Structural Characteristics of the Online Social Networks of Maltreated Youth and Offline Sexual Risk Behavior

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Abstract

Maltreated youth are at risk for exposure to online sexual content and high-risk sexual behavior, yet characteristics of their online social networks have not been examined as a potential source of vulnerability. The aims of the current study were: 1) to test indicators of size (number of friends) and fragmentation (number of connections between friends) of maltreated young adults' online networks as predictors of intentional and unintentional exposure to sexual content and offline high-risk sexual behavior and 2) to test maltreatment as a moderator of these associations. Participants were selected from a longitudinal study on the effects of child maltreatment (n=152; Mean age 21.84 years). Data downloaded from Facebook were used to calculate network variables of size (number of friends), density (connections between friends), average degree (average number of connections for each friend), and percent isolates (those not connected to others in the network). Self-reports of intentional and unintentional exposure to online sexual content and offline high-risk sexual behavior were the outcome variables. Multiple-group path modeling showed that only for the maltreated group having a higher percent of isolates in the network predicted intentional exposure to online sexual content and offline high-risk sexual behavior. An implication of this finding is that the composition of the Facebook network may be used as a risk indicator for individuals with child-welfare documented maltreatment experiences.

Keywords

maltreatment; Facebook; online social networks; sexual risk behavior; social network analysis

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Introduction

It is well-established that individuals who have experienced childhood maltreatment (i.e., physical abuse, sexual abuse, emotional abuse, and neglect) are more likely to engage in offline high-risk sexual behaviors than nonmaltreated youth (Fergusson, Horwood, & Lynskey, 1997; Gilbert et al., 2009; Tubman, Oshri, Taylor, & Morris, 2011). Similar associations have also been found between maltreatment and *online* sexual risk behaviors such as posting sexually suggestive photos, viewing sexually explicit content, and online sexual interactions with strangers (Noll, Shenk, Barnes, & Haralson, 2013). Importantly, the proliferation of the internet and social media has resulted in a new way through which maltreated youth are exposed to and may access sexual content, potentially amplifying the risk for early sexual activity and sexual risk behavior in this already vulnerable population. The research delineating the influence of online communication modalities on sexual behavior is still emerging, although evidence shows in normative samples heightened levels of exposure to sexual content in the media predicts early onset of intercourse (Brown et al., 2006) a known precursor to sexual risk behavior (Adimora, Schoenbach, Taylor, Khan, & Schwartz, 2011; O'Donnell, O'Donnell, & Stueve, 2001). Research also shows adolescents use online communication to find information and advice about sexual issues (Subrahmanyam, Greenfield, & Tynes, 2004). Unfortunately the use of online venues to discuss sexual topics may also lead to exposure to unwanted sexual content and solicitation, a risk that is particularly pronounced for those with childhood maltreatment experiences (Wells & Mitchell, 2008). As a large part of interpersonal interactions now occur online, understanding how online social network characteristics are associated with both online and offline sexual risk behavior will aid in the identification of those most vulnerable.

Child Maltreatment and Social Networks

Child maltreatment is well documented to disrupt normative interpersonal interactions as shown by aggressive and conflictual interactions (Cicchetti & Toth, 2005; Parker & Herrera, 1996), fewer same-age friendships (Salzinger, Feldman, Hammer, & Rosario, 1993), and smaller social support networks than non-maltreated youth (Green et al., 2012; Negriff, James, & Trickett, 2015). These deficits stem from a failure of the caregiver-child relationship that is present in instances of childhood maltreatment (Cicchetti & Toth, 2005). Insufficient or inconsistent responsivity by the caregiver leads to deficits in emotion regulation and recognition as well as negative-bias attributions to neutral behavior (Cicchetti & Rogosch, 2001; Dannlowski et al., 2013; Repetti, Taylor, & Seeman, 2002). In combination with insecure attachment schema (Cicchetti & Barnett, 1992), this may contribute to difficulties in both developing and maintaining interpersonal relationships for maltreated youth.

The online environment may provide an opportunity for maltreated youth to overcome the interpersonal deficiencies that hamper offline relationships. For example, research on individuals with social skills deficits shows that online interactions may mitigate some of the issues present in face-to-face interactions (Caplan, 2005). For maltreated youth, their inappropriate interactional style (i.e., aggressive or withdrawn) and deficits in emotion processing may not hinder online communications, thus allowing them to develop an online

social network. On the other hand, as with offline friendship formation (McPherson, Smith-Lovin, & Cook, 2001), the selection of online friends is likely guided by homophily (Lonnqvist & Itkonen, 2016). Given the higher rates of risk behavior among maltreated youth (Dubowitz et al., 2016; Horan & Widom, 2015; Shin, 2012), their self-selected online networks may contain individuals who also engage in high-risk behaviors. While these intricacies need to be investigated, difficulties in interpersonal interactions may also be reflected in the more easily attainable information about the size and connectedness of the network. These structural characteristics may yield important insights about predictors of risk, yet no studies have examined the effect of maltreatment on the structure of online social networks nor what the implications of network differences may be.

