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Avoidance in action: Negative tie closure in balanced triads among pupils over time

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ABSTRACT

We study avoidance tie closure in balance triads among pupils in two Dutch secondary schools using stochastic actor-oriented models (SAOMs). We find that pupils were likely to avoid the friends of those they avoided but not enough evidence is found to either fully accept or refute the idea that pupils disagree with their friends on whom to avoid. Moreover, pupils' migration background does not seem to influence avoidance tie closure in balanced triads. Results are discussed in terms of their theoretical implications. Based on our findings, we elaborate on the possibility of a singular balance promoting effect rather than multiple distinct ones. Limitations are pointed out and future research suggestions are offered.

Introduction

Traditionally the study of social networks has mostly focused on positive relationships[1] among people such as friendship and cooperation ties. Recently, however, interest in negative ties has increased with researchers examining various topics such as inter-ethnic foe and friendship ties between school students (Boda and Néray, 2015), the comparison of negative to positive tie dynamics (Harrigan and Yap, 2017), or the phenomenon of negative and positive gossip at the workplace (Ellwardt et al., 2012). This interest comes as no surprise since negative ties play an important role in classical theories such as balance theory (Heider, 1946) and structural balance theory (Cartwright and Harary, 1956). The importance to include negative ties into the study of networks stems from their influential role in forming attitudes, behaviors, and network dynamics (Labianca and Brass, 2006). The so-called negative asymmetry hypothesis, developed by Labianca and Brass, states that negative ties, compared to positive ones, have a stronger effect on both psychological outcomes, such as life satisfaction and stress, and behavioral outcomes, such as task performance and intergroup conflict. This highlights the need to examine negative ties among people to further our understanding of their antecedents and dynamics.

One prominent area of research has focused on studying the co-evolution of negative and positive tie networks, i.e., how positive ties influence the dynamics and emergence of negative ties and vice versa (Berger and Dijkstra, 2013; Huitsing et al., 2014; Rambaran et al., 2015). Thereby, studies focused, for example, on how a dislike tie from *i* to *j* is more likely to emerge when a friend of *i* already dislikes *j* (Rambaran et al., 2015). Such insights provide preliminary evidence that, to get a better understanding of negative tie dynamics, it is important to consider the positive tie environment, negative ties are embedded in. However, these studies do come with some limitations such as one year time intervals between data collection (Berger and Dijkstra, 2013; Rambaran et al., 2015) which can be related to computational problems when analyzing longitudinal network data. Because relationship patterns go through frequent changes, one year time intervals between separate waves question the assumption of gradually changing networks (Snijders et al., 2010). Furthermore, the use of bully relationships between respondents (Huitsing et al., 2014) might be related to limited generalizability, due to its strong and complex nature (Wójcik and Flak, 2019).

The present research studies avoidance tie closure in balanced triads among pupils over the course of one year. Triads are sets of three people in a network being connected with each other through ties. The avoidance network consists of pupils nominating others who they avoid having contact with (i.e., a directed tie). We argue that such a network is particularly suitable for studying negative tie dynamics because, for an average person, a negative sentiment is likely to result in the creation of

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[1] Hereafter, the term 'tie' will be used to refer to relationships.

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social distance (i.e., avoidance) between them and the person they hold negative sentiments for (Harrigan and Yap, 2017; Labianca and Brass, 2006). Additionally, stronger versions of negative ties, such as bullying and harming others, occur rather infrequent (Huitsing et al., 2014; Huitsing and Veenstra, 2012) and can be described as highly complex relationships (eg., bullies are often friends with victims as well (Wójcik and Flak, 2019)). Hence, these stronger versions might be special cases of negative ties. Avoidance, on the other hand, is a rather straightforward relationship and captures the kind of ties that are likely more prevalent in peoples' day-to-day social fabric.

The main theoretical arguments in this study derive from structural balance theory (Cartwright and Harary, 1956). Strucutral balance theory argues that people try to maintain balanced triads where no one experiences structural tension that could potentially force them to change one of their ties. It is said that a triad is balanced if it consists of either three positive ties or two negative ties and one positive tie. Hence, negative tie closure is influenced by the kind of ties a pupil has to others and the kind of ties these others have to third persons. Additionally, social identity theory (Tajfel, 1974; Tajfel and Turner, 1979; Turner, 1975) is used to explain potential interaction effects between balance mechansisms and individual characteristics.

Our research contributes to the discussion of negative tie closure in balanced triads twofold. First, avoidance ties are the strictest test for balance mechanisms because of their low visibility. Recently, researchers compared the visibility of aggression, avoidance, and antipathy ties by analyzing, for example, whether i is more likely to avoid k if i already avoids j who already avoids k (Kros et al., 2021). They argue that aggression ties are more visible by third parties than avoidance ties. Thus, studying avoidance ties provides one of the strictest tests for structural balance theory. Second, we strive to further the current understanding of structural balance theory by incorporating two new perspectives. The discussion about the direction of ties in balanced triads is still ongoing to this day. We argue in favor of using directed ties in combination with an ego perspective to properly account for the underlying social dynamics. Additionally, we test possible interaction effects between pupils' individual characteristics and balance mechanisms which have been largely neglected so far.

This study utilizes a dataset collected in the schoolyear 2017–2018 at two Dutch secondary schools with a total of 228 first year pupils. To better understand network dynamics as they are evolving, three waves of relational data were collected within each class: in the first month of the schoolyear (September), right after the Christmas break (January), and in the last month before the summer break (June). This dataset is particularly useful to test the above outlined mechanisms because it consists of first year students who typically do not know one another before entering secondary school. If they do happen to know each other, the present study is able to control for pupils who were acquainted before becoming classmates. In this way, it is possible to observe network formation in its beginning phase. The negative network of interest, as argued above, is an avoidance network of pupils nominating others who they avoid having contact with. The positive network is a friendship network of pupils nominating others who they consider as a friend. The data is analyzed using longitudinal multivariate social network analysis with the help of the RSiena package (Snijders et al., 2010, 2013). This software allows for the estimation of stochastic actor-oriented models for the co-evolution of negative and positive tie networks while accounting for individual characteristics.

Theory

Structural balance theory (Cartwright and Harary, 1956; Harary, 1953), as an extension of the original balance theory (Heider, 1946), investigates the formation and dynamics of ties across a set of actors. At its core, the theory makes predictions about triads, i.e., relationship structures consisting of three people. It is assumed that people strive to maintain balanced and stable triads because imbalanced triads create cognitive (Heider, 1946) or structural (Cartwright and Harary, 1956) tension and are therefore not sustainable. Triads are balanced if three people are either connected by three positive ties or two negative ties and one positive tie. Conversely, if three people are either connected by three negative ties or two positive ties and one negative tie, the resulting triads are considered imbalanced and unstable.

