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How the Structure of Egocentric Facebook Networks is Associated With Exposure to Risky Content for Maltreated versus Comparison Youth

Sonya Negriff, Ph.D.

Kaiser Permanente Southern California, 100 S Los Robles Ave, Pasadena, Ca 91101

Abstract

The current study examined the size and connectedness of egocentric Facebook networks as predictors of exposure to risky content among a sample of maltreated and comparison youth ($n=118$). Social network measures (i.e., size, density, average degree, percent of isolates) were computed from the mutual friend list. A content analysis of posts by friends captured references to alcohol use, marijuana use, partying, and sexual content. Multiple-group path models showed that the larger size of the Facebook network and higher average degree predicted references to marijuana use only for comparison youth, whereas for maltreated youth a higher percent of isolates predicted more references to sexual content by Facebook friends. Structural measures of online networks may have potential utility for identifying those at risk.

Keywords

social network analysis; Facebook; risk behavior; maltreatment

Contemporary youth use social media and social network sites (SNSs) at higher rates than any other generation. As many as 95% of youth aged 13–17 have access to a smartphone, 72% use Instagram, and 45% report being online “almost constantly” (Pew Research Center, May 2018). Due to the nearly seamless integration of online interactions into the lives of today’s youths, much attention has been given to the potential negative effects of social media use. Of particular concern has been the supposition that exposure to online content supporting or glamorizing substance use or risky sexual behavior may increase offline instances of those behaviors (Brown et al., 2006; Young & Jordan, 2013). A number of studies support peer influence as a risk for delinquency, substance use, or risky sexual behavior in offline settings (Valente, 2010; Valente, Fujimoto, Soto, Ritt-Olson, & Unger, 2013; Valente & Vlahov, 2001). However, there have been fewer studies examining these same links with online peers. Because adolescents and young adults are early adopters of

Sonya.x.negriff@kp.org.

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new social media platforms and prolific users, they may be especially susceptible to peer influence via this modality (Ellison, Steinfield, & Lampe, 2007; Huang et al., 2014; Lenhart, Purcell, Smith, & Zickuhr, 2010) and evidence indicates influence may be amplified in online venues (Moreno & Whitehall, 2014). Despite this apparent effect of risky online content on offline behavior (Cook, Bauermeister, Gordon-Messer, & Zimmerman, 2013; Cook, Bauermeister, & Zimmerman, 2016; Huang et al., 2014), little is known about the structural characteristics (e.g., size, density) of online networks with high levels of risk content (e.g., posts about getting drunk, using marijuana or drugs, or risky sexual behavior). The current study addresses this gap in the literature by examining structural properties of Facebook networks as predictors of risky online content. In addition, we examined these associations in a population at high-risk for exposure to online risky content, maltreated youth. Understanding what leads to higher exposure to risky online content and contextual experiences that may increase vulnerability will enhance the ability to target those at risk and reduce associated offline risk behavior.

1.1 Social Network Structure and Risk Behavior

A substantial body of evidence demonstrates how social networks influence attitudes and behavior. While some studies use aggregate variables when assessing the social network (e.g., “how many of your peers are substance users”), social network analysis takes into account the ties between network members to describe the structure of the network (Valente, 2010). Common measures of network structure include size, density, number of components, centralization, diameter, and number of isolates. Most social network sites and Facebook in particular allow the creation of egocentric networks—comprised of a focal *ego* and a set of *alters* (e.g., Facebook friends) who are connected to the ego by a predetermined metric (i.e., friend request sent and accepted) (Arnaboldi, Passarella, Tesconi, & Gazzè, 2011; Wasserman & Faust, 1994). Importantly, Facebook ties indicate a mutual friendship, that both people have agreed they have a connection, which is not always the case in offline networks. This creates an environment where friendships cannot be “hidden” and posts by one friend are often seen by the entire online network. This lack of anonymity likely has repercussions for dissemination of information throughout the Facebook network and for offline behavior. For example, risk content in the egocentric network may be higher if posting about risk behavior is perceived as a way to gain status in the peer group (Allen, Porter, McFarland, Marsh, & McElhaney, 2005). In addition, evidence indicates that adolescents and young adults perceive online posts as representative of offline behavior (Moreno, Briner, Williams, Walker, & Christakis, 2009), and therefore they may engage in similar offline risk behavior as touted by their peers online (Litt & Stock, 2011).

A number of studies show that certain characteristics of the social network such as size (i.e., number of friends) and connectedness (e.g., density, average degree, isolates) have been linked with risk behavior, mainly in offline networks. For example, in a sample of African American women larger offline networks were linked with self-report of risky sex partners and multiple sex partners in the past 90 days (Neblett, Davey-Rothwell, Chander, & Latkin, 2011). Risk behavior is likely to propagate through online social networks due to implicit social norms. According to social norms theory, individuals are likely to overestimate the prevalence of risk behavior in their network and match their own behavior to the perceived

norm (Berkowitz, 2005). In this way a higher perceived prevalence and approval of risk behavior affects both the injunctive norms (perceived approval of risk behavior among network members) and descriptive norms (perceived prevalence of risk behavior) of the network (Lee, Geisner, Lewis, Neighbors, & Larimer, 2007). This is supported by studies showing that young adults have favorable attitudes towards posting about risk behavior (Morgan, Snelson, & Elison-Bowers, 2010; Neighbors, Geisner, & Lee, 2008; Peluchette & Karl, 2008). Theoretically, larger networks provide higher likelihood of a potential insertion of risk into the network, the development of a more heterogeneous friend group (i.e., are similar in their posting of risk content), and social norms that support the continued posting about risk behavior. The connectedness of the network also has theoretical support for the propagation of risk behavior. More specifically, while denser (more connected) networks encourage the diffusion of information more easily throughout the network (Valente, 1995) and strengthening of current social norms, other aspects of connectedness such as the percentage of isolates may imply weak ties (acquaintances rather than close friends). Weak ties are an outlet for new (potentially risky) information to enter the network (Granovetter, 1973) and thus diminish the status quo social norms. In terms of evidence linking connectedness with risk behavior in offline networks, in a study over 5,000 adolescents, those classified as isolates (i.e., those not connected to the rest of the network) were the most likely to use substances (Ennett et al., 2006). However, a more connected network (higher density) predicted lower substance use. For online networks, studies have found both size and density are associated with alcohol use. Specifically, larger networks predicted higher alcohol use in a college age-sample while higher density was associated with recent unprotected vaginal intercourse (Cook et al., 2013; Cook et al., 2016). Despite numerous studies that show associations between network structure and behavior, and online posts and behavior, no studies have examined whether network structure is associated with higher exposure to risky online content, a clear gap in the understanding of how risk may be transmitted.

