

Gender and Chain Reactions in Teenagers' Social Networks

Deirdre M. Kirke

National University of Ireland, Maynooth

Over the past ten years or so there has been renewed research interest in the relative impact of peer selection and peer influence on the increasing similarity of teenagers in their substance use. Researchers have concluded that either peer selection or peer influence explained the similarity. This paper examines this research question differently using complete network data and arrives at different conclusions. Findings demonstrate that similarity in the substance use of teenagers and their peers is explained by either peer selection or peer influence for some, by both peer selection and peer influence for others, and by neither for others. Using a sociological approach and a social network perspective this paper demonstrates how chain reactions result in similarity in the substance use of teenagers in their peer groups, by drawing together those who are similar with those who are not. The paper demonstrates how chain reactions involve peer selection, the patterning of peer ties and peer influence, and explores how gender affects all aspects of the chain reaction process.

INTRODUCTION

There has been a widespread belief among researchers since the 1970s that teenagers' peer groups are likely to be homogeneous in their substance use. The source of this homogeneity has been the subject of research in the intervening years. Research evidence during the 1970s confirmed that the homogeneity in the substance use of teenagers was based primarily on peer influence. Kandel's work in the early 1970s was very influential in demonstrating that peer influence was the most important influence on teenagers' substance use (Kandel, 1973:1067; 1974a:107; Kandel, 1978a:24; Kandel, Kessler and Margulies, 1978:87). In a longitudinal study she found that teenagers who had substance using peers at one point in time were likely to be substance users themselves at a later time point. Thus, she concluded that peer influence explained the increasing similarity/ homogeneity. She found that peer influence varied between the substances and was greatest for marijuana use.

The importance of peer influence has been confirmed by many other researchers. Researchers usually studied one or two of the substances and rarely all three. Among those who confirmed the importance of peer influence for substance use were Dembo *et al.* (1982:376), Brook, Whiteman and Gordon (1983:276) and Jessor and Jessor (1978:69) for drug use; Grube and Morgan (1986:77, 104, 126) for cigarettes, alcohol and drugs, and Akers *et al.* (1979:638) for alcohol and drug use. While there was no direct evidence in these studies that particular peers influenced particular teenagers into taking the substances, the inference drawn was that peer influence had occurred if peers' substance use, or their perceived substance use, had preceded the teenagers' substance use. Such research, although based on longitudinal data, appears to have exaggerated peer effects and led to exaggerated expectations of homophily in peer groups. Most of the researchers had used perceived peer substance use data which were known to exaggerate peer effects (Kandel, 1980:269, 270) or had used data on dyads of best friends which were more likely than any other friends to be similar to each other.

Even in the 1970s some researchers were alert to the possibility that the reported effects of peers may have been exaggerated. Cohen (1977:239) and Kandel (1978b:436) suggested independently that reports of peer influence may be exaggerated if researchers attribute the similarity in substance use among teenagers to peer influence solely, when many of the teenagers may have chosen their peers because of their similarity to the teenagers' substance use. Thus, the explanation could be due to peer influence or peer selection. Kandel (1978b:433) concluded at the time that both explanations were of equal importance, with half of the observed similarity in teenagers' substance use being due to peer influence and the other half to peer selection. This cautionary note about the exaggeration of the impact of peer influence on similarity in teenagers' substance use has been largely ignored until the 1990s.

But since the 1990s there has been renewed interest in this research question and it has yet to be satisfactorily answered. What is the relative impact of peer influence and selection on teenagers' similarity in their substance use? Many researchers have contributed to this debate. An important aspect of the renewed interest is that researchers since the 1990s have been using social network analysis to try to resolve this question. But even among the social network researchers there have been limitations in the social network data available to examine the question and in the computer technology and mathematical models available to analyse the required data adequately. To date, most researchers have used dyadic or small clique data to examine this question although there is increasing recognition that what is required is complete network, longitudinal data.

