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Review

Peer influence in the development of adolescent antisocial behavior: Advances from dynamic social network studies

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ABSTRACT

In adolescence, peer influences are important in the development of antisocial behavior. Previous empirical work has often focused on peer similarity to make claims about peer influence. However, peer similarity can be the result of both peer selection and influence, or general social network processes, such as reciprocity (preference for mutual friendships) and transitivity (preference for becoming friends with the friends of one's friend). Empirically, it is often difficult to separate these processes from each other. Only recently, studies have been able to statistically separate selection from influence, using dynamic social network models. These new models thus allow for a closer study of peer influence on the development of antisocial behavior. The current article presents a review of recent empirical studies that have used dynamic social network analyses to study peer influence effects for different forms of antisocial behavior (i.e., aggression, delinquency, externalizing behavior, weapon carrying) as these forms may be differently affected by peer influence. Studies that lump different kinds of antisocial behavior together as “externalizing behavior” show mixed results with regard to peer influence. With regard to the development of delinquency and weapon carrying, peer influences were observed in studies that had six month to one-year measurement intervals, but not in those with shorter intervals. With regard to direct forms of aggression, peer influence was only observed in certain contexts and depended on individual antisocial traits. What is recommended for further advance in the field of peer influence is to avoid container variables of antisocial behavior (such as “externalizing behavior”), to pay close attention to the role of status and belonging needs, and to focus more strongly on a detailed examination of the sequential order of peer selection and influence processes and their moderation by individual and contextual conditions.

Introduction

Decades of research indicate that adolescence is characterized by a significant increase in antisocial behaviors, including aggression and delinquency. These behaviors typically peak around 16–18 years of age, with adolescents being responsible for the majority of all criminal offences (Greenberg & Lippold, 2013; Tremblay, 2010). Recent estimations suggest that the costs of such behaviors for society are high and can lead up to \$5.8 million for individual persistent youth offenders (Cohen & Piquero, 2009). Peers are a major influence in the development of antisocial behavior (Greenberg & Lippold, 2013). Yet, the dynamics of this influence differs greatly, depending on whether peers reinforce each other's behavior by forming networks of similar others, or

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whether one's behavior changes through the influence of peers in one's network (Kandel, 1978). This distinction in dynamics has become known as the difference between peer selection and influence processes, and over time this has spurred many researchers to study these processes in more detail with regard to antisocial behavior (see for excellent reviews: Brechwald & Prinstein, 2011; Dishion & Tipsord, 2011).

For understanding to what extent peer influence processes affect the development of antisocial behavior and to use this information for interventions, it is important to be able to distinguish influence from selection processes (Gest, Osgood, Feinberg, Bierman, & Moody, 2011). For example, for interventions regarding weapon carrying in schools it makes a big difference whether peers who carry weapons seek each other out and thereby reinforce their behavior, or whether a few who carry weapons influence other peers to do so as well (Dijkstra et al., 2010). Moreover, due to dependencies in the data when working with social relationships (e.g., triadic or higher-level cluster structures in social networks), claims about either peer influence or selection processes are difficult to make (Haynie, 2001). Therefore, until recently, studies have been stymied in their attempts to study peer influence effects in the development of antisocial behavior. Due to newer developments in dynamic network modeling in the last decade, it has been possible to separate peer influence from selection processes, while statistically accounting for dependencies in the data. This has spawned a new generation of studies that can more accurately determine to what extent peer influence processes affect the development of antisocial behavior. What are the findings from these studies and what should be done to advance this kind of research?

In the current article, we aim to answer these questions. We discuss findings from studies that used dynamic social network modeling to explain peer influence effects on adolescent antisocial behavior. Although there is a recent excellent meta-analysis that finds support for peer influence (Gallupe, McLevey, & Brown, 2018), our meta-analysis takes a broader scope of antisocial behavior (covering an additional 13 studies), by focusing more on theoretically relevant moderators of peer influence, such as social status, personality, and gender, and including studies on externalizing problems and weapon carrying. In the following, we start by providing a brief overview of the theory on peer influence dynamics in antisocial behavior in general and more specifically for different types of antisocial behavior. This is followed by a short introduction into the modeling approach to examine peer influence processes. After this preparation, we review the major empirical findings made by these studies. Finally, we suggest several directions for future research.

Theories of peer influence dynamics and antisocial behavior

Work by Snyder and colleagues (e.g., Snyder, Horsch, & Childs, 1997; Snyder et al., 2005) illustrates that already in kindergarten, peers are important socializing agents when it comes to antisocial behavior. As youths grow older, peer relationships intensify in intimacy and frequency (Hartup, 1996) and peer behaviors often become a guideline for normative and rewarding behaviors that may or may not be antisocial (Steinberg, 2008). Yet, in adolescence, we observe an increase in antisocial behavior which is marked by two important developments. On the one hand, antisocial behaviors become more prevalent in adolescence, and on the other hand, peers become more central in the lives of adolescents. There are several theories that describe how these developments often go hand in hand. Moffitt's (1993) taxonomy of life course persistent and adolescence limited antisocial youths suggests that the latter group shows a temporary increase in antisocial behavior in adolescence due to a discrepancy between biological and social maturity, referred to as the 'maturity gap'. This gap causes a certain strain or tension (Agnew, 2001) which leads youths to display their maturity and autonomy via the use of 'mature' behaviors, which include risky and antisocial behavior such as delinquency, smoking, and drinking. That is, strategies to close the maturity gap are likely to become normative and lead to higher status. In adolescence, antisocial behavior is particularly instrumental in closing the maturity gap and a common way to achieve autonomy and attaining status in the peer group (Hawley, 1999; Moffitt, 1993). Related to this, processes of physical maturation, increasing opportunities for mating, and increasing encounters of competitive contexts are likely to increase the salience of status striving (e.g., De Bruyn, Cillessen, & Weisfeld, 2012). Moreover, central to Moffitt's taxonomy is the notion that youths learn these antisocial behaviors from each other through imitation, or social influence. Increased sensitivity to peer contexts at that age suggests that different contexts may produce different behavior, depending on what is valued or approved in that specific context. Work focusing on brain developments and risk behaviors, including antisocial behavior, indicated brain regions related to reward increase in adolescence (Chein et al., 2011; Steinberg, 2008). Importantly, these regions are typically activated in social situations in which peer status is salient (Crone & Dahl, 2012; Somerville, 2013). As a result, when with peers, youths are more likely to display behaviors that might increase their social position. Because antisocial behaviors become more normative and are connected to a mature and high social status, these behaviors are likely to be imitated (see also Bandura, 1973; Dijkstra, Lindenberg, & Veenstra, 2008). Youths who display antisocial behaviors are thus likely to become the reference group in adolescence, in particular when they are able to strategically combine the use of antisocial and prosocial behaviors (cf. Hawley, 1999). Finally, the disapproval of such behaviors by authority figures, such as parents and teachers, may reinforce the use of antisocial behavior as a testimony to the youth's autonomy and mature status.

