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Snijders, Thomas; Fujimoto, Kayo; Valente, Thomas

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Popularity breeds contempt: The evolution of reputational dislike relations and friendships in high school

Kayo Fujimoto^{a,*}, Tom A.B. Snijders^{b,c}, Thomas W. Valente^d

^a Department of Health Promotion & Behavioral Sciences, School of Public Health, The University of Texas Health Science Center at Houston, 7000 Fannin Street, UCT 2514, Houston, TX 77030-5401, United States

^b Department of Sociology, University of Groningen, Grote Rozenstraat 31, 9712 TG Groningen, The Netherlands

^c Nuffield College, University of Oxford, UK

^d Institute for Prevention Research, Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA 90032-3628, United States

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ABSTRACT

In this study, we examined the dynamics of the perception of “dislike” ties (reputational dislike) among adolescents within the contexts of friendship, perceived popularity, substance use, and Facebook use. Survey data were collected from a longitudinal sample of 238 adolescents from the 11th and 12th grades in one California high school. We estimated stochastic actor-based network dynamic models, using reports of reputational dislike, friendships, and perceived popularity, to identify factors associated with the maintenance and generation reputational dislike ties. The results showed that high-status adolescents and more frequent Facebook users tended to become perceived as or stay disliked by their peers over time. There was a tendency for friendships to promote the creation and maintenance of reputational disliking but not vice versa. Adolescents tended to perceive others as disliked when their friends also perceived them as disliked. There was no evidence that either cigarette smoking or drinking alcohol affected reputational dislike dynamics. This study highlights the important role that the hierarchical peer system, online peer context, and friendships play in driving information diffusion of negative peer relations among adolescents.

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1. Introduction

Negative peer relations play an important role by influencing peer experiences and generating negative outcomes in childhood and adolescence (Hartup, 2003). Research on child/adolescent developmental psychology has shown that negative peer relationships are correlated with maladjustment, including aggression and victimization, peer rejection, peer acceptance, perceived popularity, social preference, and other interpersonal processes and behaviors (Card, 2010; Rubin et al., 1998; Witkow et al., 2005). In developmental psychology research, negative relations form a social context of “antipathetic relationships” (i.e., mutual dislike at the dyad level) that are distinct from group-level “peer rejections” (i.e., sum of nominations of being disliked by peers that reflect a collection of opinions about a target individual) (Card, 2010; Parker and Gamm, 2003). The constructs of antipathetic relationships

and peer rejection are modestly correlated but still confound each other, methodologically and conceptually. Methodologically, they use the same sociometric items (i.e., dislike, least like, or enemy) for assessing the mutuality and aggregation of dislike, and, conceptually, they overlap each other, as antipathetic relationships are embedded within the group-level construct of peer rejection, which may be the result of interdependent relationships of dislike (Card, 2010).

Although efforts have been made to separate these two effects and to identify their unique associations with social maladjustments (Abecassis et al., 2002; Card and Hodges, 2007; Erath et al., 2009; Murray-Close and Crick, 2006; Witkow et al., 2005), there is an inherent limitation in conceptualizing the complex dynamics of negative relationships in terms of these two constructs. This study examines the dynamics of negative peer relations using a conceptualization of the social context of negative relations that goes beyond the two constructs of the antipathetic relationships and peer rejection in three ways. First, we conceptualize negative relations as reputational dislike relations that reflect information diffusion about perceived dislike at the group level, rather than as dislike relations generated by personal dislike, among one set of

* Corresponding author. Fax: +1 713 500 9750.

E-mail addresses: Kayo.Fujimoto@uth.tmc.edu (K. Fujimoto), Tom.Snijders@nuffield.ox.ac.uk (T.A.B. Snijders), tvalente@usc.edu (T.W. Valente).

high school adolescents in Southern California. Second, we conceptualize negative relations in conjunction with other aspects of peer relations in child/adolescent development (Card, 2010) by conceptualizing them as multiplex networks that involve peer status and friendships. Finally, we address the multilevel nature of negative peer relations (Card, 2010) in a way that allows us to analyze the processes of disliking at the multiple conceptual levels of the individual, dyadic relationships, and groups (Hinde, 1987; Rubin et al., 1998). Our study takes a multiplex stochastic actor-oriented modeling approach (Snijders et al., 2013) to model the interdependent dynamics of friendship and negative peer relations, distinguishing between individual-, dyadic-, and group-level effects.

1.1. Perceived dislike relations (*reputational dislike*)

Individuals with a higher level of social intelligence can manipulate peer groups through “information social influence,” using sophisticated forms of invisible aggression, such as gossiping, manipulating peers to dislike someone, and befriending someone for the purpose of revenge (Garandeau and Cillessen, 2006). Through the process of information social influence, peer agreement with respect to targets who are perceived as being disliked, in addition to dyadic dislike, is an important aspect of the group dynamics of negative peer relations among middle adolescence. From the perspective of peer ecologies, we conceive the group-level perceived dislike as an attempt to achieve a common goal and cohesion for the group members (Saarento and Salmivalli, 2015), as negative peer reputation is more likely to achieve group consensus than is one's personal dislike that tends to be hidden.

In this study, we operationalize negative relations among middle adolescence through the individual's perception of disliked peers (not as personal dislike) and use the term “reputational dislike.” It should be noted that our concept of “reputational dislike” is different from the conventional group-level concept of peer rejection that is based on the aggregation of the personal dislike (or least liked) and known to be associated with social maladjustment in the developmental psychology literature (Card, 2010; Gorman et al., 2011; Witkow et al., 2005). We postulate that “reputational dislike” does not necessarily involve personal feelings, although it could overlap with personal dislike to some extent. Reputational dislike can be regarded more as a reflection of the information diffusion in regard to negative peer relations, rather than an aggregation of intrapersonal dislike that is not necessarily shared by peers. We aim to identify the social mechanisms of the generation or maintenance of reputational dislike in relation to friendship and perceived popularity.