1.2 Maltreatment and Online Social Networks

The online environment may be very different for youth who have experienced maltreatment. There is substantial evidence showing maltreatment interferes with the development of normative peer interactions (Trickett & Negriff, 2011). Maltreated youth may be drawn to online venues due to fewer challenges interacting in a nonsynchronous environment. Their lack of social skills and inappropriate interpersonal style may not be a hindrance in online interactions, and as such, they may reap the benefits to self-esteem and well-being shown for youth with shyness or social anxiety (Desjarlis & Willoughby, 2010; Valkenburg & Peter, 2007; Van Zalk, Van Zalk, Kerr, & Stattin, 2013). On the other hand, difficulties with face to face interpersonal interactions may drive maltreated youth to peers who are also outside the norms in some way, perhaps to those with shared interests in deviant behavior. Evidence indicates that maltreated youth have more deviant friends than nonmaltreated youth (Negriff, 2018). In this way maltreated youth may create an online network that is more likely to post about risky behavior. Maltreated youth may also be more naïve, allowing strangers into their online network. As one study found, maltreated girls

were more likely to meet someone offline that they had first met online (Noll, Shenk, Barnes, & Putnam, 2009).

Only one study has examined maltreatment in relation to the structure of online networks. Among a sample of young women, a less interconnected network (i.e., higher clustering coefficient) mediated the association between sexual abuse and fewer alcohol use problems (Oshri, Himelboim, Kwon, Sutton, & Mackillop, 2015). In this instance, a less connected network was protective against alcohol use problems for women with sexual abuse histories. However, this finding does not address whether the size and/or connectedness of the online network may predict exposure to risky content differentially for maltreated versus nonmaltreated youth.

1.3 The Current Study

Research shows that peers' risk behavior or simply the perception of risk behavior is a strong predictor of individual substance use (Deutsch, Chernyavskiy, Steinley, & Slutske, 2015). While a number of studies have demonstrated that exposure to online risky content affects individual's attitudes and behavior (Moreno et al., 2009; Moreno, Brockman, Wasserhit, & Christakis, 2012; Moreno, Christakis, Egan, Brockman, & Becker, 2012), none have examined the social network predictors of risky content posted by Facebook friends. The current study addressed this gap by testing features of the Facebook egocentric network such as size and connectedness (i.e., density, average degree, and percent isolates) as predictors of references to substance use, partying, and sexual content by online friends. Based on the current literature, we hypothesized that larger, more interconnected networks would be associated with more exposure to risk behavior. In addition, because maltreated youth may create different online contexts for themselves, we examined whether these associations differed for maltreated versus nonmaltreated youth but lack an empirical basis to develop specific hypotheses.

2 Methods

2.1 Participants

Data for the current study came from Time 5 of an ongoing longitudinal study examining the effects of maltreatment on adolescent development. The parent study was composed of 454 adolescents aged 9–13 years at baseline (2002–2005; $n=303$ maltreated, $n=151$ comparison; 241 males and 213 females). Baseline (Time 1) took place between 2002 and 2005, followed by three additional assessments. Time 2 (2003–2006), Time 3 (2005–2008) and Time 4 (2009–2012) occurred approximately 1 year, 1.5 years and 4.4 years following each prior assessment. Time 5 (2013–2015) was conceptualized as pilot study on social networks using a subsample of enrolled participants ($n=152$; $M_{\text{age}}=21.84$; $SD=1.46$) and took place approximately 11 years after baseline. For Time 5, participants enrolled in the larger study were contacted and asked to participate in a study of online social networks, with attention placed on maintaining equal numbers for the maltreated and comparison groups (a deviation from the design of the parent study). There were 152 participants who completed some portion of the study assessment, 23 did not have a Facebook profile but completed the survey, and 118 had complete data for the social network variables and risk content coding

(analytic sample). The total Time 5 sample was primarily Black (39%), Latino (37%), White (11%), and Biracial (13%), which was similar to the racial/ethnic composition at baseline for the full sample. Demographic characteristics of the analytic sample at Time 5 and comparison to the full enrolled sample can be found in Table 1.

2.1.1 Recruitment (Parent study)—Adolescents selected for the maltreatment group were recruited from a list of new referrals to the Children and Family Services (CFS) agency of a large west coast city. The inclusion criteria were: (1) a new referral to CFS in the preceding month for any type of maltreatment; (2) child age of 9–12 years (though some turned 13 in the time between scheduling and completion of interview); (3) child identified as Latino, African-American, or Caucasian (non-Latino) (4) child residing in one of 10 zip codes in a designated county at the time of referral to CFS. Caregivers of potential participants were contacted and asked their willingness to participate after approval from the child welfare agency and the Institutional Review Board of the affiliated university. Approximately 50% of families contacted were enrolled, which is likely an underestimation of participation due to a high number of incorrect addresses.

Adolescents in the comparison group were recruited using school lists of children aged 9–12 years residing in the same 10 zip codes as the maltreated sample. As with the maltreated group, the caregivers were contacted and asked about their willingness to participate. To ensure the fidelity of the maltreatment group, the comparison families confirmed they had no previous or ongoing experience with child welfare agencies. Approximately 77% of the families contacted were enrolled in the study.

For Time 5, contact was attempted for all enrolled participants (N=433; 21 requested to be dropped from the study at a previous wave) for a one year period while maintaining the planned design of equal numbers in the maltreated and comparison groups. Of those contacted, 26 declined to participate, 3 were deceased, 5 were in the military and unable to have contact, 4 were incarcerated, one was likely in Mexico with no contact, and one was in a treatment facility. There were 18 participants who were consented and given the study instructions but did not start the Facebook app. There were 76 participants who did not complete the previous timepoint (Time 4) and due to lack of current contact information none were able to be reached. Of the remaining 300, 152 participants completed one or more parts of the study assessment (Facebook and and/or survey), while the remaining 148 could not be reached (either because no contact information could be located or the participant would not return our messages). Because we could not determine if our messages were not returned due to lack of interest or an incorrect number the actual participation rate is difficult to estimate.

2.1.2 Demographic composition of the current sample—Within the Time 5 sample, the demographic characteristics of the maltreated and comparison groups were very similar. Chi-square tests showed no differences in the proportion of males and females in each group nor in the ethnic composition for each group (see Table 1), demonstrating that the Time 5 sample is very similar to the full sample which provides assurance that the findings are not biased by the selection of the Time 5 sample.

Chi-square analyses were also conducted to determine if there were any significant differences in the composition of a) the Time 5 sample versus the full sample and b) the Time 5 sample with Facebook data ($n=118$) versus the full Time 5 sample ($n=152$). The results indicated that for the full ($n=454$) versus the analytic sample ($n=118$) fewer maltreated youth and males were selected for the Time 5 sample versus the proportions in the full sample ($p<.05$). In part, this is due to the equal proportion of maltreated and comparison youth required for the Time 5 study design versus the 2/3 maltreated that were enrolled in the original sample. Nonetheless, both of these variables would have biased the outcome variables upward, such that inclusion of more maltreated youth or more males would result in more variability and likely amplify any significant findings. For the full Time 5 sample ($n=152$) versus the analytic sample ($n=118$) there were no differences in the demographic variables.