Social Network Sites and Sexual Behavior

Developing and maintaining successful interpersonal relationships and social support networks are key developmental tasks (Steinberg, 2004) and Social Network Sites (SNSs) are now a significant consideration in the study of these salient developmental skills (Subrahmanyam, Reich, Waechter, & Espinoza, 2008). According to the most recent data from the Pew Research Center, 75% of young adults have a profile on at least one SNS and 90% use social media (Lenhart, 2015). As digital media and SNSs become increasingly integrated into the lives of youth, communication between peers is also moving to these venues and the content they are exposed to online may influence acceptance of sexual risk behavior. For example, a study of college students found that exposure to sexually suggestive Facebook photos promoted favorable attitudes towards unprotected sex (Young & Jordan, 2013). A concern is that exposure to online sexual content can have consequences for offline sexual risk behavior. Studies have shown that exposure to sexually explicit media (e.g., internet pornography) has been linked with earlier sexual debut and multiple sexual partners (Braun-Courville & Rojas, 2009; Kraus & Russell, 2008). However, not all youth may be actively seeking out sexual content online (Bleakley, Hennessy, Fishbein, & Jordan, 2008) and there are many who experience unwanted exposure. Estimates for unwanted exposure to online sexual content range between 21% and 66% (Braun-Courville & Rojas, 2009; Wolak, Mitchell, & Finkelhor, 2007; Ybarra & Mitchell, 2005) and unwanted exposure has been linked with online sexual solicitation and offline interpersonal victimization (Wolak et al., 2007). Taken together, this line of research shows that online exposure to sexual content (whether intentional or unintentional) has implications for offline sexual behavior. However, further work is needed to discern the specific sources of online risk.

Child Maltreatment and Sexual Risk Behavior

Research shows that individuals who have experienced maltreatment are a particularly vulnerable group to both online exposure to sexual content and offline sexual risk behavior. Childhood maltreatment has been found to predict solicited and unsolicited online sexual advances (Noll et al., 2013; Wells & Mitchell, 2008), early sexual debut, and heightened rates of multiple sex partners, unprotected sex, and sexually transmitted disease (Fergusson et al., 1997; Gilbert et al., 2009; Tubman et al., 2011). Maltreated youth have also been found to seek out sexual content online at higher rates than non-maltreated youth and are at higher risk for online sexual victimization (Wells & Mitchell, 2008). Maltreated youth are a

group that is at risk for exposure to online sexual content and high-risk sexual behaviors (Noll et al., 2013), and studies indicate they are more likely to become enmeshed in deviant peer groups than nonmaltreated youth (Fergusson & Horwood, 1999). Understanding how characteristics of online social networks may amplify vulnerability for sexual risk behavior can lead to targeted interventions for maltreated youth.

Social Network Analysis

Social network research has developed a substantial body of evidence that documents the characteristics of various types of networks and how these properties may influence attitudes and behaviors. Generally, social network analysis either uses sociometric (i.e., all individuals within a specified community such as a school) or egocentric networks (i.e., individual's self-report of their network members) to examine characteristics of the network as predictors of specified outcomes. For egocentric networks, the network characteristics are calculated for each person in the study then entered into statistical models as predictors. This type of analysis yields insights into the individual differences in network structure that may influence behavior. For example, studies have shown that the prevalence of substance use (i.e., a higher number of substance–using alters) within egocentric networks is predictive of individual substance use (Valente, 2010; Valente, Fujimoto, Soto, Ritt-Olson, & Unger, 2013; Valente & Vlahov, 2001). Similarly, in a study of homeless youth a higher number of prosocial peers (condom users) in the network reduced the odds of unprotected sex (Rice, Milburn, & Rotheram-Borus, 2007).

Social Network Indicators of Risk Outcomes—While there are a myriad of social network metrics, size and fragmentation have accumulated the most evidence as indicators of risk. In an egocentric network, size is simply the number of friends in the network while fragmentation indicates how tightly connected the network is. Common indicators of fragmentation are density, (the total number of possible ties in the network/actual number of ties) and the number or percent of isolates (those not connected to others in the network). A more tightly connected network will allow information to pass more readily between members increasing exposure to potentially risky content (Valente, 2010). Both size and fragmentation of the network have been linked with risk behavior such as substance use (Ennett et al., 2006) and risky sexual behavior (Neblett, Davey-Rothwell, Chander, & Latkin, 2011). While the current study focuses on high-risk sexual behavior, inclusion of substance use will provide a more complete review of possible network influences on risk behavior particularly because the two risk behaviors are often correlated (Graves & Leigh, 1995; Kinsman, Romer, Furstenberg, & Schwarz, 1998; Lowry et al., 1994). In a longitudinal study of 5,104 adolescents, those not connected to the rest of the network (i.e. isolates) were the most likely to use substances. Additionally, higher network density (a more interconnected network) was related to lower substance use providing evidence that social embeddedness may actually constrain substance use (Ennett et al., 2006). In a sample of 513 African American women, larger offline networks were associated with risky sex partners and multiple sex partners in the past 90 days (Neblett et al., 2011). In terms of online networks, the evidence is still emerging. The few studies that have been completed show that denser online networks and larger network size were associated with alcohol use among young adults (Cook, Bauermeister, Gordon-Messer, & Zimmerman, 2013) and