1.2. Multiplex networks of negative relations, perceived popularity, and friendships

Peer relations are organized around a hierarchical clustering of peer groups whereby peer status is determined by perceived popularity among peers (Schwartz and Gorman, 2011). Perceived popularity signifies prestige, visibility, and social dominance (Bellmore and Cillessen, 2006) that reflect an individual's perceived position in the competitive status hierarchy among the group. Perceived popularity and aggression are dynamically related to each other (Cillessen and Borch, 2006; Cillessen and Mayeux, 2004), perhaps because bullies use aggression to achieve a status goal of dominating peers (Sijtsema et al., 2009).

These status-driven negative relations come in tandem with friendships. Because bullies are not necessarily liked or accepted by their peers (de Bruyn et al., 2009; Reijntjes et al., 2013; Sijtsema et al., 2009), they pursue the goal of affection from significant others by striving to realize peer status without losing the affection from the significant others (Huitsing and Veenstra, 2012; Veenstra

et al., 2010). Bullies receive the affection from or are defended by in-group members, such as other bullies, assistants, and reinforcers (Huitsing and Veenstra, 2012), by strategically choosing victims that are already rejected by others (Veenstra et al., 2010) or sharing targets with their friends for aggression (Card and Hodges, 2006). Thus, unpopular adolescents tend to be disliked by higher-status peers (Berger and Dijkstra, 2013) and may be more prone to victimization (Gorman et al., 2011), yet victims are supported by peers who defend each other (Huitsing and Veenstra, 2012).

In summary, negative peer relations operate through complex group processes that involve high-status bullies, unpopular victims, and their friends who respond to bullying behavior. To reflect this complexity, our study conceptualizes the negative peer relations as multiplex networks that are dependent on other relations, such as perceived popularity and friendships.

1.3. Modeling dynamics of negative relations at multiple levels

An increasing numbers of network studies have contributed significantly to examining the group dynamics involved in negative peer relations and their behavioral correlates at multiple levels: individual, dyadic, and group. Cross-sectional network studies have employed multivariate exponential random graph models (ERGMs) (Lazega and Pattison, 1999; Wang et al., 2009) to model local configurations of the multiplex relations composed of liking, disliking, and bullying (Huitsing et al., 2012) and bivariate configurations of defending among bullies and victims (Huitsing and Veenstra, 2012).

To identify the social mechanisms of negative peer relations in combination with friendships, this cross-sectional network analysis can be extended to a longitudinal approach using the stochastic actor-based model (Snijders et al., 2010), or RSiena analysis. This model has been used for studying the co-evolution of networks and for changing individual attributes (Burk et al., 2007; Steglich et al., 2010), allowing researchers to disentangle the effect of networks. This method was applied to the co-evolution of friendship and victimization, treating the latter as a changing individual attribute (Sentse et al., 2013; Sijtsema et al., 2014). The actor-oriented model for the co-evolution of multiplex networks (Snijders et al., 2013) can be used similarly to disentangle the effects of each network on another network. This model was applied in a study of defending and bullying as co-evolving networks (Huitsing et al., 2014). In network analysis, the different levels of individual (node), dyad, triadic, or other subgroup and the entire network are present, mainly in an implicit way. One of the elements of a network-network co-evolution study is the explicit presence of distinct effects at these levels.

In summary, a growing number of network studies have identified network configurations that include networks of negative peer relations and have modeled their complex dynamics co-evolving with other aspects of peer relations and attribute or behavioral correlates at multiple levels by using ERGMs or actor-oriented models. These network methodologies advance our understanding of the multilevel nature of negative peer relations by enabling us to deal with the issue of network interdependencies.

The majority of these prior social network studies, however, have used elementary school children (Berger and Dijkstra, 2013; Dijkstra et al., 2011; Huitsing et al., 2012, 2014; Huitsing and Veenstra, 2012), early adolescents in middle schools (Sentse et al., 2013; Sijtsema et al., 2010), or both (Sijtsema et al., 2009, 2014) in various countries. As far as we know, rarely have any multiplex network studies that combine friendships with negative peer relations examined high school adolescents in the United States. This is important, in part, because different age groups may have different levels of striving for status (Sijtsema et al., 2009), and patterns of negative relations may be different in different cultures. As social intelligence develops with age, group dynamics of

negative relations change, exhibiting the distinct processes of similarity between friends in terms of the forms of aggression (Sijtsema et al., 2010) and the attitudes toward bullying (Pozzoli and Gini, 2013). Thus, the dynamics of multiplex networks comprised of the negative relations, friendships, and the role that perceived popularity plays in the dynamics for middle adolescents in a high school setting may need to be examined on its own, as these dynamics are different from those of the networks in childhood and early adolescence.

2. Conceptual framework and hypotheses

2.1. Reputational dislike dynamics driven by status competition

We investigate the role played by perceived popularity in influencing the diffusion of reputational dislike among adolescents. Grounded in the theory of status competition in group process (Gould, 2003), network studies (Faris and Felmlee, 2011, 2014) indicate that aggressive behavior is a negative relational process of “instrumental targeting,” whereby aggressors, motivated by status attainment, tactically choose targets with relatively high levels of peer status, which will yield higher social rewards in the eyes of their peer observers, instead of choosing marginal ones (Faris and Felmlee, 2011, 2014). In “instrumental targeting,” high-status adolescents can be both aggressors and victims who vie for premium peer status positions. This “reputational aggression” against higher status targets to increase one’s own status was found among middle adolescents in the social contexts of small, bounded, and less-hierarchical peer networks (Faris, 2012).