2.2 Procedures

All data collection took place online. Research assistants obtained verbal consent over the phone and then proceeded with the study protocol. First, the participant received an email with the URL for the Facebook application (developed for the current study). Upon clicking on the URL, the participant was asked to select the button “Login with Facebook”. This action opened a new window where they entered their Facebook login and were informed of the permissions and data accessed by the application. The Facebook application downloaded the list of Facebook friends, the list of mutual friends (links between participants’ Facebook friends), and the participants’ Timeline data (this data included status updates/posts, comments, and likes). More sensitive information such as photos, videos and private messages were not downloaded. The mutual friends list was used to create the egocentric Facebook friend network for each participant. All Facebook data was downloaded between 2013 and 2015 and contained information from 2007–2015.

Upon completion of the Facebook application, a personalized online survey was sent to each participant, however none of the data from the survey were used for the current analyses. Participants were compensated for completion of the Facebook application and/or online survey by check or gift card (\$75 for both the Facebook app and survey). All procedures were approved by the Institutional Review Board of the affiliated university.

2.2.1 Facebook coding—After participants completed the Facebook app, research staff downloaded the ‘Timeline’ file from the server. The Timeline file included all the posts from the participant (e.g., status updates, comments) and all posts and comments from those on the participant’s friend list made on the participant’s timeline. Five coders were trained by the first author (S.N.) to evaluate the posts and comments for risky content (specified in the measures section). All coders were trained on the same Timeline file until they achieved acceptable agreement. Discordant coding was discussed until agreement was reached. Coders then independently coded individual files assigned to them, with 20% of the files randomly assigned to be double-coded to test inter-rater reliability. Halfway through, agreement was checked again by having all coders work on the same file and discrepancies were discussed until agreement was reached. The 20% independently double-coded Timeline files were used to compute Cohen’s κ and determine the extent of overall

agreement for the presence or absence of each risk behavior code. The inter-rater reliability ranged from 0.54 to 0.89 indicating moderate to excellent agreement (Viera & Garrett, 2005). The reliability for each risk behavior code can be found in the measures section below. For the current study only the friends/alters posts were coded.

2.3 Measures

2.3.1 Dependent variables: Risky content posted by Facebook friends—A codebook was developed for the current study based on a priori topic areas of interest, i.e., substance use and sexual content. Codes captured references to alcohol use, excessive alcohol use, marijuana, hard drugs, and sexual content. Each post was assessed for all of the individual risk behavior codes and each were coded as present (1) or absent (0). The posts were summed to create a variable indicating the number of posts for each risk behavior. The code was only marked as present if the post *endorsed or supported* the target risk behavior, for example if a post was anti-substance use (e.g., “please don’t get wasted”) it was not coded as present for that content. Substance use codes were not mutually exclusive (except general and excessive alcohol use), that is, if a post contained reference to drinking beer AND smoking marijuana then both general alcohol use and marijuana use were coded. If the post only contained a reference to drinking beer, then only general alcohol use was coded. On the other hand, sexual content codes were mutually exclusive as detailed below. The general codes and distinctions between codes were developed from reading Timeline posts from a pilot study of college undergraduates (Ross et al, in press). Based on those data we developed the following codes and added clarifications or additional terminology at the initial and halfway reliability checks.

Substance use

1. General alcohol use ($\kappa=0.72$): any references to alcohol including purchasing, consuming, seeing, desiring. For example, “scotch n gin :D” or “We invented booze to relax us in this world. “
2. Excessive alcohol use ($\kappa=0.73$): any reference to a) feeling the effects of alcohol or binge drink (e.g., being drunk, drinking to get drunk, playing drinking games etc. “Your [sic] drunk. lol”; b) direct indications that alcohol use is interfering with poster’s life, that alcohol has negatively impacted school, job performance or relationships, caused physical sickness or withdrawal problems (e.g., feeling “hung over”, vomiting), legal problems, physical fights, or made a situation unsafe or dangerous (For example, “Been at work for an hour now. And, I might still be drunk.”); or c) references to alcohol tolerance and/or addiction. For example, “i can’t stop drinking, i can’t stop smoking, i can’t stop writing, i should be the ‘i can’t stop spokesman’.” If the posts included references to both drinking beer and getting drunk then only excessive alcohol use was coded.
3. Marijuana use ($\kappa=0.78$): any reference to marijuana including consuming, seeing, desiring, being under the influence, purchasing, selling. For example, “420 wake n bake!!”, “i want to blaze!!!!”.

4. Hard drug use ($\kappa=0.89$): any reference to substance use other than alcohol and marijuana including depressants stimulants, narcotics, and hallucinogens and references may be broad, e.g., “popping pills.”
5. Partying ($\kappa=0.54$): any references to partying (e.g., getting ill, turnt, etc.) or establishments where a person is likely to come into contact with drugs and/or alcohol (e.g., clubs, bars, music festivals, etc.). No direct mention of drug/alcohol use. For example, “Bored as hell and I wanna get ill...”

Sexual references: Sexual references were coded hierarchically, first the coder determined if the post contained reference to sexual intercourse. If not, they determined if it contained reference to soft sexual content. If not, it was coded as sexualized content.

1. Sexualized content ($\kappa=0.57$): general references to sexual promiscuity, derogatory references toward women or men, name-calling that includes sexual terms, references to being sexually attracted to someone, or references to person or person’s behaviors that are sexual (e.g., stripper, pornstar, virgin). For example, “sexy ladies”.
2. Soft sexual references ($\kappa=0.68$): references to sexual anatomy (excluding name-calling), sexual touching, oral sex, but no direct mention of sexual intercourse. For example, “I suck dick and what :D”.
3. Sexual intercourse ($\kappa=0.71$): any reference to sexual intercourse (thinking about, desiring, engaging in, observing). As noted above, any reference to oral sex was coded as a soft sexual reference not a sexual intercourse reference. For example, “Watching live sex hahah”.

2.3.2 Independent variables: Facebook egocentric network characteristics—

The mutual friends list downloaded using the Facebook application was used to calculate network metrics. The mutual friend list was in the form of an edgelist which contains all ties between the participants’ Facebook friends (excluding the participant). For example, if Participant 1 has five friends the mutual friends list will show which of those five are Facebook friends independent of the participant. In the present study the term “Facebook friends” was used to refer to the network members, but this is a term set by Facebook and the “Friend list” can include friends, family members, acquaintances, or strangers.