In addition to Moffitt's theory, Dishion, Patterson, and Griesler (1994) developed a theory about the role of peer processes and the development of antisocial behavior. In doing so, they introduced the concept of confluence describing how adolescent characteristics, such as antisocial behavior, develop in the context of friendship as a function of (a) peer acceptance and rejection, (b) initial selection of friends, and (c) peer influence among friends through peer reinforcement processes such as deviant talk. They argued that antisocial youths may be rejected by the peer group, resulting in fewer friendship options. Hence, antisocial youths are more inclined to seek out available peers, who may also be antisocial. Subsequently, antisocial peers may mutually influence each other's antisocial behavior, through processes such as *deviancy training* (Dishion & Tipsord, 2011; Dishion, Spracklen, Andrews, & Patterson, 1996). This process pertains to shifts in the direction of deviant attitudes and values due to the fact that these shifts are rewarded in social

interactions. As such, peers implicitly or explicitly promote antisocial behavior and may learn to display antisocial behavior to fit in, or to gain and maintain a central position in the peer group. Another explanation for these social influence effects comes from coercion theory, which states that social processes in the family teach youths that antisocial behavior can be used to have one's way (Patterson, 1982). In adolescence, this is associated with more coercive interaction patterns between friends, which may further reinforce the use of antisocial behaviors, in particular with regard to overt aggressive behaviors (Snyder et al., 2008).

Peer influence processes may not only explain the rise in antisocial behavior in adolescence, but also offer an explanation for the development of more severe forms of antisocial behavior, including violence, gang involvement, and other more serious offenses (Van Ryzin & Dishion, 2013). Yet, what looks like peer influence may in effect be the result of selection and thus reinforcement processes. It stands to reason that different kinds of antisocial behavior may differ with regard to the prominence of peer influence processes compared to selection processes, and that makes it important to separate the two kinds of dynamics. In the following, we discuss the most important findings with regard to different forms of adolescent antisocial behavior.

Peer influence with regard to different forms of antisocial behavior

Previous work has found quite consistent support for different developments in different forms of antisocial behavior in adolescence. However, it should be noted that research fields typically differ in the terminology used to refer to antisocial behavior. Whereas psychological disciplines usually use 'antisocial behavior' or 'rule-breaking' to refer to a wide set of externalizing behaviors, including theft, vandalism, violence, and other transgressions, criminologists and sociologists are more likely to use the term 'delinquency' to refer to such behaviors. The definition of antisocial behavior is further complicated by the inclusion of aggressive and non-aggressive behaviors. Much work on adolescent antisocial behavior includes physical forms of violence or aggression. In the current review, we thus make a distinction between aggression, delinquency, weapon carrying, and broad definitions of antisocial behavior. With regard to *aggression*, when possible, we distinguish between direct, or overt, (e.g., physical, verbal) and indirect, or covert, (e.g., gossiping, ostracizing) forms. Moreover, most studies that we reviewed included mild forms of aggression. In keeping with the terminology used by the specific studies, we will sometimes use the term *violence*, to refer to more severe (and physical) forms of aggression. *Delinquency* is used to refer to rule-breaking and typically includes amongst others vandalism, and police contact. However, some measures of delinquency also include aggressive behaviors. *Weapon carrying* is a rather specific antisocial behavior, and refers to carrying a knife, gun, or other weapon that can be used in a violent or aggressive way. Finally, *externalizing behavior* is used to refer to a broad set of deviant behaviors. In the studies we reviewed, this included antisocial behavior in addition to other forms of externalizing behaviors, such as substance use or oppositional and defiant behaviors (e.g., disruptive behavior in the classroom).

What do we already know about peer influence and what can we learn from the new ways of separating influence from selection processes? Previous work has indicated that these forms of antisocial behavior have different developmental trajectories and are differently related to peer influence processes in adolescence. Whereas direct forms of aggression typically decrease in adolescence, several studies show that indirect forms of aggression and delinquent behaviors increase during this period (Barker et al., 2007; Ormel, et al., 2012; Tremblay, 2010). These developments are possibly linked to different peer influence dynamics (Dishion & Tipsord, 2011). With regard to aggressive behavior, peer influence is not straightforward, due to the heterogeneous nature of aggression. Indirect aggression has been associated with social prominence and is often viewed as socially rewarding and thus more likely to be adopted from peers (Card, Stucky, Sawalani, & Little, 2008; Heilbron & Prinstein, 2008). In contrast, direct aggression is not always associated with social prominence, and in fact is often related to avoidance or rejection by peers (Card et al., 2008). Earlier work on physical aggression also suggests that this form of aggression may not be linked to peer influence dynamics, but only to peer selection dynamics (Poulin & Boivin, 2000).

Similar to indirect aggression, delinquent behaviors may be more conducive to popularity or acceptance in the peer group, because it is associated with autonomy and a more mature status (Dijkstra et al., 2015; Moffitt, 1993). Hence, the development of delinquency is likely to be related to influence dynamics (Dishion, Piehler, & Myers, 2008; Monahan, Steinberg, & Cauffman, 2009). That is, when youths observe the social rewards associated with these behaviors, they may imitate their peers in this respect (cf. Moffitt, 1993). For example, youths may positively respond to delinquent behavior or use humor to positively reinforce such behaviors.

Weapon carrying is thought to be part of a delinquent lifestyle and a means to defend oneself against threats from the environment (Webster, Gainer, and Champion, 1993). Given its association with other antisocial behaviors and contexts, such as youths gangs, also weapon carrying is likely the result of peer influence. Indeed, previous work has shown that youths who carry weapons serve as a role model for other peers and suggest that weapon carrying is accepted (Bailey, Flewelling, & Rosenbaum, 1997).

The role that peer influence plays in the development of externalizing behavior is likely difficult to determine because it is confounded by the inclusion of both aggression, delinquency and often other deviant behaviors, such as substance use. Peer influence may be differently related to these aspects of antisocial behavior and hence it is unlikely that we will observe straightforward findings with regard to peer influence in these studies.

In short, peer influence may work differently for different forms of antisocial behavior, such that peer influence would be prominent in the development of indirect aggression, delinquency, and weapon carrying, whereas peer influence is unlikely to be observed in the development of direct aggression and violence. However, until recently, research on peer influence was complicated by the difficulty in separating peer influence from peer selection effects or general social processes that are typically observed in peer groups (e.g., reciprocity, or the tendency to form mutual ties). With the introduction of dynamic social network models this limitation has been addressed and hence we are better able to test peer influence effects. In the following, we describe the details of these

models and how they account for additional structural and social processes in testing peer influence effects.

The use of dynamic social network analysis in explaining peer processes

Recently, researchers have employed SIENA or RSIENA (Simulation Investigation for Empirical Network Analysis) models to assess peer influence, while accounting for peer selection processes (Snijders, Steglich, & Schweinberger, 2007). Next to its advantage to separate peer influence from selection effects, in comparison to traditional methods (e.g., regression analyses), estimates of influence are less likely to be inflated, because standard errors among friends are smaller. Moreover, SIENA also accounts for general structural processes that are common in social networks and confounding processes of selection on gender, age, or other variables. Not accounting for such processes also inflates estimates for peer influence.