denser online networks predicted recent unprotected vaginal intercourse (Cook, Bauermeister, & Zimmerman, 2016). Although not specific to sexual risk behavior, another study found that adolescents with online friends that drink were at higher risk for drinking (Huang et al., 2014). Only one study has examined maltreatment as a predictor of online network structure. This study found that in a sample of young women, having a less interconnected network (higher clustering coefficient) mediated the association between self-reported sexual abuse and fewer alcohol use problems (Oshri, Himelboim, Kwon, Sutton, & Mackillop, 2015). Although these studies are the first steps to understanding connections between online social networks and risk behavior, none have investigated whether online social network characteristics predict exposure to online sexual content or high-risk sexual behavior for young adults with a history of child-welfare documented maltreatment.

The Current Study

Maltreated youth are at higher risk for online victimization and engagement in sexual risk behavior, yet no studies to date have examined the structure of their online social networks and whether network characteristics predict sexual risk outcomes. Many youth may use the convenience or secrecy of the internet to explore their emerging sexuality (Subrahmanyam et al., 2004). They may select online friends who suit these goals, however the result may be exposure to and engagement in risky sexual behavior. Due to the high prevalence of SNS use among today's youth, studies of sexual risk behavior must consider the influence of online friends in order to develop a comprehensive understanding of the etiology. This is particularly critical for individuals with a history of maltreatment. Based on these gaps in the literature, the aims of the current study were: 1) to test indicators of size and fragmentation of the online network as predictors of intentional and unintentional exposure to online sexual content and high-risk sexual behavior and 2) to test maltreatment as a moderator of these associations. It was hypothesized that larger networks would be associated with more exposure to online sexual content and higher levels of high-risk sexual behavior. In terms of fragmentation, the evidence is mixed. Therefore, we could not definitively hypothesize expected associations. We also expected that maltreatment would amplify these effects due to the likelihood that maltreated youth's networks would contain more antisocial individuals (Herrenkohl, Huang, Tajima, & Whitney, 2003). These questions were examined using a sample of young adults with documented child-welfare maltreatment in childhood and a comparison group from the same neighborhoods.

Research Design and Methods

Participants

For the current study, a pilot sample was drawn from an ongoing longitudinal study examining the effects of maltreatment on adolescent development. The original longitudinal study enrolled 454 adolescents aged 9–13 years at baseline (n=303 maltreated, n=151 comparison; 241 males and 213 females). The cross-sectional pilot assessment took place approximately 11 years after baseline when the participants were mean age of 21.84 years (SD=1.46). The participants for the pilot study were selected from all those enrolled in the larger study and restricted to those participants who had a current Facebook profile and/or

completed the online survey. The study design required approximately equal number of maltreated and comparison participants, which deviated from the original proportions of the full sample. This resulted in a sample of n=152 for the current study (n=78 maltreated, n=74 comparison; males=63 females=89). The ethnic/racial composition of the final pilot sample was Black (39%), Latino (37%), White (11%), and Biracial (13%), which was similar to the distribution at baseline for the full sample.

Recruitment—The maltreatment group was recruited from active cases in the Children and Family Services (CFS) of a large west coast city. The inclusion criteria were: (1) a new substantiated referral to CFS in the preceding month for any type of maltreatment; (2) child age of 9–12 years; (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. With the approval of CFS and the Institutional Review Board of the affiliated university, potential participants were contacted and asked their willingness to participate. Of the families referred by CFS, 77% agreed to participate.

Child Welfare case records were abstracted to ensure the maltreated sample experienced documented maltreatment (physical abuse, sexual abuse, emotional abuse, or neglect). The Maltreatment Classification Abstraction Instrument was used to code the case record data and classify maltreatment types (details are described in [withheld for blind review]). According to information abstracted from the CFS case records, most children in the maltreated group experienced multiple forms of maltreatment and had multiple referrals as well. The majority (76.6%) of the maltreatment sample experienced neglect in some form, 51.5% experienced physical abuse and/or emotional abuse, and 19.8% experienced sexual abuse. On average, the participants had experienced two types of maltreatment and four referrals to CFS.

The comparison group was recruited using names from school lists of children aged 9–12 years residing in the same 10 zip codes as the maltreated sample. Comparison caregivers were contacted the same way as the maltreated group. Comparison families confirmed they had no previous or ongoing experience with child welfare agencies. Approximately 50% of the comparison families contacted agreed to participate.