To date, there is still an ongoing discussion about whether balance mechanisms work in the case of undirected (symmetric) ties, in the case of directed ties, or even in both cases. Whereas earlier network studies have assumed symmetric ties, Cartwright and Harary's (1956) position is that investigating balanced triads with undirected ties clearly limits the theory's applicability. To illustrate, in an empirical context, it is possible for i to direct a negative tie to j while j does not direct a negative tie to i. In contrast, recently researchers acknowledged that balance mechanisms can be observed in networks with either undirected or directed ties (Abell, 2015). A second unresolved and mostly disregarded issue in structural balance research is the case of asymmetrical relations where, for example, i directs a positive tie to j while j directs a negative tie to i. Cartwright and Harary (1956) argue, based on the origins of balance theory (Heider, 1946), that such relations are regarded as imbalanced. For the purpose of the present study, however, asymmetrical relations are included in the analysis because we apply an ego perspective to investigate balance mechanisms. This perspective highlights that decisions about ties are based on the actor's perception of the ties they have to others, and not on their perception of the ties others have to them. Particularly for less visible ties, such as avoidance, incoming ties could be unknown to a person, and therefore do not influence their relational decisions. We argue that this perspective can help to understand conflicting results of prior research. Among other things, Rambaran et al., (2015) inspect negative tie closure in balanced triads and find inconsistent patterns which might be explainable by our proposed ego perspective.

Applying an ego perspective to the arguments of structural balance theory results in two testable predictions (Fig. 1). First, when i has a positive tie to j who in turn has a negative tie to k, i is more likely to direct and maintain a negative tie to k at subsequent timepoints (Hypothesis 1). This has been framed as the *friends' agreement hypothesis* (Rambaran et al., 2015), because two friends agree on their enemy and direct negative ties to the same actor. Second, when i has a negative tie to j who in turn has a positive tie to k, i is more likely to direct and maintain a negative tie to k at subsequent timepoints (Hypothesis 2). This has been framed as the *reinforced animosity hypothesis* (Rambaran et al., 2015), because people disagree with the ones they direct negative ties to and ultimately direct negative ties to that person's friends as well. As already stated above, we apply an ego perspective to investigate balance mechanisms, which means that i needs an outgoing tie to j in order to take into consideration who j has a positive or negative tie to. Furthermore, j needs an outgoing tie to k because i bases their decision on their tie sign to k on who j has outgoing ties to and not on who j has incoming ties from. We make this assumption because balance mechanisms can only play out if i bears in mind or cares enough about the ties they have to others and, further, the ties those others have to third persons. This, we argue, only occurs when ties from i are outgoing ties and the recipients of those ties also have outgoing ties to third persons.

Hypothesis 1. If i has a positive tie to j who has an avoidance tie to k, i is more likely to direct and maintain an avoidance tie to k at subsequent timepoints.

Hypothesis 2. If i has an avoidance tie to j who has a positive tie to k, i is more likely to direct and maintain an avoidance tie to k at subsequent timepoints.

Apart from balance mechanisms, recent literature has documented a wide range of social forces behind directing, breaking, and/or receiving ties in a network of people (Yap and Harrigan, 2015). Therefore, balance mechanisms are unlikely to operate unimpeded without being

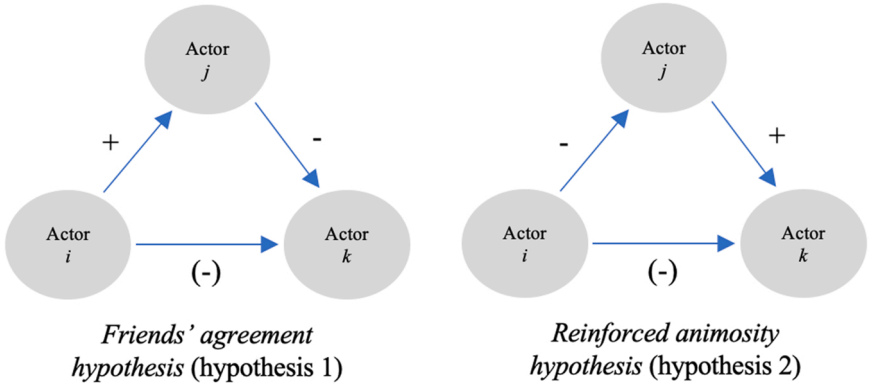


Fig. 1. Hypotheses based on structural balance theory with predictions shown in brackets.

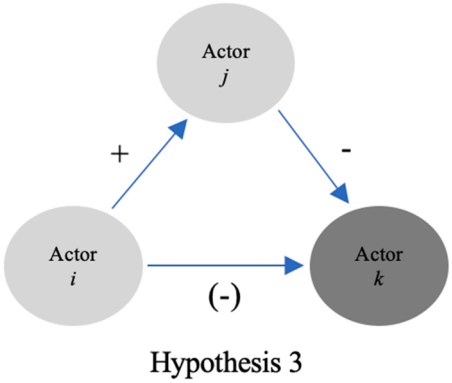


Fig. 2. Hypothesis based on the interaction between structural balance theory and social identity theory with prediction shown in brackets. Different colors represent different migration backgrounds.

influenced by other social dynamics. Based on homophily, people prefer to interact with similar others due to shared norms and knowledge which reduces investment costs in the relationship and increases mutual understanding (Kalmijn, 1998; McPherson et al., 2001). In contrast, ties between people sharing dissimilar characteristics are more demanding and require more investment costs, which increases the probability of a negative tie (Völker and Flap, 2007). Therefore, we argue that avoidance ties are more likely to emerge between people from different groups compared to people from the same group. Additionally, positive ties are more likely to emerge between people from the same group compared to people from different groups. Following social identity theory (Tajfel, 1974; Tajfel and Turner, 1979; Turner, 1975), peoples' ties to other are driven by social categorization, social identity, and social comparison processes. Whereas social categorization refers to the structuring of the social environment in an ingroup and relevant outgroups, social identity refers to a persons' sense of significance and meaning derived from belonging to a particular social group. It is argued that people engage in comparisons between their ingroup and relevant outgroups to construct a positive image of their ingroup and consequently achieve a positive social identity. Such comparison processes are facilitated through ingroup-favoritism (Turner and Reynolds, 2001) and negative behavior and attitudes aimed at outsiders.

With regard to schools, pupils intuitively use ethnic markers to categorize others into belonging to their ingroup or an outgroup (Cameron et al., 2001; Hogg and Abrams, 2006). We argue that student *i* cares particularly about the outgoing ties of student *j,* when they share the same ethnic background. Therefore, we use migration background as a group formation characteristic. Bearing these considerations in mind, we test the interaction between the *friends' agreement hypothesis* and migration background (Fig. 2).[2]

Hypothesis 3. If *i* has a positive tie to *j* who has an avoidance tie to *k*, *i* is more likely to direct and maintain an avoidance tie to *k* at subsequent timepoints, provided that *i* and *j* are both Dutch (non-Dutch) pupils and *k* is non-Dutch (Dutch).