SIENA is a stochastic actor-oriented model, in which individuals are assumed to choose their relationships and behaviors based on an evaluation of their utility function, which is largely based on their preferences and position in the network. At a given moment, individuals may change a relationship (i.e., create a new tie, drop one existing tie, or keep the tie unchanged) or their behavior (i.e., changing in an upward or downward direction or remaining status quo) in response to the current network structure and the current behavior of other individuals in the social network. These changes are called 'micro-steps'. The social network at the first observation is taken as the starting point, and from there SIENA models each subsequent step by repeated imputation of the micro-steps. By means of simulation, the likelihood of changes in the social network and behavior are determined, based on the observed data. It is assumed that changes may occur continuously between discrete observations. Because we do not know exactly what took place between the two observations (technically these are regarded as snapshots), SIENA accounts for this by modeling a number of potential changes that could have occurred.

To account for general social network processes, SIENA estimates the role of structural network effects. These include amongst others reciprocity (preference for mutual ties) and transitivity (preference for befriending the friends of one's friends). SIENA also estimates whether individuals in the social network are more likely to select friends or be selected by network members based on certain characteristics (e.g., the level of antisocial behavior). Moreover, and relevant to the current review, based on the observations, SIENA estimates whether individuals who are similar on a characteristic are more likely to become friends over time. With regard to such selection processes in friendship networks, previous work has largely focused on attraction-based similarity. In the case of antisocial behavior, youths may select peers or peer groups as friends because they are similar in their cognition about and attitudes toward antisocial behavior and hence are more inclined to affiliate (McPherson, Smith-Lovin, & Cook, 2001). Relatedly, youths may actively *de-select* peers due to their behavior, suggesting that they break-off friendship ties over time (e.g., aggression within the friendship may lead to breaking off the relationship).

Next to these selection effects, SIENA estimates the degree to which individual characteristics are the result of the social network, while accounting for general behavioral changes. That is, the program estimates whether individuals are more likely to move their behavior into the direction of their average friends' behavior. For estimating these selection and influence effects, SIENA assesses the individual's position in the network, their ties, their behavior, and the (behavioral) characteristics of their ties (e.g., friends' level of antisocial behavior).

Despite the advantage that SIENA has over standard regression and multilevel approaches, one drawback of SIENA in comparison to such analytical procedures is the lack of effect size estimation. In the current review, we therefore cannot make claims about the magnitude of peer influence effects.

The present review

In the following, we review the evidence on peer influence with regard to the development of different forms of antisocial behavior, based on studies that are able to test peer influence processes, while separating these effects from selection processes, general behavioral developments, and general social processes. To this end, we selected all studies to date that used dynamic social network modelling to explain the development of antisocial behavior in adolescence. We aim to address the following research questions: (1) to what extent is the development of adolescent antisocial behavior associated with peer influence; (2) to what extent do peer influence processes differ between types of antisocial behavior; and (3) to what extent do these peer influence effects depend on study design and individual or contextual characteristics?

Methods

Selection of studies

In our review, we included all (to our knowledge) internationally peer-reviewed studies to date that focused on (a) antisocial behaviors, (b) youths (age 10 – 25), and (c) used SIENA models to study social selection and influence processes in friendship networks. The different forms of antisocial behavior we will discuss are delinquency, aggression, weapon carrying, and externalizing behavior. These studies were identified via the SIENA webpage (<https://www.stats.ox.ac.uk/~snijders/siena/>), which provides an almost complete overview of all internationally published and peer-reviewed SIENA studies to date, including 26 studies that met our criteria. Four additional published studies were found via Google Scholar and Web of Science, by using search algorithms based on combinations of the following terms: 'antisocial', 'aggress*', 'violen*', 'delinq*', 'devia*', 'externali*', 'social network', 'peer dynam*', and 'SIENA'. Finally, two additional studies were suggested by an anonymous reviewer. In total, we found 32 studies that fit our

criteria, of which two studies reported the same peer influence and selection effects regarding antisocial behavior (Franken, Moffitt, et al., 2016; Franken, Keijsers, Dijkstra, & Ter Bogt, 2017). These two studies were thus discussed as one.

Social networks

Social networks (i.e., the ties between actors in a specific context) are the most important input for SIENA models. In all studies, social networks included the social relationships between youths that occurred naturally at two or more time points. Without exception, all studies used peer nomination procedures in which youths nominate peers from a list or roster, or by providing their names to identify social relationships (e.g., affiliation, friendship, like) between the actors in the social network. In most studies, the social network spanned the classroom, grade or school. However, in a few studies, the social network included a whole community, with youths being able to nominate any other peer within that community. Network size, number of assessment waves, and the proportion of missing data may affect social selection and influence processes for practical and theoretical reasons (e.g., different effects in larger more anonymous networks, with less social control), but may also affect statistical power for detecting effects, in particular for effects related to behavioral variables (Haynie, Doogan, & Soller, 2014; Stadtfeld et al., 2017). This means that statistical power to observe social selection effects (related to the social ties) is higher than for observing social influence effects (related to behavior). However, in a recent simulation study, it was shown that (pooled) networks of 120 or more actors, are likely to have sufficient statistical power to estimate both social selection and influence effects (Stadtfeld et al., 2017). In our review, all studies included at least 120 actors per (pooled) network.

Behavioral variables

Next to information about social relationships, SIENA requires information on behavioral variables over at least two time points. Information about individual behavior can be based on self- or informant-reports (e.g., peers, parents). Behavioral data should be ordinal or continuous. Because most studies used different measurements and reporters for antisocial behavior, we noted details about the content and informants of each measure in Table 1. Behavioral data can be used to describe the individual and to describe the social network. In that sense, for the estimation of selection effects, behavioral data are the independent variable, or predictor, whereas for the estimation of influence effects behavioral data is the dependent variable, or outcome. Moreover, behavioral data can be used as a control variable (e.g., one may control for the development of depressive symptoms when estimating peer influence and selection effects on aggressive behavior).

Sienna effects

For a full list of the effects that SIENA can produce, we refer the reader to the SIENA manual (Ripley, Snijders, Boda, Vörös, & Preciado, 2017) or one of the excellent articles on SIENA parameters (e.g., Snijders, Van de Bunt, & Steglich, 2010). Here, we will briefly focus on the effects that are relevant to the current review. Central to our research question are the social selection and influence effects. To estimate selection effects, SIENA estimates parameters related to the general *activity* and to *popularity* of individuals in the network, indicating the extent to which individuals select and are selected by others, respectively. In addition, SIENA estimates to what extent activity and popularity depend on individual characteristics. The *ego activity* effect indicates the degree to which higher scores on a specific characteristic (e.g., antisocial behavior) are related to selecting more social ties over time. The *alter popularity* effect indicates the degree to which higher scores on a specific characteristic (e.g., antisocial behavior) are related to being selected by others over time. Finally, SIENA can estimate whether individuals in the network who have similar scores on a specific characteristic (e.g., antisocial behavior) are more likely to have a tie over time. The latter effect is estimated as the net result of creating new ties to similar others (*network creation effect*) and breaking off ties with dissimilar others (*network endowment* or *deselection effect*). These effects can also be estimated separately. To estimate influence effects, SIENA estimates general *linear* and *quadratic* behavioral tendencies, reflecting the general behavioral development over time. Next, SIENA can estimate the extent to which behavioral development depends on the behavior (e.g., antisocial behavior) of an individual's social ties. In most studies that we reviewed, researchers used the *average similarity* effect to estimate to what extent individuals prefer being similar in antisocial behavior to their social ties. Here, the total influence of peers is independent of the number of befriended peers (*behavior evolution*). In addition, some studies estimated the *total similarity* effect, which indicates the preference for being similar to one's social ties, but where the total influence is proportional to the number of befriended peers.