For the pilot study, study participants were contacted by phone by research personnel. Contact was attempted for all enrolled participants (N=433; 21 requested to be dropped from the study at Time 2 or Time 3) and continued for one year, while taking care to maintain 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. In addition, 18 were consented and given the study instructions but did not complete any section of the assessments. There were 76 who did not complete the previous timepoint (Time 4), none were able to be reached. Of the remaining 300, there were 152 participants who completed at least some part of the study assessment, while the remaining 148 could not be reached (either because no contact information could be located or the participant would not return our messages). Multiple methods were used to locate and

contact participants: back-up contacts (given by participant at previous assessments), Facebook messages, texts, email, and internet database searches (e.g., pipl, spokeo).

Demographic Composition of the Pilot Sample—Within the pilot sample, the demographic characteristics of the maltreated and comparison groups were very similar. Chi-square tests showed there were no differences in the proportion of males and females in each group nor in the ethnic composition of each group (see Table 1). Based on these data the pilot sample is very similar to the full sample which provides confidence the findings are not biased by the selection of the pilot sample.

Although none of the data from previous assessments with the full sample was used in the current study, chi-square analyses were conducted to determine if there were any significant differences in the composition of the pilot sample versus the full sample. Demographic variables were group (maltreated vs comparison), sex (male, female), and ethnicity (Black, Hispanic, White, Biracial). Analyses showed that fewer maltreated youth and males were selected for the pilot 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 pilot 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.

Procedures

Facebook data were downloaded via an application developed for the current study. After verbal consent was obtained from the participant over the phone, the research staff emailed the participant the URL for the Facebook application to access from their personal computer on their own schedule. Consent documents were available at this web address should the participant have wanted to view or print them. Whenever the participant had time they simply clicked the button "Login with Facebook" and a window appeared for the participant to enter their Facebook login and informed them of the permissions and data accessed by the application (photos, videos and private messages were not accessed). The application ran in a series of seven steps and apprised the participant of the progress and completion. The participant did not need to be at the computer for the application to run. Depending on the amount of data, the time needed to complete the Facebook application ranged from 5 minutes to 10 hours (average time was about 2 hours). The Facebook application downloaded the list of Facebook friends, the list of mutual friends (i.e., whom on the friend list were friends with each other), and the participants' Timeline data (included posts, comments, likes, etc.). This information was used to create the Facebook friend network for each participant. All Facebook data was downloaded between 2013 and 2015.

Following the completion of the Facebook application, each participant was sent a link to an online survey (hosted by the Qualtrics platform) specific to that participant containing the names of 5 friends drawn from the Facebook data. The survey included questions about those online friends, 5 offline friends, and self-reported substance use, delinquency, peer delinquency, sexual activity, and demographics. After completion of the Facebook application and Qualtrics survey the participants were compensated $75 for their

participation by check or gift card. All procedures were approved by the Institutional Review Board of the affiliated university.

Measures

Facebook Friends Egocentric Network—In the present study two networks were defined: 1) the full Facebook friends and 2) the 12 month Facebook friends. The first reflected the entire Facebook network and may have included a number of people whom the participant no longer communicated with but has not "defriended." The second reflected the friends whom the participant actively communicated with in the past 12 months and was based on the expectation that those friends with whom they have had recent communication would be more influential. Because Facebook communication can be quite variable, we chose 12 months to allow for a more thorough inclusion of recent Facebook friends. Although the term "Facebook friends" was used in the present study to refer to the network members, by the convention set by Facebook the "Friend list" includes friends, family members, and acquaintances, i.e., any individual the user has "friended." The full network was created using the mutual friends list downloaded using the Facebook application. This supplied a list (i.e., edgelist) containing all ties between the participants' Facebook friends (excluding the participant). For example, the edgelist may show that Friend 1 was friends with Friend 2, Friend 3, and Friend 7 whereas Friend 2 was friends with Friend 1, Friend 4, and Friend 6. This captured all possible ties between friends in the Facebook network. The second network, 12-month Facebook friends, included only those friends whom the participant had some type of Facebook communication with in the past 12 months. Based on the data available on the Timeline "communication" was defined as: friend post TO participant, friend post FROM participant, friend comment on participant post (tags and likes were not included as they were not explicit communication).

For the purpose of the current study two structural characteristics were examined that have been linked with offline risk behavior: size and fragmentation of the network. Size was the number of friends in the network, and in the case of SNSs this was defined as the number of "Facebook friends". Fragmentation was measured using three indicators: (1) density of the network (the number of total possible links between friends/number of actual links between friends), (2) average degree (average number of ties each friend had to participant's other friends), and (3) percent isolates (percent of friends not connected to participant's other friends).

Exposure to Online Sexual Content—The Online Experiences Scale measured intentional and unintentional exposure to online sexual content (Noll et al., 2013). The "Intentional exposure" scale contained 8 items such as "I like going to websites that include sexual stuff"; the "Unintentional exposure" scale contained 10 items such as "people have started sexual conversations with me online." Answer options were on a 5-point scale from "strongly disagree" to "strongly agree." Each scale was summed with higher scores indicating more exposure to sexual content; possible scores ranged from 0–32 for the unintentional scale and 0–40 for the intentional scale. For this sample the Cronbach's alpha was .89 for the unintentional scale and .82 for the intentional scale.