It must be noted that this process of “instrumental targeting” generated by status competition is different from the aforementioned alternative process of the negative relations generated by popular peers who pursue the goal of peer status, whereby unpopular youth tends to be disliked and targeted for victims among children or early adolescents (Berger and Dijkstra, 2013). For the former, popular adolescents could be both aggressors and victims, both of whom are the players in status competition through reputational aggression. For the latter, popular adolescents are regarded only as aggressors who try to achieve the personal goal of peer status. We postulate that reputational aggression operates through the process of information social influence whereby popular adolescents are more likely to be perceived as a target for aggression or aggressors by peers and, thus, receive higher levels of reputational dislike by peers. Thus, our research question concerns the relationship between a peer’s higher perceived popularity and higher reputational dislike. We posit:

Hypothesis 1. There will be a positive relationship between a peer’s perceived popularity and reputational dislike.

2.2. Reputational dislike dynamics driven by friendship

Our second set of hypotheses concern a set of cross-network effects that operate at the actor, dyadic, and triadic levels. The cross-network dependencies between reputational dislike and friendship can operate through the process of information social influence at multiple levels. The cross-network effects described below will be included in the section on model specification and illustrated through Fig. 1.

First, at the actor level, there are straightforward expectations for the indegrees, representing shared perceptions in the group. Positive and negative perceptions are expected to be negatively associated.

Hypothesis 2a. There will be a negative indegree effect of friendship on reputational dislike, indicating that adolescents who are popular (higher indegree in friendship) tend not to be seen as

disliked persons (lower indegree in reputational dislike). Conversely, those who are seen as generally disliked are less attractive as friends.

In contrast, we also expect a positive outdegree effect of activity, represented by outdegrees of friendship and reputational dislike, which is predicted on the basis of response tendencies, i.e., some adolescents tend to mention many names, while others tend to mention few names, irrespective of the question asked.

Hypothesis 2b. There will be a positive effect of friendship outdegrees on reputational dislike outdegrees; and of reputational dislike outdegrees on friendship outdegrees.

Second, at the dyadic level, from the relational dissonance that would occur if friends were disliked (Bond et al., 2014), we expect a mutual negative dependence between the two relations.

Hypothesis 2c. There will be a negative effect of dyadic entrainment and reciprocation of friendship on reputational dislike, as well as of reputational dislike on friendship.

Third, at the triadic level, social balance theory suggests that there is a generative mechanism for changes in dyadic ties in which signed (like/dislike) networks move toward balance in the mind of the individual (Cartwright and Harary, 1956; Heider, 1946; Newcomb, 1961), occurring through micro- and macro-level processes (Hummon and Doreian, 2003). Existing network studies indeed document the tendency of friendships between individuals who are disliked by the same person (Huising et al., 2012) and the tendency of friends, over time, to agree upon which peers to dislike (Berger and Dijkstra, 2013). Although balance theory conceptualizes dislike relations in terms of personal dislike, the theory also may be applied to local processes that drive the interdependence between reputational dislike and friendship. This is because balance theory also implies that friends will tend to agree in other positive and negative appreciations, such as, here, reporting reputational dislike.

Balance theory predicts three mixed triadic configurations (see Fig. 1): dislikes of friends will be dislikes; dislikes of dislikes will be friends; friends of dislikes will be dislikes.

Hypothesis 2d. Those who are reputationally disliked by one’s friends will tend to be reputationally disliked; those who are reputationally disliked by those whom one mentions as reputationally disliked will tend to be friends; and those who are friends of whom one mentions as reputationally disliked will be themselves also tend to be reputationally disliked.

2.3. Reputational dislike dynamics in relation to behavioral correlates

As a supplementary analysis, we explored specific behaviors that adolescents might engage in to increase their popularity, which may then increase their reputational dislike among peers. The specific behaviors considered in this study will be Facebook use and the two risk behaviors of alcohol use and cigarette smoking.

2.3.1. Facebook use

Cyberbullying and victimization often overlap with the offline world relations (Raskauskas and Stoltz, 2007), and diffusion of reputational dislike is likely to occur in the online context as well. Social networking sites, such as Facebook, provide an opportunity for adolescents to augment their offline popularity or to compensate for inadequate offline popularity (Zywica and Danowski, 2008). Nevertheless, this may become the locus of diffusion of reputational dislike as a means to achieve peer agreement on the target of invisible aggressions among peers. Thus, we postulate:

Fig. 1. Cross-network reputational dislike-friendship configurations for multiplex network-behavioral coevolution models.

Hypothesis 3. More frequent Facebook users will tend to have a higher reputational dislike among their peers.

2.3.2. Drinking alcohol and smoking cigarettes

Peer status may be correlated with adolescent substance use (Mayeux et al., 2008; Michell and Amos, 1997; Prinstein et al., 2011), as supported by research that shows that membership in a popular group tends to be associated with higher rates of substance abuse (Schwartz and Gorman, 2011). In the negative relational process of “instrumental targeting,” high-status adolescents can be both aggressors and victims (Faris and Felmlee, 2014), and there is some evidence that these bullies and victims tend to be substance users (Peets et al., 2007). This could be explained by aggressive or rejected adolescents’ tending to have difficulty in managing social information when evaluating information within a social context. Thus, they are more likely to overestimate their friends’ health risk behaviors, which may place them at greater risk for engaging in deviant and health risk behavior (Prinstein and Wang, 2005). Thus, we posit:

Hypothesis 4. More frequent drinkers or smokers will tend to have a higher reputational dislike among their peers.