Methods

Data collection and final sample

The present study uses the *ORA Social Network Survey* (Jaspers, 2019), a longitudinal dataset collected in the schoolyear 2017–2018 at three Dutch secondary schools. The focus was on first year students (age 12–13) in order to examine network formation in its beginning phase. The three waves of data were collected in the first month of the schoolyear (September), right after the Christmas break (January), and in the last month before the summer break (June). Potential schools were contacted over the phone and received a concise project overview. If a school consented to participate, they received further information and documents such as the withdrawal consent form that parents were to receive. In addition, each pupil participated voluntarily and could decide not to partake or skip questions. For each wave, pupils filled out an online survey which took about 45 min (one lesson). During each day of data collection, a team of researchers made sure that everyone understood all aspects of the survey and could login with their own credentials. The questionnaire was made up of two parts. The first part consisted of peer nomination questions and required pupils to list as many classmates as they wanted for different types of ties, such as friendship, esteem, dislike, or avoidance ties. The second part consisted of more conventional type questions such as information about gender or parents' country of birth. For the questionnaire of the second and third wave some questions about time-invariant information were excluded.

Participating schools were one high level school track ('gymnasium'), one intermediate level school track ('Havo/VWO'), and one low level school track ('praktijkschool'). Excluding the lowest level school track,[3] a total of 233 first-year students were enrolled in the other two

[2] The current RSiena version does not include a parameter to model the interaction between the *reinforced animosity hypothesis* and migration background.

[3] There were two reasons for excluding the 'praktijkschool''. First, this type of school followed a very different educational system aimed at teaching more practical skills. Additionally, pupils did not stay within the same class which led to peer nomination questions being asked about all pupils in ones' year group. Second, there were a lot of pupils who did not participate in wave two (about 45%) and some student IDs could not be matched from wave two to wave three.

schools, spread out over nine classes. Two of the students withdrew their consent and, thus, were excluded from the survey. Furthermore, three students were excluded from the sample because they joined the secondary schools after the second wave and could only be nominated during the third wave. Therefore, the final sample consisted of 228 first-year pupils who participated in all three waves and could be nominated by their classmates.

Table 1 shows that the number of pupils who did not participate in a certain wave increased over the course of the year with a peak of 17.5% for the overall sample in wave three. In that regard, missing information represents pupils who agreed to participate but were absent from school during the day of data collection. Such wave non-response issues (Huisman and Steglich, 2008), where peer nomination information of some respondents is only available at certain waves, can lead to model convergence issues in longitudinal network studies. However, low levels of missing data, as in our case, are manageable within the framework of stochastic actor-oriented models when using the Methods of Moments estimation procedure (Huisman and Steglich, 2008; Krause et al., 2018). In general, the influence of missing ties on the estimation results is minimized by only taking non-missing data into account for the final parameter values.[4] Gender and migration background information was missing for a total of 11 pupils. For the estimation process, missing covariate data are treated by imputing the mean value of the variable (Ripley et al., 2021). However, for calculating the final parameter values, cases with imputed values are not considered.

Measures

Dependent variable

The *avoidance* network was measured with a peer nomination question. Each pupil received a list with the names of all classmates, asking them to nominate as many classmates as they wanted. Avoidance was measured with two questions: First, pupils were asked to nominate classmates whom they avoided working with on a school project. Second, pupils were asked to nominate classmates whom they avoided sitting next to during lunch. For both questions, nominations were coded as 1 and non-nominations were coded as 0 to construct directed networks. We generated a composite network measure of both of these independent networks in order to capture the overall tendency of pupils avoiding each other. This overall avoidance network had the value 1 if a pupil avoided one of their classmates in any of the two independent avoidance networks, and the value 0 otherwise. Theoretically this is more applicable to our case because we were not looking for a measure capturing either an academic aptitude or leisure avoidance.

In order to test the extent of overlap and pupil similarity between the two independent avoidance networks, we calculated Jaccard indices and in- and outdegree correlations (Jaccard, 1908; Szell et al., 2010). The amount of overlap between the two networks is displayed by the Jaccard index measuring whether the same actors in one network are also connected in the other. On the other hand, in- and outdegree correlations are an actor-level similarity measure correlating the in- or outdegree of actors in one network with the in- or outdegree of actors in the other. As presented in Table 2, the average Jaccard index across all waves was 0.43, indicating that about half of existing ties between pupils existed in both networks. Even though there is no rule of thumb for a high enough value, researchers determined that values of about 0.5 are rather high regarding the overlap between distinct networks (Vörös and Snijders, 2017). Additionally, the average indegree correlation across all waves was 0.76 and the average outdegree correlation across all waves was 0.62. These measures indicated that pupils displayed more similarity with regard to sending avoidance ties than receiving them in the two networks. Concluding, the results of the Jaccard indices and in- and outdegree correlations, paired with theoretical reasons in favor of combining the two independent avoidance networks, provided support for our decision of using a composite avoidance network measure (cf. Kros et al., 2021).

Table 1
Final sample size, actual sample size, and missings per wave and per school for peer nomination questions.

		Wave 1		Wave 2		Wave 3	
	Sample	*N*	Missing (%)	*N*	Missing (%)	*N*	Missing (%)
School 1	142	133	9 (6.3)	120	22 (15.5)	113	29 (20.4)
School 2	86	84	2 (2.3)	76	10 (11.6)	75	11 (12.8)
Total	228	217	11 (4.8)	186	32 (14.0)	188	40 (17.5)

[4] For more information on how missing tie data is treated in stochastic actor-oriented models, please refer to the fourth method as described in Huisman and Steglich (2008).

Predictor variables

In order to test the *balance* mechanisms, three balance effects and two imbalance effects were included in the model that capture the dependency of one type of network on the other (see Table 3). The first balance effect (friendship agreement to avoidance) was included to capture the tendency of actors directing and maintaining avoidance ties to alters to whom their friends had existing avoidance ties. The second balance effect (reinforced animosity) was included to capture the tendency of actors directing and maintaining avoidance ties to friends of those they avoided. The third balance effect (friendship agreement to avoidance jumping migration background) was included to capture the tendency of actors directing and maintaining avoidance ties to alters to whom their friends had existing avoidance ties, provided that the focal and mediating actor had the same migration background, and the target actor had a different migration background. Analogous to Rambaran and colleagues (2015), we also included two imbalance effects in order to observe if replacing the hypothesized avoidance ties with friendship ties resulted in negative effects. This change of ties resulted in two imbalanced triads which are considered unstable and should therefore not be sustainable. The first imbalance effect (avoidance agreement to friendship) was included to capture the tendency of actors directing and maintaining friendship ties to friends of those they avoided. The second imbalance effect (reinforced friendship) was included to capture the tendency of actors directing and maintaining friendship ties to alters to whom their friends had existing avoidance ties.