High-Risk Sexual Behavior—Participants self-reported sexual behavior using the Sexual Attitudes and Activities Questionnaire (Noll, Trickett, & Putnam, 2003). Eleven "yes/no" items indicating different high-risk sexual behaviors (e.g., have you ever had sexual intercourse without a condom; have you ever had sexual intercourse in a one-night stand relationship) were summed to yield a composite score indicating the number of high-risk sexual behaviors.

Covariates—Participants were asked the amount of time spent on SNSs in a typical day. Weekday and weekend were assessed separately and five answer options ranged from "none" to "more than 10 hours." Weekend and weekday time were summed to for a composite of "time spent online". Age was calculated based on birthdate and the date the participant finished the online survey.

Data Analysis

Social network techniques were used to compute structural network characteristics for each participant's Facebook network (full network and 12-month network). Using the Statnet package (Handcock et al., 2016) in the R statistical program the following network characteristics were calculated: size (number of friends), density (number of possible ties between friends/number of actual ties), average degree (average number of ties each friend in the network has), and percent isolates (percent with no ties to others in the network). Two example networks are shown in Figure 1 (excluding the participant) to demonstrate these network metrics. Both networks are the same size (n=6), but differ on density, average degree, and percent of isolates.

Using Mplus (Muthen & Muthen, 2014), a multiple-group path model was tested which included the four network variables (size, density, average degree, and percent isolates) as predictors of high-risk sexual behavior, unintentional exposure, and intentional exposure scales (included as manifest variables; see Figure 2). Sex, age, and time spent online (weekday and weekend combined), were entered as covariates with direct effects on the three outcomes. By default, Mplus estimates the correlations between exogenous variables (e.g., network variables and covariates) and between residual variances (i.e., intentional exposure, unintentional exposure, and high-risk sexual behavior). The Maximum-Likelihood-Robust (MLR) estimator was used to address multivariate non-normality. Moderation effects were examined using multiple-group analysis which estimates the model parameters simultaneously for the maltreated and comparison groups. Moderation is indicated by a significant change in the Chi-square statistic when a specific parameter is constrained to equality across groups. Significance levels were set to $p<.05$ and trend level significance was reported for $p<.10$.

Results

Preliminary Analyses

Missing data—Of the 152 participants who completed some section of the pilot study, 129 completed some or all of the Facebook app (either friend list or friend list and timeline), 114 completed both the Facebook app and the survey, and 23 completed only the survey. There

were 106 with no missing data. Item level missingness on the outcome measures was handled using the k-Nearest Neighbor imputation within the VIM package for R (Templ, Alfons, & Kowarik, 2010). The amount of item level missingness was less than 1%. The path models were able to use the full sample (n=152) because Mplus uses Full Information Maximum Likelihood (FIML) estimation to address variable level missingness. Under assumptions of Missing at Random or Missing Completely at Random FIML results in unbiased parameter estimates and standard errors (Arbuckle, 1996).

Descriptives—Correlations were computed between all study variables. As expected many of the network variables were significantly correlated for both the full and 12-month network (see Table 2). On the other hand, none of the outcome variables were correlated with any network variables. Maltreatment was negatively correlated with average degree ($r=$ −.28, $p<$.01) and positively with percent isolates ($r= .35$, $p<$.01) only for the 12-month network. The direction of the coefficients indicated that having been maltreated was associated with lower average degree and a higher percent isolates. The mean number of hours spent on SNSs was 2.21(SD=1.20) for weekday and 2.36 (SD=1.38) for the weekend and was not significantly different between maltreated and comparison participants This was equivalent to approximately 3.5 hours as the scale ranged from 0–10 with 2=1 to 3hrs and 3=4 to 6 hrs.

Mean Group Differences—Independent samples t-tests showed no mean differences between maltreated and comparison groups for the full network. For the 12-month network there were two significant differences, the maltreated group had lower average degree ($p<$. 01; Cohen's d=.58) and higher percent of isolates ($p<$.01; Cohen's d=.65). All results are shown in Table 3.

Network Predictors of Sexual Risk Variables

For each network (full and 12-month) the path model was calculated with all parameters unrestricted between maltreated versus the comparison groups, then the parameter between each independent and dependent variable was restricted to equality across groups in turn (resulting in 12 separate one-degree-of-freedom nested chi-square difference tests). All parameter estimates can be found in Table 4.

