Binge drinking at University: a social network study in Belgium

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SUMMARY
Many university students engage in risky alcohol consumption behaviour during their stay at university. So far, however, most studies have relied on cross-sectional surveys and paid little attention to the role of social ties. University students, however, are socially connected, so it is likely that their alcohol consumption behaviour is also connected. We hypothesized that university students’ social positions within their networks are related to their drinking behaviour. We carried out a social network analysis within a whole network approach with undergraduates in two faculties (n = 487), those of Engineering and Psychology, in a Belgian university. All students filled out a questionnaire recording their drinking behaviour and their social ties (friendship, working with, partying with and room-mate). For each individual, indicators of centrality, social capital, and cross-gender relationships were computed. We found that being socially close to binge drinkers was associated with a higher frequency of binge drinking. The risk of binge drinking increased with centrality but decreased with social capital. Having cross-gender relationships decreased the risk of binge drinking. We found indications that the effect of centrality and gender on binge drinking depends on the composition of the network. We conclude that social position has important effects on risky drinking behaviour and that the composition of the network may affect these factors. Those developing health promotion strategies could investigate the benefits of targeting central individuals in order to prevent binge drinking among university students.

Key words: alcohol drinking; school health; social network analysis

INTRODUCTION
Excessive alcohol consumption accounts for an important share of morbidity and mortality among teenagers and young adults (Rehm et al., 2009). The university is a key player in this issue: an increasing percentage of younger people are heading to university after secondary school (Organisation for Economic Co-operation and Development and Centre for Educational Research and Innovation, 2009) and this transition is often associated with more frequent and risky drinking behaviour (Schulenberg and Maggs, 2002).

In Europe, the consumption of alcohol among teenagers is a rather recent topic of research. In recent research, more than 40% of students aged 17–30 in several European countries reported having drunk heavily (Dantzer et al., 2006). Risky drinking has also been found to be a common practice (Stock et al., 2009). Although some of this behaviour may become less frequent as teenagers become adults, cohort studies suggest that excessive alcohol behaviour, including problematic alcohol consumption, may persist into adulthood, leading to a higher risk of dependence (McCambridge et al., 2011). Thus, reducing alcohol drinking during adolescence and young adulthood is important for preventing long-term adverse consequences in adulthood.

Programmes to limit excessive alcohol drinking have relied on a wide range of preventive...
strategies, including educational or school approaches, community-based programmes and treatment within the health sector, regulations on drinking, driving and advertising, and policies affecting alcohol availability or price. Policies influencing the availability and the regulation of alcohol marketing are more effective than information or educational approaches (Anderson et al., 2009). A meta-analysis of individual-based approaches confirmed that their effectiveness in terms of reducing the quantity of drinking is small, with an average effect size of <0.20 of a standard deviation (Carey et al., 2007). This has led to something of a shift towards more community-based educational approaches (Saltz et al., 2010) rather than individual-based ones. More recently, the cutting edge of community health policy has relied on approaches that use social norms (Pischke et al., 2012) and social ties as the main preventive vehicle (Valente, 2010), with promising results (Webel et al., 2010).

To date, alcohol consumption has been analysed from an individual perspective, with the main focus on individual risk factors such as gender, age, socio-economic status, personality, psychological factors and drinking motives. Alcohol consumption among university students, however, takes place in a very specific social environment that includes independent living, reduced social control, increased social homogeneity, wide availability of social activities such as pre-gaming (i.e. drinking alcohol prior to going out in order to prime oneself for the social occasion ahead) (Read et al., 2010), drinking games (Borsari et al., 2003) and other student recreational activities. These social activities and contexts affect alcohol consumption, partly through norms, as the perception of the drinking norm has been shown to be a potent predictor of actual drinking in the USA (Borsari and Carey, 2003; Perkins et al., 2005) and in Europe (Lorant et al., 2013).