One of the earliest papers reporting on substance use in teenagers' peer groups was by Hunter, Vizelberg and Berenson (1991). Using data from the Bogalusa heart study they examined the impact of the students' friendship cliques in school on their adoption of tobacco and alcohol use. Their findings suggested that peer influence and peer selection were at work. Some of the students reported the direct or indirect effects of friends and others confirmed the formation of cliques around a preferred behaviour, which was mainly alcohol use (1991:101). A little later Ennett and Bauman (1993) examined this question further. They used the NEGOPY (Richards, 1989) network analysis programme to group their adolescents into clique members, liaisons or isolates in order to examine whether their social position among their peers was associated with their cigarette use. Clique members were adolescents in a group of at least three members, who had most of their links with other members of the group, and were all connected by a path entirely within the group. Liaisons were not members of cliques but had at least two links with clique members or other liaisons. Isolates were those who had few or no links with other adolescents. They could be in dyads or tree structures, in which the removal of one link would result in the individual being separated from the rest of the network (Ennett and Bauman, 1993:229, 230). Ennett and Bauman (1993:231) confirmed that social position was associated with the adolescents' smoking behaviour with isolates being more likely than those in cliques or liaisons to be current smokers and subsequently confirmed that peer influence and peer selection contributed equally to the homogeneity in cigarette smoking that they had observed in the adolescents' cliques (Ennett and Bauman, 1994:660). Bauman and Ennett (1996:186 – 189) have also concluded that only half of the similarity in teenagers substance use is explained by the influence of their peers, with the other half being due to selection. Although their research was on small cliques, these researchers pointed to the need for complete network data in order to identify peer groups directly and to examine the substance use of individual adolescents in the context of their peer groups (Ennett and Bauman, 1993:234; Bauman and Ennett, 1994:820; 1996:191).

In the meantime, many researchers addressed the question of peer influence and selection using a similar approach to that used by Ennett and Bauman, examining the association between adolescents' substance use and their social position in cliques, liaisons and isolates. Using the NEGOPY program but with slightly different definitions of these social positions, Pearson and Michell (2000:27, 28) supported the findings of Ennett and Bauman (1993:231) when they found that their relative isolates were most likely to have smoked cigarettes ($p < 0.08$) and to have taken drugs ($p < 0.07$). (These small differences were above the $p < 0.05$ level of significance). But Pearson and West (2003:67-69) also

reported evidence of changes in substance use occurring within peer groups, suggesting peer influence, and of changes occurred due to the selection by peripheral members of risk-taking groups. Fang et al. (2003:262) also confirmed, using NEGOPY, that isolates were more likely to have experimented with smoking cigarettes, except among 10th grade boys, where the results were reversed and more group members and liaisons than isolates had experimented. Contradictory results were reported by Abel, Plumridge and Graham (2002). They regrouped students into different social positions from those identified in the NEGOPY programme and they identified school pupils as 'popular', 'try-hards', 'ordinary' and 'loners.' Their findings confirmed that it was those least well connected, the 'loners', who were least likely to smoke cigarettes.

It is difficult to unravel the relative importance of peer influence and selection from these contradictory findings. Also, if isolates are more likely than those in other social positions to smoke cigarettes or take drugs, as some researchers have suggested (Ennett and Bauman, 1993:231; Fang et al., 2003: 262; Pearson and Michell, 2000:27, 28) and, if they were truly isolates, it would appear that neither peer influence nor selection would be associated with their substance use. The definition used, of course, included teenagers who had no peer ties with teenagers who had some peer ties, which is problematic.

These contradictory findings suggest the need for researchers to examine the association between social position and teenagers' substance use with social network data on peer groups larger than cliques. The kind and size of sample chosen, the definition of peer group used and the number of friends a teenager is allowed to name, have profound effects on the size of the peer groups which will ensue and, indeed, on whether some teenagers will be seen as liaisons or isolates. Clique data appear to be inadequate as a way of measuring peer groups for a number of reasons. They are unnaturally small because the teenagers are usually only allowed to name a small number of friends rather than all of their friends (Wasserman and Faust, 1994:256). The criteria for inclusion in a clique appear to be too rigid and exclude some teenagers who have peer ties with clique members. Results from clique studies may exaggerate the level of similarity in behaviour in peer groups because the cliques are so small, while naturally existing peer groups, which would emerge if teenagers were allowed to name all of their friends, may be much larger. The definition of isolate used in these studies is also problematic because it combines, into this category, teenagers who have no peer ties with teenagers who have some peer ties, including those in dyads or tree structures.