Full Network—For the full network, there was a significant moderation effect for the parameter between percent isolates and intentional exposure to online sexual content ($\chi 2$ (df)=5.41 (1), $p<$.05) and between percent isolates and high-risk sexual behavior ($\chi 2$ (df)=5.67 (1), $p<$.05). The coefficients indicated that, only for the maltreated group a higher percent of isolates in the network predicted higher levels of intentional exposure to online sexual content ($\beta= .40$, $p<$.01) and more high-risk sexual behavior ($\beta= .30$, $p<$.05). There were trend moderating effects for the parameter between average degree and both intentional and unintentional exposure to online sexual content ($\chi 2$ (df)=3.73 (1), p=.05 and $\chi 2$ (df)=3.76 (1), p=.05., respectively). The coefficients indicated there was a significant association for the maltreated group (intentional $\beta= .71$, $p<$.01; unintentional $\beta= .54$, $p<$.01) but not for the comparison group (intentional $\beta= .05$, $ns;$ unintentional $\beta= −.10$, ns).

12-Month Network—For the 12-month network, only a trend level moderating effect was found for the parameter between average degree and unintentional exposure to online sexual content (χ^2 (df)=3.25 (1), p=.07). However, the parameter coefficient was not significant in either the maltreated or comparison group (see Table 4).

Discussion

Maltreated individuals are at particular risk for offline maladaptive interpersonal relationships yet little is known about their online social networks. Given the prominence of social media in the lives of youth and young adults, there is significant benefit to determining how the characteristics of online social networks may put online users at risk. The findings from the current study show that particular network properties are associated with exposure to online sexual content and high-risk sexual behavior for individuals with child-welfare documented maltreatment experiences. Online networks may represent another source of risk for those with maltreatment experiences.

Child Maltreatment and Online Social Network Characteristics

The current findings showed few differences in the structural properties of the online network between the maltreated and comparison groups. There was a higher percent of isolates only in the 12-month networks of maltreated young adults. This may be an artifact of multiple placements or residential instability associated with child welfare involvement (U.S. Department of Health and Human Services, 2013) ([reference withheld for blinded review]). In the present study, approximately 50% of the maltreated sample were in out-of-home care. Frequent change of residence will likely yield a more fragmented network of individuals who do not know each other, a supposition that is congruent with data showing that the networks of maltreated youth are more insular (Salzinger et al., 1993). The only other group difference was a lower average degree within the 12-month network for the maltreated group. This difference of approximately 10 fewer ties, on average, for each network member may reflect substantive differences between the individuals comprising the online networks of maltreated versus comparison youth. For example, the fewer overall ties for each network member may indicate that, like the maltreated participant, the network members also have difficulties forming and/or maintaining interpersonal relationships (Cicchetti & Toth, 2005). Additionally, the fact that this group difference for average degree was found only for the 12-month network strengthens these suppositions.

Interestingly, the size of the network (i.e., total number of Facebook friends) was not different between the groups. In a previous analysis with the full study sample we found that maltreated youth had smaller offline social support networks (reference blinded for review). This result did not carry over to online networks but may be due to differences in the type of network being defined (social support relationships versus online interaction). It is also possible that the online forum of Facebook allows for a more normative number of friendships because the behaviors that may deter potential friends are not evident in online communications (Caplan, 2005). For example, data show that those who prefer online communication are perceived as less socially skilled in face-to-face interaction (Kang & Munoz, 2014). Research has also shown that physical abuse is associated with sparse

networks (i.e., low density) in a sample of homeless women (Green et al., 2012), yet we found no group differences in density. Again, this may be an artifact of online versus offline networks but warrants further investigation.

Online Social Network Characteristics and Sexual Risk Behavior

Regarding the outcomes, the percent of isolates in the full network was a strong predictor of intentional exposure to online sexual content and high-risk sexual behavior only for the maltreated group. This provides evidence that fragmentation of the network may indicate a "higher-risk" online network. This finding is similar to data for offline networks showing that substance use is higher in isolates than in the connected friends (Ennett et al., 2006), yet this is the first data showing this association for online networks and sexual risk behavior. In online networks the isolate differs from the traditional offline definition in that they likely have many ties, just not to the participants' friends. This may put them in the position of a liaison, those that bridge between different networks. Because isolates are not connected to others in the participant's network they may reflect different norms than are present in the connected friends. Thus, they may be a point of exposure to outside or deviant influences that are not present in the connected component of the egocentric network. The significant effect only for the full network may provide support for this as the isolates may actually be more peripheral than in the 12-month network, where communication has taken place between the participant and the isolates in the recent past and may more emotionally close sublayer of the full network (Roberts, Dunbar, Pollet, & Kuppens, 2009). Weak ties are one point by which new information may enter a network (Granovetter, 1973) and isolates in Facebook networks may fulfill this purpose. The findings from this study would suggest that in the networks of maltreated youth, isolates are links to information that is riskier than what is contained in their connected friends. It is also possible that maltreated youth build a network of isolates in order to share risky content that they do not want to reach their network as a whole. Either way, the results indicate that there are properties of the online network that indicate a risk profile for maltreated youth. On the other hand, the null findings for size and density are counter to other studies showing larger offline networks affect the high-risk sexual behavior of adult women (Neblett et al., 2011) and denser online networks predict unprotected sex among young adults (Cook et al., 2016).

