1988) investigated how people are able to exploit their social resources to their personal advantage particularly in terms of their attainment in the workplace. They found that people were able to utilise their social ties to get jobs beyond the position they were initially in, thus those ties were a form of social capital.

Coleman (1990) wrote of social capital in his overview of the "Foundations of Social Theory." He claimed that the situations that provide social capital typically have two characteristics. Firstly they consist of some form of social structure and secondly they facilitate certain actions of the members of that structure. Coleman gives the example of a group of activist students in Korea. The students meet under the guise of church groups or study groups. This gives the social structure to the group. The social capital of the group can then be used not only to worship or to study but also to discuss politics and to plan actions. In this way social capital that is found in a group with one purpose can facilitate the actions of its members for another purpose.

In terms of applying this notion to education, Coleman claimed that "Probably the most important and most original development in the economics of education in the past thirty years has been the idea that the concept of physical capital, as embodied in tools, machines, and other productive equipment, can be extended to include human capital as well. Just as physical capital is created by making changes in materials so as to form tools and facilitate production, human capital is created by changing persons so as to give them skills and capabilities that make them act in new ways. Social capital in turn is created when the relations among persons change in a way that facilitates action. Physical capital is wholly tangible, being embodied in observable material form; human capital is less tangible, being embodied in the skills and knowledge acquired by an individual; social capital is even less tangible, for it is embodied in the *relations* among persons."

Coleman (1988) investigated social networks in high school education from the social capital perspective. In particular Coleman talks of how important the closure of social networks is in the formation of norms. He claims that in Catholic high school education, parents of children know each other and this helps to establish and reiterate the norm that enforces the importance of high educational achievement. This is also known as "intergenerational closure" (Hallinan & Kubitschek, 1999), and Coleman argued that students' increased academic performance will come about due to such closure as it means that parents have shared norms and values, an interest in social control and an active interest in school-related matters. He claimed that the religious ideology of the Catholic school was such that all of the children were seen to be important in the eyes of God and so the education of each one is important. The religious aspect also added to the social closure in that not only would the parents know each other through their children, but also through their community and the church. In summary, Coleman claims that Catholic schools produce more learning than the public schools in America because they have a greater wealth of social capital to draw upon. This work has been controversial however and has sparked-off some debate. Morgan and Sorensen (1999) used publicly available data from the National Educational Longitudinal Study (NELS) which was carried out in America in 1988 in order to investigate Coleman's claims for the effects of social network closure upon educational performance. Rather than labelling the two types of schooling as Catholic or Public, Morgan and Sorensen labelled them as norm-enforcing schools and horizon expanding schools. They felt that where schools had horizon expanding networks, this meant that the children's parents had friends outside the school's social circles and that this opened up different and more fruitful opportunities for learning than did the closed system of the norm-enforcing or Catholic schools. The links between such types of network relationships and its effects upon the children's learning of mathematics was tested. Morgan and Sorensen found that the horizon spanning schools produced more learning of mathematics as opposed to Coleman who found that the Catholic schools produced more. They claimed that this was due to the parents having links with adults outside of the school and that this provided the children with more opportunity to get help and to talk with people outside the system. In network terms the children are able to make use of structural holes. The children have access to different groups that they could not access if the system were closed, thus the parents bridge the gaps between different cliques, allowing the children to benefit from knowledge held in these cliques. Morgan and Sorensen claimed that the horizon expanding schools produced more learning for two reasons: " (1) Exposure to the wider society within which local school communities are embedded increases student's efforts to learn and (2) social closure among parents limits access to informal learning opportunities provided by information flows from the wider society."

In the same issue of the American Sociological Review, Carbonaro (1999) referred to his 1998 study in which, using the same set of data as Morgan and Sorensen, he came to the opposite conclusions. Carbonaro found a "modest positive association" between closure and the students' learning. He claimed that Morgan and Sorensen's statistical methods did not concentrate on learning at the individual level but rather on the aggregate school wide level. He claimed that Morgan and Sorensen's measure of social closure "confuses rather than clarifies the matter."

Hallinan and Kubitschek (1999) writing in the same issue of the American Sociological Review also criticised Morgan and Sorensen. They criticised both their conceptual and methodological approaches. They claimed that "The absence of clear and concise definitions of norm enforcing and horizon-expanding schools and the social networks that characterise them leads to logical gaps in their reasoning and raises questions about the fit between their propositions and their analyses." Indeed they then go on to question their analyses also: "Inattention to careful interpretation of the effects of collinear variables leads [Morgan and Sorensen] to questionable conclusions that, even when statistically accurate, are overly detached from the social processes they purport to examine. As a result we cannot determine on the basis of their study, whether social capital and intergenerational social closure behave in the fashion presented by Coleman, in the manner represented by [Morgan and Sorensen], or in some other way."

Morgan and Sorensen where able to take up the right of reply, once again within the same issue of the American Sociological Review (Volume 64, 1999). They claimed that much of the criticism that was aimed at their work in fact applied to Coleman's original theories. They acknowledged the limitations of the data that they used, and that their definitions of norm-enforcing and horizon-expanding schools were an "ideal-type distinction." They still maintained however that "the main conclusion of [their] article stands without dispute... With careful analysis of the best available data, the well-studied Catholic school effect on mathematics achievement cannot be explained away by any specification of network closure variables."

In a investigation again utilising the same data, Morgan, (2000) found that closure in parental networks of middle school children had a positive association with learning. However, in the case of high school children there is no positive relationship between such network closure and learning in mathematics and reading. Morgan conjectures that in middle school the children benefit from the network closure because this helps to reinforce norms that state the importance of education and of being well behaved in school etc. In high school however, the children would benefit more from relationships outside of the school. By high school information becomes more important than the norm of valuing scholarly behaviour. By high school the children need to be not only well behaved but also need access to information if they are to pass their exams.

Putnam (1993) and Bourdieu (1986) have proposed further definitions of social capital. Putnam (1993) carried out influential work and was followed up by various papers (e.g. 1995). Putnam's notion of social capital consisted of four components. The first component Putnam claimed consisted of various networks which combined to constitute the civic community. Networks of institutions, facilities and relationships in family circles, the state and voluntary circles and the density of the relationships within and between such networks constitute (claimed Putman) only the first aspect of social capital. The second component consists of a person's feeling of belonging to these networks and to the civil community in which they are embedded, and so whether they feel a sense of solidarity and also equality with others within this system. The third component of social capital as outlined by Putman contains the norms of trust, reciprocity and co-operation that govern the networks (as also mentioned in Coleman's definition of social capital. Finally, the fourth component outlined by Putman consists of having a positive attitude towards the relationships one has in such networks and towards the wider community in which one is embedded. Putman claimed that levels of social capital under his definition could be seen to have a causal effect upon economic development in different States of America. He claimed that people's relation towards their social networks and the wider community that their networks link them to has wide reaching effects upon their health and well being.

The focus of the work coming from American researchers has been rather different to that of the European and UK research in the same sort of area. Indeed there have been criticisms of transposing arguments that apply to American research to UK settings (Rustin, 1997). There are many cultural differences between America and the UK, including notions of citizenship mentioned by Putman that do not necessarily apply to the UK. One of Putman's measures of social capital for example looked at to what degree a person feels positively towards ones city and ones country. This measure of social capital is not really applicable in a culture that does not always value outward displays of national pride. Another difference in the two cultures is the norm of business involvement in schooling. Sponsorship and involvement by business of schooling at all levels is regarded as a norm in the USA and is one of the ways in which Coleman (1994) suggested that social capital be enhanced. Indeed Bordieu warned of the possibility of "persistent and serious misunderstandings in the international circulation of ideas." (1991: 382.)

Bordieu, along with Coleman and Putman has been one of the most influential writers in the field of social capital. Bordieu (1993) distinguished between cultural and social capital. He described cultural capital as academic qualifications, modes and styles of presentation including language, confidence and etiquette, and cultural material objects such as paintings and writings etc. He described social capital as consisting of social networks and connections: "contacts and group memberships which, through the accumulation of exchanges, obligations and shared identities, provide actual or potential support and access to valued resources." (1993, p252). For Bordieu social capital also contains an element of sociability, the skill a needed to be able to promote ones self in such networks and hence to be able to profit from the wealth of social capital that is built up.

Bordieu's theories were taken up by Allatt's studies of three middle class English families (1993, 1996). Allat found that parents actively encouraged "responsibility, individuality, hard work, effort and pleasure in achievement, social competence and access to critical social networks." (1993, p157)

Whilst Bordieu warned of the dangers of applying theories from different cultures, the same may be said about generalising his 'old boy network' theories of cultural and social capital to any other sector of the British population.

Other criticisms of Coleman and Putman theories of social capital include that of the work being ethnocentric and that it does not take into account gender (Morrow, 1999). Morrow also accuses Coleman of not contextualising his work in terms of social and economic history. His 1961 study, upon which he bases his notion of social capital, was of young people who would have been born at the time of World War Two. Whilst Coleman continues to refer to this study through the 1990's he does not take into consideration any differences in generation or the effects that being born at such a turbulent time my have had on his set of subjects.

The structuralist approach to social capital emphasises that social capital is embedded in all relationships in society. The majority of studies regarding social capital focus on the positive aspects that it can bring about, but as social capital is embedded in all social relationship, some relationships are positive and some are negative. Greeley (1997) claimed that social capital is "a resource, available in social structures, that facilitates actors who wish to seek certain goals and as such is neither good or bad." Indeed it may well be that the goal a person is seeking to achieve is not a positive goal.

Portes and Landolt (1996) undertook a study in poor neighbourhoods in America and found that:

> "In poor areas, many people rely on their social and family ties for economic survival… There is considerable social capital in ghetto areas, but the assets obtainable through it seldom allow participants to rise above their poverty. For all their negative connotations, inner-city youth gangs are also social networks that provide access to resources and enforce conformity… For a ghetto teenager, membership in a gang may be the only way to obtain self-respect and material goods. In the long run, however, the pressures from these groups may hold him down rather than raise him."

Although this study did investigate the effects of social capital on youngsters, the work on social capital in education by such authors as Coleman, Putman and Bordieu has traditionally taken a top down approach. They have looked at the effects of the networks of parents and how this has influenced children and young adult's educational experiences and performance. These studies have tended to neglect the importance of the social capital created by the youngsters themselves. Whether looking at networks of five year or fifteen year olds, or indeed the networks of eighteen to twenty one year olds (the traditional age for higher education attendance), these children or young adults have the ability to choose their own friends and to develop their own social networks. They can build and utilise social capital just as their parents can.

In order to investigate directly how such linkages are formed and the effects of these patterns within education the more direct social network analysis approach would be better placed to provide meaningful conclusions than the less tangible theories of social capital.

Whilst the American literature has tended to concentrate on the rather "nebulous concept" (Morrow, 1999) of social capital, the European research has tended towards narrowing down the field to that of social networks. Social capital has been associated with various rather intangible meanings such as the formation of norms and feelings of belonging and civic pride. Measures of social capital have included such variables as how parents relate to children, how people feel about where they live, to what extent they trust their politicians and how much they feel that they belong to their community.

Social network analysis on the other hand is both conceptual and methodological. Rather than the researcher attaching social categories a priori, the network analyst investigates network ties in order to find the pattern of a social network and investigates the links between micro network behaviour and macro outcomes.

3.4.7 Networks and Performance in Education

There has been little reported research linking the fields of social networks and performance in education. The majority of social networks / performance literature has concentrated largely on performance of and within organisations.

Research into the effects of performance in education is interesting not only in terms of viewing education as just another sector, but because the educational setting also has properties which differ form other commercial organisations. Each individual is in the educational organisation to achieve a personal goal. Amongst their peers, individuals are free to develop social relationships freely; there are no hierarchical restrictions such as those in a commercial organisation, which restrict a person's friendship and communication choices. People can generally choose with whom they make connections and in turn develop relationships that may enhance one's closeness to knowledge and resources. However in reality, despite there being no hierarchical or structural reasons to prevent friendships occurring, social norms and cultural differences may influence who one is likely to make friends and communicate with. Early research has suggested the importance of visible attributes such as gender and race as a basis for choice in the formation of networks (Hughes, 1946). Blau (1977) also suggested that individuals tend to choose to interact with people similar to themselves, particularly in the case of relationships such as friendship where the relationship is emotional rather than instrumental. Such homophily in networks can lead to people from minority groups being segregated into separate informal networks (Brass 1985). Mehra, Kilduff and Brass (1998) investigated a cohort of an American master of business administration (M.B.A.) class. They found that relative to the majority of students, women and racial minorities were more likely to identify and make friendships within group. This marginalization of racial minorities was the product of being excluded and also the minority's own choice. The marginalization of women however was found to be more the result of exclusion by men rather than the women's own choice. Such exclusion from informal networks is likely to have an effect upon the access a person has to the resources and information that may help them to do well in an educational setting.

Baldwin, Bedell and Johnson (1997) carried out a study of 250 American M.B.A students, investigating the effects of social networks upon individual and team performance. Many undergraduate and post-graduate degrees have as an element; a certain amount of team based project work. As the provision of this team-based education is becoming increasingly popular, it is assumed that such co-operative learning will have a different outcome than individual learning. It is assumed that the interaction of students will contribute in some way to the student's learning. They claimed that there are two different ways in which student's interaction can have an influence on their performance and their attitudes. Firstly, such interaction can have a direct influence in cognitive processes for instance in how they communicate with others and how they verbalise their ideas and opinions, restructuring information. Secondly, such interaction promotes mediating variables, creating an emotional climate conducive to learning through peer motivation, emotional support etc. Johnson and Johnson (1993) similarly said that peer interaction within education can significantly affect a students performance and their satisfaction with the course, independent of instruction or other educational variables.

In their network study of M.B.A. students Baldwin, Bedell and Johnson (1997) found that student's centrality in a communication network was positively related to their individual grades, with their satisfaction with the course, and with satisfaction of the provision of team based learning. Centrality in the friendship network was also positively associated with satisfaction with the course and team based learning, though there was no positive association between friendship centrality and individual grades. Further more, Baldwin et al found that friendship and communication relationships were largely formed within teams. It is not surprising then that Baldwin et al also found that levels of communication within teams had a direct and strong influence upon the members perception of team effectiveness, thus showing that groups who communicate more have a stronger level of group cohesion. Where teams had a large degree of friendships outside of their group they were found to be less successful than the groups whose friendships and communication remains within the group. This would appear to go against the structural hole theory. If the communication stays within the group, all of the students will eventually know the same thing, there is no opportunity to bridge the gap between different groups and hence the gaps between different sets of knowledge. Baldwin et al conjectured that there is a limit to the usefulness of socialising and that students who are extremely sociable may not in fact find the time to do their work, so that embeddedness in friendship networks may lead to positive or indeed negative outcomes for the student.

3.4.8 Social Network Analysis as a Methodology and Theoretical Framework

Social network analysis investigates the relationships amongst social entities and the patterns and implications of those relationships. It is the systematic study of social structures. Wasserman and Faust (1994) define structures as regular patterns that occur in relationships, and the qualities that measure such structure are known as structural variables. The type of relationship measured in social network analysis can vary from economic and political to emotional. This section outlines Social Networks Analysis as both a framework and a methodology. It then goes on to describe its' historical development.

Social Network Analysis provides precise formal definitions to aspects of political, economical or social structural environment and the patterns and regularities occurring in relationships amongst interacting units.

The approach differs from other perspectives in that rather than the unit of analysis being the individual, it is an "entity consisting of a collection of individuals and the linkages among them." (Wasserman and Faust 1994).

Historically, research has focused on individuals and the society that they live in. People have been categorized a priori into categories such as sex or race and then the link between such an attribute and another, for example religion and sex is examined to see if there is any correlation between a person's sex and whether they have a strong faith. Many correlation analyses can be carried out, for example sex and religion or sex and littering but all of the results will depend upon how the researcher categorised the individuals in the first place. In fact classification does not determine ones actions. One does not say I am male therefore I litter.

Historically, sociological research has indicated that individuals who share similar characteristics share the same norms and so will act in a similar way. The behaviour of individuals is thought to be embedded in the structure to which they belong. The structural analysis perspective opposes this view, it says that in fact such norms arise from the position of the individual or the group. It is this position that determines the constraints and opportunities available to the individual. This is not because of the relationship of the individual to the whole, but rather the whole is an abstract form which is in fact made up of many actual solid relationships. It is these relationships which determine the opportunities and hence the flow of resources and information between individuals. It is the relationships amongst individuals which puts some people in a better position than others, they have access to more resources than others and thus they can use their position to their own advantage. It is not then the structure that influences the norms of the individual, but rather the individual creates the relationships that make up the structure.

Network analysis investigates overall relations of a group inductively in order to discover behavioural patterns and emergent groupings. The important groups are identified a posteriori, and the constraints of the structure can then be ascertained. For example, by examining all of the relationships that make up the structure of an undergraduate cohort, it may transpire that one student has significantly less relationships than the others. His position in this structure and the constraints of this position mean that he has less access to resources than the other students and so this may effect his academic performance. If one was to investigate the students' performance, correlating it with various a priori categorisations, none such categorisation would be a true indicator of this phenomenon.
Social network analysis makes assumptions regarding the importance of relationships amongst interacting individuals or units. Wasserman and Faust (1994) outlined other notions that differentiate social network analysis from other approaches:

- "Actors and their actions are viewed as interdependent rather than independent, autonomous units."

- "Relational ties (linkages) between actors are channels for transfer or "flow" of resources (either material or nonmaterial)."
- Network models focusing on individuals view the network structural environment as providing opportunities for or constraints on individual action."
- Network models conceptualize structure (social, economic, political, and so forth) as lasting patterns of relations among sectors."

The focus of this type of social network analysis has grown out of social theory concepts whereby the focus is on social aspects and attributes, using the network analysis approach to gain insight into such phenomenon. Another focus of network analysis investigates the structural properties of networks themselves.

Social network analysis can be used both descriptively and as a theory-testing device. Descriptively it can be used to provide formal definitions and descriptions and measures of social groups, identifying structural relationships and providing statistical analysis of systems that contain complex multiple relationships. This can be taken a step further and used to test theory. For example in this study, social network analysis is used descriptively to gain further understanding of the relationships amongst a group of students. The results of this analysis are then used to investigate whether there is any correlation between friendship and communication and students performance, testing the theory that those who are more central in the network will out perform those who are less so.

3.4.9 The Historical Development of Social Network Analysis

Initially there were three main traditions in social network analysis. Sociometric analysts investigated small groups and produced many technical advancements in graph theory. A group of Germans working in the USA in the 1930's, these analysts were highly influenced by Wolfgang Kohlers gestalt theory. Kurt Lewin, Jacob Moreno and Fritz Heider were particularly influential social psychologists who were influenced by the gestalt approach. Their work looked at group dynamics and sociometry from a cognitive and social psychology perspective. Laboratory experiments and case studies were used to investigate the structure of small groups and the way in which information flowed throughout them. Moreno (1934) in particular used experimentation to discover how the way in which people react and relate to each other in the group setting could bring about opportunities and limitations for their personal psychological development. Moreno was concerned with micro level social interaction and its effect upon the macro level society. He linked psychological well being with the social configuration that an individual is involved in. He claimed that all of the relationships of friendship, adversary, attraction etc, combined into a whole which he termed the social configuration. These social configurations in fact combine to make the whole structure of the society, right up to the level of the economy and the state as a whole. His outlook can be directly related to gestalt theory. The meaning of the word gestalt is "organised whole". Thoughts are structured into organised patterns that create a whole. The whole has distinct properties from the parts that it is made up of and so the whole is more than the sum of its parts. For example the way in which people perceive individual objects relies upon preconceptions within the complex conceptual structures of the mind. Such objects are not perceived independently, but symbiotically contribute to the structure through which they are perceived. In the same way Moreno (1934) claimed that people's relationships made up the social aggregate and this society influenced the way in which relationships are developed. This focus on the interaction of people at the micro level and the resultant macro level aggregates were a development of the sociological ideas of German sociologists Weber, Tonnies and Simmel.

Moreno invented the 'sociogram', a device used to represent the formal properties of social structure. In the sociogram, individuals are represented by points, and the relationships between them are represented by lines. This was a new development as previously the terms network and web were used purely metaphorically. This sociogram was used to identify the flow of information along with the leaders of a group and those on the outskirts. The sociogram could also be utilised in the investigation of the symmetry and reciprocity of relationships amongst individuals.

Lewin (1936) investigated how group behaviour is determined by the field of social forces in which it is embedded. This perspective claimed that groups do not exist independently of their environment, but rather the group and environment have a symbiotic existence. In turn the environment is not independent from the perceived environment. Its members actively construct the perceived environment. In 1951, Lewin further investigated this phenomenon. Field theory identifies the interdependence between the group and its environment through a system of relationships. Like the sociogram, in field theory, individuals are represented by points, the lines represent the goals, actions, interactions and causal sequences apparent in the system. Within the field model, isolated patterns can be identified whereby the field as a whole is separated into regions with connections amongst members of the regions but not between them. These patterns determine how individuals can move amongst their social circles and show the opportunities and constraints offered by their boundaries.

Heider (1946), also a cognitive psychologist, concentrated on interpersonal attitudes, and the balance of such relationships amongst groups. Attitudes can be positive or negative and balance is achieved when people have the same sign. Again it is the perceived attitude that is vital rather than the actual attitude. For example Heider would concentrate on whether person A perceived that B and C had the same attitude to each other rather than whether they actually did. This was a phenomenological approach rather than a realist approach. It was Lewins' mathematical approach to social networks however that was taken up by other scholars rather than the field theory approach. In particular, Cartwright and Harary (1956) applied graph theory to group behaviour. Graph theory is a set of mathematical principles that can be used to describe and investigate the properties and patterns of the points and lines that make up the sociogram. This enables the identification of group cohesion, power, leadership and social pressures / opportunities and constraints. The lines in the graph can be attributed positive or negative to imply the status of the attitude, and also can be given direction by adding an arrow-head. In particular, Cartwright and Harary found that large complicated structures were constructed from very many smaller, simple structures consisting of triads, or groups of three individuals. An analysis of the balance of the whole network can be derived from an analysis inside and between subgroups.

This concept of balance was particularly prevalent in studies of leadership and group cohesion, and was also incorporated into general systems theories, rationality and cybernetics. Rapoport, (1952, 1958), was particularly influential in espousing the formal implications of such studies and applied the ideas to the spread of information, ideas and innovation.

While the German researchers in America were concentrating on social network analysis from a cognitive psychology perspective, Harvard researchers were concentrating on interpersonal relationships and the formation of cliques. Mayo (1933) developed the work of Radcliffe – Brown, a British born anthropologist. In particular they focused upon the importance of informal relationships in social systems with particular emphasis placed upon the effects of such relationships in the factory work place. Mayo carried out an investigation of the informal relationships in the Hawthorne electrical factory in Chicago, and a community in New England. In the 1920's, the Hawthorne studies were initiated after researchers found that by making various changes in the working environment, the productivity of the workers was increased despite what alterations were made, whether positive or negative. Mayo that this increase in productivity came about because the workers felt that the management were taking an interest in them and including them in the development program of the firm. This instigated a further anthropological investigation by Mayo and Warner, into the behaviour of work groups within the natural setting of the factory. The Harvard group used sociograms to identify the group structure in the bank wiring rooms of the factory, and were able to recognise the informal structures that the workers developed as opposed to the formal structures that were imposed by management. The group talked of informal structures, these structures were self-identified by the workers, they were not deduced, and did not arrive from a theoretical understanding of how social networks may influence group behaviour.

Warner and Lunt (1941)carried out his anthropological study of a small New England city that he nicknamed 'Yankee City' between 1930 and 1935. He found sub-groups, such as the church, families or classes, but he also found cliques within those subgroups. These cliques were given the same significance as the informal organisation in the Hawthorne studies, and the cliques were seen as vital to the integration of an individual to the society as a whole. "Such overlapping in clique membership spreads out into a network of interrelations which integrate almost the entire population of a community in a single vast system of clique relations." (Warner and Lunt, 1941, p111.)

The Hawthorne and New England studies were being carried out at around the same time as the sociometric analysts were working on cognitive psychology related studies, but it appears that these studies were carried out in isolation. George Homans, a Harvard sociologist brought the two strands together in the late 1940's. Homans felt that in order to understand the wider scale society, one must understand small-scale interactions between the individuals who make it up. He brought together the experimental work of the social psychologists and the observational work of the anthropologists, concentrating on the interactions between individuals and how they vary in direction, frequency and duration etc. He re-examined the data from the New England study by reshuffling the matrix. Data had been collected about women attending social engagements. A x was placed in the matrix where a woman had attended a particular engagement. When the functions were placed randomly in the columns it appeared that there was no pattern to the relationships. Homans pioneered the process of reshuffling the matrix, convinced that a pattern could be found. He placed events with a large number of attendees together in the columns and in the rows, he placed together the women that attended a large number of events. By reshuffling the data in this way a clear delineation of two cliques could be observed. This method later came to be known as block modelling. Homans did not do any further mathematical analysis on these blocks however, he carried out the reshuffle by trial and error, and algorithms were later developed to carry out this process by computer. Homans developed a framework similar to that of the earlier small group analysts, perceiving the individual and the group (internal system) to be part of a symbiotic system with an environment (external system). He thought that the internal system was more of a scientific concept than the informal system referred to by Mayo and Warner. He claimed that the internal system contained certain universal propositions. He claimed for instance that people who interacted frequently with each other liked each other and that subsequently, as interaction increases, so too does that liking. The external environment may interfere in the form of the management of workers, for example and this too can increase liking amongst the internal system and create cliques of individuals bonding together to the exclusion of others. Homan claims that this is the way in which the complex social network develops, divided in to recognisable cliques.

A group of anthropologists in Manchester also developed the ideas of Radcliffe-Brown but in a different direction. In particular the influential members of the group were, John Barnes, Clyde Mitchell, Max Gluck and Elizabeth Bott. Their emphasis was not on cohesion and integration, but rather on conflict and change. Gluckman carried out anthropological studies in African villages, linking the cultural perspective and the structural approach into his investigations. Gluckman thought that power and conflict were a vital part of any social structure. For him interactions consisted not only of friendship and liking, but there was also a constant negotiation, bartering and bargaining involved and an underlying battle for supremacy. Rather than concentrating on the formal norms and values of society, the Manchester researchers concentrated on the relationships amongst individuals that arise through the process of conflict and power seeking. Previously models of kinship and interaction had been assumed but the notion of conflict did not fit in with this outlook, and so they began to employ the metaphorical terms of networks and webs of interaction. Though purely used metaphorically in the first instance, Barnes began to use the network concepts more analytically in the 1950's. Barnes along with Bott produced many papers (Barnes, 1954; Bott, 1955, 1956) in which the need to recognise the role of the network in complex societies was espoused.

It was Clyde Mitchell who really began to bring all of the strings together in the 1950's. He returned to graph theory and used it to create a sociological framework to explain the structural organisation of society.

Nadel was an Austrian psychologist who was also influential in the field of social network analysis. He transferred to anthropology in the early 1930's and in 1955 presented a series of lectures that were influenced by Barnes and Bott. Nadel (1957) argued that in order to describe and investigate the structural features of relationships, and hence society, one must separate the form of the relationship from its contents. In particular Nadel saw the concept of roles as vital in sociological theory. He said that social structures are in fact structures made up of roles and that sets of roles can be defined through networks of activities that are interdependent. After Nadels untimely death in 1956, Mitchell carried on his work and codified social network analysis and began to talk of 'personal order'. Mitchell (1969, p10) said that personal order was the pattern of "personal links individuals have with a set of people and the links these people have in turn among themselves." He said that the interactions between individuals can fall into two types. The first is communication whereby individuals transfer information, establishing social norms and consensus amongst the population. The other type of interaction involves the transfer of actual goods and services between individuals. (Mitchell, 1969, p36-39). He claimed that interactions often combine the two elements and so social networks consist of the flow of both information and materials and services. He said that in order to study the entire social network or community empirically as a whole it is often necessary to select part of network. This can be achieved in two ways. Firstly one can study the network surrounding one individual in particular (the ego network). Secondly one can study the partial network as a form of representative or abstraction of the total network, for example kinship or friendship ties, work related ties, or as is the case in this study, the ties of friendship and communication within a group of classmates.

Mitchell also identified the need to describe the quality of relationships, highlighting reciprocity, intensity and durability. These categories were similar to Homans's direction, frequency and intensity. For example, as will be highlighted throughout this study, one person may chose another as a friend, but the feeling may not be reciprocated.

Alternatively exchanges may be complicated and two individuals may provide each other with different things. For instance, one student may be able to offer academic advice, while in turn the other may reciprocate with friendship.

Mitchell found that the durability of relationships was another important aspect for social network analysis. Kinship ties for instance are likely to last for a life-time, while those ties created in order to work on a project together may prove to be transient.

Relationships may also differ in intensity, for example, more may have a 'best friend' or an acquaintance. Mitchell also adapted some concepts from graph theory to social network analysis such as density, the extent to which all possible relationships are actually present. Barnes and Bott had referred to this as the 'mesh' and 'connectedness of the network', but the use of graph theory provided more explicit mathematical definition. Mitchell also talked of 'reachability', or how easy it is for one person to contact another through a limited number of steps. This concept is particularly useful when looking at the spread of information, rumours or innovation. Barnes (1969) later added to this by defining the terms 'cliques', and 'clusters' in order to describe groupings of individuals within the total network.

The work of the Manchester group in Britain came to be largely associated with anthropological studies and in particular ego-centric networks. This focus was perhaps to the detriment of realising the global potential of network properties, and so broader applications of network theory were not conducted in Britain.

A crucial breakthrough occurred at Harvard where Harrison White began to talk of the global properties of social networks, developing comprehensive social network analysis as a methodology to investigate the underlying basis of social structure. In particular the group of colleagues and students led by White concentrated on a mathematical approach to structural analysis, modelling social structures of all kinds. They did not follow one particular theoretical approach, but rather what they had in common was that they used algebraic models in order to gain further understanding into structural relations, thus it was the use of network analysis that linked them rather than the subject area or the theoretical approach.

Granovetter's 1973 paper "The Strength of Weak Ties", was a relatively non-technical piece which came to be highly influential in the promotion of the utility and validity of network analysis. Previously the network analysis had been largely used to investigate interpersonal relationships, but Granovetter's work prompted others to begin to investigate relationships between organisations, and interlocking corporations. In this way the focus began to lie on the methodology and its use in a wide variety of applications and the International Network for Social Network Analysts was founded in Toronto, lead by Wellman and Berkowitz, both former students of White. The studies carried out by Granovetter (1974) on 'Getting a Job' and by Lee (1969) on 'The Search for an Abortionist' were particularly influential in promoting the use of social network analysis not only as a descriptive tool, but also as a deductive one. Thus enabling the researchers to test theory as well as to describe a social structure. These studies used simple frequency tables, but they showed that even the simplest social network analysis methods can give a great deal of insight into a given social structure.

The application of formal mathematical models led some researchers to go so far as to claim that social network analysis may offer a new theory of social structure. For example Barnes and Harary (1983), argued that formal concepts that are utilised in social network analysis could be extended and used as formal theories, based upon formal mathematical theorems.

Others have taken this further, and have suggested that the developments in social network analysis actually point towards a new sociological theory. Authors such as Cook (1977, 1982); Emerson (1962, 1964); and Cook and Whitmeyer, (1992) associate an exchange theory approach to social network analysis. Bailey (1969) and Boissevain (1974) relate it to a transactional approach while Lin (1982) has been an advocate of rational choice theory as a perspective on social networks.

Most extremely and indeed most recently, Emirbayer (1997) and Emirbayer and Goodwin (1994) argued that social network analysis may be seen as a basis for 'relational sociology'. This could replace previous sociological approaches that have concentrated on culture and meaning, but do not take into account rational choice and exchange theories.

In this way social network analysis has developed from being seen as purely a set of methods, into an actual theoretical orientation which points towards the structure of society and the micro level exchanges which constitute those structures.

In more recent years the focus on Social Network Analysis has become split between the mathematical and the social. Statisticians are continually developing further algorythms in order to measure various forms of centrality. Social Scientists are developing the use of Social Network Analysis in the field. Typically they are linking the Social Network Analysis with something else that they are investigating, searching for the links between a persons social network and other aspects of their life such as getting a job, promotion or indeed performance on an undergraduate degree.

3.4.10. Summary

An emphasis on social networks has been evident in areas such as sociology, anthropology, psychology and even molecular biology since the 1930's. Social networks consist of patterns of relationships between social entities such as individuals, teams or organisations. The social network approach (also known as the structural approach), investigates patterns of relationship and flows of information and resources and the implications of such relationships.

Social Network Analysis has developed as both a theoretical framework and a methodology since the 1930's.

Organisation theorists have investigated social networks at different levels of resolution from the individual to the organisation and industrial sector. The embeddedness of individuals in a social network is inevitable in an organisation and the implications of this are far-reaching. Notions of self-organisation and emergence can be seen as a natural form of organising behaviour. Work often gets achieved by the use of such informal networks, and these informal networks are often at the centre of political life within an organisation. Such social or informal networks can not only help to get things done when one is in the organisation, but can often help in getting the individual into the organisation in the first place. Friends, or even more so, friends of friends (weak ties) are often used to find out about job vacancies and to introduce an individual to fill a vacancy. Once a person is in an organisation they may also use their social network both to get things done and to move ahead and gain promotion.

The transfer of knowledge in an organisation is said to be highly dependent on social interaction, both with the organisation and across organisational boundaries. Such relationships rely upon a firm foundation of trust and reciprocity which is often built up over time, enabling individuals to share both information regarding access and opportunity and also more technical information.

Since the Hawthorne experiments in the 1930's researchers have been interested in the links between social networks and performance. People who have large social networks have access to a flow of resources that they could make use of and hence enhance their performance. Structural hole theory suggests that where a person has indirect relationships, bridging gaps between different groups, they are likely to access to more information. This is also known as Granovetter's (1973) theory of the strength of weak ties. One is likely to be aware of all of the opportunities of access that one's closest friends are also aware of. However an indirect relationship is more likely to throw up some new information regarding for example a job opportunity or a flat share. For example one asks people in their social network to "keep an eye out" for a particular job vacancy etc.

Centrality in such networks have been linked with increased performance of individuals and groups in terms of power, profitability, innovation and influence in decision making. Research shows that the ability to obtain information through such networks is directly related to job performance at the individual and group level (O'Reilly, 1997; O'Reilly and Roberts, 1977a, 1977b).

Social capital is a term first coined by Loury (1977), used to describe the set of resources that are evident within families and communities. In particular such resources can provide important educational advantage for children and young adults. Coleman (1990) claims that social capital typically has two characteristics: the form of social structure and the facilitation of certain actions of the members of that structure. For example a group of church goers whose structure is formed for the act of worship may utilise that structure to facilitate other outputs such as political action or charity fundraising.

There has been great debate regarding social capital and schooling. In particular authors such as Hallinan and Kubitschek (1999) have argued that where social capital is high, for example in Catholic communities, children's education benefits. Some claim that this is due to social closure, where children's parents all know each other and are able to reinforce norms regarding the importance of education. Others such as Morgan and Sorensen (1999) feel that in contrast public (non-Catholic, horizon –expanding) schools, where children's parents know people outside their own religious community offer children more opportunities for learning than the norm-enforcing or Catholic schools.

Bordieu is one of the most influential writers in the field of social capital. Bordieu (1993) distinguished between cultural and social capital. Cultural capital includes academic qualifications, modes and styles of presentation including language, confidence, etiquette and cultural objects such as paintings and writings. Social capital according to Bordieu, consists of social networks and connections which provide actual support or potential support and access to valuable resources.

Some of the theories of social capital have been criticised for being ethnocentric, not taking into account gender and not putting studies into context in terms of economic and social history.

Greely (1997) pointed out that while the majority of studies regarding social capital focus on its positive aspects, there may also be some negative outcomes to social capital. As social capital is a resource that actors utilise in order to achieve their goals, that goal may not always be a positive one, for example the social capital found with in a street gang may help an individual to be successful in criminal activities.

American literature has tended to concentrate on social capital while European research has focused more upon social networks.

There has been relatively little research that specifically links social networks and performance in education. In a study of 250 American M.B.A. students, Baldwin, Bedell and Johnson (1997) found that a student's centrality in communication networks was positively related to their individual grades and their satisfaction with the course. Centrality in friendship networks was also positively associated with satisfaction with the course, though not with individual grades. They thought that students may experience a detrimental effect on their individual grades when they are extremely central in friendship networks and socialise a great deal.

3.5 Performance Predictors in Education

3.5.1 Introduction

The next section outlines research regarding predictors of educational performance. Academic predictors of educational performance include previous academic performance and entrance examinations. Other predictors of educational performance include demographic variables, cognitive variables, psychosocial variables, and attitudes towards working in groups.

3.5.2 Entrance Examinations and Previous Academic Performance as Predictors of Performance in Higher Education

There have been various contradictory studies regarding the relationships between gender, race and performance in entrance examinations in comparison with actual performance in higher education. Such research includes American studies such as Kaczmarek and Franco (1986), and Michael, Nadson and Michael (1983) who investigated the links between graduate record examinations (GRE) which students sit in order to get into graduate school, and their performance as graduate students. They found that GRE scores for women were significantly correlated with their actual graduate grades, the men's entrance examination grades did not correlate with their subsequent performance. Kirchner (1993) however, came to the opposite conclusion and found that student gender was not a significant moderator variable of the relationship between the American entrance examinations to graduate school and their subsequent performance. House (1994) investigated this further and found that there was significant correlation between a students' performance on the entrance examinations and their performance at graduate school. This conflicting research cannot therefore tell us with any degree of certainty whether such a test can accurately predict subsequent performance or indeed whether the student's gender is a moderating variable in such a prediction.

Similar studies were carried out in Australia. Overall the research found that correlation between end of high school performance and performance at university was stronger for science related courses than in humanities, social science and arts related topics. (Lewis, 1994, p.6).

Power et al (1987) found that the correlation between secondary school grades and Grade Point Average (GPA) at university was around 0.5. They did however find that the degree to which university performance can be predicted by secondary school achievement differs for various individuals and groups. For example secondary school grades were found to be less accurate at predicting university level performance in mature students, than in school leavers. They also found that where female students had the same secondary school grades as male students, the female's performance out-stripped the male's at subsequent university level.

Other academic predictors of academic performance include study skills. Abbott – Chapman, Hughes and Wyld (1992) found that students who had poor study skills would be the most likely to have problems adjusting to university academic life, and will be the most likely to withdraw from their chosen course of study.

The links between previous academic performance and performance in graduate education have also been investigated. In research on graduate management education, previous academic performance stems from the student's achievement as an undergraduate and at secondary school. The evidence regarding previous performance as an academic predictor is not conclusive and is often conflicting. Hecht and Powers (1982) carried out a multiple correlation investigation taking undergraduate grade point average, GMAT (Graduate Management Admission Test) scores and first year MBA grades as the variables. The correlation ranged between .12 and .67, and so they were not able to conclusively show a relationship between performance at the three different levels.

Such investigations into the performance predictability of such examinations as A levels are however skewed from the beginning. Any student that gets a place on an undergraduate degree at university earns that place by performing to a certain standard at A level or equivalent. For the undergraduate degree in Management and Systems in this study for example, all of the participating students were required to gain a minimum of 24 out of a possible 30 points for the year 2 and 3 cohorts and 26 points for the year 1 cohort at A level. (Entry requirements were raised for the 2001 intake.) This means that only 20% of the possible performance scale at A level have been accepted onto the course (although in some circumstances age and work experience may be taken into consideration).

The fact that students within higher education must have performed well on A level or equivalent entrance examinations rather skews the sample. It is impossible to fully predict whether high scores in such tests are truly a predictor of performance in higher education because those who did not score highly would not be eligible for a place at university.

3.5.3 Demographic Variables as Predictors of Performance in Higher Education

Research into the relationship between age and academic performance at university level has shown inconsistent results. Clark and Ramsay (1990) for example found a significant negative relationship between age and academic achievement. Others claim that mature students are more likely to be high achievers at university. Mature students are often more focused on achieving their goals, have clear career intentions and less need for social integration as they already have a life outside of the university setting. Employment status has also been shown to be an effective predictor of performance in universities. Pantages and Creedon (1975) found that full-time students that hold part-time jobs of more than fifteen hours per week are more likely to withdraw from a degree course than those who have employment of less than fifteen hours weekly. Yang and Lu (2001) found that neither the student's age or gender proved to be significant predictors of academic performance.

3.5.4 Cognitive Variables as Predictors of Performance in Higher Education

Research has shown that self-efficacy is a predictor of performance at university level. Lecompte et al (1983) found that the degree to which a student believes that they will succeed (self-efficacy) has a highly significant positive association with the level of performance that the student actually achieves. Student with high self-efficacy also are significantly less likely to withdraw from the degree course. Peterson and Barrett (1987) similarly found a negative relationship between student's negative attributional style and performance in the first year of study at degree level. Gul and Fong (1993) investigated performance predictors in an introductory accounting course in Hong Kong, They found that self expectation of success, followed by personality and then English Secondary school education were the largest contributors to the regression model they built in order to predict success.

Further research has examined the relationship between cognitive complexity and student performance. Armenic and Beechy (1984) found differences in performance between students with high cognitive complexity and low cognitive complexity. Gul et al (1992) investigated the performance of accountancy students with different personality types. Their results suggested that students with a field-independent cognitive style out performed those with field dependent cognitive style.

3.5.5 Psychosocial Variables as Predictors of Performance in Higher Education

Tinto (1975) has been a major contributor the literature regarding how psychosocial variables can predict performance in higher education. One of the main variables that Tinto found to predict university performance is the degree to which the student is integrated into the university. When investigating student attrition, Terenzini and Pascarella (1978) found the most significant predictors to be social and academic integration. They found that previous academic performance and personality traits were accountable for only four percent of the variance in attrition rates. It is clear than that integration into the university via friends and communication networks can have significant implications for academic performance at undergraduate level.

Other psychosocial variables which research has shown to be effective predictors of performance at university include: financial situation, career orientation, and social support. Lecompte, Kaufman and Rouseeuw (1983) found that the most common reason for leaving university was financial difficulties. Himelstein (1992) found that those students who expressed clear career orientation were likely to perform better on degree courses. Gerdes and Mallinckrodt (1994) found that social support was particularly influential in terms of academic performance at university. They found that students who had friends, family or a spouse to provide strong social support were less likely to leave their studies and were more likely to do well academically. Lecompte et al (1983) found that students who reported high anxiety at the start of the academic year were likely to perform poorly at the end of the academic year. Again, if students have more social support they are likely to feel less anxious than those who do not have anyone to talk to at this difficult time of adjustment.

3.5.6 Attitudes to Working in Groups as a Predictor of Performance

Freeman (1996) carried out an investigation into whether attitudes towards group work can be used as a predictor of academic success. She found that such attitudes explained a significant amount of variance in student's grade point average. Time spent working in groups was also found to be a significant factor. The longer a student spent working in such project-based groups the higher their individual performance. Group grades were also affected by the amount of time that they worked together, the more time the group spent together the higher the subsequent group grade. Freeman also found that the concept of fairness was a significant predictor of performance. Individuals and groups performed better when they felt that the entire group contributed equally. Freeman hypothesises that "perhaps the efforts contributed by others assisted the student in learning the material, and, to the degree that other members contributed fairly, there was more opportunity to perform at a higher level."

Freeman also found perceptions of the value of group work to be a significant predictor of an individual's grade point average. Those who valued working in groups were seen to get more out of the experience, such people are able to utilise the relationships to their own advantage.

3.5.7 Summary

Research into the relationships between gender, race and performance in entrance examinations and subsequent performance in higher education has been contradictory. High school performance is a more accurate predictor of performance in science related higher education courses than in social science and arts related subjects. The evidence regarding previous academic performance as a predictor of educational performance is not conclusive and is often conflicting. Indeed performance indicators such as A level or equivalent are skewed from the start as a student must achieve a certain level at A level in order to be allowed a place at University. This means that we cannot assess the how a student with low grades at A level would perform at University as they would not gain a place.

Research into the relationship between age and academic performance also shows inconsistent results. Cognitive variables such as self-efficacy, personality types and cognitive complexity, were found to be effective predictors of academic achievement. Psychosocial factors such as the degree to which a student is integrated into the University can be used as a predictor of academic performance. Other such psychosocial variables include financial situation, career orientation and social support.

Another predictor of academic performance is a student's attitude towards group work. Particularly where group work is an integral part of a degree program, the students who valued this type of work format were found to perform better.

3.6 Learning From and With Others

3.6.1 Introduction

This section will begin by defining what a relationship is and highlighting the literature that expresses how relationships can play a crucial part in learning. I then discuss the elements which research suggests should be present within a relationship that promotes learning. Such elements include trust, commitment, reciprocity and an empathy with the vulnerability of the learner, though I argue that the relationship may not be reciprocated in the same manner as there is often an imbalance of power or emotion present in relationships. The section continues by outlining the proliferation of group project work in education and particularly in higher education in Management. It explains how working in groups can provide various opportunities for learning. The group members learn both with and from each other. Much of this learning is from peers, both the individuals within their project group, and also other peers that are on the course, at the same University or simply going through the same experiences. There follows in this section a review of the literature regarding learning from peers and the informal learning of which this is constituted.

3.6.2 Relationships and Learning

The very word relationship has certain implications towards how people interact and can learn from and with each other. The word relationship stems from the Latin 'to carry back' e.g. one individual can relate information back to another. In this way communication is implied, so that relationships can be expected to consist of some form of communication, a relation between people and ideas. The word relation shows the existence of a connection or association. Tiffany (2001, p.94) said the word "[Relationship] might be the 'fit between two bricks in a wall, the links among nations in an association such as NATO, the logical connection between two ideas." More commonly a relationship signifies interpersonal relationships. Usually such relationships have positive connotations such as friendship; love and respect, but some interpersonal relationship may also be construed as negative such as animosity or jealousy. Generally in order to promote learning and in particular informal learning relationships should be positive. Goetschius and Tash (1967, p137) described a relationship as "... a connection between two people in which some sort of exchange takes place." The notion of exchange is indeed crucial also to the concept of informal learning. Students communicate and swap ideas with each other regarding both knowledge and information as well as an exchange of social support. In order for such an exchange to take place there must be at least two people in the relationship. This means that there are likely to be two viewpoints of the topic being discussed, but also of the relationship itself. The two people will interpret things differently and understand things differently. Tiffany (2001, p95) therefore suggests that in order to get to the type of exchange that Goetschius and Tash talk about something more is need. "The idea of exchange involves something moving between two people, an 'in-betweenness' to which both contribute and which affects both. A relationship in this sense involves a series of commitments and obligations over and above those typical of everyday contact."

The main emphasis in a relationship then is exactly what is exchanged. In education it may be the interchange of information about particular subject areas or about study skills, ideas on both subject matter and ideas regarding how best to go about learning. There may also be an exchange of friendship which would be a basis for sharing, a reason to share.

Tash (1967, p19) summarised the notions regarding 'what is a relationship?'

> "First there are (at least) two persons in the relationship, each with thoughts and feelings about the other. Second, it can be seen (presumably by participants and / or onlookers) that the connection between the two people is of a particular kind, which results in people talking of a 'mother / child relationship', a sexual relationship', or a professional relationship. Third, the definitions imply that the two persons are in contact with each other, exchanging ideas, giving and taking, talking and listening. Fourth, they indicate movement, that a relationship is not static, but that changes as well as exchanges are taking place."

Theories regarding relationships do not necessarily include learning as an outcome. Indeed theories of learning are often inclined to concentrate more on cognitive rather than relational moderators. Learning theories tend towards how people learn rather than the relationships that must be present in order to facilitate such learning. It is often accepted however that the learning of small children is highly dependent upon the relationships that they have with their parents or carers, and that such early relationships can have far reaching effects well into later life. Therefore it is not unreasonable to suggest that relationships that are built throughout childhood, adolescence, and on to adulthood can have a substantial affect upon a persons learning. Indeed Rustin (1998, p29) suggests that:

"If emotional interaction is as fundamental an element as this in the development of the mind of the infant, it seems likely that emotions continue to be dynamic elements in the learning process throughout life, and certainly throughout childhood."

Given that relationships can influence learning, Tiffany (2001, p99) suggests that in order to be beneficial to learning a relationship must contain trust and commitment, mutuality and an appreciation of vulnerability. In terms of trust and commitment Tiffany went on to say:

> "Trust implies some form of emotional investment in a relationship. At the same time, it implies thought. We can make judgements about whom to trust, when to trust and what to trust these others with. In addition we learn to trust (or not) as the trust we invest in others is confirmed or disproved. A pattern develops of trust at different levels, a product of both experience and the context of the relationship we are in." (2001, p99)

Such trust is vital in all relationships and this is also the case in a relationship that facilitates informal learning. Research has shown that there are some features that are particularly prominent in establishing trust in relationships. Salzberger-Wittenberg et al (1983) talked of 'beginnings' and 'endings' in learning relationships. They claimed that beginnings indicate initial trust and are the foundations upon which a relationship can be built. Endings signify the withdrawal of any emotional input. They said that learning actually becomes more difficult the greater the number of beginnings and endings that are experienced by the learner. Each new beginning means establishing trust and that may become harder to do as a person experiences more beginnings and endings. A person will find it harder to trust if that trust has been broken on the past. This means that all of one's actions may potentially have an effect upon another's ability to trust and so to learn. The trust in a relationship allows people a safe environment in which to explore ideas, reflect upon their own thinking and assimilate the thinking of others into their own judgements. It is this form of reflection that makes learning possible. Such trust Tiffany suggests (2001, p101) must also be accompanied by a degree of commitment if it is to provide a fruitful learning opportunity. Relationships involve give and take and to some the aspect of reciprocity may be important. However whilst Tiffany suggests that relationships must be reciprocal for learning to take place, any relationship will involve two people's viewpoints and outlooks so that whilst relationships are usually reciprocal that may not necessarily be equal. There may be a balance of power in the relationship or it may be that one person gets more out of the relationship than the other. Relationships do not necessarily have to be reciprocal in order to produce learning, indeed quite often a weaker student will turn continually to a stronger student for help and so the learning process is not reciprocal. However there is likely to be some other aspect of the relationship which is reciprocated in order for the stronger student to decide to help the weaker one. Either way, if learning is to take place within the relationship, Tiffany (2001) suggests that an appreciation of a persons (the learners) vulnerability must be present. In order for a person to feel confident enough to make the mistakes that may be necessary in order to learn, and to engage in new tasks, they must be able to feel that they are being understood, and their feelings of anxiety and nervousness are being empathised with. Rustin (1998, p38) says that there is a need to "tolerate lack of knowledge and competence, invest effort in [enabling learners] to acquire these, and to bear with the pain of doing so."

Such aspects of relationships are crucial not only to personal relationship but also according to Habermas (1984, 1990, 1990a) for society as a whole. Habermas challenged the predominance of 'instrumental reason' in industrial society. Such a society tends towards reasoning and scientific thinking and tends to ignore the importance of the more social aspects of society, and the importance of human relationships. People are essentially social and learn best from others. Any learning will benefit from a facilitating relationship as people do not function individually but are embedded within a series of social relationships. Rustin (1998, p34, p38) described learning as an:

> "emotionally charged process in which relationships in which persons feel themselves to be valued and understood are a key precondition... nothing can compensate for the absence of engagement in the learning task in a creative relationship with a teacher and with fellow – learners."

Indeed the relationship with fellow learners can provide as much opportunity for learning as that of the educator, and the manipulation of learners into project work groups has become more and more widespread within Management education.

3.6.3 Learning in Groups

Project work groups are thought to be useful in many ways. They are thought to mirror the real life business and management situations that the students are preparing to enter. For example Lawler (1991), and Magjuka and Baldwin (1991) reported a dramatic increase in the involvement of employees in work teams or groups for project based work in organisations throughout the 1980's and into the 1990's. It is argued by Slavin (1995) and Chalmers and Volet (1997) that collective methods of learning such as group project work suit some students better than individualistic styles of learning in more traditional courses. Group projects can also aid learning by providing a variety of learning opportunities. By working in a group a student can gain access to different points of view and different problem solving methods. The group can provide a forum that enables the members to discuss and even defend their points of view, hopefully formulating a better answer than if they were to work on the project individually. It is hoped that by working in groups, not only will performance on such group works be improved but also future individual performance will improve on tasks such as problem solving, decision making and examinations (Freeman, 1996). In the context of the BSc degree course in Management and Systems, the role of group work is particularly important. If the students are later to become managers they will almost certainly need to form and supervise working groups of some sort.

Each project group consists of individuals, each of whom brings a unique set of experiences and beliefs. Each individual will differ in terms of what motivates them, how they form social relationships, how they are likely to interact with other group members, the confidence they have in their own ideas and the degree to which they are willing to listen to the ideas of others. (Bar-Tal, 1990; Fiske and Taylor, 1984; Markus and Zajonc, 1985; Price, 1987; Veiga, 1991).

Bar –Tal (1990) and Sherif, (1966) found that such beliefs and values brought by individuals to the group collectively form the groups attitudes and therefore directly affect cognitive behaviour and performance both at the individual level and at the group level.

A great deal of research has been carried out on the relationships and behaviour of small groups. Freeman (1996) identified in the literature many factors that influence how much a person will identify with their group. Some of these factors include common goals, common standards, common interests, common knowledge, shared sentiments, perceived similarities, interpersonal attraction, proximity and time spent together. (Asch, (1952); Campbell (1958); Hogg and Turner (1985); Moreland (1987); Pryor and Ostrom (1987).
Asch (1952) and Bar-Tal (1990) found that such variables could be used to predict group behaviour and individual behaviour within the group. They found that this was particularly the case in groups where the members become reliant on each other. Bar-Tal (1990) and Bar-Tal and Kruglanski (1988) found that much of an individual's knowledge comes from interacting with other people. Thus the knowledge shared within a project group is very likely to have a large impact upon the individual's performance both within the group and in subsequent individual projects.

Lawler (1991) found that not all individuals welcome the opportunity to work as part of a group. In particular, where individuals have a strong need for personal achievement, they may feel restricted by membership of a group who they feel may not be as committed. For a person to gain form a group work experience, they must place some value on social interaction. Shea and Guzzo (1987) also found that if individuals have a strong need for achievement and do not value the group experience, they are likely to reject the group concept and the individuals making up the group. Such individuals may undermine the relationships that make up the group, thus having an adverse effect upon both group and individual performance.

In terms of learning through group project work at university, Freeman (1996) claimed that "In a group environment, the student is exposed to divergent opinions and ideas that may serve to develop and clarify his or her own perspectives and appreciation for alternative viewpoints. Work in groups also provides each student the opportunity to build on mutual inputs in a collaborative learning environment. Group interaction and discussion should help augment what an individual could learn and retain on his or her own. Academic performance should reflect this enriched learning environment and enhance an individual's likelihood of performing well."

Feichtner and Davis (1984) and Slavin (1995) have presented evidence to show that learning in groups can improve the performance of students under conditions of outcome interdependence such as shared goals to earn good grades, recognition, or other measures of group success. This shows that interaction among students, be it through social support or the transfer of knowledge and the discussion of ideas, is a vital constituent of performance both as an individual and as a group as a whole. This logic can easily be taken up a level from the project work group to the cohort as a whole. The interaction of students with others who are sharing the same academic experiences, course works, examinations and deadlines is an important component that may add to their academic achievement on the course.

3.6.4 Peer Learning

The concept of peer learning was recorded as first being introduced into higher education at the Free University of Berlin in 1951. The concept of a peer can be defined broadly as "someone of the same social standing. While a peer group consists of those of the same status with whom one interacts." (Falchikov, 2001).

Newcomb and Wilson (1966) identified the peer group as the most powerful influence in teaching and learning in undergraduate education.

Piaget (1971) felt that co-operation between peers in education can encourage discussion and exchange of thoughts. He claimed that such co-operation was vital for developing an analytical or critical mind, objectivity and discursive reflection. It is only through co-operation and discussion amongst peers that one can develop such skill; it is relatively difficult to have a discussion with ones self. Indeed Vygotsky (1962) argued that the range of skills that can be learned through co-operation with peers far outweighs those that could be developed by an individual in isolation.

The literature regarding peer learning has often tended towards the peer tutoring model rather than peer learning (e.g. Falchikov, 2001) Rather than the term peer learning meaning the informal exchange of knowledge, it tends to refer to formal sessions in which one student will tutor another. Such sessions tend to be set up by the educators. Peer tutoring implies that one of the peers takes on the role of tutor while the other takes on the role of students. Peer learning however is more of a reciprocal process in which both of the peers are learning, roles are not set and can change at any time. Indeed Boud, Cohen and Sampson (2001, p4) define peer learning as "students learning from and with each other in both formal and informal ways."

Much of what is learned from peers however is done so in informal exchange, or informal agreements to help one another that are not sanctioned by the educator. Boud et al (2001, p6) go on to say that it is a common misconception that peer learning is purely about group projects. This mistake is often made, as there are a confusing array of terms in the literature such as peer learning, peer tutoring, co-operative learning, collaborative learning etc. To add to the confusion some terms are used interchangeably and often proponents of for example co-operative learning are also proponents of group work learning (e.g. Johnson and Johnson, 1997). Boud et al (2001 p.7) describe how the notion of co-operative learning grew from developmental psychology – cognitive, social and developmental psychology. This approach focused on group interaction, social learning, individual skill development and management of the education environment.

Collaborative learning has its roots in American higher education institutions. In collaborative learning there is an emphasis on the educator setting open ended though focused tasks that the students are expected to work together on. Thus a form of interdependent study is encouraged rather than independent study. Bruffee (1999) refers to this approach as 'constructive conversation' because the students construct their own knowledge by discussing ideas and knowledge and coming to conclusions through such conversations.

Not only can peer learning lead a student to gaining greater academic success, it is also thought that it may help student to learn other vital skills that will stand them in good stead in the work force and in society in general. Boud et al (2001) felt that peer learning can help to promote the following learning outcomes: working with others; critical enquiry and reflection; communication and articulation of knowledge, understanding and skills; managing learning and how to learn and self and peer assessment.

3.6.5 Informal Learning

The sociology of education literature usually emphasizes the individual's formal rather than informal learning and level of education (Girod, 1990). However, a sub group of researchers at the Economic and Social Research Council (ESRC) have become increasingly interested in the notion of informal learning and are involved in a program of research into informal learning, entitled "The Learning Society." Frank Coffield (ed. 2000 p1) described informal learning in the following way: "If all learning were to be represented by an iceberg, then the section above the surface of the water would be sufficient to cover formal learning, but the submerged two thirds of the structure would be needed to convey the much greater importance of informal learning." The program commissioned 14 research projects, none of which originally had informal learning as its main focus. As the research came to light, they found increasingly that in fact informal learning was much more significant than they had anticipated. Within the same program Michael Eraut (2000, p12) redefined informal learning as "non-formal learning". He claimed that the term informal is "...associated with so many other features of a situation – such as dress, discourse, behaviour, diminution of social differences – that its colloquial application as a descriptor of learning contexts may have little to do with learning per se." Eraut (2000, p12) claims that the "majority of human learning does not occur in formal contexts."

Eraut (2000) goes on to develop a typology of non-formal learning that is set on a continuum based upon the degree of intention to learn. At the beginning of the continuum is implicit learning. Eraut here quotes Reber (1993) who defined implicit learning as "the acquisition of knowledge independently of conscious attempts to learn and in the absence of explicit knowledge about what was learned." In this case not only is there no intention to learn, but the individual is not even aware that they have actually learned anything. At the opposite end of the typology lies deliberative learning, which occurs when individuals deliberately set aside time for the learning. Eraut also introduces the notion of reactive learning, which lies in between implicit and deliberate learning. He defines reactive learning as "near spontaneous and unplanned, the learner is aware of it but the level of intentionality will vary and will often be debatable." (2000 p12.). Eraut (2000) outlined a time continuum for non-formal learning, resulting in the following typology as shown in table 3.1:

Time of Stimulus	**Implicit Learning**	**Reactive Learning**	**Deliberative Learning**
Past episode(s)	Implicit linkage of past memories with current experience.	Brief near-spontaneous reflection on past episodes, communications, events, experiences	Review of past actions, communications, events, experiences. More systematic reflection
Current experience	A selection from experience enters the memory	Incidental noting of facts, opinions, impressions, ideas. Recognition of learning opportunities.	Engagement in decision making, problem solving, planned informal learning.
Future behaviour	Unconscious effects of previous experiences	Being prepared for emergent learning opportunities	Planned learning goals. Planned learning opportunities.

Table 3.1 " A typology of non-formal learning" Eraut (2000, p13)

It is ironic that Eraut's work to set out a typology of non-formal learning in fact formalises the process. However it is clear in Eruat's work that not only will students benefit from learning informally from one another, but also this can occur at different times and in different ways. Such learning may not even be intentional, but the students will still benefit from having the relationships that allow such implicit learning to come about. Eraut found that much of the learning that goes on in organisations is informal, and though it may go unnoticed by employers, this informal learning is vital to the organisation. So too is informal learning vital to both the students and the university as an organisation. Students not only learn informally about specific academic subjects, but also learn tacit knowledge about how to study and how to integrate socially into the fabric of university life.

3.6.6 Summary

The word relationship comes from the Latin 'to carry back' this implies some form of communication. Relationships generally consist of some form of connection between two or more people. Positive relationships can promote informal learning. The literature suggests that in order to promote informal learning a relationship should contain trust, commitment, mutuality, reciprocity and an appreciation of vulnerability (Tiffany 2001, p99). Whilst some authors argue that reciprocity should be present in an informal learning relationship, I argue that relationships are not always equal. If one student helps another with their math's homework for example, it does not necessarily follow that they will get something in return. As there are at least two people within the relationship, so there are at least two worldviews, two different sets of experiences and two different sets of wants and needs. Such learning relationships can contain more than two people, indeed the use of group project work has become more and more prolific, particularly in higher education. Such group work is thought to reflect the nature of the work that students will experience in their later working life. Research has shown that students learning can be enhanced through group work as it provides access to different points of view, different problem solving methods, it allows a forum for discussion, a forum to defend one's ideas and to accept the ideas of others. Each individual brings a unique set of beliefs and experiences to the group, all of which can provide learning opportunities for its members. Such interaction and learning can extend from the project group, to all students on the same course, or at the same university, indeed one can learn informally from all of one's peers. The concept of peer learning was first introduced into higher education in the 1950's in Berlin, and since then authors such as Newcombe and Wilson (1966) have referred to peer learning as the most powerful influence in undergraduate education. Much of the peer learning literature has focused on the peer tutoring model. Some authors however claim that as much (if not more) can be learned in the informal setting as in the formal context of tutoring relationships. In an informal setting, reacting with peers, one can not only learn the subject areas detailed in a degree course, but also the more tacit knowledge such as how to cope with exams, or how manage one's time, etc.

3.7 Summary of Critical Literature Review and Learning Points

All organisations, regardless of their primary purpose, contain people and are therefore also social entities. Individuals are embedded within the social society, their thoughts, actions and attitudes are all influenced by the social society in which they are embedded. This means that the social aspect and its influences on organisational and individual performance cannot be ignored. Research has found that relationships have an effect on various aspects of work performance including one's attitude to work, job opportunities and promotions. Just as commercial organisations are embedded in social systems, so too are educational establishments such as universities.

Universities not only provide an academic education, but also a social education. Such social relationships can provide many functions including that of social support. Social support helps to counteract the effects of stress, which in turn has been found to effect health, morbidity, adjustment, work performance and academic performance. Social support has been found to have both a buffering effect which is evident only when a person is under great stress, and a direct effect which is evident at all times. Research has also shown that people perform better at work when stress is reduced. As social support reduces stress this can have an indirect positive affect upon an individual's work performance. Research indicates that students are particularly likely to turn towards friends for social support at times of high stress. Socially supportive relationships between friends link many individuals thus in time combining to develop a social support network.

Social networks have been the focus of various disciplines such as anthropology, psychology and sociology since the 1950's. A social network consists of a number of people linked by patterns of relationships. It is such patterns of relationships that have led the field of social networks to also be known as the structural approach. Other concepts that have come out of the social network approach have been emergence and self-organisation. Social networks are utlised throughout by people all types of organisations to create access, opportunity and personal advantage. In particular the strength of weak ties has been noted in the literature. Centrality in social networks has been linked with increased performance of individuals and groups in aspects such as power, profitability, innovation and influence.

The term social capital is used to refer to the sum total of relationships within many social networks. There is current debate regarding the effects of social capital in education. Some researchers suggest that social capital provides social closure whereby all of the people involved from a close knit community, this closure is said to have a positive effect upon children's education. Others argue that such social closure in fact limits the opportunities of youngsters and children in more horizon - expanding community are more likely to do well. Some theories of social capital have been criticised for being ethnocentric, ignoring gender and ignorant of economic and social context. One study has linked social networks with performance in higher education. This study by Baldwin, Bedell and Johnson (1997) found that a student's centrality in communication networks was positively linked to the grades and to their satisfaction with their course of study. The student's centrality in friendship networks was also positively associated with group grades though not with individual grades. The study was carried out in an American university on M.B.A. students. Such students are likely to be heavily socialised into the concept of networking and so this study will investigate the role of centrality in communication and friendship in undergraduates in a British university who are less socialised into networking and culturally different from American students. Other predictors of educational performance to be found in the literature include previous academic performance, entrance examinations, demographic variables, psychosocial variables and attitudes towards group work. Each of these predictors are a form of attribute, by utilising social network analysis this study investigates how relationship between people affect performance rather than how an individual's attributes have an effect.

It is widely acknowledged that relationships affect our learning when we are very small children and so it should not be surprising if our relationships can continue to have an affect throughout our life. Research has shown that student's learning can be enhanced through group work, learning from their peers and informal learning opportunities.