Four social network metrics were calculated: 1) size (the number of friends in the network) was defined as the number of “Facebook friends”; 2) density (the number of total possible links between friends/number of actual links between friends); 3) average degree (average number of ties between participant’s friends); 4) percent isolates (percent of friends not connected to any of the participant’s other friends).

2.3.3 Covariates—The following covariates were included in the analyses: age at Time 3 (approximate Time point when Facebook data were from), sex (male=1, female=2), and total number of Facebook Posts. Age was included due to developmental increases in risk behavior during adolescence and sex was included because of documented sex differences in

risk behavior, with males being higher. Number of Facebook posts was included to control for those with more activity on their timeline having higher likelihood of risky content.

2.3 Data Analysis

The following network characteristics were calculated (described in measures section): size, density, average degree, and percent isolates using the Statnet package (Handcock et al., 2016) in the R statistical program.

Due to high correlations between the two alcohol reference codes (general and excessive) and the three sexual reference codes, these codes were summed to create one alcohol reference code and one sexual reference code. Using Mplus (Muthen & Muthen, 2014), four separate path models were tested for each of social network variables (i.e., size, density, average degree, and percent isolates). In each of the four models, the specified social network variable was entered as a predictor of the four risk behavior Facebook posts by friends (i.e., alcohol references, marijuana references, partying references, sexual references). Hard drug references were removed due to low variance. The social network predictors were tested in separate models due to collinearity or nonindependence between the variables. Maltreatment status (maltreated vs. comparison) and sex (male vs female), Time 3 age, and number of Facebook posts (log transformed because of large variance) were included as covariates. The maximum likelihood with robust standard errors estimator (MLR) estimation method was used to adjust for skewness in the outcomes.

Next, multiple-group path modeling was used to examine whether maltreatment status moderated the effect of network characteristics on risky Facebook content posted by friends. The four models described above were used to test moderation effects. First, the parameters of interest were allowed to freely vary across groups, then they were restricted to equality. Moderation was indicated by a significant change in the Chi-square statistic when a specific parameter was constrained to equality across groups. The Satorra-Bentler Scaled Chi-square difference test was used to determine significant interaction effects (Satorra, 2000). Significance levels were set to $p < .05$.

4 Results

4.1 Preliminary Analyses

4.1.1 Missing data—Of the 152 participants enrolled in the Time 5 study, 129 completed at least some of the app, of those, 118 completed the Facebook app and had available data to compute both the social network characteristics and Facebook post content codes (analytic sample). There were no systematic differences between 11 participants who began the app but did not finish versus those that finished the app.

4.1.2 Descriptives—Participants joined Facebook between August 2007 and December 2014. All were active on Facebook at the time their data were downloaded (between 2013 and 2015). On average, participants were active on Facebook for 3.8 years ($SD=1.37$) at the time their data were downloaded; this ranged from 1 to 80 months (0.08 to 6.7 years). The number of posts ranged from 7 to 30403 with an average of 6320.25 posts ($SD=6156.92$). As shown in Table 2, the number of participants with no posts from friends containing risky

content was quite low, ranging from 3.3% for sexual content to 15.6% for hard drug use. Only five participants had no risky content posted from their friends for any of the coded categories.

Correlations were computed between all study variables (see Table 3). In terms of the correlations between social network and Facebook content variables, size was significantly correlated with marijuana, hard drug, partying and sexual content references by Facebook friends ($p < .01$), density was only correlated with partying and sexual content ($p < .05$), average degree was correlated with marijuana references ($r = .33, p < .01$), and percent isolates was correlated with sexual content, soft sexual references and sexual intercourse references ($p < .01$). The direction of the coefficients indicated that a higher number of friends in the Facebook network was associated with more references to marijuana, partying, and sexual content by friends. Lower density (less connected network) was associated with more references to partying and sexual content. Also, having a higher percent of the total network as isolates (not connected to anyone else in the egocentric Facebook network) was associated with more references to all three types of sexual content posts.

4.1.3 Mean group differences—Independent samples t-tests showed no mean differences between maltreated and comparison groups for any of the study variables including the total number of Facebook posts (Table 4). For both groups the most prevalent type of post by friends were references to sexual content ($M = 20.13$ for comparison; $M = 26.70$ for maltreated). The least prevalent was hard drug references ($M = 1.40$ for comparison; $M = 1.11$ for maltreated).

4.2 Path Models

4.2.1 Total sample—The results from each of four path models can be found in Table 5. There were significant main effects of network size on references to marijuana ($\beta = 0.62, p < .01$) and partying ($\beta = 0.38, p < .01$) indicating a larger network predicted more posts from Facebook friends containing risky content. Higher average degree was associated with fewer references to alcohol use ($\beta = -0.16, p < .05$). Lastly, a higher percentage of isolates in the Facebook network predicted fewer alcohol references ($\beta = -0.12, p < .05$). That is, a higher percentage of the network that was disconnected from the other egocentric Facebook friends was associated with fewer alcohol and partying references. Of the covariates, males had higher number of references to alcohol, marijuana and partying by friends and a higher number of total Facebook posts predicted a higher number of risky posts by friends.

4.2.2 Moderation analyses—The multiple-group analysis showed that three of the parameters were moderated by maltreatment status (Table 6). Specifically, the parameter coefficient from network size to marijuana references was significant for the comparison ($\beta = 0.88, p < .01$), but not the maltreated ($\beta = 0.08, ns$) group, indicating that having more Facebook friends was associated with more references to marijuana by friends only for comparison youth ($\chi^2 = 31.33, df = 1, p < .01$). In addition, the parameter between average degree and marijuana references was moderated by maltreatment status ($\chi^2 = 12.15, df = 1, p < .01$). The regression coefficient was significant for the comparison group ($\beta = 0.45, p < .01$), but nonsignificant for the maltreated group ($\beta = -.13, ns$), indicating that for the

comparison group a higher average number of ties between friends in their Facebook network predicts higher number of friends' posts with references to marijuana. Lastly, the parameter between the percent of isolates and sexual references was positive and significant only for maltreated group ($\beta = 0.63$, $p < .01$; comparison $\beta = -0.07$, ns), meaning a higher percentage of the Facebook network that were isolates (i.e., no connection to others in the participant's egocentric network) predicted more posts by friends that contained sexual references ($\chi^2 = 17.65$, $df = 1$, $p < .01$).