To test Hypothesis 3, we constructed the variable *non-native migration background* using the self-reported measure of pupils' parents' country of birth. Following the definition of Statistics Netherlands (Centraal Bureau voor de Statistiek, 2021), a binary variable was created that distinguished between native Dutch and non-native Dutch pupils. Pupils were considered native Dutch if both their parents were born in the Netherlands or at least one parent with missing information of the other parent. In contrast, all other cases were treated as non-native pupils: both parents born outside the Netherlands, one parent born

Table 2
Jaccard index and in- and outdegree correlations between the 'avoid school project' and 'avoid lunch' networks, averaged across the nine classes, for each wave separately.

	Wave 1	Wave 2	Wave 3
Jaccard index	0.384	0.482	0.430
Indegree correlation	0.790	0.754	0.725
Outdegree correlation	0.516	0.704	0.644

Table 3
Summary of parameters, their interpretation, and graphical representation.

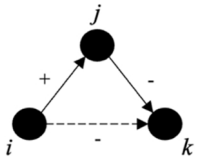
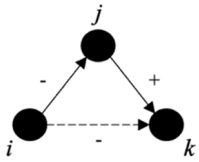
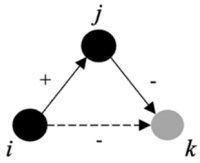
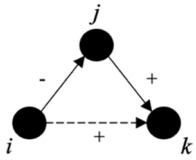
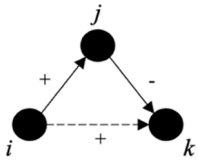
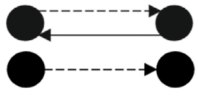
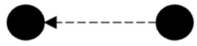
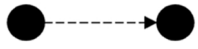
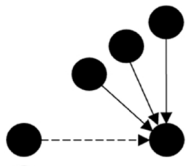
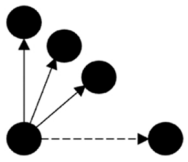
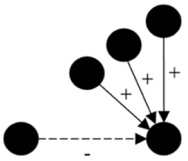
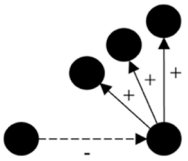
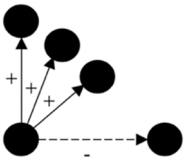
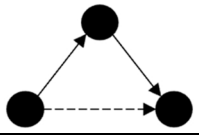
Parameter	Interpretation (RSiena short name)	Graphical representation
Predictor parameters		
riendship agreement to avoidance (B)	Pupil *i* and friend *j* agree on who they avoid (*k*) (to)	
Reinforced animosity (B)	Pupil *i* directs avoidance ties to the friends (*k*) of those they avoid (*j*) (cl.XWX)	
Friendship agreement to avoidance jumping migration background (B)	Pupil *i* and friend *j* agree on who they avoid (*k*), provided that they have the same migration background and *k* has a different one (jumpWXClosure)	
Not-hypothesized imbalanced parameters		
Avoidance agreement to friendship (I)	Pupil *i* directs friendships ties to the friends (*k*) of those they avoid (*j*) (to)	
Reinforced friendship (I)	Pupil *i* directs friendship ties to someone who is avoided (*k*) by a friend (*j*) (cl.XWX)	
Control parameters		
Reciprocity	Pupil *i* reciprocates ties to others (recip)	
Covariate ego	Pupil *i* sends more ties due to a higher (lower) value on a covariate (egoX)	
Covariate alter	Pupil *i* receives more ties due to a higher (lower) value on a covariate (altX)	
Covariate dyad	Pupil *i* sends ties to others due to similarity (dissimilarity) in an attribute (sameX)	
Known prior	Pupil *i* directs ties to others due to knowing them before entering secondary school (X)	
Indegree-avoidance	Pupils with many incoming ties receive many (more) (inPop)	
Outdegree-avoidance	Pupils with many outgoing ties send many (more) (outAct)	

Table 3 (*continued*)

Parameter	Interpretation (RSiena short name)	Graphical representation
Avoidance popularity on friendship popularity	Pupils avoid others who are nominated by many pupils as friends (inPopIntn)	
Avoidance popularity on friendship activity	Pupils avoid others who nominate many pupils as friends (inActIntn)	
Avoidance activity on friendship activity	Pupils avoid others if they nominate many as friends (outActIntn)	
Transitive triplets	Pupils are likely to close 2-paths (transTrip)	

Note: Solid lines represent the initial tie arrangement that was observed at the starting point of the estimation; dashed lines represent ties that were formed or maintained after the estimation procedure was completed; B = balanced triad, I = imbalanced triad; control variables were included for the avoidance and friendship network; The control variables ego, alter, and dyad were included for both covariates male and non-native migration background.

outside and missing information of the other, and one parent born in the Netherlands and the other outside. Cases where pupils' parents' country of birth was missing for both parents were treated as missings. Table A1 shows the ethnic composition of all classes.

Control variables

The following four effects were included in the model to capture the tendency of actors to form and maintain ties. *Outdegree* was included to capture the general tendency of actors to direct and maintain ties to others. This control variable has the function of a constant in traditional regression models. *Reciprocity* was included to control for the tendency to reciprocate avoidance ties. Even though negative ties, compared to positive ones, are less likely to be reciprocated, research generally supports the finding of some reciprocity in negative networks and even in avoidance networks (Boda and Néray, 2015; Harrigan and Yap, 2017; Huitsing et al., 2012). Furthermore, we included two degree-related effects to control for the tendency of actors who receive many avoidance nominations to receive many (more) over time (*indegree-avoidance*), and for the tendency of actors who avoid many alters to avoid many (more) over time (*outdegree-avoidance*).

The covariate selection effects *ego*, *alter*, and *dyad* were included for the covariate male. The individual ego and alter effects capture the impact of gender on tie creation or maintenance (ego) and tie reception (alter). Therefore, they control for the likelihood that boys or girls either create or receive more avoidance ties. The dyadic effect captures the impact of ties being created or maintained due to ego and alter sharing similar gender and thus controlled for homophily effects. Additionally, ego, alter, and dyad effects were also included for the covariate non-native migration background. Lastly, the dyadic covariate *known prior* was included to control for pupils knowing each other before the first timepoint of data collection. It was measured with a peer nomination question asking pupils to nominate the classmates they knew before they

came to their current school.

Apart from dyadic effects, three *multiple network effects* were included in the model to safeguard against incorrect findings regarding our balance effects (Boda, 2018). First, the tendency to avoid those pupils who are nominated as friends by many others (inPopIntn). Second, the tendency to avoid those pupils who nominate many pupils as friends (inActIntn). Third, the tendency to avoid many pupils if someone simultaneously nominates many as friends (outActIntn).

Although our focus is on avoidance, we need to include the friendship network in the model in order to test the balance effects. As a result, all of the abovementioned control variables were also included as covariates in the friendship network.