Chapter Four: Analysis of Networks

4.1. Introduction

The objective of this chapter is to analyse the friendship and communication networks of all three cohorts. Each of the networks is analysed in terms of connectivity, that is the degree to which all of the individuals (or nodes) are connected to each other. Where graphs are not fully connected but rather are divided into sub-graphs, each sub-graph is called a component. There follows in this chapter an analysis of components in the friendship and communication networks of all three cohorts. The chapter then goes on to analyse the density of the networks, the degree to which all of the possible relationships are actually present. This analysis of density investigates not only where the nodes in the graph are connected, but also the degree to which they are connected. The chapter then goes on to investigate the degree to which relationships are reciprocated and then the presence of cliques and sub-groups within the networks. Finally I look at the centralization of networks. This involves looking at the extent to which the graph as a whole has a centralized structure, the degree to which the graph is centralized around focal points.

4.2 Connectivity

A vital attribute to any graph is the amount to which it is connected. A graph is said to be connected if there is a path between every pair of nodes within it. This means that each node is reachable within the graph by another whether directly or indirectly. Conversely if a graph is not connected then it is disconnected. If a node within the graph is not connected by a path to all of the other nodes then the graph as a whole is disconnected.

For example in the diagram below, the students in figure 4.1 are all connected and so information can flow across the paths of communication to each and every one of the students within the group. In this way the graph in fig 4.1 is connected. The graph in fig 4.2 however is disconnected. The arrows depict the direction of the relationship. The length of the arrows in this diagram as in all of the network diagrams in this thesis, is not significant. All of the pairs of students are not connected, and so not everyone will be able to send and receive information through communication channels.

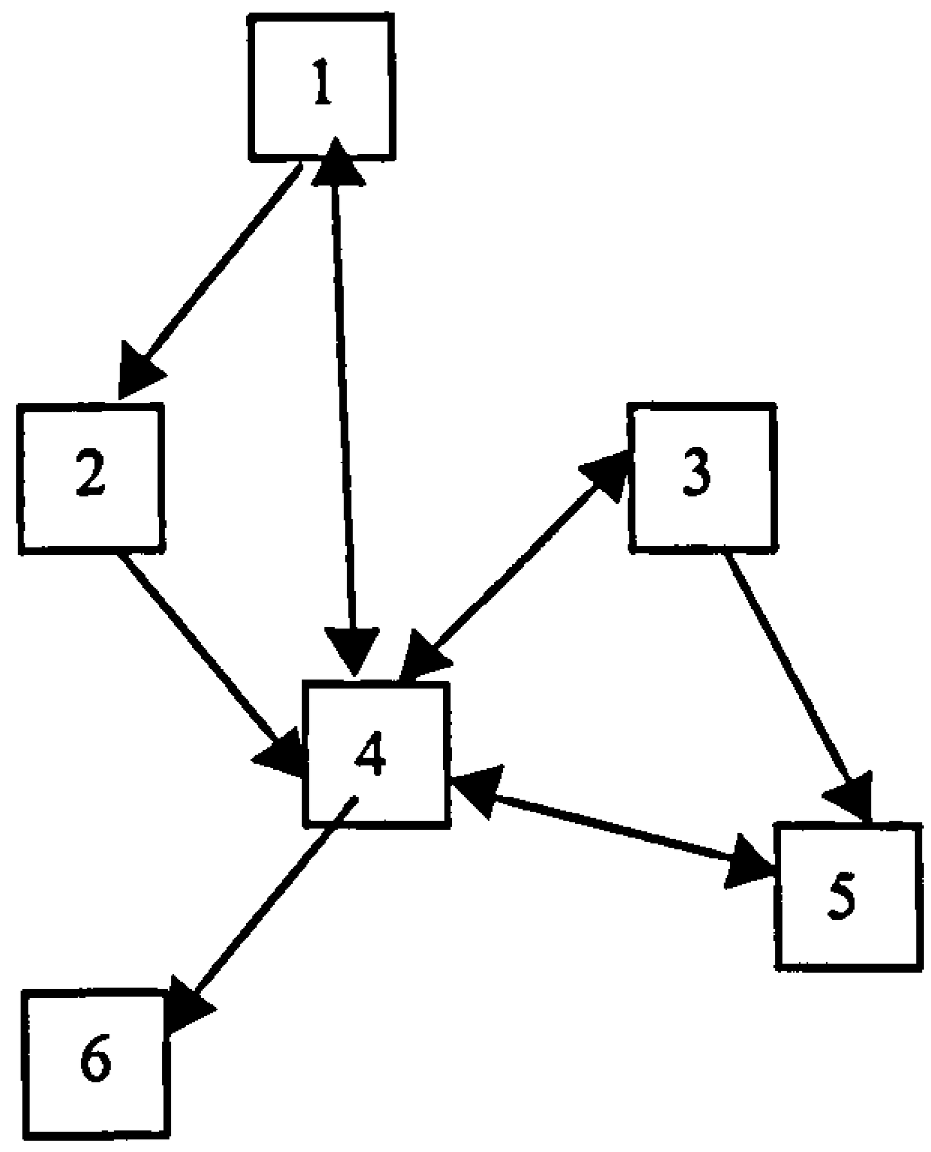


Fig 4.1 A Connected Graph

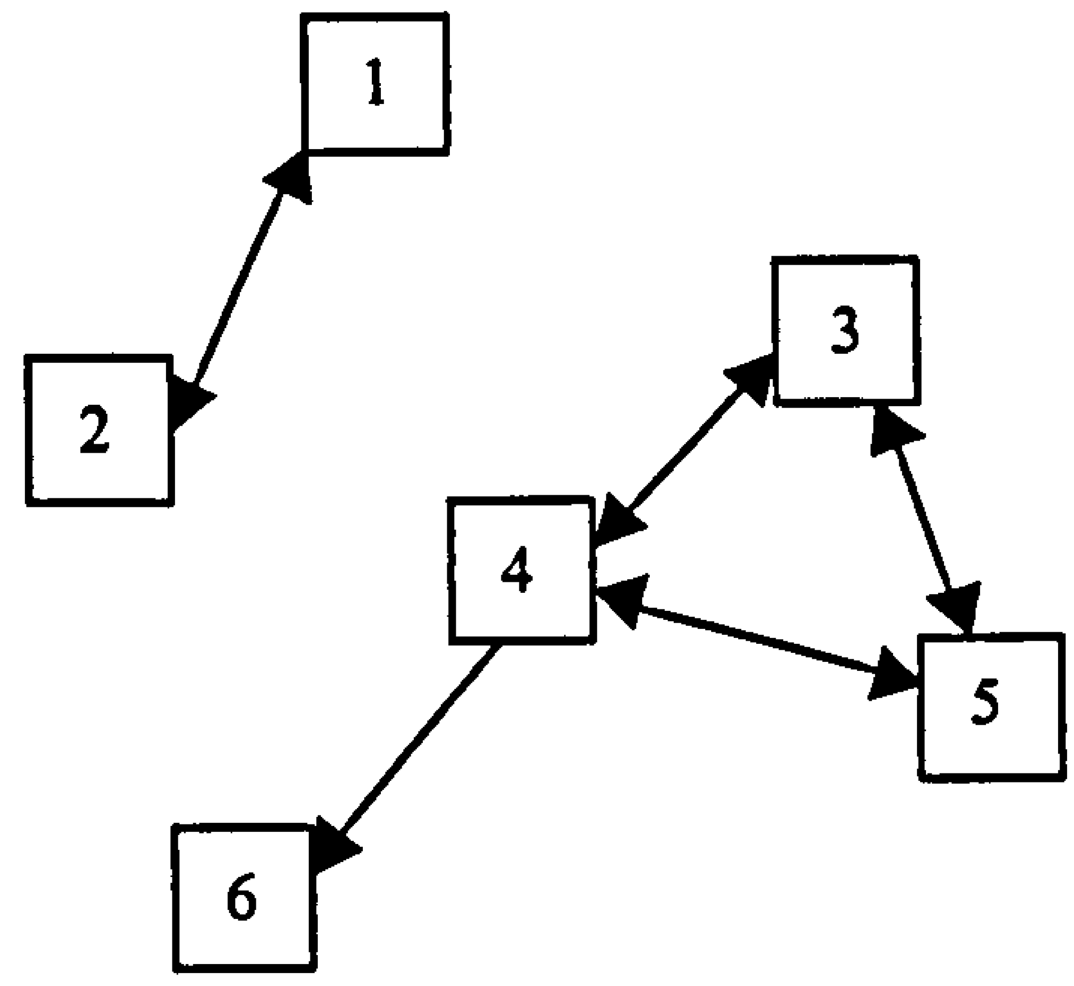


Fig 4.2 A Disconnected Graph

This shows an important property of the graph and the individuals in it. Just how connected are those individuals? To what extent can information flow between them? If the nodes represent students, then are the students all connected into one large group to allow the flow of information? Are subsets evident within the cohort, or are individual isolates[4] separated from the group as a whole limiting their access to information?

4.3 Components

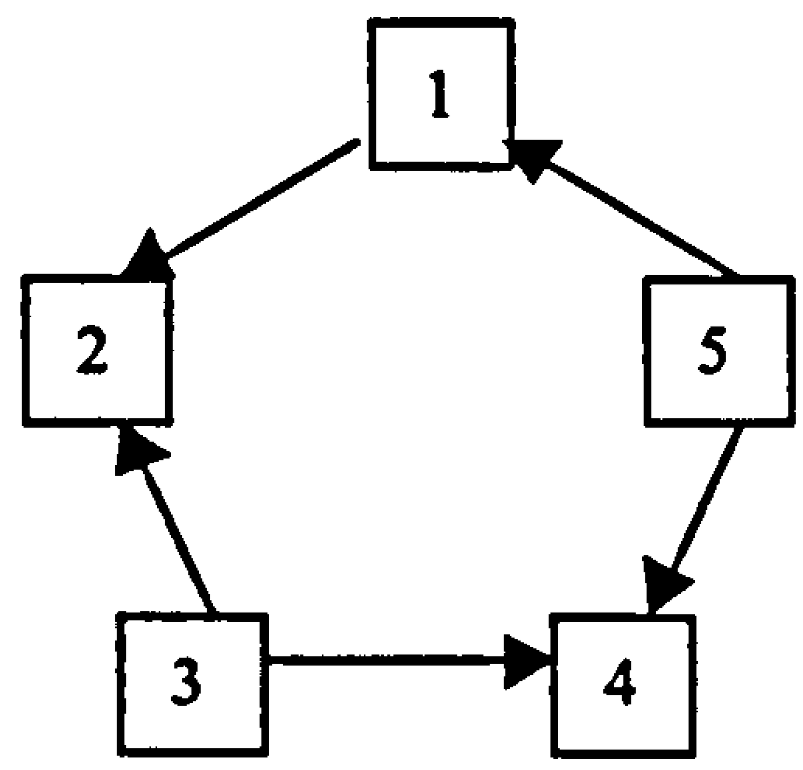
If a graph is disconnected it can be defined as two or more subgroups or sub-graphs. A sub-graph is, in its own right, fully connected. A connection runs between each of the nodes, either directly or indirectly, binding them together into a sub-graph. Each of these subgroups is called a component. A component is defined as a maximal connected sub-graph. It is maximally connected when it is not possible to add any more nodes without destroying the properties of the sub-graph. If an unconnected node was to be added, the sub-graph would no longer be fully connected throughout and so would not be maximal, and therefore this could no longer be termed a component. (Scott 2000, p.p. 100 – 102.)

[4] An isolate is an individual who is not connected to any other person.

4.4 Strong and Weak Components

It is possible to search for components within data which is both directed and undirected. In the case of directed data such as the data gained when measuring friendship and advice / communication networks, the component may be weak or strong. A strong component is one in which the connection runs all the way through the sub-graph without a change in direction. It is assumed that the direction of the continuous line indicates the ability for some resource to flow throughout the group. For example, a continuous line of communication traveling in one direction throughout a sub-group of undergraduates would indicate that information could flow to each of the members of that sub-graph. The weaker definition of the component includes those nodes with a relationship in any direction. In this case it is assumed that any relationship regardless of direction gives the opportunity for communication and so can contribute to the dissemination of information. It could be said though, that the information travels throughout the group in one direction until such time as it meets a path travelling in the opposite direction, at which point the flow would be reversed and then may come to a halt. For the purpose of this study, both strong and weak components will be identified in order to understand fully how the information flows throughout the group. It is assumed however that in order for students to gain from their position in a communication network, the information must be able to flow easily throughout any subgroups that exist in the cohort as a whole. In which case it is the strong component that is truly of worth to the group and indeed the individual.

Fig 4.3 below depicts a weak component, here all of the group members are connected but the connection does not run in one continuous direction. Fig 4.4 below depicts a strong where the connection runs all the way through without changing in direction component. The arrows indicate the direction of the relationship or flow of information. No meaning is attached to the size of the line.



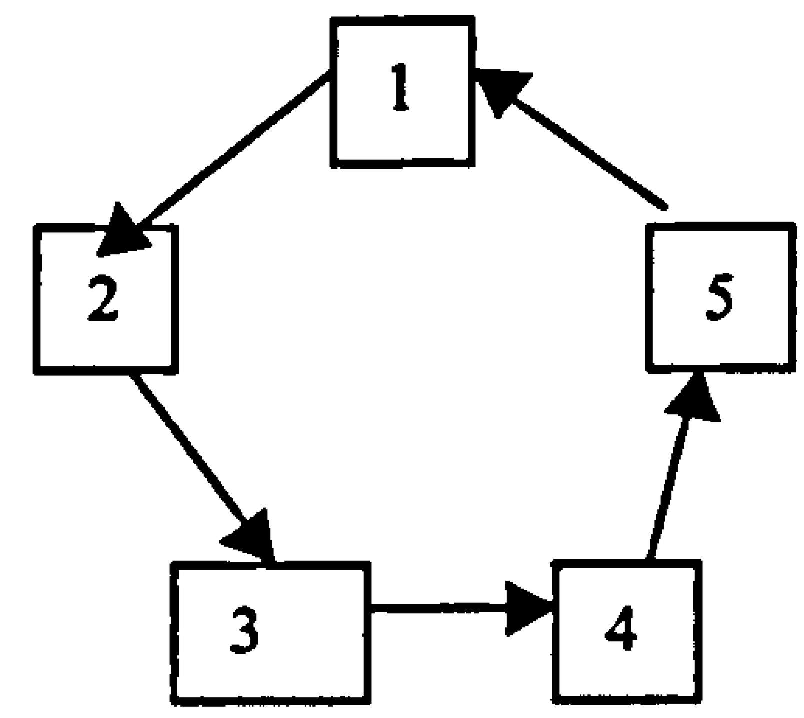


Fig 4.3 A Weak Component

Fig. 4.4 A Strong Component

The following table 4.1 provides definition of terms used in this section:

Term	Definition
Component	A sub-graph with a connection running all the through it.
Strong Component	A sub-graph in which the connection runs all the way though in the same direction.
Weak Component	A sub-graph with a link running all the way through regardless of the direction of the link

Table 4.1 Definitions at a Glance - Components

4.5 Analysis of Components in Three Cohorts of an Undergraduate Degree Course

4.5.1. Components in Undergraduate Year 1 Cohort

The following diagrams were created using the Pajek visualisation tool. Fig 4.5 depicts the communication network and Fig 4.6 depicts the friendship network that occur in the Year 1 cohort. The dots represent the individual students and are labelled with the students' identification number. These dots are also known as nodes. The relationships between individuals are represented by lines, also known as paths. This graph is directional, this means that an arrow indicates the direction of the relationships. These graphs are directional as the relationships are not always reciprocated. The graphs produced are highly complex.

Analysis of the friendship and communication components of the first year undergraduate group, showed that both the friendship and communication networks are made up of one strong component. This shows the group is highly connected by both friendship and communication. For both of the networks the graphs are connected as a whole. The high connectivity of the communication network in particular shows that information can flow freely throughout the entire group. The path runs in a constant direction and so the flow of information through the communication channels is uninterrupted making the information accessible to all members of the group. The high connectivity of the friendship group shows that not only is there the possibility for the information to flow, but also given that there is a continuous path of friendship throughout the group, the movement and sharing of information is also likely.

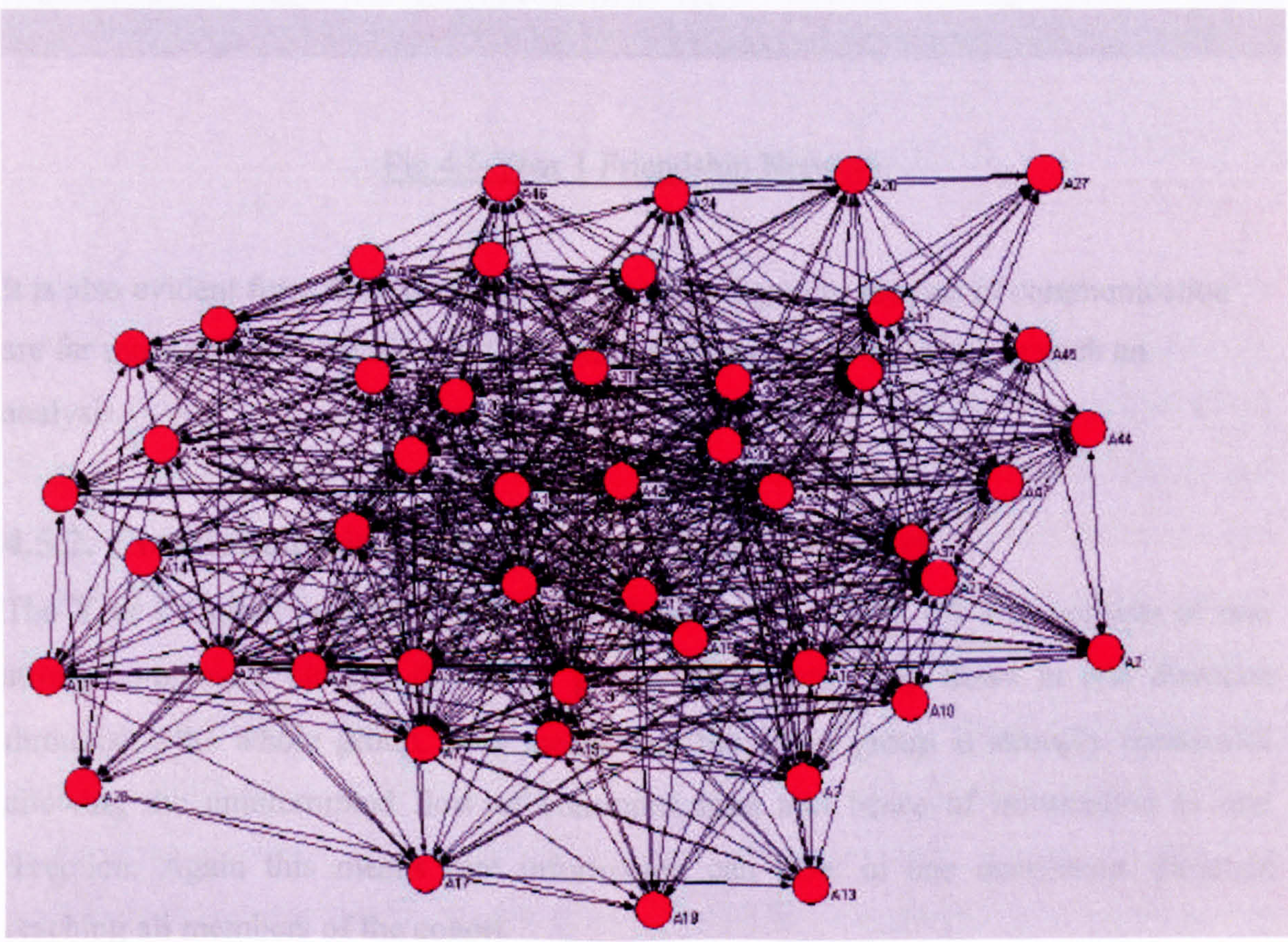


Fig. 4.5 Year 1 Communication Network.

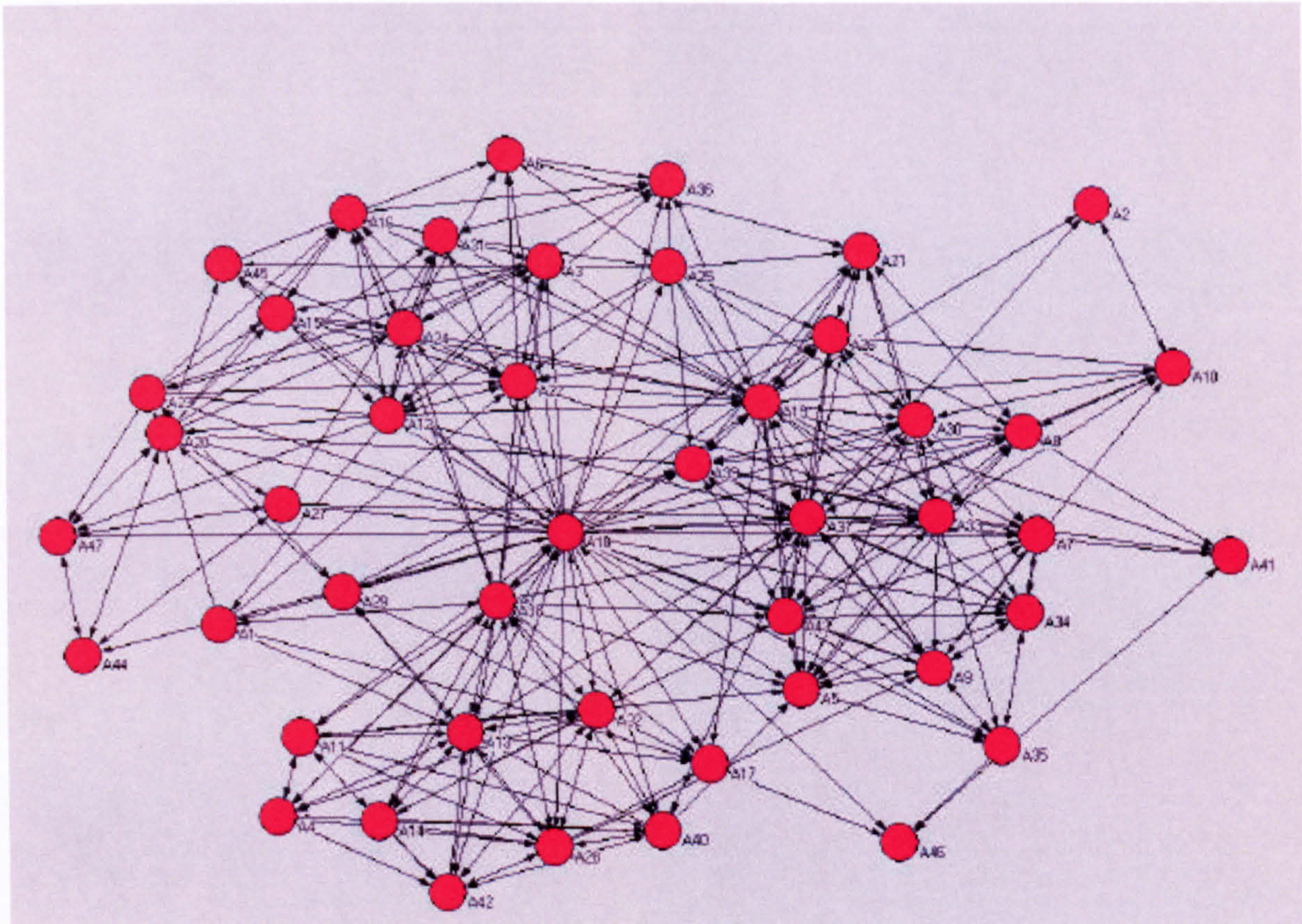


Fig.4.6 Year 1 Friendship Network

It is also evident from the comparison of the two diagrams; the ties of communication are far more prolific than the ties of friendship, as would be expected in such an analysis.

4.5.2. Components in Undergraduate Year 2 Cohort

The Year 2 Cohort communication network as shown in Fig. 4.7 also consists of one strong component binding the entire group. The relationship flows in one direction throughout the whole group. This means that the entire group is strongly connected, allowing the uninterrupted flow of communication and hence of information in one direction. Again this means that information can flow in one continuous direction reaching all members of the cohort.

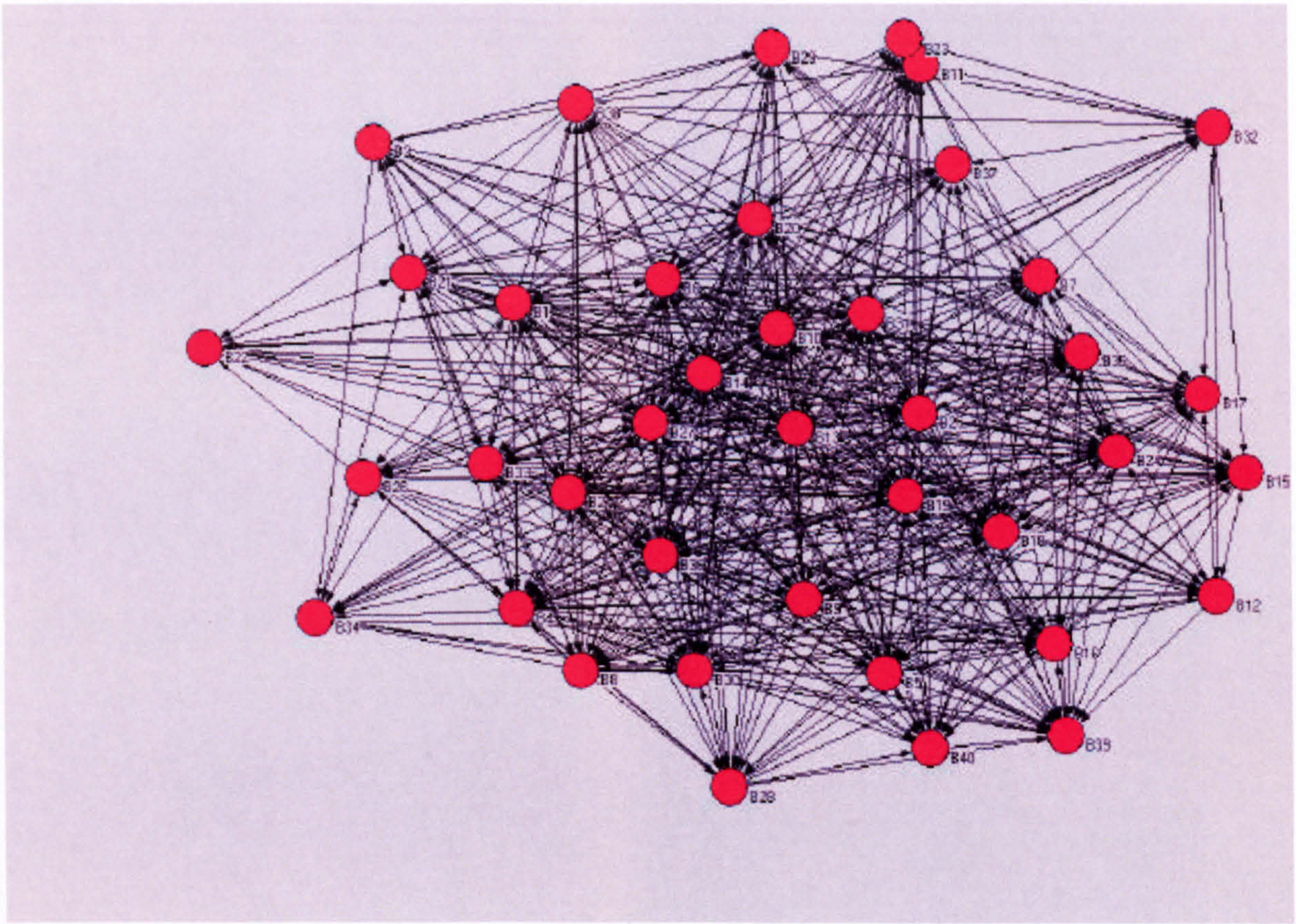


Fig. 4.7 Year 2 Communication Network

The friendship network however as depicted in Fig 4.8 consists of two strong components. On further investigation it transpires that there is just one agent, B32, that is not connected strongly to the groups' friendship network. Student B32 appears in the diagram at the top right hand corner. The lines connected to him indicate that he has five friendship relationships. All of those relationships however are directed from him towards other people. There are no friendship relationships directed towards him. As no friendship relationships are directed towards B32 he is not part of the strong component. A strong component requires that the relationship run all the way through a group in one direction, reaching every member of that group (See Fig. 4.8). All of the other members of the cohort make up one strong component as the friendship relationship flows in a continuous line throughout the entire group. The UCINET software then classes student B32 as a strong component in himself, though in reality his position as an isolated component is unlikely to bring about the benefits that would be apparent in membership of the other strong component.

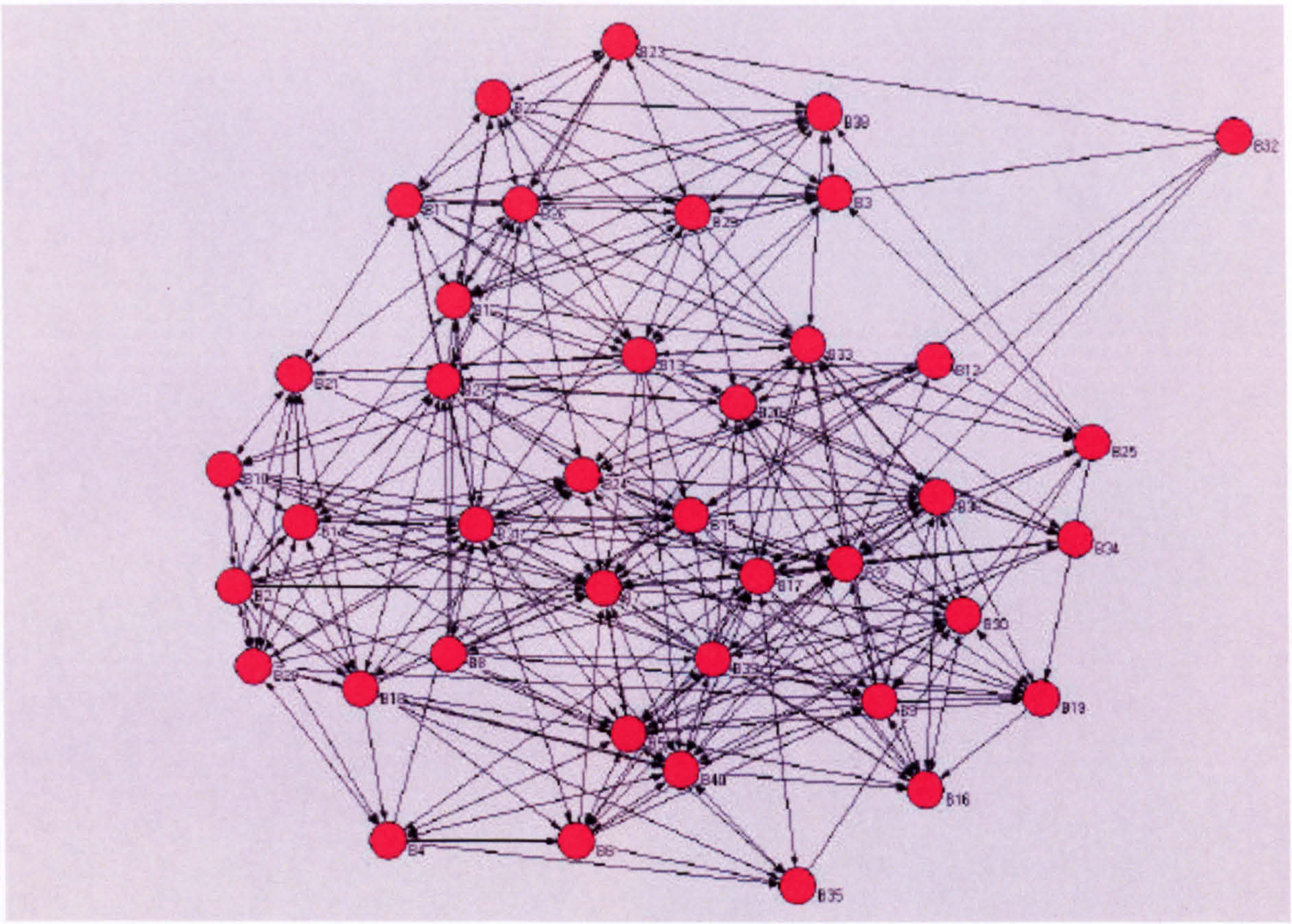


Fig. 4.8 Year 2 Friendship Network

Although this path flow does not conform to the definition of a strong component, it does however correspond with the definition of a weak component. As there is a link between agent B32 and the rest of the group, by definition the cohort consists of one large weak component. Agent B32 is however not included in the strong component and so the path of friendship does not flow to him, isolating him from the group. In this example the strong component analysis is much more poignant because, although the weak analysis shows that there is some friendship connection between agent B32 and the other agents in the cohort, this connection is not reciprocated and so is unlikely to be useful to him. He is however included in the one strong component evident in the communication network of the cohort, allowing communication and information to flow through the entirety of the connected graph even if friendship does not.

It is interesting to note that the analysis of individual centrality indicates that student B32 has a low in-degree of communication (number of communication relationships directed towards him) with nine communication relationships being directed towards him. This is not however the lowest in the cohort, the lowest being seven. Therefore there are fellow students that seek his advice and communication regarding academic related matters. He has an out-degree of ten in the communication network, this means that he seeks communication regarding academic matters from ten students in his cohort. Again this is not the lowest number as student B11 seeks communication only with five other students. Whilst B32 clearly has the lowest in-degree of friendship, he seeks friendship from five students which again is not the lowest of activity as student B19 seeks friendship from only three others. His final end of year grade at 53.59% is not the lowest is the cohort but is certainly lower than the average of 60.57%. It is interesting to note that this student in fact had to repeat the year due to personal reasons. Due to these circumstances then it is not surprising that student B32 is not highly central in the friendship network as he came into the cohort a year after all of the other members. The rest of the cohort has already been together for their first year of their studies. It may be that the lack of friendship and communication affected the performance of this individual, or that such relationships could have assisted in his progression on the course. The high correlation between centrality in friendship and communication networks indicated in Chapter 7 of this thesis indicates that this may well indeed be the case.

4.5.3. Components in Undergraduate Year 3 Cohort

The analysis of the communication network in the Year 3 Cohort also shows that it is made up of one strong component. Fig 4.9 indicates that the group is highly connected allowing communication and information to flow freely without interruption throughout the entire group. Again the web of relationship as indicated by the lines connecting the nodes in the graph is highly complex.

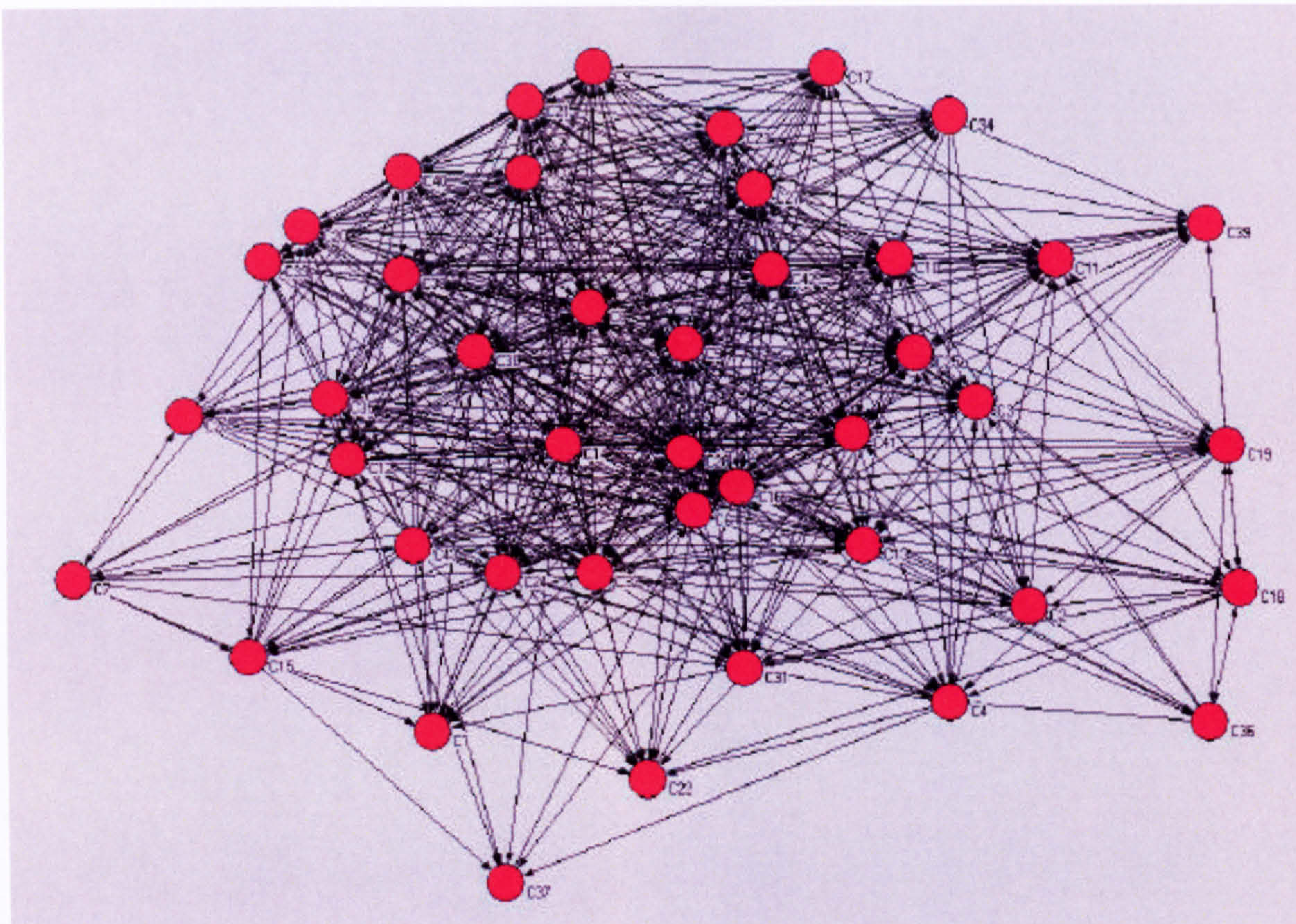


Fig 4.9 Year 3 Communication Network

Analysis of the friendship network as depicted in Fig 4.10 however showed that there were two strong components evident in the graph. These strong components in fact consisted of one group that consists of all agents except C7; the other group contains C7 alone. C7 is a complete isolate, he has claimed no one as a friend and no agents have claimed him as a friend. In the same way as B32 in the Year 2 friendship cohort, UCINET classes C7 as a strong component in himself. There would however be none of the benefits associated with being part of a strong component, if that component consisted only of one person.

The cohort as a group does not even conform to the weak component definition, as there is no tie between C7 and the other agents what so ever. We can see then that the Year 3 Cohort friendship network consists of one strong component and one isolate.

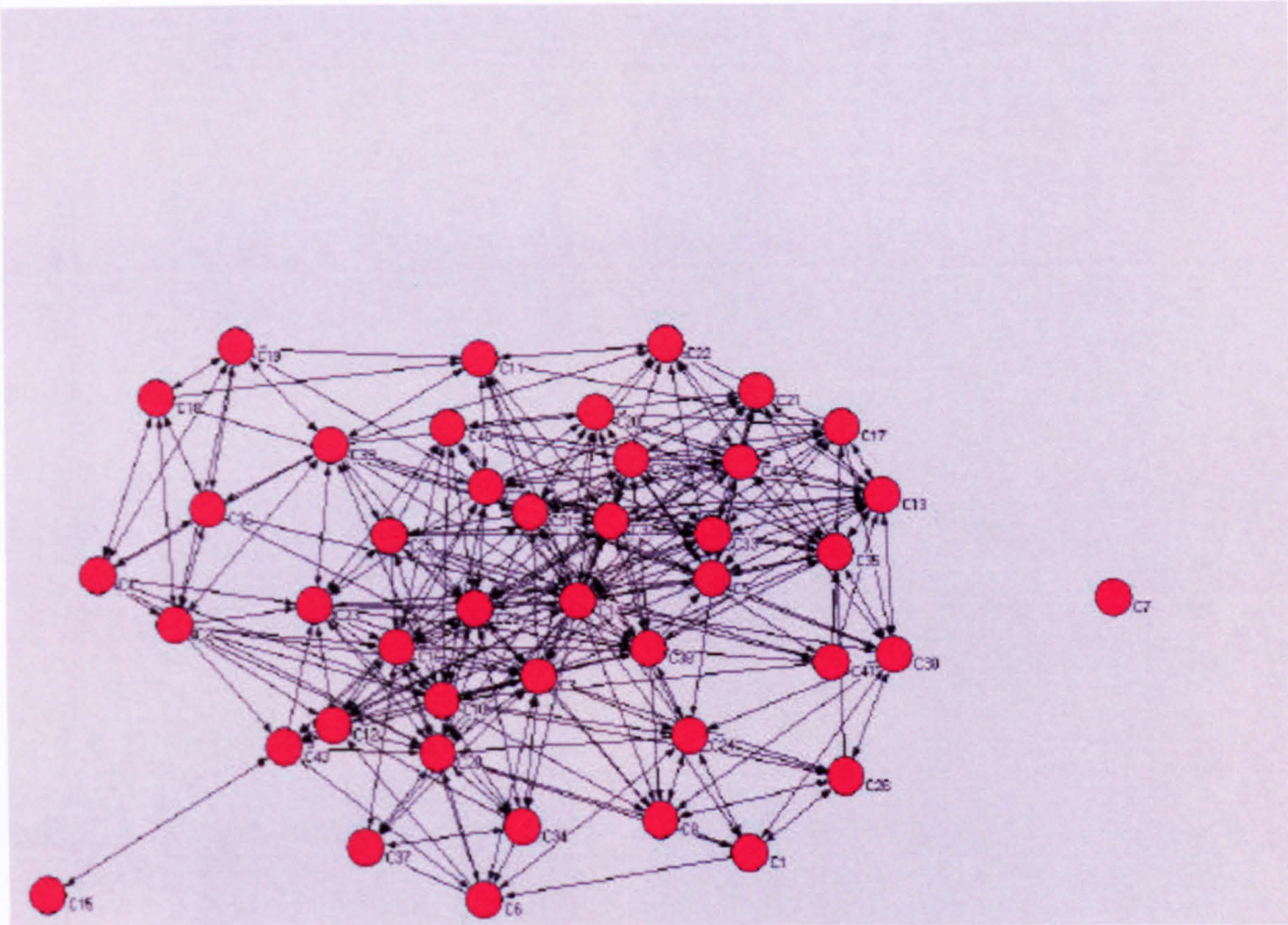


Fig. 4.10 Year 3 Friendship Network

It is also interesting to note that although there is one strong component, agent C15 is also rather isolated, she shares a friendship with only one other person within the group, a point which is highlighted by the above diagram. Student C7 had particular personal problems which meant that he had to retake the third year on the course. This meant that he (like student B32 in Year 2) had not previously had the opportunity to develop friendships with the rest of the cohort. Student C7 in fact attained the lowest end of year grade in his cohort at 43.14%.

4.6 Graph Density

It was mentioned earlier that as expected, the ties of communication are far more prolific than the ties of friendship. This attribute can be further explored through the measure of density. Mitchell (1969) described the density of a graph as its completeness. Within the network it is the extent to which all of the possible relationships are actually present. As such, a complete graph is one in which all of the points are connected directly to each other, they are all adjacent. Blau (1977) recommended density as a measure of group cohesion, rather than purely analyzing whether the group is connected, it also investigates the extent to which it is connected. This differs from the measure of connectivity because a graph is said to be fully connected if a path runs through all of the points, allowing information to flow to every member as opposed to the measure of density in which the number of ties are also counted. The event of a graph being totally complete is very rare and the measure of density assesses just how far from the full stage of completion the graph is. It looks at two aspects of the network: whether nodes are included (inclusion), and how much those nodes are included (the extent of that inclusion). For example some points will be connected to many others and some to only a few. An isolate cannot contribute to a measure of density as it is has no ties at all and is connected to no other node.

Scott (2000, p.71) defined density as "the number of lines in a graph, expressed as a proportion of the maximum possible number of lines." He goes on to outline the slight difference when dealing with directed data: "The matrix for directed data is asymmetrical, as a directed line from A to B will not necessarily involve a reciprocated line directed from B to A. For this reason, the maximum number of lines that could be present in a directed graph is equal to the total number of pairs that it contains."

UCINET 5 was used to analyze the density of the networks. The definition given for the density measure in UCINET 5 is as follows: "The density of a binary network is the total number of ties divided by the total number of possible ties. For a valued network it is the total of all values divided by the number of possible ties."(1999-2000, Analytic Technologies, Inc.)

The output of the density measure will differ according to the population and the relationship that is being measured. For example, if one were investigating advice networks and took a random sample of 100 people from across a whole university campus and the relationship, 'whom do you go for advice to?', then one would expect the density of this graph to be very small. If on the other hand one was investigating the spread of AIDS and took the same sample of 100 people and the relationship 'has not had sex with', then one would expect the density of such a graph to be very large.

Different types of relationship require different amounts of time and effort. One must put a lot more time into a friendship for example than into a relationship that is purely communicative or advisory. Because of this, in the case of the three cohorts of undergraduates, one would expect there to be many more communication relationships than friendships. This can be noticed in the diagrams depicting the networks. From these diagrams we can see that the ties are more prolific in the communication networks than the friendship networks, but in order to discover just how much more prolific they are, we must measure the density of each network.

Table 4.2 provides a definition of graph density:

Term	**Definition**
Graph Density	The degree to which all of the possible relationships are actually present. In a maximally dense graph each individual would be tied to every other.

Table 4.2 Definitions at a Glance – Graph Density

4.7 Analysis of Graph Density of Networks of Three Undergraduate Cohorts.

Table 4.3 indicates the density of relationships in the friendship and communication networks of all three cohorts. These figures were gained by running the graph density algorithm in UCINET.

Network	Density
Year 1 Communication	0.3451
Year 1 Friendship	0.1873
Year 2 Communication	0.4314
Year 2 Friendship	0.2679
Year 3 Communication	0.3843
Year 3 Friendship	0.2366

Table 4.3 Table Showing the Density of Communication and Friendship Networks in Three Undergraduate Cohorts.

In each of the three cohorts we can see a large difference between the density of the friendship network and that of the communication network. This difference in density is to be expected as the friendship relationship takes more time and emotion, meaning that we are likely to claim less people as friends than we are to simply communicate with or seek advice from. The Year 1 communication network has a density of 0.3451, this means that around 35% of all relations / ties that could possibly be there are actually present.

While this figure is high the Year 2 communication network is particularly dense at 0.4314. The work-load in the second year of the degree is considerably heavier and it seems that the students are making good use of their network to seek advice about school - work and school related issues, with almost half of the possible ties actually being present. The mean density of the year 3 cohort communication network falls in the middle of the years 1 and 2 at 0.3843, showing that around 38% of all possible ties are present. In their third year students choose electives and do not spend as much time together as a whole group. This could perhaps explain why there are fewer communication links in the Year 3 cohort.

Friendship ties are also strongest in the Year 2 cohort, the graph being quite dense at 0.2679. This means that over a quarter of all possible friendship links are in fact evident. For the category of friendship the students were asked to identify "Which of the following students are good friends of yours, people whom you see socially outside of classroom hours, e.g. you have lunch or coffee together between classes and discuss topics other than those which are University related." The data implies that the Year 2 cohort are a very integrated group who socialize together outside of classes and both communicate and seek advice regarding scholarly topics and also connect outside of the realms of academia. The Year 3 cohort also has quite a dense friendship network at 0.2366. Also showing that almost 24% of all possible friendship ties are in fact apparent, a large number given that the friendship tie requires time and effort from its participants.

This density measure has shown to what extent each of the cohorts is connected. We have also seen from the component analysis, the extent to which a path runs through the group, facilitating the flow of information through all of its members. But while the group may be quite dense, perhaps it is only certain members that communicate with each other, and perhaps these members make up most of the density of the group, skewing the results. It may be that while there is a path that runs through the entire group, there are still some smaller groups within the cohort that communicate with each other more than others.

Perhaps cliques of students within the cohort push up the measure of density, giving a false indication. So we move on to investigate the presence of cliques and subgroups within the three cohorts.

4.8 Cliques and Subgroups.

The term clique has been widely used throughout general conversation for many years, but in the 1930's the sociological meaning of the term clique began to be investigated. The Hawthorn experiments (see Roethlisberger and Dickson, 1939) identified the cliques in a bank wiring factory by collecting relational data. The Harvard team lead by Elton Mayo (1933) argued that people formed cohesive subgroups which had their own norms, values and culture which could operate counter to the official groups and the more formal structure. These subgroups were said to be one of the major sources of self-identity, people identify with their set, gang, or simply with people who they can say are 'one of us'. The subgroups highlighted in the Hawthorne studies, were identified by the workers themselves, no formal criterion defining a clique was outlined in the study. A clique could be for example a group of mutually interconnected people, or a very densely linked group. Either of these would be a sub-graph. A sub-graph is simply a section of the graph as a whole. This could be randomly selected, or it could be split by attribute for instance by sex or job title. Clique analysis however, separates the data into sub-groups by finding the naturally occurring linkages. The sub-graph is defined as maximal in relation to what ever characteristic it is measuring, for example the component sub-graph is defined as connected when all points can reach one another through a flowing path, but with no connections outside. This makes it maximal. A clique sub-graph can be defined as being both maximal and complete, so that all points are connected to each other and they are also adjacent to each other. To be defined as a clique, each node must be adjacent so that there is only one path between them i.e. they are directly linked together. Degenne and Forse (1999, p80) define the clique as "a set of completely interconnected nodes.... It has a chain length of 1 between each pair of nodes. ...The adjacency matrix of a clique consists exclusively of 1's (except possibly on the diagonal, whose value is irrelevant here.)"

In an undirected graph all lines can be seen as reciprocal. If a graph is directed then there can be two types of cliques. A strong clique can be identified where the lines or arcs are reciprocated. In order to identify a weak clique, the direction of a line is disregarded and the presence of any line no matter in what direction is taken to indicate that there is a reciprocal relationship. If a matrix is symmetrical the data will be undirected; the lines are all reciprocal. If however, the data is directed then the matrix will be asymmetrical and so the cliques can be analysed as either strong or weak. To expand on this point, Degenne and Forse (1999 pp.80) went on to say, "In a directed graph every ordered node pair must be connected by a path of length 1 (strong clique). If the relational context so allows, we may soften this last criteria and ignore direction in a graph (weak clique)".

The type of clique analysis used will depend then upon the symmetry of the matrix.

The following table 4.4 provides definitions of the key terms used in this section:

Term	Definition
Clique	A maximal subset of points in which each point is directly tied in a reciprocal relationship with every other.
Strong Clique	In a directed graph, a strong component is a maximal sub-set of points that are all related reciprocally.
Weak Clique	In a directed graph a weak clique is one in which every node is tied to another but the direction of the line is disregarded. This means that the relationship could be in either direction and does not have to be reciprocal but rather any relationship no matter in what direction is counted.

Table 4.4 Definitions at a Glance - Cliques

4.9 Symmetry / Reciprocity.

The data collected through a questionnaire in this study on three undergraduate cohorts can be defined as direct sociometric choice data. This indicates the presence or absence of a particular relationship as indicated by the respondent. In this case the respondent was asked in particular to indicate whether they had a friendship relationship and a communication relationship with each of their fellow students within their cohort. This type of data is directional. Each respondent indicates which other students are a friend or someone they communicate with or seek advice from, from the list of all students in the cohort. In this way the claim of friendship is directed from one student to another, but this does not necessarily imply that the feeling is reciprocated. For example if we just take three students and ask them who they are friends with, it may be that in Fig. 4.11, A names C and C names A and B, so that the direction of the ties (or arcs) are as follows:

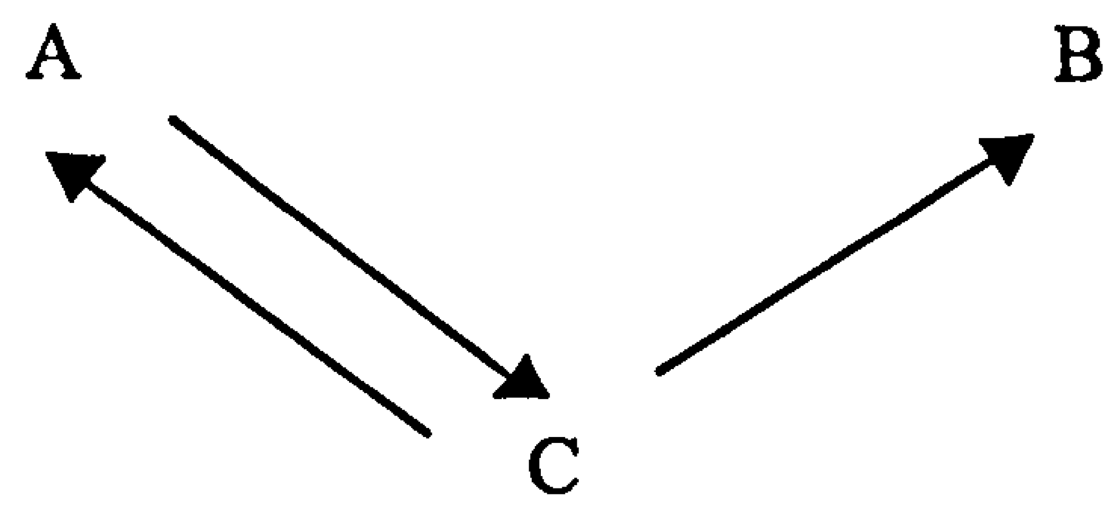


Fig. 4.11 An Illustration of Reciprocity.

In this case the relationship between A and C is reciprocal but the relationship between C and B is not reciprocal. Rather it is directed only from C to B. This means that not only is the data directional, it is also asymmetrical, as it produces an asymmetrical matrix, as shown table 4.5 below:

	A	B	C
A	*	0	1
B	0	*	0
C	1	1	*

Table 4.5 An Example of a Matrix Table.

The degree of reciprocity or symmetry will be dependent upon the question asked. For example in Fig 4.12, we can expect that if we asked students to indicate who was their best friend, the degree of reciprocity would be high and yet it is still possible that agents would not choose each other reciprocally. It may be that A considers B to be her best friend while D indicates that in fact A is her best friend, and D chooses A, which would give the following graph. (Scott, 2000).

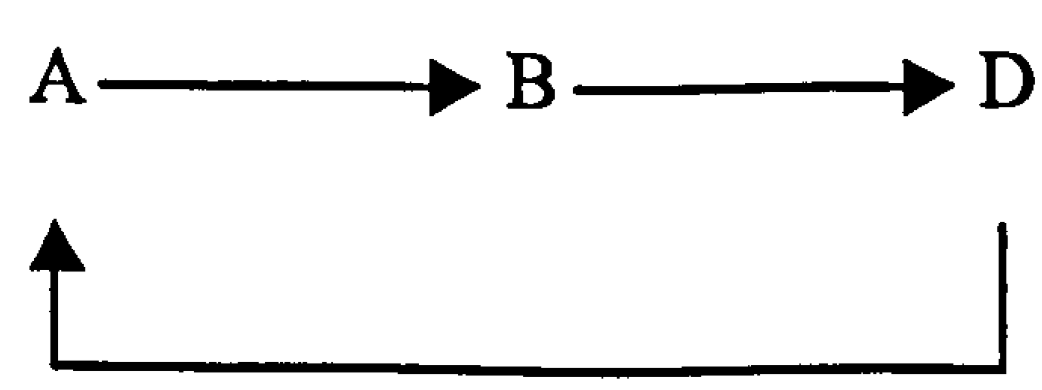


Fig 4.12 An Illustration of Non-Reciprocal Relationships

Similarly one can expect that the relationship of communication or advice seeking need not necessarily be symmetrical. Student A may seek out student B because they feel that student B is knowledgeable on the subject, while student B may not feel the need to seek advice from student A on any academic matter, but may still consider A to be a friend.

Table 4.6 below provides definitions of key terms used in this section:

Term	Definition
Reciprocity	In a directed graph a relationship is directed from one person to another. If both individuals chose each other then the relationship is reciprocated.
Symmetry	Within the graph as a whole if all relationships are reciprocal then there the large matrix produced will be symmetrical. The amount of symmetry within the matrix is a measure of how much the relationships are reciprocated.

Table 4.6 Definitions as a Glance – Reciprocity and Symmetry

Table 4.7 below indicates the percentage of symmetric pairs in the communication and friendship networks of each of the three cohorts. These figures were obtained by running the symmetric pairs algorithm in UCINET.

Network	Percentage of Symmetric Pairs %
Year 1 Communication	63.37
Year 1 Friendship	87.51
Year 2 Communication	56.54
Year 2 Friendship	82.30
Year 3 Communication	63.23
Year 3 Friendship	87.25

Table 4.7 Table showing the Percentage of Symmetric Pairs in Each of the Networks.

Within all three cohorts it was evident that the symmetry of friendship relationships was far greater than that in the communication networks. While the symmetry in each of the friendship matrices was quite high it is clear that students seek others to communicate with about academic matters in more of a non-reciprocal manner. It seems that many of the students seek communication from others regarding academic matters, using their contacts as a resource. Mutual exchange is less evident in the communication network, certain students seek advice and communication, while others are perhaps more likely to be suppliers of the information. This will be investigated further by the use of centrality measures later in this study. On the whole, friendship relationships are much more mutually entered into as can be seen by the high percentage of symmetrical pairs in each of the three cohorts' friendship networks.

4.10 Clique Analysis of Cohorts

UCINET 5 was used to search for cliques, it implements the algorithm by Bron and Kerbosch (1973) in order to find all cliques as defined by Luce and Perry (1949) that are greater than a chosen size. The smaller the size of the clique, the more loose the measure. The minimum amount that can be in a clique is three (as two would be a diad.) The UCINET 5 clique measure also provides analysis on the number of times that individuals are in the same cliques, showing the overlapping structure of the cliques. Single link hierarchical clustering is shown in order to visualize where students lie in the hierarchy of overlapping cliques.

4.10.1. A Weak Clique Analysis of Year 1 Communication Network

In a weak clique analysis of the Year 1 communication network as depicted in Fig. 4.13 the direction of the relationship is disregarded. With the group size set at a minimum of 3, UCINET 5 identified 943 discreet cliques. A minimum of 3 in the clique means that at 3 students are tied to each other. The weak cliques measure means that these students are tied together, but the direction of that tie or relationship is disregarded.

With a total membership of 46 students, 943 cliques is a large amount and this indicates that there is considerable overlap between these cliques.

The following diagram in Fig. 4.13 is produced by UCINET in order to illustrate the hierarchical levels of cliques that are apparent in the network and how these cliques overlap.

The x axis represents the hierarchical level of relationships. As the graph would be very large if it indicated all 943 of the cliques, UCINET clusters these cliques into an hierarchy. The levels are indicate were there is a change in the clique membership. In this case there is a hierarchy of 344 levels of cliques membership.

The y axis indicates the students, they are represented by their allocated id number.

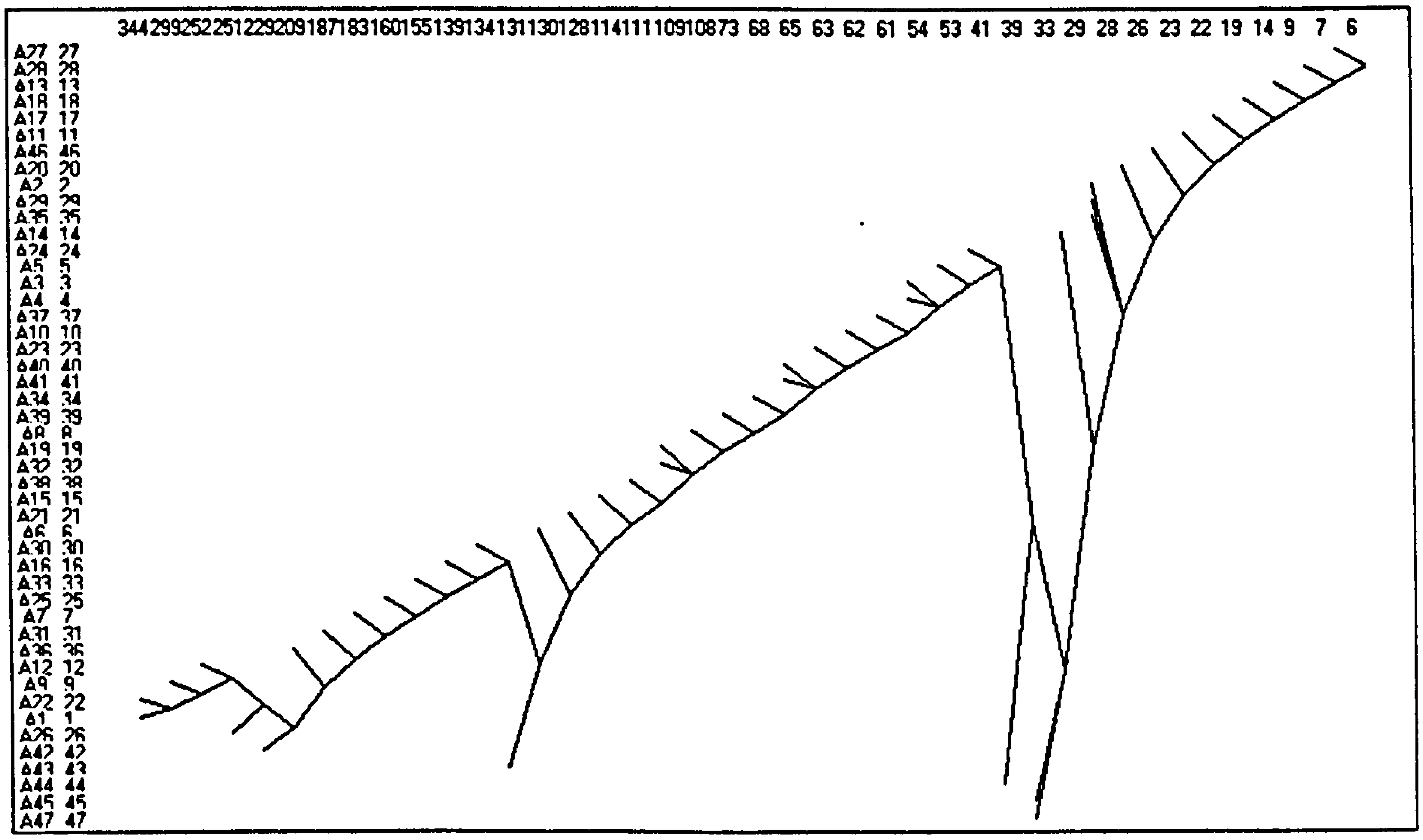


Fig. 4.13 A Tree Diagram Showing the Weak Clique Analysis of the Year 1 Communication Network at a Minimum Group Size of 3

The graph in Fig 4.13 indicates that students A1 and A22 belong to 344 hierarchical levels of clique, this would include all of the 943 cliques in total. This means that A1 and A22 are highly central in the Year 1 communication network. They are linked to every single grouping of up to three people in the cohort. On later investigation of individual centrality in Chapter 6, student A1 also has the highest out-degree centrality of the cohort, he therefore seeks communication from a lot of his fellow students. He also has a relatively high in-degree of communication and so he is often sought for communication on academic related topics. He is however not the highest. As the weak clique analysis does not take into account the direction of the relationship, his high communication seeking behaviour puts him at the top of the weak clique analysis hierarchy of relationships. Student A22 on the other hand shares the highest in-degree of communication with student A6. This means that these two students are sought out by the highest number of colleagues for communication regarding academic matters. A22 has a far higher out-degree of communication than A6 and so this is why this student is far higher up the clique hierarchy in this weak clique analysis that disregards the direction of the communication relationship.

We can see that all of the lines flow into the same continuous line in the diagram, showing that the very many groupings actually overlap considerably making up one large group. This may be expected given that the group consists of one component.

UCINET can also be used to produce a single link hierarchical clustering model which can also be used for further investigation of the overlap of the cliques. This clustering tool is another way of illustrating which students are in the same cliques together, as well as which students are present in the most amount of groups. The following single link hierarchical clustering model represents exactly the same data as the tree diagram (fig 4.13) above. The x axis represents the student id. and the y axis represents the hierarchical level of the cliques identified. In this way hierarchical clustering is simply a method of structuring the data in the opposite way from the tree diagram in order to gain further understanding of the same data. This form of diagram indicates the layers of hierarchical clustering.

For the Year 1 Communication network we can see that students A1 and A22 share the most amount of cliques at the hierarchical level of 344(see fig. 4.14). They are at the top of the pile of hierarchical clustering. This means that they are highly central in all of the cliques. The pattern of the cliques shows that they flow into one large component. There do not appear to be any factions in the group as a whole as this would manifest itself by showing two or more peaks rather than one peak, flowing into the remainder of the group. Taking three people as the minimum number of a clique, we can see that there are very many cliques with a high degree of overlap, essentially merging into one large group.

At the very bottom is the hierarchical level six. As there are x's allocated to each of the students at this level, the diagram indicates that all students actually belong to cliques. As previously discussed the Year 1 communication network consists of one large component and so it is no surprise that all of the students contained within it actually belong to one or more cliques.