3. Methods

3.1. Data and sample

This study is nested within a larger cohort network study of 10–12th grade adolescents and their substance use in five southern California (Los Angeles County) high schools in the El Monte Union High School District (EMUHSD) that are characterized by a predominantly Hispanic/Latino population, with 75–90% of adolescents eligible for a free or reduced-cost lunch (Fujimoto and Valente, 2015; Huang et al., 2014; Valente et al., 2013). The current study used a longitudinal sample of two waves (wave 3 and wave 4), comprising 11th grade adolescents who were interviewed in spring 2012 and 12th grade adolescents who were interviewed in spring 2013 from one school with at least a 75% participation rate for both surveys. Our sample includes those who completed

the baseline but not the follow-up (1.0%) and those who completed only the follow-up but not the baseline (1.4%). In our analysis, their outgoing tie information at their absent wave was coded as missing values. The study procedures and data collection instruments were approved by the Committee for the Protection of Human Subjects at the University of Southern California.

3.2. Measures

3.2.1. Network dependent variables

Both friendship and reputational dislike relations are used in this study. Participants were provided a roster of all of their same-grade students' IDs and photos. Then, they were asked to write the roster IDs of up to seven close friends (plus up to 12 additional friends, totaling a maximum of 19 friends). Similarly, respondents were asked to nominate up to seven students who they think are the "most disliked." Friendship and dislike relations were collected at both waves.

3.2.2. Behavior dependent variables

Alcohol use and cigarette smoking are used as the behavior dependent variables. Drinking stage was measured by using five items in the survey that asked respondents about their alcohol use behaviors, which were combined into a six-stage ordered categorical scale: (1) "Non-susceptible to drink" (neither drank nor were susceptible to drink in the next year), (2) "Susceptible to drink" (current non-drinkers who refuse to disavow drinking in the next year), (3) "Ever drank" (have ever drunk alcohol in their lives), (4) "Past-year drink" (have drunk alcohol in the past 12 months), (5) "Past-month drink" (have drunk alcohol in the past 30 days), and (6) "Binge drink" (have had five or more drinks of alcohol in a row during the past 30 days). Similarly, a six-stage ordinal categorical smoking measure was created.

3.2.3. Perceived popularity (peer status)

Relational data on "perceived popularity" were collected by asking respondents to nominate up to seven students who they think are the most popular. These data were used to measure each adolescent's peer status as the number of times that each adolescent was named (i.e., indegree), adjusted by taking its square root to account for its skewed distribution.

3.2.4. Facebook use

Facebook use was collected by asking respondents about the number of times that they visited Facebook in the past month, which was coded as an ordered categorical variable with five levels: (1) Never, (2) Rarely (about once a month or less), (3) Occasionally (about once a week or less), (4) Frequently (about once every 2–3 days), and (5) Very frequently (about once a day or more).

3.2.5. Other covariates

As control variables, gender (female = 1, male = 0); self-reported academic grades, coded as 1 ("mostly Ds or Fs") to 4 ("mostly As"); and being in the same classroom (1 = yes, 0 = no) were used as other covariates in the analysis.

3.3. Data analysis

This study employed a stochastic actor-oriented model (Ripley et al., 2015; Snijders, 2001) whereby the actors are assumed to make changes in their outgoing ties in a sequence of many small steps, shaping each other's dynamics of relational structures. The small steps are not observed individually, but the network observations at the two waves are snapshots of this evolving process. To model the mechanisms of these changes, the probability distributions of these small changes are defined by the so-called "evaluation

function." The evaluation function is specified by a linear combination of network effects, actor attributes, and corresponding parameters.

The study combined two variants of the previously introduced stochastic actor-oriented models (Snijders et al., 2007, 2013; Steglich et al., 2010) to model co-evolution of multiplex network dynamics and the behavioral dynamics of drinking and smoking simultaneously. We refer to this combined model as the stochastic actor-oriented "multiplex network-behavioral co-evolution model." This model controls for both processes of peer influence and selection as well as behavioral co-evolution of drinking and smoking.

In our application, the evaluation function determines the likelihood of creating specific new dislike or friendship ties and maintaining existing ones, dependent on co-evolving smoking and drinking behaviors, and the changing social context of multiplex network structures as well as their interactions with actor attributes primarily of perceived popularity, drinking, smoking, and Facebook use.

The RSiena version 1.1.289 package (Ripley et al., 2015) of the statistical system R v3.2.2 (R Development Core Team, 2015) was used for the actor-oriented model analysis. We tested parameters estimated using the method of moments by comparing the *t*-ratios (estimate divided by standard error) to a standard normal distribution (Snijders et al., 2007, 2013). The final models were those that attained good convergence with overall maximum convergence *t* ratio ≤ 0.27 , as well as with all *t*-ratios for convergence being less in absolute value than 0.1. More information on the stochastic actor-oriented co-evolution modeling approach, as well as on our modeling procedure and goodness-of-fit tests, is available in the [supplement](#) to the online version of this article.

3.4. Model specification

The model specification was chosen so as to express the various investigated associations, and further was in accordance with the usual specifications within each of the networks (Ripley et al., 2015), adapted to the specifics of each to obtain a good fit.

3.4.1. Within-network effects for reputational dislike dynamics

We included the structural effects to represent the average degree (*outdegree*), tie reciprocation (*reciprocity*), and the tendency for receiving a dislike reputation (*indegree dislike*, *sqr*), the number of named reputational disliked (*outdegree dislike*, *sqr*). We also included indegree–outdegree association at the actor level (*outdegree–indegree dislike*, *sqr*), and for not nominating any reputational disliked persons (*outdegree* = 0). No triad-level structural effects were included for the reputational dislike relation because of the sparseness of the network and the low level of transitivity that is usually observed in negative tie networks (Everett and Borgatti, 2014; Huitsing and Veenstra, 2012). Additionally, for the control covariates of *gender* and *academic grades*, covariate-related *similarity* effects were included, with the *same* effect for *classroom*. These effects represent homophily and classroom meeting opportunities. A positive parameter value for the effects of *perceived popularity level*, *smoker*, *drinker*, and *Facebook use* indicates that higher values for these variables lead to higher reputational dislike.