Many questions relating to the relative impact of peer influence and peer selection on teenagers' substance use can not be answered using data on the social positions of cliques, liaisons and isolates. Another important issue is that it is not social position per se that is likely to affect teenagers' substance use, but the teenagers' social position among peers, who use any of the substances, that is likely to affect their use. Researchers, including Haynie (2001:1023) and Ennett and Bauman (1993:234), have suggested that these questions can be more adequately addressed using complete network data on all adolescents and their friends in a population. In the remainder of this paper I will examine the question of the relative impact of peer selection and peer influence on the similarity of teenagers in their substance use using complete network data and present findings from my research which propose a new chain reaction explanation (Kirke, 2004, 2006).

METHOD

Complete network data were collected by interviewing all teenagers aged 14-18 years in one community in Dublin in a cross-sectional study. The hidden population of 14-18 year olds was identified by doing a house-to-house census. The census identified 298 teenagers of the required age, of whom 267 were successfully interviewed, giving a response rate of 90%. Data were collected by personal interviews, using a structured questionnaire, in the teenagers' homes (Kirke, 1996:335-338). Teenagers were asked to name all of their friends and pals (i.e. peers). Peer groups were identified by using the 'weak component' and

'adjacency' procedures of GRADAP (Sprenger and Stokman, 1989:17). In social network analysis "...a weak component is a maximal weak subgraph" (Harary et al., 1965:405). This means that it is the maximum unique subset of points which are connected, directly or indirectly, to each other by lines. This was a very appropriate way to identify the peer groups because the peer groups identified included all of the teenagers and their peers who were connected to each other through peer ties by paths of any distance (Kirke, 1996:340). Each peer group was, therefore, distinct from all others and there was no peer tie, however distant, between any of the teenagers in one peer group with any of the teenagers in another. This approach differs from that used by other researchers who had used NEGOPY (Richards, 1989). The peer groups identified would include cliques, liaisons, dyads and tree structures. Isolates would only be those who had no peer ties. Further details of the method used for delineating the peer groups are given in Kirke (1996:335-344) and for all aspects of the study in Kirke (1990:84-105).

RESULTS

Early results (Kirke 1990) indicated that homophily/ similarity in the drug use of teenagers in their peer groups was much lower than anticipated, that it varied by the size of the peer group and that peer influence was much less potent than would have been expected based on previous research. The findings suggested, rather, that a complex process of peer group and individual influences were at play which sometimes resulted in changed drug behaviour on the part of the teenagers and sometimes did not (Kirke, 1990). Thus, even when there were drug users in a peer group who had direct peer ties with teenagers who had not yet used drugs, peer influence did not necessarily occur. A later paper reported on a case study of one all-male peer group in which there was a high rate of drug use (Kirke, 1995). This paper demonstrated the process by which peer influence permeated the peer group and resulted in some, but not all, of the teenagers using drugs. Basically their peers facilitated the drug use of the teenagers when they wished to use drugs, but did not put any pressure on those who did not wish to use them. Peers facilitated the teenagers' drug use by providing the drug and / or being in the company of the teenager for their first and current use of the drug.

These earlier studies (Kirke, 1990; 1995) shed some light on the role of peer influence in drug use, by confirming that it did occur for some teenagers and the process by which it occurred. But these analyses also confirmed that peer influence did not apparently work on some teenagers. They didn't change their behaviour but they maintained their friendships nevertheless.

Since previous research had confirmed associations between social position and teenagers' substance use, I examined the complete network data for such an association. In this study, social position related to being in a peer group or being an isolate. Peer groups varied in size from 26 teenagers to two teenagers, and isolates had no peer ties in the population. The findings were that there was no association between the social position of the teenagers in this study and their ever or current use of cigarettes, alcohol or drugs (Kirke, 2006). When the peer groups were divided into larger peer groups (six or more teenagers), smaller peer groups similar to cliques (five or fewer teenagers), and the tests were repeated, there was still no association. Thus, the findings do not support those of previous researchers who found an association between social position and substance use. These findings confirm, therefore, that social position per se was not associated with the teenagers' substance use. But the real question to ask is whether the social position of teenagers, relative to other peers who are substance users, has an impact on their substance use. This question is addressed below (Kirke, 2004).