5 Discussion

Much attention has been given to online social networks as potential sources of risk, but no studies have examined how the structural characteristics of Facebook networks may be linked with risky content posted by friends. Through content analysis of the Facebook posts of participants' friends, the current study was able to link certain structural properties of the egocentric Facebook network with a higher number of references to risk behavior by online friends. For the total sample, larger, less connected networks (i.e., lower average degree and higher percent isolates) contained more posts from friends that contained alcohol, marijuana and partying references, while having a higher percent of isolates in the network was related to fewer references to alcohol. Although there were no mean differences in the amount of risk behavior posted by the friends of youth in the maltreated versus comparison group, several of the associations between network characteristics and risky content were conditional on maltreatment status. The similarity in the amount of risky content both groups were exposed to may indicate more about the contextual similarities of the cohort than differences driven by child maltreatment. Importantly this result indicates that all the youth in our sample were at high-risk for exposure to risky online content, which may potentially affect their offline risk behavior.

In terms of moderation effects, first, the association between the size of the network and marijuana references was only significant for comparison youth. That is, a larger Facebook network predicted more references to marijuana by friends. The association between number of friends and more references to marijuana may be due, in part, to the fact that having more friends provides more opportunities for exposure to risky content. However, controlling for the total Facebook activity accounts for this and the finding that larger networks contained more posts about marijuana remained. The association between network size and marijuana use only for comparison youth may reflect the more normative peer processes found in offline networks. In offline social networks, popular, well-liked students have been found more likely to be substance users (Alexander, Piazza, Mekos, & Valente, 2001; Diego, Field, & Sanders, 2003; Santor, Messervey, & Kusumakar, 2000), and in a longitudinal study regular substance abusers were more likely to be popular and maintain this social standing over time (Killea-Jones, Nakajima, & Costanzo, 2007; Moody, Brynildsen, Osgood, Feinberg, & Gest, 2011). In turn, maltreated youth have more difficulties with social interactions and are less popular than nonmaltreated youth (Trickett & Negriff, 2011). Yet, maltreated youth have higher rates of substance use (Afifi, Henriksen, Asmundson, & Sareen, 2012; Arellano, 1996; Danielson et al., 2009; Lansford, Dodge, Pettit, & Bates, 2010; Moran, Vuchinich, & Hall, 2004). There is some evidence that the pathways to substance use may differ for youth with experiences of maltreatment (Negriff & Trickett,

2012). Thus, early trauma may be a stronger predictor of substance use than peer influence, whereas for nonmaltreated youth social standing and peer influences may be more important.

Second, the parameter between average degree and marijuana references was also only significant for the comparison group. Although density and average degree are both indicators of the connectedness of the network, density takes into account the total possible ties in the network, whereas average degree does not (Valente, 2010). In addition, density is inversely related to size—larger networks have lower density simply because it's less likely for all the people to have ties between each other. On the other hand, average degree is not dependent on network size and simply indexes the average number of ties across all alters in the egocentric network. A high average degree and low density may result if the network is comprised of distinct components or group of friends that are highly intra-connected but have few inter-connections. In the current study, a higher average degree (but not density) was associated with more references to marijuana by alters. This significant result only for comparison youth likely reflects a similar popularity process to that discussed regarding network size. That is, a network with higher average degree indicates that the Facebook friends are more connected to others in the egocentric network. This result is similar to other studies showing that a more interconnected online network is associated with alcohol use (Cook et al., 2013; Huang et al., 2014), but this is the first study to link network connectedness to marijuana references.

The third parameter moderated by maltreated status was that between percent of isolates and sexual references. Specifically, for the maltreated group a higher percent of isolates in their Facebook network predicted more references to sexual content made by their online friends. This finding reinforces the vulnerability of maltreated youth in online contexts. According to the Second Youth Internet Safety Survey, those who received an online sexual solicitation were 2.5 times more likely to have experienced physical, sexual abuse or high parental conflict (Wells & Mitchell, 2008). Similarly, a study of maltreated adolescents found that maltreated girls reported significantly more unintentional exposure to online sexual content and online sexual solicitations than nonmaltreated girls (Noll, Shenk, Barnes, & Haralson, 2013). In a prior analysis with the current sample we found that a higher percent of isolates predicted higher levels of offline high-risk sexual behavior (e.g., unprotected sex, multiple sex partners) (Negriff & Valente, 2018). When incorporated with our current results, the evidence indicates that a Facebook network with many unconnected friends is high-risk, but only for maltreated youth. These isolates may represent individuals whom the participant has met outside the context of their normal friendship group and may reflect deviant influences. Perhaps maltreated individuals seek out these disconnected friends whereas nonmaltreated youth do not. The absence of a link between isolates and the other three risk behaviors may indicate that sexual behavior is higher among this fringe group than the main network, as opposed to substance use and partying which are more often discussed in social contexts among friends.

5.1 Theoretical Implications

The evidence is clear that exposure to online risk behavior shapes descriptive and injunctive norms regarding substance use and sexual behavior, and in turn increases favorable attitudes about those behaviors (Beullens & Vandebosch, 2016; Moreno & Whitehall, 2014). A study of adolescents found that they typically interpret references to substance use as indication of actual use rather than exaggeration or selective self-presentation (Moreno et al., 2009). Similarly, exposure to sexually suggestive Facebook photos was associated with favorable attitudes towards unprotected sex among a sample of college-students (Young & Jordan, 2013). As such, the content posted by online friends is likely to have a significant impact on adolescents' offline risk behavior, as found in one study of young adults (Beverley Branley & Covey, 2017). Although in the current study we cannot tease apart whether the participant or the friend first posted risky content and the other was following suite, the associations between risky posts by the ego and alters is likely reciprocal and contributes to an online space with more exposure to risky content and more permissive attitudes regarding risk substance use and sexual behavior—a strong predictor of actual risk behavior.

5.2 Limitations

A number of limitations should be noted when interpreting the findings. The current sample was a subset of the original enrolled sample, however we have no indication that the networks or posts by those not included in the Facebook study differed from the current sample. We also enrolled fewer maltreated youth and males than in the full sample. While this may introduce bias, it likely would do so in the direction of fewer posts. Thus, while we may not have had the power to detect associations with some of the categories with lower variance we can be assured that the significant findings would only be bolstered if we had been able to recruit more males and maltreated youth. Although a small sample size, we have confidence that there was adequate power to test the interactions effects because of approximately equal numbers in the maltreated and comparison groups. Nonetheless, these findings should be replicated. A significant challenge in replication is the time intensiveness of content coding, making larger sample sizes prohibitive. Natural language processing (NLP) may be a way to circumvent this issue, but NLP functions best when all possible phrase or terms are known. This is a challenge when slang terms for risky behavior are used frequently in online interactions. Most studies use self-reports of exposure to risky posts to circumvent this coding issue, however we were able to code for risky content, providing naturalistic data. In addition, we captured network structure via the mutual friend list negating the necessity of relying on self-report in this study. This is a significant advance over prior research. Unfortunately, some of the codes such as partying had low inter-rater reliability and findings pertaining to those codes may be less reliable. That is, the construct we are attempting to measure may not be accurately represented by our coding. Exclusion of photos and videos is also a significant limitation, however we found that when a photo containing risk behavior was posted there were often comments on it that indicated the content. However, we acknowledge that we lost some potential information by not being able to include photos and videos. Lastly, we should note that these data were limited to Facebook and although other social media sites have similar modalities for sharing information (e.g., timeline/feed/followers), the centrality of photos to Instagram or the

anonymity of Snapchat likely lead to different interactions and exposure to risky content. Future research should explore similar questions in other online platforms.