Results

Studies that have used SIENA to examine peer influence effects in antisocial behavior vary in several respects, such as the size of the social networks (e.g., classrooms, grades, schools), age group, and informant of antisocial behavior (self-, peer-, teacher-reports) (see Table 1). We grouped studies according to the following outcome measures: aggression and violence, delinquency, weapon carrying, and broad assessments of externalizing and deviant behavior that include antisocial behavior, but also other deviant behaviors (e.g., substance use). We start by discussing the main findings on peer influence. Subsequently, we discuss the role of moderators in these processes. Please note that most studies controlled for structural network effects (e.g., reciprocity, transitivity), general linear and quadratic behavioral development, and selection on gender (i.e., activity, popularity, and similarity effects).

Table 1
Overview of studies that included dynamic social network analysis to examine peer influence processes in aggression and violence, delinquency, externalizing behavior, and weapon carrying.

	Authors	Study characteristics	Country	Assessment	Peer Effects		Notable additional findings
					Sel.	Infl.	
1	Dijkstra and Berger (2017)	N = 612, age 10–12 years, two waves (1 year), 4 all-male classrooms (n = 150), 4 all-female classrooms (n = 190), 8 mixed classrooms (n = 272)	Chile	Peer-reported physical aggression (one item: 'who fights a lot')	NS	NS	Findings were not affected by classroom gender composition
2	Dijkstra et al. (2011)	N = 274 (51.8% boys), age 10–12 years, two waves (1 year)	Chile	Peer-reported relational and physical aggression	NS	NS	Selection on similarity in aggression explained by network effects and selection on sex; Only social influence on relational aggression, but marginal when controlling for selection on social status
3	Kornienko et al. (2018)	N = 998 (52.7% boys), 6th graders, three waves (1 year), two cohorts in 3 middle schools	US	Self-reported antisocial and violent behavior	+ /NS	NS/+	Peer selection on similarity in antisocial behavior was only present in the younger cohort Peer influence in violence was only present in the older cohort
4	Lanninga-Wijnen et al. (2017)*	N = 1,134 (50.1% boys), M age = 12.66, SD = 0.48, three waves (3–4 months), 2 cohorts in 2 schools	The Netherlands	Peer-reported aggression	+	+	Selection only present in classrooms with high popularity norm for aggression; Influence only present in classroom with high or moderate popularity norms for aggression Aggressive youths more active in selecting friends, but less likely to be selected as friends.
5	Logis et al. (2013)	N = 639 (53% boys), M age = 10.7, SD = 0.42, three waves (2–4 months), 34 classrooms in 13 schools	US	Peer-reported overt and relational aggression	NS	++	Stronger social influence for youths higher on hostile attribution bias.
6	Molano et al. (2013)	N = 900 (49.1% boys), M age = 8.62, SD = 0.69, two waves (6 months), 74 classrooms in 18 schools	US	Teacher-reported aggression	NS	+	Physically aggressive youths more popular and more active in selecting friends.
7	Rulison et al. (2013)	N = 480 (54.4% boys), 6th and 7th graders, four waves (6 months), 1 school	US	Peer-reported physical aggression	NS	++	Physically aggressive youths more often selected as friends and become more popular, but less socially preferred;
8	Shin (2017)	N = 736 (48% boys), 5th and 6th graders, two waves (5 months), 26 classrooms in 4 elementary schools	South-Korea	Teacher-reported physical aggression	++	+	Youths high in social preference were less likely to select physically aggressive friends; Social influence stronger in boys compared to girls.
9	Sijtsema et al. (2010)	N = 337 (51.3% boys), age 12–14 years, three waves (6 months), 8 grades	US	Self-reported instrumental, reactive, physical, and relational aggression	NS/+ +	NS/+ +	Influence in reciprocal friendships for instrumental, reactive, and relational aggression; Selection effects in reciprocal friendships for instrumental aggression
10	Sijtsema et al. (2014)	N = 133 (57.1% boys), age 9–10 years; N = 236 (59.4% boys), age 11–14 years, two waves (1 year), 6 and 10 classrooms	Italy	Peer-reported bullying (proactive aggression)	+	+	Selection and influence only in adolescents; Peer influence marginally stronger in youths with higher moral disengagement; Bullying was also indirectly influenced through friends' moral disengagement.
11	Turanovic and Young (2016)	N = 1948 (50.8% boys), M age = 17.07, two waves (1 year), nine high schools	US	Self-reported violence	++	NS	Findings adjusted for sociodemographic factors, depressive symptoms, verbal ability, impulsivity, and victimization.

(continued on next page)

Table 1 (continued)