The question of the relative impact of peer selection and peer influence on the teenagers' use of all three substances was examined more comprehensively in a recent paper (Kirke, 2004). In this paper multilevel analyses were used to examine this question. Retrospective data on the timing of the selection of peers, the timing of changes in the teenagers' use of the three substances and reports by the teenagers of peer influence, were combined with dyadic data on each peer tie, in case studies of the three largest peer groups. The purpose of the paper was to examine:

1. whether there was any direct evidence in the teenagers' peer groups of similarity in their substance use and whether there was evidence of peer influence having occurred between those who were similar;
2. whether there was evidence of the relative impact of peer influence and selection on similarity; and
3. whether the peer group had contributed to the similarity.

The findings, using dyadic data for the complete network, confirmed that similarity had occurred between teenagers and their peers in their use of the three substances. Similarity was greatest for alcohol use and lowest for cigarette use. The results were similar in the three peer groups studied. The rate of use of alcohol was the highest, and of drug use was the lowest, reflecting the level of similarity among the teenagers forming those peer groups (Kirke, 2004:7, 8). Was there any evidence of peer influence having occurred? Traditionally researchers have assumed that peer influence has occurred within the peer tie if teenagers have become similar to their peers in their substance use. In this study peer influence was not assumed in such circumstances. Instead, two indices of peer influence were used: whether the teenagers had been in the company of their peers and whether the teenagers had been provided with the substance by their peers. If their peers were involved in either way, or in both ways, it was accepted that peer influence had occurred. The findings confirmed that peer influence had occurred for a large proportion of the teenagers. Influence was more likely to have taken the form of being in the company of peers than being provided with the substances by their peers. Surprisingly, those who provided the substance and those with whom the adolescent used the substance were frequently different people. Thus, more than one peer was often involved in the peer influence process. This would suggest the need to approach this question using social network rather than dyadic peer data.

Although these findings have confirmed that the teenagers had become similar to their peers in dyads and in peer groups, and that peer influence had occurred for most of the teenagers who had used substances, these findings did not confirm whether those who were similar in their substance use had experienced peer influence *from each other*. Having examined the multilevel data for each of the peer group case studies, the findings confirmed that teenagers adjacent to each other in the peer groups were likely to be similar in their substance use and to form chains of users of similar substances and that peer influence had occurred in nearly all of the peer ties in the chains. But the findings confirmed that, although peer influence had occurred, it had *not necessarily been between the teenagers and the peers to whom they were similar in the substance use chains*. Similarity in peer ties had occurred through peer influence *between those who were similar* for proportions varying from 68.9% to 34.4% of the peer ties in the peer groups studied. Similarity was due to selection *between those who were similar* in proportions varying from 17.8% to 40.6% of the peer ties in the peer groups, since the teenagers had already taken their first substance before forming the peer ties. Although selection explained the similarity in these peer ties, however, peer influence had also occurred. But the peer influence had come *from different peers* before the formation of the peer ties. In some other peer ties peer influence, which had occurred, *could not have been between those who were similar* (6.6% - 18.8%) because of differences in the timing of the formation of the peer tie and the substance use of the teenagers and their peers. Thus for some of the teenagers, similarity had resulted from peer influence only, for others similarity had resulted from selection and for other teenagers similarity had resulted from neither peer influence nor selection *between those who were similar*. When similarity had resulted from selection, peer influence had also occurred but by peers outside these chains.

These findings confirm those of Bauman and Ennett (1996); Kandel (1978a, b) and Cohen (1977) that either peer influence or selection is usually at work when teenagers and their peers become similar in their substance use. But these findings (Kirke, 2004) suggest that researchers should be more cautious about attributing similarity to peer influence when the peer in the dyad, or peer group, may have had

nothing to do with increasing the similarity of the substance use of the teenager with whom he or she has a peer tie. They would also suggest that it would be prudent to check whether peer influence by others had occurred when selection explains the similarity. Otherwise the role of peer influence may be underestimated.