5.3 Conclusion

The current findings point to use of structural measures of online networks as potential tools to identify those at risk. Rather than needing to exhaustively code online posts, the social network metrics provide a simpler way to obtain a proxy of risky online networks. While the assessment of all measures of network structure may not be feasible in clinical practice, ascertaining the size or number of isolates in the network is quite feasible. Our results do not provide specific cut-offs for these network metrics, but the use of the social network measures can (and should) be used in combination with other sources of information to identify vulnerable youth. In terms of intervention research, social network information could be obtained from a large potential population of interest and used to determine an at-risk group to target for the intervention. More specifically, these findings could be used to identify potential intervention targets through social media profiles. This could result in online interventions delivered via social network platforms to those selected based on their social network metrics.

Importantly, the results also advance our understanding of risky online networks for maltreated adolescents. As noted, maltreated youth are already a vulnerable population and care should be taken to encourage participation in supportive, safe online venues. This may necessitate educational efforts to increase knowledge of the harms of certain online interactions. The current results point to large networks as a source of risk for nonmaltreated youth, particularly for high levels of marijuana references. Several studies have found exposure to alcohol use and sexual references influence attitudes about these behaviors (Moreno et al., 2009; Moreno, Brockman, et al., 2012; Moreno, Christakis, et al., 2012), but none have studied these processes with marijuana use. Further research is needed to understand whether network effects are specific to certain risk behaviors or generalize across risk behaviors. Such knowledge would enhance the development of prevention programs aimed at reducing exposure to online risky content and associated offline risk behavior for adolescents.

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References

- Afifi TO, Henriksen CA, Asmundson GJ, & Sareen J (2012). Childhood maltreatment and substance use disorders among men and women in a nationally representative sample. *Canadian Journal of Psychiatry*, 57(11), 677–686. [PubMed: 23149283]
- Alexander C, Piazza M, Mekos D, & Valente TW (2001). Peers, schools, and adolescent cigarette smoking. *Journal of Adolescent Health*, 29, 22–30.
- Allen JP, Porter MR, McFarland FC, Marsh P, & McElhaney KB (2005). The two faces of adolescents' success with peers: Adolescent popularity, social adaptation, and deviant behavior. *Child Development*, 76(3), 747–760. [PubMed: 15892790]

- Arellano CM (1996). Child maltreatment and substance use: a review of the literature. *Substance Use & Misuse*, 31(7), 927–935. [PubMed: 8776808]
- Arnaboldi V, Passarella A, Tesconi M, & Gazzè D (2011). Towards a characterization of egocentric networks in online social networks. Paper presented at the OTM Confederated International Conferences "On the Move to Meaningful Internet Systems".
- Berkowitz AD (2005). An overview of the social norms approach. *Changing the Culture of College Drinking: A socially situated health communication campaign*, 193–214.
- Beullens K, & Vandenbosch L (2016). A conditional process analysis on the relationship between the use of social networking sites, attitudes, peer norms, and adolescents' intentions to consume alcohol. *Media Psychology*, 19(2), 310–333.
- Beverly Branley D, & Covey J (2017). Is exposure to online content depicting risky behavior related to viewers' own risky behavior offline? *Computers in Human Behavior*, 75, 283–287.
- Brown JD, L'Engle KL, Pardun CJ, Guo G, Kenneavy K, & Jackson C (2006). Sexy media matter: exposure to sexual content in music, movies, television, and magazines predicts black and white adolescents' sexual behavior. *Pediatrics*, 117(4), 1018–1027. [PubMed: 16585295]
- Cook SH, Bauermeister JA, Gordon-Messer D, & Zimmerman MA (2013). Online network influences on emerging adults' alcohol and drug use. *Journal of Youth and Adolescence*, 42(11), 1674–1686. [PubMed: 23212348]
- Cook SH, Bauermeister JA, & Zimmerman MA (2016). Sex differences in virtual network characteristics and sexual risk behavior among emerging adults. *Emerging Adulthood*, 4(4), 284–297. [PubMed: 28083447]
- Danielson CK, Amstadter AB, Dangelmaier RE, Resnick HS, Saunders BE, & Kilpatrick DG (2009). Does typography of substance abuse and dependence differ as a function of exposure to child maltreatment? *Journal of Child and Adolescent Substance Abuse*, 18(4), 323–342. [PubMed: 20151043]
- Desjarlis M, & Willoughby T (2010). A longitudinal study of the relation between adolescent boys and girls' computer use with friends and friendship quality: Support for the social compensation or the rich-get-richer hypothesis? *Computers in Human Behavior*, 26, 896–905.
- Deutsch AR, Chernyavskiy P, Steinley D, & Slutske WS (2015). Measuring peer socialization for adolescent substance use: a comparison of perceived and actual friends' substance use effects. *Journal of Studies on Alcohol and Drugs*, 76(2), 267–277. [PubMed: 25785802]
- Diego M, Field T, & Sanders C (2003). Academic performance, popularity, and depression predictor adolescent substance use. *Adolescence*, 38, 35–42. [PubMed: 12803452]
- Ellison NB, Steinfield C, & Lampe C (2007). The benefits of Facebook "friends": Social capital and college students' use of online social network sites. *Journal of Computer-Mediated Communication*, 12, 1143–1168.
- Ennett ST, Bauman KE, Hussong A, Faris R, Foshee VA, & Cai L (2006). The peer context of adolescent substance use: Findings from social network analysis. *Journal of Research on Adolescence*, 16(2), 159–186.
- Granovetter MS (1973). The strength of weak ties. *The American Journal of Sociology*, 78(6), 1360–1380.
- Handcock MS, Hunter DR, Butts CT, Goodreau SM, Krivitsky PN, Bender-deMoll S, & Morris M (2016). Software tools for the statistical analysis of network data: Available at: <https://cran.r-project.org/web/packages/statnet/statnet.pdf>.
- Huang GC, Unger JB, Soto D, Fujimoto K, Pentz M, Jordan-Marsh M, & Valente TW (2014). Peer influences: The impact of online and offline friendship networks on adolescent smoking and alcohol use. *Journal of Adolescent Health*, 54, 508–514. [PubMed: 24012065]
- Killea-Jones L, Nakajima R, & Costanzo P (2007). Peer standing and substance use in early adolescent grade-level network: A short-term longitudinal study. *Prevention Science*, 8, 11–23. [PubMed: 17013672]
- Lansford JE, Dodge KA, Pettit GS, & Bates JE (2010). Does physical abuse in early childhood predict substance use in adolescence and early adulthood? *Child Maltreatment*, 15(2), 190–194. [PubMed: 20019026]