Analysis

Analyses were performed using stochastic actor-oriented models with the package RSiena (Simulation Investigation for Empirical Network Analysis) in R that allowed for the investigation of the avoidance and friendship networks over the three waves (Snijders et al., 2010, 2013). Simultaneously, this approach allowed to control for individual characteristics, such as pupils' gender or migration background. First, individual analyses were performed in each of the nine classes separately.[5] These individual models were re-estimated until the *t*-ratios of convergence for all effects were below 0.1 and the overall maximum convergence ratio[6] was below 0.25 (Ripley et al., 2021).

In order to summarize the results of the nine independent analyses, the built-in meta-analysis method in the RSiena framework was applied (Siena08; Snijders and Baerveldt, 2003). This approach used an iterative weighted least squares (IWLS) method,[7] first established by Cochran (1954), which provided the weighted average parameter effects across the nine classes. However, because we only looked at nine classes, the assumption that they were a random sample originating from the population of Dutch secondary schools might be too overzealous. Therefore, we also reported the test statistic of Fisher's method for combining independent *p*-values (Fisher, 1932). Fisher's method tested each parameter with two independent one-sided hypotheses with the alternative hypothesis stating that a parameter either had a positive or a negative effect in at least one of the nine classes (Ripley et al., 2021). Our hypotheses were evaluated on the basis of the results of both of these tests. If the weighted average parameter as well as Fisher's method provided significant evidence in favor of a hypothesis, and Fisher's method was not significant in the not-expected direction in a single class, we consider this convincing evidence for that hypothesis. This case showed that the hypothesized effect corresponded to a general pattern throughout the nine classes. If the weighted average parameter was not significant but in the expected direction plus Fisher's method showed significance in the expected direction in at least one class and no significance in the not-expected direction in a single class, we cannot completely refute a hypothesis. We cautiously interpret cases like this because, given the relatively low power of each class (class sizes range between 20 and 30 pupils), finding a significant result even in one class provided not enough evidence for a rejection if it is not disconfirmed explicitly by significant effects in other classes in the opposite direction. Additionally, a significant effect in one class might also emerge due to class-specific mechanisms or due to coincidence further stressing the importance of a careful interpretation. If none of the two tests was significant as expected by a hypothesis, we found no support for a hypothesis.

Lastly, to assess and compare the importance of the friend's agreement to avoidance and reinforced animosity effects on actor decisions, we calculated the relative importance of parameters following the procedure developed by Indlekofer and Brandes (2013). This statistic is comparable to an effect size measure capturing the influence of each effect on actor decisions of creating or dissolving ties. The sum of the relative importance of all effects equals one. Therefore, a value of 1 indicates that the actor's choice to create or dissolve a specific tie from one time point to the next is determined solely by the value of this effect. The relative importance was calculated for each class independently with the *sienaRI* function. Because it is not implemented yet to calculate if two effects operate at similar levels, this analysis allows us to get a feeling of the weight an effect has on actor decisions. This procedure is slowly getting adopted by social network scholars to facilitate the interpretation and comparison of effects (Rambaran et al., 2020; Schaefer et al., 2022).

Results

Descriptive results

Table 4 presents the descriptive results of the avoidance, friendship, and known prior networks as well as individual variables, averaged across the nine classes, for each wave separately. As expected, the friendship network was denser than the avoidance network, with an average density of 28.1% compared to 19.8%, across all classes and waves. On average, pupils considered about 6.7 of their classmates as friends, avoided about 4.5 of their classmates, and were acquainted with about 2.3 of their classmates before entering secondary school (average class size was 25). Furthermore, 145 (66.8%) pupils were native Dutch, 72 (33.2%) pupils had a migration background, and 98 (45.2%) were girls.

With regard to the Jaccard index, indicating the amount of change between subsequent waves, values of 0.3 or higher are preferable for good estimation (Ripley et al., 2021; Snijders et al., 2010). Avoidance networks showed an average of 0.307, with values ranging from 0.192 to 0.505 across the nine classes. Friendship networks showed an average of 0.561 with values ranging from 0.457 to 0.675 across the nine classes. Therefore, both networks displayed good stability. Even though a few avoidance networks showed rather small Jaccard indices, there were no problems with regard to model convergence. Table A3 in the online Supplementary Material shows a more detailed, class-wise depiction of descriptive statistics.

Explanatory results

Table 5 reports the results of the IWLS method and Fisher's method for combining individual *p*-values for each parameter included in the meta-analysis.

[5] See Note A2 in the online Supplementary Material for a concise note on steps taken to reach convergence in the nine independent classes.

[6] RSiena models network evolution based on the Method of Moments in a three-phase process where a Markov process simulates actor decisions through microsteps, thereby generating parameters which are subsequently compared to the observed parameters. The algorithm repeatedly goes through this process to search for the parameter values where these deviations average out near zero. Because this algorithm is of stochastic nature, results from repeated model runs can vary. As suggested, the estimation process for the final model was repeated at least once to make sure that the results stemmed from a stable run of the estimation algorithm. The *t*-ratio combines the average parameter deviation and the standard deviation of it. The overall maximum convergence ratio is the maximum value of the average deviation divided by the standard deviation of the deviations. For more details on the RSiena algorithm and estimation see Snijders (2001, 2005).

[7] Goodness of fit measures are not yet available for this method (Snijders and Baerveldt, 2003). Therefore, we conducted goodness of fit analyses on the independent nine classes to see how well our models reproduce auxiliary statistics of the observed data which were not explicitly fit in the model (Lospinoso and Snijders, 2019). Overall, we plotted 72 goodness of fit auxiliary statistics and about 75% indicated a good fit (55 out of 72 indicators). Please consult figure A4-A21 in the online supplementary material for the corresponding figures.

Table 4
Descriptive statistics of the network measures and individual attributes (N = 228).

		Wave 1		Wave 2		Wave 3		Jaccard index[a]
		Mean	S.D.	Mean	S.D.	Mean	S.D.	
Avoidance	Density[b]	0.191	0.062	0.205	0.103	0.199	0.130	0.307
	Degree[c]	4.487	1.157	4.667	1.855	4.421	2.381	
Friendship	Density	0.319	0.065	0.266	0.067	0.258	0.073	0.561
	Degree	7.647	1.399	6.362	1.545	6.214	1.659	
Non-native migration background[d]		0.332	0.174					
Male[e]		0.548	0.145					
Known prior[f]	Density	0.085	0.046					
	Degree	2.254	2.708					

Note: Mean is an average across the nine classes, standard deviation represents the degree to which means vary across the nine classes.
[a] Jaccard index was calculated as the fraction of stable ties relative to stable ties plus all new and lost ties.
[b] Density was calculated as the ratio of the number of ties to the number of possible ties.
[c] Degree was calculated as the out-degree, representing the number of alters, pupils nominated.
[d] Non-native migration background was coded 1 = non-Dutch migration background, 0 = native Dutch.
[e] Male was coded 1 = male, 0 = female
[f] Known prior was coded 1 = pupils knew each other before entering secondary school, 0 = pupils did not know each other before entering secondary school.