Because of this social dimension, several studies have investigated the role of peers in alcohol-drinking behaviour (Delk and Meilman, 1996; D’Alessio et al., 2006; Keller et al., 2007; McAlaney and McMahon, 2007; McMahon et al., 2007). However, most of these studies have relied on cross-sectional surveys in which one’s own drinking and peer drinking behaviour are reported by the same individual (Alva, 1998; Rose, 1999; Durkin et al., 2005). A couple of recent social network surveys have investigated the role of ties among the adult population (Rosenquist et al., 2010) or at high school (Ennett et al., 2006) in the USA. These studies have shown that alcohol use increases when people’s (best) friends drink more alcohol. With the exception of one ego network study (Reifman et al., 2006), there is a clear paucity of work about the influence of social networks on drinking habits among university students.

Our study applied Social Network Analysis (SNA) to the study of risky drinking behaviour among university students. We set out to analyse the role of peers and of social position within a university network in drinking behaviour. In particular, we hypothesized that social position in the network affects drinking behaviour and that cross-gender relationship is an important component of this drinking-network effect.

METHOD

Design and data source

This study is part of an important multi-method investigation into alcohol drinking among university students. It was carried out in a Belgian university that has two main campuses, located in the centre of Belgium. The investigation included several data collections: a social-network analysis in two faculties, a web survey open to all students (Lorant et al., 2013), a prospective study of student academic performance, a geographical analysis of nuisance complaints and qualitative interviews about pre-partying and pre-gaming (pre-loading). This article presents the results of the social-network analysis.

We used a whole-network approach (Hawe et al., 2004; Knoke et al., 2008), with the boundary of the network defined as those in the first year of two faculties, Engineering and Psychology: these two faculties, respectively, predominantly male (84%) and female (90%), were chosen because they are likely to display different norms of drinking behaviour. All first-year students were provided with a complete list of all students and were asked to identify those with whom they had the following relationships: being friends of, roommate of, studying or working with, and spending leisure time with.

In May 2010, paper-pencil questionnaires were handed out in the classroom to two groups of first-year undergraduate students of Psychology (n = 421) and Engineering (n = 354); we received 278 and 270 responses, respectively. Twenty-five
and 36 responses had to be removed because of missing data, yielding 253 (Psychology) and 234 (Engineering) valid responses (participation rates of 60 and 66%, respectively). Essentially, non-participation was due to no-show on the day of the survey.

**Measurement**

Alcohol consumption measurements and patterns were defined according to the Eurostat European Health Interview Survey schedule: average number of drinks per day, frequency of alcohol consumption in the last year and frequency of risky abusive drinking [also called binge drinking in the literature, i.e. six drinks or more on one occasion (Wechsler et al., 1994)].

For each student, we computed indices describing ego centrality, his/her cross-gender relationships and his/her social capital, using friendship ties. We computed two indices of centrality: in-degree centrality, and closeness. In-degree centrality reflects the extent to which one individual was cited within the several relations investigated. It is a measurement of popularity, which, it has been suggested, is more relevant than out-degree centrality for substance use by young people (Kramer and Vaquera, 2011). Closeness captures the centrality of an individual, related to the minimum number of ties needed to reach all the other individuals in the network. We hypothesized that centrality measures would be associated with more frequent drinking, because central individuals are more exposed to the prevalent norms of heavy drinking at the University (Dowdall, 2009; Wicki et al., 2010) than peripheral individuals.

Alcohol is known to be an important issue in male–female relationship as it helps to facilitate cross-gender relationships and, sometimes, even becomes a key component of risky sexual behaviour (Lavikainen et al., 2009). Cross-gender relationship was assessed by the Krackhardt E-I index (Krackhardt and Stern, 1988), which measures how gender-heterophile an individual is. The index ranges from −1, when all ties are internal to the gender group, to +1, when all ties are external to the gender group. Our hypothesis was that gender-heterophile students would engage in less frequent drinking behaviour because brokering would require combining the norms and preferences of the two gender groups.