- Lee CM, Geisner IM, Lewis MA, Neighbors C, & Larimer ME (2007). Social motives and the interaction between descriptive and injunctive norms in college student drinking. *Journal of Studies on Alcohol and Drugs*, 68(5), 714–721. [PubMed: 17690805]
- Lenhart A, Purcell K, Smith A, & Zickuhr K (2010). Social media and mobile internet use among teens and young adults. Washington, D.C.: Pew Internet & American Life Project.
- Litt DM, & Stock ML (2011). Adolescent alcohol-related risk cognitions: The roles of social norms and social networking sites. *Psychology of Addictive Behaviors*, 25(4), 708–713. [PubMed: 21644803]
- Moody J, Brynildsen WD, Osgood DW, Feinberg ME, & Gest S (2011). Popularity trajectories and substance use in early adolescence. *Social Networks*, 33(2), 101–112. [PubMed: 21765588]
- Moran PB, Vuchinich S, & Hall NK (2004). Associations between types of maltreatment and substance use during adolescence. *Child Abuse & Neglect*, 28(5), 565–574. [PubMed: 15159070]
- Moreno MA, Briner LR, Williams A, Walker L, & Christakis DA (2009). Real use or “real cool”: Adolescents speak out about displayed alcohol references on social networking websites. *Journal of Adolescent Health*, 45, 420–422. [PubMed: 19766949]
- Moreno MA, Brockman L, Wasserhit J, & Christakis DA (2012). A pilot evaluation of older adolescents’ sexual reference displays on Facebook. *Journal of Sex Research*, 49(4), 390–399. [PubMed: 22239559]
- Moreno MA, Christakis DA, Egan KG, Brockman L, & Becker T (2012). Associations between displayed alcohol references on Facebook and problem drinking among college students. *Archives of Pediatric and Adolescent Medicine*, 166(2), 157–163.
- Moreno MA, & Whitehall JM (2014). Influence of social media on alcohol use in adolescents and young adults. *Alcohol Research: Current Reviews*, 36(1), 91–100. [PubMed: 26259003]
- Morgan EM, Snelson C, & Elison-Bowers P (2010). Image and video disclosure of substance use on social media websites. *Computers in Human Behavior*, 26(6), 1405–1411.
- Muthen LK, & Muthen BO (2014). Mplus (version 7.2). Los Angeles, CA: Muthen & Muthen.
- Neblett RC, Davey-Rothwell M, Chander G, & Latkin CA (2011). Social network characteristics and HIV sexual risk behavior among urban African American women. *Journal of Urban Health*, 88(1), 54–65. doi:10.1007/s11524-010-9513-x [PubMed: 21234695]
- Negriff S (2018). Developmental pathways from maltreatment to risk behavior: Sexual behavior as a catalyst. *Development & Psychopathology*, 30(2), 683–693. [PubMed: 28925343]
- Negriff S, & Trickett PK (2012). Peer substance use as a mediator between early pubertal timing and adolescent substance use. *Drug and Alcohol Dependence*, 126, 95–101. [PubMed: 22609060]
- Negriff S & Valente TW (2018). Structural characteristics of the online social networks of maltreated youth and offline sexual risk behavior. *Child Abuse & Neglect*, 85, 209–219 [PubMed: 29428353]
- Neighbors C, Geisner IM, & Lee CM (2008). Perceived marijuana norms and social expectancies among entering college student marijuana users. *Psychology of Addictive Behavior*, 22(3), 433–438. doi:10.1037/0893-164X.22.3.433
- Noll JG, Shenk CE, Barnes JE, & Haralson KJ (2013). Association of maltreatment with high-risk internet behaviors and offline encounters. *Pediatrics*, 131(2), e510–e517. [PubMed: 23319522]
- Noll JG, Shenk CE, Barnes JE, & Putnam FW (2009). Childhood abuse, avatar choices, and other risk factors associated with Internet-initiated victimization of adolescent girls. *Pediatrics*, 123, 1078–1083.
- Oshri A, Himelboim I, Kwon JA, Sutton TE, & Mackillop J (2015). Childhood physical and sexual abuse and social network patterns on social media: Associations with alcohol use and problems among young adult women. *Journal of Studies on Alcohol and Drugs*, 76(6), 845–851. [PubMed: 26562592]
- Peluchette J, & Karl K (2008). Social networking profiles: An examination of student attitudes regarding use and appropriateness of content. *CyberPsychology and Behavior*, 11(1), 95–97. [PubMed: 18275320]
- Pew Research Center. (5 2018). Teens, social media & technology 2018.
- Ross AC, Moss IK, Schwartz D, Luo T, Mali LV, Yau JC, & Negriff S (in press). Associations between offline social functioning and online social network interactions among emerging adults. *Emerging Adulthood*.

- Santor D, Messervey D, & Kusumakar V (2000). Measuring peer pressure, and conformity in adolescent boys and girls: Predicting school performance, sexual attitudes, and substance abuse. *Journal of Youth and Adolescence*, 29(2), 163–182.
- Satorra A (2000). Scaled and adjusted restricted tests in multi-sample analysis of moment structures In Heijmans RDH, Pollock DSG, & Satorra A (Eds.), *Innovations in multivariate statistical analysis* (pp. 233–247). London: Kluwer Academic Publishers.
- Trickett PK, & Negriff S (2011). Child maltreatment and interpersonal relationships In Underwood MK & Rosen LH (Eds.), *Social development: Relationships in infancy, childhood, and adolescence* (pp. 403–426). New York, NY: The Guilford Press.
- Valente TW (1995). *Network models of the diffusion of innovations*. Cresskill, NJ: Hampton Press.
- Valente TW (2010). *Social networks and health*. New York, NY: Oxford University Press.
- Valente TW, Fujimoto K, Soto D, Ritt-Olson A, & Unger JB (2013). A comparison of peer influence measures as predictors of smoking among predominately hispanis/latino high school adolescents. *Journal of Adolescent Health*, 52(3), 358–364. [PubMed: 23299016]
- Valente TW, & Vlahov D (2001). Selective risk taking among needle exchange participants in Baltimore: Implications for supplemental interventions. *American Journal of Public Health*, 91, 406–411. [PubMed: 11236405]
- Valkenburg PM, & Peter J (2007). Preadolescents' and adolescents' online communication and their closeness to friends. *Developmental Psychology*, 43(2), 267–277.
- Van Zalk MHW, Van Zalk N, Kerr M, & Stattin H (2013). Influences between online-exclusive, conjoint and offline-exclusive friendship networks: The moderating role of shyness. *European Journal of Personality*, 28(2), 134–146.
- Viera AJ, & Garrett JM (2005). Understanding interobserver agreement: The kappa statistic *Family Medicine*, 37(5), 360–363. [PubMed: 15883903]
- Wasserman S, & Faust F (1994). *Social network analysis: Methods and applications*. New York, NY: Cambridge University Press.
- Wells M, & Mitchell KJ (2008). How do high-risk youth use the Internet? Characteristics and implications for prevention. *Child Maltreatment*, 13, 227–234. [PubMed: 18349302]
- Young SD, & Jordan AH (2013). The influence of social networking photos on social norms and sexual health behaviors. *Cyberpsychology, Behavior, and Social Networking*, 16(4), 243–247.