	Authors	Study characteristics	Country	Assessment	Peer Effects		Notable additional findings
					Sel.	Infl.	
12	Van Zaik and Van Zaik (2015)	N = 1772 (48.9% boys), M age = 13.03, SD = 0.53, three waves (1 year), community	Sweden	Self-reported violence	n/a	+	Youths were more likely to adopt violence from peers higher on CU or GM traits; Influence stronger in youths with low self-esteem; No significant sex differences
Delinquent behavior							
13	Baerveldt, et al. (2008)	N = 859 (52% boys), age 12–18, two waves (1 year), 16 schools	The Netherlands	Self-reported delinquency	++	++	
14	Burk et al. (2008)	N = 445 (50.6% boys), M age = 10.6, five waves (1 year), community	Sweden	Self-reported delinquency	++	++	Delinquent youths were more often selected as friends.
15	Burk et al. (2007)	N = 260 (50.7% boys), M age = 12.33, SD = 1.36, four waves (1 year), 1 school	Sweden	Self-reported minor delinquency	++	++	Peer influence stronger in reciprocal friendships.
16	Haynie et al. (2014)	N = 1857 (52.2% boys), grade 9–11, two waves (1 year), two large schools	US	Self-reported violence and delinquency	+	+	Violence: selection and influence, but only in girls; Delinquency: selection and influence in girls, marginal selection in boys.
17	Jose et al. (2016)	N = 1284 (49.1% boys), M age = 14.35, SD = 1.72, three waves (6–12 months), 12 small schools; N = 976 (51.5% boys), M age = 15.73, SD = 1.27, three waves (6–12 months), 1 large school	US	Self-reported delinquency	NS/++	++	Selection (only in large school) and influence; Influence stronger in small public schools; Findings were not moderated by structural network effects.
18	Kerr et al. (2012)	N = 847 (59.1% boys), M Age = 14.32, five waves (1 year), community	Western Europe	Self-reported delinquency	+	+	Youths high on psychopathic traits were less influenced; Youths high on psychopathic traits exerted stronger influence; No significant gender differences.
19	Knecht et al. (2010)	N = 544 (55% boys), M age = 12.2, SD = 0.52, 4 waves (3 months), 21 classrooms	The Netherlands	Self-reported delinquency	++	NS	
20	McMillan et al. (2018)	N = 9135 (48.5% boys), 6th and 7th graders, 5 waves (6 months), 2 cohorts in 51 public schools	US	Self-reported delinquency	++	+	Peer influence is significantly greater for girls than it is for boys.
21	Svensson et al. (2012)	N = 1169 (50.4% boys), M age = 13.92, SD = 0.85, two waves (1 year), community	Sweden	Self-reported delinquency	++	++	No significant differences between nonimmigrant and immigrant youths.
22	Tilton-Weaver et al. (2013)	N = 1730 (53.3% boys), age 9–18 years, three waves (1 year), 3 cohorts (early, middle, late adolescence) from community	Sweden	Self-reported delinquency	+	+	Selection stronger when parents communicated more disapproval of adolescents' friends; More parental monitoring of rules, weaker selection;
23	Weerman (2011)	N = 1156 (57% boys), M age = 13.9, two waves (1 year), 10 schools	The Netherlands	Self-reported delinquency	NS	NS/+++	Selection weaker when parents monitor, but only when adolescents did not feel overly controlled. Social influence became non-significant after accounting for changes in morality and self-control.
24	Weerman et al. (2017)	N = 155, M age = 14.37, SD = 0.56, five waves (two weeks), 1 grade	US	Self-reported delinquency	NS	NS	

Externalizing/deviant behavior

(continued on next page)

Table 1 (continued)

	Authors	Study characteristics	Country	Assessment	Peer Effects		Notable additional findings
					Sel.	Infl.	
25	Fortuin et al. (2015)	N = 542 (49% boys), M age = 13.3, SD = 0.50, three waves (3 months), 24 classrooms in 4 schools	The Netherlands	Self-reported externalizing behavior	++	++	
26	Franken, Moffitt, et al. (2016) and Franken et al. (2017)	N = 1,144 (50% boys), M age = 12.7, SD = 0.47, three waves (3–4 months), 2 cohorts in 2 schools	The Netherlands	Self-reported externalizing behavior (antisocial behavior, alcohol use, tobacco use)	++	++	Findings were not moderated by self-control.
27	Franken, Prinstein, et al. (2016)	See Franken, Moffitt, et al. (2016)	The Netherlands	See Franken, Moffitt, et al. (2016)	NS	+	Youths higher on externalizing behavior were more active in selecting friends; Deselection of dissimilar peers for those with higher pubertal development who engaged more in externalizing behavior.
28	Light and Dishion (2007)	N = 1289 (45% boys); 6th grade, 3 waves (1 year), 8 schools	US	Self-reported antisocial behavior	n/a	NS	Influence in 1 out of 8 schools; Mixed evidence that antisocial youths are less often selected as friends.
29	DeLay et al. (2016)	N = 998 (52.7% boys); 6th grade, 2 waves (1 year), three middle schools in high crime neighborhood	US	Self-reported deviant peer-affiliation	NS	NS	In one school (n = 398) youths who took part in the Family-Checkup intervention were less likely to select peers based on similarity in deviant peer affiliation;
Weapon carrying							
30	Dijkstra et al. (2012)	N = 468 (47.9% boys), grade 10, two waves (1 year)	US	Self-reported weapon carrying	NS	++	Youths who carried weapons more active in selecting friends.
31	Dijkstra et al. (2010)	N = 167 high-risk boys, 7th – 9th graders, two waves (1 year), 5 grades in 3 schools	US	Self-reported weapon carrying	NS	++	Youths who carried weapons less active in selecting friends, but more often selected as friends.

Note. Sel. = peer selection based on similarity in behavior; Infl. = peer influence on behavior; NS = not significant; + = conditional significant effect; ++ = unconditional significant effect; US = United States of America; n/a = not applicable.

* These studies used the same sample.

Aggression and violence

As Table 1 indicates, there is a largely support for peer influence effects in the development of aggression and violence, with nine out of twelve studies reporting significant effects. Differences between studies become clearer when zooming in on direct and indirect aggression and accounting for additional variables. One study illustrates this diversity in findings for different types of self-reported aggression (Sijtsema, et al., 2010). Peer influence effects in reciprocal friendships were observed for instrumental, reactive, and relational aggression, but not for similarity in physical, or more direct, aggression. Moreover, the findings from this study suggest that only for instrumental forms of aggression, youths were likely to select peers similar in aggression.

Echoing these findings, two studies that only included direct (i.e., physical) aggression also did not observe peer influence effects (Dijkstra & Berger, 2017; Turanovic & Young, 2016). While accounting for sociodemographic factors, depressive symptoms, verbal ability, impulsivity, and victimization, Turanovic and Young (2016) found no peer influence effects with regard to self-reported violence in older adolescents (age 17 years old). Dijkstra and Berger (2017) accounted for gender selection, gender-composition of the classroom, and perceived popularity, and found no peer influence effects with regard to peer-reported direct aggression in a Chilean sample of young adolescents (age 10–12 years). Gender-composition of the classroom did not affect these findings.

Another study from the same lab and using partly similar data also found no peer influence effects (Dijkstra, Berger, & Lindenberg, 2011). Here, the authors concluded that most peer selection and influence effects in peer-reported direct and indirect aggression were in fact explained by structural network effects, selection on gender, and selection on social status. It should be noted that peer influence was observed in the development of indirect aggression, but this effect became marginal when controlling for selection on similarity in social status (Dijkstra et al., 2011).

When looking at peer selection effects, other studies support these findings on gender and social status selection, showing that similarity in aggression was often unrelated to selecting peers as friends. In fact, directly aggressive youths were less likely to be selected as friends (Logis, Rodkin, Gest, & Ahn, 2013; but see also Rulison, Gest, & Loken, 2013), especially by peers with high social preference (Shin, 2017), which suggests that direct forms of aggression are not preferred by peers and hence also less likely to be adopted. However, using self-reports instead of informants, directly aggressive youths were likely to select similarly aggressive peers as friends (Turanovic & Young, 2016), which could indicate processes related to default selection.

In sum, research with SIENA models seem to find some support for peer influence effects in the development of indirect aggression. Though caution is warranted, as only a few studies included indirect aggression. There are no researchers that report peer influence effects in direct aggression, and similarity in direct aggression is not a criterion for selecting peers as friends. However, findings are somewhat more nuanced when looking at work that has included moderators of peer influence effects.