Finally, an index of social capital, effective size, was computed. Effective size records how much ego is locked within ties in which he/she has little choice: it is the number of alters that ego has, minus the average number of ties that each alter has to other alters. In practice, effective size is often considered to be a measure of social capital or power, as it is the actual size of the network minus its redundancy (Burt, 1992). Our assumption was that the more a student is locked into ties exposed to drinking, the more likely he/she is to drink because of the normative expectations associated with maintaining such ties.

**Statistical analysis**

In the first step, Moran’s I coefficients were computed to measure peer-effect diffusion (Bailey and Gatrell, 1995). Moran’s I is an autocorrelation coefficient that ranges from −1, when socially close students display contrasting patterns of drinking, to 1, when socially close students display identical patterns of drinking. We used the following social proximity matrices: friendship, reciprocated friendship, sharing the same dorm, working together, spending leisure time together. The p-value for Moran’s I was computed with permutation tests on 1000 permutations (risky drinking is randomly permuted across the nodes with the Moran being computed at each iteration).

The next step involved statistical analysis of students’ drinking patterns with individual and structural features as covariates. As the frequency and quantity of drinking are counts (number of occasions per month or number of drinks), Poisson regression was carried out. Obviously, in social-network analysis, the assumption of independent observation is—by definition—violated, so classical tests could overestimate precision. Instead, permutation tests were used to assess the distribution of the estimates. The data were permuted 1000 times, with Poisson regression being estimated at each draw. The p-values were computed according to the estimates distribution. Finally, we tested whether the model differed between Psychology and Engineering, using a Chi-square test. All graphs and structural indices were carried out using UCINET, while statistical analysis was achieved with SAS 9.2.

**RESULTS**

The frequency and magnitude of drinking was quite high among these groups, with 5 to 10...
occasions of drinking per month and 2 to 5 occasions of binge drinking per month (Table 1). Females had fewer drinking occasions and drank smaller quantities than men; these statistical differences, however, were only significant for drinks per day (Fisher exact test, \( p < 0.001 \)).

Due to the sex ratio in Psychology and Engineering, females were gender-homophile in Psychology (they had more ties with females than with males), while men were heterophile (they had more ties with females than with males); the reverse was true in Engineering. Centrality features were higher in Engineering than in Psychology: on average, a student in Engineering had between 3.7 (female) and 4.5 (male) ties, as against 2.1 times for both genders in Psychology. Similar differences were found for effective size and closeness centrality.

Overall, all Moran’s I coefficients were positive, significant and of moderate magnitude (Table 2), which suggests that ego drinking behaviour is positively and moderately related to alter drinking behaviour. The Moran’s I was higher for friendship relationships than for dorm-sharing, leisure, or working relationships. However, the Moran’s I varied according to faculty: Moran I was greater among students in Engineering than among students in Psychology for dorm-sharing, while the reverse was true for leisure relationships: it was greater among psychology students than among engineering students. When we focused on friendship ties, we found that the Moran’s I coefficients were higher for reciprocated friendship ties than for all friendship ties (Table 2).

Figure 1a and b displays the friendship graphs for 1st-year psychology (top) and engineering (bottom) students. Red symbols stand for at least weekly binge drinkers and blue for the rest; circles represent women and squares men; symbol size is proportional to in-degree centrality. The Psychology network was less dense than the Engineering network and also contained more individuals with higher centrality: this is because high density tends to be negatively correlated with centrality. Overall, blue dominated the centre of the Psychology graph while red dominated the Engineering graph.