3.4.2. Within-network effects for friendship dynamics

We included the structural effects to represent the average degree (*outdegree*), tie reciprocation (*reciprocity*), and the tendency for incoming friendships to reinforce existing *indegree* differentials (*indegree-popularity*, *sqr*), for changes in number of outgoing friendship nominations to reinforce existing *outdegree* differentials (*outdegree-activity*, *sqr*), for indegree–outdegree association at

the actor level (*outdegree popularity*, *sqrt*), a tendency for friends-of-friends to become or remain friends (*transitive triplets*) and the interaction term between reciprocity and transitivity (*transitive reciprocity triplets*) with the exclusion of the three-cycle effect (Block, 2015). For the covariates of *gender*, *academic grades*, *grade*, and *classroom*, covariate-related *similarity* effects were included as mentioned above for *dislike*. For the study's main explanatory variables *perceived popularity*, *smoker*, *drinker*, and *Facebook use*, in addition to the similarity effects, also covariate-related effects of sending friendship ties (*covariate-ego*) and receiving friendship ties (*covariate-alter*) were included. A positive value of the *covariate-ego* effect represents that ego will send more nominations for a higher value for the covariate. A positive parameter value of the *covariate-alter* effect represents that alter will receive more nominations for a higher value for the covariate, and is used for testing Hypotheses H1, H3, and H4. A positive value of the *similarity* effect represents that adolescents with similar values on the covariate tend more strongly to create and maintain ties (i.e., *homophily*).

3.4.3. Cross-network effects for dislike-friendship dynamics

To assess the cross-network effects of Hypotheses H2, we included effects at the actor, dyadic, and triadic levels, specified according to Snijders et al. (2013) and Ripley et al. (2015). Fig. 1 illustrates the cross-network reputational dislike-friendship configurations used in our analysis.

At the actor level, three types of cross-network effects were tested, representing Hypotheses 2a and 2b. The first type is the *mixed outdegree activity* (*sqrt*) (A1) effect that represents the extent to which an individual's current number of friendship nominations promotes or maintains the number of this individual's reputational dislike nominations (*friend outgoing leading to dislike outgoing*) or vice versa (*dislike outgoing leading to friend outgoing*). The second type is the *mixed indegree popularity* (*sqrt*) (A2) effect that represents the extent to which being nominated as a friend promotes or maintains the perception of being disliked (*friend incoming leading to dislike incoming*) or vice versa (*dislike incoming leading to friend incoming*). The third type is the *mixed outdegree-indegree* (*sqrt*) (A3) effect that represents the extent to which nominating friends promotes or maintains the perception of being disliked (*friend outgoing leading to dislike incoming*) or vice versa (*dislike outgoing leading to friend incoming*).

At the dyadic level, two types of cross-network effects were tested, representing Hypotheses 2c. The first type is the *mixed direct association* (B1) effect that represents the extent to which friendship promotes the creation and maintenance of perceived dislike ties (*friend leading to dislike*) or vice versa (*dislike leading to friend*). The second type is the *mixed reciprocation* (B2) effect that represents the extent to which friendship promotes and maintains reciprocated perceived dislike ties (*friend leading to reciprocal dislike*) or vice versa (*dislike leading to reciprocal friend*).

At the triadic level, three types of mixed-tie triplet configurations were included to represent Hypotheses 2d. These are three triplets composed of two dislike ties and one friendship tie, representing the three different balance mechanisms as shown in Fig. 1 (C1–C3). The first triplet type is the *mixed 2-path friend-dislike-dislike closure* (C1) effect that represents the extent to which “the reputational dislike of a friend will lead to my reputational dislike” (*friend's dislike leading to dislike*). The second triplet type is the *direct 2-path dislike-dislike-friend closure* (C2) effect that represents the extent to which “I will befriend those who are disliked by my dislikes” (*dislike's dislike leading to friendship*). The third triplet type is the *mixed 2-path dislike-friend-dislike closure* (C3) effect that represents the extent to which “a friend of a disliked person will be or stay disliked” (*dislike's friend leading to dislike*). ”

3.4.4. Behavioral evaluation functions for drinking and smoking dimensions

The next component of the evaluation function models the behavioral dynamics of the two dimensions of drinking and smoking. The main purposes of including these functions are to control for peer influence (i.e., the effect of friends' drinking and smoking) (*average similarity*) and co-evolving smoking or drinking. The behavioral evaluation function also includes linear (*linear shape*) and quadratic (*quadratic shape*) effects to express the shape of the variables' long-term distribution (Steglich et al., 2010) as well as main effects of *gender*, *academic grade*, *perceived popularity*, and *Facebook use* for each of these behavioral variables.

3.5. Model building procedure

Our study specified two models, a preliminary (Model 1) and a final model (Model 2).

3.5.1. Preliminary model (Model 1)

Our goal for fitting the preliminary model is to identify any important cross-network dislike-friend effects at actor, dyadic, and triadic levels (as illustrated in Figure 1) by testing the significance of each effect by conducting a score-type test (Ripley et al., 2015). The score-type test allows us to test each cross-network effect without actually estimating the corresponding parameters, and hence avoids the pitfall of failing to achieving convergence which may happen for complex models when including all cross-network effects in a single model simultaneously. We also conducted the score-type test for the three covariate-related *similarity* effects for *perceived popularity*, *smoker*, *drinker*, and *Facebook use* for only reputational dislike dynamics.