Balance effects

With regard to balance effects, Hypothesis 1 was tested with the parameter 'friendship agreement to avoidance'. In contrast to our expectation, there was no overall effect of pupils directing and maintaining avoidance ties to others to whom their friends had existing

Table 5
Results of the meta-analysis of independent SIENA multivariate network analyses: Iterative weighted least squares (IWLS) method and Fishers' method for combining independent p-values (N = 228).

	IWLS			Fisher's positive test			Fisher's negative test		
	Mean	s.e.	p (2-sided)	X^2	d.f. [a]	p (1-sided)	X^2	d.f. [a]	p (1-sided)
Avoidance network:									
Friendship agreement to avoidance (B)	0.151	0.072	0.069	44.875	18	< 0.001	8.612	18	0.968
Reinforced animosity (B)	0.093	0.015	< 0.001	88.467	16	< 0.001	5.319	16	0.994
Friendship agreement to avoidance jumping migration background (B)	-0.004	0.153	0.980	20.992	16	0.179	20.668	16	0.192
Control parameters:									
Outdegree (density)	-2.194	0.214	< 0.001	0.064	18	1.000	318.238	18	< 0.001
Reciprocity	0.380	0.092	0.003	44.623	18	< 0.001	5.630	18	0.997
Indegree-avoidance	0.049	0.029	0.130	43.805	18	< 0.001	11.087	18	0.891
Outdegree-avoidance	0.076	0.012	< 0.001	181.124	16	< 0.001	0.046	16	1.000
Transitive triplets	-0.065	0.049	0.226	13.375	18	0.769	66.739	18	< 0.001
Avoidance popularity on friendship popularity	-0.307	0.270	0.460	1.753	4	0.781	7.233	4	0.124
Avoidance popularity on friendship activity	0.039	0.174	0.830	19.339	16	0.251	18.258	16	0.309
Avoidance activity on friendship activity	-0.164	0.107	0.169	11.115	16	0.802	25.419	16	0.063
Male ego	-0.076	0.097	0.459	12.497	18	0.821	27.415	18	0.072
Male alter	0.081	0.113	0.495	33.430	18	0.015	20.658	18	0.297
Same male	-0.252	0.136	0.101	8.229	18	0.975	48.205	18	< 0.001
Non-native migration background ego	-0.123	0.113	0.309	10.918	18	0.898	27.569	18	0.069
Non-native migration background alter	0.032	0.132	0.817	21.358	18	0.262	20.718	18	0.294
Same migration background	-0.068	0.137	0.632	15.953	18	0.596	24.605	18	0.136
Known prior	-0.188	0.105	0.110	8.129	18	0.977	30.324	18	0.034
Friendship network:									
Avoidance agreement to friendship (I)	0.108	0.048	0.057	18.412	16	0.300	12.816	16	0.686
Reinforced friendship (I)	-0.123	0.033	0.008	3.353	16	1.000	41.746	16	< 0.001
Control parameters:									
Outdegree (density)	-0.977	0.325	0.017	6.6509	18	0.993	48.816	18	< 0.001
Reciprocity	0.740	0.161	0.002	86.243	18	< 0.001	1.365	18	1.000
Indegree-friendship	-0.096	0.034	0.023	6.827	18	0.992	42.320	18	< 0.001
Outdegree-friendship	0.023	0.021	0.293	43.561	18	< 0.001	15.777	18	0.608
Transitive triplets	0.178	0.014	< 0.001	168.637	18	< 0.001	0.063	18	1.000
Friendship popularity on avoidance popularity	-0.273	0.182	0.208	7.171	10	0.709	11.444	10	0.324
Friendship popularity on avoidance activity	-0.041	0.163	0.815	8.739	10	0.557	8.350	10	0.595
Friendship activity on avoidance activity	0.029	0.086	0.754	10.738	12	0.552	7.955	12	0.789
Male ego	-0.008	0.194	0.967	23.280	18	0.180	23.595	18	0.169
Male alter	0.050	0.143	0.734	25.396	18	0.114	19.571	18	0.357
Same male	0.485	0.165	0.019	73.276	18	< 0.001	5.185	18	0.999
Non-native migration background ego	0.096	0.137	0.505	20.698	16	0.190	12.236	16	0.728
Non-native migration background alter	0.041	0.143	0.782	19.317	18	0.373	18.165	18	0.445
Same migration background	-0.188	0.111	0.128	9.657	18	0.943	36.221	18	0.007
Known prior	0.556	0.111	0.001	69.443	18	< 0.001	2.139	18	1.000

Note: Rate effects were included in the model but omitted from the table; mean represents a weighted average across the nine classes and is approximately normally distributed (Ripley et al., 2021); Fisher's test statistic has a chi-squared distribution with 2 N degrees of freedom, where N represents the number of independent analyses (Snijders & Bosker, 1999, p. 36); B = balanced triad, I = imbalanced triad.
[a] Degrees of freedom can differ because parameters might be fixed in some classes due to multicollinearity or convergence issues (Ripley et al., 2021).

avoidance ties. However, Fisher's method showed a positive effect ($X^2 = 44.875$, d.f. $= 18$, $p < 0.001$), suggesting that if i had a friendship tie to j who had an avoidance tie to k, i was more likely to direct and maintain an avoidance tie to k at subsequent timepoints in at least one class. Therefore, we can neither fully refute nor accept Hypothesis 1. Hypothesis 2 was tested with the parameter 'reinforced animosity'. In line with our expectations, pupils were more likely to direct and maintain avoidance ties to friends of those they avoided (M = 0.093, s.e. = 0.015, $p < 0.001$). If i had an avoidance tie to j who had a friendship tie to k, i was more likely to direct and maintain an avoidance tie to k at subsequent timepoints. Moreover, the results of Fisher's method showed no negative effect in a single class. Concluding, these results provided good evidence in support of Hypothesis 2. Hypothesis 3 was tested with the parameter 'friendship agreement to avoidance jumping migration background'. In contrast to our expectation, there was neither an overall effect nor an effect in at least one class. If i had a friendship tie to j who had an avoidance tie to k, i was neither more nor less likely to direct and maintain an avoidance tie to k at subsequent timepoints, provided that i and j have the same migration background and k has a different migration background. Therefore, Hypothesis 3 was not supported. Connecting the results of Hypotheses 1 and 3, in at least one class pupils and their friends were likely to send avoidance ties to a third pupil. This effect, however, was independent of pupils' migration background suggesting that two Dutch (non-Dutch) friends were not likely to both send avoidance ties to a non-Dutch (Dutch) pupil.