Statistical association between social position and binge-drinking frequency is investigated in Table 3. Being a female was associated with lower frequency of binge drinking. Centrality

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**Table 1:** Mean or percentage of socio-demographics, drinking patterns and network structural indicators: University Social Network Study, Belgium 2010

<table>
<thead>
<tr>
<th></th>
<th>Psychology</th>
<th></th>
<th>Engineering</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female ((n = 231))</td>
<td>Male ((n = 26))</td>
<td>Female ((n = 38))</td>
<td>Male ((n = 195))</td>
</tr>
<tr>
<td>Drinks per day (no.)</td>
<td>4.7</td>
<td>6.5</td>
<td>5.2</td>
<td>7.3</td>
</tr>
<tr>
<td>Drinking frequency (mthly occasions)</td>
<td>4.8</td>
<td>9.8</td>
<td>7.8</td>
<td>9.9</td>
</tr>
<tr>
<td>Binge frequency (mthly occasions)</td>
<td>1.9</td>
<td>4.0</td>
<td>2.5</td>
<td>4.6</td>
</tr>
<tr>
<td>Reach closeness (nodes per step)</td>
<td>4.5</td>
<td>4.3</td>
<td>20.9</td>
<td>20.3</td>
</tr>
<tr>
<td>In-degree (no. of ties)</td>
<td>2.1</td>
<td>2.1</td>
<td>4.5</td>
<td>3.7</td>
</tr>
<tr>
<td>Effective size (no. of alters)</td>
<td>3.4</td>
<td>3.8</td>
<td>8.1</td>
<td>6.9</td>
</tr>
<tr>
<td>Gender heterophilicity ((-1, +1))</td>
<td>-0.8</td>
<td>0.5</td>
<td>0.4</td>
<td>-0.7</td>
</tr>
</tbody>
</table>

**Table 2:** Peer effect of drinking pattern according to ties and faculty, University Social Network Study Belgium 2010: Moran’s I coefficient

<table>
<thead>
<tr>
<th></th>
<th>Room-mates</th>
<th>Ingoing friendship</th>
<th>Reciprocated friendship</th>
<th>Leisure</th>
<th>Working</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Engineer</td>
<td>Psych.</td>
<td>Engineer</td>
<td>Psych.</td>
<td>Engineer</td>
</tr>
<tr>
<td>Drinks per day (no.)</td>
<td>0.04</td>
<td>0.12</td>
<td>0.23***</td>
<td>0.32***</td>
<td>0.08***</td>
</tr>
<tr>
<td>Drinking freq.</td>
<td>0.41***</td>
<td>0.34</td>
<td>0.23***</td>
<td>0.32***</td>
<td>0.08***</td>
</tr>
<tr>
<td>Binge Freq.</td>
<td>0.22</td>
<td>0.15</td>
<td>0.25***</td>
<td>0.33***</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Statistical significance computed on 1000 permutations: \(* p < 0.05\); \(** p < 0.01\); \(*** p < 0.001\).
was associated with increased binge-drinking frequency: for each additional in-degree (friendship nomination), binge-drinking frequency increased by 26%. Out-degree centrality was not statistically related to binge-drinking frequency (beta = -0.007, p = 0.48). In contrast, having a higher effective size decreased the risk of binge drinking: for each additional non-redundant friendship tie, binge-drinking frequency was reduced by 13%. Cross-gender relationships were protective. Increasing gender heterophily by one point meant a reduction of 24% in binge-drinking frequency.

We tested whether the effects of gender, in-degree centrality, closeness and effective size taken together were different between the two


Table 3: The role of structural indicators in binge-drinking frequency, University Social Network Study Belgium 2010: beta coefficient of the Poisson regression

<table>
<thead>
<tr>
<th>Covariate</th>
<th>Beta</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>−0.03</td>
<td>0.01</td>
</tr>
<tr>
<td>Sex female (ref = male)</td>
<td>−1.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Reach closeness (no. of nodes)</td>
<td>0.15</td>
<td>0.06</td>
</tr>
<tr>
<td>Indegree (no. of ties)</td>
<td>0.26</td>
<td>0.02</td>
</tr>
<tr>
<td>Effective size (no.)</td>
<td>−0.13</td>
<td>0.05</td>
</tr>
<tr>
<td>Gender heterophily (−1, +1)</td>
<td>−0.24</td>
<td>0.05</td>
</tr>
</tbody>
</table>

*p-value based on 1000 permutations.

faculties: the likelihood ratio test was significant ($\chi^2 = 27.30, p < 0.001$): being female was a more protective factor in Psychology ($beta = −1.47$, 95% CI: $−1.78, −1.16$) than in Engineering ($beta = −0.63$, 95% CI: $−0.91, −0.34$). Closeness had a much stronger effect in Engineering than in Psychology ($beta = 0.15$ 95% CI: 0.05, 0.25 vs. $beta = −0.04$ NS).