Student Number

```
      2 2 1 1 1 1 4 2   2 3 1 2       3 1 2 4 4 3 3   1 3 3 1 2   3 1 3 2   3 3 1   2   2 4 4 4 4 4
Level 7 8 3 8 7 1 6 0 2 9 5 4 4 5 3 4 7 0 3 0 1 4 9 8 9 2 8 5 1 6 0 6 3 5 7 1 6 2 9 2 1 6 2 3 4 5 7
----- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
  344 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX . . . . . .
  299 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXX . . . . . .
  252 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXX . . . . . .
  251 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXX . . . . .
  229 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX . . . .
  209 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXX . . . .
  187 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXX . . . .
  183 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXX . . . .
  160 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXX . . . .
  155 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXX . . . .
  139 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXX . . . .
  134 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXX . . . .
  131 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
  130 . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
  128. . . . . . . . . . . . . . . . . . . . . . . . . . . . .XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
  114 . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
  111 . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
  109 . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
  108 . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
   73 . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
   68 . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
   65 . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
   63 . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
   62 . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
   61 . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
   54 . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
   53 . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
   41 . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . .
   39 . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . .
   33 . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   29 . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   28 . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   26 . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   23 . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   22 . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   19 . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   14 . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    9 . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    7 . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    6 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

<u>Fig. 4.14 Single Link Hierarchical Clustering of Year 1 Communication Network Weak Cliques Analysis at a Minimum Group Size of 3</u>

UCINET can then be used to perform the clique analysis defining a clique as having at least 5 members. Tightening the criteria of clique membership in this way means that there will be a smaller number of cliques.

When the criteria is tightened to a minimum of 5 in the group, UCINET 5 identifies 929 cliques, with a tree diagram and hierarchical clustering diagram that appear to be virtually the same. At a minimum of 8 members, 468 cliques are found, again in a similar pattern of clustering. When the minimum is set to 10 as in Fig 4.15 (consider that there are 47 students in the group so a clique of 10 is a large clique), 47 cliques can be identified, which is still a very large number. Such a large number of cliques at such a tight definition of clique membership shows that the network over all is particularly cohesive.

The cliques form a pattern that can be observed in the following tree diagram in Fig 4.15:

Hierarchical Level of Relationships

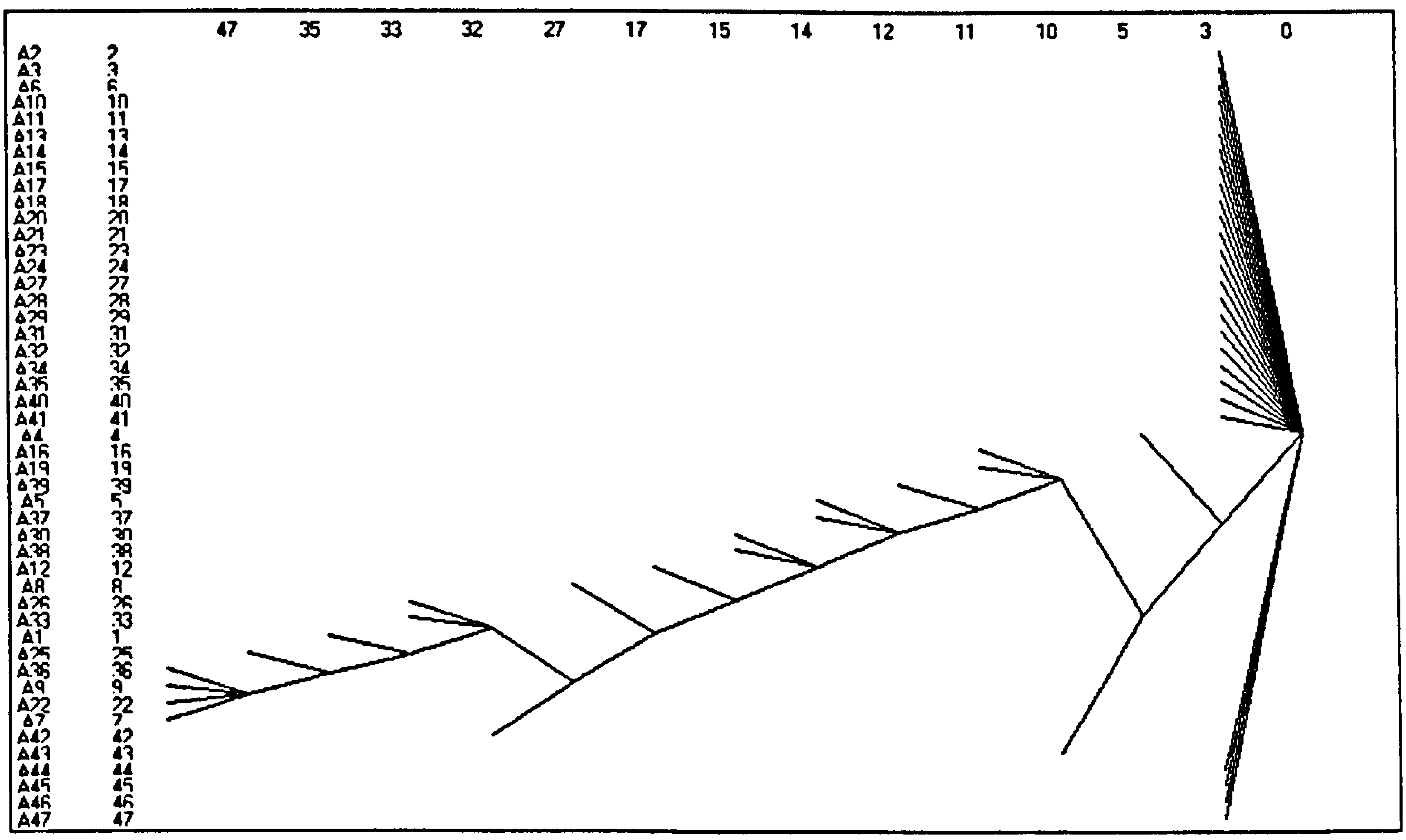


Fig. 4.15 A Tree Diagram Showing the Weak Clique Analysis of the Year 1 Communication Network at a Minimum Group Size of 10

It is only when the criteria of clique membership is tightened to a minimum of 10 that we start to see that not all of the individual students belong to such a clique.

Most of the students are situated between hierarchy level three and zero, showing that while some students are in a lot of cliques with 10 or more students, there are many who are in a few or none. Within the tree diagram, the students that are in many cliques all appear to follow in a line this means that ultimately they come together to form one large group. We can see this in more detail in the single link hierarchical clustering diagram in Fig 4.16 below:

Student Number

```
               1 1 1 1 1 1 1 2 2 2 2 2 2 2 3 3 3 3 4 4   1 1 3   3 3 3 1   2 3   2 3   2   4 4 4 4 4 4
Level   2 3 6 0 1 3 4 5 7 8 0 1 3 4 7 8 9 1 2 4 5 0 1 4 6 9 9 5 7 0 8 2 8 6 3 1 5 6 9 2 7 2 3 4 5 6 7
-----   - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
   47   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXX . . . . . .
   35   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXX . . . . . .
   33   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX . . . . . .
   32   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXX . . . . . .
   27   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXX . . . . .
   17   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXX . . . . .
   15   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXX . . . . .
   14   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXX . . . . .
   12   . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . . . .
   11   . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . . . .
   10   . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . . . .
    5   . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . . .
    3   . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . . .
    0   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Fig. 4.16 Single Link Hierarchical Clustering of Year 1 Communication Network Weak Clique Analysis at a Minimum Group size of 10

It is interesting to note that when the criterion for clique membership is raised to 10 people, student A1 is no longer at the top of the hierarchy and so we can see that this student has many more relationships within small cliques and fewer in the larger cliques. Students A36, A9, A22 and A7 are in the most cliques at this level of clustering. When we compare this with the students' degree centrality in the communication networks we see that only student A22 has a particularly high out-degree of centrality which may influence his prominent membership in such cliques. The other students do not have particularly high in or out-degrees of communication. These students do however show fairly high levels of closeness centrality in later analysis of individual centrality. It is their closeness in terms of communication ties that places them within such a large number of closely knit cliques.

All of the cliques still run into one group, but there are many students who do not belong to such large cliques.

4.10.2. A Strong Clique Analysis of Year 1 Communication Network

In order to create a strong clique analysis the data was first symmetrized. The matrix was symmetrized by taking the minimum value. This means that for each of the possible ties between individuals in the matrix UCINET checks to see if there is actually a relationship. The program then checks to see if this relationship runs ion both directions. If the relationship is reciprocal then a 1 is allocated. If the relationship is not reciprocal then a 0 is allocated. In this way a new symmetrical matrix is produced from the previously unsymmetrical one. A strong clique analysis can then be performed on the data. The strong clique is one in which all of the nodes (in this case students) are directly and reciprocally related to one another. This is a stronger measure than the weak clique measure because in the weaker measure the relationship does not need to be reciprocal and so information or friendship etc may only flow in one direction.

When the strong clique measure is applied to the Year 1 communication network, with the minimum number of clique members set to three, UCINET 5 identifies 86 cliques as can be seen in Fig 4.17 below. The number of cliques is considerably lower with this more rigorous measure of a strong clique which requires reciprocity.

The tree diagram in Fig. 4.17 shows that the cliques fall into quite discreet hierarchical levels, flowing into one large group. Students A7 and A22 belong to the highest number of cliques. Other students cluster around the level 4, 3, 2 and 1 hierarchies.

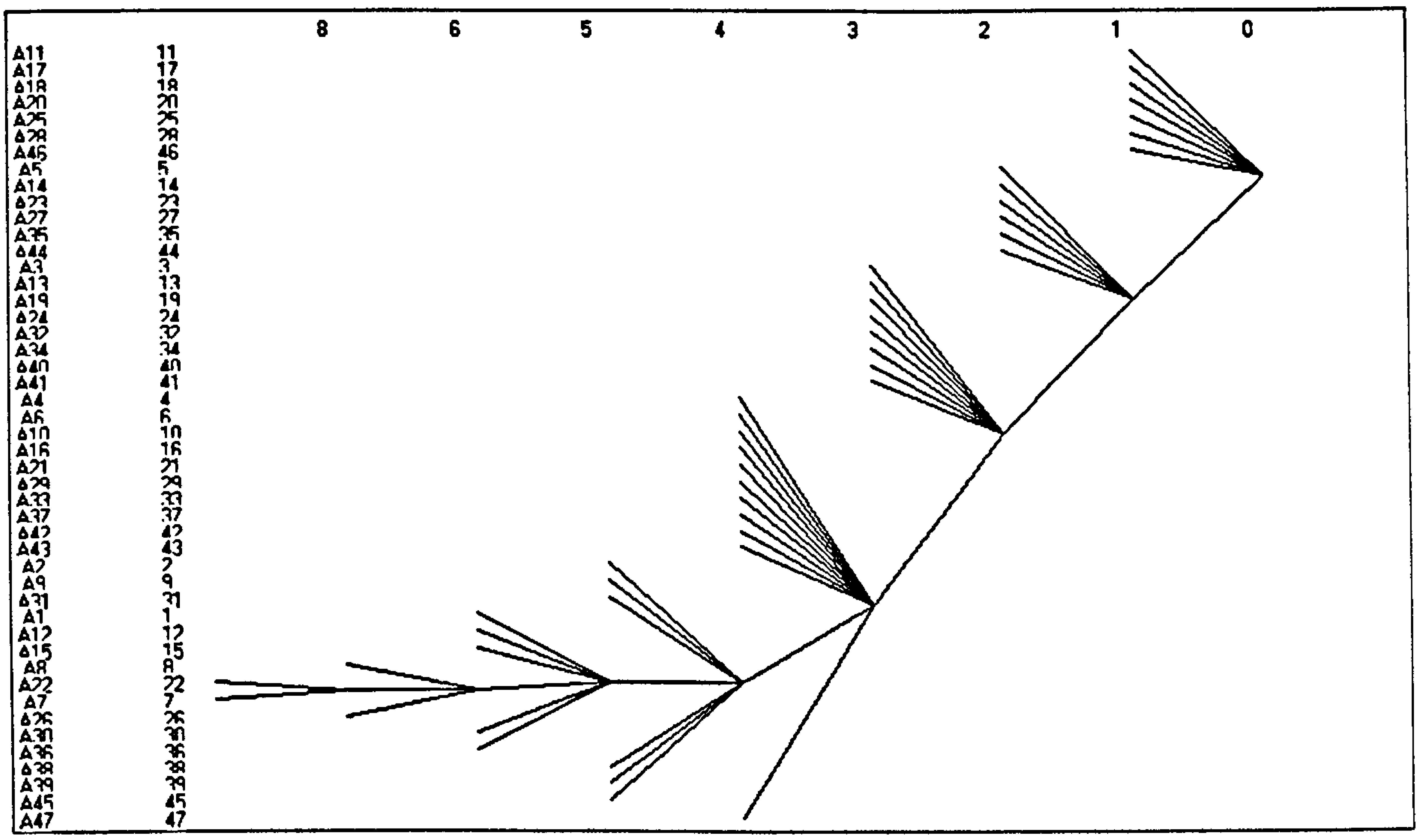


Fig. 4.17 A Tree Diagram Showing the Strong Clique Analysis of the Year 1 Communication Network at a Minimum group size of 3

This can be more clearly illustrated by the single–link hierarchical clustering diagram in Fig 4.18:

Student Number

```
        1 1 1 2 2 2 4   1 2 2 3 4   1 1 2 3 3 4 4     1 1 2 2 3 3 4 4     3   1 1   2   2 3 3 3 3 4 4
Level   1 7 8 0 5 8 6 5 4 3 7 5 4 3 3 9 4 2 4 0 1 4 6 0 6 1 9 3 7 2 3 2 9 1 1 2 5 8 2 7 6 0 6 8 9 5 7
-----   - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
    8   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . xxx . . . . . . .
    6   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . xxxxxxx . . . . . . .
    5   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . xxxxxxxxxxxxxxxxx . . . . .
    4   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . xxxxxxxxxxxxxxxxxxxxxxxxxxxxx .
    3   . . . . . . . . . . . . . . . . . . . . . xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    2   . . . . . . . . . . . . . . xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    1   . . . . . . . xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    0   xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

Fig. 4.18 A Single Link Hierarchical Clustering of Year 1 Communication Network Strong Clique Analysis at a Minimum Group Size of 3

Here we can see that when the criteria is restricted so that the communication process must be reciprocal, A22 and A7 are most prominent. It is these students that are involved in the most reciprocal communication cliques. There is a great deal of overlap, once more there are no factions within the group as is illustrated by the dissemination of communication from the top of the hierarchy to the bottom with no separate peaks to indicate a split in the cohort as a whole. There are however many students that do not belong to any of the cliques. These students are to the left of the diagram. Students A11, A17, A18, A20, A25, A28 and A46 all show x's in the 0 level of hierarchy and no others. This indicates that these students do not belong to any strong cliques where there are a minimum number of 3 members with reciprocated communication relationships.

When the minimum number of members in the clique is increased to four, UCINET 5 identifies 23 cliques.

Hierarchical Level of Relationships

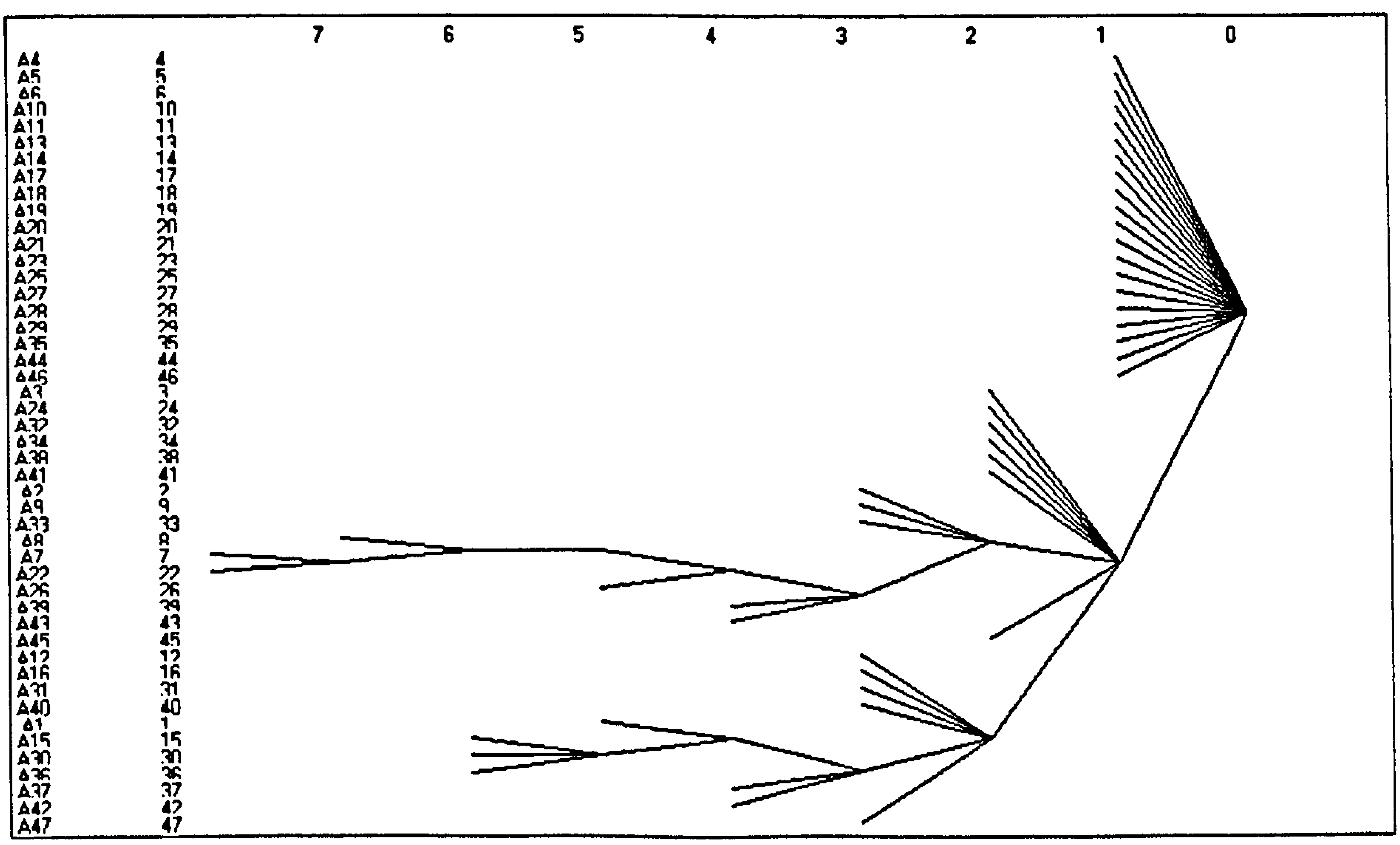


Fig. 4.19 A Tree Diagram Showing the Strong Clique Analysis of the Year 1 Communication Network at a Minimum group size of 4

The tree diagram in Fig 4.19 shows that the cohort divides into two branches at this level of analysis, with a third set of students bunched together at the lowest hierarchical level. This is the first time in the analysis that a split in the cohort becomes evident.

Where the clique membership must consist of four individual all with reciprocal communication networks two distinct branches appear within the cohort. Again students A7 and A22 head one of these branches. Student A22 has one of the highest betweenness scores of the cohort and so it is evident that he is in a strong position when it comes to the communication network. Both students also performed well academically with student A7 achieving an end of year grade of 61.71% and A22 with a grade of 71.75%, one of the highest in the cohort.

The hierarchical clustering diagram in Fig 4.20 represents the same data and shows further how the cohort split when the criteria are tightened to include reciprocity and a minimum clique membership of 4.

Student Number

```
              1 1 1 1 1 1 1 2 2 2 2 2 2 2 3 4 4   2 3 3 3 4     3     2 2 3 4 4 1 1 3 4   1 3 3 3 4 4
Level   4 5 6 0 1 3 4 7 8 9 0 1 3 5 7 8 9 5 4 6 3 4 2 4 8 1 2 9 3 8 7 2 6 9 3 5 2 6 1 0 1 5 0 6 7 2 7
-----   - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
    7   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX . . . . . . . . . . . . . . .
    6   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXX . . . . . . . . . . . . . . .
    5   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXX . . . . . . . . . XXXXX . . .
    4   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXX . . . . . . . XXXXXXX . . .
    3   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX . . . . . XXXXXXXXXXX .
    2   . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXX . XXXXXXXXXXXXXXXXXXXXX
    1   . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    0   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

<u>Fig. 4.20 A Single link Hierarchical Clustering of Year 1 Communication Network Strong Clique Analysis at a Minimum Group Size of 4</u>

The cluster diagram in Fig 4.20 clearly shows the split in the Year 1 reciprocal communication network. For these criteria there is a clear divide between the group led by students A7, A22 and that led by A36, A30 and A15. Both of these groups are separate in their communication behaviour with those at level 1 spanning the two groups and creating a means of communication between the two. All of the students on the left of the diagram from A4 through to A46 do not however belong to any of these cliques. This means that they may not be able to take advantage of the communication opportunities that are available to those students that are highly involved in reciprocal communication relationships.

When the minimum group membership is increased to five, UCINET 5 identifies zero cliques. This illustrates the stringency of the strong measure as compared to the weak measure that identifies 929 cliques with a minimum of five members.

4.10.3. A Weak Clique Analysis of Year 1 Friendship Network

A weak clique analysis of the Year 1 friendship network, with a minimum of 3 members in the group, provides 79 cliques as can be seen in Fig. 4.21. This is a large amount of cliques given that there are 47 students, and the time and effort that must go into a relationship such as friendship. This number is considerably lower than the 943 cliques found in the comparative clique measure for communication, indicating the difference between the two types of relationship.

Hierarchical Level of Relationships

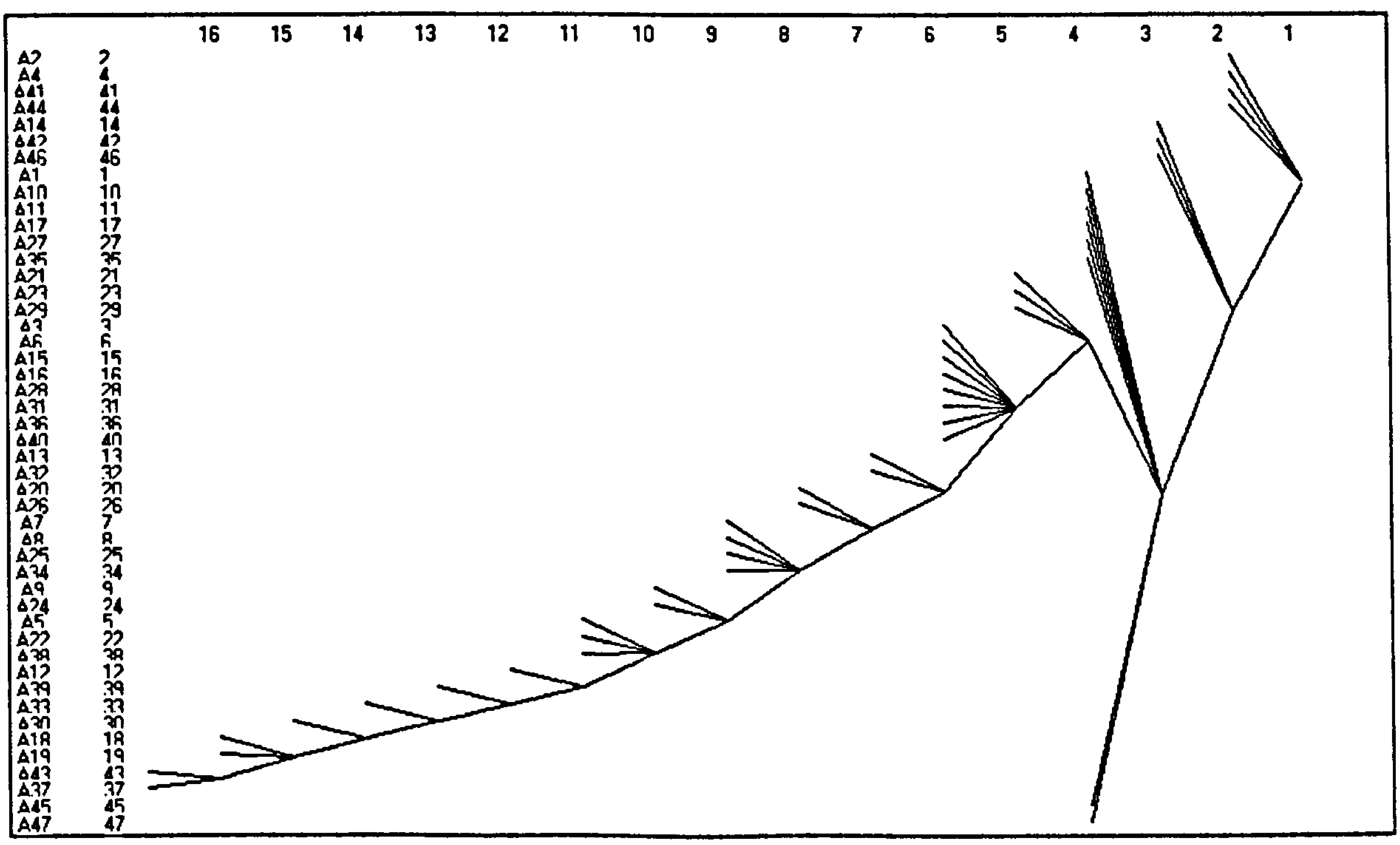


Fig. 4.21 A Tree Diagram Showing the Weak Clique Analysis of the Year 1 Friendship Network at a Minimum Group Size of 3

It is interesting to note that all of the cliques flow into one large group, showing that even in friendship the Year 1 cohort are one cohesive unit. The degree of overlap can also be seen in the cluster diagram. Showing one peak, headed by A37 and A43, the cliques overlap into 16 hierarchical levels, without a split in the cohort as a whole. If there were to be a split we would see separate piles of clusters, but in this diagram there is only one pile of clusters. The lowest hierarchical level is 1, this indicates that in fact all of the students belong to at least one of these weak cliques in which the flow of friendship can be in any direction and the relationship need not be reciprocal. It is interesting that although students A37 and A43 appear in the highest number of cliques in the friendship network they do not feature as highly in cliques of communication. Indeed student A37 has the highest in-degree of friendship in the entire cohort. This means that he is sought out the most for his friendship. Student A43 has the second highest in-degree of friendship. It is little wonder then that these two highly popular students feature the most in a weak clique analysis of friendship. The relationship need not be reciprocal in a weak cliques analysis and so the act of fellow students seeking out their friendship puts A43 and A37 in an advantageous position.

Student Number

```
           4 4 1 4 4   1 1 1 2 3 2 2 2     1 1 2 3 3 4 1 3 2 2     2 3   2   2 3 1 3 3 3 1 1 4 3 4 4
Level  2 4 1 4 4 2 6 1 0 1 7 7 5 1 3 9 3 6 5 6 8 1 6 0 3 2 0 6 7 8 5 4 9 4 5 2 8 2 9 3 0 8 9 3 7 5 7
-----  - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
   16  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX . .
   15  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXX . .
   14  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXX . .
   13  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX . .
   12  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXX . .
   11  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXX . .
   10  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXX . .
    9  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXX . .
    8  . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . .
    7  . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . .
    6  . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . .
    5  . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . .
    4  . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . .
    3  . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    2  . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    1  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Fig. 4.22 A Single Link Hierarchical Clustering of Year 1 Friendship Network Weak Clique Analysis at a Minimum Group Size of 3

At a minimum of 4 members, UCINET 5 identifies 73 weak cliques, with a clustering pattern similar to that when the minimum is 3 as can be seen in Fig. 4.22. At a minimum group size of 5, 49 cliques are found and there is a slight split in the cohort with students A12 and A24 separating from the group as a whole. At a minimum of 6 members, 28 weak cliques are found.

Student Number

```
              2 2 2 3 3 4   1 1 1 1 2 1 1 1   2 2 2 3 4 4 1 2 3 3 2   2       3 1 1 3 3 3 3 4 4 4 4 4
Level   1 2 6 0 7 9 1 6 1 4 0 4 7 1 3 2 5 6 3 2 4 5 5 0 2 3 8 2 8 1 8 6 5 7 9 4 8 9 3 9 0 7 3 4 5 6 7
-----   - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
   16   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX . . . .
   13   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXX . . . .
   12   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXX . . . .
   11   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXX . . . .
   10   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXX . . . .
    8   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXX . . . .
    7   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXX . . . .
    4   . . . . . . . . . . . . . . . . . . XXXXX . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXX . . . .
    3   . . . . . . . . . . . . . . . XXXXXXXXXXX . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . . .
    2   . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . . .
    1   . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX . . . .
    0   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Fig. 4.23 Single Link Hierarchical Clustering of Year 1 Friendship Network Weak Clique Analysis at a Minimum Group Size of 6

At this minimum size of 6, the group splits slightly, led by students A24, A22 and A3 as can be seen in Fig 4.23. There are also students at the far left and the far right of the diagram that do not feature in any of these weak cliques with a minimum membership of 6 students.

4.10.4. A Strong Clique Analysis of Year 1 Friendship Network

A strong clique analysis was applied to the Year 1 friendship network. Again this involved symmetrizing the data so that a relationship is recorded only where it is reciprocated.

When a strong clique analysis measure is applied to the Year 1 friendship network with a minimum of 3 members, 34 cliques are identified (see Fig 4.24).

When the measure contains the reciprocal criterion, different factions within the cohort begin to show. Three clear lines of association are formed, with a fourth group consisting of those at the lower hierarchy of association. Where friendship is reciprocated, there is perhaps a limit as to how far the integration into the entire group can spread. Within a group of 47 students everyone is unlikely to be friends with everyone else and so it is comprehensible that grouping will occur.

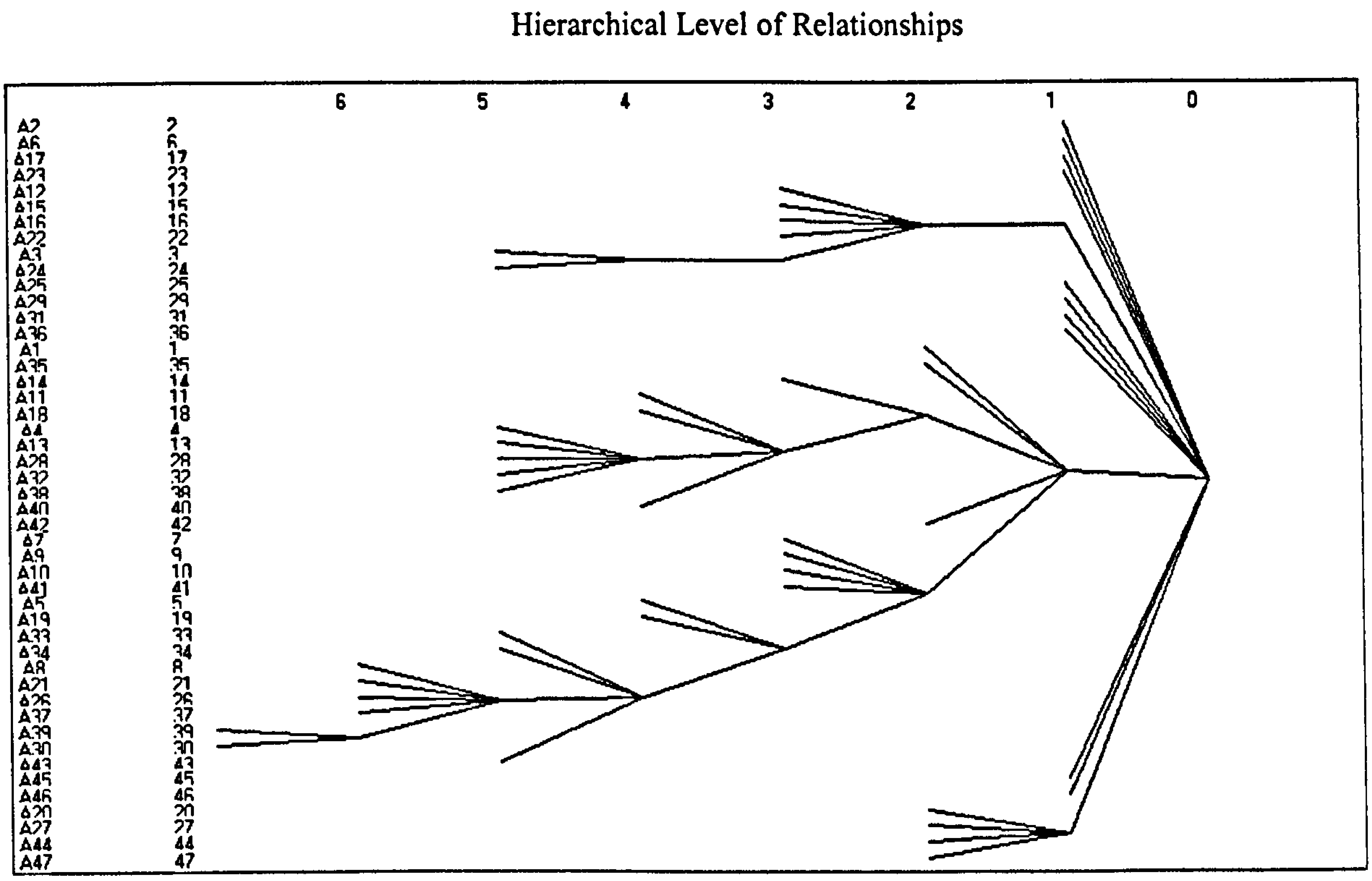


Fig. 4.24 A Tree Diagram Showing the Strong Clique Analysis of the Year 1 Friendship Network at a Minimum Group Size of 3

Here we can see the difference between the tree diagram in Fig 4.24 when there is a split between the different cliques and previous tree diagrams such as Fig. 4.13 where all of cliques flow into one continuous flow of clique relationships. Here we can see that the cliques do not overlap but there are three separate steams of friendship groupings within the cohort, as well as some students who do not belong to any such cliques at all.

This grouping can also be seen in the single – link hierarchical clustering analysis below in Fig 4.25 which represents the same data set:

Student Number

```
1 2 1 1 1 2   2 2 2 3 3   3 1 1 1   1 2 3 3 4 4     1 4   1 3 3   2 2 3 3 3 4 4 4 2 2 4 4
Level   2 6 7 3 2 5 6 2 3 4 5 9 1 6 1 5 4 1 8 4 3 8 2 8 0 2 7 9 0 1 5 9 3 4 8 1 6 7 9 0 3 5 6 0 7 4 7
-----   - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
    6   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . xxx . . . . . . .
    5   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . xxxxxxxxxxx . . . . . . .
    4   . . . . . . . . xxx . . . . . . . . . xxxxxxxxx . . . . . . . . xxxxxxxxxxxxxxxxx . . . . . .
    3   . . . . . . . . xxx . . . . . . . xxxxxxxxxxxxxxx . . . . . xxxxxxxxxxxxxxxxxxxxx . . . . . .
    2   . . . . xxxxxxxxxxx . . . . . . xxxxxxxxxxxxxxxxx . xxxxxxxxxxxxxxxxxxxxxxxxxxxxx . . . . . .
    1   . . . . xxxxxxxxxxx . . . . xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx . . xxxxxxx
    0   xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

Fig. 4.25 Single Link Hierarchical Clustering of Year 1 Friendship Network Strong Clique Analysis at a Minimum of 3 Group Size.

There are only six levels of hierarchy in Fig 4.25, indicating that in this network the crossover of cliques occurs less frequently. One main group is headed by A3 and A24, another by A4, A13, A28, A32 and A38 and finally a group is headed by A30 and A39. Some students such as A2, A6, A17 and A23 do not belong to any such strong cliques.

4.10.5 A Weak Clique Analysis of Year 2 Communication Network.

At a minimum of 3 members, the Year 2 communication network consists of 1166 cliques, as can be seen in Fig 4.26. This is a very high number of cliques for a group of 40 students. The cliques are also highly overlapping with 343 hierarchical levels. The overlapping of the cliques occurs to the extent that all of the students flow into what can be seen as one large group. This feature is demonstrated by the tree diagram below. Students B2 and B13 belong to the largest number of weak cliques in the Year 3 communication network and B32 belongs to the lowest.

Hierarchical Level of Relationships

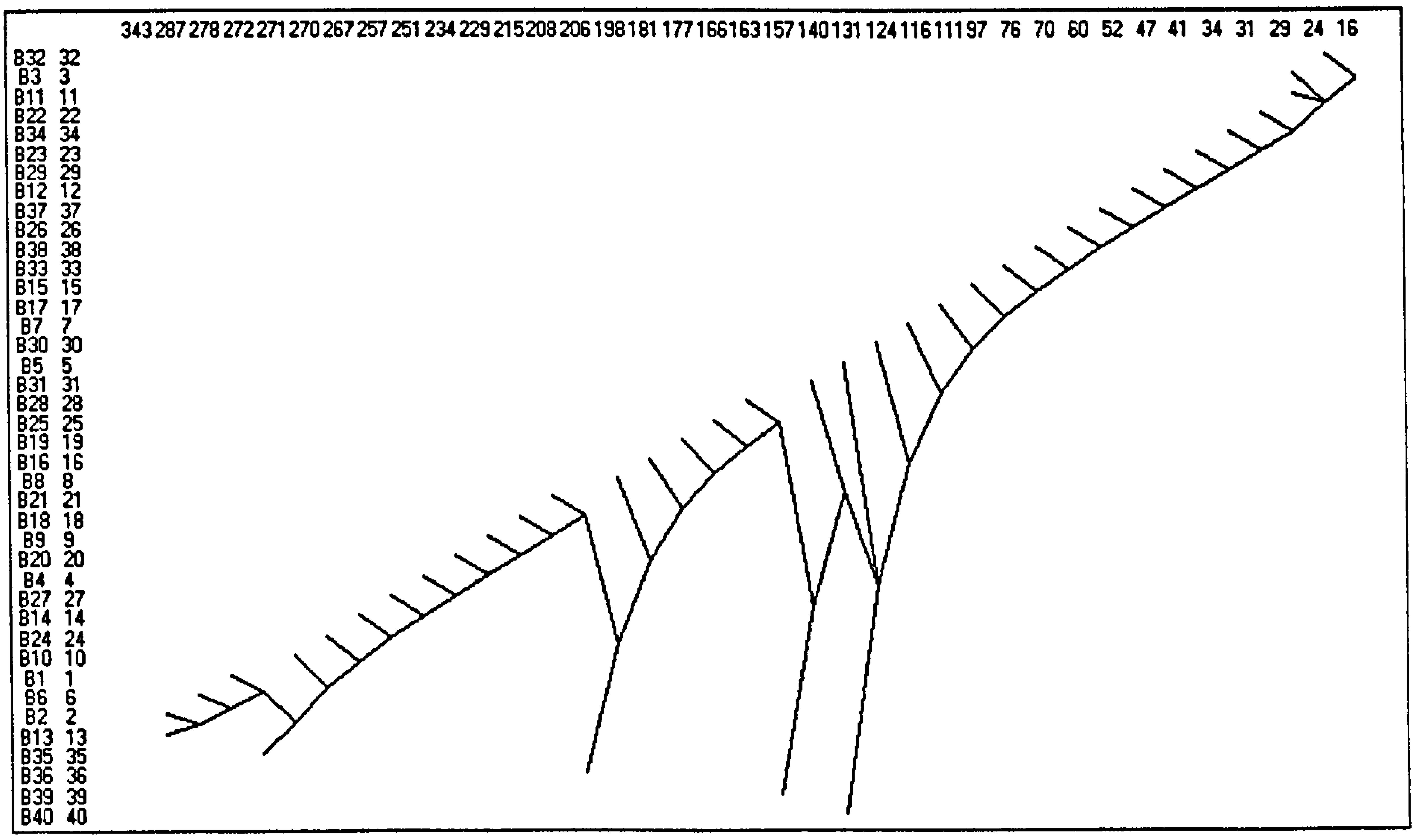


Fig. 4.26 A Tree Diagram Showing the Weak Clique Analysis of the Year 2 Communication Network at a Minimum Group Size of 3

When the criteria for clique membership is set at a minimum of 5 students once more 1166 cliques are identified. The number of cliques remains high even up to a minimum group size of ten. Again this shows that there is a very high degree of overlap amongst the cliques in the Year 3 communication network.

Table 4.8 below indicates the minimum number group size and the corresponding number of cliques found in a weak cliques analysis of Year 2 communication Networks.

Minimum Number in Group	Number of Cliques Identified
4	1166
5	1166
6	1161
7	1123
8	944
9	482
10	233
11	22
12	0

Table 4.8 Table Showing the Minimum Number Group Size and the Corresponding Number of Cliques Found in a Weak Cliques Analysis of Year 2 Communication Networks.

The clique numbers are high and so too is the degree of overlap, combining all of the students into one large group. This was also evident in the component analysis of the communication network in the Year 2 cohort as it is made up of one large component. This shows the degree of integration in the Year 2 communication network, but only as a weak measure. A strong measure will show whether this still holds when the communication is reciprocated.

4.10.6. A Strong Clique Analysis of Year 2 Communication Network.

When a strong clique measure is applied to the Year 2 communication network the number of cliques reduces to 88 at a minimum group size of 3, as illustrated in Fig 4.27. This strong clique analysis reflects clique membership only where the relationship is reciprocated.

Once again we can see that the communication cliques still cross over and flow into one large communication group. At a minimum group size of 4, 29 cliques are identified, and when the minimum level is set at 5, there are only 3 cliques.

Hierarchical Level of Relationships

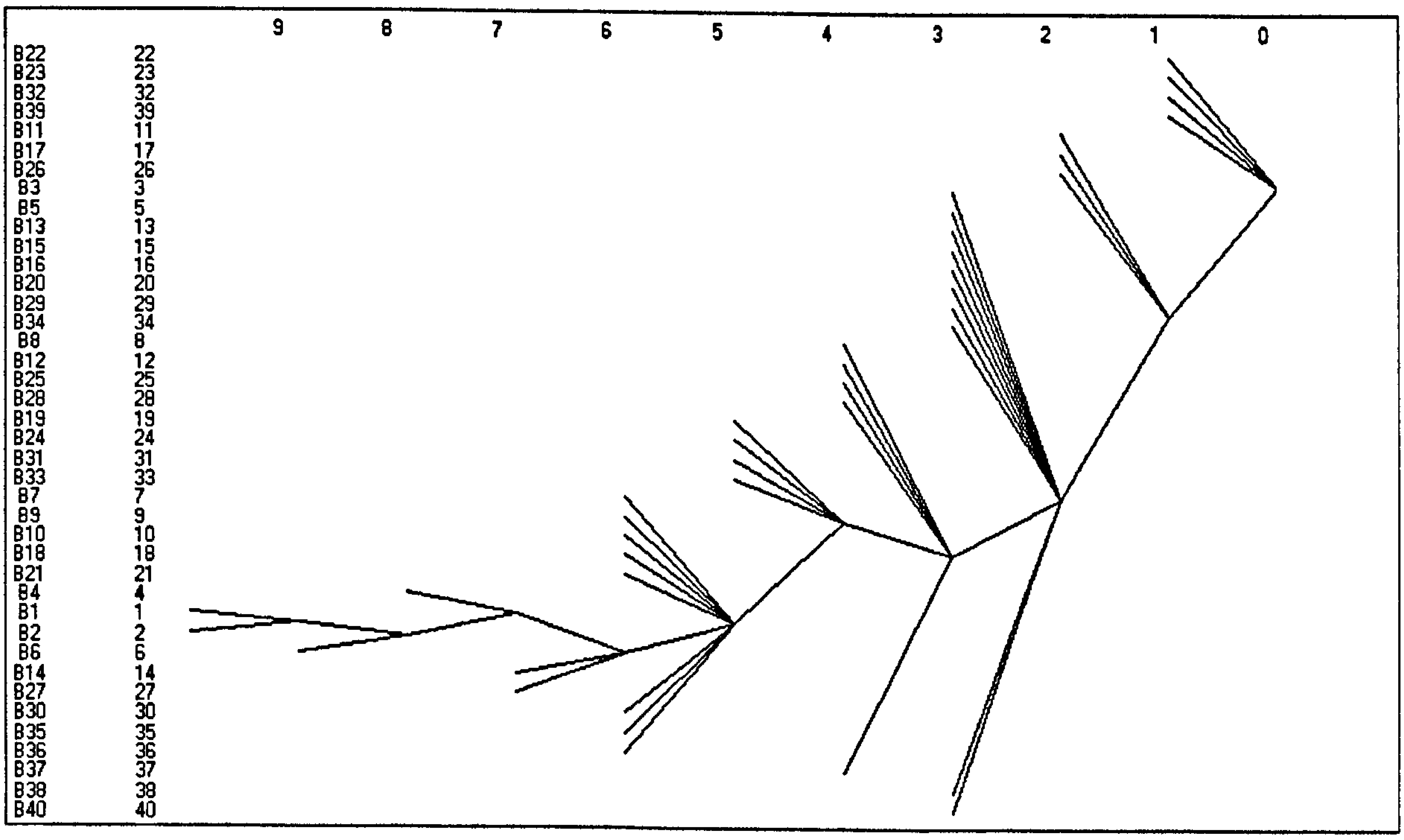


Fig. 4.27 A Tree Diagram Showing the Strong Clique Analysis of the Year 2 Communication Network at a Minimum Group Size of 3

This weak clique analysis shows that students B1 and B2 belong to the highest number of strong cliques in the communication network. These students have a high out-degree of communication along with fairly high in-degree measures of communication centrality. This is also reflected in their membership of the highest number of strong cliques. Similarly B22, B23 and B32 all have relatively low in and out-degrees of communication and belong to the least number of strong, reciprocal cliques.

4.10.7 A Weak Clique Analysis of Year 2 Friendship Network.

A weak clique analysis of the Year 2 friendship network at a group size minimum of 3 identifies 85 cliques, as illustrated in Fig 4.28. We can see from the single-link hierarchical clustering model in Fig 4.28 that two streams within those cliques are formed:

Student Number

```
        3 3   2 2 2 3 1 1 2   1 2 2 3 1 1   2     1 1 1 2 3 3   2   1 1 2 3   3   3 3 4
Level   2 5 3 1 3 5 4 2 9 2 1 1 6 9 8 0 3 4 8 6 8 4 5 6 0 0 3 2 7 9 8 7 4 6 5 1 7 7 9 0
-----   - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
   19   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXX .
   18   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXX .
   15   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXX .
   14   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXX .
   13   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXX .
   11   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXX
   10   . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXX
    9   . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXX
    7   . . . . . . . . . . . XXXXX . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    6   . . . . . . . . . . XXXXXXX . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    5   . . . . . . . . . . XXXXXXX . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    4   . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    3   . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    2   . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    1   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Fig. 4.28 A Single Link Hierarchical Clustering of Year 2 Friendship Network Weak Clique Analysis at a Minimum Group Size of 3

The two factions in the cohort are headed by B37, B39 and B11, B26, B29. All of the students do however belong to at least one of these cliques as can be seen above. This pattern of division between the two sets of cliques continues as the minimum number of members in the group size is increased, as can be seen by the tree diagram below. Again students B37 and B39 can be seen to belong to the most number of weak cliques in the friendship network. These cliques then bring in other members until we reach students B11 and B26 who head another set of cliques. From this point onwards the two steams of cliques do not have overlapping membership. Student B39 also has the highest out-degree of friendship. As this is a weak clique measure the relationships do not have to be reciprocal in order for a clique to be identified. B37 also has a relatively high out-degree but his in-degree of friendship is also high. This means that not only does he choose many other students as friends, but also he in turn is sought out for friendship by his colleagues.

Hierarchical Level of Relationships

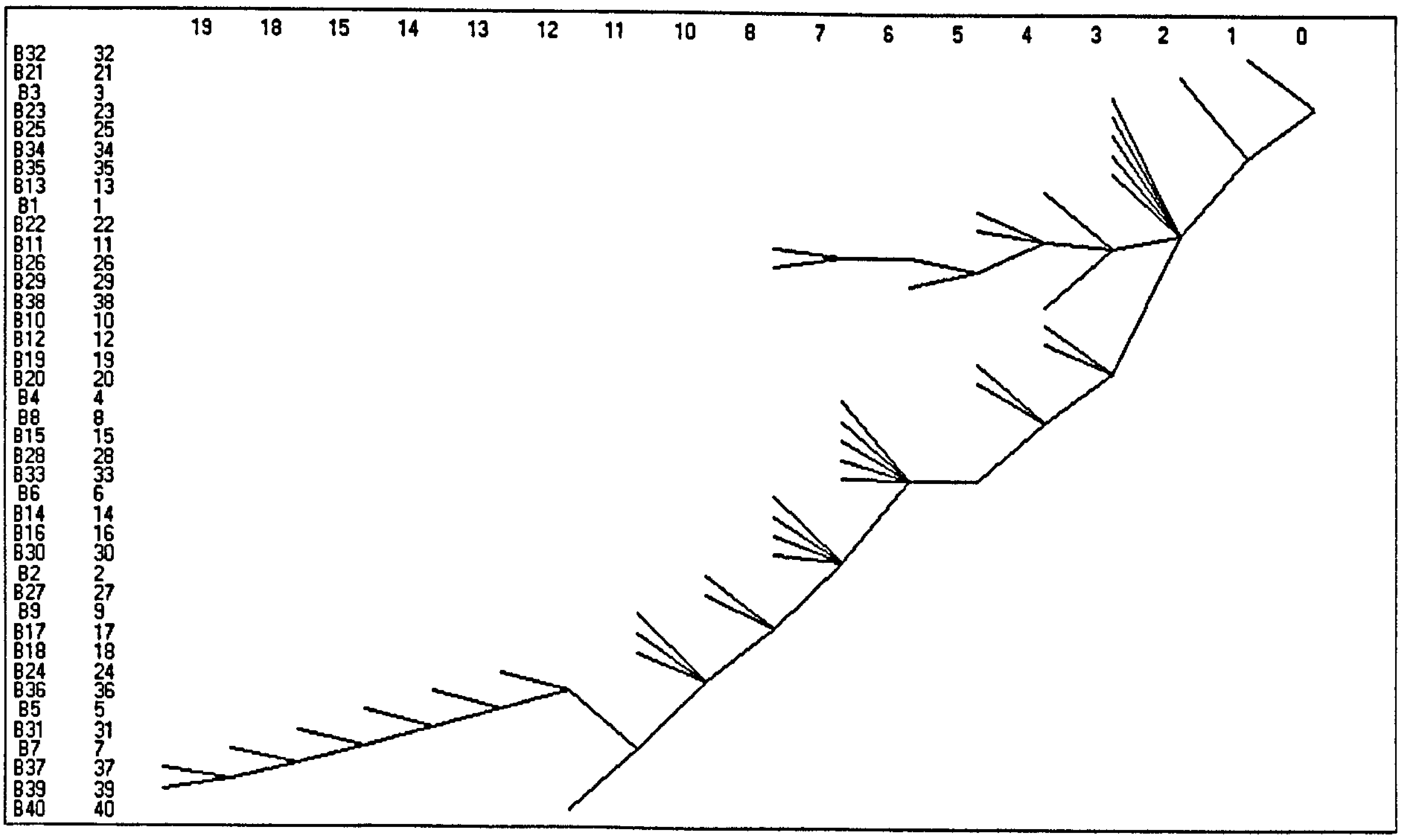


Fig. 4.29 A Tree Diagram Showing the Weak Clique Analysis of the Year 2 Friendship Network at a Minimum Group Size of 5

Fig 4.29 shows the tree diagram of a weak clique analysis of the Year 2 friendship network where the minimum group size is five. This weak measure takes into account any path regardless of direction. But with friendship in particular it is important to look at a strong measure where only reciprocal ties are acknowledged.

4.10.8. A Strong Clique Analysis of Year 2 Friendship Network.

When a strong clique analysis is performed on the Year 2 friendship network with a minimum group size of 3, UCINET 5 identifies 45 cliques as can be seen in Fig 4.30. The cliques separate into different streams, producing identifiable groupings.

Hierarchical Level of Relationships

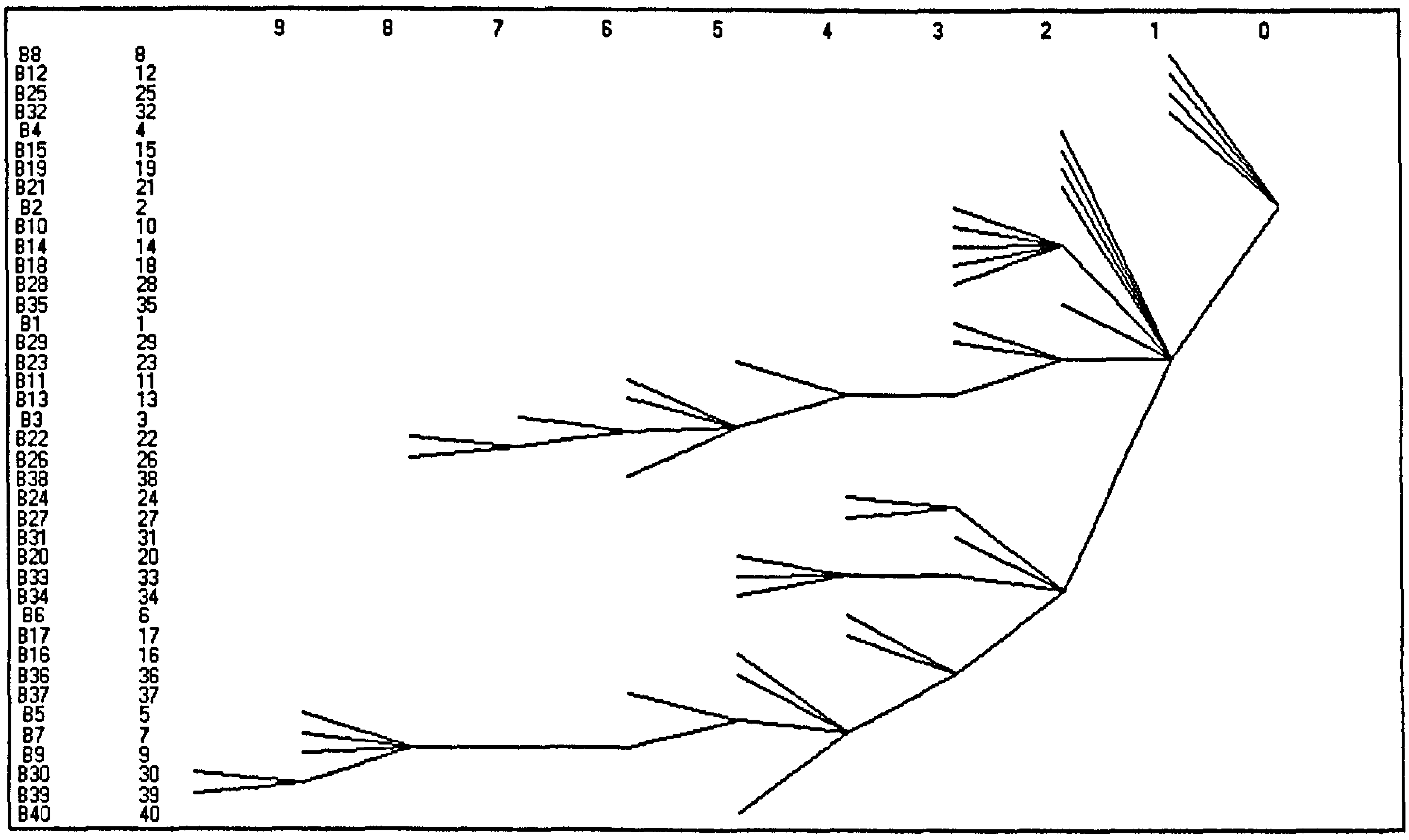


Fig. 4.30 A Tree Diagram Showing the Strong Clique Analysis of the Year 2 Friendship Network at a Minimum Group Size of 3

There are two main groups headed by B30, B39 and B22, B26. There are also other groupings headed by B20, B33, B34 and another by B10, B14, B18, B28. With the strong clique measure the relationships must ne reciprocal. In this case B39 still heads the largest number of cliques, though this time jointly with B30 rather than B37. Also when the friendship measure is reciprocal clearer groupings appear in the network. As the measure is tightened, increasing the minimum membership to 4, the groupings become more pronounced as can be seen in the diagram below:

Student Number

```
          1 1 1 2 2 3   2 2   1 1 1 2 3 3   2 1 2 1   2 2 3   1 2 3 3 1 3 3   3     3 4
Level   8 2 5 9 1 5 2 4 4 7 2 0 4 8 8 1 5 1 9 1 3 3 3 2 6 8 6 7 0 3 4 6 6 7 5 0 7 9 9 0
-----   - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
    8   . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . XXXXXXXXX .
    7   . . . . . . . . . . . . . . . . . . . . . . . XXX . . . . . . . . . XXXXXXXXX .
    6   . . . . . . . . . . . . . . . . . . . . . . XXXXX . . . . . . . . . XXXXXXXXX .
    5   . . . . . . . . . . . . . . . . . . . . . XXXXXXXXX . . . . . . . . XXXXXXXXX .
    4   . . . . . . . . . . . . . . . . . . . XXXXXXXXXXXXX . . XXXXX XXXXXXXXXXXXXXXXX
    2   . . . . . . . . . . XXXXXXXXX . . XXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXX
    1   . . . . . . . . XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    0   XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Fig. 4.31 A Single Link Hierarchical Clustering of Year 2 Friendship Network Strong Clique Analysis at a Minimum Group Size of 4

We can see in Fig 4.31 that there are three definite groupings of the overlapping cliques. There are also a few students that do not belong to any of these groups from student B8 through to student B32 at the left hand side of the diagram.

4.10.9 A Weak Clique Analysis of Year 3 Communication Network.

A weak clique analysis of the Year 3communication network at a minimum group size of 3, identifies 870 cliques. The cliques all overlap into one large group. Even when the minimum group size is set at 10, many weak cliques are identified. There are 43 students in the cohort, therefore 374 cliques at a minimum group size of 10 students is a particularly high level, showing that the communication network of the third year cohort is very highly integrated.

Table 4.9 indicates the number of cliques identified when the minimum number in a group was set at varying levels in a weak clique analysis of the Year 3 communication network:

Minimum Number in Group	Number of Cliques Identified
3	870
4	868
5	858
6	832
7	769
8	669
9	549
10	374

Table 4.9 A Table Showing the Minimum Number Group Size and the Corresponding Number of Cliques Found in a Weak Cliques Analysis of Year 3 Communication Networks.

Fig. 4.32 below indicates a weak clique analysis of the Year 3 communication network where the minimum size of the group was set at 3.

All of the cliques flow into one large group as can be seen in the tree diagram below. The cliques do not split into distinctly separate branches as is the case in other clique analyses such as the strong clique analysis of the Year 2 friendship network as shown in Fig. 4.30. Students C8 and C14 belong to the largest number of weak cliques in the Year 3 communication network. Student C14 also has the highest in-closeness, in-betweeness in the cohort. This student also has the highest out-degree of communication in the cohort, this means that he seeks communication with the highest number of students.

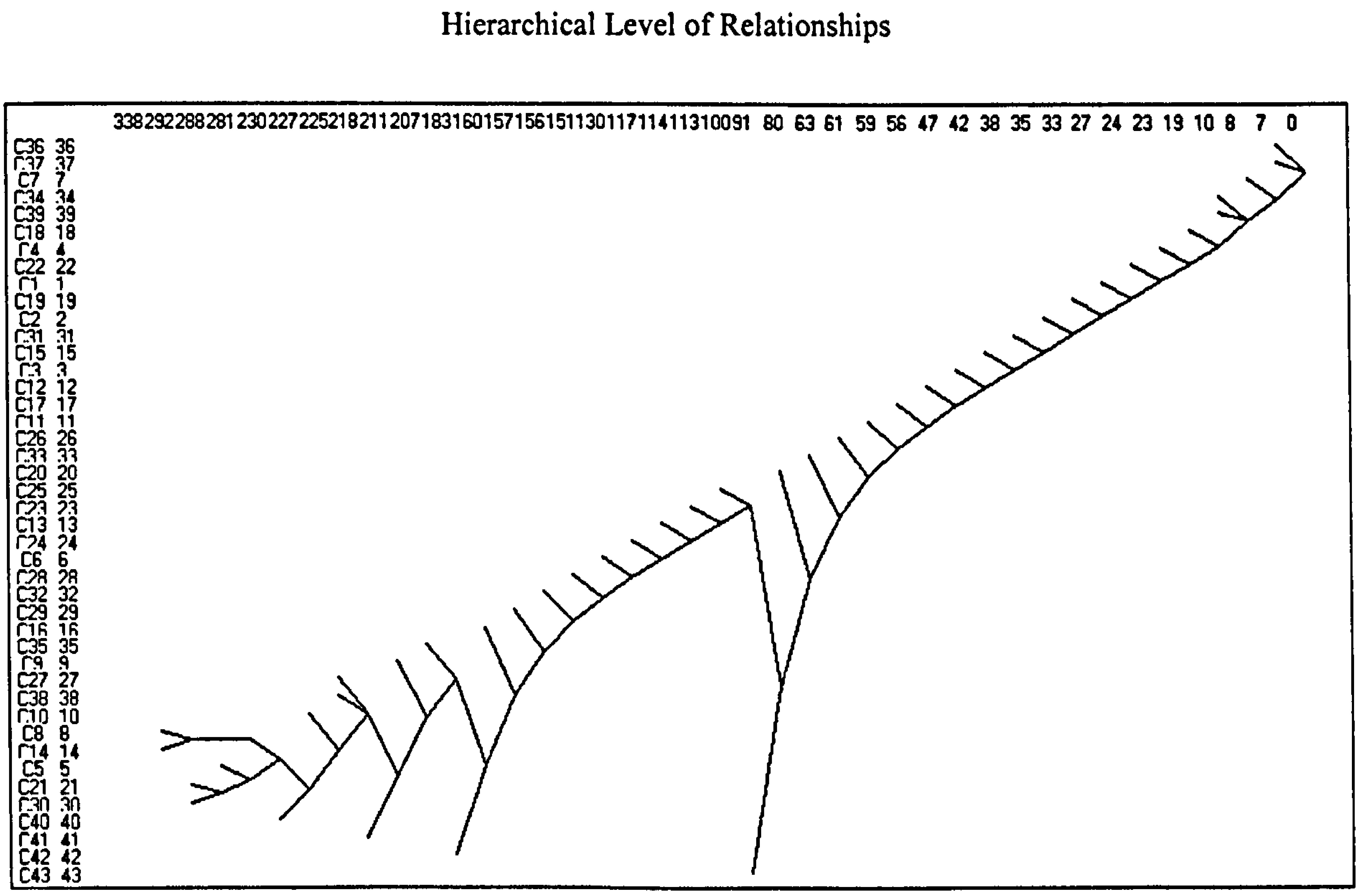


Fig. 4.32 A Tree Diagram Showing the Weak Clique Analysis of the Year 3 Communication Network at a Minimum Group Size of 6

4.10.10 A Strong Clique Analysis of the Year 3 Communication Network

In a strong clique analysis where the communication is reciprocated, 82 cliques are found at the minimum size of 3 students per group as can be seen in Fig. 4.33. At a minimum membership of 4, 51 cliques are found and at a minimum group size of 5, 15 cliques are found. The group is only very slightly fragmented, with all of the connections between students once again flowing into one large communication network. The diagram below shows a strong clique analysis of the Year 3 communication network where there is a minimum number of 4 students per clique. Students C27 and C29 are in the highest number of these reciprocal communication cliques.

Hierarchical Level of Relationships

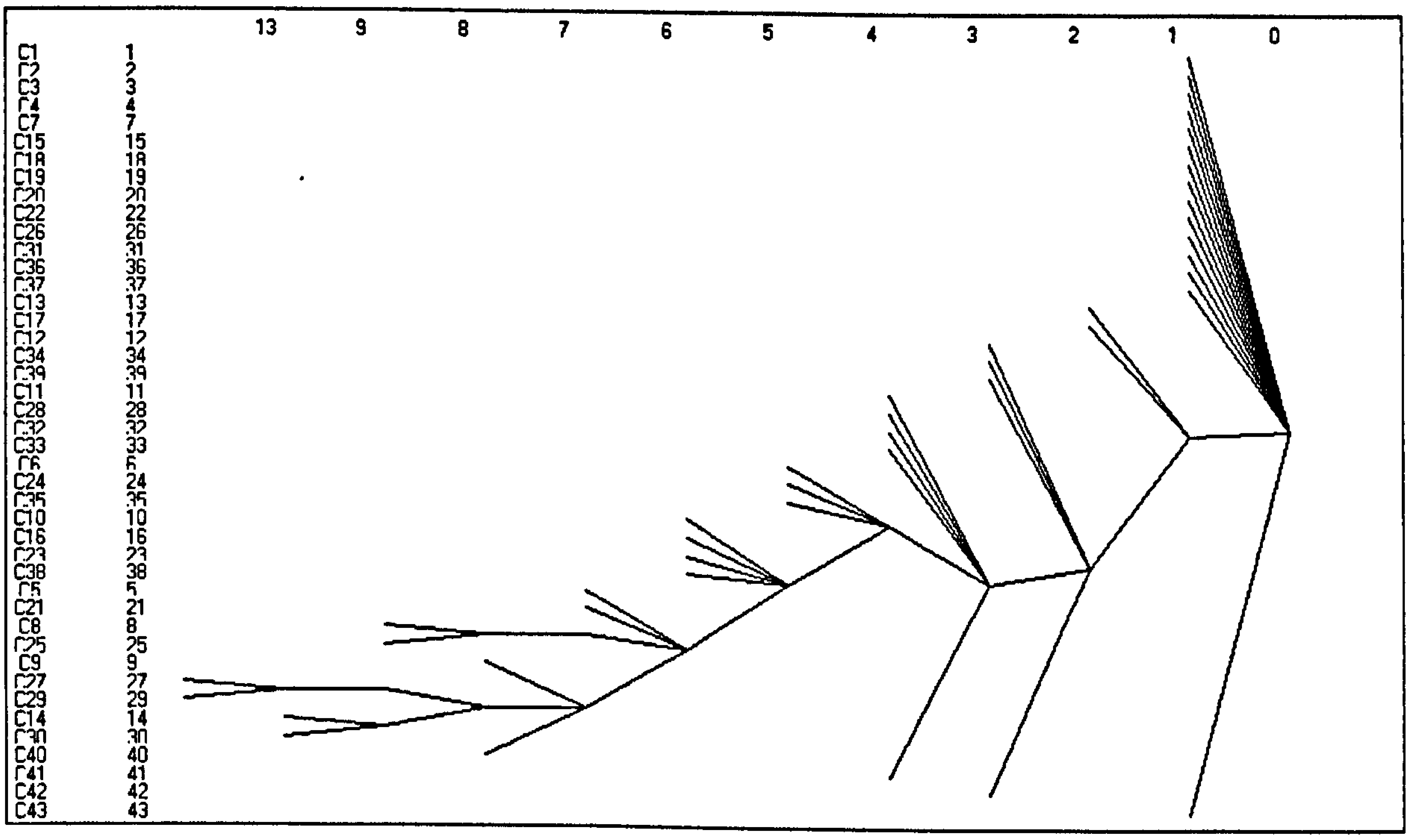


Fig. 4.33 A Tree Diagram Showing the Strong Clique Analysis of the Year 3 Communication Network at a Minimum group size of 4

4.10.11 A Weak Clique Analysis of the Year 3 Friendship Network

A weak clique analysis of the Year 3 friendship network with a minimum group membership of 3 identifies 96 weak cliques. Even for friendship networks, in which much more time and effort must be exerted in order to establish and maintain relationships, the number of identifiable cliques remains high. However as this is a weak clique analysis this would include friendships that are not reciprocated. The following table 4.10 represents the number of weak cliques identified when the minimum number of group members is increased.

Minimum Number in Group	Number of Cliques Identified
3	96
4	89
5	74
6	41
7	17
8	6

Table 4.10 A Table Showing the Minimum Number Group Size and the Corresponding Number of Cliques Found in a Weak Cliques Analysis of Year 3 Friendship Networks.

In the Fig 4.34 below we can see that once again all of the weak friendship cliques overlap in membership effectively making one large group with some students being involve in more of the individual groups than others. Students C3, C38, C14, C9 and C29 belong to the largest number of weak cliques. Students C7 and C15 belong to the smallest number of such cliques.

Hierarchical Level of Relationships

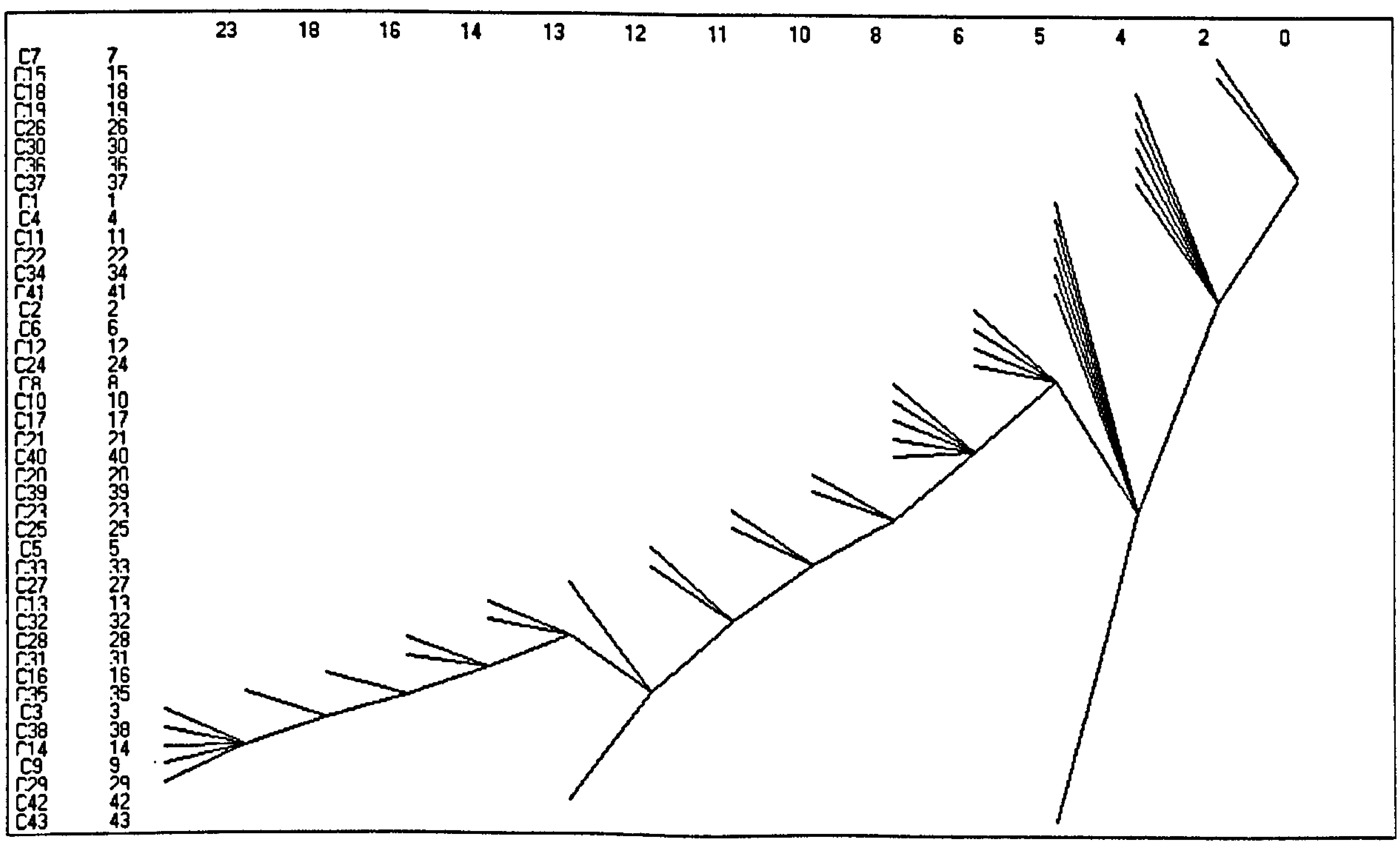


Fig. 4.34 A Tree Diagram Showing the Weak Clique Analysis of the Year 3 Friendship Network at a Minimum Group Size of 4

4.10.12 A Strong Clique Analysis of the Year 3 Friendship Network

When a strong analysis of the Year 3 friendship network is carried out at the minimum group membership of 3, 49 cliques are identified as can be seen in Fig 4.35 below. The cohort begins to split slightly into two groupings of cliques.

In particular students C35, C42 belong to the most strong cliques that have a membership of at least 3 students. Other cliques also then fit into this branch with overlapping membership. C3, C28 then belong to cliques of at least 3 students whose membership do not overlap with the first branch of cliques. C10 and C23 then belong to cliques whose membership again does not overlap with the first two branches of cliques. This is when cliques begin to form in the more common sense of the word. This is where there are friendship groupings within the cohort that are both reciprocal and do not overlap. At just above the level hierarchical three some students belong to both of the branches. These students are C28, C31, C32 and C34. It is these students that would be able to bring together the different factions of the cohort as their membership of the cliques flows into both branches. In this way it may not only be the number of cliques that an individual belongs to that is important, but exactly which cliques, and how that clique is related to the others in the cohort.

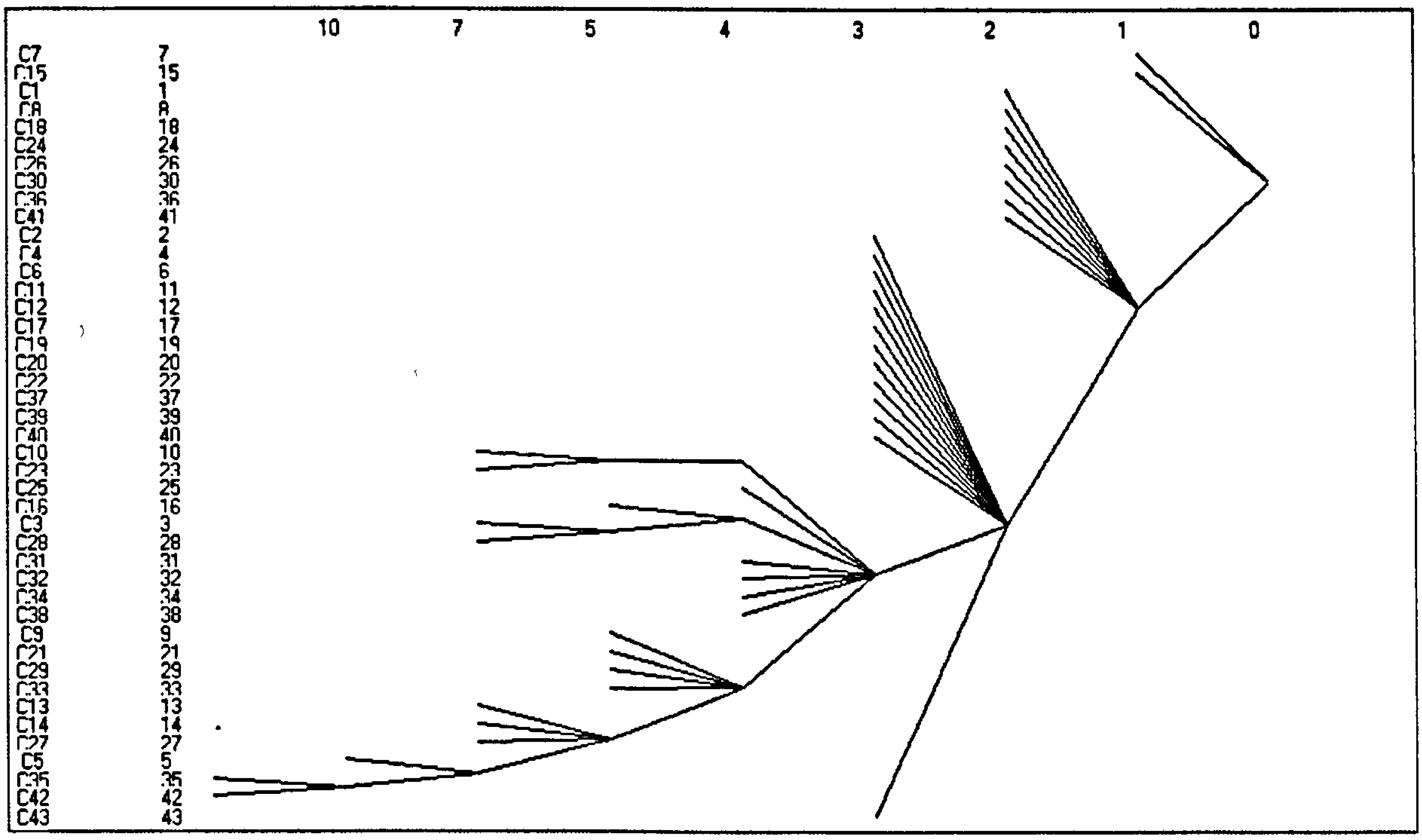


Fig. 4.35 A Tree Diagram Showing the Strong Clique Analysis of the Year 3 Friendship Network at a Minimum Group Size of 3

4.11 Comparison of the Cliques Apparent in Networks in all Three Cohorts.

The following table 4.11 shows the number of cliques that were identified in the friendship and communication networks of all three cohorts. The table shows that the highest number of weak cliques in all three cohorts appear in the communication networks. The Year 2 communication network has a particularly high number of cliques at 1166. This very high number of cliques formed by a relatively low number of students also shows a great deal of overlap. The strong or reciprocal cliques found in the communication networks of all three cohorts also number very highly. They are similar in numbers for cohorts one, two and three at 86, 88 and 82 respectively. Again the second cohort has the largest number of strong cliques in its communication network. This is despite the Year 2 cohort having the least number of students in the cohort at 40, while the Year 1 cohort contains 47 students and the Year 3 cohort contains 44. Such large amounts of cliques and such overlap between the cliques indicate a great deal of cohesion in the communication networks of all three cohorts, though particularly in the Year 2 cohort. Imagine if there were very few cliques that did not overlap, this would mean that it would be difficult for information to spread throughout the cohort.

In all three cohorts the number of weak cliques identified in the friendship networks are a great deal lower than in the communication networks. The weak cliques identified for Years 1, 2 and 3 are 79, 85 and 96 respectively. It is likely that as students progress throughout their years of study they are likely to develop their friendships and so it is not surprising that the Year 3 cohort has the largest number of cliques in the friendship network. Where the criterion is strengthened to only include reciprocal relationships the Year 3 also maintain the largest number of cliques at 49, while the Years 1 and 2 cohorts contain 34 and 45 cliques correspondingly. This is despite the fact that there are less students in the third year (44) than in the first year (47), though the second year cohort consist of the lowest number at 40 students.

Network	**Number of cliques with minimum of 3 members**
Year 1 weak communication	943
Year 1 strong communication	86
Year 1 weak friendship	79
Year 1 strong friendship	34
Year 2 weak communication	1166
Year 2 strong communication	88
Year 2 weak friendship	85
Year 2 strong friendship	45
Year 3 weak communication	870
Year 3 strong communication	82
Year 3 weak friendship	96
Year 3 strong friendship	49

Table 4.11 The Number of Strong and Weak Cliques Identified in the Friendship and Communication Networks of all Three Cohorts.

4.12 Centralization of Networks.

The measure of graph centralization identifies to what extent the graph as a whole has a centralized structure. The term centralization is used when referring to the graph as a whole, and centrality is used when referring to the point centrality of the individual. Rather like the density measure, the centralization measure also refers to how compact the graph is. The density measure investigates how cohesive the group is or how many nodes are connected and to what extent they are connected. The centralization measure however examines to what extent the graph is centralized around focal points. Freeman (1979) showed how individual point centrality can be converted into a centralization measure for the whole graph. The procedure involves calculating the difference between the centrality scores of the most central nodes and the centrality scores of all the other nodes.

As with the individual centrality measures there are various centralization measures each with a different focus. With individuals the degree centrality is a measure of how many points the individual is connected to. In directed data an in-degree and an out-degree can be observed. This measure examines how many times an individual directs a relationship to others (out-degree) and how many times others direct a relationship to the individual (in-degree). The graph degree centralization measure is a global measure which examines to what extent the graph is centralized around focal points.

Table 4.12 provides definitions of the key terms used in this section:

Term	Definition
Graph / Network Centralization	A measure indicating to what extent the graph is focused around focal points.
In-Degree Centralization	A measure indicating to what extent the graph is focused around focal points on the inward directed relationship
Out-Degree Centralization	A measure indicating to what extent the graph is focused around focal points on the outward directed relationship

Table 4.12 Definitions at a Glance – Graph Centralization

Network	In Degree Centralization %	Out Degree Centralization %
Year 1 Communication	33.60	46.93
Year 1 Friendship	25.28	71.93
Year 2 Communication	24.13	50.43
Year 2 Friendship	35.63	25.12
Year 3 Communication	33.79	43.54
Year 3 Friendship	17.23	48.92

Table 4.13 Table Showing the In-Degree and Out-Degree of Centralization for Each Network.

Table 4.13 shows the in-degree and out-degree centralization for the friendship and communication networks in all three cohorts.

We can see that in the Year 1 friendship network, the graph is particularly centralized around its most central point in the out-degree. This would indicate that one particular point is dominating the out-degree of friendship centrality, ie they are choosing the most friends. It is interesting to see that the degree of in-centralization is significantly lower and so the amount to which friendship is directed at one central individual is a lot less than the extent to which it is directed from a central individual. The Year 1 communication network is also centered more around the out-degree than the in-degree of graph centralization. The Year 2 communication network is also more centralized around the out-degree measure. This indicates that the graph is tightly organized around the individual who seeks the most communication/advice. The Year 2 friendship network is unusual in that it is the only one where the in-degree of centralization is higher than the out-degree of centralization. This means that the network is more focused around the person in the network that people consider a friend than it is around the person who claims the most friendship relationships. The in-degree centralization measure for the Year 3 friendship network is the lowest of all of the results. This shows that the graph revolves around one central point to the least extent. The out-degree for the Year 3 friendship network however is quite high at 48.92%, while both the in-degree and out-degree for the communication network appear to be about average in comparison with the other two years.

4.13 Summary

An analysis of the connectivity of the friendship and communication networks of all three cohorts was carried out. In order to do this the sub-groups or components were investigated. Components can be strong or weak. A strong component is one in which the connections between nodes all run in the same direction, giving a continuous line in which resources can be disseminated. A weak component is one that is also fully connected, but the connections can be in different directions. A strong component is more likely to mean that information or resources can easily be spread throughout the group as it can flow to each part of the group. Information or resources may get stuck at a particular node in a weak component. Analysis of the components in the first year cohort found both the friendship and communication networks to be made up of one strong component. This shows that both networks in the year one cohort are highly connected. The component is a strong one, so that the connections flow in one direction throughout the cohort, thus showing that information, ideas, support and other resources can flow easily to everyone in the cohort.

The communication network in the Year 2 cohort also consists of one strong component. Again this shows that ideas, information and knowledge etc regarding coursework examinations, and university related issues can flow to all members of the cohort. It was found that the friendship network for the Year 2 cohort was split into two strong components. In fact one of these strong components consists of only one student. This student chose five others as his friends, however this friendship was not reciprocated by any other student. This means that the links do not flow in a continuous direction and so he is not included in the other strong component. In which case the friendship network of the Year 2 cohort is actually made up of two strong components or one weak component. In the Year 1 communication network, 35% of all possible ties are actually present. This is a very dense network, though the density of ties in the Year 3 communication network is higher at 38%, those in the Year 2 communication network is even higher at 43%. The work- load in the second year is notoriously high and this may account for the higher density of communication relationships. Friendship ties are also the most dense in the Year 2 network at 27%, followed by Year 3 at 24% and Year 1 at 19%.

The Year 3 communication network is also made up of one strong component, allowing resources to flow throughout the cohort. Analysis of the friendship cohort, highlighted the presence of two strong components. As with the friendship network in Year 2, the Year 3 friendship network is made up of two strong components, one of which contains only one student. This student is completely isolated from the friendship network with no relationships flowing either to or from him.

Analysis was then carried out on the density of ties in the communication and friendship networks of the three cohorts. This shows to what extent all of the connections that could be present actually are present. This can be seen as a measure of group cohesion (Blau 1977). In each of the three cohorts, the communication networks were found to be far more dense than the friendship networks. Indeed it takes more time and effort to establish or maintain a friendship relationship than a communication relationship and so it is to be expected that the communication network would be more dense than the friendship network.

The chapter goes on to investigate reciprocity in the communication and friendship networks of all three cohorts. Within all three cohorts the symmetry of friendship relationships was far greater than that of the communication networks. It seems that students seek out communication contacts and use them as a resource, while the friendship relationships are entered into on a more mutual understanding.

An analysis of the cliques in all of the networks was carried out. Cliques are defined as being maximal and complete so that within a clique all points are both connected to each other and are adjacent to each other. They consist of completely interconnected nodes so that the each person has a tie with each other in the clique. A strong clique occurs where these links are reciprocated and a weak link clique occurs when each of the nodes are connected but the relationship is not necessarily reciprocated.

A weak clique analysis of the Year 1 communication network shows that there is a great deal of overlap between the cliques as would be expected in a network that is made up of one strong component. The data was then symmetrized[5] and a strong clique analysis

[5] Symmetrized: Adjusting the data so that a relationship is recorded only where it is reciprocated.

of the Year 1 communication network was carried out. Where a minimum number of four members is set for the clique, a split occurs in the cohort showing two separate groupings of students in the cohort who communicate with each other. There are some students however who belong to both groups and so there is still communication amongst all members of the cohort.

A weak clique analysis of the Year 1 friendship network also identified a great number of cliques with a large degree of overlap, though the 79 cliques found at the minimum number of three in a clique is considerably lower than the 943 found in the communication network. This is in keeping with the component analysis as the cliques all mesh into one large component, showing a very integrated cohort of students, and that the communication network is more integrated than the friendship. A strong clique analysis of the Year 1 friendship network begins to show up a few fractions. A strong clique involves all relationships being reciprocated and so when this criteria is set three separate groupings of friendship cliques can be seen in the Year 1 cohort.

A weak clique analysis of the Year 2 communication network at a minimum of three members showed an extremely high number of cliques at 1166 for only 40 students. The tree diagram shows that all of these cliques flow into one large group, this indicates an extremely cohesive cohort. Even with a strong clique analysis 88 cliques are evident at a minimum membership of three students. Even here when the communication relationships are reciprocated the cliques flow into one large group. The communication network in the Year 2 cohort is extremely cohesive.

A weak clique analysis of the Year 2 friendship network identifies 85 cliques, which cluster into two streams, showing a slight divide in the cohort in terms of friendship. When the condition of reciprocity is applied using strong clique analysis 45 cliques are found with a minimum membership of three students. These cliques separate into three identifiable streams.

A weak clique analysis of the Year 3 communication network identifies 870 at a minimum membership of three students. Again these cliques all overlap into one large group. When the membership criterion is set at ten, 374 cliques are identified, again flowing onto one large group, indicating that the Year 3 communication network is extremely cohesive. A strong clique analysis shows only a very slight fragmentation of the cohort as a whole.

A weak clique analysis of the Year 3 friendship at a minimum membership of three identifies 96 weak cliques. These cliques still overlap into one large grouping. When the criterion of reciprocity is added to make it a strong clique analysis 49 cliques are identified, and the cohort begins to split slightly into groupings of cliques.

In comparison the Year 2 cohort has the largest number of weak and strong cliques in the communication network. This may be due to the fact that there is a considerable work- load in the second year of study, and students make use of their communication ties within the cohort. The Year 3 cohort contains the most strong and weak cliques in the friendship network. A possible explanation for this is that students develop their friendship ties throughout their years of study so that by their third year it is not surprising that there are more cliques evident in the friendship network.

Finally in this chapter the networks were analysed by investigating how centralized they were around focal points. Centralization refers to the entire graph while centrality refers to individuals. The graph degree centralization measure indicates to what extent the graph is centralized around its' most central point. The out-degree centralization of the Year 1 friendship network is particularly high at 71.93% This indicates that one focal point is choosing a lot of people as a friend. The in-degree centralization however is particularly lower that the in-degree (25.28%), indicating that the rest of the cohort is not as centralized around a focal point. In most cases the out-degree centralization is higher than the in-degree except in the case of the Year 2 friendship network where the inward friendship relationships are centralized around a focal point to 35.63% whilst the outward centralization is 25.12%. This indicates that one or more individuals are particularly focal in this network and are chosen often though these relationships are not necessarily reciprocated.

Chapter Five: Analysis of Measures of Group Cohesion

5.1 Introduction

Following Chapter five which analyzed relationships at the cohort level, the objective of this chapter is to provide an analysis of data at the project work-group level. This chapter takes each of the networks for the three cohorts and first examines the density of friendship and communication networks within the project-based work-groups and then examines the relationships between different work-groups. The data is then dichotomized[6] to show which of the groups have equal to or above average density of relationships both within their work-groups and with other groups.

5.2 Cohesion Within and Between Work-Groups

During the course of their studies on the BSc Management and Systems Science course at City University, all students carry out courseworks, which involve working in groups. Students were asked to form themselves into groups, they were not allocated group membership but instead were free to work with whom ever they please. The size of the group was not strictly allocated either, with the maximum being ten, so that the students had even more choice by not being limited according to group size. Upon completing the coursework, which included the submission of both a written report and a presentation, the peer group assessment questionnaire was then administered to the students (see Appendix II for the peer group assessment questionnaire). Students were asked to rate each of their group member peers out of six in the following categories:

- Overall effort in the group.
- Intellectual contribution to the group.
- Cooperation within the group.

The responses to the questionnaire (Appendix II) gave an explicit indication of group cohesion as expressed by the students. Each student gained a score for the above three variables, giving them extra nodal properties. The nodal properties obtained from the

[6] The process of dichotomizing data involves allocating a 1 where a value is equal to or above the average and a 0 when it is below the average. This is a valuable method of visualisation and allows for more immediate interpretation of results.

peer group assessment questionnaire will be put into the correlation analysis in order to ascertain whether there is any link between these nodal properties and individual academic performance. Another way to identify group cohesion is to inductively examine the density of linkages of communication and friendship with the self-assigned groups and between them.

5.3 Density of Relationships Within and Between Groups

This sociometrical[7] study examines the links between individuals, groups and their nodal properties. In order to discover the effect of the nodal[8] property of group membership UCINET 5 is used to pull out the property of group membership in the density algorithm. Density is defined as the number of lines in a graph expressed as a percentage of the number of all possible lines in that graph. This is a way of showing the completeness of the network, or the cohesion of the group, the extent to which all "possible relations are actually present" (Scott 2000, p32). By using the density function it is possible to split the groups a priori and so to discover the density (or cohesion) both within each group and also amongst the separate groups.

The following table provides definitions of the key terms used in this chapter:

Term	Definition
Density	A measure showing the completeness of the network. The number of lines present in a graph expressed as a percentage of the possible number of lines.
Sociometric	Using data to understand the underlying structure of relationship choices
Nodal Properties	Properties relating to the individual e.g. sex, in degree, effort, grade e.t.c.
Dichotomize	Allocating a 1 when the value is equal to or above the average and a 0 where it is not.

Table 5.1 Definitions at a Glance – Density, Sociometric, Nodal Properties and Dichotomize

[7] Sociometry uses data to uncover the structure of relationship choices.
[8] Nodal properties are those which can be attributed to the individual or node, e.g. their in degree or out degree centrality, or the group that they are assigned to.

5.4 Density of Relationships in Groups in Year 1

The cohort was split into self -assigned project work groups. The following table indicates the membership of students to groups 1 to 7.

Group Number	Members
1	A5, A7, A9, A34, A35, A37, A43
2	A3, A12, A16, A22, A23, A24
3	A15, A20, A27, A41, A44, A46, A47
4	A6, A25, A31, A36, A45
5	A1, A14, A17, A18, A28, A29, A38
6	A2, A8, A10, A19, A21, A26, A30, A33, A39
7	A4, A11, A13, A32, A40, A42

Table 5.2 Table Showing Group Membership in Year 1

5.4.1 Density of Communication Relationships Within and Between Year 1 Groups

UCINET was used to calculate the average density of relationships within groups and in between groups. The following diagram is produced by UCINET in order to illustrate the density of these relationships within the Year 1 communication network.

Density / Average Value Within Blocks for Year 1 Communication

	1	2	3	4	5	6	7
	------	------	------	------	------	------	------
1	0.3571	0.3571	0.1429	0.3429	0.2653	0.4444	0.2143
2	0.5714	0.4333	0.3333	0.7000	0.4762	0.4630	0.5278
3	0.2449	0.2857	0.4286	0.4571	0.1633	0.1905	0.1429
4	0.3429	0.4000	0.1714	0.4000	0.1429	0.4000	0.2000
5	0.3673	0.2619	0.1837	0.3429	0.3571	0.3333	0.2619
6	0.3968	0.3519	0.3016	0.6000	0.2381	0.5278	0.1481
7	0.5238	0.5278	0.3333	0.6333	0.4286	0.3704	0.0000

Table 5.3 Table Showing a Matrix of Average Values of Density within the Year 1 Communication Network.

The figures highlighted indicate the density of communication within each group. Specifically students were asked to indicate "Which of the following students are important sources of school, coursework, examinations related advice and conversation, or whom you approach if you have a school–related problem." All of the groups for this coursework were self–assigned. It is interesting to note then that members of Group 7 do not communicate about school–related issues at all, even though they formed the group themselves in order to work upon a group assignment. None of the members of Group 7 deemed each other to be important sources of school-related information or advice. The average density of communication within groups in the first year cohort is 0.3577, so group 6 is well above the average with the highest density at 0.5278. It is interesting to note however that the highest densities of communication are not within groups but amongst them. For example while members of Group 7 do not communicate on school–related topics within the group, they do consult members of other groups on such matters. The density of communication between Group 7 and Group 2 for example is well above the average density within groups at 0.5278.

The overall average density of communication both within and amongst groups is 0.3488. The table recording average densities of communication can be simplified by dichotomizing it. This process involves indicating a relationship only where the value is equal to or above the average. A 1 is allocated wherever the density is greater or equal to the average while a 0 is allocated where the density is below average. This provides a simple visualisation tool which allows us to see instantly which groups have an average or above average density of relationships both within and between groups.

The following diagram illustrates which of the groups in Year 1 have an average or above average density of communication within and between their self-allocated work-groups. The relationships within groups are highlighted and so too are other interesting cases.

Dichotomized Year 1 Group Communication Densities

	1	2	3	4	5	6	7
1	1	1	0	0	0	1	0
2	1	1	0	1	1	1	1
3	0	0	1	1	0	0	0
4	0	1	0	1	0	1	0
5	1	0	0	0	1	0	0
6	1	1	0	1	0	1	0
7	1	1	0	1	1	1	0

Table 5.4 Table Showing a Matrix of Dichotomized Densities of Communication Within and Between Groups in Year 1

By dichotomizing the data it is clear that every group with the exception of Group 7 has above average density of communication within its membership. In particular Group 2 has above average communication density with six out of the possible seven self-assigned groups which could put them in an advantageous position for the assignment.

5.4.2 Density of Friendship Relationships Within and Between Year 1 Groups

The following table 5.5, illustrates the density of friendship relationships within and between the self-assigned work-groups. As with all of these diagrams they are produced by UCINET. The average density can range between 0 where there are no relationships present and 1 where all of the relationships that are possible are actually present. For example a 1 would be allocated within the group if all of the group have relationship ties to one another. A 1 is allocated between groups if all of the members of each of the groups is tied by the relationship.

	1	2	3	4	5	6	7
	------	------	------	------	------	------	------
1	1.0000	0.0000	0.0408	0.0000	0.0612	0.3651	0.0714
2	0.0238	0.8000	0.1905	0.2667	0.1190	0.0556	0.0000
3	0.0408	0.1667	0.3571	0.0857	0.0408	0.0317	0.0000
4	0.0286	0.1333	0.0000	0.5000	0.0000	0.1333	0.0000
5	0.2245	0.2619	0.1633	0.1429	0.5000	0.1587	0.5476
6	0.3810	0.0926	0.0794	0.0444	0.0159	0.6806	0.0000
7	0.1190	0.0000	0.0000	0.0000	0.5238	0.0185	0.9333

Density / Average Value Within Blocks for Year 1 Friendship

Table 5.5 Table Showing a Matrix of Average Values of Density within the Year 1 Friendship Network.

The average friendship density within groups is considerably higher than the communication density at 0.5482. It is interesting that Group 7, though showing zero communication density, has the second highest friendship density at 0.9333. Group 7 also has very low friendship density with other groups with the exception of Group 5. The groups were self–assigned and so perhaps the individuals in Group 7 chose to work with each other due to friendship ties rather than feeling that they can communicate with each other on academic issues. Conversely it is interesting to note that Group 3 had relatively high communication density at 0.4286, but has the lowest friendship density at 0.3571. The density of friendships amongst groups is lower than within groups in all but one case. Group 5 has a within group friendship density of 0.5000 and a friendship density with Group 7 of 0.5476 (all of which is not reciprocated as Group 7 has a friendship density of 0.5238 with Group 5). The average density of friendships between all groups is 0.1918.

The following table 5.6 illustrates a dichotomized version of table 5.5. Where the density of friendship relationship is equal to or above the average of 0.1918 a 1 is allocated and where it is below this average a 0 is allocated. This provides an immediate visualisation tool with which we can get an idea of which groups have a high density of friendship relationships. The relationships within groups on the diagonal are highlighted.

Dichotomized Year 1 Group Friendship Densities

	1	2	3	4	5	6	7
	-	-	-	-	-	-	-
1	1	0	0	0	0	1	0
2	0	1	0	0	0	0	1
3	0	0	1	0	0	0	0
4	0	0	0	1	0	0	0
5	1	1	0	0	1	0	1
6	1	0	0	0	0	1	0
7	0	1	0	0	1	0	1

Table 5.6 Table Showing a Matrix of Dichotomized Densities of Friendship Within and Between Groups in Year 1

By dichotomizing the data we can see that all of the groups have above average density of friendship relationships within the groups. Group 5 has a particularly high friendship density with other groups whereby they also have an above average friendship density with three out of the six remaining groups as well as having a high friendship density within their own group.

5.5 Density of Relationships in Groups in Year 2

The cohort was split into self- assigned project work groups. The following table illustrates the membership of Year 2 students in groups 1 through to 8.

Group Number	Members
1	B7, B19, B30, B34, B37
2	B4, B5, B6, B17, B35, B40
3	B9, B16, B25, B39
4	B3, B13, B23, B29, B32, B38
5	B8, B11, B22, B26, B31
6	B1, B12, B20, B33, B36
7	B2, B10, B21, B28
8	B14, B15, B18, B24, B27

Table 5.7 Table Showing Group Membership in Year 2

5.5.1 Density of Communication Relationships Within and Between Year 2 Groups

UCINET was used to calculate the density of communication relationships within and between the work-groups. The following table indicates these density values. The density of communication relationships within groups is highlighted on the diagonal.

Density / Average Value Within Blocks for Year 2 Communication

	1	2	3	4	5	6	7	8
1	0.2500	0.3667	0.3000	0.1333	0.2800	0.3600	0.7000	0.6000
2	0.4667	0.6667	0.5833	0.1944	0.1333	0.4333	0.2917	0.4667
3	0.4000	0.5000	0.5000	0.1667	0.4500	0.5000	0.3125	0.6500
4	0.3000	0.2778	0.2500	0.4667	0.4333	0.4333	0.5000	0.4333
5	0.2800	0.4667	0.4000	0.1333	0.2000	0.4800	0.6000	0.3600
6	0.5200	0.5333	0.4500	0.4333	0.4800	0.7000	0.4000	0.4000
7	0.7000	0.6667	0.4375	0.2500	0.4000	0.4000	0.6667	0.7500
8	0.6000	0.7333	0.6500	0.3667	0.3200	0.6400	0.5000	0.5000

Table 5.8 Table Showing a Matrix of Average Values of Density within the Year 2 Communication Network.

The average density of communication within groups in the Year 2 cohort is 0.4938, and so Groups 1 and 5 are considerably below the average. It is interesting to note however that while these two groups have low communication density within their self-allocated groups, they do have high communication density with other groups. Group 1 for example has a particularly high communication density with Group 7 at 0.7000 and with Group 8 at 0.6000. Group 5 also has a high communication density with Group 7 at 0.6000 even though the density within their own group is low. In fact all of the groups have a higher communication density with other groups than their own, with the exception of Group 2 and also Group 6 who also have the highest within group communication density at 0.7000.

We should also note that where two groups have a seemingly reciprocal level of communication this may not necessarily be the case. For example Group 1 has a density of relationship with Group 5 of 0.2800. The relationship ties in this network are directional and so the matrix is not symmetrical. In this case however Group 5 also has a communication of density with Group 1 of 0.2800. This does not however necessarily indicate reciprocity. It may be that the communication relationships come from different individuals. If student A from Group 1 communicates with student B from Group 5, it may be student C from Group 5 that communicates to student A. In this way this measure of density of relationships can only be known certainly to be reciprocal if the value is 1 where all participants communicate, or 0 where there is no communication at all.

The overall average communication density within and amongst groups in the Year 2 cohort is 0.4409. The data was dichomotmized. This means that where the density of relationships is equal to or above the average a 1 is allocated and a 0 is allocated where it is below the average density. Again the dichotomized density of relationships within groups is highlighted on the diagonal.

Dichotomized Year 2 Group Communication Densities

Dichotomized Year 2 Group Communication Densities

1	0	0	0	0	0	0	1	1
2	1	1	1	0	0	0	0	1
3	0	1	1	0	1	1	0	1
4	0	0	0	1	0	0	1	0
5	0	1	0	0	0	1	1	0
6	1	1	1	0	1	1	0	0
7	1	1	0	0	0	0	1	1
8	1	1	1	0	0	1	1	1

Table 5.9 Table Showing a Matrix of Dichotomized Densities of Communication Within and Between Groups in Year 2

It is interesting to note that while Groups 1 and 5 have below the overall average of communication density within their own groups, they do have above average communication density with other groups. Groups 3 and 8 each have above average density with five out of the remaining seven groups (disregarding the above average density within the group), and so are especially adept at seeking knowledge and advice on school–related topics.

5.5.2 Density of Friendship Relationships Within and Between Year 2 Groups

The following table illustrates the density of friendship relationships both within the self-assigned groups and between groups in the Year 2 cohort. The values can range between 0 where there are no relationships present and 1 where the group or groups are maximally related.

Density / Average Value Within Blocks for Year 2 Friendship

	1	2	3	4	5	6	7	8
1	0.6500	0.2667	0.5000	0.0000	0.1200	0.4800	0.0000	0.1600
2	0.4667	1.0000	0.4583	0.0000	0.1333	0.1667	0.0833	0.0667
3	0.6500	0.3333	0.5833	0.1250	0.1000	0.3500	0.1250	0.1500
4	0.1333	0.0556	0.0417	0.6000	0.4667	0.3000	0.0833	0.2000
5	0.2000	0.1333	0.0500	0.5333	0.5500	0.3200	0.2000	0.2400
6	0.4800	0.1667	0.2500	0.1667	0.2400	0.4500	0.0500	0.2400
7	0.2000	0.2500	0.0000	0.0000	0.2500	0.1000	0.9167	0.5500
8	0.2000	0.2000	0.1000	0.0333	0.3200	0.2000	0.5500	0.9000

Table 5.10 Table Showing a Matrix of Average Values of Density within the Year 2 Friendship Network

The average friendship density within groups is considerably larger than the communication density at 0.7063. As the groups are self–assigned it seems that perhaps the individuals chose to work together on more of a friendship basis rather than grouping with people whom one would seek out for academic related advice. Group 2 for example has a considerably higher group friendship density within the group at 1.0 than with any other group. Some groups, however, do have a larger friendship density with groups out side of their own. For example Group 3 has a within–group friendship density of 0.5833, while their friendship density with Group 1 is 0.6500. Group 6 also has a slightly higher friendship density with Group 1 at 0.4800 than within their own group at 0.4500.

The average overall friendship density in the Year 2 cohort of groups is 0.2795. The data in table 5.10 was dichotomised to produce the following table 5.11.

Dichotomized Year 2 Group Friendship Densities

	1	2	3	4	5	6	7	8
1	1	0	1	0	0	1	0	0
2	1	1	1	0	0	0	0	0
3	1	1	1	0	0	1	0	0
4	0	0	0	1	1	1	0	0
5	0	0	0	1	1	1	0	0
6	1	0	0	0	0	1	0	0
7	0	0	0	0	0	0	1	1
8	0	0	0	0	1	0	1	1

Table 5.11 Table Showing a Matrix of Dichotomized Densities of Friendship Within and Between Groups in Year 2

By dichotomizing the data to show where each group has a density equal to or above the average we can see that each of the groups has an above average density of friendship relationship within their groups. All of the groups also have an above average density of friendship with at least one other group in the Year 2 cohort, with Group 3 having three above average densities which is the highest number of all the groups.

5.6 Density of Relationship in Groups in Year 3

The cohort was split into self -assigned project work. The following table indicates how the Year 3 cohort was arranged into 8 separate groups.

Group Number	Members
1	C3, C6, C15, C16, C28, C37, C43
2	C1, C7, C8, C24, C26, C30
3	C10, C11, C22, C25, C31, C39
4	C12, C23, C29, C32, C34, C38
5	C5, C13, C17, C20, C35, C42
6	C2, C4, C18, C19, C36
7	C9, C14, C21, C27, C33, C40
8	C41

Table 5.12 Table Showing Group Membership in Year 3

5.6.1 Density of Communication Relationships Within and Between Year 3 Groups

The following table indicates the density of communication relationships within and between the self-assigned groups in the Year 3 cohort.

Density / Average Value Within Blocks for Year 3 Communication

	1	2	3	4	5	6	7	8
1	0.3333	0.4762	0.4286	0.4048	0.6667	0.4571	0.4524	0.7143
2	0.3571	0.6000	0.3333	0.4444	0.4167	0.0333	0.3889	0.1667
3	0.1667	0.2500	0.4000	0.2778	0.3333	0.2000	0.3333	0.5000
4	0.2857	0.2778	0.3333	0.6667	0.2222	0.1333	0.5833	0.1667
5	0.2619	0.4722	0.3611	0.3889	0.5000	0.1333	0.6389	0.1667
6	0.1714	0.1000	0.4667	0.0667	0.1667	0.6000	0.0000	0.4000
7	0.4524	0.5833	0.5556	0.7222	0.5833	0.1333	0.7000	0.1667
8	0.7143	0.6667	0.6667	0.8333	1.0000	0.6000	0.6667	

Table 5.13 Table Showing a Matrix of Average Values of Density within the Year 3 Communication Network

The average density of communication relationship within groups in the Year 3 cohort was 0.5429. Group 8 consisted of only one person and so it has not been possible to calculate a communication density for this group. As with all of the average value of density within block calculations, the diagonal was not taken into account. The individuals did not count any relationship with themselves and so by omitting the diagonal these 'non-relationships' cannot skew the average.

The average density of communication within groups has been calculated from the other seven groups that contained more than one individual. The one member of Group 8 does however have particularly high communication density with all of the other groups. This student also allocated himself into his group of which he is the only member. Although this student chose to work on his own, analysis at the individual level in Chapter 6 indicates that he has a particularly high out-degree of communication at 73.81, this means that he seeks communication with 73.81% of his cohort. He is also sought out by 33.33% of his colleagues for communication. Although he has chosen to work alone then, he is still quite central in the communication network and has access to information. His in-degree of friendship is also quite revealing at an especially low level of 7.14. This may give some indication as to why he has worked on his own on this project, Given his rather unpopular status within the group he may not have been able to find anyone to work with. Despite being unpopular in terms of friendship however, this student does have access to communication and his grade for this piece of work does not suffer at 65%.

Group 1 has the lowest average density within their own group and also has a higher density of communication with all other groups than with themselves. Group 3 has a higher communication density with the one individual in Group 8 at 0.5 than they do with themselves, with an internal density of communication of 0.4. Group 5 acts similarly with an internal communication density of 0.5 and an average density of communication with Group 7 of 0.6389. Group 7 has a slightly higher communication density with Group 4 at 0.7222 than within the group (0.7). This means that four out of the possible eight groups have a higher density of communication relationship outside of their group than within.

The overall average density of communication within and between groups in the Year 3 cohort is 0.4086. The data was dichotomized to produce table 5.14:

Dichotomized Year 3 Group Communication Densities

	1	2	3	4	5	6	7	8
1	0	1	1	0	1	1	1	1
2	0	1	0	1	1	0	0	0
3	0	0	0	0	0	0	0	1
4	0	0	0	1	0	0	1	0
5	0	1	0	0	1	0	1	0
6	0	0	1	0	0	1	0	0
7	1	1	1	1	1	0	1	0
8	1	1	1	1	1	1	1	

Table 5.14 Table Showing a Matrix of Dichotomized Densities of Communication Within and Between Groups in Year 3

It is interesting to note that not all of the groups in the Year 3 cohort have a density of communication equal to or above the overall average. Group 1 for example did not reach the average density within their own group and yet they did have above average communication density with six out of the seven remaining groups, the highest amount of above average communication densities with other groups in the cohort. Group 3 also did not have above average density within the group but did have an above average density of communication with Group 8 (consisting of only one member). The lone member of Group 8 in fact has above average communication density with all of the other groups within the cohort.

5.6.2 Density of Friendship Relationships Within and Between Year 3 Groups

The following table illustrates the density of friendship relationships within and between the self-assigned work groups in Year 3.

Density / Average Value Within Blocks for Year 3 Friendship

	1	2	3	4	5	6	7	8
1	0.6667	0.0952	0.1190	0.4048	0.0476	0.0286	0.1905	0.0000
2	0.1190	0.6667	0.0556	0.0278	0.1111	0.0000	0.0000	0.0000
3	0.1429	0.1111	0.6000	0.3056	0.3333	0.2333	0.2500	0.1667
4	0.3095	0.0833	0.1944	0.6333	0.1667	0.0333	0.3333	0.3333
5	0.0476	0.1667	0.3056	0.1667	0.9667	0.0000	0.5556	0.0000
6	0.1429	0.0000	0.2667	0.1000	0.0000	1.0000	0.0000	0.0000
7	0.2143	0.0833	0.2222	0.4444	0.4444	0.0333	0.9333	0.0000
8	0.0000	0.0000	0.3333	0.3333	0.5000	0.0000	0.1667	0.0000

Table 5.15 Table Showing a Matrix of Average Values of Density within the Year 3 Friendship Network

The average density of friendship relationships within groups in the Year 3 cohort is 0.7810. The result for Group 8 containing only one group member was not factored into the calculation of the average, as relationships with one self were not included. In the Year 3 cohort all groups (discounting Group 8) had a higher density within their group than with other groups.

The overall average density of friendship calculated using all of the averages (disregarding Group 8) is 0.2252. The data was dichotomised using UCINET. A 1 was allocated where the density of friendship relationships was shown to be equal to or above the average and a 0 was allocated where the density was below average. This process produced the following table:

Dichotomized Year 3 Group Friendship Densities

	1	2	3	4	5	6	7	8
	-	-	-	-	-	-	-	-
1	1	0	0	1	0	0	0	0
2	0	1	0	0	0	0	0	0
3	0	0	1	1	1	1	1	0
4	1	0	0	1	0	0	1	1
5	0	0	1	0	1	0	1	0
6	0	0	1	0	0	1	0	0
7	0	0	0	1	1	0	1	0
8	0	0	1	1	1	0	0	

Table 5.16 Table Showing a Matrix of Dichotomized Densities of Friendship Within and Between Groups in Year 3

All groups in the Year 3 cohort have above average density of friendship relationships within their own group (discounting Group 8 because it has only one member). Group 2, whilst having above average density of friendship within the group, does not have above average density with any other group in the cohort. Group 3 on the other hand has above average density of friendship with four out of the seven other possible groupings.

5.7 Comparison of Mean Densities of Relationships in all Cohorts

The mean density of relationships of communication and friendship within the self-assigned work groups was calculated from table 5.3; table 5.5; table 5.8; table 5.10; table 5.13 and table 5.15. This is contrasted with the mean density of such relationships across all of the groups calculated from the same tables. This comparison is represented in the table below:

Network	Mean Density Within Group	Mean Density In all Groups
Year 1 Communication	0.3577	0.3488
Year 1 Friendship	0.5482	0.1918
Year 2 Communication	0.4938	0.4409
Year 2 Friendship	0.7063	0.2795
Year 3 Communication	0.5429	0.4086
Year 3 Friendship	0.7810	0.2252

Table 5.17 Table Showing a Comparison of Mean Densities of Relationships in all Cohorts

The following diagram represents the data in table 5.17. It shows a comparison of the mean densities of friendship and communication within the groups and across all of the groups.

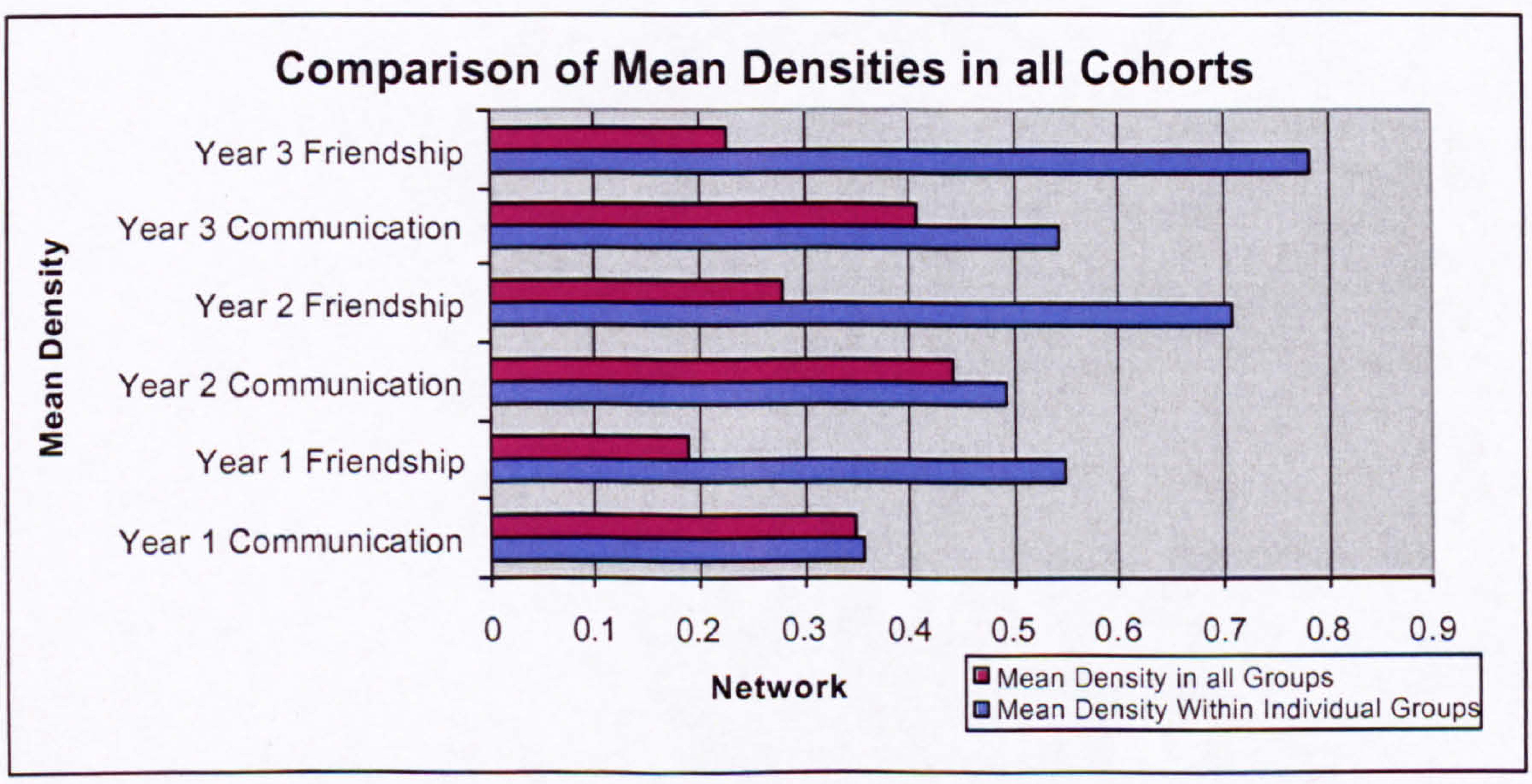


Fig. 5.1 A Graph to Show a Comparison of Mean Densities of Relationships in all Cohorts

Through a comparison of the mean densities of communication and friendship throughout the year groups the following patterns were identified:

- The mean density of communication within individual groups is slightly larger than the density of communication throughout all groups in all year groups, though only slightly so in the Year 1 cohort.
- The mean density of friendship relationships within individual groups is considerably larger than the density of friendship relationships throughout all groups in all three cohorts.
- The mean density of communication within individual groups is larger in the second year then the first and larger in the third year than the second.
- Similarly the mean density of friendship relationships within individual groups is larger in the second year then the first and larger in the third year than the second.
- The mean density of communication amongst all groups is highest in the Year 2 cohort.
- The mean density of friendship amongst all groups is also highest in the Year 2 cohort.

5.8 Summary

This chapter investigated the density of communication and friendship relationships within and between self-assigned project-based work groups. This was a way of implicitly measuring the cohesion within and between the groups in each of the three cohorts. In the Year 1 cohort it is interesting that the highest levels of communication are often not within the work-groups but between them. All of the groups in the Year 1 cohort did however have above average communication within their own group except for Group 7 who actually did not have any communication and advice seeking within their own group even though they did have above average density of relationships with other groups. The average friendship density within groups in the Year 1 cohort is considerably higher than the communication. It is interesting that even though Group 7 has no communication relationships within their group, they do have the second highest density of friendship relationships, and also have a low density of friendship relationships with other groups. This builds a picture of why some individuals choose to work together because they are friends rather than because they seek to collaborate for group-work. The density of friendship relationships in between groups is lower than within groups in all but one case again indicating that the first year students choose their project work – groups on the basis of friendship.

The average communication within groups is higher in the Year 2 cohort than in the Year 1 cohort. The second year students also have a higher density of communication relationships overall, including communication between groups, than the first year students. Not only have the students had more time to settle into their work, but also the workload is higher in the second year. It seems that the Year 2 cohort of students are making better use of their possible lines of communication. In order to really investigate whether such factors play a part in the larger density of communication in the Year 2 cohort, a longitudinal study would be required, following the same cohort throughout all three years of study. Again in the Year 2 cohort, the density of friendship relationships within groups is considerably larger than the communication within groups. Again this appears to indicate that the students choose their work-group in terms of friendship. The overall average density of friendship relationships within and between the work groups is higher in the second year than the first indicating that the students have settled into a stronger social support system.

The average density of communication relationships within groups is again higher in the Year 3 cohort than the other two cohorts, indicating that communication relationships grow as the students progress through the course. The average density of friendship relationships within groups also grows as the students reach their third year of study. The average density of friendship throughout the cohort in the third year however is less than in the second year. This would indicate again that the students tend to choose their work-groups on a friendship basis. These project groups in the third year are more cohesive than in the first or second years though this is somewhat to the detriment of a wider friendship and support network.

Overall in all three cohorts, the mean density of communication relationships within individual work-groups is slightly larger than throughout all groups. The mean density of friendships within groups is larger than the mean density of relationship throughout all groups. The mean density of communication and friendship relationships within work-groups increases throughout the three years of study. The mean density of communication and friendship relationships amongst all groups is the highest in the Year 2 cohort.

Chapter Six: Analysis of Individual Measures of Centrality

6.1 Introduction

This chapter analyses the measures of individual centrality within each of the three cohorts. Concentrating on the individual level of analysis follows on from the analysis at the group level in Chapter Six and analysis at the network level in Chapter Five.

The notion of individual centrality is one of the most important and one of the earliest to arise out of social network analysis, and as such many of the references contained within this chapter are from earlier years than other chapters. In particular the centrality of an individual is thought to be of importance because it is an indicator of his or her importance or prestige. In turn this importance indicates that a person who is highly central in a network enjoys some kind of privilege over those who are less central, they can be seen as the hub of the network, which is where the power would lie rather than with those on the periphery.

As far back as 1934, Moreno investigated the sociometric 'stars', the person who can be seen as the most popular or important and the 'isolates', those on the outskirts.

Bavelas (1948) showed that individuals with high centrality were influential over others. With a group of MIT researchers Bavelas (1948), carried out a series of studies investigating the impact of centrality in small groups. They found that centrality impacted on many areas from leadership to the amount to which individuals were personally satisfied with their membership of the group.

The measures of centrality indicate the agents' location within the social network. This individual centrality can also be described as point centrality, or how central a particular point is within a graph. This is different from the centrality of a graph as a whole, so that the individual measures are one of centrality and those concerning the graph as a whole are referred to as centralization measures.

Various measures of centrality have been established, which each emphasize various aspects of an individuals position in the social network. This chapter will utilize the degree, betweenness and closeness measures of individual centrality. An analysis of each of the measures is given for the communication and friendship networks for each of the three cohorts. Interesting individual cases are highlighted and discussed. The measures outlined in this chapter then provide the data for the correlation and multiple-regression models that are used to investigate the hypotheses.

6.2 Degree Centrality

The degree centrality measure is in a sense the most intuitive of the measures. It measures the centrality of the individual in terms of how many connections he or she has to others in the graph. If the data is undirected then there is just one measure of degree centrality. Undirected data simply measures whether a relationship is apparent between two variables. For example in figure 6.1 there is a relationship between individuals A and B because they belong to the same club.

$$A \text{———} B$$

Fig. 6.1 An Undirected Relationship

Data may also be directed. If for example in Fig 6.2, within the same club that A and B belong, the researcher were to investigate advice seeking relationship, they may find that A seeks advice from B meaning that the data is directed.

$$A \longrightarrow B$$

Fig. 6.2 Directed Relationship

If the data is directed as is the case with the friendship and communication relationships measured in this study, then there will be an in degree and an out degree of centrality. The in degree measures the relationships coming in (number of ties received by ego), and the out degree measures the number of links going out (number of ties initiated by ego). A problem with this measure can occur when comparing different graphs with for example, a different number of agents in them. If an agent has ten connections, the meaning of this degree of centrality will be very different if there are one hundred members of the group than if there are thirty. To compensate for this, UCINET 5 produces a normalized in degree and out degree (Freeman, 1979). This gives the measure as a percentage of all the possible linkages, so that in the example above, ego with 10 connections would have a normalized degree of 10% if the group contained 100 agents, and of 33.3% if the group totaled 30. The definitions of degree centrality are summarized in table 6.1:

Measure	**Definition**
Degree	A measure of local centrality. A direct count of the number of ties with other individuals.
In-Degree	Number of ties directed at an individual.
Out-Degree	Number of ties directed out from an individual.
Normalized Degree	Number of ties expressed as a percentage of the possible number of ties.

Table 6.1 Definitions at Glance – Degree Centrality

Degree centrality was measured for all students within the three cohorts in terms of both the communication and friendship networks. The following tables are comprised of the degree centrality measures for each of the individual students within those particular networks. Cases have been highlighted that show particularly high in or out degree centrality. Cases are also highlighted were there is a strong anomaly between in degree and out degree scores, for example where a student shows a high in-degree but a low out-degree.

6.2.1 Degree Centrality of Year 1 Communication Network

The following measures of degree centrality for individual students in the Year 1 communication network was obtained using UCINET. Table 6.2 indicates the individual measures of degree centrality in the Year 1 communication network. Cases have been highlighted that indicate particularly high in or out-degree's of communication. Cases are also highlighted that show extreme differences between the in-degree and out-degree of communication.

It is interesting to note that the person with the highest normalized in-degree of centrality, student A25 at 67.39%, also has one of the lowest out degrees at 6.52%. The mean in and out-degree is 34.51%, so this shows that student A25 is highly sought after in the communication network. He is highly central as many people seek him out for his communication and advice on school related issues. He is not a great seeker of communication and advice himself though and so the relationship is rarely reciprocated. Other students that rank highly in the in-degree centrality measure include A6 and A31, with in degrees of 56.52% and 52.17%, both of whom receive more ties than they initiate, with out degrees of 15.21% and 39.13% respectively.

Another student however who has a large in-degree is student A1, with a normalized in-degree of 50% showing that half of the people in the group come to him for advice and communication on school related issues. He however seeks such communication from 80.43% of his cohort, the highest communication seeker of his year group. Other large initiators of communication ties include A22 at 69.57% with an in-degree of 56.52%, student A26 with an out-degree of 69.57% and an in-degree of 36.96%, and student A42 with an out-degree of 67.49% and an in-degree of 30.44%. None of the students have a completely reciprocated match between the in-degree and the out-degree.

Student		OutDegree	InDegree	NrmOutDeg	NrmInDeg
1	A1	37.000	23.000	80.435	50.000
2	A2	15.000	9.000	32.609	19.565
3	A3	11.000	16.000	23.913	34.783
4	A4	22.000	7.000	47.826	15.217
5	A5	11.000	17.000	23.913	36.957
6	A6	7.000	26.000	15.217	56.522
7	A7	16.000	21.000	34.783	45.652
8	A8	21.000	13.000	45.652	28.261
9	A9	18.000	23.000	39.130	50.000
10	A10	15.000	14.000	32.609	30.435
11	A11	13.000	7.000	28.261	15.217
12	A12	33.000	18.000	71.739	39.130
13	A13	9.000	7.000	19.565	15.217
14	A14	11.000	9.000	23.913	19.565
15	A15	28.000	11.000	60.870	23.913
16	A16	26.000	19.000	56.522	41.304
17	A17	11.000	10.000	23.913	21.739
18	A18	2.000	12.000	4.348	26.087
19	A19	5.000	25.000	10.870	54.348
20	A20	6.000	10.000	13.043	21.739
21	A21	10.000	23.000	21.739	50.000
22	A22	32.000	26.000	69.565	56.522
23	A23	18.000	10.000	39.130	21.739
24	A24	16.000	12.000	34.783	26.087
25	A25	3.000	31.000	6.522	67.391
26	A26	32.000	17.000	69.565	36.957
27	A27	5.000	9.000	10.870	19.565
28	A28	5.000	8.000	10.870	17.391
29	A29	11.000	13.000	23.913	28.261
30	A30	25.000	21.000	54.348	45.652