Moderators of peer influence in aggression and violence

With regard to direct aggression, several studies showed that peer influence effects may depend on differences in gender, age, psychopathic traits, and self-esteem. In one study, peer influence effects in violence were only observed in girls, but not in boys (Haynie et al., 2014). Also, peer influence effects with regard to violence were only observed in the older youths, but not in younger adolescents (Kornienko, Dishion, & Ha, 2018). In other work, youths who rated themselves higher on psychopathic traits compared to their peers were more influential, such that peers were more likely to become similar to them in self-reported violent behavior (Van Zalk & Van Zalk, 2015). Moreover, in that same study, youths with low self-esteem were more likely to change their behavior in the direction of their violent friends. In two other studies researchers showed that antisocial cognitions affected peer influence processes in direct aggression. Focusing on peer-reported bullying as a specific form of direct aggression, adolescents, but not children, were more likely to become more similar to their peers and also select friends who were similar in peer-reported bullying (Sijtsema, Rambaran, Caravita, & Gini, 2014). Moreover, this peer influence effect was somewhat stronger in youths who were more likely to use exonerations for antisocial behavior in general (i.e., moral disengagement). In the other study, researchers examined teacher-reports of a broad measure of aggression, including direct and indirect forms, and showed that preadolescents were likely to become similar in aggression over the course of six months (Molano, Jones, Brown, and Aber, 2013). Importantly, these peer influence effects were stronger for youths with higher hostile attribution biases.

Regarding contextual moderators of peer influence, Rulison et al. (2013) tested whether peer influence effects regarding aggression were further moderated by social status (i.e., rejection and acceptance), but found no support for this. Using a broad measure of peer-reported aggression, another study showed that peer influence and selection were only observed in classrooms with a moderate or strong association between aggression and popularity, thus suggesting that the extent to which aggression is rewarded by peers determines the presence of these social influence processes (Laninga-Wijnen et al., 2017).

To summarize, whether peer influence is observed in the development of aggression, seems to depend on the form of aggression and moderating factors. Studies that report no peer influence effects typically focused on direct aggression. Moreover, studies that have reported peer influence effects in direct aggression or violence either focused on bullying behavior, or suggest that peer influence was only present (or exacerbated) in youths with antisocial traits or in contexts in which aggression was directly linked to social status.

Delinquency

Twelve studies included an examination of peer influence in adolescent delinquency. These studies are rather consistent in their findings, showing that most researchers observed peer influence processes. Moreover, in all studies that we reviewed, delinquency

was assessed with self-reports, thus providing great consistency in reporters of antisocial behavior. In addition, ten studies *also* observed selection based on similarity in delinquency, suggesting that delinquent youths are likely to be attracted to each other over time.

There are some additional relevant findings and differences between studies. Some of the earlier studies using SIENA, analyzed peer influence in delinquency in a Swedish community (Burk, Kerr, & Stattin, 2008; Burk, Steglich, & Snijders, 2007). These studies found support for peer influence and selection effects, showing that adolescents became more similar to their friends in delinquent behaviors over time, and also selected friends who were similar in delinquency. Moreover, these peer influence effects were sometimes stronger in reciprocal friendships (Burk et al., 2007). Other studies partly echo these findings, showing consistent support for peer influence effects in the development of delinquency, but less support for peer selection effects (Baerveldt, Völker, and van Rossem, 2008; Svensson, Burk, Stattin, & Kerr, 2012; Weerman, 2011). Only one study, using a rather broad assessment of delinquency, found no support for peer influence, but instead showed that young adolescents selected peers who were similar in delinquency (Kornienko et al., 2018). This finding was not supported in older youths.

It must be noted though, that accounting for changes in morality and self-control might explain part of these peer influence effects (Weerman, 2011). This suggests that peer influences in delinquency may be preceded by more general changes in attitudes toward delinquency and changes in the ability to resist delinquency (or peer pressures), which could ultimately pave the way for delinquent behavior and peer influence. Moreover, peer influence in delinquency seems to be a process that takes some time before it can be observed. That is, in all except two studies, researchers examined changes in behavior with measurement intervals of sixth months to one year. In the other two studies, shorter time intervals were examined (i.e., three months and two weeks, respectively) and no peer influence effects were observed (Knecht, Snijders, Baerveldt, Steglich, & Raub, 2010; Weerman, Wilcox, & Sullivan, 2017).

Moderators of peer influence in delinquency

Several researchers examined the moderating role of individual characteristics and context. For one, it was found that peer influence and selection effects were stronger in girls compared to boys (Haynie et al., 2014; McMillan, Felmlee, & Osgood, 2018). In addition, there is some support for the notion that social influence effects were moderated by psychopathic traits (Kerr, Van Zalk, & Stattin, 2012). Youths high on the dimensions Callous-Unemotional traits and Grandiose-Manipulative were less susceptible to the influence of delinquent peers, but exerted a stronger influence on their friends. Youths were thus more likely to change their delinquent behavior in the direction of friends who were high on such psychopathic traits.

Focusing on contextual factors, it was found that peer influence effects were unrelated to immigrant status (Svensson et al., 2012), but did depend on school size (Jose, Hipp, Butts, Wang, & Lakon, 2016). That is, social influence effects were stronger in small public schools selection. In contrast, in large public schools (N = 976), the authors found no peer influence effects, but instead showed that youths selected peers who were similar in delinquency. In a Swedish study that included a community cohort, it was found that parental communication affected the strength of peer influence effects in delinquency (Tilton-Weaver, Burk, Kerr, & Stattin, 2013). In delinquent youths, parent's disapproval decreased the strength of peer influence by delinquent peers. Instead, delinquent youths were more influenced by the behavior of non-delinquent peers. However, communicating disapproval could also have unwanted effects, as non-delinquent youths with disapproving parents were more likely to be influenced by delinquent friends over time. Moreover, such processes may be preceded by poor parental monitoring and negative communication about their child's friends, which were associated with youths selecting delinquent friends. These selection effects were particularly salient in older youths.

In sum, studies provide support for peer influence processes with regard to delinquency, though such effects may only be observed over a longer period of time. Moreover, there is consistent support for selection on similarity in delinquency. There are also some indications that peer influence effects depend on both individual characteristics, such as gender and psychopathic traits, and contextual differences pertaining to the size of social network and the parent-child relationship. The latter two both seem to reflect the degree of opportunity for delinquency with poor parenting as a driver for selecting delinquent peers in the first place.

Externalizing behavior

There are six SIENA studies that have included a broad self-reported measure of externalizing or deviant behavior. The majority of these studies, four in total, find support for peer influence effects, suggesting that peers became more similar to their friends in externalizing behavior (Fortuin, Van Geel, & Vedder, 2015; Franken, Moffitt, et al., 2016; Franken, Prinstein, et al., 2016; Franken et al., 2017). In addition, youths were also likely to select friends who were similar in externalizing behavior. However, findings from three of the four studies should be interpreted with caution, as they were from the same lab, using the same sample. In two other studies, researchers found no support for peer influence (Delay, Ha, Van Ryzin, Winter, & Dishion, 2016; Light & Dishion, 2007). One study only observed peer influence in 1 out of 8 schools, but it was not tested whether antisocial youths were more likely to select each other as friends (Light & Dishion, 2007). Moreover, they found that in most schools, antisocial youths were not less popular as friends, or less active in nominating friends, compared to non-antisocial youths.