We found similar results with drinking frequency, although of smaller magnitude: for example, in relation to in-degree centrality ($beta = 0.20$) and effective size ($−0.08$). No significant results were, however, observed with drinking quantity, suggesting that structural indicators had more influence on the pattern and frequency of drinking than on the quantity.

DISCUSSION

Main findings

This study explored the role of social position in binge-drinking behaviour among university students. We found evidence of a peer effect of binge drinking, higher for reciprocated ties than for non-reciprocated ties. Social position in the network had mixed effects on drinking: being central puts individuals at greater risk of binge drinking, while having more social capital decreased the risk of binge drinking. Overall, these results point to the need to look both at the cohesion of the ego-network and social status.

Individuals locked into cohesive friendship ties were more likely to binge drink than those who had fewer redundant friendship ties. This hints at a possible role of the sub-group’s social capital in drinking behaviour. However, the effect of social capital on drinking is a contentious topic in the literature. Ego-network social cohesion had a protective effect for young high-school adolescents from a rural background in the USA (Ennett et al., 2006), whereas students with high in-school embeddedness were more at risk of binge drinking, according to the National Longitudinal Study of Adolescent Health (Kramer and Vaquera, 2011). In fact, such inconsistencies are not that surprising, for two reasons, substantive and methodological. From a substantive point of view, not all forms of social capital are homogeneous in relation to health behaviour (Portes, 1998). For example, the Health Behaviour in School-aged Children (HBSC) study showed that some kinds of social involvement, such as religious or cultural participation, had a protective effect in relation to children’s drunkenness, while participating in sport clubs or political organizations increased drunkenness (Zambon et al., 2010). In the College Alcohol study, students affiliated to “Greek houses” (individuals with high bonding social capital) had high levels of binge drinking compared with those not so affiliated, while higher university-level social capital (measured by the percentage of students volunteering) decreased the risk of binge drinking (Weitzman and Chen, 2005; Zambon et al., 2010). The possibility that higher social capital may increase drinking in adults has been raised elsewhere (Carpiano, 2007) and is consistent with our study: our denser network was also the one with the higher risk of binge drinking, even for women. In the end, if excessive drinking behaviour turns out to be the prevalent norm in a network, increasing density may facilitate its spreading, as evidenced by the literature about the dark side of social capital (Portes and Landolt, 1998). As our study did not look at self-reported norms of drinking, we must remain cautious on the role of such normative expectations. Previous observational studies (Borsari and Carey, 2003) and interventional studies (Moreira et al., 2009), however, have underlined the importance of norms for drinking behaviour.

From a methodological point of view, the study by Kramer and Vaquera (Kramer and Vaquera, 2011) and the study by Ennett et al. (Ennett et al., 2006) operationalized embeddedness differently: the first study used the number of in-degree nominations, while the second also used reciprocity, neighbourhood density, out-degree nominations and isolation. However, the number of in-degree nominations, available in both studies, shows similar results: the higher the
number of in-degree nominations, the higher the frequency of recent alcohol use. Our results are consistent with this finding.