Our preliminary model includes all within-network effects for reputational dislike dynamics and for friendship dynamics, as well as the behavioral dynamics of drinking or smoking dimensions. The preliminary model also includes the basic cross-network dislike-friend effects of both *mixed outdegree activity* (A1) and *mixed indegree popularity* (A2) at the actor level, as well as of *mixed direct association* (B1) at the dyad level. The effect of *mixed outdegree activity* (A1) needs to be controlled, as it is a precondition for testing the triadic effects of *mixed 2-path friend-dislike-dislike closure* (C1) and the *mixed 2-path dislike-friend-dislike closure* (C3). The effect of *mixed indegree popularity* (A2) is included for the following two reasons. First, this is a basic cross-network effect, representing indegrees in one network influencing the indegrees in the other, which is analogous to the effect of *mixed outdegree activity* (A1). Second, the indegrees reflect shared perceptions in the peer group; shared positive affections and shared reputational dislikes seem a priori to be negatively correlated.

3.5.2. Final model (Model 2)

Our final model includes all of the effects specified in our preliminary model plus the cross-network effects and the covariate-related *similarity* effects of *perceived popularity*, *smoker*, *drinker*, and *Facebook use* on the reputational dislike dynamics that generated significant score-type test results at the $\alpha < 0.05$ level. Based on our final model, we assessed certain cross-network effects that drive dislike-friendship dynamics, and tested the effects of *perceived popularity-alter*, *smoker-alter*, *drinker-alter*, and *Facebook-alter*. More information about the effects included in our analysis and their corresponding short effect names used for RSiena analysis, are provided in the online supplement to this article.

Table 1

Descriptive statistics of individual-level variables with percentages and averages (standard deviations; min, max) for students ($N = 238$) and average degree of ties.

<i>Individual attributes</i>	
Gender (female)	58%
Hispanic/Latino	95%
Academic grades	2.5 (0.8; 1, 4)
Facebook use	3.8 (1.4; 1, 5)
Perceived popularity (sqrt)	0.7 (1.0; 0, 6.6)
Parental smoke	30%
Parental drink	49%
Past-year smoke	21%
Past-year drink	59%
<i>Behavioral dependent variables</i>	
Smoking stage t_1	2.1 (1.5; 1, 6)
Smoking stage t_2	2.1 (1.5; 1, 6)
Drinking stage t_1	3.6 (1.7; 1, 6)
Drinking stage t_2	3.6 (1.9; 1, 6)
<i>Network dependent variables</i>	
Dislike degree t_1	1.0 (1.5; 0, 6)
Dislike degree t_2	0.9 (1.4; 0, 7)
Jaccard coefficient	0.10
Friendship degree t_1	6.7 (4.4; 0, 18)
Friendship degree t_2	4.7 (3.9; 0, 17)
Jaccard coefficient	0.27

Note. Academic grades were coded as 1 (“Mostly Ds or Fs”) to 4 (“Mostly As”). Average degrees were computed after excluding structurally-zero coded rows. Jaccard coefficient values were computed by excluding structurally-zero coded rows.

4. Results

4.1. Descriptive statistics

Table 1 shows the descriptive statistics (percentage and means with standard deviations in parentheses) of the sample ($N = 238$). On average, adolescents nominated one reputational dislike peer at both waves, seven friends at Wave 1, and five friends at Wave 2. The stability index between the first and second waves for the reputational dislike and friendship networks measured by the Jaccard coefficient (Batagelj and Bren, 1995; Snijders et al., 2013) were 0.10 and 0.27, respectively, which indicates rather unstable networks. For negative networks, such as dislike, this is not uncommon. An animated visual demonstration of the dislike-friendship dynamics (incorporating peer and drinking status), the distributions of dislike indegree and outdegree, and the two-by-two tables of friendship by dislike at the dyadic level are available in the [online supplement](#) to this article.

4.2. Results for the “multiplex network-behavioral co-evolution models”

Table 2 reports parameter estimates and corresponding standard errors for both the preliminary model (Model 1) and the final model (Model 2), as well as results of the score-type test for the preliminary model (“fixed” indicates the parameter was not estimated but tested by a score test).

4.2.1. Preliminary model (Model 1)

Our preliminary model achieved convergence with an overall maximum convergence t -ratio being of 0.27. Of the score-type tests, only the cross-network triadic effect of “friend’s reputational dislike leading to dislike” (mixed 2-path friend-dislike-dislike closure) (C1) was significant ($p = 0.04$). As for the results of the basic cross-network dislike-friend effects that were estimated in the preliminary model, the effect of mixed direct association (B1) of “friend leading to reputational dislike” was significant, while the other mixed direct association effect of “reputational dislike leading to friend” was not. For the reputational dislike dynamics, the results

of score-type test indicate that none of the covariate-related similarity effects of perceived popularity, smoker, drinker, and Facebook use were significant at the $\alpha = 0.05$ level.

4.2.2. Final model (Model 2)

Our final model (Model 2) added the cross-network triadic effect of “friend’s reputational dislike leading to dislike” (based on the score-type test result) to the preliminary model. The model had good convergence with an overall maximum convergence t -ratio of 0.26.

4.2.3. Cross-network effects for dislike-friendship dynamics

The results of our final model indicate that the dyadic-level effect of “friend leading to reputational dislike” was significant and positive, indicating that friendship promotes the creation and maintenance of reputational dislike ties, but not vice versa. The triadic-level effect of “friend’s dislike leading to reputational dislike” was also significantly positive.