Moderators of peer influence in externalizing behavior

With regard to individual moderators of peer influence processes, Franken, Moffitt, et al. (2016) and Franken, Prinstein, et al. (2016) looked at the influence of self-control and pubertal development. In both studies, there was no evidence that these factors affected peer influence processes. However, pubertal development was related to peer selection processes, such that youths who were

further in their pubertal development were more likely to maintain friendships with peers who engaged in similar high levels of externalizing behavior (Franken, Prinstein, et al., 2016). At the same time, these youths were more likely to break off an existing friendship with friends who were not similar in externalizing behaviors. In another study, it was examined whether taking part in the Family-Checkup intervention, a program aimed at reducing problem behavior, would affect peer influence processes in youths (DeLay et al., 2016). Although they found no peer influence effects, they showed that, in one out of three schools, youths who took part in the intervention were less likely to select peers based on the similarity in deviant peer affiliation (as a proxy for antisocial peer processes).

In sum, peer influence processes regarding externalizing behaviors are mixed, with outcomes depending largely on the specific sample, or even the specific school in which youths are embedded. So far, peer influence processes, or the absence thereof, on externalizing behavior seem to be unrelated to differences in self-control, pubertal development, and taking part in the Family-Checkup intervention.

Weapon carrying

Although some of the studies that we discussed before also included weapon carrying (or using a weapon) as part of delinquency or externalizing behavior, two studies specifically examined peer group dynamics in weapon carrying (Dijkstra et al., 2010; Dijkstra, Gest, Lindenberg, Veenstra, & Cillessen, 2012). Although the two studies come from partly the same lab, they comprise different samples. Both studies find support for peer influence effects in weapon carrying, suggesting that youths become similar to their friends in weapon carrying. This social influence effect was present in more intimate friendships as well as the in the larger friendship network. Findings were similar in high-risk boys from the US (Dijkstra et al., 2010) and in a general population of boys and girls from the US (Dijkstra et al., 2012). The latter study also showed that social influence processes were equally strong in boys and girls. Weapon carrying thus seems to be the result of social influence and not of social selection. The relevance of status for these processes can be gleaned from the fact that youths who carried weapons were more likely to be selected as friends and less active in selecting friends than those who did not carry weapons.

Discussion

Peer influence processes play an important part in the development of antisocial behavior, especially during adolescence, but studying influence processes was up until recently hampered by the fact that they were difficult to separate from selection and general social network processes. Newer developments in dynamic social network modeling allowed a novel approach to the study of peer influence, by making it possible to test peer influence while accounting for these additional processes. In the last decade, an increasing number of studies have adopted this approach to examine peer influence processes with regard to various forms of antisocial behavior. Based on our review of these studies, we advanced our understanding of peer influence in antisocial behavior in three important ways. First, peer influences in the development of aggression differ for direct and indirect aggression. The few studies that examined indirect forms of aggression, suggest that aggression is adopted from friends. However, the majority of studies examined direct aggression and observed no peer influence effects. Instead, what might look like peer influence is most likely the result of selection processes based on gender and status, especially when individual antisocial traits make it easier to adopt such behaviors. Together, these findings align with the notion that indirect aggression is linked to gaining social prominence, whereas direct aggression is often linked to social rejection and hence less likely to be a characteristic on which youths select or imitate each other.

Second, as expected, peer influence processes were most apparent in the development of delinquency and weapon carrying. Imitating these behaviors from other peers may be seen as instrumental in terms of gaining social status (Dishion & Tipsord, 2011; Moffitt, 1993). It is important to note that these peer influence and selection processes were only observed in studies that used a six-month to one-year interval between the measurements of delinquency, thus suggesting that such processes only become apparent after a certain time.

Third, because of the distinct processes involved in aggression and delinquency described above, findings from studies that included broad measures of antisocial behavior were muddled. For the study of peer influence on antisocial behavior, it thus seems advisable not to use broad container variables, such as “externalizing behavior” and rather test the role of peers separately for different types of antisocial behavior.

What are the next steps?

Although previous work has observed both peer influence and selection processes in the development of antisocial behavior (see also Gallupe et al., 2018), it remains largely unclear what the major drivers of these peer dynamics are. In the following, we offer a theoretical outline for future advance in this direction, by suggesting that status needs drive selection processes with regard to antisocial behavior and in turn foster peer influence processes. We describe this process for (direct) aggression, as the role of moderators became most apparent for this behavior, but similar processes could also be at play in the development of delinquency and weapon carrying. That is, our review of studies on delinquency showed that certain factors may provide more opportunity for peer influence, for example depending on school size or parental behaviors.

First, most theories on peer influence and antisocial behavior place much emphasis on the role of peer status (Dishion et al., 1996; Moffitt, 1993). In fact, several SIENA studies showed support for the notion that peer processes in the development of direct aggression, are explained by selection based on popularity instead of peers’ aggressive behavior (Dijkstra et al., 2011; Logis et al., 2013;

but see Rulison et al., 2013). Because popularity in adolescence is also associated with antisocial behavior, including aggressive behavior, (Dijkstra et al., 2008), similarity in aggressive behavior seems to be a by-product of a selection based on status. This notion was also illustrated in one study, showing that youths only selected similarly aggressive youths in contexts where this behavior was rewarded with peer status (Laniga-Wijnen et al., 2017). Moreover, work examining peer selection and influence with regard to social status showed that status competition is reduced if higher status members in a group seek each other out as friends and if lower status members are kept from attempts at dethroning higher status members (Dijkstra, Cillessen, & Borch, 2013). This is realized if the high status group becomes the major focus for the lower status youths for wanting to belong. Being accepted is more rewarding if it comes from a member with higher status (Lott & Lott, 1965). This acceptance then depends on lower status youths emulating behaviors and attitudes of the high status members but do not challenge their position (Dijkstra, Cillessen, Lindenberg, & Veenstra, 2010). Selection may thus occur based on social status, and influence processes are a derivative of this process combined with effects of the need to belong. These status and belonging effects may also bring about changes in attitudes toward delinquency and changes in the ability to resist delinquency (or peer pressures), which, in turn, increases the likelihood of being influenced by the higher status peers.

Relatedly, the sequential order of selection and social influence may also be evident in low status youths. Such youths are likely to have a greater need to fit in and do whatever it takes to gain status or approval from peers and are thus more subject to peer influence processes (see Dishion & Tipsord, 2011, but also Rulison et al., 2013). Moreover, such processes may put low status youths at risk for more problematic developments, such as gang involvement (Dishion, Nelson, & Yasui, 2005). In one study, this notion of increased risk for low status youths was directly supported, showing that youths with low self-esteem were more likely to adopt aggressive behaviors from their friends (Van Zalk & Van Zalk, 2015). To our knowledge, there is one study that has tested such a sequential process, showing that youths selected peers who were more similar in academic achievement and subsequently reinforced similarity in academic achievement through peer influence (Gremmen, Dijkstra, Steglich, & Veenstra, 2017). Future work on the development of antisocial behavior should thus aim to replicate such sequential processes.