It is worth noting that there was neither an overall effect nor an effect in at least one class of the imbalanced parameter 'avoidance agreement to friendship'. However, there was an overall effect of the imbalanced parameter 'reinforced friendship', suggesting that pupils were less likely to direct and maintain friendship ties to others to whom their friends had existing avoidance ties (M = −0.123, s.e. = 0.033, $p = 0.008$). This result is in line with balance theory and provided some additional, ad hoc evidence for structural balance theory in terms of positive relations, or could point at other mechanisms such as rivalry and/or jealousy in friendship triads. This could be the case when two classmates fight over the affection of another classmate or when one classmate is jealous of another one's close friendship (Besag, 2006; Faris and Felmlee, 2011).

Control variables

Control variables are only interpreted for the avoidance network, as this is the focus of this study. There was an overall tendency to reciprocate avoidance ties. Moreover, in at least one class we found an additive effect of avoidance indegree, suggesting that pupils who received many avoidance nominations at one timepoint were likely to receive many (more) at subsequent timepoints. Additionally, there was an overall positive effect of avoidance outdegree. This points towards the idea that pupils who avoided many others avoided many (more) at subsequent timepoints. With regard to transitive triplets, our results showed a negative effect of transitivity in at least one class.

Concerning multiple network effects, our results neither showed an overall effect nor an effect in at least one class of any of the three included parameters. Therefore, neither activity nor popularity in friendship nominations had an effect on sending and maintaining avoidance ties. As evident from the degrees of freedom of the parameter 'avoidance popularity on friendship popularity', it led to multicollinearity issues or did not converge well and had to be fixed in several classes.

Turning to gender, there was no overall ego or alter gender effects, indicating that neither boys nor girls were more likely to send or receive avoidance ties. However, Fisher's method showed that boys were more likely to receive avoidance ties in at least one class. Additionally, Fisher's method showed a negative effect of gender similarity, suggesting that pupils with the same gender were less likely to avoid each other in at least one class.

Concerning migration background ego, alter, and dyad effects, results did not show an overall pattern. This suggested that neither native Dutch nor non-native pupils were more likely to send or receive avoidance ties.

Lastly, there was no overall effect of pupils knowing each other before entering secondary school on sending avoidance ties. However, Fisher's method showed that in at least one class pupils who knew each other before entering secondary school were less likely to direct and maintain avoidance ties to each other.

Relative importance of effects

In general, degree related effects had the strongest influence on actor decisions (see Fig. A22 in the online Supplementary Material for relative importance of all effects). Outdegree, indegree-avoidance, and outdegree-avoidance effects explain at the lower end around 41% (class 6) and at the higher end up to 63% (class 5) of pupils' avoidance decisions. On the other side, multiple network effects, such as balance and avoidance popularity/activity on friendship activity/popularity effects, only explain 12% (class 9) to 36% (class 2) of pupils' avoidance decisions. This implies that a major influence on pupils' decisions whom to avoid is attributable to straightforward degree related effects rather than complex multiple network interdependency effects.

Turning to the reinforced animosity and friends' agreement effects, Fig. 3 displays their relative importance on pupil avoidance decisions for

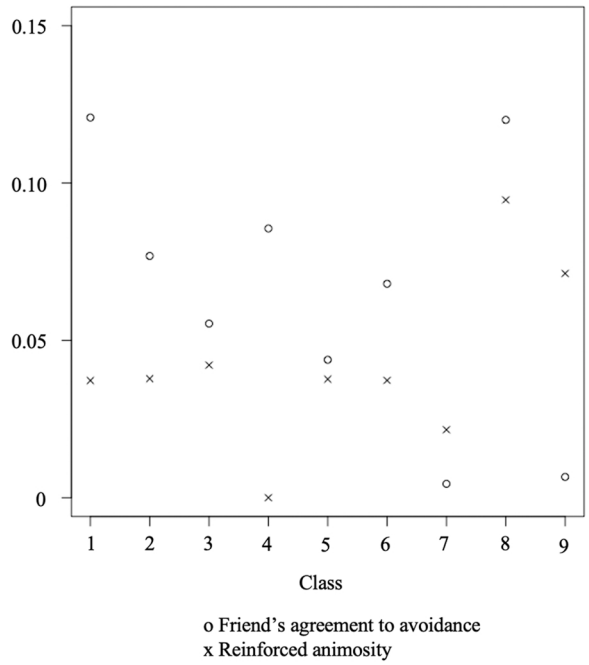


Fig. 3. Relative importance of friend's agreement to avoidance and reinforced animosity effects for each classroom separately, averaged over the three waves. Reinforced animosity had to be fixed in class 4.

each class separately. Except for class 7, the friend's agreement to avoidance effect was more important than the reinforced animosity effect in explaining changes in pupils' avoidance ties. This highlights that it was more important for pupils to adjust their avoidance ties to their friends avoidance ties rather than to the friendship decisions of those they avoided.

Discussion

This study investigated negative relationship closure in balanced triads among pupils over the course of one year. In order to examine everyday instances of negative ties, we studied an avoidance network consisting of pupils nominating others who they avoid having contact with. Based on structural balance theory (Cartwright and Harary, 1956), we expected that friends were likely to agree on whom they avoided (*friends' agreement hypothesis*). Additionally, we expected that pupils were likely to avoid the friends of those they avoided (*reinforced animosity hypothesis*). Furthermore, to get a better understanding of the complex social dynamics which are at the root of avoidance nominations, we studied how balance mechanisms are influenced by social identity (Tajfel, 1974; Tajfel and Turner, 1979; Turner, 1975) and homophily (McPherson et al., 2001) considerations. We expected that pupils were likely to agree on whom they avoided, provided that the focal pupil and their friend shared the same migration background, and the target pupil had a different migration background. These expectations were tested on a sample of 228 pupils of two Dutch secondary schools.

Regarding the triadic expectations of structural balance theory (Cartwright and Harary, 1956), we found the general pattern of pupils ending up avoiding the friends of those they avoided (*reinforced animosity hypothesis*). However, only in at least one class pupils ended up agreeing with their friends on whom they avoided (*friends' agreement hypothesis*). This means we cannot fully refute the hypothesis, but the finding should be interpreted with caution because it could be due to class-specific, not-modeled mechanisms or simply be a random variation. These findings leave us with two possible interpretations of which we side with the second one. First, it could be that our findings are due to the low visibility of avoidance relationships (Kros et al., 2021), even to those that avoidance is directed to (Marineau and Labianca, 2021). If it is the case that pupils do not notice whom their friends are avoiding, there might be neither cognitive (Heider, 1946) nor structural (Cartwright and Harary, 1956) forces at play that could cause a change in imbalanced triadic relationships. Therefore, the resulting image in an actor's mind might be balanced, even though the existing triad is imbalanced (Hummon and Doreian, 2003). In contrast, due to high visibility of friendship relationships, pupils surely notice whom classmates they already avoid are friends with. This difference in the visibility of the relationship between other classmates could potentially explain our lack of support for the *friends' agreement hypothesis*. However, there are two reasons why we object this interpretation. First, it would require a significance test for the difference between the reinforced animosity and friends' agreement balance parameters, which is not currently possible within the RSiena framework. Whether there is some merit in our relationship visibility argument remains to be tested by future scholars. Second, our relative importance of effects analysis showed that, despite the missing overall significant friends' agreement effect, pupils avoidance decisions are stronger influenced by a pattern consistent with friends' agreement in comparison to a pattern consistent with reinforced animosity.