4.2.4. Within-network effects for reputational dislike dynamics

Results in our final model indicate that adolescents tend to reciprocate reputational dislike (reciprocity); and that there is a substantial tendency for a subset of the students not to report any peers as disliked (outdegree = 0). There are significant similarity effects of gender on reputational dislike dynamics. Adolescents with higher perceived popularity tend to become-or-stay perceived by others as disliked (perceived popularity-alter). More frequent Facebook users tend to become-or-stay perceived by others as dislike when compared to less frequent Facebook users (Facebook-alter). The effects of smoker-alter and drinker-alter for reputational dislike dynamics were not significant. It should be noted that, after including the cross-network effect of “friend’s reputational dislike leading to reputational dislike” in our final model (Model 2), the significant effects of indegree dislike (sqrt) and outdegree-indegree dislike (sqrt) in our preliminary model (Model 1) became non-significant. A similar tendency was found in the perceived popularity-alter effect for reputational dislike dynamics, i.e., its significance level in our preliminary model was attenuated in our final model. This was not because of important changes in parameter estimates, but mainly due to larger standard errors.

4.2.5. Within-network effects for friendship dynamics

All structural effects except indegree popularity and outdegree activity were significant. There was a tendency for friendships to be reciprocated and to seek popular others as friends. The significant positive effect of transitive triples indicates that friends’ friends’ tend to become or stay friends. There were significant positive similarity effects with respect to gender, academic grades, and classroom. There was a significant positive smoker-ego effect; adolescents who smoke more frequently were more active in developing friendships. No significant effects were found for smoking or drinking homophily effects (smoker-similarity, drinker-similarity). Results of goodness-of-fit tests for the final model indicated a good fit for both indegree and outdegree distributions for reputational dislike as well as the friendship dynamics ($p > 0.05$). A more complete report on the results with distribution graphs, as well as other results of interpretation of effects pertaining to behavioral dynamics, are available in the [online supplement](#) to this article.

5. Discussion

Peer status influences a middle adolescent’s reputation of being disliked in such a way that students perceived as popular are more likely to have higher reputational dislike by others. This highlights the role of competition for peer status plays in information diffusion of negative peer relations in the high school setting. Our results imply a tendency for high school adolescents to strive for status in

Table 2

Parameter estimates, their standard errors (SE), and significance test for reputational dislike and friend dynamics of multiplex network-behavioral coevolution models.

Network dynamics Effects	Preliminary model (Model 1)		Final model (Model 2)	
	Dislike	Friend	Dislike	Friend
Rate	8.639 (1.270)	19.987 (1.287)	8.651 (1.563)	19.930 (1.408)
Outdegree (density)	−4.027*** (0.885)	−2.881*** (0.254)	−3.896*** (1.030)	−2.873*** (0.284)
Reciprocity	1.461** (0.539)	2.617*** (0.187)	1.415* (0.552)	2.621*** (0.149)
Transitive triplets	–	0.583*** (0.058)	–	0.584*** (0.045)
Transitive recipr. triplets	–	−0.547*** (0.086)	–	−0.549*** (0.080)
Indegree dislike (sqrt)	0.412** (0.142)		0.308 (0.197)	0.138 (0.095)
Indegree popularity (sqrt)		0.140 (0.099)		
Outdegree–indegree dislike (sqrt)	0.544* (0.264)		0.559 (0.462)	−0.381*** (0.104)
Outdegree popularity (sqrt)		−0.379*** (0.106)		
Outdegree dislike (sqrt)	−0.119 (0.336)		−0.105 (0.438)	0.033 (0.041)
Outdegree activity (sqrt)		0.032 (0.045)		
Outdegree = 0	3.914*** (0.769)	–	3.924*** (0.972)	–
Same gender	0.703** (0.243)	0.307*** (0.074)	0.640** (0.235)	0.306*** (0.084)
Grade similarity	0.345 (0.457)	0.580*** (0.184)	0.330 (0.395)	0.579* (0.231)
Same classroom	0.310 (0.226)	0.309*** (0.090)	0.280 (0.229)	0.306** (0.110)
Perceived popularity alter	0.360*** (0.100)	0.076 (0.051)	0.352* (0.146)	0.076 (0.060)
Perceived popularity ego	−0.076 (0.108)	−0.042 (0.046)	−0.073 (0.098)	−0.041 (0.063)
Perceived popularity similarity	fixed	0.031 (0.327)	–	0.028 (0.329)
Smoker alter	−0.137 (0.100)	−0.006 (0.031)	−0.134 (0.0905)	−0.006 (0.033)
Smoker ego	0.041 (0.062)	0.081* (0.030)	0.045 (0.067)	0.081* (0.033)
Smoker similarity	Fixed	0.232 (0.168)	–	0.231 (0.157)
Drinker alter	−0.124 (0.085)	−0.043 (0.028)	−0.116 (0.134)	−0.043† (0.025)
Drinker ego	0.029 (0.056)	0.032 (0.026)	0.039 (0.066)	0.032 (0.033)
Drinker similarity	Fixed	0.070 (0.128)	–	0.072 (0.115)
Facebook alter	0.151† (0.091)	−0.002 (0.027)	0.155* (0.077)	−0.001 (0.035)
Facebook ego	0.058 (0.063)	−0.033 (0.031)	0.053 (0.077)	−0.033 (0.027)
Facebook similarity	Fixed	0.009 (0.120)	–	0.009 (0.141)
(A) Cross-network at the actor level				
(A1) Mixed outdegree activity (sqrt)				
Friend → Dislike	0.037 (0.123)		−0.132 (0.225)	
Dislike → Friend		0.075 (0.106)		0.080 (0.098)
(A2) Mixed indegree popularity (sqrt)				
Friend → Dislike	−0.194 (0.289)		−0.208 (0.195)	
Dislike → Friend		−0.192 (0.133)		−0.195 (0.127)
(A3) Mixed outdegree–indegree (sqrt)				
Friend → Dislike	Fixed		–	
Dislike → Friend		Fixed		–
(B) Cross-network at the dyad level (H1)				
(B1) Mixed direct association				
Friend → Dislike	1.187*** (0.338)		1.184** (0.441)	
Dislike → Friend		0.180 (1.175)		0.148 (1.054)
(B2) Mixed reciprocation				
Dislike → reciprocal friend		Fixed		–
Friend → reciprocal dislike	Fixed		–	
(C) Cross-network at the triad level (H1)				
(C1) Mixed 2-path friend-dislike-dislike closure				
	Fixed ($p = 0.041$)		0.488* (0.231)	
(C2) Direct 2-path dislike-dislike-friend closure				
	Fixed		–	
(C3) Mixed 2-path dislike-friend-dislike closure				
	Fixed		–	
Overall max convergence t	$t = 0.27$		$t = 0.26$	