The third question which was being explored in this paper was whether the peer group had contributed to the similarity. The answer is that the peer group contributes to the similarity by linking those who are similar in their substance use with those who are not (see figures, Kirke, 2004). When a teenager selects another as a peer, the resulting peer tie connects the teenager directly and indirectly into a peer group. The peer group may be very small or very large. Whatever the size of the peer group, the resulting pattern of peer ties in it is an unpredictable outcome of the formation of the new peer tie. Nevertheless, that pattern is important to the individual's substance use, as is the location of the peer whom the individual teenager has selected. Through the patterning of the peer ties an individual, who forms a new peer tie, may be connected to a chain of users of a particular substance or to a chain of non-users. Thus, the selection of one peer links the teenager into a pattern of peer ties in the peer group. The peer group contributes to the similarity of the teenagers in their substance use by linking teenagers, who are already similar, to teenagers who become similar through their continued association with their peers in the peer network. The result is a *chain reaction process*. The chain reaction results from linking those who are similar with those who are not. Some of those who are similar in these chains will have influenced each other; others will have been influenced by others outside the chains. The outcome is the same: chains of similar users, in which the chain reaction has been brought about by peer selection, the patterning of their peer ties and peer influence. The peer group contributes to the similarity in a profound manner by providing a pattern of peer ties in which peer influence can flourish (Kirke, 2004: 26, 27).

Another aspect of the chain reaction process which I have addressed is the role of gender. Traditionally, the role of gender in the substance use of teenagers is addressed as an individual attribute: whether the teenagers' gender is associated with their substance use. I think it would be more appropriate to address it as a social network variable which affects the composition and structure (i.e. the patterning of peer ties) of peer groups. In recent work I have examined the role of gender in the chain reaction process and have found that it has an effect on all aspects of it: the selection of peers, the patterning of peer ties and peer influence (Kirke, 2006). Teenagers selected their peers strictly along gender lines, resulting in almost all single gender peer ties and peer groups. The patterning of peer ties in the complete network also reflected a gender influence, with different patterns emerging for males and females. Males clustered into large more dense groups, while females generally were in smaller groups and less densely clustered, with many in dyads or tree-like structures. Those less densely clustered like this were considered to be isolates in previous research (Ennett and Bauman, 1993:231; Fang et al., 2003:262). There is a possibility that, by doing so, the impact of the social position, isolate, on substance use may have masked a gender effect.

Peer influence, on the other hand, operated differently for males and females. For males, mixed gender influence was only important for their current cigarette use, but for females, it was important for all substance use other than their ever cigarette use. Thus, single gender patterns of peer ties would be sufficient for chain reactions to occur in all but their current cigarette use for males, but female teenagers need mixed gender patterns to ensure chain reactions occur for all substances other than their first cigarette use. Thus the patterning of peer ties along gender lines, or across gender lines, will have a profound effect on whether, or when, chain reactions will occur for male and female teenagers.

These findings suggest, therefore, that gender impacts on the composition and structure of the networks teenagers form with their peers. The gender composition of peer groups reflects the impact of gender on peer selection, which is usually single gender and rarely mixed gender while males and females are in their childhood and early teenage years. The structure of the networks also appeared

to vary by gender with males being more likely than females to form larger more dense patterns. Since male teenagers who were substance users, had been predominantly influenced by other males, and females predominantly by males and females, the structure and composition of this complete network would have enhanced the likelihood of male teenagers being influenced while, at the same time would have hindered the likelihood of females being influenced. Changes in the pattern over time will alter the likelihood of influence for males and females.

CONCLUSION

This paper has examined the question of the relative impact of peer selection and peer influence on the similarity of teenagers in their substance use. Previous researchers have suggested that either peer selection or peer influence explain the similarity, usually in equal measure. Findings presented in this paper suggest that researchers can not assume that peer influence has occurred between teenagers who are similar, because the results presented confirm that, for some teenagers who become similar in their substance use, peer influence has occurred between them, for others peer influence has not occurred, for some, peer selection explained the similarity (although peer influence had also occurred by other peers outside the chain) and, for others, neither peer selection nor peer influence explained the similarity. Findings also confirmed, contrary to previous research, that social position per se was not associated with the teenagers' use of any of the three substances, but their social position, relative to other teenagers in their peer groups who had used the substances, was of immense importance. The paper proposes a chain reaction explanation, which includes peer selection, the patterning of peer ties and peer influence, for changing similarity in the substance use of teenagers, and suggests that gender plays a role in all aspects of the chain reaction process.

It is not possible to definitively answer the question of the relative impact of peer influence and selection on similarity in the substance use of teenagers even with cross-sectional, complete network data. Using retrospective data on the timing of events adds a longitudinal element and is valuable in that it relates to the teenagers' childhood and early teenage years. But longitudinal, complete network data are required to provide definitive answers and to re-examine the results and the chain reaction explanation presented in this paper. There are huge methodological issues to be addressed in such research.

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