Highlights

- For comparison group, size of Facebook network predicted friends' marijuana posts.
- For maltreated youth, isolates predicted sexual content posts by Facebook friends.
- Structural measures of online networks may help identify those at risk.

Table 1.

Sample Characteristics for Time 1 and 5

Demographic Variable	Group			
	Maltreated		Comparison	
	Time 1	Time 5	Time 1	Time 5
<i>N</i>	303	56	151	62
Mean Age (std deviation)	10.84 (1.15)	21.64 (1.19)	11.11 (1.15)	21.78 (1.65)
Gender (%)				
Male	50	36	60	50
Female	50	64	40	50
Ethnicity (%)				
African American	40	41	32	34
Latino	35	39	47	43
White	12	9	10	10
Mixed Biracial	13	11	11	13

Note. Time 1 shown as reference to parent study sample.

Table 2.

Percent of the Sample Whose Friends did not Post any Risky Content

	Percent coded zero
General alcohol references	8.4
Excessive alcohol references	9.7
Marijuana references	8.8
Hard drug references	15.6
Partying references	3.1
Sexual content	3.3
Soft sexual references	7.5
Sexual intercourse references	13.4

Table 3.

Correlations between Friends' Risky Facebook Posts

	Size	Density	Average degree	Percent isolates	General alcohol references	Excessive alcohol references	Marijuana references	Hard drug references	Partying references	Sexual content	Soft sexual references
Size	1.00										
Density	-.35**	1.00									
Average degree	.66**	.09	1.00								
Percent isolates	-.20*	-.14	-.45**	1.00							
General alcohol reference	.15	-.11	-.04	-.09	1.00						
Excessive alcohol reference	.18	-.11	-.02	-.10	.90**	1.00					
Marijuana references	.56**	-.12	.33**	-.05	.32**	.32**	1.00				
Hard drug references	.28**	-.09	.13	-.05	.61**	.56**	.56**	1.00			
Partying references	.46**	-.20*	.16	-.02	.62**	.53**	.49**	.34**	1.00		
Sexual content	.24**	-.21*	.01	.24**	.40**	.43**	.33**	.16	.54**	1.00	
Soft sexual references	.02	-.11	-.07	.37**	.21*	.21*	.11	.10	.18	.83**	1.00
Sexual intercourse references	.12	-.15	-.05	.29**	.32**	.31**	.25*	.18	.32**	.85**	.91**

Note.

* $p < .05$ ** $p < .01$.

Table 4.

Means, standard deviations, and range for study variables

	Comparison (n=62)					Maltreated (n=56)				
	Mean	Std Dev	Median	Min	Max	Mean	Std Dev	Median	Min	Max
<i>Social Network Variables</i>										
Size	485.44	389.13	438.00	24.00	2580.00	595.63	528.39	490.00	5.00	3059.00
Density	0.10	0.07	0.08	0.01	0.33	0.08	0.07	0.07	0.01	0.50
Average degree	36.91	27.45	30.38	3.51	150.83	37.14	28.57	25.21	2.00	108.17
Percent isolates	0.04	0.05	0.03	0.00	0.37	0.06	0.06	0.04	0.00	0.26
<i>Facebook Post Content Variables</i>										
			n=68					n=65		
Number of posts	6431.12	6263.69	4499.50	141	30036	6199.31	6093.63	4653.00	7	30403
General alcohol reference	7.82	13.56	2.00	0	73	8.18	19.44	2.00	0	121
Excessive alcohol reference	3.58	6.88	1.00	0	40	4.02	7.88	1.00	0	43
Marijuana reference	5.89	19.44	1.00	0	146	4.52	8.13	1.00	0	51
Hard drug reference	1.40	2.65	0.00	0	13	1.11	2.59	0.00	0	14
Partying reference	14.21	25.24	5.00	0	123	14.70	29.43	5.00	0	198
Sexual content	20.13	44.36	9.00	0	295	26.70	56.71	9.00	0	400
Soft sexual reference	6.03	11.19	2.50	0	76	13.88	53.38	2.50	0	394
Sexual intercourse reference	1.95	4.07	0.00	0	27	3.80	10.48	0.00	0	70

Note: no mean differences were found between groups for any of the variables (using independent samples t-test)

Table 5.

Path Model Results for Total Sample

	Alcohol references	R^2	Marijuana references	R^2	Partying references	R^2	Sexual references	R^2
Size	-0.07	0.17	0.62**	0.39	0.38**	0.34	0.05	0.07
Density	0.22	0.19	0.01	0.11	0.14	0.24	-0.40	0.05
Average degree	-0.16*	0.19	-0.06	0.18	0.12	0.25	-0.13	0.08
Percent isolates	-0.12*	0.18	-0.10	0.11	-0.12	0.24	0.39	0.20

Note: Alcohol references is the sum of general alcohol and excessive alcohol references by friends; Sexual references is the combination of sexual content, soft sexual references and sexual intercourse references by friends. Hard drug references were removed due to low frequency. Covariates were age, sex (male=1, females=2), maltreatment status (0=maltreated, 1=comparison), and number of Facebook posts.

* $p < .05$

** $p < .01$.

Table 6.

Standardized Parameter Estimates by Maltreated and Comparison Groups

	Alcohol references		Marijuana references		Partying references		Sexual references	
	Comparison	Maltreated	Comparison	Maltreated	Comparison	Maltreated	Comparison	Maltreated
Size	0.06	-0.24	0.88**	0.08	0.47**	0.21	0.29*	-0.11
Density	-0.21	0.11	-0.17	-0.07	-0.23	-0.08	-0.22	-0.14
Average degree	-0.09	-0.21	0.45**	-0.13	0.20	0.09	0.02	-0.21
Percent isolates	-0.13	-0.06	-0.06	0.10	-0.12	-0.06	-0.07	0.63**

Note: Bolded coefficients are significantly different from each other based on Scaled Chi-square difference test $p < .05$.