31	A31	18.000	24.000	39.130	52.174
32	A32	21.000	12.000	45.652	26.087
33	A33	16.000	19.000	34.783	41.304
34	A34	16.000	14.000	34.783	30.435
35	A35	9.000	14.000	19.565	30.435
36	A36	24.000	21.000	52.174	45.652
37	A37	16.000	19.000	34.783	41.304
38	A38	20.000	19.000	43.478	41.304
39	A39	12.000	21.000	26.087	45.652
40	A40	16.000	12.000	34.783	26.087
41	A41	9.000	20.000	19.565	43.478
42	A42	31.000	14.000	67.391	30.435
43	A43	13.000	20.000	28.261	43.478
44	A44	16.000	11.000	34.783	23.913
45	A45	15.000	13.000	32.609	28.261
46	A46	5.000	13.000	10.870	28.261
47	A47	15.000	13.000	32.609	28.261

Table 6.2 Table Showing Individual Degree Centrality of Year 1 Communication Network

6.2.2 Degree Centrality of Year 1 Friendship Network

The following measures of degree centrality for individual students in the Year 1 friendship network were obtained using UCINET and are indicated in Table 6.3. Cases are highlighted that show high or low in or out-degree's as well as those that show great disparity between the two measures.

In most cases the students identify far less friendship relationships than communication relationships, the mean for the friendship network is 18.73%. Student A18 however only chose 2 people as having a communication relationship with, while he chose 41 as friends (89.13% of all possible ties). His normalised in-degree of friendship relationships is 17.39%. A similarity in in-degree and out-degree does not necessarily indicate reciprocity. The person that the individual chooses for a friend may not be the person that reciprocates the friendship. Only if an individual had a maximal score of both in and out-degree could we say that there is trues reciprocity. However it is clear that student A18 has chosen far more people as a friend than have chosen him. We can see in this case then that there is little reciprocity in his friendships.

Student A19 has the next highest out degree at 45.65%, but he also has a high in-degree at 30.44%, indicating that there is less of a discrepancy between the friendships coming in to and out of student A19 than the less balanced A18.

The student with the highest in degree is A37 with 43.48% of all of the students claiming him as their friend. In return A37 has an out-degree of 39.13%, so that he chooses almost as many friends as choose him. Student A43 also has a high in-degree at 32.61% and a lower in-degree at 23.91%. Others with a particularly high normalised in-degree include A5, and A39 all at 30.44%, the number of people that they choose as friends differs though with A5 at 21.74% and A39 at 19.57%. A high in-degree of friendship relationships means that a student has a larger number of people to call upon for social support if he or she comes across periods of stress.

Student		OutDegree	InDegree	NrmOutDeg	NrmInDeg
1	A1	6.000	5.000	13.043	10.870
2	A2	1.000	3.000	2.174	6.522
3	A3	7.000	7.000	15.217	15.217
4	A4	7.000	8.000	15.217	17.391
5	A5	10.000	14.000	21.739	30.435
6	A6	3.000	6.000	6.522	13.043
7	A7	8.000	9.000	17.391	19.565
8	A8	10.000	11.000	21.739	23.913
9	A9	9.000	10.000	19.565	21.739
10	A10	6.000	6.000	13.043	13.043
11	A11	9.000	9.000	19.565	19.565
12	A12	13.000	8.000	28.261	17.391
13	A13	11.000	11.000	23.913	23.913
14	A14	6.000	7.000	13.043	15.217
15	A15	5.000	8.000	10.870	17.391
16	A16	6.000	9.000	13.043	19.565
17	A17	2.000	8.000	4.348	17.391
18	A18	41.000	8.000	89.130	17.391
19	A19	21.000	14.000	45.652	30.435
20	A20	8.000	7.000	17.391	15.217
21	A21	7.000	10.000	15.217	21.739
22	A22	6.000	13.000	13.043	28.261
23	A23	5.000	6.000	10.870	13.043
24	A24	12.000	8.000	26.087	17.391
25	A25	12.000	2.000	26.087	4.348
26	A26	8.000	12.000	17.391	26.087
27	A27	5.000	4.000	10.870	8.696
28	A28	11.000	9.000	23.913	19.565
29	A29	5.000	5.000	10.870	10.870
30	A30	11.000	13.000	23.913	28.261
31	A31	1.000	8.000	2.174	17.391
32	A32	13.000	9.000	28.261	19.565
33	A33	13.000	11.000	28.261	23.913
34	A34	9.000	10.000	19.565	21.739
35	A35	8.000	8.000	17.391	17.391
36	A36	2.000	8.000	4.348	17.391
37	A37	18.000	20.000	39.130	43.478
38	A38	18.000	12.000	39.130	26.087
39	A39	9.000	14.000	19.565	30.435
40	A40	10.000	9.000	21.739	19.565
41	A41	4.000	5.000	8.696	10.870
42	A42	6.000	8.000	13.043	17.391
43	A43	11.000	15.000	23.913	32.609
44	A44	3.000	4.000	6.522	8.696
45	A45	3.000	4.000	6.522	8.696
46	A46	3.000	4.000	6.522	8.696
47	A47	3.000	6.000	6.522	13.043

Table 6.3 Table Showing Individual Degree Centrality of Year 1 Friendship Network

The buffer effect of having friendships for social support suggests that these relationships can help alleviate stress when it occurs. Other authors suggest that such social support can have a more direct effect, alleviating stress at all times that the friendship is there. Either way students A37, A5 and A39 all have high numbers of friendship relationship as indicated by other students identifying them in the roster choice questionnaire. This high level of social support may not only help to reduce stress, but in turn with the reduction in stress, help to promote their academic achievements.

6.2.3 Degree Centrality of Year 2 Communication Network

The following measures of degree centrality for individual students in the Year 2 communication network was obtained using UCINET and is indicated in Table 6.4. Cases are highlighted that illustrate particularly high levels of in or out-degree centrality in the communication network as well as those cases where there is a great difference between the two measures.

In general the Year 2 cohort are higher seekers and receivers of communication than the Year 1 cohort with a mean of 43.14% for the normalized in and out-degrees. Student B13 is a great seeker of communication and advice amongst his cohort with a very high normalized out-degree of 92.31%. Of his cohort only 17.95% seek communication from him. This means that this student is very active in utilizing the network that he is embedded in. His colleagues however do not on the whole find him a particularly useful provider of academic information and advice.

Student		OutDegree	InDegree	NrmOutDeg	NrmInDeg
1	B1	29.000	19.000	74.359	48.718
2	B2	30.000	16.000	76.923	41.026
3	B3	12.000	9.000	30.769	23.077
4	B4	17.000	24.000	43.590	61.538
5	B5	14.000	16.000	35.897	41.026
6	B6	20.000	26.000	51.282	66.667
7	B7	16.000	19.000	41.026	48.718
8	B8	19.000	13.000	48.718	33.333
9	B9	22.000	19.000	56.410	48.718
10	B10	21.000	24.000	53.846	61.538
11	B11	5.000	13.000	12.821	33.333
12	B12	18.000	12.000	46.154	30.769
13	B13	36.000	7.000	92.308	17.949
14	B14	25.000	25.000	64.103	64.103
15	B15	10.000	19.000	25.641	48.718
16	B16	15.000	16.000	38.462	41.026
17	B17	6.000	20.000	15.385	51.282
18	B18	23.000	15.000	58.974	38.462
19	B19	22.000	17.000	56.410	43.590
20	B20	20.000	18.000	51.282	46.154
21	B21	14.000	24.000	35.897	61.538
22	B22	8.000	10.000	20.513	25.641
23	B23	10.000	10.000	25.641	25.641
24	B24	24.000	15.000	61.538	38.462
25	B25	25.000	14.000	64.103	35.897
26	B26	16.000	8.000	41.026	20.513
27	B27	23.000	25.000	58.974	64.103
28	B28	17.000	12.000	43.590	30.769
29	B29	11.000	13.000	28.205	33.333
30	B30	12.000	21.000	30.769	53.846
31	B31	22.000	21.000	56.410	53.846
32	B32	10.000	9.000	25.641	23.077
33	B33	11.000	20.000	28.205	51.282
34	B34	9.000	13.000	23.077	33.333
35	B35	26.000	18.000	66.667	46.154
36	B36	17.000	26.000	43.590	66.667
37	B37	12.000	15.000	30.769	38.462
38	B38	11.000	15.000	28.205	38.462
39	B39	5.000	20.000	12.821	51.282
40	B40	10.000	17.000	25.641	43.590

Table 6.4 Table Showing Individual Degree Centrality of Year 2 Communication Network

Other students who are particular seekers of communication include B1 and B2 at 74.36% and 76.92%, while 48.72% and 41.02% of their colleagues respectively choose to seek communication with them. This means that students B1 and B2 make good use of their contacts and that in return many of these contacts are able to seek academic knowledge from them, leading to an exchange of ideas that may help the students to do well academically.

Students B6 and B36 have the highest normalized in degrees at 66.67%, and so a high percentage of students actively seek communication and advice from these students. In turn they ask advice and communicate with 51.28% (B6) and 43.59% (B36) of their colleagues, so that they provide more information than they gain from their cohort.

6.2.4 Degree Centrality of Year 2 Friendship Network

The following measures of degree centrality for individual students in the Year 2 friendship network was obtained using UCINET and are represented in Table 6.5.

Interesting individual cases are highlighted and described below. These are examples of students that have a particularly high in or out-degree of friendship.

The mean of the Year 2 friendship normalized in and out degree is considerably lower than that of the communication network at 26.80%. This is to be expected as it takes much more time and effort to maintain a friendship than a communicative relationship. The mean degree of friendship in the Year 2 cohort is however larger than the Year 1 mean which was 18.73%. As may be expected in a group that has been together for a further year the number of friendships has risen.

The student with the highest in degree of friendship is B7, with 61.54% of the cohort choosing him as a friend, you might say that he is the most 'popular'. This also means that he has a great deal of social support to call upon. Of the whole cohort, student B7 chooses 30.77% as his friends and so he is not completely reciprocal in his relationships.

Student		OutDegree	InDegree	NrmOutDeg	NrmInDeg
1	B1	5.000	14.000	12.821	35.897
2	B2	14.000	5.000	35.897	12.821
3	B3	8.000	9.000	20.513	23.077
4	B4	7.000	8.000	17.949	20.513
5	B5	13.000	19.000	33.333	48.718
6	B6	11.000	8.000	28.205	20.513
7	B7	12.000	24.000	30.769	61.538
8	B8	10.000	4.000	25.641	10.256
9	B9	12.000	10.000	30.769	25.641
10	B10	8.000	9.000	20.513	23.077
11	B11	10.000	11.000	25.641	28.205
12	B12	7.000	3.000	17.949	7.692
13	B13	16.000	9.000	41.026	23.077
14	B14	11.000	9.000	28.205	23.077
15	B15	4.000	12.000	10.256	30.769
16	B16	5.000	12.000	12.821	30.769
17	B17	19.000	14.000	48.718	35.897
18	B18	14.000	6.000	35.897	15.385
19	B19	3.000	10.000	7.692	25.641
20	B20	7.000	14.000	17.949	35.897
21	B21	6.000	10.000	15.385	25.641
22	B22	9.000	9.000	23.077	23.077
23	B23	8.000	7.000	20.513	17.949
24	B24	12.000	17.000	30.769	43.590
25	B25	8.000	5.000	20.513	12.821
26	B26	12.000	12.000	30.769	30.769
27	B27	15.000	12.000	38.462	30.769
28	B28	11.000	9.000	28.205	23.077
29	B29	11.000	8.000	28.205	20.513
30	B30	13.000	11.000	33.333	28.205
31	B31	14.000	17.000	35.897	43.590
32	B32	5.000	0.000	12.821	0.000
33	B33	15.000	13.000	38.462	33.333
34	B34	7.000	8.000	17.949	20.513
35	B35	6.000	6.000	15.385	15.385
36	B36	15.000	13.000	38.462	33.333
37	B37	15.000	17.000	38.462	43.590
38	B38	8.000	10.000	20.513	25.641
39	B39	20.000	10.000	51.282	25.641
40	B40	12.000	14.000	30.769	35.897

Table 6.5 Table Showing Individual Degree Centrality of Year 2 Friendship Network

Other 'popular' or central characters include B5 with an in-degree of 48.72% and an out- degree of 33.33%, and B24, B31 and B37 all with an in-degree of 43.59% and the respective out-degree values of 30.77%, 35.90% and 38.46%. Another student that stands out is B32 who unfortunately nobody chooses as a friend, even though he has chosen five others as his friends. Although this student has an in-degree of 0 for friendship, he is sought out for communication with a normalised in-degree of communication at 23.08. In an analysis of closeness measures in the Year 2 communication network, student B32 shows a high in-closeness at 54.17 and out-closeness at 56.52 (see Table 6.21). This would indicate that although he does not have many friendship relationships, he is close to those in the network that do have a lot of communication relationships. With an end of year grade of 53.59%, this closeness to the information may have proved beneficial.

The student with the highest out-degree is B39 who chooses 51.28% as her friends while half the amount choose her at 25.64%. Other students who choose highly in the friendship network include B17 who chooses 48.72% of the group while 35.90% of the cohort choose her, and B13 who has an out-degree of 41.03% and an in-degree of 23.08%.

6.2.5 Degree Centrality of Year 3 Communication Network

The following measures of degree centrality for individual students in the Year 3 communication network was obtained using UCINET and are illustrated in Table 6.6. Interesting individual cases are highlighted that indicate particularly high or low levels of degree centrality in the communication network

The mean value for the normalized in-degree and out-degree for the Year 3 communication is 38.43%, which lies in between the values of the first and second year cohorts. The student who seeks the most communication is C14 who has an out-degree of 80.95%, she also has quite a large in degree at 47.62%. Other students who are large seekers of communication in the Year 3 communication network include C41 who seeks communication from 73.81% of his cohort and is sought out by 33.33%. Students C6 and C28 also attempt to make good use of the communication network with out going ties to 66.67% of the year group. In return they are sought out by 30.95% (C6), and 35.71% (C28) of the cohort population for communication. It is interesting to note that student C28 is the year group representative at the departmental board of studies, and so it is vital that he communicate with his fellow students in order to fully represent them.

Student		OutDegree	InDegree	NrmOutDeg	NrmInDeg
1	C1	3.000	13.000	7.143	30.952
2	C2	10.000	10.000	23.810	23.810
3	C3	14.000	17.000	33.333	40.476
4	C4	10.000	11.000	23.810	26.190
5	C5	27.000	24.000	64.286	57.143
6	C6	28.000	13.000	66.667	30.952
7	C7	10.000	3.000	23.810	7.143
8	C8	22.000	30.000	52.381	71.429
9	C9	21.000	19.000	50.000	45.238
10	C10	26.000	18.000	61.905	42.857
11	C11	10.000	20.000	23.810	47.619
12	C12	17.000	15.000	40.476	35.714
13	C13	14.000	22.000	33.333	52.381
14	C14	34.000	20.000	80.952	47.619
15	C15	14.000	9.000	33.333	21.429
16	C16	26.000	22.000	61.905	52.381
17	C17	10.000	13.000	23.810	30.952
18	C18	7.000	12.000	16.667	28.571
19	C19	10.000	12.000	23.810	28.571
20	C20	3.000	22.000	7.143	52.381
21	C21	18.000	19.000	42.857	45.238
22	C22	6.000	11.000	14.286	26.190
23	C23	14.000	20.000	33.333	47.619
24	C24	21.000	19.000	50.000	45.238
25	C25	19.000	24.000	45.238	57.143
26	C26	11.000	14.000	26.190	33.333
27	C27	21.000	22.000	50.000	52.381
28	C28	28.000	15.000	66.667	35.714
29	C29	20.000	21.000	47.619	50.000
30	C30	25.000	23.000	59.524	54.762
31	C31	2.000	20.000	4.762	47.619
32	C32	10.000	23.000	23.810	54.762
33	C33	13.000	17.000	30.952	40.476
34	C34	12.000	9.000	28.571	21.429
35	C35	22.000	16.000	52.381	38.095
36	C36	7.000	5.000	16.667	11.905
37	C37	2.000	6.000	4.762	14.286
38	C38	15.000	22.000	35.714	52.381
39	C39	8.000	12.000	19.048	28.571
40	C40	26.000	17.000	61.905	40.476
41	C41	31.000	14.000	73.810	33.333
42	C42	22.000	13.000	52.381	30.952
43	C43	25.000	7.000	59.524	16.667

Table 6.6 Table Showing Individual Degree Centrality of Year 3 Communication Network

C31 is also an interesting example. While he seeks communication with very few people (4.76%), he is relatively central in the communication network with 47.62% of the group seeking advice from him. This would indicate that he is a student that others respect in terms of his academic abilities though he does not appear to think many of his classmates are worth seeking information from in return.

The most central in the network in terms of those whom people seek to communicate with is C8. She has an in-degree of 71.43% and an out-degree of 52.38%. Other highly central characters include C5 and C25 who both have an in-degree of 57.14%. C5 also has a high out-degree at 64.29% while C25 is also quite central in the out-degree network at 45.24%.

6.2.6 Degree Centrality of Year 3 Friendship Network

The following measures of degree centrality for individual students in the Year 3 friendship network was obtained using UCINET as represented in Table 6.7. Interesting individual cases are highlighted that exhibit particularly high or low degree centrality in the Year 3 friendship network.

The student with the highest out-degree of friendship in the Year 3 friendship network is C14 at 71.43%, she also has the joint highest out degree at 40.48%, and so she is the most central in the Year 3 friendship network overall. This will have a great affect upon the amount of social support that she has at her disposal both in times of need and in normal everyday life. Research has suggested that this type of support can be particularly helpful in alleviating stress and in turn, improving performance (Mallinckrodt & Leong, 1992 and House, 1981).

The next highest normalized out-degree of friendship is considerably lower at 40.48%, held by students C9, C38 and C42.These students have a lower in-degree than out-degree, ranging from 26.19% to 35.71% thus showing that they seek friendship more than it is returned. Student C28 is also chosen by 40.48% of the cohort, he himself chooses less than half of this amount as his friends with an out-degree of 19.05%.

Student		OutDegree	InDegree	NrmOutDeg	NrmInDeg
1	C1	6.000	5.000	14.286	11.905
2	C2	12.000	6.000	28.571	14.286
3	C3	23.000	14.000	54.762	33.333
4	C4	8.000	5.000	19.048	11.905
5	C5	14.000	11.000	33.333	26.190
6	C6	7.000	7.000	16.667	16.667
7	C7	0.000	0.000	0.000	0.000
8	C8	6.000	9.000	14.286	21.429
9	C9	17.000	12.000	40.476	28.571
10	C10	11.000	13.000	26.190	30.952
11	C11	8.000	8.000	19.048	19.048
12	C12	8.000	11.000	19.048	26.190
13	C13	12.000	14.000	28.571	33.333
14	C14	30.000	17.000	71.429	40.476
15	C15	1.000	1.000	2.381	2.381
16	C16	15.000	14.000	35.714	33.333
17	C17	10.000	9.000	23.810	21.429
18	C18	5.000	5.000	11.905	11.905
19	C19	7.000	7.000	16.667	16.667
20	C20	8.000	11.000	19.048	26.190
21	C21	5.000	10.000	11.905	23.810
22	C22	6.000	9.000	14.286	21.429
23	C23	10.000	16.000	23.810	38.095
24	C24	8.000	9.000	19.048	21.429
25	C25	12.000	8.000	28.571	19.048
26	C26	5.000	6.000	11.905	14.286
27	C27	12.000	15.000	28.571	35.714
28	C28	8.000	17.000	19.048	40.476
29	C29	13.000	14.000	30.952	33.333
30	C30	7.000	11.000	16.667	26.190
31	C31	16.000	14.000	38.095	33.333
32	C32	8.000	12.000	19.048	28.571
33	C33	8.000	14.000	19.048	33.333
34	C34	7.000	7.000	16.667	16.667
35	C35	13.000	16.000	30.952	38.095
36	C36	4.000	7.000	9.524	16.667
37	C37	4.000	6.000	9.524	14.286
38	C38	17.000	15.000	40.476	35.714
39	C39	15.000	9.000	35.714	21.429
40	C40	9.000	10.000	21.429	23.810
41	C41	8.000	3.000	19.048	7.143
42	C42	17.000	11.000	40.476	26.190
43	C43	7.000	9.000	16.667	21.429

Table 6.7 Table Showing Individual Degree Centrality of Year 3 Friendship Network

It is unfortunate to note that there is one student, C7, who neither chooses nor is chosen as a friend by anyone in the cohort. This student has to repeat his third year and so he joined this cohort only in Year 3, he has not been with them for the previous two years and perhaps found it difficult to fit in or make friends. Student C7 also ended the year with the lowest grade of all of the cohort at 43.14% (see Appendix III).

6.2.7 Comparison of Mean Degree Centrality in all Networks

The mean normalized degree centrality score was taken from UCINET for each of the friendship and communication networks in all three cohorts and then compared in Table 6.8.

Network	**Mean Normalized Degree Centrality Score**
Year 1 Communication	34.51
Year 1 Friendship	18.73
Year 2 Communication	43.14
Year 2 Friendship	26.8
Year 3 Communication	38.43
Year 3 Friendship	23.64

Table 6.8 Table showing Mean Normalized Degree Centrality in all Networks

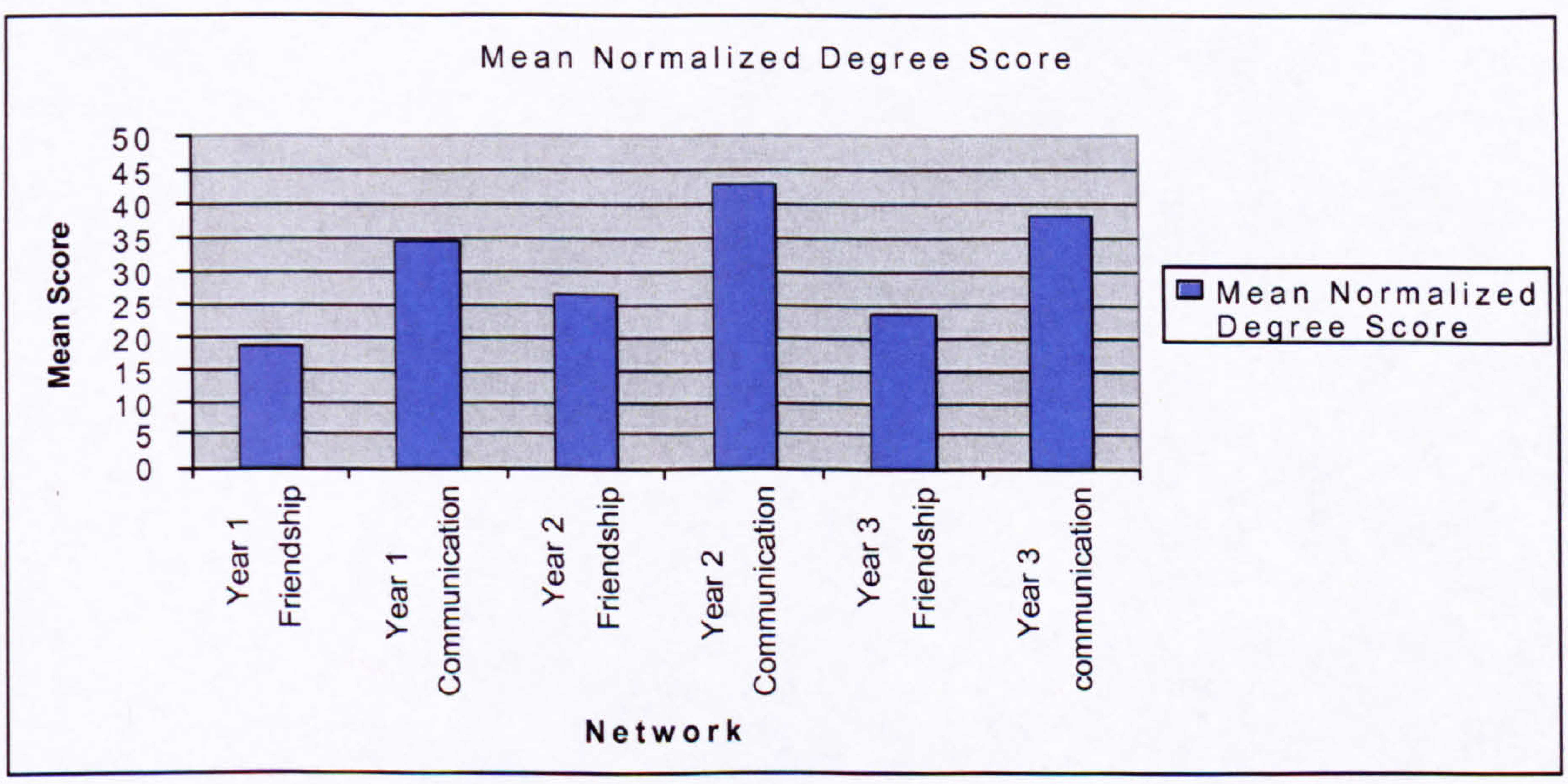


Fig. 6.3 Graph Showing a Comparison Between Mean Normalized Degree Centrality Scores for all Networks

Fig. 6.3 is a graphical representation of the data contained in Table 6.8, showing the mean normalized degree centrality in the friendship and communication networks of all three cohorts.

In each of the three cohorts the mean degree centrality is higher in the communication networks than in the friendship networks. This is because it takes more time and effort to build up a friendship relationship than a communicative one and so it is likely that there will always be more communication ties than friendship ties. The mean communication ties are highest in the second year of study. The workload is particularly high in the second year and so it is likely that this is the reason that the students in the Year 2 cohort seek more advice and guidance from each other. The mean degree centrality of friendship ties is also highest in the Year 2 cohort, showing that this group of students is a particularly cohesive one.

The mean degree centrality as illustrated in this analysis relates to a localised measure of centrality for the individual. This is also relates to Table 4.3 in Chapter 4 which shows the graph density of networks in all three cohorts. The individual relationship all add up to provide the density of the relationships within the cohort.

6.3 Betweenness Centrality.

The measure of betweenness is another type of point centrality. It shows to what extent a point lies between other points in the graph. Outlined by Freeman (1979), this measure highlights those in the network who may not have a high degree centrality but perhaps are the bridge between particular points, playing the role of intermediary. In this way it may not be as important to know a lot of people but rather it is who you know that counts, a person may be well connected in terms of being the link between two groups. A high betweenness centrality can indicate a position of power, there is potential for control of information and control of relationships, and so someone with a low degree centrality but a high betweenness could in fact be very central to the network. Freeman's (1979) measure of betweenness is based upon local dependency as opposed to global dependency. In terms of local dependency and betweenness, a point is dependent upon another if it must pass through that point in order to get to another. For example, point A is dependent upon point B if it must pass through B to get to point C. In this case point B has a high betweenness centrality. Burt (1992) described the situation where two points are connected at a distance of two rather than directly at a distance of one as a structural hole. When there is a structural hole between two points, the third point, the one that has the power to connect the two, can become an intermediary, but is also in a position to choose not to be an intermediary. In this way the third agent can have control over information.

The betweenness measure used in UCINET 5 is that of Freeman (1979). This algorithm deals only with symmetrized data and so for the purpose of this analysis the networks have been symmetrized. Given that one student has chosen another we can say that a relationship is apparent between them. In this way the data has been symmetrized so that where-ever there is a relationship recorded in any direction, then this relationship is given the value of one. Only when there is no relationship between a pair (in any direction), then a zero is allocated. Networks can be symmetrized another way so that a one is only allocated when the relationship exists in both directions, but with the relationship of friendship and communication it is assumed that a relationship in any direction constitutes some form of bond and so the data can be analyzed for betweenness by symmetrizing it in this way. The UCINET 5 definition for the measure is given as follows: "Let bjk be the proportion of all geodesics linking vertex j and vertex k which pass through vertex i. The betweenness of vertex i is the sum of all bjk where i, j and k are distinct and j < k. Betweenness is therefore a measure of the number of times a vertex occurs on a geodesic. The normalised betweenness centrality is the betweenness divided by the maximum possible betweenness expressed as a percentage." Analytic Technologies, Inc. (1999 – 2000)

The following Table 6.9 provides definitions for some of the key terms used in this chapter.

Term	Definition
Betweenness	The extent to which a point lies in between others, becoming a bridging relationship
Strutural Hole	Two points are connected at a distance of two, i.e. they do not know each other directly (which would be a relationship at the distance of one) but go between an intermediary. In this case a point cannot be connected to itself.
nBetween	A normalized betweenness measure that expresses the betweenness measure as a percentage of the ties possible.
Symmetrize	Take directed data and make it undirected by allocating a 1 where there is a tie in any direction and a 0 where there is no tie at all.

Table 6.9 Definitions at a Glance – Betweenness

6.3.1 Betweenness Centrality of Year 1 Communication Network

The betweenness centrality for the Year 1 communication network was calculated by running the algorythm in UCINET. The following table, Table 6.10 was produced. Cases are highlighted that exhibit particularly high or low betweenness centrality. These cases are then discussed below.

Student		Between	nBetween
1	A1	33.079	3.196
2	A2	2.143	0.207
3	A3	3.842	0.371
4	A4	8.467	0.818
5	A5	7.020	0.678
6	A6	10.347	1.000
7	A7	10.266	0.992
8	A8	5.473	0.529
9	A9	14.886	1.438
10	A10	3.913	0.378
11	A11	3.856	0.373
12	A12	29.723	2.872
13	A13	1.755	0.170
14	A14	4.047	0.391
15	A15	19.211	1.856
16	A16	23.631	2.283
17	A17	8.294	0.801
18	A18	2.799	0.270
19	A19	12.818	1.238
20	A20	2.063	0.199
21	A21	8.915	0.861
22	A22	33.039	3.192
23	A23	9.052	0.875
24	A24	8.358	0.807
25	A25	20.628	1.993
26	A26	25.417	2.456
27	A27	1.183	0.114
28	A28	1.945	0.188
29	A29	5.335	0.515
30	A30	23.862	2.305
31	A31	13.971	1.350
32	A32	11.606	1.121
33	A33	9.040	0.873
34	A34	7.953	0.768
35	A35	3.348	0.323
36	A36	10.700	1.034
37	A37	14.824	1.432
38	A38	10.082	0.974
39	A39	8.974	0.867
40	A40	6.225	0.601
41	A41	7.646	0.739
42	A42	26.236	2.535
43	A43	10.616	1.026
44	A44	6.710	0.648
45	A45	4.434	0.428
46	A46	5.098	0.493
47	A47	7.171	0.693

Table 6.10 Table Showing Individual Betweenness Centrality of Year 1 Communication Network

Student A27 is the weakest in terms of betweenness and so is not in a good position when it comes to being a broker of information or friendship. He also has a low in and out-degree of communication at 19.565% and 10.870% respectively.

6.3.2 Betweenness Centrality of Year 1 Friendship Network

The following measures of betweenness were found for the Year 1 friendship network by running the algorithm in UCINET, and are represented in Table 6.11. Interesting cases that reflect high or low betweenness scores are highlighted and discussed.

Student A18 has the highest betweennness score in the year 1 friendship network at 36.783%. He is in a position to act as an intermediary amongst his friends. However this may be because he chose a lot of people as friends (he has an out-degree of 89.13% in this network). A 18 has a low in-degree of 17.391%. (see Table 6.3). His high betweenness rating is likely to be because of his high friendship seeking behaviour. As the betweenness measure does not take into account the direction of the relationship the dichotomy between the relationship to and from the individual is not taken into account. This may in fact skew the betweenness measure if the matrix is likely to be particularly unsymmetrical.

As a stark contrast student A44 has a betweenness measure of 0%, while she has both chosen and been chosen as a friend, (see Table 6.3) she is not actually between any two people, and so is in a weak brokerage position.

Student		Between	nBetween
1	A1	2.393	0.231
2	A2	0.000	0.000
3	A3	1.233	0.119
4	A4	0.000	0.000
5	A5	10.276	0.993
6	A6	1.819	0.176
7	A7	0.754	0.073
8	A8	6.235	0.602
9	A9	8.234	0.796
10	A10	2.271	0.219
11	A11	1.392	0.134
12	A12	21.978	2.123
13	A13	9.367	0.905
14	A14	1.483	0.143
15	A15	1.680	0.162
16	A16	3.413	0.330
17	A17	5.800	0.560
18	A18	380.700	36.783
19	A19	104.742	10.120
20	A20	16.102	1.556
21	A21	3.450	0.333
22	A22	17.681	1.708
23	A23	5.975	0.577
24	A24	8.110	0.784
25	A25	10.921	1.055
26	A26	9.120	0.881
27	A27	3.492	0.337
28	A28	6.548	0.633
29	A29	6.253	0.604
30	A30	9.449	0.913
31	A31	2.933	0.283
32	A32	10.004	0.967
33	A33	16.515	1.596
34	A34	0.754	0.073
35	A35	3.803	0.367
36	A36	2.107	0.204
37	A37	75.293	7.275
38	A38	44.906	4.339
39	A39	13.364	1.291
40	A40	4.117	0.398
41	A41	2.436	0.235
42	A42	0.125	0.012
43	A43	10.205	0.986
44	A44	0.000	0.000
45	A45	0.867	0.084
46	A46	2.992	0.289
47	A47	1.708	0.165

Table 6.11 Table Showing Individual Betweenness Centrality of Year 1 Friendship Network

6.3.3 Betweenness Centrality of Year 2 Communication Network

The following measures of betweenness were found for the Year 2 communication network by running the algorithm in UCINET and are represented in Table 6.12. Cases are highlighted that show particularly high or low betweenness centrality.

Student		Between	nBetween
1	B1	12.911	1.742
2	B2	10.470	1.413
3	B3	1.781	0.240
4	B4	6.356	0.858
5	B5	4.335	0.585
6	B6	11.409	1.540
7	B7	5.049	0.681
8	B8	5.192	0.701
9	B9	8.320	1.123
10	B10	16.556	2.234
11	B11	1.350	0.182
12	B12	3.164	0.427
13	B13	19.210	2.592
14	B14	16.303	2.200
15	B15	6.102	0.824
16	B16	3.894	0.525
17	B17	5.135	0.693
18	B18	6.478	0.874
19	B19	9.722	1.312
20	B20	9.859	1.330
21	B21	6.897	0.931
22	B22	0.546	0.074
23	B23	1.621	0.219
24	B24	6.538	0.882
25	B25	12.211	1.648
26	B26	3.672	0.496
27	B27	14.401	1.944
28	B28	2.438	0.329
29	B29	2.846	0.384
30	B30	5.020	0.677
31	B31	14.375	1.940
32	B32	3.367	0.454
33	B33	6.553	0.884
34	B34	1.778	0.240
35	B35	6.138	0.828
36	B36	7.324	0.988
37	B37	3.081	0.416
38	B38	5.105	0.689
39	B39	3.904	0.527
40	B40	2.590	0.350

Table 6.12 Table Showing Individual Betweenness Centrality of Year 2 Communication Network

Student B13 has the highest betweenness measure of the Year 2 communication network at 2.592%, so that he is in a position to choose whether or not to pass information on to other members of his cohort. B13 also has the highest normalized out-degree of communication in the cohort at 92.308%. Again it appears that the high out-degree is particularly significant in raising the betweenness measure for this student. As the betweenness measure does not take into account the direction of the relationship we would not know that the relationships directed out from B13 have a large effect upon his betweenness rating.

Student B22 is particularly low in terms of betweenness in this network at 0.074% giving him a low level of brokerage within the cohort. This student has an in-degree of communication of 25.641% and an out-degree of 20.513% (see Table 6.4). Whilst these scores on degree centrality are quite low they are not the lowest in the cohort. This would indicate that he indeed his betweenness rating is relatively low compared with his degree centrality.

6.3.4 Betweenness Centrality of Year 2 Friendship Network

The following measures of betweenness were found for the Year 2 friendship network by running the algorithm in UCINET and are represented in Table 6.13. Cases that show exceptionally high or low betweenness scores have been highlighted and discussed.

Student B31 at 6.355% is particularly central in terms of betweenness in the Year 2 friendship network. He has an in-degree of friendship of 43.590% and an out degree of friendship of 35.897% (see Table 6.5). These figures are high though not the highest in the cohort. This would indicate that not only doe he have a high number of relationships with his colleague, but also that those relationships are strategically placed within the network.This student is in a position where by students may need to come to him in order to reach other people in terms of friendship, social engagements etc. This is a powerful position to be in as when it comes to for example getting a favour, B31 will be in the strongest position to facilitate this.

Student		Between	nBetween
1	B1	18.034	2.434
2	B2	10.100	1.363
3	B3	4.993	0.674
4	B4	2.094	0.283
5	B5	19.689	2.657
6	B6	4.371	0.590
7	B7	29.366	3.963
8	B8	4.126	0.557
9	B9	8.203	1.107
10	B10	3.415	0.461
11	B11	7.473	1.009
12	B12	2.754	0.372
13	B13	36.437	4.917
14	B14	4.344	0.586
15	B15	14.790	1.996
16	B16	1.568	0.212
17	B17	44.408	5.993
18	B18	10.657	1.438
19	B19	3.327	0.449
20	B20	14.829	2.001
21	B21	7.911	1.068
22	B22	1.689	0.228
23	B23	3.679	0.496
24	B24	29.563	3.990
25	B25	16.947	2.287
26	B26	8.092	1.092
27	B27	39.218	5.293
28	B28	5.019	0.677
29	B29	12.536	1.692
30	B30	6.982	0.942
31	B31	47.094	6.355
32	B32	4.174	0.563
33	B33	29.603	3.995
34	B34	1.244	0.168
35	B35	2.856	0.385
36	B36	12.739	1.719
37	B37	26.875	3.627
38	B38	3.309	0.447
39	B39	14.588	1.969
40	B40	14.903	2.011

Table 6.13 Table Showing Individual Betweenness Centrality of Year 2 Friendship Network

Student B34 is in the weakest position when it comes to betweenness. With a score of 0.168% he is the least likely to be a successful broker of friendship. He also has a relatively low degree centrality in the friendship network with an in-degree of 20.513% and an out-degree of 17.949% (see Table 6.5). Again although his degree centrality in the friendship network is not high it is not the lowest of the cohort. This would indicate that although he is not well connected, those connections are also not in an especially fruitful position in the network in terms of betweenness.

6.3.5 Betweenness Centrality of Year 3 Communication Network

The following measures of betweenness were found for the Year 3 communication network by running the algorithm in UCINET and are represented in Table 6.14. Cases are highlighted that show particular extremes in the betweenness centrality measure.

The student holding the highest betweenness centrality in the communication network in the third year is C14 at 3.664%. This student also has the highest out-degree of centrality at 80.95% (see Table 6.6), and so is in a particularly powerful position. Student C16 at 3.519% has the second highest betweenness score. This student has no-where near the highest degree centrality (out-degree = 61.91%, in-degree = 52.38%, see Table 6.6), but despite this is still in a powerful position when it comes to being a broker of communication with this high betweenness score. This shows that although the student does not have many ties, those that are present make him particularly influential.

Alternatively student C37 holds the lowest betweenness score at 0.032%. This student also has a low degree centrality (out-degree = 4.76%, in-degree = 14.29% see Table 6.6), and so will be in a weak position within the communication network.

Student		Between	nBetween
1	C1	1.735	0.201
2	C2	7.623	0.885
3	C3	12.495	1.451
4	C4	9.859	1.145
5	C5	14.736	1.711
6	C6	26.342	3.059
7	C7	1.190	0.138
8	C8	17.410	2.022
9	C9	4.435	0.515
10	C10	14.112	1.639
11	C11	5.212	0.605
12	C12	9.700	1.127
13	C13	10.468	1.216
14	C14	31.546	3.664
15	C15	5.540	0.643
16	C16	30.297	3.519
17	C17	3.069	0.356
18	C18	3.752	0.436
19	C19	5.408	0.628
20	C20	4.255	0.494
21	C21	4.608	0.535
22	C22	2.309	0.268
23	C23	5.411	0.628
24	C24	10.111	1.174
25	C25	12.026	1.397
26	C26	2.638	0.306
27	C27	9.383	1.090
28	C28	17.483	2.031
29	C29	3.687	0.428
30	C30	15.611	1.813
31	C31	6.078	0.706
32	C32	7.217	0.838
33	C33	3.472	0.403
34	C34	2.090	0.243
35	C35	9.117	1.059
36	C36	0.845	0.098
37	C37	0.273	0.032
38	C38	7.275	0.845
39	C39	2.033	0.236
40	C40	7.521	0.874
41	C41	18.734	2.176
42	C42	7.595	0.882
43	C43	16.301	1.893

Table 6.14 Showing Individual Betweenness Centrality of Year 3 Communication Network

6.3.6 Betweenness Centrality of Year 3 Friendship Network

The following measures of betweenness were found for the Year 3 friendship network by running the algorithm in UCINET and are represented in Table 6.15.

Student		Between	nBetween
1	C1	2.371	0.275
2	C2	19.786	2.298
3	C3	73.368	8.521
4	C4	5.648	0.656
5	C5	17.016	1.976
6	C6	4.969	0.577
7	C7	0.000	0.000
8	C8	4.246	0.493
9	C9	9.628	1.118
10	C10	24.216	2.813
11	C11	14.345	1.666
12	C12	5.918	0.687
13	C13	7.013	0.815
14	C14	128.511	14.926
15	C15	0.000	0.000
16	C16	26.283	3.053
17	C17	5.218	0.606
18	C18	2.020	0.235
19	C19	2.223	0.258
20	C20	4.595	0.534
21	C21	1.237	0.144
22	C22	2.100	0.244
23	C23	21.332	2.478
24	C24	12.182	1.415
25	C25	5.762	0.669
26	C26	2.116	0.246
27	C27	12.319	1.431
28	C28	30.461	3.538
29	C29	12.558	1.459
30	C30	9.187	1.067
31	C31	50.376	5.851
32	C32	7.461	0.867
33	C33	5.440	0.632
34	C34	1.317	0.153
35	C35	14.835	1.723
36	C36	5.165	0.600
37	C37	0.334	0.039
38	C38	18.624	2.163
39	C39	24.727	2.872
40	C40	3.323	0.386
41	C41	3.170	0.368
42	C42	11.619	1.350
43	C43	43.980	5.108

Table 6.15 Table Showing Individual Betweenness Centrality of Year 3 Friendship Network

Cases are highlighted that show particularly high or low levels of betweenness centrality.

In terms of the third year friendship network student C14 has by far the highest betweenness score at 14.926%. She also has the highest out-degree of friendship at

71.43% and shares the highest in-degree of friendship at 40.48% (see Table 6.7). A very popular girl in terms of both communication and friendship, she is also in a position of power where by she can be a broker of both, a go between in terms of both information and advice, and emotional support and friendship. Student C7 however is in a very weak position as a broker with 0 in and out- degree (see Table 6.7)and hence 0 betweenness, he has no brokerage power what so ever in the friendship network.

Student C15 has a betweenness measure of 0.000. He has an in-degree of 1 and and out-degree of 1 in the friendship network (see Table 6.7), showing that he is sought by one other student for friendship and seeks the friendship of one other. Although he does have this relationship (or these as we cannot be certain that it is one reciprocal relationship), this does not afford him any betweenness centrality.

6.3.7 Comparison of Mean Betweenness in all Networks.

The mean betweenness scores for the friendship and communication networks of all three cohorts was calculated and then compared in table 6.16 below:

Network	Mean Betweenness
Year 1 Communication	1.55
Year 1 Friendship	2.929
Year 2 Communication	1.518
Year 2 Friendship	2.294
Year 3 Communication	1.602
Year 3 Friendship	2.272

Table 6.16 Table Showing a Comparison of Mean Betweenness in all Networks.

Fig 6.4 below provides a graphical representation of the comparison of mean betweenness in all networks.

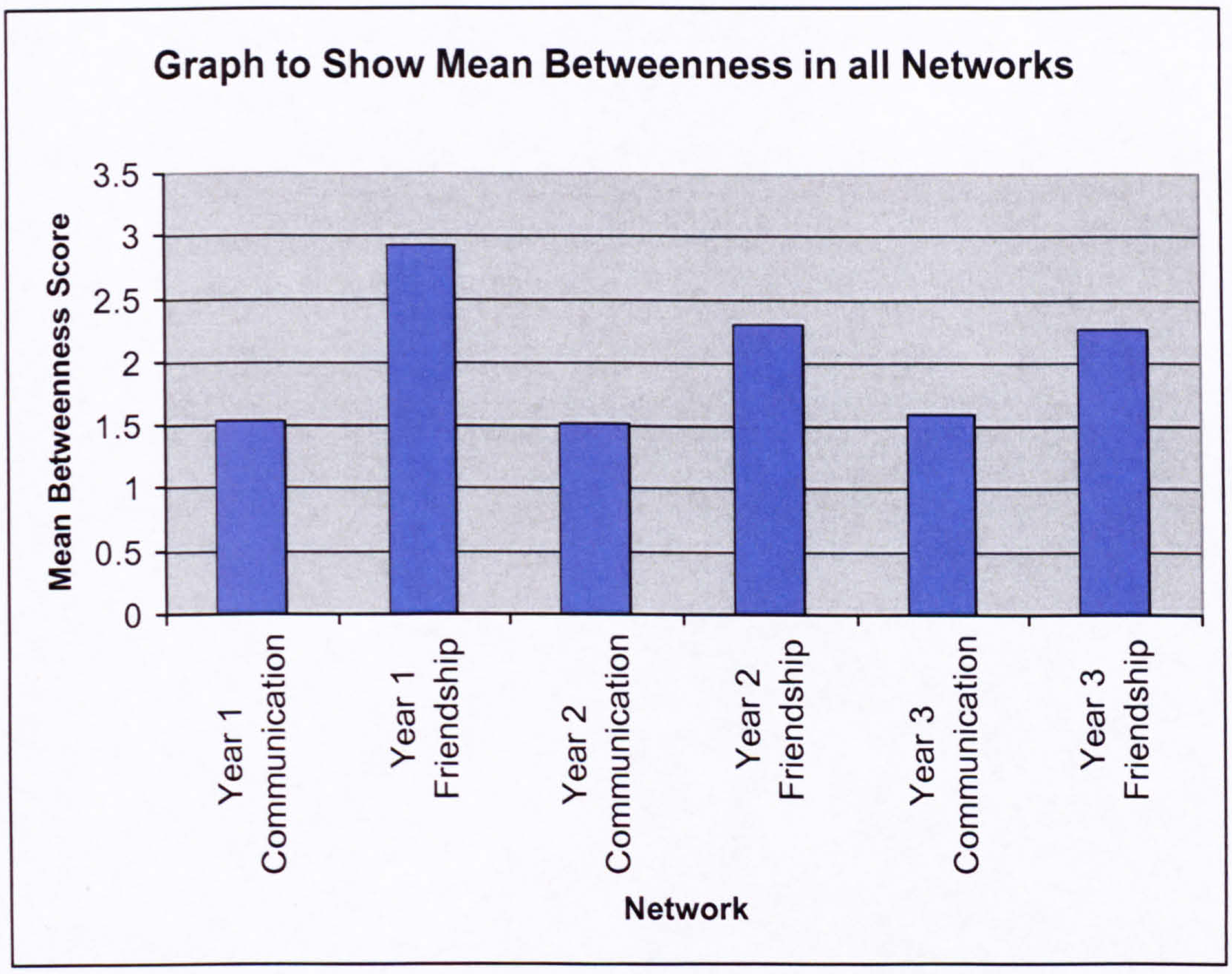


Fig 6.4 Graph to Show a Comparison of the Mean Individual Betweenness in all Networks

It is interesting to note that in all cohorts the mean betweenness score is higher for the friendship network than the communication. This would show that the links are stronger in the friendship ties, people are positioned more 'in between' each other than in the communication networks. This differs from the closeness measure where the communication networks have the higher mean score. Of the three cohorts, the Year 1 friendship network has the highest betweenness in the friendship network, while all of the communication network scores are very similar with the Year 3 cohort being very slightly ahead at 1.602%.

6.4 Closeness Centrality

Another view of actor centrality focuses on the closeness or distance to and from their peers in the network. In this way an agent is central if he / she can reach the other actors quickly i.e. they are close to them. The measure of closeness centrality is particularly poignant in communication networks. In a communication network if an agent has a high closeness centrality, they do not need to rely on other agents to carry information, they are close to the centre themselves. Beauchamp (1965) found that where agents have a high closeness centrality, they can be particularly adept at communicating information to other agents in the network. Beauchamp went on to discover that where agents were engaged in problem solving, solutions were most efficiently found when an agent had a very short path of communication to other agents, hence showing the importance of closeness centrality. The notion of closeness can be turned around and viewed as minimum distance. In this way centrality can be seen as inversely related to distance so that as the node is further away from the other nodes its centrality decreases. As centrality decreases it is observed that it takes more links to get to other nodes. Hakimi (1965) and Sabidussi (1966) clarified this point when they talked of the minimum steps it takes to link one node to another. The shortest path (geodesics) linking those nodes which are central to all others must be as short as possible. For example take the star graph below in Fig. 6.5:

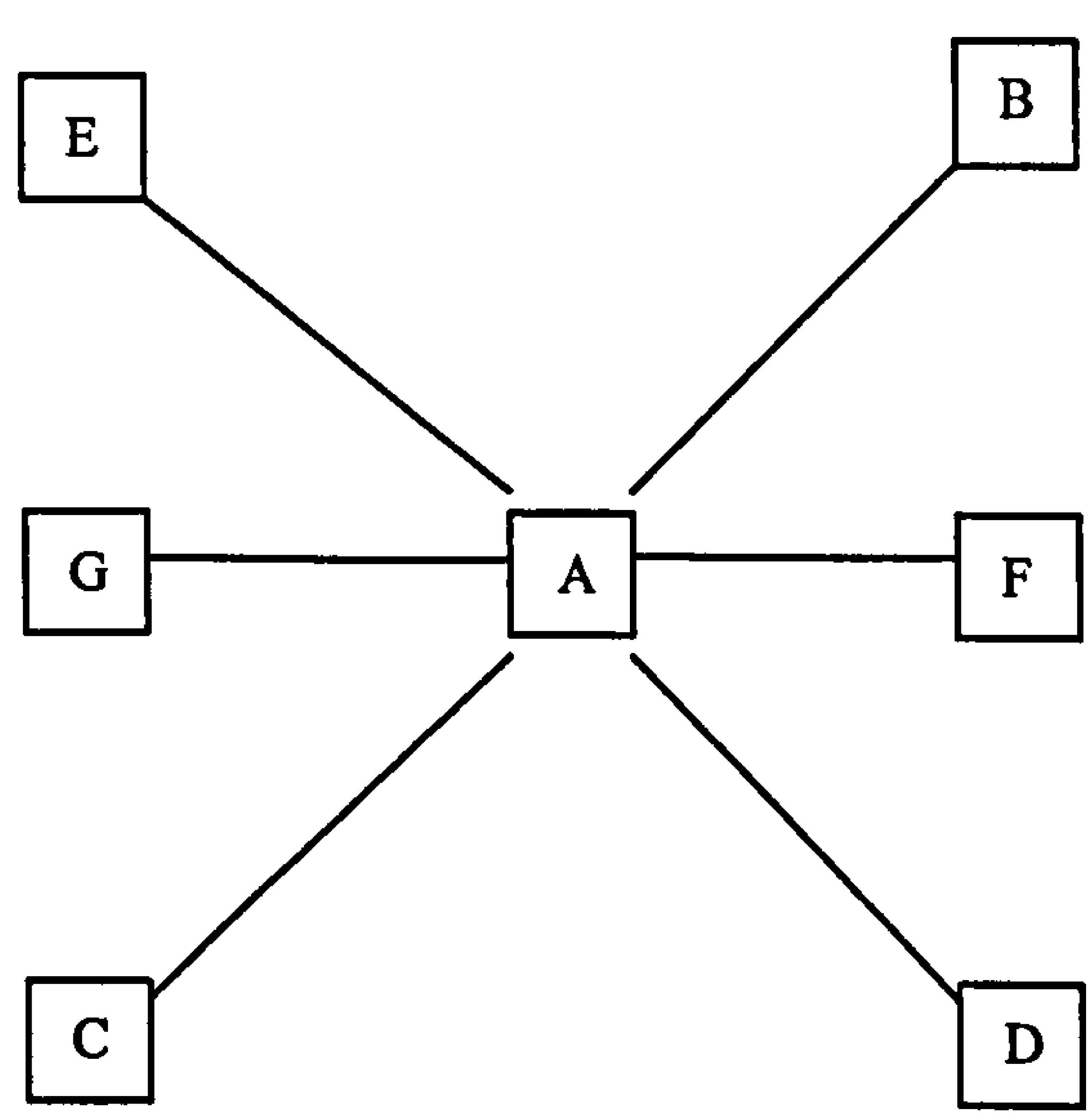


Fig. 6.5 Example of a Star Graph.

In the star network shown above, agent A has the shortest path to all of the other agents and so has the highest closeness centrality. In fact as agent A has one path to each of the other agents, she is maximally close, she does not need to rely on anyone else to get to any of the other actors.

Freeman (1979) reviewed the measures of closeness centrality offered by Bavelas (1950), Harary (1959), Beauchamp (1965), Sabidussi (1966), Moxley and Moxley (1974) and Rogers (1974). He found that the simplest and most appropriate measure was that by Sabidussi (1966) which measures closeness as a function of geodesic distances. As the length of geodesics increases, the centrality of the agent decreases. In this way, the measure of geodesics is weighted inversely in order to arrive at the Sabidussi closeness centrality measure. UCINET 5 uses this measure to investigate closeness centrality and this measure has been applied to the friendship and communication networks of the three undergraduate cohorts.

Measure	**Definition**
Closeness	The distance from one node to the others in the network. A maximally close node is one that is directly linked to all others.
In-Closeness	How close the other nodes are to the individual in terms of incoming relationships in a network with directed data.
Out-Closeness	How close the individual is to other nodes in the network in terms of out going relationships in a network with directed data.
In-Farness	The inverse of in closeness, how far away the other nodes are from the individual in a network with directed data.
Out-Farness	The inverse of out closeness, how far away the individual is from other nodes in a network with directed data.

Table 6.17 Definitions at a Glance - Closeness

Table 6.17 provides the definitions for key terms used in the analysis of closeness centrality.

6.4.1 Closeness Centrality of the Year 1 Communication Network.

The following measures of closeness were found for the Year 1 communication network by running the algorithm in UCINET and are represented in Table 6.18. Cases that indicate a particularly high or low measure are highlighted as are cases where a particular anomaly between in-closeness and out-closeness are evident. The closeness measures are discussed as the farness measures simply constitute the inverse of closeness.

The student with the highest out-closeness centrality is A1 at 86.64, this student also has the highest normalized out-degree at 80.435% (see Table 6.2). He has an in-closeness centrality of 65.71 which is also relatively high, and again his in-degree centrality in the communication network is relatively high at 50.00% though not the highest which is held by A26 at 67.391% (see Table 6.2).

Other students with a high out-closeness measure include A12 at 77.97 and A26 with 76.67, they also have relatively high in-closeness centrality at 62.16 and 60.53 respectively.

The highest in-closeness centrality is 75.41 which is attained by student A25 who has a relatively low out-closeness centrality of 46.00. This means that the other students in the cohort have the shortest path to student A25 out of the entire cohort. A25 has a particularly low out-degree centrality at just 6.522%, though as mentioned above he is sought out a great deal for communication with an in-degree of 67.391% which makes him very close to incoming information.

Student		inFarness	outFarness	inCloseness	outCloseness
1	A1	70.000	55.000	65.714	83.636
2	A2	87.000	77.000	52.874	59.740
3	A3	76.000	82.000	60.526	56.098
4	A4	90.000	70.000	51.111	65.714
5	A5	76.000	81.000	60.526	56.790
6	A6	66.000	88.000	69.697	52.273
7	A7	73.000	76.000	63.014	60.526
8	A8	82.000	71.000	56.098	64.789
9	A9	70.000	74.000	65.714	62.162
10	A10	82.000	77.000	56.098	59.740
11	A11	90.000	79.000	51.111	58.228
12	A12	74.000	59.000	62.162	77.966
13	A13	88.000	84.000	52.273	54.762
14	A14	88.000	81.000	52.273	56.790
15	A15	81.000	64.000	56.790	71.875
16	A16	74.000	66.000	62.162	69.697
17	A17	91.000	82.000	50.549	56.098
18	A18	81.000	122.000	56.790	37.705
19	A19	67.000	91.000	68.657	50.549
20	A20	83.000	89.000	55.422	51.685
21	A21	70.000	83.000	65.714	55.422
22	A22	66.000	60.000	69.697	76.667
23	A23	85.000	74.000	54.118	62.162
24	A24	81.000	76.000	56.790	60.526
25	A25	61.000	100.000	75.410	46.000
26	A26	76.000	60.000	60.526	76.667
27	A27	83.000	101.000	55.422	45.545
28	A28	91.000	89.000	50.549	51.685
29	A29	82.000	81.000	56.098	56.790
30	A30	71.000	67.000	64.789	68.657
31	A31	69.000	74.000	66.667	62.162
32	A32	81.000	71.000	56.790	64.789
33	A33	74.000	76.000	62.162	60.526
34	A34	81.000	76.000	56.790	60.526
35	A35	81.000	86.000	56.790	53.488
36	A36	71.000	68.000	64.789	67.647
37	A37	74.000	76.000	62.162	60.526
38	A38	76.000	72.000	60.526	63.889
39	A39	72.000	82.000	63.889	56.098
40	A40	83.000	76.000	55.422	60.526
41	A41	73.000	84.000	63.014	54.762
42	A42	80.000	61.000	57.500	75.410
43	A43	74.000	79.000	62.162	58.228
44	A44	85.000	76.000	54.118	60.526
45	A45	80.000	78.000	57.500	58.974
46	A46	82.000	99.000	56.098	46.465
47	A47	79.000	77.000	58.228	59.740

Table 6.18 Table Showing Individual Closeness Centrality of the Year 1 Communication Network.

Other students with a high in-closeness centrality include A6 and A22 at 69.70. A6 has an out centrality of 52.27which is above the average. A22 is particularly interesting because she also has one of the highest out-closeness measures at 76.67, making her very important in the group in terms of being close in the communication network. A22 also has high in and out-degree centrality in the communication network at 56.522% and 69.565% respectively (see Table 6.2)

6.4.2 Closeness Centrality of the Year 1 Friendship Network.

The following measures of closeness were found for the Year 1 friendship network by running the algorithm in UCINET and are represented in Table 6.19. Interesting cases such as those that show extremes or anomalies between in measures and out measures are highlighted and discussed.

Student A18 has a particularly high out-closeness at 90.20. We saw from his degree centrality (Table 6.3), that this student was chosen many others as a friend and so will have a short path out to many of the cohort. His in-closeness, 42.99, is just below the average of 43.74. This means that although he feels he is particularly close to the rest of the cohort, the feeling is not necessarily mutual. In terms of social support, although he has a high out-closeness score, because his in-closeness score is particularly low, then he is unlikely to benefit from a large amount of social support.

A37 has the highest in-closeness at 59.74, well above the average of 43.74. He also has quite a high out-closeness of 54.76, showing that he is very central in terms of friendship, he is closer than most with short paths leading to friendship and support. This should bode well for the student in times of need when he can turn to many friends for mutual support.

Other students with high in-closeness of friendship include A22 (52.87), who was also central in the communication network, and A19 (51.69), who also had a high closeness in communication score. This means that students A22 and A19 are close to others in both networks and so should be able to use this to their advantage in their studies.

Student		inFarness	outFarness	inCloseness	outCloseness
1	A1	117.000	89.000	39.316	51.685
2	A2	114.000	165.000	40.351	27.879
3	A3	109.000	99.000	42.202	46.465
4	A4	122.000	109.000	37.705	42.202
5	A5	94.000	96.000	48.936	47.917
6	A6	110.000	133.000	41.818	34.586
7	A7	103.000	100.000	44.660	46.000
8	A8	96.000	107.000	47.917	42.991
9	A9	100.000	99.000	46.000	46.465
10	A10	110.000	120.000	41.818	38.333
11	A11	114.000	88.000	40.351	52.273
12	A12	111.000	86.000	41.441	53.488
13	A13	115.000	81.000	40.000	56.790
14	A14	123.000	104.000	37.398	44.231
15	A15	103.000	116.000	44.660	39.655
16	A16	99.000	103.000	46.465	44.660
17	A17	104.000	130.000	44.231	35.385
18	A18	107.000	51.000	42.991	90.196
19	A19	89.000	82.000	51.685	56.098
20	A20	101.000	112.000	45.545	41.071
21	A21	95.000	106.000	48.421	43.396
22	A22	87.000	113.000	52.874	40.708
23	A23	118.000	123.000	38.983	37.398
24	A24	103.000	80.000	44.660	57.500
25	A25	133.000	92.000	34.586	50.000
26	A26	93.000	103.000	49.462	44.660
27	A27	127.000	107.000	36.220	42.991
28	A28	121.000	96.000	38.017	47.917
29	A29	125.000	102.000	36.800	45.098
30	A30	91.000	100.000	50.549	46.000
31	A31	98.000	221.000	46.939	20.814
32	A32	101.000	79.000	45.545	58.228
33	A33	94.000	94.000	48.936	48.936
34	A34	100.000	99.000	46.000	46.465
35	A35	105.000	85.000	43.810	54.118
36	A36	100.000	176.000	46.000	26.136
37	A37	77.000	84.000	59.740	54.762
38	A38	99.000	74.000	46.465	62.162
39	A39	92.000	99.000	50.000	46.465
40	A40	102.000	96.000	45.098	47.917
41	A41	110.000	112.000	41.818	41.071
42	A42	123.000	116.000	37.398	39.655
43	A43	93.000	94.000	49.462	48.936
44	A44	127.000	137.000	36.220	33.577
45	A45	116.000	124.000	39.655	37.097
46	A46	125.000	93.000	36.800	49.462
47	A47	116.000	137.000	39.655	33.577

Table 6.19 Table Showing Individual Closeness Centrality of the Year 1 Friendship Network.

6.4.3 Closeness Centrality of Year 2 Communication Network.

The following measures of closeness were calculates for the Year 2 communication network by running the algorithm in UCINET and are represented in Table 6.20 below.

Student		inFarness	outFarness	inCloseness	outCloseness
1	B1	59.000	49.000	66.102	79.592
2	B2	62.000	48.000	62.903	81.250
3	B3	70.000	66.000	55.714	59.091
4	B4	54.000	61.000	72.222	63.934
5	B5	62.000	64.000	62.903	60.938
6	B6	52.000	58.000	75.000	67.241
7	B7	59.000	62.000	66.102	62.903
8	B8	66.000	59.000	59.091	66.102
9	B9	59.000	56.000	66.102	69.643
10	B10	54.000	57.000	72.222	68.421
11	B11	65.000	74.000	60.000	52.703
12	B12	67.000	60.000	58.209	65.000
13	B13	73.000	42.000	53.425	92.857
14	B14	53.000	53.000	73.585	73.585
15	B15	59.000	68.000	66.102	57.353
16	B16	62.000	63.000	62.903	61.905
17	B17	58.000	78.000	67.241	50.000
18	B18	63.000	55.000	61.905	70.909
19	B19	62.000	56.000	62.903	69.643
20	B20	60.000	58.000	65.000	67.241
21	B21	54.000	64.000	72.222	60.938
22	B22	69.000	70.000	56.522	55.714
23	B23	68.000	68.000	57.353	57.353
24	B24	63.000	54.000	61.905	72.222
25	B25	64.000	53.000	60.938	73.585
26	B26	72.000	62.000	54.167	62.903
27	B27	53.000	55.000	73.585	70.909
28	B28	66.000	61.000	59.091	63.934
29	B29	65.000	67.000	60.000	58.209
30	B30	57.000	66.000	68.421	59.091
31	B31	57.000	56.000	68.421	69.643
32	B32	72.000	69.000	54.167	56.522
33	B33	58.000	67.000	67.241	58.209
34	B34	66.000	69.000	59.091	56.522
35	B35	60.000	52.000	65.000	75.000
36	B36	52.000	61.000	75.000	63.934
37	B37	63.000	66.000	61.905	59.091
38	B38	63.000	67.000	61.905	58.209
39	B39	58.000	77.000	67.241	50.649
40	B40	61.000	69.000	63.934	56.522

Table 6.20 Table Showing Individual Closeness Centrality of Year 2 Communication Network

Cases are highlighted that show extremely high or low scores of closeness. Cases are also highlighted were there is a marked difference between in scores and out scores.

Student B13 has an especially high out-closeness of 92.86, implying that this student has the shortest path to the other students in the cohort. This is far above the average of 64.49. He also has the highest betweenness score at 19.210 (see Table 6.12).He has a low in closeness of 53.43, well below the average of 63.94, such a difference implies that although the student seeks the most communication in the cohort, this communication is not reciprocated and other students do not seek out student B13 to talk about and gain advice on school related issues. This is also reflected in B13's degree centrality scores with an in-degree centrality in the communication network of 17.949% and an out-degree of 92.308% (see Table 6.4)

There are many students in Year 2 with a high out-closeness score, including B2 (81.25), B1 (79.59), B35 (75.00), and B14 and B25 each with a score of 73.59, these students also have relatively high out-degree centralities in the communication network (see Table 6.4).

Year 2 is a highly integrated group and this shows with the high levels of closeness. The highest in-closeness score after B13 is held by B36 and B6 and is 75.00, their out closeness differs slightly at 63.93 (B36) and 67.24 (B6).

Other individuals with a high in-closeness include B14 and B27 who both have a score of 73.56. All of these students will have a short path to the information and communication that they need to help them do well in their studies.

6.4.4 Closeness Centrality in Year 2 Friendship Networks.

The following measures of closeness were found for the Year 2 friendship network by running the algorithm in UCINET and are represented in Table 6.21. Cases are highlighted that show particular extremes of high or low closeness are discussed as are those which show large differences between in scores and out scores.

Student		inFarness	outFarness	inCloseness	outCloseness
1	B1	67.000	128.000	58.209	30.469
2	B2	92.000	104.000	42.391	37.500
3	B3	90.000	117.000	43.333	33.333
4	B4	81.000	115.000	48.148	33.913
5	B5	64.000	109.000	60.938	35.780
6	B6	78.000	111.000	50.000	35.135
7	B7	54.000	106.000	72.222	36.792
8	B8	82.000	109.000	47.561	35.780
9	B9	75.000	107.000	52.000	36.449
10	B10	73.000	114.000	53.425	34.211
11	B11	70.000	118.000	55.714	33.051
12	B12	85.000	114.000	45.882	34.211
13	B13	81.000	101.000	48.148	38.614
14	B14	73.000	110.000	53.425	35.455
15	B15	70.000	123.000	55.714	31.707
16	B16	71.000	128.000	54.930	30.469
17	B17	67.000	99.000	58.209	39.394
18	B18	86.000	106.000	45.349	36.792
19	B19	74.000	133.000	52.703	29.323
20	B20	64.000	117.000	60.938	33.333
21	B21	73.000	115.000	53.425	33.913
22	B22	77.000	120.000	50.649	32.500
23	B23	98.000	124.000	39.796	31.452
24	B24	61.000	108.000	63.934	36.111
25	B25	84.000	110.000	46.429	35.455
26	B26	69.000	108.000	56.522	36.111
27	B27	69.000	102.000	56.522	38.235
28	B28	76.000	110.000	51.316	35.455
29	B29	77.000	110.000	50.649	35.455
30	B30	69.000	107.000	56.522	36.449
31	B31	61.000	103.000	63.934	37.864
32	B32	1560.000	78.000	2.500	50.000
33	B33	65.000	102.000	60.000	38.235
34	B34	71.000	118.000	54.930	33.051
35	B35	83.000	121.000	46.988	32.231
36	B36	66.000	104.000	59.091	37.500
37	B37	63.000	103.000	61.905	37.864
38	B38	80.000	121.000	48.750	32.231
39	B39	77.000	98.000	50.649	39.796
40	B40	65.000	110.000	60.000	35.455

Table 6.21 Table Showing Individual Closeness Centrality in Year 2 Friendship Networks.

It is interesting to note that the student with the highest out-closeness (B32 at 50.00), has by far the lowest in closeness at 2.50. This student has very short paths out, reaching out the hand of friendship, but there are not many students taking him up on his offer unfortunately. With such a low in- closeness he cannot be central in the group, he does not have a very good position. Indeed we can see from an analysis of degree centrality in Table 6.5 that this student has an in-degree of 0 in the friendship network, meaning that none of the other students choose him as a friend.

The student with the highest in-closeness is B7 with 72.22. He is highly central in the friendship network, he has short inward paths of friendship so that many people can come to him for support. This is also reflected in the fact that he has the highest in-degree centrality in the friendship network at 61.538% (see Table 6.5)

Another student with a high in-closeness is B31 at 63.93, while his out-closeness is only 37.86, indicating that his friendship is highly sought in the group though he does not have such high friendship seeking behaviour in return.

6.4.5 Closeness Centrality of the Year 3 Communication Network.

The following measures of closeness were calulated for the Year 3 communication network by running the algorithm in UCINET and are represented in Table 6.22. Cases are highlighted that show extremely high or low scores as well as those that demonstrate an anomaly between in and out measures.

Student C14 has a particularly high out-closeness at 84.00, she is very close to many people in the communication network which means that she has access to communication to obtain information, help and advice quite quickly. She has an in-closeness of 64.62 which is above the mean (61.08), she is quite close to others then and her help with college work can easily be sought. C14 also has by far the highest out-degree of communication at 80.952% and an in-degree of 47.619% (see Table 6.6) and so is active in seeking and being sought out for communication regarding academic matters.

Student C8 has the highest in-closeness at 77.78, it is she that the other students are closest to in terms of communication. Many people seek to communicate with her on school - related topics and the shortest paths lead to her. Her normalized in-degree of communication is the highest at 71.429% (see Table 6.6). Her out closeness measure is also high at 67.74 so that she in return is close to her classmates in terms of communication.

Student		inFarness	outFarness	inCloseness	outCloseness
1	C1	73.000	86.000	57.534	48.837
2	C2	77.000	75.000	54.545	56.000
3	C3	67.000	70.000	62.687	60.000
4	C4	76.000	75.000	55.263	56.000
5	C5	60.000	57.000	70.000	73.684
6	C6	72.000	56.000	58.333	75.000
7	C7	94.000	74.000	44.681	56.757
8	C8	54.000	62.000	77.778	67.742
9	C9	65.000	63.000	64.615	66.667
10	C10	66.000	58.000	63.636	72.414
11	C11	65.000	75.000	64.615	56.000
12	C12	70.000	68.000	60.000	61.765
13	C13	64.000	70.000	65.625	60.000
14	C14	65.000	50.000	64.615	84.000
15	C15	79.000	70.000	53.165	60.000
16	C16	62.000	58.000	67.742	72.414
17	C17	73.000	76.000	57.534	55.263
18	C18	73.000	89.000	57.534	47.191
19	C19	73.000	76.000	57.534	55.263
20	C20	63.000	93.000	66.667	45.161
21	C21	65.000	67.000	64.615	62.687
22	C22	75.000	81.000	56.000	51.852
23	C23	65.000	72.000	64.615	58.333
24	C24	66.000	63.000	63.636	66.667
25	C25	60.000	65.000	70.000	64.615
26	C26	72.000	73.000	58.333	57.534
27	C27	63.000	63.000	66.667	66.667
28	C28	70.000	56.000	60.000	75.000
29	C29	64.000	64.000	65.625	65.625
30	C30	61.000	59.000	68.852	71.186
31	C31	64.000	95.000	65.625	44.211
32	C32	61.000	74.000	68.852	56.757
33	C33	68.000	72.000	61.765	58.333
34	C34	80.000	74.000	52.500	56.757
35	C35	70.000	64.000	60.000	65.625
36	C36	85.000	79.000	49.412	53.165
37	C37	85.000	90.000	49.412	46.667
38	C38	62.000	70.000	67.742	60.000
39	C39	73.000	78.000	57.534	53.846
40	C40	68.000	58.000	61.765	72.414
41	C41	70.000	53.000	60.000	79.245
42	C42	74.000	62.000	56.757	67.742
43	C43	80.000	59.000	52.500	71.186

Table 6.22 Table Showing Individual Closeness Centrality of the Year 3 Communication Network.

6.4.6 Closeness Centrality in the Year 3 Friendship Network

The following measures of closeness were calculated for the Year 3 friendship network by running the algorithm in UCINET and are represented in Table 6.23.

Student		inFarness	outFarness	inCloseness	outCloseness
1	C1	136.000	142.000	30.882	29.577
2	C2	142.000	120.000	29.577	35.000
3	C3	114.000	102.000	36.842	41.176
4	C4	152.000	128.000	27.632	32.813
5	C5	124.000	114.000	33.871	36.842
6	C6	133.000	128.000	31.579	32.813
7	C7	1806.000	1806.000	2.326	2.326
8	C8	121.000	137.000	34.711	30.657
9	C9	117.000	111.000	35.897	37.838
10	C10	115.000	118.000	36.522	35.593
11	C11	121.000	121.000	34.711	34.711
12	C12	118.000	118.000	35.593	35.593
13	C13	119.000	120.000	35.294	35.000
14	C14	115.000	95.000	36.522	44.211
15	C15	158.000	163.000	26.582	25.767
16	C16	112.000	116.000	37.500	36.207
17	C17	127.000	121.000	33.071	34.711
18	C18	144.000	142.000	29.167	29.577
19	C19	135.000	131.000	31.111	32.061
20	C20	119.000	123.000	35.294	34.146
21	C21	123.000	130.000	34.146	32.308
22	C22	126.000	133.000	33.333	31.579
23	C23	111.000	120.000	37.838	35.000
24	C24	123.000	125.000	34.146	33.600
25	C25	125.000	115.000	33.600	36.522
26	C26	129.000	142.000	32.558	29.577
27	C27	113.000	117.000	37.168	35.897
28	C28	108.000	125.000	38.889	33.600
29	C29	116.000	116.000	36.207	36.207
30	C30	125.000	136.000	33.600	30.882
31	C31	113.000	109.000	37.168	38.532
32	C32	118.000	123.000	35.593	34.146
33	C33	118.000	127.000	35.593	33.071
34	C34	126.000	132.000	33.333	31.818
35	C35	113.000	117.000	37.168	35.897
36	C36	127.000	150.000	33.071	28.000
37	C37	127.000	137.000	33.071	30.657
38	C38	114.000	112.000	36.842	37.500
39	C39	123.000	112.000	34.146	37.500
40	C40	123.000	125.000	34.146	33.600
41	C41	146.000	123.000	28.767	34.146
42	C42	123.000	111.000	34.146	37.838
43	C43	118.000	123.000	35.593	34.146

Table 6.23 Table Showing Individual Closeness Centrality in the Year 3 Friendship Network

Cases are highlighted and discussed that show particularly high or low scores of closeness centrality in the Year 3 friendship network. Cases are also highlighted where there is a big difference between the in score and the out score.

Student C7 is particularly low in both the in and the out-closeness measure (both at 2.33). This student was repeating year 3 and clearly found it difficult to integrate with the group. In the component analysis in Chapter 4 student C7 was found to be outside of the main component. His closeness centrality in the communication network is below average but at least there is some communication both in and out. This is not the case for his friendship network, and this lack of social support may effect his performance. Student C14 not only has the highest out-closeness in the communication network, but also in the friendship network at 44.21 she has many short paths to the support provided by friendship. Her in-closeness is also above average at 36.52, so other students can readily gain access to her friendship.

The student with the highest in-closeness is C28 with 38.90, he also has an out-closeness at 33.60 which is just above the average. It is interesting to note that C28 is the Year 3 cohort representative on the board of studies, and so his friendship could be useful to other members of the group. Student C28 shares the highest in-degree of friendship with C14 at 40.476% (see Table 6.7), showing that these two students are highly central in the Year 3 friendship network.

6.4.7 Comparison of Mean Closeness in All Networks.

The mean out closeness of friendship and communication was calculated and compared for all three cohorts as represented in Table 6.24 below:

Network	Mean In Closeness	Mean Out Closeness
Year 1 Communication Network	59.43	60.24
Year 1 Friendship Network	43.74	45.61
Year 2 Communication Network	63.95	64.49
Year 2 Friendship Network	52.34	45.43
Year 3 Communication Network	61.08	61.77
Year 3 Friendship Network	33.37	33.46