Note. † $p < 0.1$; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. The above models controlled for behavioral dynamics of drinking and smoking, and co-evolution of drinking and smoking. Non-significant indicates non-significant results for the score-type test ($df = 1$). For “fixed” parameters, score-type tests were conducted.

competition to others and demonstrate that the dynamics of negative relations for high school adolescents may be distinct from the unpopularity-driven negative relations for childhood and early adolescents based on personal dislike.

At the triadic level, our study found a tendency for adolescents to perceive those who are perceived as disliked by the adolescent's friends as being disliked, which underlines the reputational nature of this type of dislike and suggests information diffusion of reputational dislike among peers. This is in line with findings for other and more serious negative social ties. For example, Salmivalli (2014) found that bullying may be generated as a group phenomenon and that peer bystanders may actually contribute to the bullying dynamics in the classroom.

Interestingly, our findings indicate that Facebook use was related to being perceived as disliked by peers. Perhaps this is an

effect of personality traits that are related to Facebook use, and this should be investigated further. Dislike ties are not more likely to be perceived within the same classroom, which indicates that physical proximity does not matter for information diffusion of negative peer relations.

An unexpected finding is the significant positive dyadic Friend → Dislike effect, implying that friends have an elevated probability to have a reputational dislike relation. This is based on a small number of cases; however, in Wave 3 there were 13 combinations of friendship and reputational dislike and 9 in Wave 4 (see the results in the online supplement). Although these numbers were low, the odds ratios are greater than 1, which descriptively confirms the positive association between friendship and reputational dislike. The significance of the dyadic Friend → Dislike effect means that the rest of the fitted model, without this effect included,

would have implied a still lower value than 9 for the combined friendship-dislike dyads.

We have three potential interpretations. First, reputational dislike ties are conceptually different from those of dyadic personal dislike. Second, some friendships have a relational ambiguity that may be combined with reputational dislike. Third, this relational ambiguity might reflect insufficient control over meeting opportunities; if two individuals are not acquainted, they will mention each other neither as a friend nor as a perceived disliked person.

In comparison with the results obtained by Berger and Dijkstra (2013) among adolescents in Chile, we found some striking differences, which, to some degree, was expected, as we used different conceptualization of dislike relations. Berger and Dijkstra used the concept of personal dislike by asking for nominations of disliked classmates, which is different from our use of reputational dislike. Nonetheless, these differences should be noted.

First, Berger and Dijkstra (2013) found a negative dyadic dependence in both directions. Second, they found the significant triadic effect of “friend’s dislike leading to dislike,” which confirms our finding, but also reported a significant indegree dislike effect. Our study indicated that the indegree dislike effect was diminished after including the “friend’s dislike leading to dislike” effect. However, Berger and Dijkstra’s study did not include any degree effects, which are components of the triadic effects and, therefore, should be controlled for. This implies that their results in regard to triadic effects are difficult to interpret, as it is possible that they are due to the omitted degree effects. Thus, a direct comparison with our results, aside from different conceptualizations of dislike relations, is impossible.

Third, their results for the effects of perceived popularity (which they called “popularity” that affects the antipathy network) were quite different from ours. They found a negative similarity effect and a negative alter effect, whereas we found a positive perceived popularity-alter effect on reputational dislike. These differences may be related to differences in measuring perceived popularity and dislike. Berger and Dijkstra (2013) calculated perceived popularity (or what they call “popularity”) by subtracting non-popular nominations from popular nominations, standardizing within classrooms and then z-standardizing across all classes, while we computed the indegree of popular nominations and applied a square-root transformation. Future study is needed to explore the sensitivity of effects of perceived popularity on dislike dynamics for the operationalization of perceived popularity and dislike relations (i.e., personal vs reputational).

Our study has some limitations. First, our results are based on one school with a majority Hispanic/Latino population in grades 11–12. Therefore, our results may not be generalizable to other schools and to different age groups. Second, Facebook was chosen as the primary social media site, as based on a previous study. Although Facebook was the most popular social networking site in use at the time of this study, there are other social network sites that could potentially contribute to the reputational dislike dynamics, including Instagram (which is more popular today than it was when these data were collected).

Despite these limitations, our study offers an unprecedented understanding of the dynamics of the negative side of peer relations from an informational perspective, as driven by perceived popularity, Facebook use, and substance use, with consideration of friendship dynamics and friends’ influence on substance use. We show that high-status students often may be perceived as disliked by their peers and that this can lead to discomfort and a negative atmosphere in a school through informational social influence. It is noteworthy that we did not find support for an association of substance use with the tendency to be perceived as disliked.

In addition, we found that reputational disliking relationships sometimes emerged from existing friendships, indicating that

youth do not perceive others as disliked indiscriminately but, instead, form peer agreement of disliked peers through information diffusion. Further, reputational dislike relations are transitive in diffusion such that youth perceived others as disliked if their friends also perceived them as disliked. These findings suggest that the dynamics of status-driven negative peer relationships could be better understood by being examined in tandem with friendship dynamics. We hope that our study provides further insight into the complex social mechanisms of peer relations as triangulated by perceived popularity, reputational dislike, and friendships among youth.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.socnet.2016.07.006>.

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