Limitations

There are a number of limitations that should be considered when interpreting the findings. A primary limitation is that only a pilot sample of the original enrolled sample completed the study assessment. We found that those in the maltreated group and males were less likely to be retained and we recognize that this may have resulted in a biased sample. However, the direction of bias would have been in opposition to our current findings, making it more difficult to detect the effects of interest. The outcomes in this study are known to be more prevalent in males and maltreated youth (Kraus & Russell, 2008; Mitchell & Ybarra, 2009), therefore although we likely had lower variance for the outcomes in the pilot sample we still found significant effects. This demonstrates that the sample was not biased in the direction of finding associations where there were none. Second, our maltreated and comparison groups were matched based on zip code, but more detailed matching of caregiver and child risk factors may have been preferable. Third, the sample size was small necessitating

replication of these findings. Based on the several trend level effects that were found it was likely the analyses lacked the power to detect interaction effects at a level of significance. In addition, future research should continue to investigate the characteristics of online networks to determine whether at-risk individuals can be identified by observing their online profiles. Obtaining information about the list of online friends is the simplest option with least burden for data collection. Importantly, we cannot infer directionality or causality from these data. It may be that exposure to online sexual content or engagement in high-risk sexual behaviors serves as a catalyst for the formation of online social networks with individuals with those traits or behaviors, rather than the other way around. In addition, self-report of high-risk sexual behavior was not restricted to a particular timeframe and (although unlikely) could have occurred prior to the available Facebook data. Lastly, there is the possibility that there was unreported maltreatment that occurred in the comparison group. If present this would likely have the effects of negating significant group differences, not amplifying them. Therefore, we can infer our results capture associations relevant to youth with child welfare documented maltreatment versus those without.

Conclusion

This is the first study to describe the characteristics of the online social networks of individuals with child welfare documented maltreatment. Given this is a high-risk population, research in this area is sorely needed. These findings demonstrate that although there were few differences between the online social networks of maltreated and comparison young adults, there may be characteristics of the network that are riskier for maltreated individuals. Young adults with maltreatment experiences are already at risk for involvement in high-risk internet behaviors, and our results show that the composition of the Facebook network may only serve as an additional source of risk. Specifically, the results point to isolates in the online network as an indicator of a high-risk profile. Our ability to develop risk profiles based on easily attainable information about the online social network may help to prevent or curtail associated deleterious outcomes.

Acknowledgments

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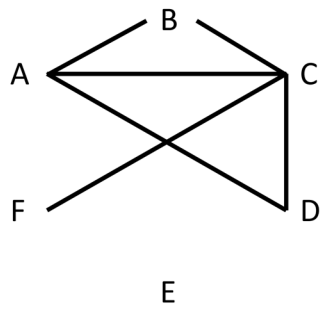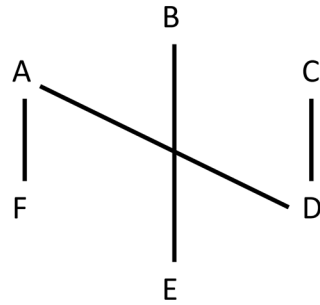
Figure 1.
Example egocentric networks demonstating the structural network characteristics used in the current study
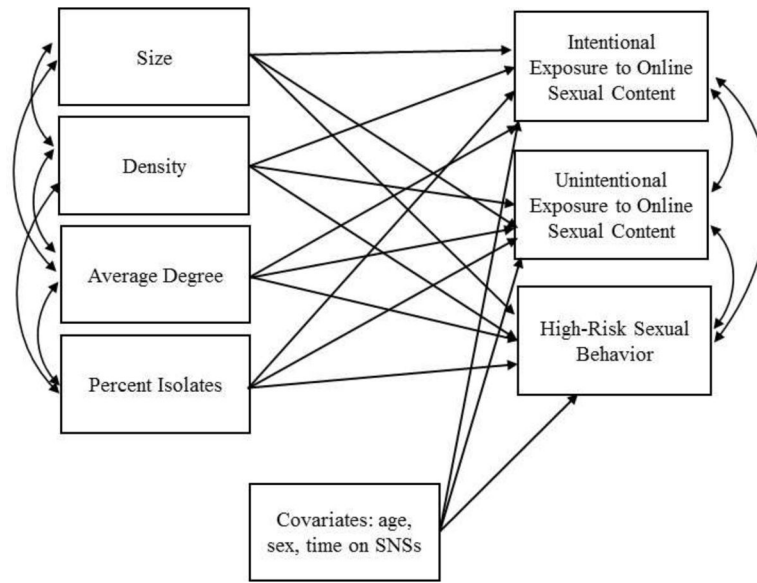
Figure 2.
Graphical representation of the multiple-group path model testing network characteristics as predictors of outcomes for maltreated versus comparison groups; default covariances between the covariates and the exogenous variables is not depicted.