Table 6.24 Table Showing Comparison of Mean Closeness in All Networks.

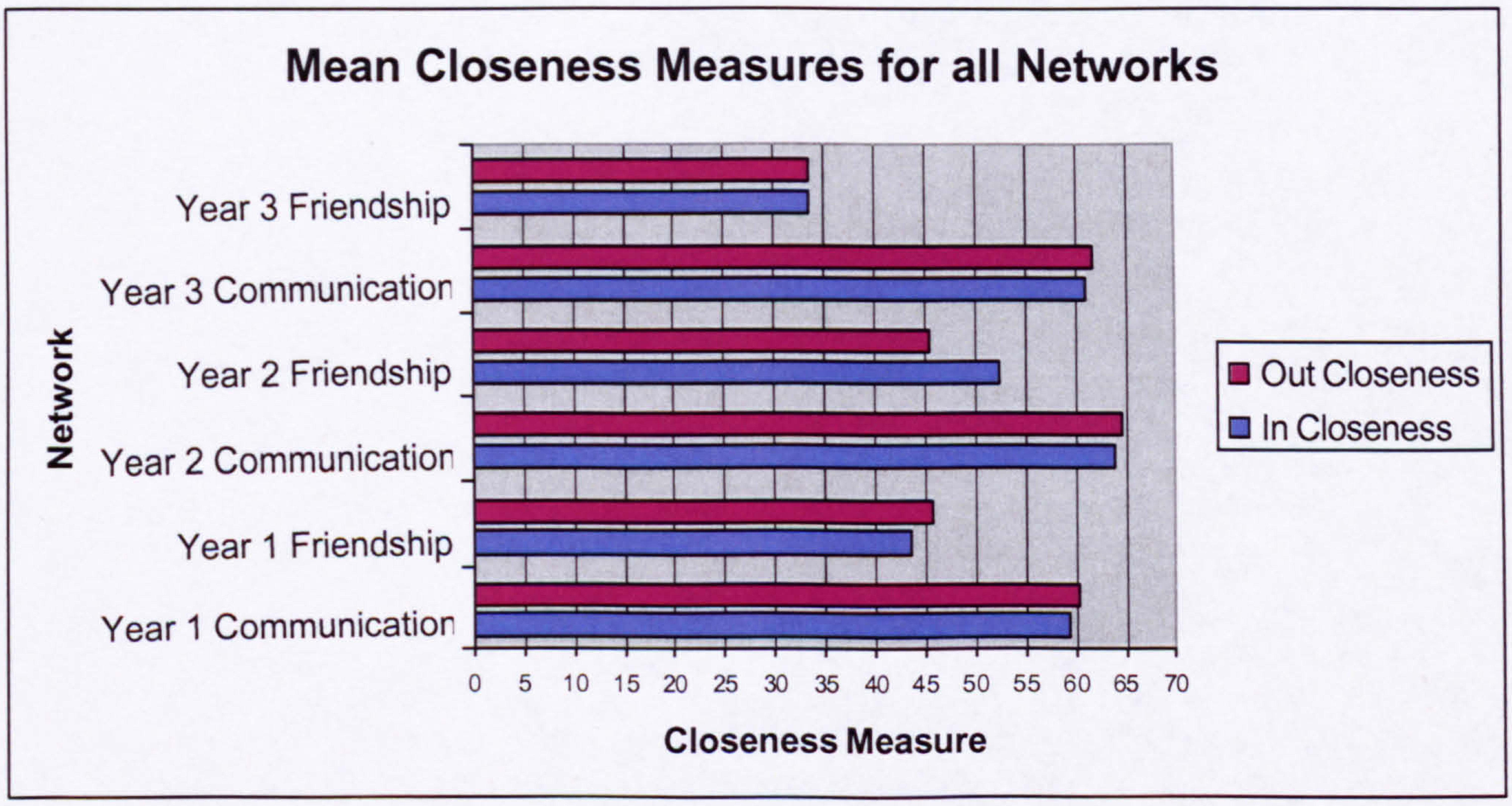


Fig 6.6 Graph Showing a Comparison of Mean Individual Closeness Measures in all Networks

Figure 6.6 is a graphical illustration of the data in Table 6.24 showing the mean individual closeness measures in the friendship and communication networks of all three cohorts.

In terms of path length the communication relationships are closer than friendship relationships for all year groups. In most cases the in and out-closeness are very similar and so information and communication / friendship and support can flow in both directions throughout the group. The Year 2 cohort has the highest closeness in terms of both communication and friendship.

6.5 Summary

In this chapter the three different measures of centrality for individuals were applied: degree, betweenness and closeness centrality.

The degree centrality measure is a simple count of the number of ties that an individual has. The in-degree centrality is the number of ties coming into a node, or in this case the number of times a student is chosen by the other students in the cohort for friendship or communication. The out-degree centrality is the number of ties that the student directs towards his or her class-mates. A normalized degree centrality was also reported for each of the cohorts. The normalized measure gives the number of ties as a percentage of the number of possible ties. This allows for easy comparison between the three cohorts. Individual cases of interest were highlighted and discussed. The mean degree centrality for the friendship and communication networks for all three cohorts was then examined. The mean degree centrality of communication ties was higher than the mean degree centrality of friendship ties in all of the cohorts. Of course one would expect to have less friendships than communicative type relationships. Both the mean friendship and communication degree centralities were highest in the Year 2 cohort which is evidently a particularly cohesive group of students.

The betweenness measure of centrality for the individuals in the friendship and communication networks was also gained by running the algorithm in UCINET. This measure investigates the amount to which a person sits in between others in the network. Those with a high betweenness measure can be seen to have a type of brokerage role. They are in a position to bridge gaps of friendship or communication if they want to, or indeed the brokerage position could allow the student to withhold contacts or information. In all three cohorts the mean betweenness score in the friendship networks was larger than in the communication networks. This shows that although there may be less actual ties of friendship than of communication, those ties have a high betweenness, hence there are many ties link chains of students together producing a cohesive friendship network. Interesting individual cases were highlighted and discussed.

The closeness measure was also applied to the friendship and communication networks of the three cohorts. Closeness centrality identifies how close a student is to another. For example a maximally close student would be directly linked to all others. In terms of path length the communication relationships were found to be closer than the friendship relationships in all three year groups.

These measures of centrality of individuals within friendship and communication networks in the three cohorts, although very interesting, can only be purely descriptive. They describe how many contacts a person has (degree centrality), the amount to which they are in between the other students and can use their role for brokerage (betweenness centrality), and how close they are in terms of ties to the other students (closeness centrality.) In order to go past the descriptive stage, these centrality scores are next fed into a correlation model. The correlation model can move on from the descriptive and begin to explain whether there is any relationship between the students' centrality and their academic performance. A multiple regression model will then be used to ascertain how much of the variance in academic performance can be explained by these centrality scores.

Chapter Seven: Findings

7.1 Introduction

The objective of this chapter is to present the findings of the data analysis. The individual centrality measures were obtained using UCINET as discussed in Chapter 6. A correlation analysis was then carried out using SPSS in order to ascertain whether there is any relationship between a student's centrality in friendship and communication networks and their academic performance. The relationship between degree centrality, betweenness centrality, closeness centrality and academic performance was investigated. Variables obtained from the peer group assessment were also included in the correlation. Such variables as group mark, effort within the group, intellectual contribution to the group and co-operation with group members were included in the correlation analysis in order to discover if the group work experience had a significant impact upon the students' individual academic performance. The relationship between group level variables as discussed in Chapter 5 and individual academic performance was also investigated. This meant that variables such as density of communication within work-group, density of friendship within group, density of communication with other groups and density of friendship with other groups were included in the correlation analysis.

Multiple regression models were then built in order to discover how much of the variance in an individual student's end of year grade can be explained by which variables. The step wise regression method was used to build the multiple regression models for each of the three cohorts, the results of which are presented in this chapter.

7.2 Correlation

An investigation into the Pearson correlation[9] of the following variables for all three cohorts was carried out using SPSS software (see appendix IV for full correlation matrix).

Variable	SPSS Shorthand	Data Source
1. End of academic year grade	grade	Academic registrar
2. A level or equivalent points	alevel	Academic registrar
3. Group-work grade	grougrad	Academic registrar
4. In-degree of communication	indegrco	UCINET analysis
5. Out-degree of communication	outdegrc	UCINET analysis
6. In-degree of friendship	indfrien	UCINET analysis
7. Out-degree of friendship	outdefri	UCINET analysis
8. Betweenness of communication	betwcom	UCINET analysis
9. Betweenness of friendship	betwfrie	UCINET analysis
10. In-closeness of communication	inclocom	UCINET analysis
11. Out-closeness of communication	outcloco	UCINET analysis
12. In-closeness of friendship	inclofri	UCINET analysis
13. Out-closeness of friendship	outclofr	UCINET analysis
14. Group density of communication	grdencom	UCINET analysis
15. Group density of friendship	grdenfri	UCINET analysis
16. Effort within group	effort	Peer group assessment
17. Intellectual contribution to group	intelcon	Peer group assessment
18. Co-operation with group members	coperati	Peer group assessment
19. Group friendship with other groups	gfrieoth	UCINET analysis
20. Group communication with other groups	gcommoth	UCINET analysis

Table 7.1: Table showing all variables used in the correlation analysis.

[9] **Pearson Correlation Coefficient** "A measure of linear association between two variables. Values of the correlation coefficient range from -1 to 1. The sign of the coefficient indicates the direction of the relationship, and its absolute value indicates the strength, with larger absolute values indicating stronger relationships." (SPSS 10.00 help file definition)

Table 7.1 indicates the variables used in the correlation analysis. The SPSS shorthand for the variables is given along with a brief description of the source of the data.

The following variables were found to be significantly[10] correlated with the end of year grade:

* Correlation is significant at the 0.05 level (2 – tailed)[11]

** Correlation is significant at the 0.01 level (2 – tailed)[12]

7.2.1 Variables Significantly Correlated with Individual Grade in Year 1.

- Group grade (3): .325*
- In degree of communication (4) : .439**
- In closeness of communication (10) : .536**

7.2.2 Variables Significantly Correlated with Individual Grade in Year 2.

- A level or equivalent (2): .332*
- Group grade (3) : .510**
- In degree of communication (4) : .463**
- In degree of friendship (4) : .360*
- In closeness of communication (10): .460**
- Group density of communication (14) : .367*

7.2.3 Variables Significantly Correlated with Individual Grade in Year 3.

- Group grade (3): .453**
- In degree of communication (4): .415**
- In degree of friendship (6): .340*
- In closeness of communication (10) : .408**
- In closeness of friendship (12) : .504**
- Out closeness of friendship (13) : .483**
- Group communication with other groups (20) : -.389**

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[10] When a statistic is significant it indicates that one can be reasonably sure that it is reliable, in terms of correlation, one can be sure that the two variables have a linear relationship.

[11] There is a 5% chance of this relationship occurring by chance, the two-tailed test assumes that the direction of the relationship is not known and so also tests for the direction of the linear relationship.

7.2.4 Summary of Variables Significantly Correlated with Individual Grade.

As can be seen in Appendix IV which provides the full correlation matrices, in all three cohorts the group-grade is significantly associated with the individual end of year grade, with a strong positive relationship. The group-grade variable was taken as the grade achieved in one group-project. This particular group-project was also the one to which the peer group assessment was applied. The mark attained in this group-project is contributory to the individual's final end of year mark, though the percentage of the end of year mark contributed by this group-grade is negligible. This one group project grade constitutes 2.195% of the individual end of year grade. The group-grade variable then contributes slightly to the end of year grade, but the high correlation indicates that the linear relationship between the group-grade and individual end of year grade is stronger than one would expect from such a small contributory factor.

The in-degree of communication is also significantly correlated with the individual grade at the 0.01 level (2– tailed) in all three cohorts, all exhibiting a strong positive relationship of over .4. The in-degree of communication score is a direct count of the people that seek advice from ego[13] regarding academic related matters. This significant correlation demonstrates that there is a strong positive association between the degree to which a person is sought out for communication and advice regarding academic matters, and their end of year grade in all three cohorts.

The in-closeness of communication score is also significantly correlated with the individual end of year grade at the 0.01 level in all three cohorts. In-closeness of communication is a less direct measure than the in-degree. This measure investigates the distance of an actor to their peers in the network, in particular, the shortest path (geodesic) which links ego to nodes that are central. In a communication network such as this, if an actor has a high closeness centrality, it means that they do not need to rely upon other actors to bring the information, they are close to the centre themselves. The significant correlation between the in closeness of communication and end of year grade

[12] There is a 1% chance of this relationship occurring by chance.
[13] Ego is the term frequently used in social network analysis to refer to the person that is the focus of the analysis.

indicates a high association between how close a person is to the centre of the communication network and how well they perform academically.

In the second and third year of the undergraduate degree, the in-degree of friendship also is positively associated with the student's individual grade (at the 0.05 level 2 – tailed). This indicates that the more a student is claimed to be a friend by others, the higher their individual end of year grade and vice versa. It is the in-degree of friendship that is associated with the grade rather than the out degree so that the degree to which a student's friendship is sought is significantly associated with their grade as opposed to the degree to which he or she seeks friendship from others.

In the Year 2 cohort, the density of communication within groups is significantly associated with the individual grade at the 0.05 level (2 tailed). This indicates that where a project group communicates more with each other, their ultimate individual end of year grade will be likely to be higher.

The number of variables which correlate significantly with the individual grade increase through the years of study from three in the first year, to six in the second and seven in the third.

Both the in and out-closeness of friendship variables become highly significantly correlated at the 0.01 level (2 tailed) with the individual grade in the third year. This indicates that the closeness of a student to the core of a network of friendship is positively associated with how well they perform on the undergraduate degree.

Finally, the density of communication outside of the work groups with members of other work groups has a negative association with the individual grade in the third year cohort. This correlation is significant at the 0.01 level (2 tailed) indicating that as the amount of communication with other groups increases the individual's grade decreases significantly.

7.3 Multiple Regression

A multiple regression analysis was carried out using SPSS software. The same procedure was followed for all three cohorts using the stepwise method. The individual grade was set as the dependent variable with the independent variables as listed above. The resultant regression models were as follows:

7.3.1 Multiple Regression Model Year 1

The model summary of the Year 1 regression model is represented in Table 7.2. With an R Square of .287 we can say that around 28% of the variance in end of year grade in the Year 1 cohort can be explained by the predictor variable which in this case is the in-closeness of communication. This means that to a certain extent the students' position in the communication network can be used as a predictor for their end of year grade.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.536	.287	.271	7.9518

a. Predictors: (Constant) In closeness of communication

Table 7.2 Table Showing a Summary of the Multiple Regression Model for Year 1

Table 7.3 provides an analysis of variance for the model. Although the 28% of variance is not especially high, the F test proves to be significant. This indicates that the relationship between the in-closeness of communication measure and individual end of year grade does not occur by chance.

ANOVA (Analysis of Variance)

Model	Sum of Squares	df	Mean Square	F	Sig
Regression	1147.029	1	1147.029	18.140	.000
Residual	2845.402	45	63.231		
Total	3992.431	46			

Predictors: In closeness of communication

Dependent Variable: Grade

Table 7.3 Table Showing an Analysis of Variance for the Year 1 Multiple Regression Model

Table 7.4 goes on to analyse the significance of the individual coefficients in the model, in this case the in-closeness of communication. Here the observed significance value (or p value) is shown to be significant at .000. This indicates that the in-closeness of communication significantly influences the model overall.

Coefficients

Model	Unstandardized coefficient	Unstandardized Coefficient	Standardized Coefficient		
	B	Std. Error	Beta	t	Sig.
(Constant)	4.939	12.180	.536	.406	.687
In-closeness of communication	.869	.204		4.259	.000

Dependent Variable: Grade

Table 7.4 Table Showing the Coefficients in the Year 1 Multiple Regression Model

Table 7.5 provides an analysis of the variables that were excluded by the model. This is indicates that these excluded variables did not significantly influence the model and so they were eliminated by the step-wise regression procedure.

Excluded Variables

Variables	Beta In	t	Sig.	Partial Correlation	Collinearity Statisitcs Tolerance
alevel	.034	.264	.793	.040	.967
grougrad	.010	.064	.949	.010	.648
indegrco	-.645	-1.698	.097	-.248	.105
outdegrc	.032	.250	.804	.038	.973
indfrien	-.028	-.213	.833	-.032	.959
outdefri	-.149	-1.189	.241	-.176	.994
betwcom	.009	.060	.952	.009	.810
betwfrie	-.200	-1.620	.112	-.237	.999
outcloco	.064	.501	.619	.075	.980
inclofri	.057	.445	.659	.067	.995
outclofr	-.167	-1.336	.188	-.197	.999
grdencom	-.273	-2.011	.050	-.290	.808
grdenfri	.152	1.214	.231	.180	1.000
effort	.001	.007	.995	.001	.927
intelcon	.004	.030	.976	.005	.955
coperati	-.076	-.598	.553	-.090	.986
gfrieoth	.057	.444	.659	.067	.995
gcommoth	.074	.577	.567	.087	.986

Table 7.5 Table Showing the Variables Excluded from the Year 1 Multiple Regression Model

From an analysis using SPSS, the regression model for predicting student's individual end of year grade in the Year 1 cohort was developed as follows:

Grade = 4.939 + .869 (in closeness of communication)

The R square[14] figure for this model indicates that 28.7% of the variance in individual end of year grade in the Year 1 cohort can be explained by the in-closeness of communication score. In the analysis of variance (ANOVA),[15] the F test[16] is significant (.000) indicating that the null hypothesis is proved to be incorrect and therefore, although the R square of .287 is not particularly high, this occurrence is not by chance. The p value is significant at .000 indicating that the in-closeness of communication significantly influences the model.[17]

7.3.2 Multiple Regression Model Year 2

Table 7.6 provides a model summary of the Year 2 multiple regression model that was developed with the use of SPSS. The predictors in the model can explain almost 46% of the variance in the individual end of year grade for students in the Year 2 cohort. Those predictors are group grade, group friendship with other groups and in-degree of friendship.

[14] **R Squared** "Goodness-of-fit measure of a linear model, sometimes called the coefficient of determination. It is the proportion of variation in the dependent variable explained by the regression model. It ranges in value from 0 to 1. Small values indicate that the model does not fit the data well." (SPSS 10.00 help file definition)

[15] "**Analysis of variance (ANOVA)** is used as a test of means for two or more populations. The null hypothesis, typically, is that all means are equal. For example, suppose the researcher was interested in examining whether heavy, medium or light, and nonusers of cereals differed in their preference for Total cereal, measured on a nine-point Likert scale. The null hypothesis that the four groups were not different in preference for Total could be tested using analysis of variance." (Malhotra 1993)

[16] **F Test** "The F test is used to test the null hypothesis that the coefficient of multiple determination in the population, R square is zero." (Malhotra, 1993)

[17] **Observed Significance Level** "Often called the p value. The basis for deciding whether or not to reject the null hypothesis. It is the probability that a statistical result as extreme as the one observed would occur if the null hypothesis were true. If the observed significance level is small enough, usually less than 0.05 or 0.01, the null hypothesis is rejected." (SPSS 10.00 help file definition)

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.677	.459	.414	4.4452

Predictors: (Constant), group grade, group friendship with other groups, in-degree of friendship

Table 7.6 Table Showing a Summary of the Multiple Regression Model for Year 2

Table 7.7 provides an analysis of variance for the regression model developed for the Year 2 cohort. The F test proves to be significant. This indicates that the relationship does not occur by chance.

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig
Regression	602.665	3	200.888	10.166	.000
Residual	711.367	36	19.760		
Total	1314.032	39			

Predictors: (Constant), group grade, group friendship with other groups, in-degree of friendship
Dependent Variable: Grade

Table 7.7 Table Showing an Analysis of Variance for the Year 2 Multiple Regression Model

Table 7.8 provides an analysis of the significance of the individual coefficients that are present in the model. Each of the individual coefficients in the model has a significance of less than 5% and so we can say that they each have a significant influence in the model.

Coefficients

Model	Unstandardized coefficient	Unstandardized Coefficient	Standardized Coefficient		
	B	Std. Error	Beta	t	Sig.
(Constant)	38.212	6.483		5.894	.000
GROUGRAD	.592	.127	.726	4.674	.000
GRFRIOTH	-82.643	27.996	-.461	-2.952	.006
INDFRIEN	.157	.063	.318	2.511	.017

Dependent Variable: Grade

Table 7.8 Table Showing the Coefficients in the Year 2 Multiple Regression Model

Table 7.9 provides an analysis of the significance of all of the variables that are excluded from the final model. Each of these variables was found not to significantly influence the model and so they were excluded by the step-wise regression procedure.

The regression model for predicting student's individual end of year grade in the Year 2 cohort is as follows:

Grade = 38.212 + .592 (group grade) – 82.643 (group friendship with other groups) + .157 (in-degree of friendship)

This model explains 46% of the variance in grade in the Year 2 cohort. The F test is significant implying that this does not occur by chance. Each of the coefficients has a significance of less than 5% and so significantly influences the model.

Excluded Variables

Variables	Beta In	t	Sig.	Partial Correlation	Collinearity Statisitcs Tolerance
alevel	.140	1.062	.296	.177	.859
indegrco	.256	1.830	.076	.295	.721
outdegrc	.039	.303	.764	.051	.926
outdefri	-.034	-.260	.796	-.044	.885
brewcom	.184	1.503	.142	.246	.973
betwfrie	.078	.496	.623	.084	.625
inclocom	.245	1.753	.088	.284	.728
outcloco	.044	.340	.736	.057	.937
inclofri	-.267	-1.157	.255	-.192	.279
outclofr	.103	.808	.424	.135	.932
grdencom	.191	1.359	.183	.224	.740
grdenfri	.195	1.535	.134	.251	.902
effort	-.177	-1.140	.262	-.189	.618
intelcon	-.225	-1.488	.146	-.244	.639
coprati	-.120	-.931	.358	-.155	.908
grcomoth	.073	.552	.585	.093	.868

Table 7.9 Table Showing the Variables Excluded from the Year 2 Multiple Regression Model

7.3.3 Multiple Regression Model Year 3

Table 7.10 provides a model summary regression model for predicting individual end of year grade in the Year 3 cohort. The predictors in this model are in-closeness of friendship, group communication with other groups and group grade. The R square for this model is .553, indicating that around 55% of the variance in individual end of year grade for this cohort can be explained by this model.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.744	.553	.519	4.7687

Predictors: (Constant), in-closeness of friendship, group communication with other groups, group grade

Table 7.10 Table Showing an Analysis of Variance for the Year 3 Multiple Regression Model

Table 7.11 provides an analysis of variance for the model. The F test proves to be significant which would indicate that this relationship does not occur by chance.

ANOVA

Model	Sum of Squares	df	Mean Square	F	Sig
Regression	1098.829	3	366.276	16.107	.000
Residual	886.893	39	22.741		
Total	1985.722	42			

Predictors: (Constant), in-closeness of friendship, group communication with other groups, group grade
Dependent Variable: Grade

Table 7.11 Table Showing an Analysis of Variance for the Year 3 Multiple Regression Model

Table 7.12 shows an analysis of the individual coefficients for the Year 3 multiple regression model. Each of the three coefficients prove to be significant. This indicates that they each individually have an influence upon the model.

Coefficients

Model	Unstandardized coefficient	Unstandardized Coefficient	Standardized Coefficient		
	B	Std. Error	Beta	t	Sig.
(Constant)	15.453	13.231		1.168	.250
INCLOFRI	.622	.134	.506	4.643	.000
GRCOMOTH	-23.078	6.438	-.393	-3.584	.001
GROUGRAD	.535	.183	.321	2.927	.006

Dependent Variable: Grade

Table 7.12 Table Showing the Coefficients in the Year 3 Multiple Regression Model

Table 7.13 provides an analysis of the variables that were excluded from the model. These variables were not seen to influence the regression model and so they were eliminated by the step-wise regression procedure.

The regression model for predicting student's individual end of year grade in the Year 3 cohort is as follows:

Grade = 15.453 + .622 (in closeness of friendship) – 23.078 (group communication with other groups) + .535 (group grade)

This model can explain 55% of the variance in individual grade in the Year 3 cohort. The F test proves to be significant showing that this relationship between the predictor variables and the dependent variable (grade) is not by chance. Each of the individual coefficients in the model (In closeness of friendship, group communication with other groups and group grade) has significance at less than 5% showing that each one significantly influences the model.

Excluded Variables

Variables	Beta In	t	Sig.	Partial Correlation	Collinearity Statisitcs Tolerance
alevel	.002	.017	.986	.003	.861
indegcom	.124	.968	.339	.155	.696
outdegco	.019	.151	.881	.024	.704
indegfri	-.110	-.681	.500	-.110	.442
outdegfr	-.057	-.453	.653	-.073	.736
betwcom	.072	.576	.568	.093	.754
betwfrie	.039	.340	.735	.055	.877
inclocom	.115	.878	.386	.141	.674
outcloco	.049	.383	.704	.062	.705
outclofr	.113	.485	.630	.078	.216
effort	.001	.005	.996	.001	.914
intelcon	.086	.766	.448	.123	.911
coprati	.009	.079	.937	.013	.850
grdencom	-.016	-.118	.907	-.019	.608
grdenfri	-.006	-.050	.960	-.008	.845
grfrioth	-.023	-.169	.866	-.027	.653

Table 7.13 Table Showing the Variables Excluded from the Year 3 Multiple Regression Model

7.4 Summary

An analysis of correlation was carried out for each of the cohorts. Variables tested for correlation were: measures of individual centrality; group cohesion; communication and friendship between work-groups; measures of individuals' contribution to work-groups; students' previous academic performance and their end of year grade as a measure of current academic performance.

The group-grade is significantly correlated with the individual grade in all three cohorts. Although the group grade is slightly contributory to the individual grade, how a work group fares does appear to have an effect upon how the individual fairs academically on the course.

The in-degree of communication is significantly correlated with the individual performance of students in all three cohorts. This means that the more times a person is sought out for advice and communication regarding school related issues, the better he or she is likely to perform and visa versa. This relates to the actual number of in coming communication ties that the student has.
The in closeness of communication is also significantly correlated with the individual's academic performance in all three cohorts. This means that not only is the number of incoming ties important, but also the closeness of ties. Those students with a high number of others close to them in terms of communication are likely to better.

In the Years 2 and 3 cohorts the in-degree of friendship is also positively correlated with their end of year performance. As this is an incoming measure this essentially shows that those students that are more popular are more likely to do well.

In the third year of study the in and out-closeness of friendship are highly correlated with academic performance. This indicates that the role of friendship is high in personal attainment, particularly as the student gets to the last stages of the course. In the Year 2 cohort, density of communication within work-groups is significantly correlated with individual performance. This means that communicating within the group not only provides higher performance for the group but also for he individual as well. In the Year 3 cohort the density of communication of one work group to another is negatively correlated with individual success.

Multiple regression models were then built for all of the cohorts using a stepwise method in SPSS. The dependent variable was the individual end of year grade, and the multiple regression model was used to ascertain to what degree the variance in grade (the measure of performance) could be explained by any of the variables put into the model.

In the Year 1 cohort 28% of the variance of individual grade can be explained by the in closeness of communication. Although statistically 28% is not especially high the F test is significant, indicating that this does not occur by chance. In the Year 2 cohort, 46% of the variance in individual end of year grade is explained by the group grade, the groups' friendship with other groups in the in degree of friendship.

In the Year 3 cohort, 55% of the variance in individual end of year grade is explained by the in closeness of friendship, the groups' communication with other groups and the group grade.

Chapter Eight: Discussion

8.1 Introduction

The objective of this chapter is to discuss the findings in relation to the hypotheses. Each of the hypotheses is discussed individually. The relationship between some other nodal properties such as gender, A level points, effort in project based group, intellectual contribution to group and co-operation with group, and academic performance is also discussed.

The implications of the results for educators and students are discussed. Finally the limitations of the study in terms of the methodology and the sample are considered.

8.2 The Relationship Between A Levels and Undergraduate Performance

The relationship between performance at A level and at undergraduate level was investigated. There was significant correlation between A level performance and end of year performance on the undergraduate degree only in the Year 2 cohort. In order to gain entry onto the degree course all students needed a minimum of twenty- four points at A level, or the equivalent qualification from overseas students; this was raised to twenty-six in the Year 1 cohort. This produces a bias in the correlation analysis as there is only a very small variation in each of the students' A level or equivalent points. The students can have between a possible twenty- four and thirty points. As no students have low A level points then we cannot truly say that a fair spread of points was used to ascertain whether performance at A level is an indicator of performance at degree level. Indeed in order to investigate this fully, a true spread of scores must be available in the study, including students who do not have any A level qualifications at all. In this study only 20% of the possible spread of A level points is available for examination. This was not the emphasis of the study, but rather the A level score was included in order to gather whether this had a significant relationship to undergraduate performance in comparison to centrality scores. The analysis indicates that A level points are less significantly related to undergraduate study than centrality in friendship and communication networks. This is particularly true for the in-coming relationships. For the Year 1 cohort the correlation between A level grade and final end of year grade is -.0.65. This is low compared to the correlation between in-closeness of communication and end of year grade at .536. In the Year 2 cohort the correlation between A level points and end of year grade is .332, this is compared to a correlation of .463 with in-degree of communication and .340 with the in-degree of friendship.In the Year 3 cohort the correlation between A level points and end of year grade stands at .266 compared to .415 for correlation between end of year grade and in-degree of communication, and .340 with in-degree of friendship. (The full correlation matrices for all three cohorts is available in Appendix IV).

Further investigation would be necessary in order to establish systematically a comparison between A level performance with undergraduate performance and a students' position in a social network and their undergraduate performance. However if such a study showed systematically that the students' position in friendship and communication networks were more strongly correlated than their A level points to their undergraduate performance there could be significant consequences for the way in performance is measured. Perhaps further assessment of students leading up to the point of their A levels could ascertain whether the student has the emotional intelligence to develop networks and use these to their advantage? Perhaps this assessment of emotional intelligence could add to the grade of an A level student, bumping up the grades of those students who may not perform as well academically, but who are likely to have the emotional intelligence that would enable them to form socially supportive relationships. After all, in the work place the degree to which a person can interact and work as a team is very highly revered and so this aspect of human interaction could perhaps be included in the A level curriculum as a further measure of perceived future performance.

8.3 The Relationship Between Gender and Academic Performance

It is interesting to note that gender and individual academic performance are not significantly correlated in any of the three cohorts. In the Year 1 cohort the correlation between end of year grade and gender is .078, in the Year 2 cohort it stands at -.115 and in the Year 3 cohort, .186.This finding is in keeping with the research by Yang and Lu (2001), who found that gender is not a significant predictor of academic performance.

One of the aims of the social network analysis approach is not to attach apriori variables to the data. Rather this approach seeks to investigate the apparent networks and then look for patterns that can be used to predict behaviour. It is interesting to note then that the student's position within friendship and communication networks appear to be more significantly correlated with end of year performance than the student's gender (see Appendix IV for the full correlation matrix.) Again, this was not the emphasis of this study. In order to fully investigate the links between gender and performance, further investigation would be necessary with a larger sample across different universities and in different academic disciplines etc.

8.4 The Relationship Between Peer Assessment of Effort, Intellectual Contribution and Co-operation in Work Groups and Individual Performance

The peer group assessment questionnaire resulted in each of the students attaining a score for their effort, intellectual contribution and co-operation with their work group.

There is no significant correlation between co-operation with the group and academic performance in any of the cohorts. The academic performance in this case is measured by the student's end of year grade. This measure was used as it is the one that is both used by the University to judge student's academic performance and by the student's themselves as a measure of achievement. There is correlation between the effort put into group-work as assessed by their peers and academic performance only in the Year 2 cohort. Also in the Year 2 cohort there is significant correlation between intellectual contribution to the group project and group performance. Again this correlation does not occur in the Years 1 and 3 cohorts (see Appendix IV for the full correlation matrices for all three cohorts.)

This could suggest that working in groups does not quite have the strong effect upon individuals' learning that educators might expect. Group work is generally utilised in order to provide the opportunity to learn more and also to learn how to co-operate and work together as a team. However, it could also suggest that the students are biased when they score their peers. The groups were all completely self-assigned; perhaps students favour group members who are their particular friends, rather than those that may actually contribute more.

On some occasions it was noted that all group members gave each other full scores for each of the three categories. It may be that each of the group members really felt that the others put in maximal effort, intellectual contribution and co-operation. However, it may also be the case that the students have decided politically to give each other full marks. They may have discussed the peer group assessment and decided amongst themselves that they should award each other maximal marks. It is also possible that students have decided to opt out of the peer assessment by giving each other the maximum possible mark on the scale.

It may be that students have different perceptions regarding what constitutes a great deal of effort or high intellectual contribution to the group. It is possible then that the peer group assessment questionnaire did not give a reliable measure of students' actual contribution to the work groups. In turn the insignificant correlation between such measures and individual / group performance (see Appendix IV) would also not be reliable. Further study would be required in order to validate these results. The questionnaire could be further tested with other groups. A debrief exercise would be necessary in order to establish why students assessed their peers as they did. Further definition of the terms effort, intellectual contribution and co-operation may also be necessary in order to improve reliability of the data. It could have been useful to follow up the questionnaire with some in depth interviews with a sample of the students participating. Through such anonymous individual interview the students could be asked to explain why they allocated the marks they did to their team members. As this was not the main focus of the study however such in-depth interviews were not carried out due to constraints of time and resources. However it would appear that further work could be carried out in order to investigate further the role of peer group assessment in grading at undergraduate level.

The more implicit measures of density of communication within groups may give further indication as to whether working in groups has an effect upon individual performance.

8.5 The Relationship Between Group Grade and Individual End of Year Grade

In all three of the cohorts the group grade is significantly associated with the individual end of year grade. In the Year 1 cohort the correlation stands at .325, in the Year 2 cohort; .510 and in the Year 3 cohort; .453. The group grade used for this correlation was from the same group project that the students were asked to rate their fellow group members in the peer group assessment exercise. The group grade that was achieved by the whole group was allocated to the individual members of the group. All of the group members got the same grade it was not divided up according to the peer group assessment score. Some of the courseworks undertaken by these students are peer group assessed and the marks given by the peers can effect the grade achieved by the individual for that piece of group work. This may have effected the way in which the students marked each other in the peer group assessment. The only way to really tell if this would have an effect would be to use one peer group assessment where the peer group mark did affect the students' individual grade and one where it did not. In this study this was not possible both due to time and resource constraints but also because it would not be ethical to interfere with the students' actual grades in this way. This may have produced some form of bias into the study though, as the students were aware that the mark they allocated to their colleagues in the peer group assessment would not be reflected in the individual grade awarded.

The grade achieved in this group project does contribute to the individual grade at 2.195%. This is a relatively low percentage of the overall end of year grade however. It is interesting then that the performance of the group is significantly associated with the individual end of year grade. This indicates that the group work aspect of the course does make a positive contribution to the student's individual learning. How they fare in the group work is an indication of how they will fair overall individually.

It could also indicate that the higher achieving students chose to work with each other on group based projects, hence the link between higher achieving groups and higher achieving individuals.

It would be interesting also to compare self-assigned work groups with groups that were assigned by the researcher. In this way it would be possible to ascertain whether the group grade would still be as highly correlated with end of year grade if the students were forced to work with people that they do not wish to work with. This would have implications for the way in which group work is carried out. It may be that the reason why group work is successful in this case is because students were enabled to make use of the social and communicative networks that they have developed for themselves. Bringing together the 'what they know' and 'who they know' to their own advantage. Possible if the use of their self-developed networks is prohibited a further insight into the value of such networks could be established.

8.6 The Relationship Between Communication Within and Between Groups and Academic Performance

The density of communication within work-groups is significantly correlated with individual academic performance in the Year 2 cohort. The correlation is 0.367 at the 0.05 level (2 – tailed). This means that we can be 95% sure that this relationship does not occur by chance. The second year of study on the BSc Management and Systems degree course is notoriously more difficult than the first year. The first year of study on the course does not actually count towards the final mark in the degree. The work- load also increases in the second year of study, as does the amount of group-based project work. This may explain why in the second year the density of communication within the work group is important to the individual's academic performance. By working hard in the group and maintaining communication the individual can benefit from gaining further knowledge and experience which may improve their performance in future examinations. By communicating with the work-group, individuals have the opportunity for reflective learning. This means that the student can discuss the information, reflect upon it with their fellow students and take advantage of this discourse to further their own understanding and theories. They are able to develop their ideas and defend them. This gives a form of practice for the examination, allowing the student to both formulate answers and benefit from a more active learning process.

In the Year 3 cohort it is not the density of communication within the work-group that is significantly correlated with individual performance, but the density of communication with other groups. There is a correlation of -.389 at the 0.01 level (2-tailed) between the density of correlation with groups other than the student's own and their individual academic performance. This negative relationship shows that we can be 99% sure that as communication with other groups goes up, individual academic performance goes down. The density of communication with other groups may have adverse effects upon the individual's learning. It seems that the learning within groups is likely to be less distracting. Rather than worry about how other groups are doing, the students perform better if they communicate within their own project groups and concentrate on discussing the project within the work-group.

8.7 The Relationship Between the Density of Friendship Within and Between Groups and Individual Performance

It is interesting to note that there is no evidence of a link between the density of friendship within the project based work -group and the students' individual performance. There is also no correlation between the friendship between groups and individual academic performance.

The membership of groups in all cases was self-assigned. An interesting further study would be to see if there was any correlation between friendship within and between groups and individual academic performance if the researcher assigned the group membership. Without this type of control group it is difficult to tell if friends choosing to work with each other makes a difference to their academic achievements.

8.8 The Relationship Between Centrality in Friendship Networks and Academic Performance

The first hypothesis in this study states that - *Centrality in an undergraduate friendship network is positively associated with individual academic performance.*

This hypothesis was derived from a thorough examination of the available literature. The literature suggests that people are social animals and that all of their behaviour is embedded within a social context. Friendship provides social support, the literature states that such support can act both as a buffer and directly upon reducing stress. Indeed the literature suggests that a perceived lack of social support can itself act as an independent stressor. In turn the literature also states that the reduction of stress can have a positive impact upon performance, including academic performance.

In order to fully investigate the relationship between centrality in a friendship network and academic performance, three different measures of centrality were used. These three measures were degree centrality (in and out-degree), closeness centrality (in and out- closeness) and betweenness centrality. The first hypothesis was split into five individual sub-hypotheses in order to investigate these different measures of centrality.

8.8.1 Hypothesis 1 (a)

In-degree centrality in an undergraduate friendship network is positively associated with academic performance.

The in-degree centrality measure investigates the actual count of ties coming in to an individual. In this case it is the number of times the individual has been cited by the rest of his / her cohort as a friend. The rationale behind this hypothesis is that the more times that a student is cited as a friend by others, the more people the student can turn to for social support. The in-degree of friendship then has both a direct and a buffering effect upon stress. The reduction of stress in turn is positively associated with improved academic performance (Bhagat, 1983; Latack, 1984; Motowidlo, Packard & Manning, 1986).

The in-degree of friendship is not significantly correlated with individual grade in the Year 1 cohort.

In the Year 2 cohort the correlation between in-degree of friendship and individual end of year grade has a significance of 0.360 at the 0.05 level (2 – tailed). This means that we can be 95% sure that this relationship does not occur by chance.

In the Year 3 cohort, the correlation between in-degree of friendship and an individual's end of year academic performance has a significance of 0.340 at the 0.05 level (2 – tailed). Again we can be 95% sure that the relationship between in degree of friendship and academic performance does not occur by chance.

The in-degree of friendship then is positively associated with academic performance in the Year 2 and 3 cohorts though not in the Year 1 cohort. This may be because it takes time for the effects of the friendship network to build. In the first year the students have only recently become friends. They may turn for social support to sources other than their newly made friends at university. In the second and third years of study, students become more embedded in the friendship networks within the cohort, and so may be more likely to turn to friends at university for social support.

As there is significant positive association in the second and third year cohort, we can say confidently that these relationships are not by chance. We can certainly reject the null hypothesis in the case of the Year 2 and 3 cohorts, accepting hypothesis 1 (a) in these cases.

The analysis indicates that having a larger number of people chose you as their friend in the Year 2 and 3 cohort is positively associated with improved academic performance. In accordance with the literature on social support, the very presence of friendship relationships in these cohorts helps the individual student. They have more people that they can actually turn to for social support. This can relieve stress and in turn help to improve academic performance.

Further validation would be necessary in order to accept fully the hypothesis in all cases however. A longitudinal study on the Year 1 cohort would provide the evidence needed to support the theory that the importance of in-degree centrality in a friendship network grows after the first year of study. A study could also be carried out in order to ascertain just whom the first year students do turn to for social support as they begin their studies. In order to investigate this further it could also have been useful to assess the levels of stress felt by the students that took part in the study. This would still have been problematic however as it would be difficult to directly attribute the students' stress to their current situation as a student. It would be advantageous if a longitudinal study were to follow a cohort throughout their undergraduate degree. The researcher could assess their levels of stress before they begin the course. They would then continue to assess stress levels along with their perceived levels of social support and at the same time mapping their friendship and communication networks to see if their position in such networks has an effect upon their stress levels and perceived levels of social support. Again, time and resource constraints prohibited this type of study from being carried out, but it would be the next step to take this work forward.

8.8.2 Hypothesis 1 (b)

Out-degree centrality in an undergraduate friendship network is positively associated with academic performance.

The out-degree centrality in a friendship network is a count of the number of students chosen by the individual as friends in the roster choice questionnaire.

The rationale behind this hypothesis was that the higher the number of students that an individual chooses as their friend (out-degree) the higher their perceived network of social support.

The out-degree centrality score however is not significantly correlated with individual performance in any of the three cohorts (see Appendix IV)

Given that there is significant correlation with the in-degree of friendship and end of year grade, the implication is that the perceived social support is not as important as the actual level of social support. The in-degree relates to the number of people who actually count the individual as their friend. The out-degree relates to the number of people the individual thinks are his / her friend. The people that choose an individual are the people that the individual can definitely turn to for support. This relationship may not be reciprocal, so that the people that the individual chooses as his friend may not be the ones that he could actually turn to support, they are who he perceives to be his friend rather than those who choose him. As there is no correlation between the out-degree and the grade, the implication is that actual levels of social support outweigh perceived levels of social support.

Again, in order to fully investigate this phenomenon a further study would be required. It would be interesting to follow up this social network analysis with a qualitative study. By using in-depth individual interviews the researcher could establish who the students actually turn to for social support. This would also give an indication of the students' friendship networks outside of the group. One of the limitations of social network analysis is that at some point one must draw a boundary around the group being investigated. It may be that by doing so some valuable information regarding the social networks of the students outside of this boundary is overlooked. Further qualitative investigation could establish whether perceived social support is more or less powerful in acting as a buffer or directly upon stress and so ultimately effecting the performance of the students on their programme of undergraduate study. Individual interviews could ask the students directly who they would be likely to turn to in a crisis and why.

Despite this, the implication in this study is that the number of friendships coming into the student are positively associated with performance on the undergraduate degree, and the number of friendship relationships directed from the student to other colleagues is not. Does this imply that basically the more popular a student is the more likely he / she is to succeed? Again further qualitative investigation could reveal why the students chose the friendships that they did.

8.8.3 Hypothesis 1 (c)

In-closeness centrality in an undergraduate friendship network is positively associated with academic performance.

While degree centrality is a local centrality measure, closeness is a global centrality measure. The in-degree measure is a count of the actual ties coming in to the individual. The in-closeness measure investigates the proximity of the individual to incoming ties in the network globally.

The rationale behind this hypothesis is that a student with a higher in-closeness of friendship centrality will have more access to socially supportive relationships. This should in turn have a positive effect upon their stress levels, levels of well-being etc, and ultimately their academic performance.

The in-closeness of communication is significantly positively correlated with individual academic performance in the Year 3 cohort only. This relationship is however particularly strongly correlated at 0.504 at the 0.01 level of significance (2 tailed). We can be 99% sure than that this relationship does not occur by chance.

In the Year 3 cohort then, the student's proximity in the friendship network is positively associated with their individual academic performance. It may be that it takes until the third year of study for this type of measure in a friendship network to really be important. As the years of study go by the role of the friendship network and the individual's position in it becomes more integral to the performance of the student. In the Year 3 cohort it is not only the actual number of incoming friendship ties that a student has which can affect the individual's well-being and performance etc, but also the position globally in the friendship network.
In order to fully investigate this further, a longitudinal study would be required. Only by following the same cohort through the three years of study could we be sure that the importance of the students' place in the friendship and communication networks becomes more significant as they develop through their three years of study.

8.8.4 Hypothesis 1 (d)

Out-closeness centrality in an undergraduate friendship network is positively associated with academic performance

The out-closeness of friendship is also only positively associated with academic performance in the Year 3 cohort. There is a correlation of 0.483 at the 0.01 level (2 tailed) between out-closeness centrality and academic performance in the Year 3 cohort. Again this means that we can be 99% sure that this relationship does not occur by chance.

The rationale behind hypothesis 1 (d) is that if a student is in close proximity to out going friendships, then they will have a perception of a high level of social support. The closeness measure however, only appears to become of importance in the third year of study. By the third year the student's position in the friendship in terms of in-closeness and out-closeness has become important in terms of their academic performance.

A picture of the increasing importance of the friendship network throughout the years of study is beginning to become evident. Again in order to investigate fully the effects of the network throughout the different years of study, a longitudinal study would be necessary, following the same group of students throughout their three years of study.

8.8.5 Hypothesis 1 (e)

Betweenness centrality in an undergraduate friendship network is positively associated with academic performance.

The betweenness measure of centrality is not significantly correlated with the individual end of year grade in any of the three cohorts studied.

The rationale behind this hypothesis was that students with a high betweenness score found themselves in a position of brokerage, or bridging between different students or sets of students. It was thought that this bridging position would help to make the student feel quite central within the group as a whole. This feeling of centrality would empower the students, giving them a sense of worth in the social support network.

This hypothesis was however found to be untrue. The degree centrality in a friendship network in the Year 2 and 3 cohort, and the closeness centrality in the friendship network in the Year 3 cohort has been found to be significantly related to academic performance. The betweenness centrality in a friendship network however, was not positively associated academic performance in any of the cohorts. It would appear then that it is the actual number of friendship relationships that the students have that is more important than the position of brokerage in the network that the student occupies. It seems that the ability to act as a gatekeeper to friendships is not significantly associated with the students' end of year performance.

8.8.6 Summary of Hypothesis 1

Hypothesis 1 states that: *Centrality in an undergraduate friendship network is positively associated with individual academic performance.*

The results from this study found that the in-degree measure of centrality in the friendship network was significantly correlated with individual academic performance in the Years 2 and 3 cohorts. The out-degree measure of centrality was not significantly associated with academic performance in any of the three cohorts.

The in-closeness and out-closeness measures of centrality in the friendship networks were significantly correlated with individual academic grades in the Year 3 cohort only.

The betweenness-centrality measures in the friendship networks were not significantly correlated with the students' academic performance.

Overall the results of the study indicate that the most important type of centrality in friendship networks in terms of its association with individual academic performance is the in-degree of friendship centrality. This indicates that the higher the number of people choosing the individual as a friend the higher that individual's academic performance.

The correlation relationship is not causal but it is linked. The implication of this result is that the number of friends a student has provides more social support for them, which can act as a buffer against stress and also directly upon reducing stress. In turn a higher level of support leads to enhanced performance. A further implication may be that students in the cohort choose to be friends with the higher achieving students in the class. It is likely that a combination of the two can be used to explain the relationship between in-degree centrality in a friendship network and individual academic performance. Students may be sought out for friendship because they are higher achieving. In turn this friendship adds to the individual's social capital and provides social support, access and opportunity. An iterative process is then set in place whereby students choose higher achievers as friends, the social support of the friendship then enables that student to perform better, and so it is likely that they will be chosen for friendship by further students.

The closeness measure of centrality becomes significant only in the third year of study. The closeness measure of centrality is a global measure, investigating the proximity of the individual to others globally in the network. The results indicate that by the third year of study, the student's global position in the friendship network is significant as well as the number of times they are chosen as a friend (in-degree). The students' closeness to others in terms of friendship, both incoming and outgoing is significantly correlated with their individual academic performance.

In order to investigate fully the influence of development throughout the three years of study a longitudinal study would be needed to test such hypotheses. Further qualitative in-depth interviews could also assist in the process of data-triangulation. In such interviews the researcher could directly ask the students whom they would turn to for social support. If the students said they would turn to their classmates then this would further reinforce the conclusion that centrality in friendship networks within cohorts is linked with academic performance.

8.9 The Relationship Between Centrality in Communication Networks and Academic Performance

The second hypothesis was that centrality in an undergraduate communication network is positively associated with academic performance.

This hypothesis was developed from a thorough review of the literature. The literature suggests that social networks can be instrumental in providing not only social support, but also in providing opportunities for individuals in terms of access to employment and further opportunities within employment. The literature suggests that social networks provide opportunities for the transfer and dissemination of knowledge and information. Within the context of education the transfer of knowledge and information is essential. Another important part of education is reflective practice. The communication network provides students with the facility not only to exchange information, but also to reflect upon that information. The network can be used to develop one's ideas and also to defend those ideas.

The total number of such ties that a person holds at any time is referred to as their social capital. The literature suggests that social capital is a resource in much the same way as tools or money. The literature also suggests that social capital as a resource can provide educational advantage for both children and young adults.

The literature supports the view that communication networks provide advantage in terms of access and opportunity. This increase in knowledge and information provides improved academic performance, as does the opportunity for reflective learning that the communication network provides.