Thus, both the need for status (Anderson, Hildreth, & Howland, 2015) and the need to belong (e.g., approval, affiliation, or affection) (Baumeister & Leary, 1995; Lindenberg, 2013) seem to be important drivers for these peer dynamics. Both needs are considered to be universal but they play a particularly important role during adolescence. During adolescence, youths become more sensitive to peer evaluation, and peer behaviors often become a guideline for normative and rewarding behaviors (Steinberg, 2008). Fitting in with the larger or popular peer group is thus an important aspect of adolescent life. At the same time, the increasing importance of mating during this period also increases vying for status (Maner, Gaillot, Rouby, & Miller, 2007). Social selection based on status needs is likely to precede peer influence processes driven by belonging needs and there are contextual differences in the extent to which status is associated with antisocial behavior. In short, future research might focus more than it does at present on the potentially important role of status and belonging needs for peer influence processes.

Second, individual and contextual differences may also affect the sequence of peer selection and influence. Again, evidence is limited, but several studies that we reviewed indicate that selection processes were in part driven by demographic differences (e.g., gender; Haynie et al., 2014), differences in pubertal development (Franken, Prinstein, et al., 2016), and parental communication (Tilton-Weaver et al., 2013). Such selection processes may kick-start the observed peer dynamics and further increase antisocial behavior through peer influence. Furthermore, such peer influence processes may be stronger in youths with more antisocial personality traits. Not only were youths with high psychopathic traits more likely to exert influence (e.g., Kerr et al., 2012; Van Zalk & Van Zalk, 2015), youths who had antisocial cognitions were also more likely to adopt antisocial behaviors (Molano et al., 2013; Sijtsema et al., 2014).

Third, our review points out several other lines for future research. It seems worthwhile to consider the possibility that there are combined dynamics between negative forms of selection and influence processes. Some of the earlier presented studies showed that adolescents actively select peers who are similarly high on antisocial behaviors, in particular with regard to delinquency. However, in contrast to active selection processes, in which selection refers to creating new relationships based on similarity or attraction, some studies also hinted at alternative selection processes, namely de-selection and default selection (Turanovic & Young, 2016; Weerman, 2011). The first refers to breaking off existing relationships based on certain characteristics, whereas the latter refers to the process of forming relationships due to a lack of viable alternatives (see Deptula & Cohen, 2004). These processes seem particularly relevant with regard to direct aggressive behaviors, which are less rewarding in adolescence (see Cillessen & Mayeux, 2004). Especially, in the pursuit of status and affiliation, approval seeking can easily backfire when approaching social approval and acceptance as a direct goal rather than dealing with these needs obliquely through praiseworthy behavior (Sheldon, 2004). Being aggressive in order to gain approval can thus be counterproductive. Indeed, cross-sectional studies observed that aggressive youths with poor prosocial skills had limited opportunities for establishing friendships and hence settled for less preferred friendships (Ellis & Zarbatany, 2007; Sijtsema, Lindenberg, & Veenstra, 2010; see also Dishion et al., 1996).

Several studies have also included controls for additional explanations of the development of antisocial behavior in the SIENA framework. That is, while testing for peer influence, researchers included factors such as gender, social status, and self-control to explain both the development of antisocial behavior and that of the social network. We reviewed two studies (Turanovic & Young, 2016; Weerman, 2011) that accounted for a range of additional variables and found no support for peer influence with regard to self-reported violence and delinquency, respectively. Future research may thus want to explore alternative processes related to antisocial behavior development in more detail, when examining peer influence.

Finally, there are several statistical issues that warrant improvement. For one, currently it is not possible to determine effect sizes of social selection and influence effects. Because of this, it is not (yet) possible to determine how important such peer influence effects are in comparison to selection processes or general social network processes, and whether they are for example more important than

other factors related to the development of antisocial behavior, such as personality traits (e.g., impulsivity), parenting, life events, and biological dispositions. Moreover, there is also some discussion about the most optimal models for examining the development of social networks. A recent comparison of SIENA models to another family of dynamic social network models (i.e., Temporal Exponential Random Graph Models [TERGM]) showed that both model types share a similar mathematical core, but that TERGM sometimes outperformed SIENA models (Leifeld & Cranmer, 2016). However, this conclusion was tentative and in all cases, SIENA models outperform standard regression or multilevel level models, because it can account for higher-order network structures (e.g., triadic relationships between individuals in the network). Thus, when one is interested in the evolution of social networks and the underlying processes, it is recommended to use actor-oriented models, such as SIENA (Block et al., 2017). As of yet, there are no studies using TERGM to study peer influence in the development of antisocial behavior, but it would be important to examine whether these models yield similar findings.

Without going into detail, our review highlights several other aspects that may be included in future research to shed more light on peer influence processes. For one, we observed a lack of studies that specifically included a test for gender differences. Although most studies accounted for selection on gender, only a handful of studies tested whether peer influence differed between adolescent boys and girls, and findings from these studies were mixed. Moreover, most work focused on unilateral (best) friendships, without testing whether certain peer influence processes differed between unilateral and reciprocal friendships (with one notable exception: Burk et al., 2007). Furthermore, as suggested by Weerman et al. (2017), the time frame within which peer influence takes place may play an important role. For example, for studying the development of delinquency, a few weeks may be too short, whereas time lags of one year may result in so much change in behavior and relationships that important dynamics are missed. Unfortunately, there is little variance in the time between intervals across the studies that we reviewed. When setting up new research designs the time lag between measurements should thus be explicitly considered.

Conclusion

The advance that has been made in the past decade has increased our understanding of peer influence processes in adolescent antisocial behavior: influence processes differ for different forms of antisocial behavior, and status and belonging needs are likely to be important drivers of these dynamics. At the same time, our review also generates many new questions. To answer some of the most pressing questions, we suggest a more comprehensive analysis of the possible sequential order of peer selection and influence processes. The sequence may be especially influenced by need-related processes and thus attention to the role of status and belonging needs seems particularly warranted. Understanding these dynamics may also be important for effective interventions in the development of antisocial behavior in youths who are at risk (Gest et al., 2011). Importantly, it seems pivotal to account for the different peer processes for direct aggression compared to delinquency and weapon carrying. Moreover, it may be worth-while to investigate the possibilities for and effects of alternative ways for youths to gain status and belonging (see Ellis, Volk, Gonzalez, & Embry, 2016). When status is associated with prosocial behaviors, instead of antisocial behaviors, group norms may change and support positive social influence processes. Hence, providing youths with alternative, non-antisocial, means for acquiring social status and belonging may be particularly effective in reducing antisocial behavior during adolescence. To this end, more detailed SIENA studies that focus on sequence and need-based dynamics would be welcome.

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