Table 1

Demographics for Time 5 Sample (N=152)

	Maltreated	**Comparison**
N	78	74
Age (std deviation)	21.86 (1.29)	21.80 (1.62)
Gender (%)		
Male	36	47
Female	64	53
Ethnicity (%)		
African American	43	35
Latino	36	38
White	9	14
Mixed Biracial	12	13

Note: males were less likely than females to be retained in the T5 sample.

Table 2

Correlations between Study Variables

Full Network	1	2	3	4	5	6	7
1. Size	.53**						
2. Density	–.35**	.85**					
3. Average degree	.67**	.14	.42**				
4. Percent isolates	–.19*	–.11	–.46**	.37**			
5. Unintentional EOSC	.10	.00	.13	.00	.89		
6. Intentional EOSC	.10	–.03	.17	.00	.75**	.82	
7. High-risk sexual behavior	–.03	.05	.08	.01	.44**	.53**	--
8. Maltreated	.09	–.12	–.04	.13	–.01	–.15	–.15
12 month network							
1. Size	--						
2. Density	–.44**	--					
3. Average degree	.67**	–.09	--				
4. Percent isolates	–.28**	–.11	–.51**	--			
5. Unintentional EOSC	.11	–.05	.08	.06	--		
6. Intentional EOSC	.09	–.05	.04	.06	.75**	--	
7. High-risk sexual behavior	.07	–.06	.07	–.11	.44**	.53**	--
8. Maltreated	–.11	–.08	–.28**	.35**	–.01	–.15	–.15

Diagonal contains the correlations between full network and 12 month network or Cronbach's alpha for EOSC subscales. For correlations between Full network variables n=129, for 12 month network variables n–113, for EOSC correlations n=106.

Note: EOSC=exposure to online sexual content; maltreated=1, comparison=0.

Table 3

Mean differences between maltreated and comparison groups for network and sexual risk variables

	Comparison	Maltreated	*p*
Full Facebook Network (n=129)	65	64	
Size	492.89 (389.23)	572.02 (519.78)	ns
Density	.10 (.07)	.08 (.07)	ns
Average degree	37.57 (27.70)	35.57 (27.21)	ns
Percent isolates	.04 (.05)	.06 (.06)	ns
12 month Network (n=113)	60	53	
Size	135.37 (110.82)	109.25 (134.14)	ns
Density	.29 (.23)	.26 (.16)	ns
Average degree	25.49 (19.52)	15.64 (13.97)	.00
Percent isolates	.07 (.07)	.13 (.11)	.00
Outcome Variables (n=133)	68	65	
Intentional EOSC	6.63 (5.42)	5.08 (5.02)	.09
Unintentional EOSC	7.81 (6.37)	7.69 (6.29)	ns
High-risk sexual behaviors	3.21 (2.11)	2.55 (2.16)	.09

Note: Group differences tested using t-tests; Outcome variables include item level imputed data; EOSC=exposure to online sexual content

Table 4

Path Model Results Predicting Intentional or Unintentional Exposure to Online Sexual Content and High-Risk Sexual Behavior (n=152)

	Intentional			Unintentional			High-risk Sexual Behavior		
	Maltreated	Comparison	χ^2(df)	Maltreated	Comparison	χ^2(df)	Maltreated	Comparison	χ^2(df)
Full network									
Sex	−.14	−.39 **		−.19	−.15		−.20	−.31 **	
T5age	.14	−.02		.13	−.05		.03	.15	
Time spent online	.33 **	.18		.39 **	.15		.14	−.20	
Size	−.43	−.12	.36 (1), *ns*	−.16	−.04	.07 (1), ns	−.35	−.18	.09 (1), ns
Density	−.09	−.18	.22 (1), *ns*	.05	−.10	.51 (1), ns	.07	−.25	2.42 (1), ns
Average degree	.71 **	.05	3.73 (1), *p*=.05	.54 **	−.10	3.76 (1), *p*=.05	.38	.17	.53 (1), ns
Percent isolates	.40 **	−.31	5.41 (1), *p*=.02	.26	−.26	3.46 (1), *p*=.06	.30 *	−.32	5.67 (1), *p*=.02
12 month network									
Sex	−.23	−.37 **		−.23	−.16		−.19	−.33 **	
T5age	.06	.01		.05	.02		−.05	.17	
Time spent online	.28	.21		.30 *	.16		.12	−.19	
Size	−.11	.21	1.17 (1), ns	−.13	.08	.42 (1), ns	−.16	−.04	.13 (1), ns
Density	.04	−.02	.10 (1), ns	.09	−.04	.39 (1), ns	.12	−.23	2.13 (1), ns
Average degree	.15	−.21	1.29 (1), ns	.39	−.12	3.25 (1), *p*=.07	.18	−.08	.74 (1), ns
Percent isolates	.19	.05	.15 (1), ns	.22	.04	.33 (1), ns	−.20	.03	.35 (1), ns

*
p<.05,

**
p<.01;

sex coded male=0, female=1.