In order to investigate fully the effects of the communication network upon the performance of undergraduates, three different measures of centrality were used in this study of communication networks.

Those measures were degree centrality, closeness centrality and betweenness centrality. Five separate hypotheses were developed regarding the relationship between these different centrality measures and academic performance.

8.9.1 Hypothesis 2 (a)

In-degree centrality in an undergraduate communication network is positively associated with academic performance.

The in-degree of communication was positively correlated with academic performance in all three of the cohorts. The correlation was 0.439 in the Year 1 cohort, 0.463 in the Year 2 cohort and 0.415 in the Year 3 cohort, all significant at the 0.01 level (2 –tailed). This result is highly significant particularly as this means that we can be 99% sure that this relationship does not occur by chance and it occurs within all of the cohorts.

The in-degree measures the actual number of communication relationships coming towards the individual, the number of times an individual is sought out for communication.

It is logical that those students that are sought by others for communication regarding academically related issues are those that do well academically. It is also logical that students who do not do well academically are not sought out as much for communication regarding such topics. There may also be other forces at play however. If a student is sought out for communication regarding school-related issues they have the opportunity to reflect upon their ideas. They can discuss their knowledge and defend their ideas on various academic subjects. Indeed if they are asked to teach or tutor others on academic subjects, then they must first fully understand the subject themselves. The fact that the students who are sought for communication do better academically, may be because they are actually more capable academically, but the process of being sought out may also help in achieving a higher level of academic performance. Either way the correlation between being sought out for communication on academically-related topics and academic performance is apparent in each of the three cohorts and so is seen to be an important element of academic performance.

8.9.2 Hypothesis 2 (b)

Out-degree centrality in an undergraduate communication network is positively associated with academic performance.

The out-degree centrality measures the actual number of out going ties from the student. If a student has a high out-degree centrality in the communication network, this means that they are actively seeking communication regarding academically related issues. They are seeking knowledge and information, and help with their studies. They will have the opportunity to develop and defend their ideas. This active approach to improving one's learning should have a positive affect upon their academic performance.

However, there was no significant correlation between the out-degree centrality in the communication network and academic performance in any of the three cohorts.

It appears that those who actively seek out communication are not the students that do well academically. There is no significant correlation in either direction which means that whilst we cannot say that students who seek communication do better academically, we also cannot say that students who seek communication do worse academically. The lack of significance shows that there is no relationship between the number of ties sought in the communication network and the student's academic performance.

A follow up interview may have helped to explain this phenomenon further. In doing so the researcher could ascertain why those students' with high out- going communication seeking behaviour sought help. Indeed the communication relationships were often not reciprocated and so it may be that those students who seek communication and advice from others do not actually get the answers that they are looking for. Or the students with high communication seeking behaviour may be seeking to communicate with the wrong people.

8.9.3 Hypothesis 2 (c)

In-closeness centrality in an undergraduate communication network is positively associated with academic performance.

A high in-closeness centrality in the communication network is hypothesised to indicate increased academic advantage. Firstly because those that are sought out are likely to be the ones that students feel are knowledgeable in the area. Also those with a high in-closeness centrality in the communication network will be able to benefit from the discursive relationship. They are able to develop their ideas through such communicative relationships as well as defend their ideas, and learn in order to teach others.

The difference between the in-degree centrality and the in-closeness centrality is that the in-degree is a direct count of the number of ties coming in to the individual. The in-closeness is a global measure, which is relative to the whole graph. The in-closeness measure examines how near the student is to other points in the graph or individuals. How many steps away the other students are from the student, or how directly they can be reached in terms of communication.

The in-closeness centrality measure was significantly correlated with academic performance in all three cohorts. In the Year 1 cohort the significance was 0.536, in Year 2 it was 0.460 and in Year 3 the significance was 0.408, all significant at the 0.01 level (2 – tailed.)

The highly significant correlation in all three cohorts implies that the more directly the student can be reached in terms of communication regarding academic issues, the more likely that they will do well academically. Not only is the number of ties coming in significant but also how close the ties are to the student, how directly others can get to communicate with the student has a significant association with that student's own academic performance.

This indicates that the more directly a student can be approached to provide communication the better they are likely to perform academically. Again a follow up interview may have helped to find out why students. seek communication from particular colleagues. It may be that those that are sought out most directly are seen to be the most academically capable in the cohort, or it may be that they are seen as the most helpful and kind people who are willing to give their time to others?

8.9.4 Hypothesis 2 (d)

Out-closeness centrality in an undergraduate communication network is positively associated with academic performance.

The rational behind hypothesis 2 (d) is that students with a higher out-closeness centrality in the communication network will be closer to the social capital that is available in the cohort. They will be closer to the knowledge and information that is available. The out-closeness measure is a global measure of the distance of the student to other students in the communication network. Those with a higher out-closeness centrality will have closer access to the information and the reflective practise that communication will afford.

However, the out-closeness centrality in the communication network was found not to be significantly correlated with academic performance in any of the three cohorts. Although the in-closeness centrality in the communication network was found to be highly significant in its association with academic performance, the out-closeness measure shows no association. This indicates that the proximity of students to seeking communication is far less significant than the proximity of the other students seeking information from the individual. Again the relationship may indicate that those who are most highly sought out are in fact the most gifted academically students in the first place. The act of being sought out provides a discursive opportunity that is not afforded by the act of seeking communication. It may be that those seeking communication and hence with a high out-closeness measure are likely to be the less able students academically.

8.9.5 Hypothesis 2 (e)

Betweenness-centrality in an undergraduate communication network is positively associated with academic performance.

The rationale behind hypothesis 2 (e) was that students with a high betweenness - centrality score in the communication network are in a position of brokerage of communication. As a broker of communication, they are a broker of knowledge and information and are in a position of power. A student with a high betweenness score can use this position to their advantage if the environment is competitive. They can use their knowledge to gain academic advantage.

However, the betweenness score of students in a communication network was found not to be significantly correlated with their academic performance in any of the three cohorts. This implies that such a position of brokerage is not as important in this case as the number of contacts directed towards the student or the in-closeness of the student in the communication network.

This would be an interesting finding to portray to future students. It could be used to tell the students that they are not so much in competition but that they can benefit from working as a team. Where there is correlation between communication within the team and individual academic performance, the students can see the benefit from pulling together. In doing so the team will not only do well but so can the individual. In contrast there is no individual benefit to be found from occupying a brokerage position. This finding could be used as an encouragement to the students.

8.9.6 Summary of Hypothesis 2

Hypothesis 2 states that: *Centrality in an undergraduate communication network is positively associated with individual academic performance.*

The results from this study indicate that there is significant correlation between the in-degree centrality score and individual academic performance in all three cohorts. This means that the higher the number of people seeking out an individual for communication regarding academic matters, the higher that individual's performance. The students are likely to seek out the more capable of their colleagues to discuss such topics. In turn the process of discussion will provide reflective learning opportunities for such students. They will be able to develop their ideas and arguments, defend their answers and practice arguments for inclusion in assignments and examinations. In turn this will improve their academic performance which again, in turn increases the chances of them being sought out for communication regarding academic matters.

The score on the out-degree measure of communication is not significantly correlated with individual academic performance in any of the three cohorts studied. This indicates that there is no relationship between actively seeking communication relating to school-related topics and individual academic performance. Rather the significant relationship is with being sought out for communication.

The in-closeness centrality measure is significantly correlated with individual academic performance in all three of the cohorts studied. The in-closeness measure the global proximity of all students to the individual. This shows that it is not only the number of communication contacts coming into the individual that is important, but also the individual's global position in the communication network. The proximity of the individual to the incoming information is closely related to their individual academic performance. The more directly the information reaches the student, or the more directly that they are sought out for communication, the higher end of year grade they will ultimately achieve.

There was found to be no significant correlation between the out-closeness measure of centrality in the communication network, and the students' academic performance in any of the three cohorts studied. This result indicates that the global proximity of a student to seeking communication does not relate to their performance. Perhaps the students that are in such a position are the less able students and so they need to seek extra help. However as there is no correlation at all, neither positive not negative, then the act of seeking advice and communication on academic matters equally does not relate to poorer individual academic performance.

The results also indicated that the betweenness measure of centrality in the communication network, and individual academic performance were not significantly correlated in any of the three cohorts studied. This result indicates that the students' ability to be a broker of information in such a network is not significantly related to how well they perform individually. This in turn indicates that students do not benefit by using that position of brokerage to keep their peers down, or indeed that the students do not need to attempt to keep their peers down by using their network position and their ability to act as a broker of information.

Table 8.1 provides a break down of the acceptance or rejection of all of the hypotheses.

Hypothesis	**Year 1 Accept**	**Year 2 Accept**	**Year 3 Accept**
1 (a) In-degree centrality in an undergraduate friendship network is positively associated with academic performance.	✗	✓	✓
1 (b) Out-degree centrality in an undergraduate friendship network is positively associated with academic performance.	✗	✗	✗
1 (c) In-closeness centrality in an undergraduate friendship is positively associated with academic performance.	✗	✗	✓
1 (d) Out-closeness centrality in an undergraduate friendship network is positively associated with academic performance	✗	✗	✓
1 (e) Betweenness centrality in an undergraduate friendship network is positively associated with academic performance.	✗	✗	✗
2 (a) In-degree centrality in an undergraduate communication network is positively associated with academic performance.	✓	✓	✓
2 (b) Out-degree centrality in an undergraduate communication network is positively associated with academic performance.	✗	✗	✗
2 (c) In-closeness centrality in an undergraduate communication network is positively associated with academic performance	✓	✓	✓
2 (d) Out-closeness centrality in an undergraduate communication network is positively associated with academic performance	✗	✗	✗
2 (e) Betweenness centrality in an undergraduate communication network is positively associated with academic performance	✗	✗	✗

Table 8.1 Table Showing Acceptance or Rejection of Hypotheses

8.10 The Multiple Regression Models

For each of the three cohorts studied a multiple regression model was built using stepwise regression in SPSS, in order to show how much of the variance in individual academic performance could be explained by the various measures of centrality in friendship or communication networks.

8.10.1 Multiple Regression Model Year 1

The regression model for predicting the end of year grade of a student in the Year 1 cohort is:

Grade = 4.939 + .869 (in-closeness of communication)

The r square figure indicates that 28.7% of the variance in end of year grade can be explained by this model. Although an r square of 28.7% is generally not that high, considering all of the other variables at play in terms of academic performance, this is still quite a significant finding. This model does not take into account for example the amount of time spent studying, or the students attitudes toward the course, etc. Despite this 28.7% of the variance in the students' grades can be explained using this model.

In the analysis of variance the F test is significant at .000. This indicates that the null hypothesis is incorrect, so that although the variance is fairly low at .287, it does not occur by chance.

The in-closeness of communication refers to the proximity of information coming in to the individual student. This result shows that a student's position in a communication network can be used to partially predict their academic performance.

8.10.2 Multiple Regression Model Year 2

The percentage of variance in the end of year grade in the Year 2 cohort grows to 45.9%. The model to predict the end of year grade in the Year 2 cohort is as follows:

Grade = 38.212 + .592 (group grade) – 82.643 (group friendship with other groups) + .157 (in degree of friendship)

The combination of group grade, the amount to which friendship runs across work groups and the number of friendships coming towards the students can be used to explain over 45% of the variance in their grade. Again this is despite other factors which can influence a student's performance. Hence the role of friendship in predicting performance is a relatively large one. The F test implies that this relationship does not occur by chance and each of the coefficients has a significance of less than 5% and therefore significantly influences the model.

The group grade, the interaction of friendship between different groups and the number of friendship relationships coming in towards a student can be used to partially predict over 45% of the variance in the students grade. This is a significant percentage given the multitude of other factors that can influence academic performance.

8.10.3 Multiple Regression Model Year 3

The percentage of variance in end of year grade that can be predicted by the Year 3 multiple regression model rises further, this time to 55.3%

The regression model is as follows:

Grade = 15.453 + .622 (in-closeness of friendship) – 23.078 (group communication with other groups) + .535 (group grade)

The F test is significant, this indicates that the relationship between the predictor variables and the grade (dependent variable) does not occur by chance. Each of the individual coefficients within the regression model are also significant, indicating that the coefficient's influence upon the model is significant. Once more it is interesting that such a large amount of the variance in grade can be explained by the model given that there are other forces involved in academic achievement. This shows that a person's position in the friendship and communication network is particularly significant in terms of using it to predict their academic performance.

Along with the grade achieved by the group, the level of communication with other groups can be used to predict performance. The in-closeness of friendship is also a significant factor in such a prediction. This measure indicates not the number of friendship relationship a person has access too, but rather the global proximity of a person to in-coming friendship relationships. So the students' position in a friendship network can help to predict their ultimate individual end of year grade.

Overall it is also interesting to note that amount of variance in individual grade that can be explained by the multiple regression models increases throughout the three cohorts. It may be that the influence of the networks becomes stronger as the students go through the course. The longer the networks are in place, the more influential they become. Again in order to fully test this phenomenon a longitudinal study would be necessary, following the same cohort throughout the three years of study.

8.11 Implications of the Results for Educators and Students

The significant correlation found in this study between measures of centrality in friendship and communication networks and individual academic performance have implications for both educators and students. The implications are similar for both audiences but how the two groups can put this information to good use differs slightly.

The in-degree centrality in the friendship network is significantly correlated with individual academic performance in the Years 2 and 3 cohorts. This may occur because the friendship network becomes more important as the students go through their studies, or it may be that the friendship networks are not fully developed in the first year of study. Despite which direction the explanation takes, it is certainly worthwhile for educators to think about encouraging the development of friendship networks from the very start of the students' academic career.

The in-degree measure in a friendship network is a count of the number of times a student is chosen as a friend, the number of friendships coming in to the individual. These friendship relationships provide social support that enables the student to perform better academically in the long term. In order to encourage the formation of such bonds, educators could take several measures. They could set up group activities from the start. Use team building exercises and even a buddy system. The pastoral role of the educator should be taken seriously as emotive issues such as friendship relationships can greatly effect a student's performance. Group activities, and even trips away may help to build the bonds of friendship throughout the group which will later provide social support, and hopefully, ultimately improved academic performance. It is impossible for the educator to force students into friendships however. By informing the students of the importance of the role of friendships and social support in their education, the educator may encourage the students to be more dynamic in their relationship building.

The implications of the correlation between centrality in a friendship network and academic performance is more poignant for the student. Although it is the in-degree that is positively correlated with performance rather than the out-degree, the student should aim to be dynamic in their participation of friendship relationships and aim to build up a network of social support. By building up their support network the student will know that they have friends to turn to should they come across difficulties in their studies, or if they begin to feel stressed or pressured. Indeed the network of social support is likely to have a direct effect upon the stress that the student is likely to encounter.

The in-closeness measure is significantly correlated with academic performance in the Year 3 cohort. Students may be encouraged to think about not only the number of friendships that they have, but also their position in the network globally. It is not only important to have many friendships but also that those friendships are with people throughout the group as a whole.

The in-degree measure of centrality in the communication network is significantly correlated to individual academic performance in all three of the cohorts studied. The implication is that students who are sought out for communication are the ones that do well in their studies. Students sometimes do not favour group based projects and would prefer to work as an individual so that they are responsible only for their own work, do not need to worry about the contribution of others and can work their schedule only around themselves. Although group project work is often not a popular choice with students, the implication is that group work encourages communication within the peer group. This study supports the use of group work by educators and indeed encourages sharing information and viewpoints, encouraging reflective learning. Again the implication for the student is that they should attempt to become involved in communication networks.

The in-closeness measure of centrality is also significantly correlated with academic performance in all three of the cohorts studied, again showing that the student should take note not only of the number of communication relationships that they are involved in, but also their position globally within the network. The student should attempt to be part of many small networks of communication, the higher the in-closeness the more likely they are to succeed academically.

Educators could use this study to highlight the importance to students of team working both at the work group level and as a cohort. This study shows significant correlation between communication within groups/ between groups and individual academic performance. The betweenness measure of communication and friendship however is not significantly correlated with individual academic performance. This would indicate that it is more valuable to the individual to put their efforts into working together as a team than it would be to try to be a broker of information or friendship. Betweenness is often seen as a measure of the extent to which a person can act as a gatekeeper, choosing whether or not they want to allow others the access to the same information and friendships that they have. In this study there is no associated benefit to the individual with being in this position. There is however an associated academic benefit to pulling together and working as a team, and so this collaborative approach should be encouraged in students.

In summary the implication of this study for students is that they should attempt to socialise within their cohort, get involved, become an active figure in the friendship and communication groups within the cohort. The implication for educators is to actively encourage and enable students to do this. The educators can help to inform the students of the importance of the relationships that they form, and help to provide facilities such as common rooms where students can have the time and space to develop their relationships of both friendship and communication.

8.12 Limitations of the Study

Some of the limitations of the study are inherent to methodology. Other limitations of the study come about due to issues such as time constraints and the sample used for the study. These two types of constraint on the study are outlined below.

8.12.1 Inherent Limitations

There are some inherent limitations to the use of social network analysis as a methodology. By using social network analysis a form of boundary has to be set, drawing a line around the social network and only measuring what is within that boundary. In terms of friendship and communication, such boundaries will not exist and so there is a risk of not including the correct sample. The alternative in terms of social network analysis however is to look at ego networks. The ego network methodology involves asking an individual to name his or her friends, and then asking those named to state who their friends are and so on, creating a snow-balling ego network. The difficulty with this approach is that this method of data collection is often inaccurate. People will forget to include others. Another problem occurs with this method when the researcher limits the number of responses. For example it is common within ego network analysis to ask the respondent to name for example five of his / her best friends. This can cause difficulties if a person has more or less than five best friends. If they have four they will then include a friend that they are not as close to in order to make it up to the required limit. If the person has more then five friends the student is limited in their choice of responses. The ego network method also has problems in terms of access. Very quickly a researcher can find that they do not have access to the people that the respondent has named in order to further the study.

By drawing the boundary around at the cohort level, and using a roster choice method, it is felt that the most meaningful results can be accessed, results that can then be interpreted and their implications understood by both educators and students. By using the roster choice method the problems of selective memory are reduced and a list of all participants is provided. By asserting the boundary at the cohort level, educators can see if there are any practical measures that can be used to enable students within a cohort to enhance their performance. Although student's friendship with people outside of the cohort may also enhance their academic performance, the educators only have access to the influence the students that are within the cohort. For this reason, although the use of the roster choice method in social network analysis does create a somewhat false boundary, it is felt that this boundary is one that can be useful in terms of results, for the researcher, the educators and the students themselves.

Another inherent limitation of social network analysis is that it is static. The methodology takes a snapshot of the participants' friendship and communication networks at a given point in time. This does not provide a dynamic picture relating to what is generally a dynamic issue. Peoples' friendship and communication relationships change throughout time. This limitation is often encountered when carrying out any type of survey. All surveys investigate factors at a particular time and place. Indeed all studies have to be placed within the historical and cultural context within which they occur. This study looks at three groups of students, in the first, second and third year of their studies. An attempt is made to investigate how friendship and communication networks affect students throughout their three years of study. In order to give a less static account, one way in which this limitation could be overcome would be to carry out a longitudinal study, following the same group of students throughout their three years of study. This would allow the researcher to investigate how the changing patterns of relationships affect the students' relationships.

Social Network Analysis is a quantitative method that is often used to investigate very soft issues such as friendship and communication networks. It may be that the process could have benefited from an extra component in the form of a qualitative study. In-depth personal interviews could have given an insight into why people chose who they do in terms of friendship and communication. This could help in the triangulation of the data. It could give an opportunity for the students to further explain their actions, and for the researcher to further examine some of the assumptions made.

8.12.2 Other Limitations

Some limitations to the study have occurred because of the sample used. All of the students were required to have a minimum of 24 points (or equivalent) in the Years 2 and 3 cohorts, and 26 points in the Year 1 cohort. Although not all of the students reached this exact standard, some may have provided other evidence to suggest that they are capable to this level. This sample means that the students studied are all already high academic achievers. In order to investigate further how the friendship and communication networks affect a students academic performance, a more full range of academic abilities could be investigated. It was also found that there was no correlation between the students' A level performance and their subsequent academic performance at the level of higher education. In order to fully investigate this relationship a sample would need to contain a full range of A level points, and indeed would need to include students with no A level points at all. It is unlikely that a study would be able to capture the full range of abilities. If a study were to be carried out in a university that accepted lower entry levels, then they would be unlikely to also have students at the higher end of the scale. A series of studies at different universities with different standards of intake could help to resolve this issue.

Another limitation that arises through the choice of sample is that the project based work groups were all self-assigned. Students tend to choose to work within friendship groups. This became evident when the peer group assessment was carried out, as students appeared to collaborate when assessing each others' performance and contribution. It would be interesting to set up a control group where the researcher assigns the group membership. Further examination could then be made into the effects of the friendship and communication upon performance when students are prevented from working within their own friendship groups. Further studies could also compare self-selected working groups with those selected by the researcher.

Friendship and communication are in themselves highly emotive subjects. Although I took great pains to define the terms friendship and communication both in the questionnaire and in the talk that I gave the students before administering the questionnaire, each student will still have their own view of what friendship is and what communication is. This meant that the study may still have suffered from the subjectivity of its participants. The definition of friendship was given as: "Which of the following students are good friends of yours, people whom you see socially outside of classroom hours, e.g. you have coffee or lunch together between or after classes and discuss topics other than those which are University related." This definition was developed from the definition used by Baldwin, Bedell and Johnson (1997) in a similar study on M.B.A. students in America. The definition was then piloted in a pretest using a similar group of students at the University. As an emotive issue, people will come along to the study with their own ideas of what constitutes friendship. Some may have more strict definitions that others and these definitions will be hard to override despite the fact that a precise definition is given for the purpose of the study. It is likely that the communication network was more easily measure. For communication the definition was given as: "Which of the following individuals are important sources of school, coursework, examinations related advice and conversation, or whom you approach if you have any school-related problem." Communication is a less emotive subject than friendship and so it is likely that the students would find it easier to adhere to the strict definition as outlined in the study. One way in which this limitation may be overcome is to spend time with the participants, encouraging them to develop a definition by consensus. This may help the participants to have a shared view of what constitutes friendship and would then give a more equal and accurate picture of the friendship network.

8.13 Summary

This chapter has discussed the correlation between various nodal properties and individual academic performance. The results showed no correlation between gender and academic performance or co-operation within the group. The relationship between performance at A level and end of year performance was significantly correlated only in the Year 2 cohort. The effort in the group and the intellectual contribution by the student to the group is not significantly correlated with individual end of year grade. The grade achieved in the group work is significantly correlated with the individual student's end of year grade in all three of the cohorts studied. The density of communication with work groups is significantly correlated in the Year 2 cohort only. In the Year 3 cohort the density of communication with other work groups is significantly correlated. There is no correlation between the density of friendship within the work groups or between the work groups and students' individual performance on the course.

The chapter then went on to discuss the correlation between centrality in friendship and communication networks and individual academic performance. Each of the individual hypotheses was discussed, accepted or rejected. Overall the results showed that the in-degree centrality and in-closeness centrality measures in communication networks were positively associated with academic performance in all three years. In-degree centrality in the friendship network is positively associated with academic performance in the Years 2 and 3 cohorts. In the Year 3 cohort only, in-closeness and out-closeness in the friendship network is positively associated with academic performance.

The implications of these results for both educators and students were discussed. Educators should encourage the formation of friendship and communication relationships through seminars, groups activities, group-based project work, team building trips and the provision of facilities such as a common room that gives the students a place to congregate and develop their networks. Although the educators can encourage such integration, the students are ultimately the ones that must develop the relationships. The implication for students is that they need to put time and effort into developing both their friendship and communication networks.

Finally the limitations of the study were discussed. The inherent limitations of social network analysis as a methodology are that it is static, and that boundaries must be drawn around the group which in practise may extend further. Social Network Analysis also suffers from the limitations that other quantitative methods have. It cannot go into the emotional side in any depth. There is not opportunity to in this type of qualitative analysis for the respondents to give an answer other than the ones provided in the methodology. A further, follow up qualitative study may have helped to triangulate the data and to examine the phenomenon of social networks further.

Other limitations include the sample which consists of students who all come to the degree program with a high level of achievement in their A level or equivalent, limiting variance of the sample. The work groups studies are all self-assigned, which also provides a limitation to the study.

Chapter Nine: Conclusions

9.1 Introduction

The objective of this thesis was to investigate the relationship between students' centrality in friendship and communication networks and their personal academic performance on an undergraduate degree. This objective has been met by carrying out a thorough literature review, identifying a gap in the literature, developing hypotheses and a methodology to test those hypotheses. This chapter will outline the contribution that is made by each of the chapters in this thesis to achieving this objective. Conclusions will then be drawn regarding the relationship between social networks and academic performance on an undergraduate degree. The novel contribution to the field of social networks in education will be identified and conclusions will be drawn as to who can benefit from this research. Hopes and suggestions for future research will then be suggested.

9.2 Contribution of Chapters to the Objective

Chapter One provided the rational behind this study. The aims were outlined and the two main hypotheses were put forward as:

- *Hypothesis 1: Centrality in an undergraduate friendship network is positively associated with individual academic performance.*
- *Hypothesis 2: Centrality in an undergraduate communication network is positively associated with individual academic performance.*

The rationale behind these hypotheses was explained. Degree centrality, closeness centrality and betweenness measures of centrality were used to investigate the hypotheses and so the two hypotheses were split accordingly to reflect the use of the different measures. The rationale behind these separate hypotheses was outlined, contributing to the overall research objective.

A full plan of the report was then provided.

Chapter Two provided an outline of the methodology. A full description of how the research question would be investigated and the objectives of this thesis would be achieved was given. This outline included a description of the population; the sample; the development of the questionnaires; the process of having the study approved by the ethics committee; the pre-test; administering the questionnaire and the final response rate. The chapter went on to describe how the data was prepared and how it was analysed in order to achieve the objective of investigating the relationship between centrality in friendship and communication networks and individual academic performance. The methods for testing the hypotheses were then discussed.

Chapter Three provided a thorough review of the appropriate literature. The literature of five areas of research was reviewed. Though these five areas are often separate in the literature, they are very closely tied, and consist of: social systems; social support; social networks; performance predictors and learning from and with others.

The literature regarding social systems revealed the social model of behaviour. This model stresses the embeddedness of people within a social system. All behaviour does not occur in isolation but is embedded within relationships that make up the social context in which the person is operating. Research has shown that people's networks within the work place can have a great effect upon factors such as opportunities for promotion, attitudes to work etc. Higher education also consists of social systems. The students on an undergraduate degree are embedded within the social system of their cohort. These students' behaviour does not occur in isolation but is embedded within this social context. It is likely therefore that this social model of behaviour will have implications for the performance of the student, just as the research shows it has implications for workers within an organisation.

A review of the literature regarding social support corroborated the view of the social model of behaviour. Research shows that social support can have a great effect upon reducing stress both in the workplace and within the field of education. This effect can be both direct i.e. the knowledge that support is available will be a constant, direct factor in reducing stress daily. Social support can also have a buffering effect upon stress, acting to reduce stress when support is called upon, in times of great need. In turn the literature shows that the reduction of stress can have a positive effect upon performance. Research has shown that students are most likely to turn to their friends for support in times of high stress. Logically then the literature is suggesting that there is a relationship between the networks of friendship amongst students and their ultimate academic performance, hence a review of this literature contributes to the aims of this thesis.

A review of the social network literature revealed that social networks can provide access and opportunity within the work place. As actions within the work place are embedded socially so too are actions embedded socially within universities. In the same way then it is logical to conclude that social networks can provide access and opportunity within the education of students. The social network literature also reveals that another major attribute of a network is the dissemination of knowledge and information. The spreading of information in this way has been linked to increased performance in the workplace. As education essentially consists of the dissemination of knowledge and information, it is logical to hypothesise that communication networks within a student cohort will be related to their academic performance. Indeed literature regarding social capital in education suggests that students are able to utilise the relationships available to them in order to enhance their academic performance.

Other performance predictors in education were examined and there have been various contradictory studies regarding the relationships between gender, race, previous academic performance and achievement within higher education. Regardless of any of these attributes, there still remains the social embeddedness of students within their peer group and so this was chosen as the (least studied alternative) focus for this study.

A review of the literature regarding learning with and from others showed that positive relationships can promote informal learning. Research has shown that students can benefit from the reflective practice that is engaged in informal and group learning. Each individual within a group or a network brings along a unique set of beliefs and experiences, all of which provide learning opportunities for the individuals involved. Again, the implication is that the friendship and communication networks in a cohort could be positively related to students' academic performance.

Baldwin, Bedell and Johnson (1997) carried out a study that encompassed many of these concepts. They investigated the social networks of a group of M.B.A. (Masters of Business Administration) students in America. Baldwin etal found that students' centrality in a communication network was positively related to their individual grades. Their position in friendship networks was not positively associated with their grades but it was positively associated with the students' satisfaction with the course and with their attitude to team based learning. This study led me to question whether the same would happen in undergraduate networks. Students at M.B.A. level have already been pre-socialised in the work place into the act of networking for their own advantage. Such students all have business experience and so will be used to developing contacts that can help them to progress. Do undergraduates who are less socialised into the act of networking, behave in the same way? It is interesting that in the Baldwin et al study the friendship networks were not significantly related to performance. Perhaps M.B.A students prefer to turn to other sources for social support, while undergraduates often develop their friendship networks within university as the students are all taking part in a shared experience. Undergraduate students have often moved away from home for the first time, this shared experience may help to develop friendship networks. The review of related literature led to the development of hypotheses regarding the relationships between friendship and communication networks and academic performance.

The literature review continues by describing the Social Network Analysis methodology that was utilised in order to achieve the objective. The historical development of Social Network Analysis was described in order to place the study within an historical context and to give the reader further background as to exactly what Social Network Analysis consists of.

Chapter Four began the analysis of the data at the level of the network. Analysis of the components in the Year 1 friendship and communication networks showed that both consisted of one strong component. This strong component occurs where all nodes (students) are connected, and the connection runs in one direction throughout the network. This means that knowledge and information can spread to each of the students within the cohort.

The communication network in the Year 2 cohort also consists of one strong component. The friendship network in Year 2 consists of two strong components, though one of these components actually consisted of just one student who was completely excluded from the network.

A component analysis of the Year 3 cohort showed the same results as the Year 2 cohort: one strong component in the communication network and two in the friendship network, one of the components again consisting of only one student. These component analyses showed there to be very cohesive networks in all three cohorts (with the exception of the two outliers).

Further analysis of the networks found them to be very dense, with the density of communication relationship being higher than that of friendships relationships in all three cohorts.

An analysis of the cliques in the networks found that they were not only numerous in all three cohorts but also that the cliques overlapped to a great extent. Again this show that the friendship and communication networks in all three cohorts were particularly cohesive.

Finally an analysis of the graph centralization of the networks was carried out. This gave an indication of the degree to which the nodes are centralised around focal points. The out degree centalization in the Year 1 friendship network was particularly high. This indicates that one focal point has chosen a great deal of friends. The in-degree of centralization was not as high in the Year 1 friendship network indicating that this person's choice of friends had not been reciprocated. In most cases the centralization measure revealed that the out-degree of centralization is higher than the in-degree. The exception to this is in the Year 2 friendship network where the inward friendship relationships are particularly focused around one individual.

Chapter Five provided an analysis at the work-group level. The density of friendship and communication relationships within and between the project-based work-groups was examined. In this way an implicit measure of the cohesion within and between the groups is supplied. In the Year 1 cohort the average density of friendship relationships within work-groups is considerably higher than that of communication relationships. This would indicate that the students choose to work with each other because they are friends, rather than because they talk about their work. In the Year 2 cohort the density of both types of relationship is higher than in Year 1. The students have had time to build up their network and the relationships have developed. In the Year 2 cohort the density of friendship relationships within the work-group is also larger than the density of communication. Again this indicates that the students have chosen their group membership on a friendship basis. In the Year 3 cohort the average density of friendship and communication rises again, supporting the notion that such networks develop as the students go through the three years of study. In the Year 3 cohort however, the average density of communication is higher than the average density of friendship. This indicates that the third year students chose their groups in terms of who they could gain higher grades with rather than through friendship.

Chapter Six in the thesis analysed the individual measures of centrality. The three measures that were applied were degree, closeness and betweenness centrality. This provided the measure that could be fed into the correlation analysis in order to ascertain whether there is any relationship between centrality in the friendship and communication networks and academic performance. The in-degree measure counted the number of relationships directed to a student, while the out-degree counted the number of relationships directed from the student. In-closeness is a global measure indicating how close the other students are to the individual spatially. The out-closeness measure indicates how close the student is spatially to all of the others in the global network. The betweenness measure shows to what amount the student can act as a broker of friendship or information. These different measures were chosen to give a broader understanding of how the network may influence performance. Not only the number of friendships was investigated, but also the students' global position within the network.

Chapter Seven outlined the findings of the correlation and regression models and Chapter Eight discussed these outputs. The findings revealed that the in-degree centrality count in a communication network is positively associated with students' academic performance in all three of the cohorts studied This means that the more a student is sought out for communication regarding academic matters, the higher they are likely to perform. The in-closeness centrality measure in the communication network is also positively associated with students' end of year grade in each of the three cohorts studied. The in-closeness measure is a global measure, identifying those with a position in the network whereby the communication channels reach the student the most directly. This means that not only is the number of communication relationships an important indicator of academic performance, so too is the student's global position within the communication network. Overall we can accept Hypotheses 2 (a) and 2 (c), that the in-degree centrality and the in-closeness centrality in communication networks is positively associated with individual academic performance.

Within the Years 2 and 3 cohorts, the in-degree centrality within the friendship network is also positively related to students' academic achievement. It may well be that in the first year of study such friendships are not as important, as students may rely on outside relationships for social support. It is also likely that such relationships take some time to develop.

In the Year 3 cohort both the in and out-closeness measure are also highly correlated with academic performance. This indicates that not only the number of friendships is important, but also as the student comes towards the end of their studies, their global position within the friendship network becomes highly relevant to their personal success. This means that we can partially accept Hypotheses 1 (a), 1 (c) and 1 (d) that in-degree and in and out-closeness centrality in a friendship network are positively associated with academic performance. The hypotheses are only partially accepted because in-degree centrality in a friendship network is positively related to academic performance in the Years 2 and 3 cohort. The in and out-closeness measures are positively associated with academic performance only in the Year 3 cohort.

Betweenness centrality was not correlated with academic performance in any of the networks.

The multiple regression models showed that an increasing amount of variance in grade could be explained by various measures of centrality through out the three years of study. In the Year 1 cohort 28.7% of the variance can be explained by the in-closeness of communication score. In the Year 2 cohort, 45.9% of the variance can be explained by a combination of group grade, group friendship with other groups and the in-degree of friendship. In the Year 3 cohort 55.3% of the variance is explained by in-closeness of friendship, group communication with other groups and the group grade combined.

9.3 Novel Contribution

The findings of this thesis constitute a novel contribution to knowledge in the field of social networks in education. The sample of undergraduate students in a British University studying for a degree in Management provides an insight into the networks of such groups that has not previously been published. The findings of this study indicate that there is a significant relationship between friendship and communication networks and students' individual academic performance.

This study provides implications for both students and educators. Students should attempt to actively participate in the social networks of their cohort, as this may prove advantageous to their ultimate goal of performing well on the degree. Educators should attempt to facilitate this process by highlighting the importance of social interaction in learning, providing team building exercises, setting up buddy schemes and the physical facilities that make it possible for students to interact.

9.4 Limitations of the Study

Limitations to the study came about due to time constraints on the data collection. A full longitudinal study following at least two cohorts throughout their years of study would take a minimum of four years, which was not available at this point in the research.

The inherent static nature of Social Network Analysis also provides a limitation to the study.

Further limitations to the study occurred through the self-assigned nature of the work groups. The groups may behave differently if the researcher assigned group membership.

The emotive topics of friendship and communication along with assessing peers contribution to group work also provided inherent limitations to this study.

9.5 Future Research

One of the limitations of Social Network Analysis is that it is static. Relationships develop through time. As new relationships develop, others fade away and visa versa. One way that this problem could be overcome would be to carry out a longitudinal study. A longitudinal study would be particularly appropriate in this case. This study looked at the friendship and communication networks of three cohorts of an undergraduate degree. Comparisons were made between these three cohorts, looking at how the networks relate to the students' academic performance throughout their years of study. In order to investigate fully the effects of such networks throughout the three years on the course, a longitudinal study would be necessary. Such a study would follow the same cohort throughout, following the development of the networks and investigating their effects upon their academic performance. In order to further eliminate the static nature of the methodology it would also be helpful if the social network questionnaire could be administered once in every term rather than once in the academic year. Within the field of Social Network Analysis there is currently some discussion regarding developing statistical tools that can deal with dynamic networks. Future research may be able to incorporate these new statistical devices as and when they are developed.

Within this study all of the project-based work-groups were self-assigned. A recommendation for future research would be to investigate how the friendship and communication networks are affected if the researcher assigns the group membership. By forcing students to work with people that they would not normally choose to work with, further friendship and communication ties may be forged. With extended communication networks comes the possibility for further dissemination of knowledge and information, and further opportunities for reflective learning. With extended friendship networks come further opportunities for social support, leading to lower levels of stress. Ultimately, if assignment to work groups affects social networks, these social networks may in turn affect the individuals' academic performance.

Future studies may also benefit from a qualitative aspect to the methodology. Follow up interviews with the participants could help to triangulate the data. It may also help to gain further insight into the students' motivations. Why did they choose the relationships that they did? A qualitative aspect to the study could help to investigate not only what were the actions of the students but also why they behaved in that way.

Another area that came out from this study as needing further investigation was the peer-group assessment questionnaire. There was found to be no correlation between the mark attained for effort, intellectual contribution and co-operation by the students and their individual academic performance. From this result we could conclude that a students efforts within the group are not related to their performance. However some of the students appeared to be collaborating with regards to what mark they would award each other on the peer-group assessment form. Where students in a group all gave each other top marks, it could be that they believed each group member deserved top marks or it could be that they have agreed to award each other the maximum marks available. As students had chosen the membership of the groups they are likely to be working with their friends and so this may also influence how the students award marks in the peer group assessment exercise. Students may also have different perceptions as to what is effort or co-operation with the group. Future research could work with students helping them to define what is meant by the different measures. A debrief would also help to ascertain why students allocate the marks that they do.

This study, along with the above suggestions for further research has implications not only for the field of social networks in education, but also practical implications for both educators and students alike. Hence this field of research is both academically interesting, and of practical interest to the academic.

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Appendices

Appendix I

The Roster Style Social Network Questionnaire

Please go down this list and put a tick next to the name of the students that you feel that a) you are friends with, b) you communicate with, c) you have an adversarial relationship with. The categories are not mutually exclusive so that for example you can be a friend with someone and also communicate with them about University issues. Please do not let anyone else see your answers, as soon as you have completed this questionnaire please hand it in to Elaine Scott.

Definitions

Friendship
Which of the following students are good friends of yours, people whom you see socially outside of classroom hours, eg you have lunch or coffee together between classes and discuss topics other than those which are University related.

Communication

Which of the following individuals are important sources of school, coursework, examinations related advice or whom you approach if you have a school-related problem.

Unknown

Is this student unknown to you, i.e. you do not recognize the name of this person.

No Response

If you leave all responses blank next to a student's name this indicates that you are aware of the student, but you classify them to be neither a friend, an adversary, nor someone with whom you communicate regarding school-related issues.

Name	Friend?	Communicate?	Unknown?

Appendix II

PEER GROUP ASSESSMENT FORM
Please complete and return to Elaine Scott room W328

Student Name .... MS Year?......................
Please make a separate rating for each member of your group, including a self-assessment, for the three dimensions indicated below. Make the rating on a scale from zero to six, interpreting the scale scores as follows:

0 = No Contribution; 1 = Very Poor; 2 = Poor; 3 = Average;

4 = Good; 5 = Very Good; 6 = An Outstanding Contribution

Normally we would expect the ratings awarded to be a 3 or 4, with some 1, 2 and 5 scores. The meaning of an award 6 to a fellow student should not be devalued. Please be willing to use a zero if necessary. For example, if you score a particular student zero for "co-operation with the group", it implies that the person never attended a group meeting.

NAME	OVERALL EFFORT IN THE GROUP (E)	INTELLECTUAL CONTRIBUTION TO THE GROUP (I)	**COOPERATION** WITH THE GROUP (C)

Appendix III

Matrix of Data for all Three Cohorts

Matrix of Data for the Year 1 Cohort

	groupno	alevel	grade	grougrad	indegrco	outdegrc	indfrien
1	5	20.00	51.77	65.00	50.00	80.44	10.87
2	6	26.00	57.45	63.00	19.57	32.61	6.52
3	2	28.00	64.92	64.00	34.78	23.91	15.22
4	7	20.00	64.05	63.00	15.22	47.83	17.39
5	1	29.00	65.69	64.00	36.96	23.91	30.44
6	4	26.00	65.59	68.00	56.52	15.22	13.04
7	1	18.00	61.71	68.00	45.65	34.78	19.57
8	6	24.00	69.71	60.00	28.26	45.65	23.91
9	1	24.00	58.51	68.00	50.00	39.13	21.74
10	6	22.00	49.65	58.00	30.44	32.61	13.04
11	7	22.00	56.69	52.00	15.22	28.26	19.57
12	2	24.00	70.52	55.00	39.13	71.74	17.39
13	7	24.00	53.24	58.00	15.22	19.57	23.91
14	5	24.00	54.27	58.00	19.57	23.91	15.22
15	3	20.00	58.52	53.00	23.91	30.87	17.39
16	2	24.00	39.43	55.00	41.30	56.52	19.57
17	5	20.00	39.43	55.00	21.74	23.91	17.39
18	5	20.00	44.05	60.00	26.09	4.35	17.39
19	6	24.00	57.39	72.00	54.35	10.87	30.44
20	3	20.00	45.37	60.00	21.74	13.04	15.22