Finally, our study suggests that there is a complex interaction between gendered identity, network and alcohol consumption. Although women drank less, less often and less excessively than men in Psychology, this difference was lower in Engineering: the alcohol risk attached to being a woman meant different things according to the social network. The two networks were very different: the network in Psychology was less dense, more centralized and included more females; while the network in Engineering was much denser, less centralized and included more males. The density difference is partly due to different recruitment and training practices: first-year Engineering students are more likely to know each other because they had to pass an admission exam the year before being admitted, while no such admission exam exists for psychology students. Secondly, engineering students are more exposed to small-group exercises from the very beginning of their training, whereas almost all psychology courses are taught in very large groups of hundreds of students. As has been shown elsewhere (Mundt, 2011), a higher density of ties could create a social environment more favourable to spreading drinking norms and behaviour, even among women: indeed, looking at the Engineering network, we noted that a few central women showed a higher frequency of binge drinking, as well as men. At the centre of this network, gender difference in binge drinking seems to disappear. Our data cannot explain this reversal of the gender effect. Previous research has, however, noted the increasing prevalence of risky health behaviour among highly competitive women, labelled as “top girls” in qualitative research on social crowds: these girls may take up alcohol consumption to maintain their prestige in the group (Michell and Amos, 1997) and—possibly—because of the group’s structure and composition. Tokenism has been suggested as an explanation of this kind of gender-minority behaviour: individuals whose social category is under-represented in particular contexts may face social isolation and cope with that risk by taking up risky behaviour that convenes social identity in order to resist marginalization. This may also apply to males: it is indeed telling that, conversely, the Psychology network (mainly female) displays a small number of very central males who do not engage in binge drinking. Caution is, however, required, as the network boundaries ignored the social ties that students maintain outside the class. This might lead one to underestimate social ties in the minority gender-group (i.e. female in Engineering and male in Psychology). Further research should investigate such gender differences in drinking network patterns, also with qualitative research.

Limitations

Our study had some limitations. The social-network analysis targeted two first-year programmes. How representative were these two groups of the University population as a whole and of the student population in general? These two networks, after all, represented only 5.3% of the University population and showed two extreme gender distributions. Our sample is thus more likely to reflect a maximum variance approach than the average distribution. Has this selection biased the average alcohol consumption? As stated above in the method section, a web survey was delivered to the whole student population at the same time as the social-network survey was carried out, thus making it possible to validate the survey. Two questions were worded in exactly the same way in the two surveys: frequency of drinking and frequency of binge drinking. This made it possible to estimate the bias of the SNA survey, taking the web survey as the reference. The average frequency of alcohol consumption in the web survey was 7.0 a month, compared with 6.9 in our social-network survey; the average frequency of binge drinking was 2.8 a month in the web survey, compared with 2.9 a month in our social-network survey. There is, thus, little evidence that our population was much different from the student population as a whole, at least in terms of alcohol consumption. We must, however, remain cautious: we need more studies comparing different networks before we can claim to offer a definite answer on this point.

Secondly, due to our cross-sectional design, it is difficult to separate peer-influence from peer-selection effects on drinking behaviour. Longitudinal research is needed to disentangle these two mechanisms and is beyond the scope of this study. Previous longitudinal research has shown that social influence is an important component, particularly for smoking (Mercken et al., 2010). Other longitudinal research into adolescents (Mundt, 2011) and adults (Rosenquist...
et al., 2010), however, has shown the role of peer influence when controlling for previous drinking behaviour.

CONCLUSIONS

Socially close students share similar drinking behaviour and their social position contributes to the explanation of their excessive alcohol consumption. Our study, however, suggests that structural position has an effect that interacts with network composition. Structural position and network composition, thus, need to be analysed together.

Two potential applications flow from our analysis. First, binge-drinking preventive measures are likely to be inefficient if social relationships are ignored. In networks known for their high level of drinking, targeting highly interconnected and cohesive groups or targeting central individuals are promising interventions (Campbell et al., 2008). Although these groups may not be very numerous, their prominence in the overall network may be enough to spread less risky drinking habits, as in other health promotion approaches. Second, one preventive solution will not fit all university networks: some programmes may require an approach that focuses on individuals with high centrality, whereas isolated individuals may need to be targeted in others.

FUNDING

This research was supported by the Université Catholique de Louvain, in particular the Vice-Rector for Student and Social Affairs. The research was also carried out with the help of students in the Faculty of Public Health: Anémone Bruneau, Alessandra Ausloos, Anne-Sophie Dehanne, Céline Denis, François Leruth, and Sandrine Race.

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