21	6	20.00	58.55	72.00	50.00	21.74	21.74
22	2	22.00	71.75	60.00	56.52	69.57	28.26
23	2	24.00	48.77	60.00	21.74	39.13	13.04
24	2	22.00	39.80	64.00	26.09	34.78	17.39
25	4	12.00	79.04	70.00	67.39	6.52	4.35
26	6	20.00	50.67	72.00	36.96	69.57	26.09
27	3	22.00	56.28	64.00	19.57	10.87	8.70
28	5	24.00	50.97	60.00	17.39	10.87	19.57
29	5	26.00	60.12	67.00	28.26	23.91	10.87
30	6	25.00	59.89	68.00	45.65	54.35	28.26
31	4	24.00	66.04	69.00	52.17	39.13	17.39
32	7	24.00	57.79	60.00	26.09	45.65	19.57
33	6	26.00	56.21	60.00	41.30	34.78	23.91
34	1	28.00	49.61	64.00	30.44	34.78	21.74
35	1	20.00	61.76	66.00	3.04	19.57	17.39
36	4	24.00	69.96	68.00	45.65	52.17	17.39
37	1	26.00	54.55	70.00	41.30	34.78	43.48
38	5	24.00	53.16	60.00	41.30	43.48	26.09
39	6	20.00	60.63	72.00	45.65	26.09	30.44
40	7	24.00	45.91	56.00	26.09	34.78	19.57
41	3	20.00	60.99	64.00	43.48	19.57	10.87
42	7	26.00	61.53	60.00	30.44	67.39	17.39
43	1	26.00	60.43	60.00	43.48	28.26	32.61

	outdefri	betwcom	betwfrie	inclocom	outcloco	inclofri	outclofr
1	13.04	3.20	.23	65.71	83.64	39.32	51.69
2	2.17	.21	.00	52.87	59.74	40.35	27.88
3	15.22	.37	.12	60.53	56.10	42.20	46.47
4	15.22	.82	.00	51.11	65.71	37.71	42.20
5	21.74	.68	.99	60.53	56.79	48.94	47.92
6	6.52	1.00	.18	69.70	52.27	41.82	34.59
7	17.39	.99	.07	63.01	60.53	44.66	46.00
8	21.74	.53	.60	56.10	64.79	47.92	42.99
9	19.57	1.44	.80	65.71	62.16	46.00	46.47
10	13.04	.38	.22	56.10	59.74	41.82	38.33
11	19.57	.37	.13	51.11	58.23	40.35	52.27
12	28.26	2.87	2.12	62.16	77.97	41.44	53.49
13	23.91	.17	.91	52.27	54.76	40.00	56.79
14	13.04	.39	.14	52.27	56.79	37.40	44.23
15	10.87	1.86	.16	56.79	71.88	44.66	39.66
16	13.04	2.28	.33	62.16	69.70	46.47	44.66
17	4.35	.80	.56	50.55	56.10	44.23	35.39
18	89.13	.27	36.78	56.79	37.71	42.99	90.20
19	45.65	1.24	10.12	68.66	50.55	51.69	56.10
20	17.39	.20	1.56	55.42	51.69	45.55	41.07
21	15.22	.86	.33	65.71	55.42	48.42	43.40
22	13.04	3.19	1.71	69.70	76.67	52.87	40.71
23	10.87	.88	.58	54.12	62.16	38.98	37.40
24	26.09	.81	.78	56.79	60.53	44.66	57.50
25	26.09	1.99	1.06	75.41	46.00	34.59	50.00
26	17.39	2.46	.88	60.53	76.67	49.46	44.66
27	10.87	.11	.34	55.42	45.55	36.22	42.99
28	23.91	.19	.63	50.55	51.69	38.02	47.92
29	10.87	.52	.60	56.10	56.79	36.80	45.10
30	23.91	2.31	.91	64.79	68.66	50.55	46.00
31	2.17	1.35	.28	66.67	62.16	46.94	20.81
32	28.26	1.12	.97	56.79	64.79	45.35	58.23
33	28.26	.87	1.60	62.16	60.53	48.94	48.94
34	19.57	.77	,07	56.79	60.53	46.00	46.47
35	17.39	.32	.37	56.79	53.49	43.81	54.12
36	4.35	1.03	.20	65.79	67.65	46.00	26.14
37	39.13	1.43	7.28	62.16	60.53	59.74	54.76
38	39.13	.97	4.34	60.53	63.89	46.47	62.16
39	19.57	.87	1.29	63.89	56.10	50.00	46.47
40	21.74	.60	.40	55.42	60.53	45.10	47.92
41	8.70	.74	.24	63.01	54.76	41.82	41.07
42	13.04	5.54	.01	57.50	75.41	37.40	39.66
43	23.91	1.03	.99	62.16	58.23	49.46	48.94

	grdencom	grdenfri	effort	intelcon	coperati	gfrieoth	gcommoth
1	.36	.50	4.29	4.33	4.71	39.42	.29
2	.05	.68	1.63	1.38	1.57	29.18	.34
3	.43	.80	4.00	3.83	4.67	34.42	.51
4	.00	.93	5.00	5.20	4.80	39.35	.47
5	.36	1.00	4.50	4.50	5.33	35.92	.29
6	.40	.50	4.50	4.00	4.40	32.90	.28
7	.36	1.00	5.17	4.83	5.17	35.91	.29
8	.53	.68	3.43	3.60	3.33	35.50	.34
9	.36	1.00	5.29	5.50	5.20	44.14	.29
10	.53	.68	2.63	2.25	2.17	32.87	.34
11	.00	.93	5.00	5.20	5.00	33.82	.47
12	.43	.80	5.14	5.40	5.00	39.05	.51
13	.00	.93	5.00	4.80	4.60	34.13	.47
14	.36	.50	4.71	4.67	5.40	38.21	.29
15	.43	.36	5.17	4.50	5.00	35.63	.25
16	.43	.80	4.17	4.40	4.33	36.67	.51
17	.36	.50	3.86	3.83	4.83	30.67	.29
18	.36	.50	3.08	3.25	4.50	38.09	.29
19	.53	.68	4.57	4.67	4.60	45.50	.34
20	.43	.36	3.80	3.80	3.60	32.42	.25
21	.53	.68	5.14	4.50	5.00	35.03	.34
22	.43	.80	5.29	5.17	5.00	39.76	.51
23	.43	.80	3.57	3.33	3.83	32.32	.51
24	.43	.80	4.83	4.80	5.00	43.98	.51
25	.40	.50	4.75	4.75	3.25	34.48	.28
26	.53	.68	4.14	3.88	4.14	38.15	.34
27	.43	.36	3.40	3.50	3.50	29.62	.25
28	.36	.50	3.86	4.20	4.33	31.50	.29
29	.36	.50	1.83	1.40	2.20	39.03	.29
30	.53	.68	4.29	4.50	4.33	38.53	.34
31	.40	.50	3.20	2.75	3.50	32.30	.28
32	.00	.93	5.00	5.00	4.80	74.74	.47
33	.53	.68	4.00	4.17	4.17	36.96	.34
34	.36	1.00	5.14	5.33	4.80	42.03	.29
35	.36	1.00	3.50	3.83	3.67	34.93	.29
36	.40	.50	3.75	4.00	4.00	33.75	.28
37	.36	1.00	4.60	4.40	4.80	40.61	.29
38	.36	.50	6.00	5.50	5.83	38.98	.29
39	.53	.68	4.43	4.50	4.40	43.40	.34
40	.00	.93	5.00	5.20	5.00	34.98	.47
41	.43	.36	4.25	4.25	4.00	32.94	.25
42	.00	.93	5.00	5.20	4.80	34.42	.47
43	.36	1.00	5.00	5.17	4.83	36.69	.29

	sex
1	1.00
2	2.00
3	2.00
4	2.00
5	2.00
6	2.00
7	2.00
8	2.00
9	2.00
10	2.00
11	1.00
12	2.00
13	2.00
14	2.00
15	2.00
16	2.00
17	1.00
18	1.00
19	1.00
20	1.00
21	2.00
22	2.00
23	2.00
24	2.00
25	1.00
26	2.00
27	1.00
28	2.00
29	2.00
30	2.00
31	1.00
32	2.00
33	2.00
34	1.00
35	1.00
36	1.00
37	1.00
38	2.00
39	1.00
40	1.00
41	1.00
42	2.00
43	2.00

	groupno	alevel	grade	grougrad	indegrco	outdegrc	indfrien
44	3	24.00	34.07	60.00	23.91	34.78	8.70
45	4	24.00	59.17	61.00	28.26	32.61	8.70
46	3	24.00	46.24	64.00	28.26	10.87	8.70
47	3	22.00	57.41	64.00	28.26	32.61	13.04
48	.	.	.	.	.	.	.

	outdefri	betwcom	betwfrie	inclocom	outcloco	inclofri	outclofr
44	6.52	.65	.00	54.12	60.53	36.22	33.58
45	6.52	.43	.08	57.50	58.97	39.66	37.10
46	6.52	.49	.29	56.10	46.47	36.80	49.46
47	6.52	.69	.17	58.23	59.74	39.66	33.58
48	.	.	.	.	.	.	.

	grdencom	grdenfri	effort	intelcon	coperati	gfrieoth	gcommoth
44	.43	.36	3.50	3.75	3.50	36.97	.25
45	.40	.50	3.20	3.50	3.75	32.35	.28
46	.43	.36	3.75	3.75	3.50	31.02	.25
47	.43	.36	4.00	4.25	4.25	31.38	.25
48	.	.	.	.	.	.	.

	sex
44	2.00
45	2.00
46	1.00
47	2.00
48	.

Matrix of Data for the Year 2 Cohort

	groupno	alevel	grade	grougrad	indegrco	outdegrc	indfrien
1	6.00	20.00	60.86	65.00	48.72	74.36	35.90
2	7.00	20.00	69.39	62.00	41.03	76.92	12.82
3	4.00	24.00	55.07	59.00	23.08	30.77	23.08
4	2.00	24.00	64.52	73.00	61.54	43.59	20.51
5	2.00	20.00	65.16	69.00	41.03	35.90	48.72
6	2.00	22.00	58.42	70.00	66.67	51.28	20.51
7	1.00	22.00	62.72	61.00	48.72	41.03	61.54
8	5.00	20.00	46.88	55.00	33.33	48.72	10.26
9	3.00	20.00	58.17	71.00	48.72	56.41	25.64
10	7.00	28.00	68.64	59.00	61.54	53.85	23.08
11	5.00	20.00	50.64	49.00	33.33	12.82	28.21
12	6.00	24.00	51.48	65.00	30.77	46.15	7.69
13	4.00	24.00	57.22	52.00	17.95	92.31	23.08
14	8.00	20.00	65.74	70.00	64.01	64.10	23.08
15	8.00	24.00	65.89	63.00	48.72	25.64	30.77
16	3.00	24.00	67.58	75.00	41.03	38.46	30.77
17	2.00	24.00	61.03	66.00	51.28	15.39	35.90
18	8.00	26.00	63.69	72.00	38.46	58.97	15.39
19	1.00	24.00	60.59	62.00	43.59	56.41	25.64
20	6.00	24.00	65.42	66.00	46.15	51.28	35.90
21	7.00	24.00	59.33	50.00	61.54	35.90	25.64
22	5.00	20.00	47.49	52.00	25.64	20.51	23.08
23	4.00	22.00	60.71	55.00	25.64	25.64	17.95
24	8.00	26.00	62.57	60.00	38.46	61.54	43.59
25	3.00	20.00	62.87	60.00	35.90	64.10	12.82
26	5.00	20.00	51.66	59.00	20.51	41.03	30.77
27	8.00	20.00	53.46	62.00	64.10	58.97	30.77
28	7.00	26.00	56.02	64.00	30.77	43.59	23.08
29	4.00	22.00	61.37	61.00	33.33	28.21	20.51
30	1.00	18.00	60.12	62.00	53.85	30.77	28.21
31	5.00	28.00	63.93	63.00	53.85	56.41	43.59
32	4.00	20.00	53.59	44.00	23.08	25.64	.00
33	6.00	20.00	61.56	65.00	51.28	28.21	33.33
34	1.00	22.00	58.53	60.00	33.33	23.08	20.51
35	2.00	22.00	61.01	73.00	46.15	66.67	15.39
36	6.00	24.00	66.79	68.00	66.67	43.59	33.33
37	1.00	24.00	70.32	60.00	38.46	30.77	43.59
38	4.00	22.00	64.63	63.00	38.46	28.21	25.64
39	3.00	22.00	64.44	71.00	51.28	12.82	25.64
40	2.00	20.00	63.33	70.00	43.59	25.64	35.90

	outdefri	betwcom	betwfrie	inclocom	outcloco	inclofri	outclofr
1	12.82	1.75	2.43	66.10	79.59	58.21	30.47
2	35.90	1.41	1.36	62.90	81.25	42.39	37.50
3	20.51	.24	.67	55.71	59.09	43.33	33.33
4	17.95	.86	.28	72.22	63.93	48.15	33.91
5	33.33	.59	2.66	62.90	60.94	60.94	35.78
6	28.21	1.54	.59	75.00	67.24	50.00	35.14
7	30.77	.68	3.96	66.10	62.90	72.22	36.79
8	25.64	.70	.56	59.09	66.10	47.56	35.78
9	30.77	1.12	1.11	66.10	69.64	52.00	36.45
10	20.51	2.23	.46	72.22	68.42	53.43	34.21
11	25.64	.18	1.01	60.00	52.70	55.71	33.05
12	17.95	.43	.37	58.21	65.00	45.88	34.21
13	41.03	2.59	4.92	53.43	92.86	48.15	38.61
14	28.21	2.20	.59	73.58	73.58	53.43	35.46
15	10.26	.82	2.00	66.10	57.35	55.71	31.71
16	12.82	.53	.21	62.90	61.91	54.93	30.47
17	48.72	.69	5.99	67.24	50.00	58.21	39.39
18	35.90	.87	1.44	61.91	70.91	45.35	36.79
19	7.69	1.31	.45	62.90	69.64	52.70	29.32
20	17.95	1.33	2.00	65.00	67.24	60.94	33.33
21	15.99	.93	1.07	72.22	60.94	53.43	33.91
22	23.08	.07	.23	56.52	55.71	50.65	32.50
23	20.51	.22	.50	57.35	57.35	39.80	31.45
24	30.77	.88	3.99	61.91	72.22	63.93	36.11
25	20.51	1.65	2.29	60.94	73.58	46.43	35.46
26	30.77	.50	1.09	54.17	62.90	56.52	36.11
27	38.46	1.94	5.29	73.58	70.91	56.52	38.24
28	28.21	.33	.68	59.09	63.93	51.32	35.46
29	28.21	.38	1.69	60.00	58.21	50.65	35.46
30	33.33	.68	.94	68.42	59.09	56.52	36.45
31	35.90	1.94	6.36	68.42	69.64	63.93	37.86
32	12.82	.45	.56	54.17	56.52	2.50	50.00
33	38.46	.88	4.00	67.24	58.21	60.00	38.24
34	17.95	.24	.17	59.09	56.52	54.93	33.05
35	15.39	.83	.39	65.00	75.00	46.99	32.23
36	38.46	.99	1.72	75.00	63.93	59.09	37.50
37	38.46	.42	3.63	61.91	59.09	61.91	37.86
38	20.51	.69	.45	61.91	58.21	48.75	32.23
39	51.28	.53	1.97	67.24	50.65	50.65	39.80
40	30.77	.35	2.01	63.93	56.52	60.00	35.46

	grdencom	grdenfri	effort	intelcon	coprati	grfrioth	grcomoth
1	.70	.45	3.75	4.00	4.25	.23	.46
2	.67	.92	4.67	4.67	4.67	.19	.51
3	.47	.60	4.40	4.40	4.60	.18	.38
4	.67	1.00	4.50	4.50	4.75	.28	.37
5	.67	1.00	4.33	3.33	4.33	.28	.37
6	.67	1.00	4.60	4.60	4.40	.28	.37
7	.25	.65	5.00	4.50	4.75	.22	.39
8	.20	.55	4.33	4.00	4.33	.24	.39
9	.50	.58	4.00	4.25	3.25	.26	.43
10	.67	.92	4.50	4.00	4.67	.19	.51
11	.20	.55	2.67	3.67	4.00	.24	.39
12	.70	.45	4.00	3.25	4.75	.23	.46
13	.47	.60	3.00	3.00	3.50	.18	.38
14	.50	.90	5.00	3.67	4.00	.23	.54
15	.50	.90	3.25	3.50	3.75	.23	.54
16	.50	.58	4.50	4.50	3.75	.26	.43
17	.67	1.00	4.33	3.67	4.00	.28	.37
18	.50	.90	5.00	4.00	4.50	.23	.54
19	.25	.65	5.25	4.75	4.00	.22	.39
20	.70	.45	4.00	4.67	3.33	.23	.46
21	.67	.92	1.50	3.00	3.67	.19	.51
22	.20	.55	4.00	3.50	4.50	.24	.39
23	.47	.60	4.00	3.33	5.00	.18	.38
24	.50	.90	2.75	3.50	3.25	.23	.54
25	.50	.58	3.00	2.75	3.00	.26	.43
26	.20	.55	4.67	5.00	5.00	.24	.39
27	.50	.90	2.75	3.75	3.75	.23	.54
28	.67	.92	5.00	4.50	5.00	.19	.51
29	.47	.60	5.00	4.00	5.33	.18	.38
30	.25	.65	5.25	4.75	4.25	.22	.39
31	.20	.55	5.75	5.50	5.75	.24	.39
32	.47	.60	2.33	1.67	4.00	.18	.38
33	.70	.45	3.75	4.25	4.00	.23	.46
34	.25	.65	3.75	4.25	5.25	.22	.39
35	.67	1.00	4.67	4.33	4.33	.28	.37
36	.70	.45	4.75	4.50	3.25	.23	.46
37	.25	.65	3.75	4.25	5.25	.22	.39
38	.47	.60	5.33	4.67	5.33	.18	.38
39	.50	.58	4.40	4.00	3.25	.26	.43
40	.67	1.00	4.50	4.00	4.25	.28	.37

	sex
1	1.00
2	1.00
3	1.00
4	2.00
5	2.00
6	2.00
7	1.00
8	1.00
9	2.00
10	1.00
11	2.00
12	2.00
13	1.00
14	1.00
15	2.00
16	1.00
17	2.00
18	1.00
19	1.00
20	1.00
21	1.00
22	1.00
23	2.00
24	2.00
25	2.00
26	2.00
27	2.00
28	1.00
29	2.00
30	1.00
31	1.00
32	1.00
33	1.00
34	1.00
35	2.00
36	1.00
37	1.00
38	1.00
39	2.00
40	2.00

Matrix of Data for the Year 3 Cohort

	groupno	alevel	grade	grougrad	indegcom	outdegco	indegfri
1	2.00	24.00	62.71	67.00	30.95	7.14	11.91
2	6.00	18.00	67.55	67.00	23.81	23.81	14.29
3	1.00	18.00	58.69	66.00	40.48	33.33	33.33
4	6.00	24.00	71.00	67.00	26.19	23.81	11.91
5	5.00	20.00	70.54	74.00	57.14	64.29	26.19
6	1.00	20.00	51.71	66.00	30.95	66.67	16.67
7	2.00	18.00	43.14	67.00	7.14	23.81	.00
8	2.00	20.00	74.04	67.00	71.43	52.38	21.43
9	7.00	22.00	56.21	69.00	45.24	50.00	28.57
10	3.00	22.00	68.39	76.00	42.86	61.91	30.95
11	3.00	24.00	74.14	76.00	47.62	23.81	19.05
12	4.00	14.00	62.21	64.00	35.71	40.48	26.19
13	5.00	22.00	67.93	74.00	52.38	33.33	33.33
14	7.00	20.00	68.97	69.00	47.62	80.95	40.48
15	1.00	18.00	60.28	66.00	21.43	33.33	2.38
16	1.00	24.00	62.77	66.00	52.38	61.91	33.33
17	5.00	26.00	66.07	74.00	30.95	23.81	21.43
18	6.00	14.00	56.63	67.00	28.57	16.67	11.91
19	6.00	24.00	70.30	67.00	28.57	23.81	16.67
20	5.00	22.00	71.39	74.00	52.38	7.14	26.19
21	7.00	22.00	58.44	69.00	45.24	42.86	23.81
22	3.00	24.00	66.18	76.00	26.19	14.29	21.43
23	4.00	24.00	74.21	64.00	47.62	33.33	38.10
24	2.00	32.00	64.18	67.00	45.24	50.00	21.43
25	3.00	24.00	70.86	76.00	57.14	45.24	19.05
26	2.00	24.00	61.54	67.00	33.33	26.19	14.29
27	7.00	22.00	63.54	69.00	52.38	50.00	35.71
28	1.00	20.00	58.39	66.00	35.71	66.67	40.48
29	4.00	22.00	68.84	64.00	50.00	47.62	33.33
30	2.00	22.00	65.71	67.00	54.76	59.52	26.19
31	3.00	24.00	71.71	76.00	47.62	4.76	33.33
32	4.00	30.00	71.56	64.00	54.76	23.81	28.57
33	7.00	22.00	68.37	69.00	40.48	30.95	33.33
34	4.00	24.00	63.34	64.00	21.43	28.57	16.67
35	5.00	22.00	71.71	74.00	38.10	52.38	38.10
36	6.00	22.00	64.85	67.00	11.91	16.67	16.67
37	1.00	20.00	61.33	66.00	14.29	4.76	14.29
38	4.00	30.00	51.32	64.00	52.38	35.71	35.71
39	3.00	24.00	71.71	76.00	28.57	19.05	21.43
40	7.00	20.00	67.12	69.00	40.48	61.91	23.81
41	8.00	20.00	54.70	65.00	33.33	73.81	7.14
42	5.00	24.00	68.68	74.00	30.95	52.38	26.19
43	1.00	20.00	62.29	66.00	16.67	59.52	21.43

	outdegfr	betwcom	betwfrie	inclocom	outcloco	inclofri	outclofr
1	14.29	.20	.28	57.53	48.84	30.88	29.58
2	28.57	.89	2.30	54.55	56.00	29.58	35.00
3	54.76	1.45	8.52	62.69	60.00	36.84	41.18
4	19.05	1.15	.66	55.26	56.00	27.63	32.81
5	33.33	1.71	1.98	70.00	73.68	33.87	36.84
6	16.67	3.06	.58	58.33	75.00	31.58	32.81
7	.00	.14	.00	44.68	56.76	2.33	2.33
8	14.29	2.02	.49	77.78	67.74	34.71	30.66
9	40.48	.52	1.12	64.61	66.67	35.90	37.84
10	26.19	1.64	2.81	63.64	72.41	36.52	35.59
11	19.05	.61	1.67	64.61	56.00	34.71	34.71
12	19.05	1.13	.69	60.00	61.77	35.59	35.59
13	28.57	1.22	.82	65.63	60.00	35.29	35.00
14	71.43	3.66	14.93	64.61	84.00	36.52	44.21
15	2.38	.64	.00	53.17	60.00	26.58	25.77
16	35.71	3.52	3.05	67.74	72.41	37.50	36.21
17	23.81	.36	.61	57.53	55.26	33.07	34.71
18	11.91	.44	.24	57.53	47.19	29.17	29.58
19	16.67	.63	.26	57.53	55.26	31.11	32.06
20	19.05	.49	.53	66.67	45.16	35.29	34.15
21	11.91	.54	.14	64.61	62.69	34.15	32.31
22	14.29	.27	.24	56.00	51.85	33.33	31.58
23	23.81	.63	2.48	64.61	58.33	37.84	35.00
24	19.05	1.17	1.42	63.64	66.67	34.15	33.60
25	28.57	1.40	.67	70.00	64.61	33.60	36.52
26	11.91	.31	.25	58.33	57.53	32.56	29.58
27	28.57	1.09	1.43	66.67	66.67	37.17	35.90
28	19.05	2.03	3.54	60.00	75.00	38.89	33.60
29	30.95	.43	1.46	65.63	65.63	36.21	36.21
30	16.67	1.81	1.07	68.85	71.19	33.60	30.88
31	38.10	.71	5.85	65.63	44.21	37.17	38.53
32	19.05	.84	.87	68.63	56.76	35.59	34.15
33	19.05	.40	.63	61.77	58.33	35.59	33.07
34	16.67	.24	.15	52.50	56.76	33.33	31.82
35	30.95	1.06	1.72	60.00	65.63	37.17	35.90
36	9.52	.10	.60	49.41	53.17	33.07	28.00
37	9.52	.03	.04	49.41	46.67	33.07	30.66
38	40.48	.85	2.16	67.74	60.00	36.84	37.50
39	35.71	.24	2.87	57.53	53.85	34.15	37.50
40	21.43	.87	.39	61.77	72.41	34.15	33.60
41	19.05	2.18	.37	60.00	79.25	28.77	34.15
42	40.48	.88	1.35	56.76	67.74	34.15	37.84
43	16.67	1.89	5.11	52.50	71.19	35.59	34.15

	effort	intelcon	coprati	grdencom	grdenfri	grcomoth	grfrioth
1	4.80	4.20	5.20	.60	.67	.31	.09
2	6.00	6.00	6.00	.60	1.00	.20	.07
3	3.86	4.00	3.67	.33	.67	.51	.13
4	6.00	6.00	6.00	.60	1.00	.20	.07
5	6.00	4.80	6.00	.50	.97	.35	.18
6	3.50	3.25	2.83	.33	.67	.51	.13
7	3.00	2.80	3.00	.60	.67	.31	.09
8	5.25	6.00	5.50	.60	.67	.31	.09
9	5.20	5.00	5.00	.70	.93	.46	.21
10	4.40	3.25	4.40	.40	.60	.29	.22
11	2.50	3.20	3.00	.40	.60	.30	.22
12	4.00	3.75	4.20	.67	.63	.29	.21
13	5.60	5.80	5.40	.50	.97	.35	.18
14	4.75	4.75	4.50	.70	.93	.46	.21
15	2.50	2.60	2.00	.33	.67	.51	.13
16	4.60	4.00	4.20	.33	.67	.51	.13
17	5.50	5.60	5.50	.50	.97	.35	.18
18	6.00	6.00	6.00	.60	1.00	.20	.07
19	6.00	6.00	6.00	.60	1.00	.20	.07
20	5.75	5.25	5.75	.50	.97	.35	.18
21	5.33	4.80	5.40	.70	.93	.46	.21
22	2.20	3.50	2.80	.40	.60	.29	.22
23	2.25	3.38	2.75	.67	.63	.29	.21
24	4.80	4.75	5.20	.60	.67	.31	.09
25	4.80	4.60	4.80	.40	.60	.29	.22
26	4.75	4.75	5.50	.60	.67	.31	.09
27	4.75	4.80	5.20	.70	.93	.46	.21
28	5.00	4.50	5.00	.33	.67	.51	.13
29	4.25	3.80	4.75	.67	.63	.29	.21
30	4.40	4.75	4.75	.60	.67	.31	.09
31	4.80	4.80	4.40	.40	.60	.29	.22
32	4.75	4.50	4.25	.67	.63	.29	.21
33	5.20	5.20	5.20	.70	.93	.46	.21
34	1.60	1.50	2.00	.67	.63	.29	.21
35	5.75	5.60	5.75	.50	.97	.35	.18
36	6.00	6.00	6.00	.60	1.00	.20	.07
37	3.80	4.60	4.20	.33	.67	.51	.13
38	4.25	4.00	4.25	.67	.63	.29	.21
39	4.60	3.60	4.40	.40	.60	.29	.22
40	4.40	4.75	4.60	.70	.93	.46	.21
41	4.50	4.67	4.00	.00	.00	.74	.19
42	5.20	6.00	5.20	.50	.97	.35	.18
43	3.60	3.40	3.80	.33	.67	.51	.13

	sex
1	2.00
2	2.00
3	1.00
4	2.00
5	2.00
6	2.00
7	1.00
8	2.00
9	2.00
10	2.00
11	1.00
12	1.00
13	1.00
14	2.00
15	2.00
16	1.00
17	1.00
18	1.00
19	1.00
20	2.00
21	2.00
22	2.00
23	2.00
24	2.00
25	1.00
26	1.00
27	2.00
28	1.00
29	2.00
30	2.00
31	1.00
32	1.00
33	2.00
34	2.00
35	1.00
36	2.00
37	1.00
38	1.00
39	2.00
40	2.00
41	1.00
42	1.00
43	2.00

Appendix IV

Correlation Matrix for all Three Cohorts

Correlation Matrix for the Year 1 Cohort

Correlations

		GROUPNO	ALEVEL	GRADE	GROUGRAD	INDEGRCO
GROUPNO	Pearson Correlation	1.000	-.106	-.028	-.097	-.147
	Sig. (2-tailed)	.	.478	.854	.518	.323
	N	47	47	47	47	47
ALEVEL	Pearson Correlation	-.106	1.000	-.065	-.127	-.111
	Sig. (2-tailed)	.478	.	.665	.395	.456
	N	47	47	47	47	47
GRADE	Pearson Correlation	-.028	-.065	1.000	.325*	.439**
	Sig. (2-tailed)	.854	.665	.	.026	.002
	N	47	47	47	47	47
GROUGRAD	Pearson Correlation	-.097	-.127	.325*	1.000	.531**
	Sig. (2-tailed)	.518	.395	.026	.	.000
	N	47	47	47	47	47
INDEGRCO	Pearson Correlation	-.147	-.111	.439**	.531**	1.000
	Sig. (2-tailed)	.323	.456	.002	.000	.
	N	47	47	47	47	47
OUTDEGRC	Pearson Correlation	.063	.122	.119	-.100	.204
	Sig. (2-tailed)	.675	.413	.425	.504	.168
	N	47	47	47	47	47
INDFRIEN	Pearson Correlation	-.060	.286	.082	.169	.237
	Sig. (2-tailed)	.691	.051	.582	.255	.109
	N	47	47	47	47	47
OUTDEFRI	Pearson Correlation	.090	-.064	-.106	.008	.063
	Sig. (2-tailed)	.548	.668	.479	.959	.672
	N	47	47	47	47	47
BETWCOM	Pearson Correlation	.029	-.055	.240	.041	.442**
	Sig. (2-tailed)	.848	.711	.104	.783	.002
	N	47	47	47	47	47
BETWFRIE	Pearson Correlation	.061	-.105	-.181	.013	.020
	Sig. (2-tailed)	.685	.483	.222	.929	.893
	N	47	47	47	47	47
INCLOCOM	Pearson Correlation	-.229	-.183	.536**	.593**	.946**
	Sig. (2-tailed)	.122	.219	.000	.000	.000
	N	47	47	47	47	47
OUTCLOCO	Pearson Correlation	.041	.119	.138	-.152	.178
	Sig. (2-tailed)	.782	.427	.354	.307	.230
	N	47	47	47	47	47
INCLOFRI	Pearson Correlation	-.162	.195	.085	.278	.404**
	Sig. (2-tailed)	.276	.189	.572	.058	.005
	N	47	47	47	47	47
OUTCLOFR	Pearson Correlation	.044	-.114	-.187	-.085	-.080
	Sig. (2-tailed)	.768	.445	.209	.571	.592
	N	47	47	47	47	47
GRDENCOM	Pearson Correlation	-.383**	-.115	.015	.364*	.427**
	Sig. (2-tailed)	.008	.443	.922	.012	.003
	N	47	47	47	47	47
GRDENFRI	Pearson Correlation	-.124	.281	.146	-.012	-.041
	Sig. (2-tailed)	.408	.055	.328	.935	.787
	N	47	47	47	47	47
EFFORT	Pearson Correlation	-.095	-.106	.146	-.071	.292*
	Sig. (2-tailed)	.525	.478	.328	.634	.047
	N	47	47	47	47	47
INTELCON	Pearson Correlation	-.104	-.080	.118	-.121	.216
	Sig. (2-tailed)	.486	.594	.431	.418	.146
	N	47	47	47	47	47

Correlations

		GROUPNO	ALEVEL	GRADE	GROUGRAD	INDEGRCO
COPERATI	Pearson Correlation	-.136	.050	-.012	-.137	.156
	Sig. (2-tailed)	.360	.738	.936	.358	.294
	N	47	47	47	47	47
GFRIEOTH	Pearson Correlation	.119	.072	.013	.099	.121
	Sig. (2-tailed)	.425	.629	.932	.509	.418
	N	47	47	47	47	47
GCOMMOTH	Pearson Correlation	.176	.166	.009	-.338*	-.115
	Sig. (2-tailed)	.238	.263	.955	.020	.440
	N	47	47	47	47	47
SEX	Pearson Correlation	.024	.316*	.078	-.192	-.051
	Sig. (2-tailed)	.874	.030	.604	.196	.736
	N	47	47	47	47	47

Correlations

		OUTDEGRC	INDFRIEN	OUTDEFRI	BETWCOM	BETWFRIE
GROUPNO	Pearson Correlation	.063	-.060	.090	.029	.061
	Sig. (2-tailed)	.675	.691	.548	.848	.685
	N	47	47	47	47	47
ALEVEL	Pearson Correlation	.122	.286	-.064	-.055	-.105
	Sig. (2-tailed)	.413	.051	.668	.711	.483
	N	47	47	47	47	47
GRADE	Pearson Correlation	.119	.082	-.106	.240	-.181
	Sig. (2-tailed)	.425	.582	.479	.104	.222
	N	47	47	47	47	47
GROUGRAD	Pearson Correlation	-.100	.169	.008	.041	.013
	Sig. (2-tailed)	.504	.255	.959	.783	.929
	N	47	47	47	47	47
INDEGRCO	Pearson Correlation	.204	.237	.063	.442**	.020
	Sig. (2-tailed)	.168	.109	.672	.002	.893
	N	47	47	47	47	47
OUTDEGRC	Pearson Correlation	1.000	.183	-.192	.721**	-.257
	Sig. (2-tailed)	.	.219	.196	.000	.081
	N	47	47	47	47	47
INDFRIEN	Pearson Correlation	.183	1.000	.418**	.158	.165
	Sig. (2-tailed)	.219	.	.003	.290	.267
	N	47	47	47	47	47
OUTDEFRI	Pearson Correlation	-.192	.418**	1.000	-.041	.862**
	Sig. (2-tailed)	.196	.003	.	.783	.000
	N	47	47	47	47	47
BETWCOM	Pearson Correlation	.721**	.158	-.041	1.000	-.089
	Sig. (2-tailed)	.000	.290	.783	.	.552
	N	47	47	47	47	47
BETWFRIE	Pearson Correlation	-.257	.165	.862**	-.089	1.000
	Sig. (2-tailed)	.081	.267	.000	.552	.
	N	47	47	47	47	47
INCLOCOM	Pearson Correlation	.164	.203	.080	.435**	.035
	Sig. (2-tailed)	.271	.171	.594	.002	.816
	N	47	47	47	47	47
OUTCLOCO	Pearson Correlation	.959**	.190	-.292*	.709**	-.380**
	Sig. (2-tailed)	.000	.201	.046	.000	.009
	N	47	47	47	47	47
INCLOFRI	Pearson Correlation	.209	.863**	.304*	.134	.159
	Sig. (2-tailed)	.158	.000	.038	.368	.287
	N	47	47	47	47	47
OUTCLOFR	Pearson Correlation	-.186	.301*	.889**	-.058	.695**
	Sig. (2-tailed)	.212	.040	.000	.697	.000
	N	47	47	47	47	47
GRDENCOM	Pearson Correlation	-.074	.090	.006	-.032	.059
	Sig. (2-tailed)	.623	.545	.969	.833	.692
	N	47	47	47	47	47
GRDENFRI	Pearson Correlation	.271	.540**	.194	.168	-.078
	Sig. (2-tailed)	.066	.000	.191	.259	.603
	N	47	47	47	47	47
EFFORT	Pearson Correlation	.231	.462**	.198	.363*	-.110
	Sig. (2-tailed)	.119	.001	.181	.012	.463
	N	47	47	47	47	47
INTELCON	Pearson Correlation	.248	.443**	.231	.359*	-.083
	Sig. (2-tailed)	.093	.002	.118	.013	.581
	N	47	47	47	47	47

Correlations

		OUTDEGRC	INDFRIEN	OUTDEFRI	BETWCOM	BETWFRIE
COPERATI	Pearson Correlation	.204	.522**	.311*	.261	.098
	Sig. (2-tailed)	.170	.000	.034	.076	.510
	N	47	47	47	47	47
GFRIEOTH	Pearson Correlation	.237	.322*	.342*	.154	.115
	Sig. (2-tailed)	.109	.027	.019	.301	.443
	N	47	47	47	47	47
GCOMMOTH	Pearson Correlation	.427**	.155	.081	.295*	-.085
	Sig. (2-tailed)	.003	.297	.587	.044	.572
	N	47	47	47	47	47
SEX	Pearson Correlation	.311*	.044	-.147	.136	-.254
	Sig. (2-tailed)	.034	.769	.324	.363	.085
	N	47	47	47	47	47

Correlations

		INCLOCOM	OUTCLOCO	INCLOFRI	OUTCLOFR	GRDENCOM
GROUPNO	Pearson Correlation	-.229	.041	-.162	.044	-.383**
	Sig. (2-tailed)	.122	.782	.276	.768	.008
	N	47	47	47	47	47
ALEVEL	Pearson Correlation	-.183	.119	.195	-.114	-.115
	Sig. (2-tailed)	.219	.427	.189	.445	.443
	N	47	47	47	47	47
GRADE	Pearson Correlation	.536**	.138	.085	-.187	.015
	Sig. (2-tailed)	.000	.354	.572	.209	.922
	N	47	47	47	47	47
GROUGRAD	Pearson Correlation	.593**	-.152	.278	-.085	.364*
	Sig. (2-tailed)	.000	.307	.058	.571	.012
	N	47	47	47	47	47
INDEGRCO	Pearson Correlation	.946**	.178	.404**	-.080	.427**
	Sig. (2-tailed)	.000	.230	.005	.592	.003
	N	47	47	47	47	47
OUTDEGRC	Pearson Correlation	.164	.959**	.209	-.186	-.074
	Sig. (2-tailed)	.271	.000	.158	.212	.623
	N	47	47	47	47	47
INDFRIEN	Pearson Correlation	.203	.190	.863**	.301*	.090
	Sig. (2-tailed)	.171	.201	.000	.040	.545
	N	47	47	47	47	47
OUTDEFRI	Pearson Correlation	.080	-.292*	.304*	.889**	.006
	Sig. (2-tailed)	.594	.046	.038	.000	.969
	N	47	47	47	47	47
BETWCOM	Pearson Correlation	.435**	.709**	.134	-.058	-.032
	Sig. (2-tailed)	.002	.000	.368	.697	.833
	N	47	47	47	47	47
BETWFRIE	Pearson Correlation	.035	-.380**	.159	.695**	.059
	Sig. (2-tailed)	.816	.009	.287	.000	.692
	N	47	47	47	47	47
INCLOCOM	Pearson Correlation	1.000	.140	.399**	-.038	.438**
	Sig. (2-tailed)	.	.347	.005	.802	.002
	N	47	47	47	47	47
OUTCLOCO	Pearson Correlation	.140	1.000	.215	-.271	-.063
	Sig. (2-tailed)	.347	.	.146	.065	.676
	N	47	47	47	47	47
INCLOFRI	Pearson Correlation	.399**	.215	1.000	.129	.302*
	Sig. (2-tailed)	.005	.146	.	.386	.039
	N	47	47	47	47	47
OUTCLOFR	Pearson Correlation	-.038	-.271	.129	1.000	-.093
	Sig. (2-tailed)	.802	.065	.386	.	.534
	N	47	47	47	47	47
GRDENCOM	Pearson Correlation	.438**	-.063	.302*	-.093	1.000
	Sig. (2-tailed)	.002	.676	.039	.534	.
	N	47	47	47	47	47
GRDENFRI	Pearson Correlation	-.012	.236	.376**	.247	-.418**
	Sig. (2-tailed)	.938	.111	.009	.095	.003
	N	47	47	47	47	47
EFFORT	Pearson Correlation	.271	.281	.287	.288*	-.172
	Sig. (2-tailed)	.066	.056	.051	.050	.247
	N	47	47	47	47	47
INTELCON	Pearson Correlation	.212	.263	.240	.321*	-.203
	Sig. (2-tailed)	.152	.074	.104	.028	.172
	N	47	47	47	47	47

Correlations

		INCLOCOM	OUTCLOCO	INCLOFRI	OUTCLOFR	GRDENCOM
COPERATI	Pearson Correlation	.118	.233	.333*	.380**	-.134
	Sig. (2-tailed)	.430	.114	.022	.008	.370
	N	47	47	47	47	47
GFRIEOTH	Pearson Correlation	.128	.210	.301*	.396**	-.179
	Sig. (2-tailed)	.391	.157	.040	.006	.230
	N	47	47	47	47	47
GCOMMOTH	Pearson Correlation	-.120	.379**	.047	.165	-.385**
	Sig. (2-tailed)	.423	.009	.752	.267	.007
	N	47	47	47	47	47
SEX	Pearson Correlation	-.117	.360*	-.065	-.131	-.003
	Sig. (2-tailed)	.434	.013	.662	.380	.987
	N	47	47	47	47	47

Correlations

		GRDENFRI	EFFORT	INTELCON	COPERATI	GFRIEOTH
GROUPNO	Pearson Correlation	-.124	-.095	-.104	-.136	.119
	Sig. (2-tailed)	.408	.525	.486	.360	.425
	N	47	47	47	47	47
ALEVEL	Pearson Correlation	.281	-.106	-.080	.050	.072
	Sig. (2-tailed)	.055	.478	.594	.738	.629
	N	47	47	47	47	47
GRADE	Pearson Correlation	.146	.146	.118	-.012	.013
	Sig. (2-tailed)	.328	.328	.431	.936	.932
	N	47	47	47	47	47
GROUGRAD	Pearson Correlation	-.012	-.071	-.121	-.137	.099
	Sig. (2-tailed)	.935	.634	.418	.358	.509
	N	47	47	47	47	47
INDEGRCO	Pearson Correlation	-.041	.292*	.216	.156	.121
	Sig. (2-tailed)	.787	.047	.146	.294	.418
	N	47	47	47	47	47
OUTDEGRC	Pearson Correlation	.271	.231	.248	.204	.237
	Sig. (2-tailed)	.066	.119	.093	.170	.109
	N	47	47	47	47	47
INDFRIEN	Pearson Correlation	.540**	.462**	.443**	.522**	.322*
	Sig. (2-tailed)	.000	.001	.002	.000	.027
	N	47	47	47	47	47
OUTDEFRI	Pearson Correlation	.194	.198	.231	.311*	.342*
	Sig. (2-tailed)	.191	.181	.118	.034	.019
	N	47	47	47	47	47
BETWCOM	Pearson Correlation	.168	.363*	.359*	.261	.154
	Sig. (2-tailed)	.259	.012	.013	.076	.301
	N	47	47	47	47	47
BETWFRIE	Pearson Correlation	-.078	-.110	-.083	.098	.115
	Sig. (2-tailed)	.603	.463	.581	.510	.443
	N	47	47	47	47	47
INCLOCOM	Pearson Correlation	-.012	.271	.212	.118	.128
	Sig. (2-tailed)	.938	.066	.152	.430	.391
	N	47	47	47	47	47
OUTCLOCO	Pearson Correlation	.236	.281	.263	.233	.210
	Sig. (2-tailed)	.111	.056	.074	.114	.157
	N	47	47	47	47	47
INCLOFRI	Pearson Correlation	.376**	.287	.240	.333*	.301*
	Sig. (2-tailed)	.009	.051	.104	.022	.040
	N	47	47	47	47	47
OUTCLOFR	Pearson Correlation	.247	.288*	.321*	.380**	.396**
	Sig. (2-tailed)	.095	.050	.028	.008	.006
	N	47	47	47	47	47
GRDENCOM	Pearson Correlation	-.418**	-.172	-.203	-.134	-.179
	Sig. (2-tailed)	.003	.247	.172	.370	.230
	N	47	47	47	47	47
GRDENFRI	Pearson Correlation	1.000	.402**	.431**	.367*	.353*
	Sig. (2-tailed)	.	.005	.003	.011	.015
	N	47	47	47	47	47
EFFORT	Pearson Correlation	.402**	1.000	.958**	.877**	.356*
	Sig. (2-tailed)	.005	.	.000	.000	.014
	N	47	47	47	47	47
INTELCON	Pearson Correlation	.431**	.958**	1.000	.860**	.359*
	Sig. (2-tailed)	.003	.000	.	.000	.013
	N	47	47	47	47	47

Correlations

		GRDENFRI	EFFORT	INTELCON	COPERATI	GFRIEOTH
COPERATI	Pearson Correlation	.367*	.877**	.860**	1.000	.323*
	Sig. (2-tailed)	.011	.000	.000	.	.027
	N	47	47	47	47	47
GFRIEOTH	Pearson Correlation	.353*	.356*	.359*	.323*	1.000
	Sig. (2-tailed)	.015	.014	.013	.027	.
	N	47	47	47	47	47
GCOMMOTH	Pearson Correlation	.577**	.283	.298*	.255	.279
	Sig. (2-tailed)	.000	.054	.042	.084	.058
	N	47	47	47	47	47
SEX	Pearson Correlation	.185	.086	.022	.080	.114
	Sig. (2-tailed)	.212	.566	.886	.593	.447
	N	47	47	47	47	47

Correlations

		GCOMMOTH	SEX
GROUPNO	Pearson Correlation	.176	.024
	Sig. (2-tailed)	.238	.874
	N	47	47
ALEVEL	Pearson Correlation	.166	.316*
	Sig. (2-tailed)	.263	.030
	N	47	47
GRADE	Pearson Correlation	.009	.078
	Sig. (2-tailed)	.955	.604
	N	47	47
GROUGRAD	Pearson Correlation	-.338*	-.192
	Sig. (2-tailed)	.020	.196
	N	47	47
INDEGRCO	Pearson Correlation	-.115	-.051
	Sig. (2-tailed)	.440	.736
	N	47	47
OUTDEGRC	Pearson Correlation	.427**	.311*
	Sig. (2-tailed)	.003	.034
	N	47	47
INDFRIEN	Pearson Correlation	.155	.044
	Sig. (2-tailed)	.297	.769
	N	47	47
OUTDEFRI	Pearson Correlation	.081	-.147
	Sig. (2-tailed)	.587	.324
	N	47	47
BETWCOM	Pearson Correlation	.295*	.136
	Sig. (2-tailed)	.044	.363
	N	47	47
BETWFRIE	Pearson Correlation	-.085	-.254
	Sig. (2-tailed)	.572	.085
	N	47	47
INCLOCOM	Pearson Correlation	-.120	-.117
	Sig. (2-tailed)	.423	.434
	N	47	47
OUTCLOCO	Pearson Correlation	.379**	.360*
	Sig. (2-tailed)	.009	.013
	N	47	47
INCLOFRI	Pearson Correlation	.047	-.065
	Sig. (2-tailed)	.752	.662
	N	47	47
OUTCLOFR	Pearson Correlation	.165	-.131
	Sig. (2-tailed)	.267	.380
	N	47	47
GRDENCOM	Pearson Correlation	-.385**	-.003
	Sig. (2-tailed)	.007	.987
	N	47	47
GRDENFRI	Pearson Correlation	.577**	.185
	Sig. (2-tailed)	.000	.212
	N	47	47
EFFORT	Pearson Correlation	.283	.086
	Sig. (2-tailed)	.054	.566
	N	47	47
INTELCON	Pearson Correlation	.298*	.022
	Sig. (2-tailed)	.042	.886
	N	47	47

Correlations

		GCOMMOTH	SEX
COPERATI	Pearson Correlation	.255	.080
	Sig. (2-tailed)	.084	.593
	N	47	47
GFRIEOTH	Pearson Correlation	.279	.114
	Sig. (2-tailed)	.058	.447
	N	47	47
GCOMMOTH	Pearson Correlation	1.000	.317*
	Sig. (2-tailed)	.	.030
	N	47	47
SEX	Pearson Correlation	.317*	1.000
	Sig. (2-tailed)	.030	.
	N	47	47

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlation Matrix for the Year 2 Cohort

Correlations

		GROUPNO	ALEVEL	GRADE	GROUGRAD	INDEGRCO
GROUPNO	Pearson Correlation	1.000	.234	-.053	-.136	.093
	Sig. (2-tailed)	.	.146	.746	.401	.568
	N	40	40	40	40	40
ALEVEL	Pearson Correlation	.234	1.000	.332*	.114	.102
	Sig. (2-tailed)	.146	.	.037	.483	.530
	N	40	40	40	40	40
GRADE	Pearson Correlation	-.053	.332*	1.000	.510**	.463**
	Sig. (2-tailed)	.746	.037	.	.001	.003
	N	40	40	40	40	40
GROUGRAD	Pearson Correlation	-.136	.114	.510**	1.000	.490**
	Sig. (2-tailed)	.401	.483	.001	.	.001
	N	40	40	40	40	40
INDEGRCO	Pearson Correlation	.093	.102	.463**	.490**	1.000
	Sig. (2-tailed)	.568	.530	.003	.001	.
	N	40	40	40	40	40
OUTDEGRC	Pearson Correlation	.291	.145	.145	.162	.114
	Sig. (2-tailed)	.069	.373	.373	.317	.483
	N	40	40	40	40	40
INDFRIEN	Pearson Correlation	-.151	.139	.360*	.205	.285
	Sig. (2-tailed)	.351	.391	.023	.204	.074
	N	40	40	40	40	40
OUTDEFRI	Pearson Correlation	-.010	-.043	.116	.167	.152
	Sig. (2-tailed)	.952	.791	.474	.304	.349
	N	40	40	40	40	40
BETWCOM	Pearson Correlation	.306	.174	.278	.101	.443**
	Sig. (2-tailed)	.055	.283	.082	.533	.004
	N	40	40	40	40	40
BETWFRIE	Pearson Correlation	.056	.179	.174	-.011	.164
	Sig. (2-tailed)	.733	.269	.282	.947	.312
	N	40	40	40	40	40
INCLOCOM	Pearson Correlation	.114	.110	.460**	.485**	.997**
	Sig. (2-tailed)	.482	.500	.003	.002	.000
	N	40	40	40	40	40
OUTCLOCO	Pearson Correlation	.281	.112	.121	.094	.044
	Sig. (2-tailed)	.079	.490	.458	.565	.789
	N	40	40	40	40	40
INCLOFRI	Pearson Correlation	-.043	.162	.294	.363*	.392*
	Sig. (2-tailed)	.791	.318	.066	.021	.012
	N	40	40	40	40	40
OUTCLOFR	Pearson Correlation	.019	-.122	-.072	-.241	-.039
	Sig. (2-tailed)	.907	.454	.661	.133	.810
	N	40	40	40	40	40
GRDENCOM	Pearson Correlation	.271	.159	.367*	.445**	.378*
	Sig. (2-tailed)	.090	.327	.020	.004	.016
	N	40	40	40	40	40
GRDENFRI	Pearson Correlation	.047	.165	.272	.292	.368*
	Sig. (2-tailed)	.772	.310	.089	.068	.019
	N	40	40	40	40	40
EFFORT	Pearson Correlation	-.095	-.038	.277	.138	.061
	Sig. (2-tailed)	.560	.816	.083	.394	.709
	N	40	40	40	40	40
INTELCON	Pearson Correlation	.166	-.161	.100	.222	.292
	Sig. (2-tailed)	.306	.320	.539	.168	.067
	N	40	40	40	40	40

Correlations

		GROUPNO	ALEVEL	GRADE	GROUGRAD	INDEGRCO
COPERATI	Pearson Correlation	.166	-.161	.100	.222	.292
	Sig. (2-tailed)	.306	.320	.539	.168	.067
	N	40	40	40	40	40
GFRIEOTH	Pearson Correlation	-.349*	-.179	.060	.611**	.356*
	Sig. (2-tailed)	.028	.268	.713	.000	.024
	N	40	40	40	40	40
GCOMMOTH	Pearson Correlation	.838**	.265	.231	.104	.335*
	Sig. (2-tailed)	.000	.098	.152	.524	.034
	N	40	40	40	40	40

Correlations

		OUTDEGRC	INDFRIEN	OUTDEFRI	BETWCOM	BETWFRIE
GROUPNO	Pearson Correlation	.291	-.151	-.010	.306	.056
	Sig. (2-tailed)	.069	.351	.952	.055	.733
	N	40	40	40	40	40
ALEVEL	Pearson Correlation	.145	.139	-.043	.174	.179
	Sig. (2-tailed)	.373	.391	.791	.283	.269
	N	40	40	40	40	40
GRADE	Pearson Correlation	.145	.360*	.116	.278	.174
	Sig. (2-tailed)	.373	.023	.474	.082	.282
	N	40	40	40	40	40
GROUGRAD	Pearson Correlation	.162	.205	.167	.101	-.011
	Sig. (2-tailed)	.317	.204	.304	.533	.947
	N	40	40	40	40	40
INDEGRCO	Pearson Correlation	.114	.285	.152	.443**	.164
	Sig. (2-tailed)	.483	.074	.349	.004	.312
	N	40	40	40	40	40
OUTDEGRC	Pearson Correlation	1.000	-.101	-.038	.780**	.162
	Sig. (2-tailed)	.	.533	.818	.000	.318
	N	40	40	40	40	40
INDFRIEN	Pearson Correlation	-.101	1.000	.321*	.028	.593**
	Sig. (2-tailed)	.533	.	.043	.864	.000
	N	40	40	40	40	40
OUTDEFRI	Pearson Correlation	-.038	.321*	1.000	.102	.611**
	Sig. (2-tailed)	.818	.043	.	.531	.000
	N	40	40	40	40	40
BETWCOM	Pearson Correlation	.780**	.028	.102	1.000	.358*
	Sig. (2-tailed)	.000	.864	.531	.	.023
	N	40	40	40	40	40
BETWFRIE	Pearson Correlation	.162	.593**	.611**	.358*	1.000
	Sig. (2-tailed)	.318	.000	.000	.023	.
	N	40	40	40	40	40
INCLOCOM	Pearson Correlation	.118	.283	.169	.447**	.162
	Sig. (2-tailed)	.469	.077	.297	.004	.319
	N	40	40	40	40	40
OUTCLOCO	Pearson Correlation	.990**	-.115	-.030	.773**	.166
	Sig. (2-tailed)	.000	.481	.856	.000	.305
	N	40	40	40	40	40
INCLOFRI	Pearson Correlation	.026	.824**	.308	.119	.443**
	Sig. (2-tailed)	.874	.000	.054	.465	.004
	N	40	40	40	40	40
OUTCLOFR	Pearson Correlation	-.061	-.109	.524**	.059	.378*
	Sig. (2-tailed)	.710	.505	.001	.717	.016
	N	40	40	40	40	40
GRDENCOM	Pearson Correlation	.220	-.109	-.008	.218	-.013
	Sig. (2-tailed)	.172	.503	.960	.177	.935
	N	40	40	40	40	40
GRDENFRI	Pearson Correlation	.111	.031	.084	.128	.029
	Sig. (2-tailed)	.494	.849	.607	.431	.858
	N	40	40	40	40	40
EFFORT	Pearson Correlation	.353*	.296	.048	.343*	.180
	Sig. (2-tailed)	.025	.064	.768	.030	.267
	N	40	40	40	40	40
INTELCON	Pearson Correlation	-.108	.457**	.497**	-.011	.356*
	Sig. (2-tailed)	.507	.003	.001	.946	.024
	N	40	40	40	40	40

Correlations

		OUTDEGRC	INDFRIEN	OUTDEFRI	BETWCOM	BETWFRIE
COPERATI	Pearson Correlation	-.108	.457**	.497**	-.011	.356*
	Sig. (2-tailed)	.507	.003	.001	.946	.024
	N	40	40	40	40	40
GFRIEOTH	Pearson Correlation	-.052	.211	.166	-.040	.107
	Sig. (2-tailed)	.748	.191	.307	.808	.510
	N	40	40	40	40	40
GCOMMOTH	Pearson Correlation	.342*	-.017	.011	.359*	.062
	Sig. (2-tailed)	.031	.916	.948	.023	.704
	N	40	40	40	40	40

Correlations

		INCLOCOM	OUTCLOCO	INCLOFRI	OUTCLOFR	GRDENCOM
GROUPNO	Pearson Correlation	.114	.281	-.043	.019	.271
	Sig. (2-tailed)	.482	.079	.791	.907	.090
	N	40	40	40	40	40
ALEVEL	Pearson Correlation	.110	.112	.162	-.122	.159
	Sig. (2-tailed)	.500	.490	.318	.454	.327
	N	40	40	40	40	40
GRADE	Pearson Correlation	.460**	.121	.294	-.072	.367*
	Sig. (2-tailed)	.003	.458	.066	.661	.020
	N	40	40	40	40	40
GROUGRAD	Pearson Correlation	.485**	.094	.363*	-.241	.445**
	Sig. (2-tailed)	.002	.565	.021	.133	.004
	N	40	40	40	40	40
INDEGRCO	Pearson Correlation	.997**	.044	.392*	-.039	.378*
	Sig. (2-tailed)	.000	.789	.012	.810	.016
	N	40	40	40	40	40
OUTDEGRC	Pearson Correlation	.118	.990**	.026	-.061	.220
	Sig. (2-tailed)	.469	.000	.874	.710	.172
	N	40	40	40	40	40
INDFRIEN	Pearson Correlation	.283	-.115	.824**	-.109	-.109
	Sig. (2-tailed)	.077	.481	.000	.505	.503
	N	40	40	40	40	40
OUTDEFRI	Pearson Correlation	.169	-.030	.308	.524**	-.008
	Sig. (2-tailed)	.297	.856	.054	.001	.960
	N	40	40	40	40	40
BETWCOM	Pearson Correlation	.447**	.773**	.119	.059	.218
	Sig. (2-tailed)	.004	.000	.465	.717	.177
	N	40	40	40	40	40
BETWFRIE	Pearson Correlation	.162	.166	.443**	.378*	-.013
	Sig. (2-tailed)	.319	.305	.004	.016	.935
	N	40	40	40	40	40
INCLOCOM	Pearson Correlation	1.000	.050	.396*	-.050	.390*
	Sig. (2-tailed)	.	.760	.011	.758	.013
	N	40	40	40	40	40
OUTCLOCO	Pearson Correlation	.050	1.000	.005	-.062	.187
	Sig. (2-tailed)	.760	.	.975	.702	.248
	N	40	40	40	40	40
INCLOFRI	Pearson Correlation	.396*	.005	1.000	-.412**	-.076
	Sig. (2-tailed)	.011	.975	.	.008	.642
	N	40	40	40	40	40
OUTCLOFR	Pearson Correlation	-.050	-.062	-.412**	1.000	.012
	Sig. (2-tailed)	.758	.702	.008	.	.942
	N	40	40	40	40	40
GRDENCOM	Pearson Correlation	.390*	.187	-.076	.012	1.000
	Sig. (2-tailed)	.013	.248	.642	.942	.
	N	40	40	40	40	40
GRDENFRI	Pearson Correlation	.376*	.075	.040	.011	.372*
	Sig. (2-tailed)	.017	.644	.806	.945	.018
	N	40	40	40	40	40
EFFORT	Pearson Correlation	.063	.352*	.367*	-.237	-.035
	Sig. (2-tailed)	.701	.026	.020	.142	.830
	N	40	40	40	40	40
INTELCON	Pearson Correlation	.300	-.140	.520**	.048	.083
	Sig. (2-tailed)	.060	.390	.001	.768	.612
	N	40	40	40	40	40

Correlations

		INCLOCOM	OUTCLOCO	INCLOFRI	OUTCLOFR	GRDENCOM
COPERATI	Pearson Correlation	.300	-.140	.520**	.048	.083
	Sig. (2-tailed)	.060	.390	.001	.768	.612
	N	40	40	40	40	40
GFRIEOTH	Pearson Correlation	.341*	-.107	.313*	-.083	.156
	Sig. (2-tailed)	.031	.513	.049	.609	.337
	N	40	40	40	40	40
GCOMMOTH	Pearson Correlation	.342*	.307	.127	-.027	.327*
	Sig. (2-tailed)	.031	.054	.435	.870	.040
	N	40	40	40	40	40

Correlations

		GRDENFRI	EFFORT	INTELCON	COPERATI
GROUPNO	Pearson Correlation	.047	-.095	.166	.166
	Sig. (2-tailed)	.772	.560	.306	.306
	N	40	40	40	40
ALEVEL	Pearson Correlation	.165	-.038	-.161	-.161
	Sig. (2-tailed)	.310	.816	.320	.320
	N	40	40	40	40
GRADE	Pearson Correlation	.272	.277	.100	.100
	Sig. (2-tailed)	.089	.083	.539	.539
	N	40	40	40	40
GROUGRAD	Pearson Correlation	.292	.138	.222	.222
	Sig. (2-tailed)	.068	.394	.168	.168
	N	40	40	40	40
INDEGRCO	Pearson Correlation	.368*	.061	.292	.292
	Sig. (2-tailed)	.019	.709	.067	.067
	N	40	40	40	40
OUTDEGRC	Pearson Correlation	.111	.353*	-.108	-.108
	Sig. (2-tailed)	.494	.025	.507	.507
	N	40	40	40	40
INDFRIEN	Pearson Correlation	.031	.296	.457**	.457**
	Sig. (2-tailed)	.849	.064	.003	.003
	N	40	40	40	40
OUTDEFRI	Pearson Correlation	.084	.048	.497**	.497**
	Sig. (2-tailed)	.607	.768	.001	.001
	N	40	40	40	40
BETWCOM	Pearson Correlation	.128	.343*	-.011	-.011
	Sig. (2-tailed)	.431	.030	.946	.946
	N	40	40	40	40
BETWFRIE	Pearson Correlation	.029	.180	.356*	.356*
	Sig. (2-tailed)	.858	.267	.024	.024
	N	40	40	40	40
INCLOCOM	Pearson Correlation	.376*	.063	.300	.300
	Sig. (2-tailed)	.017	.701	.060	.060
	N	40	40	40	40
OUTCLOCO	Pearson Correlation	.075	.352*	-.140	-.140
	Sig. (2-tailed)	.644	.026	.390	.390
	N	40	40	40	40
INCLOFRI	Pearson Correlation	.040	.367*	.520**	.520**
	Sig. (2-tailed)	.806	.020	.001	.001
	N	40	40	40	40
OUTCLOFR	Pearson Correlation	.011	-.237	.048	.048
	Sig. (2-tailed)	.945	.142	.768	.768
	N	40	40	40	40
GRDENCOM	Pearson Correlation	.372*	-.035	.083	.083
	Sig. (2-tailed)	.018	.830	.612	.612
	N	40	40	40	40
GRDENFRI	Pearson Correlation	1.000	.127	.116	.116
	Sig. (2-tailed)	.	.436	.475	.475
	N	40	40	40	40
EFFORT	Pearson Correlation	.127	1.000	.298	.298
	Sig. (2-tailed)	.436	.	.061	.061
	N	40	40	40	40
INTELCON	Pearson Correlation	.116	.298	1.000	1.000**
	Sig. (2-tailed)	.475	.061	.	.000
	N	40	40	40	40

Correlations

		GRDENFRI	EFFORT	INTELCON	COPERATI
COPERATI	Pearson Correlation	.116	.298	1.000**	1.000
	Sig. (2-tailed)	.475	.061	.000	.
	N	40	40	40	40
GFRIEOTH	Pearson Correlation	.300	.141	.238	.238
	Sig. (2-tailed)	.060	.385	.139	.139
	N	40	40	40	40
GCOMMOTH	Pearson Correlation	.237	-.140	.125	.125
	Sig. (2-tailed)	.141	.387	.442	.442
	N	40	40	40	40

Correlations

		GFRIEOTH	GCOMMOTH
GROUPNO	Pearson Correlation	-.349*	.838**
	Sig. (2-tailed)	.028	.000
	N	40	40
ALEVEL	Pearson Correlation	-.179	.265
	Sig. (2-tailed)	.268	.098
	N	40	40
GRADE	Pearson Correlation	.060	.231
	Sig. (2-tailed)	.713	.152
	N	40	40
GROUGRAD	Pearson Correlation	.611**	.104
	Sig. (2-tailed)	.000	.524
	N	40	40
INDEGRCO	Pearson Correlation	.356*	.335*
	Sig. (2-tailed)	.024	.034
	N	40	40
OUTDEGRC	Pearson Correlation	-.052	.342*
	Sig. (2-tailed)	.748	.031
	N	40	40
INDFRIEN	Pearson Correlation	.211	-.017
	Sig. (2-tailed)	.191	.916
	N	40	40
OUTDEFRI	Pearson Correlation	.166	.011
	Sig. (2-tailed)	.307	.948
	N	40	40
BETWCOM	Pearson Correlation	-.040	.359*
	Sig. (2-tailed)	.808	.023
	N	40	40
BETWFRIE	Pearson Correlation	.107	.062
	Sig. (2-tailed)	.510	.704
	N	40	40
INCLOCOM	Pearson Correlation	.341*	.342*
	Sig. (2-tailed)	.031	.031
	N	40	40
OUTCLOCO	Pearson Correlation	-.107	.307
	Sig. (2-tailed)	.513	.054
	N	40	40
INCLOFRI	Pearson Correlation	.313*	.127
	Sig. (2-tailed)	.049	.435
	N	40	40
OUTCLOFR	Pearson Correlation	-.083	-.027
	Sig. (2-tailed)	.609	.870
	N	40	40
GRDENCOM	Pearson Correlation	.156	.327*
	Sig. (2-tailed)	.337	.040
	N	40	40
GRDENFRI	Pearson Correlation	.300	.237
	Sig. (2-tailed)	.060	.141
	N	40	40
EFFORT	Pearson Correlation	.141	-.140
	Sig. (2-tailed)	.385	.387
	N	40	40
INTELCON	Pearson Correlation	.238	.125
	Sig. (2-tailed)	.139	.442
	N	40	40

Correlations

		GFRIEOTH	GCOMMOTH
COPERATI	Pearson Correlation	.238	.125
	Sig. (2-tailed)	.139	.442
	N	40	40
GFRIEOTH	Pearson Correlation	1.000	-.227
	Sig. (2-tailed)	.	.158
	N	40	40
GCOMMOTH	Pearson Correlation	-.227	1.000
	Sig. (2-tailed)	.158	.
	N	40	40

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation Matrix for the Year 3 Cohort

Correlations

		GROUPNO	ALEVEL	GRADE	GROUGRAD	INDEGRCO
GROUPNO	Pearson Correlation	1.000	.234	-.053	-.136	.093
	Sig. (2-tailed)	.	.146	.746	.401	.568
	N	40	40	40	40	40
ALEVEL	Pearson Correlation	.234	1.000	.332*	.114	.102
	Sig. (2-tailed)	.146	.	.037	.483	.530
	N	40	40	40	40	40
GRADE	Pearson Correlation	-.053	.332*	1.000	.510**	.463**
	Sig. (2-tailed)	.746	.037	.	.001	.003
	N	40	40	40	40	40
GROUGRAD	Pearson Correlation	-.136	.114	.510**	1.000	.490**
	Sig. (2-tailed)	.401	.483	.001	.	.001
	N	40	40	40	40	40
INDEGRCO	Pearson Correlation	.093	.102	.463**	.490**	1.000
	Sig. (2-tailed)	.568	.530	.003	.001	.
	N	40	40	40	40	40
OUTDEGRC	Pearson Correlation	.291	.145	.145	.162	.114
	Sig. (2-tailed)	.069	.373	.373	.317	.483
	N	40	40	40	40	40
INDFRIEN	Pearson Correlation	-.151	.139	.360*	.205	.285
	Sig. (2-tailed)	.351	.391	.023	.204	.074
	N	40	40	40	40	40
OUTDEFRI	Pearson Correlation	-.010	-.043	.116	.167	.152
	Sig. (2-tailed)	.952	.791	.474	.304	.349
	N	40	40	40	40	40
BETWCOM	Pearson Correlation	.306	.174	.278	.101	.443**
	Sig. (2-tailed)	.055	.283	.082	.533	.004
	N	40	40	40	40	40
BETWFRIE	Pearson Correlation	.056	.179	.174	-.011	.164
	Sig. (2-tailed)	.733	.269	.282	.947	.312
	N	40	40	40	40	40
INCLOCOM	Pearson Correlation	.114	.110	.460**	.485**	.997**
	Sig. (2-tailed)	.482	.500	.003	.002	.000
	N	40	40	40	40	40
OUTCLOCO	Pearson Correlation	.281	.112	.121	.094	.044
	Sig. (2-tailed)	.079	.490	.458	.565	.789
	N	40	40	40	40	40
INCLOFRI	Pearson Correlation	-.043	.162	.294	.363*	.392*
	Sig. (2-tailed)	.791	.318	.066	.021	.012
	N	40	40	40	40	40
OUTCLOFR	Pearson Correlation	.019	-.122	-.072	-.241	-.039
	Sig. (2-tailed)	.907	.454	.661	.133	.810
	N	40	40	40	40	40
GRDENCOM	Pearson Correlation	.271	.159	.367*	.445**	.378*
	Sig. (2-tailed)	.090	.327	.020	.004	.016
	N	40	40	40	40	40
GRDENFRI	Pearson Correlation	.047	.165	.272	.292	.368*
	Sig. (2-tailed)	.772	.310	.089	.068	.019
	N	40	40	40	40	40
EFFORT	Pearson Correlation	-.095	-.038	.277	.138	.061
	Sig. (2-tailed)	.560	.816	.083	.394	.709
	N	40	40	40	40	40
INTELCON	Pearson Correlation	.166	-.161	.100	.222	.292
	Sig. (2-tailed)	.306	.320	.539	.168	.067
	N	40	40	40	40	40

Correlations

		GROUPNO	ALEVEL	GRADE	GROUGRAD	INDEGRCO
COPERATI	Pearson Correlation	.166	-.161	.100	.222	.292
	Sig. (2-tailed)	.306	.320	.539	.168	.067
	N	40	40	40	40	40
GFRIEOTH	Pearson Correlation	-.349*	-.179	.060	.611**	.356*
	Sig. (2-tailed)	.028	.268	.713	.000	.024
	N	40	40	40	40	40
GCOMMOTH	Pearson Correlation	.838**	.265	.231	.104	.335*
	Sig. (2-tailed)	.000	.098	.152	.524	.034
	N	40	40	40	40	40

Correlations

		OUTDEGRC	INDFRIEN	OUTDEFRI	BETWCOM	BETWFRIE
GROUPNO	Pearson Correlation	.291	-.151	-.010	.306	.056
	Sig. (2-tailed)	.069	.351	.952	.055	.733
	N	40	40	40	40	40
ALEVEL	Pearson Correlation	.145	.139	-.043	.174	.179
	Sig. (2-tailed)	.373	.391	.791	.283	.269
	N	40	40	40	40	40
GRADE	Pearson Correlation	.145	.360*	.116	.278	.174
	Sig. (2-tailed)	.373	.023	.474	.082	.282
	N	40	40	40	40	40
GROUGRAD	Pearson Correlation	.162	.205	.167	.101	-.011
	Sig. (2-tailed)	.317	.204	.304	.533	.947
	N	40	40	40	40	40
INDEGRCO	Pearson Correlation	.114	.285	.152	.443**	.164
	Sig. (2-tailed)	.483	.074	.349	.004	.312
	N	40	40	40	40	40
OUTDEGRC	Pearson Correlation	1.000	-.101	-.038	.780**	.162
	Sig. (2-tailed)	.	.533	.818	.000	.318
	N	40	40	40	40	40
INDFRIEN	Pearson Correlation	-.101	1.000	.321*	.028	.593**
	Sig. (2-tailed)	.533	.	.043	.864	.000
	N	40	40	40	40	40
OUTDEFRI	Pearson Correlation	-.038	.321*	1.000	.102	.611**
	Sig. (2-tailed)	.818	.043	.	.531	.000
	N	40	40	40	40	40
BETWCOM	Pearson Correlation	.780**	.028	.102	1.000	.358*
	Sig. (2-tailed)	.000	.864	.531	.	.023
	N	40	40	40	40	40
BETWFRIE	Pearson Correlation	.162	.593**	.611**	.358*	1.000
	Sig. (2-tailed)	.318	.000	.000	.023	.
	N	40	40	40	40	40
INCLOCOM	Pearson Correlation	.118	.283	.169	.447**	.162
	Sig. (2-tailed)	.469	.077	.297	.004	.319
	N	40	40	40	40	40
OUTCLOCO	Pearson Correlation	.990**	-.115	-.030	.773**	.166
	Sig. (2-tailed)	.000	.481	.856	.000	.305
	N	40	40	40	40	40
INCLOFRI	Pearson Correlation	.026	.824**	.308	.119	.443**
	Sig. (2-tailed)	.874	.000	.054	.465	.004
	N	40	40	40	40	40
OUTCLOFR	Pearson Correlation	-.061	-.109	.524**	.059	.378*
	Sig. (2-tailed)	.710	.505	.001	.717	.016
	N	40	40	40	40	40
GRDENCOM	Pearson Correlation	.220	-.109	-.008	.218	-.013
	Sig. (2-tailed)	.172	.503	.960	.177	.935
	N	40	40	40	40	40
GRDENFRI	Pearson Correlation	.111	.031	.084	.128	.029
	Sig. (2-tailed)	.494	.849	.607	.431	.858
	N	40	40	40	40	40
EFFORT	Pearson Correlation	.353*	.296	.048	.343*	.180
	Sig. (2-tailed)	.025	.064	.768	.030	.267
	N	40	40	40	40	40
INTELCON	Pearson Correlation	-.108	.457**	.497**	-.011	.356*
	Sig. (2-tailed)	.507	.003	.001	.946	.024
	N	40	40	40	40	40

Correlations

		OUTDEGRC	INDFRIEN	OUTDEFRI	BETWCOM	BETWFRIE
COPERATI	Pearson Correlation	-.108	.457**	.497**	-.011	.356*
	Sig. (2-tailed)	.507	.003	.001	.946	.024
	N	40	40	40	40	40
GFRIEOTH	Pearson Correlation	-.052	.211	.166	-.040	.107
	Sig. (2-tailed)	.748	.191	.307	.808	.510
	N	40	40	40	40	40
GCOMMOTH	Pearson Correlation	.342*	-.017	.011	.359*	.062
	Sig. (2-tailed)	.031	.916	.948	.023	.704
	N	40	40	40	40	40

Correlations

		INCLOCOM	OUTCLOCO	INCLOFRI	OUTCLOFR	GRDENCOM
GROUPNO	Pearson Correlation	.114	.281	-.043	.019	.271
	Sig. (2-tailed)	.482	.079	.791	.907	.090
	N	40	40	40	40	40
ALEVEL	Pearson Correlation	.110	.112	.162	-.122	.159
	Sig. (2-tailed)	.500	.490	.318	.454	.327
	N	40	40	40	40	40
GRADE	Pearson Correlation	.460**	.121	.294	-.072	.367*
	Sig. (2-tailed)	.003	.458	.066	.661	.020
	N	40	40	40	40	40
GROUGRAD	Pearson Correlation	.485**	.094	.363*	-.241	.445**
	Sig. (2-tailed)	.002	.565	.021	.133	.004
	N	40	40	40	40	40
INDEGRCO	Pearson Correlation	.997**	.044	.392*	-.039	.378*
	Sig. (2-tailed)	.000	.789	.012	.810	.016
	N	40	40	40	40	40
OUTDEGRC	Pearson Correlation	.118	.990**	.026	-.061	.220
	Sig. (2-tailed)	.469	.000	.874	.710	.172
	N	40	40	40	40	40
INDFRIEN	Pearson Correlation	.283	-.115	.824**	-.109	-.109
	Sig. (2-tailed)	.077	.481	.000	.505	.503
	N	40	40	40	40	40
OUTDEFRI	Pearson Correlation	.169	-.030	.308	.524**	-.008
	Sig. (2-tailed)	.297	.856	.054	.001	.960
	N	40	40	40	40	40
BETWCOM	Pearson Correlation	.447**	.773**	.119	.059	.218
	Sig. (2-tailed)	.004	.000	.465	.717	.177
	N	40	40	40	40	40
BETWFRIE	Pearson Correlation	.162	.166	.443**	.378*	-.013
	Sig. (2-tailed)	.319	.305	.004	.016	.935
	N	40	40	40	40	40
INCLOCOM	Pearson Correlation	1.000	.050	.396*	-.050	.390*
	Sig. (2-tailed)	.	.760	.011	.758	.013
	N	40	40	40	40	40
OUTCLOCO	Pearson Correlation	.050	1.000	.005	-.062	.187
	Sig. (2-tailed)	.760	.	.975	.702	.248
	N	40	40	40	40	40
INCLOFRI	Pearson Correlation	.396*	.005	1.000	-.412**	-.076
	Sig. (2-tailed)	.011	.975	.	.008	.642
	N	40	40	40	40	40
OUTCLOFR	Pearson Correlation	-.050	-.062	-.412**	1.000	.012
	Sig. (2-tailed)	.758	.702	.008	.	.942
	N	40	40	40	40	40
GRDENCOM	Pearson Correlation	.390*	.187	-.076	.012	1.000
	Sig. (2-tailed)	.013	.248	.642	.942	.
	N	40	40	40	40	40
GRDENFRI	Pearson Correlation	.376*	.075	.040	.011	.372*
	Sig. (2-tailed)	.017	.644	.806	.945	.018
	N	40	40	40	40	40
EFFORT	Pearson Correlation	.063	.352*	.367*	-.237	-.035
	Sig. (2-tailed)	.701	.026	.020	.142	.830
	N	40	40	40	40	40
INTELCON	Pearson Correlation	.300	-.140	.520**	.048	.083
	Sig. (2-tailed)	.060	.390	.001	.768	.612
	N	40	40	40	40	40

Correlations

		INCLOCOM	OUTCLOCO	INCLOFRI	OUTCLOFR	GRDENCOM
COPERATI	Pearson Correlation	.300	-.140	.520**	.048	.083
	Sig. (2-tailed)	.060	.390	.001	.768	.612
	N	40	40	40	40	40
GFRIEOTH	Pearson Correlation	.341*	-.107	.313*	-.083	.156
	Sig. (2-tailed)	.031	.513	.049	.609	.337
	N	40	40	40	40	40
GCOMMOTH	Pearson Correlation	.342*	.307	.127	-.027	.327*
	Sig. (2-tailed)	.031	.054	.435	.870	.040
	N	40	40	40	40	40

Correlations

		GRDENFRI	EFFORT	INTELCON	COPERATI
GROUPNO	Pearson Correlation	.047	-.095	.166	.166
	Sig. (2-tailed)	.772	.560	.306	.306
	N	40	40	40	40
ALEVEL	Pearson Correlation	.165	-.038	-.161	-.161
	Sig. (2-tailed)	.310	.816	.320	.320
	N	40	40	40	40
GRADE	Pearson Correlation	.272	.277	.100	.100
	Sig. (2-tailed)	.089	.083	.539	.539
	N	40	40	40	40
GROUGRAD	Pearson Correlation	.292	.138	.222	.222
	Sig. (2-tailed)	.068	.394	.168	.168
	N	40	40	40	40
INDEGRCO	Pearson Correlation	.368*	.061	.292	.292
	Sig. (2-tailed)	.019	.709	.067	.067
	N	40	40	40	40
OUTDEGRC	Pearson Correlation	.111	.353*	-.108	-.108
	Sig. (2-tailed)	.494	.025	.507	.507
	N	40	40	40	40
INDFRIEN	Pearson Correlation	.031	.296	.457**	.457**
	Sig. (2-tailed)	.849	.064	.003	.003
	N	40	40	40	40
OUTDEFRI	Pearson Correlation	.084	.048	.497**	.497**
	Sig. (2-tailed)	.607	.768	.001	.001
	N	40	40	40	40
BETWCOM	Pearson Correlation	.128	.343*	-.011	-.011
	Sig. (2-tailed)	.431	.030	.946	.946
	N	40	40	40	40
BETWFRIE	Pearson Correlation	.029	.180	.356*	.356*
	Sig. (2-tailed)	.858	.267	.024	.024
	N	40	40	40	40
INCLOCOM	Pearson Correlation	.376*	.063	.300	.300
	Sig. (2-tailed)	.017	.701	.060	.060
	N	40	40	40	40
OUTCLOCO	Pearson Correlation	.075	.352*	-.140	-.140
	Sig. (2-tailed)	.644	.026	.390	.390
	N	40	40	40	40
INCLOFRI	Pearson Correlation	.040	.367*	.520**	.520**
	Sig. (2-tailed)	.806	.020	.001	.001
	N	40	40	40	40
OUTCLOFR	Pearson Correlation	.011	-.237	.048	.048
	Sig. (2-tailed)	.945	.142	.768	.768
	N	40	40	40	40
GRDENCOM	Pearson Correlation	.372*	-.035	.083	.083
	Sig. (2-tailed)	.018	.830	.612	.612
	N	40	40	40	40
GRDENFRI	Pearson Correlation	1.000	.127	.116	.116
	Sig. (2-tailed)	.	.436	.475	.475
	N	40	40	40	40
EFFORT	Pearson Correlation	.127	1.000	.298	.298
	Sig. (2-tailed)	.436	.	.061	.061
	N	40	40	40	40
INTELCON	Pearson Correlation	.116	.298	1.000	1.000**
	Sig. (2-tailed)	.475	.061	.	.000
	N	40	40	40	40

Correlations

		GRDENFRI	EFFORT	INTELCON	COPERATI
COPERATI	Pearson Correlation	.116	.298	1.000**	1.000
	Sig. (2-tailed)	.475	.061	.000	.
	N	40	40	40	40
GFRIEOTH	Pearson Correlation	.300	.141	.238	.238
	Sig. (2-tailed)	.060	.385	.139	.139
	N	40	40	40	40
GCOMMOTH	Pearson Correlation	.237	-.140	.125	.125
	Sig. (2-tailed)	.141	.387	.442	.442
	N	40	40	40	40

Correlations

		GFRIEOTH	GCOMMOTH
GROUPNO	Pearson Correlation	-.349*	.838**
	Sig. (2-tailed)	.028	.000
	N	40	40
ALEVEL	Pearson Correlation	-.179	.265
	Sig. (2-tailed)	.268	.098
	N	40	40
GRADE	Pearson Correlation	.060	.231
	Sig. (2-tailed)	.713	.152
	N	40	40
GROUGRAD	Pearson Correlation	.611**	.104
	Sig. (2-tailed)	.000	.524
	N	40	40
INDEGRCO	Pearson Correlation	.356*	.335*
	Sig. (2-tailed)	.024	.034
	N	40	40
OUTDEGRC	Pearson Correlation	-.052	.342*
	Sig. (2-tailed)	.748	.031
	N	40	40
INDFRIEN	Pearson Correlation	.211	-.017
	Sig. (2-tailed)	.191	.916
	N	40	40
OUTDEFRI	Pearson Correlation	.166	.011
	Sig. (2-tailed)	.307	.948
	N	40	40
BETWCOM	Pearson Correlation	-.040	.359*
	Sig. (2-tailed)	.808	.023
	N	40	40
BETWFRIE	Pearson Correlation	.107	.062
	Sig. (2-tailed)	.510	.704
	N	40	40
INCLOCOM	Pearson Correlation	.341*	.342*
	Sig. (2-tailed)	.031	.031
	N	40	40
OUTCLOCO	Pearson Correlation	-.107	.307
	Sig. (2-tailed)	.513	.054
	N	40	40
INCLOFRI	Pearson Correlation	.313*	.127
	Sig. (2-tailed)	.049	.435
	N	40	40
OUTCLOFR	Pearson Correlation	-.083	-.027
	Sig. (2-tailed)	.609	.870
	N	40	40
GRDENCOM	Pearson Correlation	.156	.327*
	Sig. (2-tailed)	.337	.040
	N	40	40
GRDENFRI	Pearson Correlation	.300	.237
	Sig. (2-tailed)	.060	.141
	N	40	40
EFFORT	Pearson Correlation	.141	-.140
	Sig. (2-tailed)	.385	.387
	N	40	40
INTELCON	Pearson Correlation	.238	.125
	Sig. (2-tailed)	.139	.442
	N	40	40

Correlations

		GFRIEOTH	GCOMMOTH
COPERATI	Pearson Correlation	.238	.125
	Sig. (2-tailed)	.139	.442
	N	40	40
GFRIEOTH	Pearson Correlation	1.000	-.227
	Sig. (2-tailed)	.	.158
	N	40	40
GCOMMOTH	Pearson Correlation	-.227	1.000
	Sig. (2-tailed)	.158	.
	N	40	40

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

		GROUPNO	ALEVEL	GRADE	GROUGRAD	INDEGCOM
GROUPNO	Pearson Correlation	1.000	-.050	.158	.106	.091
	Sig. (2-tailed)	.	.748	.313	.500	.561
	N	43	43	43	43	43
ALEVEL	Pearson Correlation	-.050	1.000	.266	.132	.277
	Sig. (2-tailed)	.748	.	.085	.399	.072
	N	43	43	43	43	43
GRADE	Pearson Correlation	.158	.266	1.000	.453**	.415**
	Sig. (2-tailed)	.313	.085	.	.002	.006
	N	43	43	43	43	43
GROUGRAD	Pearson Correlation	.106	.132	.453**	1.000	.184
	Sig. (2-tailed)	.500	.399	.002	.	.238
	N	43	43	43	43	43
INDEGCOM	Pearson Correlation	.091	.277	.415**	.184	1.000
	Sig. (2-tailed)	.561	.072	.006	.238	.
	N	43	43	43	43	43
OUTDEGCO	Pearson Correlation	.078	-.136	-.114	-.122	.347*
	Sig. (2-tailed)	.617	.384	.467	.435	.022
	N	43	43	43	43	43
INDEGFRI	Pearson Correlation	.115	.210	.340*	.145	.607**
	Sig. (2-tailed)	.464	.178	.025	.353	.000
	N	43	43	43	43	43
OUTDEGFR	Pearson Correlation	.209	.109	.223	.225	.417**
	Sig. (2-tailed)	.179	.486	.150	.148	.005
	N	43	43	43	43	43
BETWCOM	Pearson Correlation	-.141	-.140	-.039	-.112	.368*
	Sig. (2-tailed)	.369	.372	.804	.474	.015
	N	43	43	43	43	43
BETWFRIE	Pearson Correlation	-.039	-.090	.120	.053	.165
	Sig. (2-tailed)	.802	.565	.443	.735	.291
	N	43	43	43	43	43
INCLOCOM	Pearson Correlation	.082	.257	.408**	.170	.993**
	Sig. (2-tailed)	.602	.096	.007	.276	.000
	N	43	43	43	43	43
OUTCLOCO	Pearson Correlation	.063	-.111	-.121	-.134	.311*
	Sig. (2-tailed)	.690	.480	.441	.390	.043
	N	43	43	43	43	43
INCLOFRI	Pearson Correlation	.066	.260	.504**	.131	.539**
	Sig. (2-tailed)	.676	.093	.001	.401	.000
	N	43	43	43	43	43
OUTCLOFR	Pearson Correlation	.226	.199	.483**	.215	.501**
	Sig. (2-tailed)	.145	.201	.001	.166	.001
	N	43	43	43	43	43
EFFORT	Pearson Correlation	.467**	-.001	.213	.187	.215
	Sig. (2-tailed)	.002	.994	.170	.231	.165
	N	43	43	43	43	43
INTELCON	Pearson Correlation	.498**	.005	.294	.170	.186
	Sig. (2-tailed)	.001	.975	.056	.275	.232
	N	43	43	43	43	43
COPRATI	Pearson Correlation	.453**	.035	.276	.184	.217
	Sig. (2-tailed)	.002	.825	.073	.238	.162
	N	43	43	43	43	43
GRDENCOM	Pearson Correlation	.403**	.148	.138	-.216	.191
	Sig. (2-tailed)	.007	.342	.379	.164	.219
	N	43	43	43	43	43

Correlations

		GROUPNO	ALEVEL	GRADE	GROUGRAD	INDEGCOM
GRDENFRI	Pearson Correlation	.437**	-.095	.229	.202	-.026
	Sig. (2-tailed)	.003	.545	.139	.194	.871
	N	43	43	43	43	43
GRCOMOTH	Pearson Correlation	-.066	-.231	-.389**	-.166	.008
	Sig. (2-tailed)	.676	.136	.010	.287	.958
	N	43	43	43	43	43
GRFRIOTH	Pearson Correlation	.280	.198	.255	.412**	.380*
	Sig. (2-tailed)	.069	.204	.099	.006	.012
	N	43	43	43	43	43
SEX	Pearson Correlation	.146	-.018	.186	-.048	.029
	Sig. (2-tailed)	.349	.908	.232	.758	.852
	N	43	43	43	43	43

Correlations

		OUTDEGCO	INDEGFRI	OUTDEGFR	BETWCOM	BETWFRIE
GROUPNO	Pearson Correlation	.078	.115	.209	-.141	-.039
	Sig. (2-tailed)	.617	.464	.179	.369	.802
	N	43	43	43	43	43
ALEVEL	Pearson Correlation	-.136	.210	.109	-.140	-.090
	Sig. (2-tailed)	.384	.178	.486	.372	.565
	N	43	43	43	43	43
GRADE	Pearson Correlation	-.114	.340*	.223	-.039	.120
	Sig. (2-tailed)	.467	.025	.150	.804	.443
	N	43	43	43	43	43
GROUGRAD	Pearson Correlation	-.122	.145	.225	-.112	.053
	Sig. (2-tailed)	.435	.353	.148	.474	.735
	N	43	43	43	43	43
INDEGCOM	Pearson Correlation	.347*	.607**	.417**	.368*	.165
	Sig. (2-tailed)	.022	.000	.005	.015	.291
	N	43	43	43	43	43
OUTDEGCO	Pearson Correlation	1.000	.343*	.348*	.782**	.326*
	Sig. (2-tailed)	.	.024	.022	.000	.033
	N	43	43	43	43	43
INDEGFRI	Pearson Correlation	.343*	1.000	.662**	.319*	.505**
	Sig. (2-tailed)	.024	.	.000	.037	.001
	N	43	43	43	43	43
OUTDEGFR	Pearson Correlation	.348*	.662**	1.000	.430**	.780**
	Sig. (2-tailed)	.022	.000	.	.004	.000
	N	43	43	43	43	43
BETWCOM	Pearson Correlation	.782**	.319*	.430**	1.000	.531**
	Sig. (2-tailed)	.000	.037	.004	.	.000
	N	43	43	43	43	43
BETWFRIE	Pearson Correlation	.326*	.505**	.780**	.531**	1.000
	Sig. (2-tailed)	.033	.001	.000	.000	.
	N	43	43	43	43	43
INCLOCOM	Pearson Correlation	.362*	.586**	.410**	.394**	.169
	Sig. (2-tailed)	.017	.000	.006	.009	.278
	N	43	43	43	43	43
OUTCLOCO	Pearson Correlation	.991**	.307*	.348*	.786**	.346*
	Sig. (2-tailed)	.000	.046	.022	.000	.023
	N	43	43	43	43	43
INCLOFRI	Pearson Correlation	.224	.745**	.477**	.240	.298
	Sig. (2-tailed)	.148	.000	.001	.122	.052
	N	43	43	43	43	43
OUTCLOFR	Pearson Correlation	.292	.660**	.743**	.356*	.492**
	Sig. (2-tailed)	.058	.000	.000	.019	.001
	N	43	43	43	43	43
EFFORT	Pearson Correlation	.028	.142	.185	.067	-.014
	Sig. (2-tailed)	.858	.363	.234	.668	.927
	N	43	43	43	43	43
INTELCON	Pearson Correlation	-.062	.109	.130	-.010	-.058
	Sig. (2-tailed)	.694	.485	.405	.948	.710
	N	43	43	43	43	43
COPRATI	Pearson Correlation	-.033	.146	.112	-.056	-.083
	Sig. (2-tailed)	.833	.349	.474	.720	.598
	N	43	43	43	43	43
GRDENCOM	Pearson Correlation	-.132	.217	.044	-.316*	-.065
	Sig. (2-tailed)	.397	.161	.777	.039	.680
	N	43	43	43	43	43

Correlations

		OUTDEGCO	INDEGFRI	OUTDEGFR	BETWCOM	BETWFRIE
GRDENFRI	Pearson Correlation	-.143	.174	.131	-.172	.010
	Sig. (2-tailed)	.360	.265	.404	.270	.948
	N	43	43	43	43	43
GRCOMOTH	Pearson Correlation	.514**	.088	.123	.454**	.210
	Sig. (2-tailed)	.000	.575	.433	.002	.177
	N	43	43	43	43	43
GRFRIOTH	Pearson Correlation	.148	.497**	.399**	-.042	.159
	Sig. (2-tailed)	.343	.001	.008	.792	.310
	N	43	43	43	43	43
SEX	Pearson Correlation	.149	-.015	-.062	.017	.019
	Sig. (2-tailed)	.339	.924	.692	.913	.904
	N	43	43	43	43	43

Correlations

		INCLOCOM	OUTCLOCO	INCLOFRI	OUTCLOFR	EFFORT
GROUPNO	Pearson Correlation	.082	.063	.066	.226	.467**
	Sig. (2-tailed)	.602	.690	.676	.145	.002
	N	43	43	43	43	43
ALEVEL	Pearson Correlation	.257	-.111	.260	.199	-.001
	Sig. (2-tailed)	.096	.480	.093	.201	.994
	N	43	43	43	43	43
GRADE	Pearson Correlation	.408**	-.121	.504**	.483**	.213
	Sig. (2-tailed)	.007	.441	.001	.001	.170
	N	43	43	43	43	43
GROUGRAD	Pearson Correlation	.170	-.134	.131	.215	.187
	Sig. (2-tailed)	.276	.390	.401	.166	.231
	N	43	43	43	43	43
INDEGCOM	Pearson Correlation	.993**	.311*	.539**	.501**	.215
	Sig. (2-tailed)	.000	.043	.000	.001	.165
	N	43	43	43	43	43
OUTDEGCO	Pearson Correlation	.362*	.991**	.224	.292	.028
	Sig. (2-tailed)	.017	.000	.148	.058	.858
	N	43	43	43	43	43
INDEGFRI	Pearson Correlation	.586**	.307*	.745**	.660**	.142
	Sig. (2-tailed)	.000	.046	.000	.000	.363
	N	43	43	43	43	43
OUTDEGFR	Pearson Correlation	.410**	.348*	.477**	.743**	.185
	Sig. (2-tailed)	.006	.022	.001	.000	.234
	N	43	43	43	43	43
BETWCOM	Pearson Correlation	.394**	.786**	.240	.356*	.067
	Sig. (2-tailed)	.009	.000	.122	.019	.668
	N	43	43	43	43	43
BETWFRIE	Pearson Correlation	.169	.346*	.298	.492**	-.014
	Sig. (2-tailed)	.278	.023	.052	.001	.927
	N	43	43	43	43	43
INCLOCOM	Pearson Correlation	1.000	.324*	.562**	.526**	.231
	Sig. (2-tailed)	.	.034	.000	.000	.136
	N	43	43	43	43	43
OUTCLOCO	Pearson Correlation	.324*	1.000	.185	.266	.002
	Sig. (2-tailed)	.034	.	.235	.084	.992
	N	43	43	43	43	43
INCLOFRI	Pearson Correlation	.562**	.185	1.000	.878**	.146
	Sig. (2-tailed)	.000	.235	.	.000	.349
	N	43	43	43	43	43
OUTCLOFR	Pearson Correlation	.526**	.266	.878**	1.000	.226
	Sig. (2-tailed)	.000	.084	.000	.	.145
	N	43	43	43	43	43
EFFORT	Pearson Correlation	.231	.002	.146	.226	1.000
	Sig. (2-tailed)	.136	.992	.349	.145	.
	N	43	43	43	43	43
INTELCON	Pearson Correlation	.195	-.085	.151	.207	.890**
	Sig. (2-tailed)	.209	.586	.334	.182	.000
	N	43	43	43	43	43
COPRATI	Pearson Correlation	.225	-.062	.174	.195	.958**
	Sig. (2-tailed)	.147	.695	.264	.210	.000
	N	43	43	43	43	43
GRDENCOM	Pearson Correlation	.150	-.144	.018	-.060	.186
	Sig. (2-tailed)	.338	.356	.909	.701	.231
	N	43	43	43	43	43

Correlations

		INCLOCOM	OUTCLOCO	INCLOFRI	OUTCLOFR	EFFORT
GRDENFRI	Pearson Correlation	-.056	-.170	.057	.070	.573**
	Sig. (2-tailed)	.722	.275	.719	.657	.000
	N	43	43	43	43	43
GRCOMOTH	Pearson Correlation	.023	.524**	.113	.140	-.200
	Sig. (2-tailed)	.885	.000	.470	.372	.200
	N	43	43	43	43	43
GRFRIOTH	Pearson Correlation	.359*	.134	.416**	.457**	-.290
	Sig. (2-tailed)	.018	.393	.006	.002	.059
	N	43	43	43	43	43
SEX	Pearson Correlation	.043	.159	.089	.047	-.082
	Sig. (2-tailed)	.785	.308	.568	.764	.601
	N	43	43	43	43	43

Correlations

		INTELCON	COPRATI	GRDENCOM	GRDENFRI	GRCOMOTH
GROUPNO	Pearson Correlation	.498**	.453**	.403**	.437**	-.066
	Sig. (2-tailed)	.001	.002	.007	.003	.676
	N	43	43	43	43	43
ALEVEL	Pearson Correlation	.005	.035	.148	-.095	-.231
	Sig. (2-tailed)	.975	.825	.342	.545	.136
	N	43	43	43	43	43
GRADE	Pearson Correlation	.294	.276	.138	.229	-.389**
	Sig. (2-tailed)	.056	.073	.379	.139	.010
	N	43	43	43	43	43
GROUGRAD	Pearson Correlation	.170	.184	-.216	.202	-.166
	Sig. (2-tailed)	.275	.238	.164	.194	.287
	N	43	43	43	43	43
INDEGCOM	Pearson Correlation	.186	.217	.191	-.026	.008
	Sig. (2-tailed)	.232	.162	.219	.871	.958
	N	43	43	43	43	43
OUTDEGCO	Pearson Correlation	-.062	-.033	-.132	-.143	.514**
	Sig. (2-tailed)	.694	.833	.397	.360	.000
	N	43	43	43	43	43
INDEGFRI	Pearson Correlation	.109	.146	.217	.174	.088
	Sig. (2-tailed)	.485	.349	.161	.265	.575
	N	43	43	43	43	43
OUTDEGFR	Pearson Correlation	.130	.112	.044	.131	.123
	Sig. (2-tailed)	.405	.474	.777	.404	.433
	N	43	43	43	43	43
BETWCOM	Pearson Correlation	-.010	-.056	-.316*	-.172	.454**
	Sig. (2-tailed)	.948	.720	.039	.270	.002
	N	43	43	43	43	43
BETWFRIE	Pearson Correlation	-.058	-.083	-.065	.010	.210
	Sig. (2-tailed)	.710	.598	.680	.948	.177
	N	43	43	43	43	43
INCLOCOM	Pearson Correlation	.195	.225	.150	-.056	.023
	Sig. (2-tailed)	.209	.147	.338	.722	.885
	N	43	43	43	43	43
OUTCLOCO	Pearson Correlation	-.085	-.062	-.144	-.170	.524**
	Sig. (2-tailed)	.586	.695	.356	.275	.000
	N	43	43	43	43	43
INCLOFRI	Pearson Correlation	.151	.174	.018	.057	.113
	Sig. (2-tailed)	.334	.264	.909	.719	.470
	N	43	43	43	43	43
OUTCLOFR	Pearson Correlation	.207	.195	-.060	.070	.140
	Sig. (2-tailed)	.182	.210	.701	.657	.372
	N	43	43	43	43	43
EFFORT	Pearson Correlation	.890**	.958**	.186	.573**	-.200
	Sig. (2-tailed)	.000	.000	.231	.000	.200
	N	43	43	43	43	43
INTELCON	Pearson Correlation	1.000	.889**	.199	.580**	-.214
	Sig. (2-tailed)	.	.000	.202	.000	.168
	N	43	43	43	43	43
COPRATI	Pearson Correlation	.889**	1.000	.302*	.598**	-.309*
	Sig. (2-tailed)	.000	.	.049	.000	.044
	N	43	43	43	43	43
GRDENCOM	Pearson Correlation	.199	.302*	1.000	.571**	-.529**
	Sig. (2-tailed)	.202	.049	.	.000	.000
	N	43	43	43	43	43

Correlations

		INTELCON	COPRATI	GRDENCOM	GRDENFRI	GRCOMOTH
GRDENFRI	Pearson Correlation	.580**	.598**	.571**	1.000	-.359*
	Sig. (2-tailed)	.000	.000	.000	.	.018
	N	43	43	43	43	43
GRCOMOTH	Pearson Correlation	-.214	-.309*	-.529**	-.359*	1.000
	Sig. (2-tailed)	.168	.044	.000	.018	.
	N	43	43	43	43	43
GRFRIOTH	Pearson Correlation	-.330*	-.312*	.015	-.199	.186
	Sig. (2-tailed)	.031	.042	.922	.200	.232
	N	43	43	43	43	43
SEX	Pearson Correlation	-.143	-.029	.315*	.185	-.040
	Sig. (2-tailed)	.362	.854	.040	.234	.800
	N	43	43	43	43	43

Correlations

		GRFRIOTH	SEX
GRDENFRI	Pearson Correlation	-.199	.185
	Sig. (2-tailed)	.200	.234
	N	43	43
GRCOMOTH	Pearson Correlation	.186	-.040
	Sig. (2-tailed)	.232	.800
	N	43	43
GRFRIOTH	Pearson Correlation	1.000	.009
	Sig. (2-tailed)	.	.957
	N	43	43
SEX	Pearson Correlation	.009	1.000
	Sig. (2-tailed)	.957	.
	N	43	43

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).