Second, another possibility is that our results are in line with structural balance theory and in need for an explanation in light of previous empirical works on balance theory in natural settings. Generally, recent research found support for both the *reinforced animosity* and *friends' agreement hypothesis* in dislike networks (Berger and Dijkstra, 2013; Rambaran et al., 2015). By comparing counts of triads, the study by Doreian and Krackhardt (2001) produced different results and found more friends' agreement and less reinforced animosity triads. To test if their results hold up to stochastic actor-oriented models, we ran an additional analysis testing our hypotheses with their data which resulted in findings similar to the original study.[8] As evident, research on balanced triads in conjunction with negative relationship closure has fallen short of producing clear-cut and convincing results. A possible reason for that could be that a singular balance promoting effect is split up into two distinct effects without the evidence of doing so. A way to test this assumption would be to run the analysis with two different models. Model 1 would include a singular balance promoting negative relationship triadic closure effect which tests our first and second hypothesis in a single parameter. Model 2 would split up this singular effect into the reinforced animosity and friends' agreement parameters. If the overall model fit significantly improves, there is evidence that negative relationship triadic balance is not driven by a singular effect but rather by two distinct ones. If the overall model fit does not significantly improve, either one of the two distinct effects could be significant simply due to randomness. This would also explain diverging results of previous works on balance theory in natural settings. However, because the current RSiena does not allow to model such dynamic multiple network effects, it is left for future researchers to solve this methodological challenge.

Regarding these two interpretations, we favor the second one. Our visibility argument builds upon the premise that the reinforced animosity and friends' agreement effects are statistically different from each other. In the absent of a formal test, paired with our results regarding the relative importance of these two balance effects, we side with the more conservative interpretation and encourage researchers to further investigate this issue with the help of more advanced methodological tools.

Pertaining to our applied ego perspective to the study of balance mechanisms, we argued that pupils' relationship decisions are based on pupil's outgoing, and not incoming, relationships. We maintain that balance dynamics are more likely to evolve if the focal pupil cares to a sufficient degree about its relationships to others. Prior research on balance mechanisms in natural settings provides partial support for our proposed ego perspective. Rambaran and colleagues (2015) studied balance mechanisms in two U.S. school classes and included four parameters for negative tie closure in balanced and imbalanced triads. Whereas the direction of relationships for the two balanced triads is in line with our proposed ego perspective, the direction of relationships for the two imbalanced triads is not. Their findings show significant negative relationship closure in balanced triads in both schools and inconclusive evidence for the imbalanced triads. Even though we only found support for one of our proposed balance parameters, we still maintain that future research needs to consider this ego perspective in studying balance dynamics. There is a need for more considerate reflections about when the direction of relationships in triadic structures matters, and for which type of negative and/or positive relationship. As for the case of bully and defender triads, the direction of relationships might work in a fundamentally different manner (see Huitsing et al., 2014).

Existing research on structural balance theory has mostly missed out

[8] The data is set up that for each week, every participant ranked all others with regard to affect. Analogous to the original approach, we coded top four ranks as positive relationships, bottom three ranks as negative relationships, and all others as no relationship. Because all individual attributes have been lost, the RSiena model was build up fairly concise with only controlling for degree-related effects and transitivity. Results showed a significant positive friends' agreement effect, participants ended up agreeing with their friends on whom to send a negative relationship to (estimate = 0.301, $X^2 = 4.59$, d.f. = 1, $p = 0.032$). Moreover, results showed a negative reinforced animosity effect, participants were less likely to send negative relationships to the friends of those they send negative relationships to (estimate = −0.406, $X^2 = 11.81$, d.f. = 1, $p < 0.001$). Full table can be retrieved upon request.

on potential interaction effects between different social forces that drive peoples' relationship decisions. Based on social identity theory (Tajfel, 1974; Tajfel and Turner, 1979; Turner, 1975), we tried to further our current understanding of these complex interdependencies and argued that balance mechanisms are interconnected with positive relationships between ingroup members and negative relationships aimed at outgroup members. The cross-sectional evidence of ethnicity effects on negative dyadic relationships generally showed more inter-ethnic negative nominations in dislike networks but more intra-ethnic negative nominations in violence networks (Boda and Néray, 2015; Kisfalusi et al., 2020; Tolsma et al., 2013; Wittek et al., 2020). Our results did not support the idea that pupils agreed with their friends on whom to avoid, provided that the focal pupil and their friend shared the same migration background, and the target pupil had a different migration background. However, this finding could be in line with social identity theory. Because of different investment costs into relationships (Kalmijn, 1998) pupils are likely to generalize outgroup members and individualize ingroup members. Therefore, if the relationship from the focal actor *i* to the mediating actor *j* is negative, with a positive relationship between *j* and *k*, *i* might generalize *j* and *k* and form a negative relationship with *k* as well. In contrast, when *i* has a positive relationship with *j*, *i* treats *j* as an ingroup member and does not automatically form negative relationships with whom *j* holds negative relationships (see Hypothesis 3). Nevertheless, we encourage to follow up on this potentially promising avenue for future research and, based on sound theoretical reasoning, include further explanatory variables to study their interactions with balance mechanisms. We did not explicitly study the role of gender in such interdependent network effects because avoidance networks are rather segregated. However, it might be worthwile for future research to follow up on that.

The findings of our study should be interpreted in light of a few limitations. Even though our findings further our understanding of avoidance tie closure in balanced triads, they are limited to our sample of two Dutch secondary schools. Moreover, they are limited to classmates, which is common in school-based network studies (e.g., Berger and Dijkstra, 2013; Boda and Néray, 2015; Rambaran et al., 2015). Future studies could benefit from larger samples that move beyond classroom networks and incorporate, e.g., relationships between all students within a school, or even relationships within other contexts, such as organizations. While such studies could provide valuable insights, they demand high data quality and also complicate model fit of longitudinal multivariate social network models.

Despite these limitations, we believe to have made a valuable contribution to the existing literature on negative tie closure in balanced triads. Utilizing a three-wave sample of pupils collected in two Dutch secondary schools we add to our understanding of structural balance theory by applying an ego perspective to balance. We showed that adolescents base their decisions on whom to avoid on the friendship patterns of the ones they already avoid. In contrast, the interplay between ethnic considerations and balance mechanisms did not appear to influence adolescents' decisions whom to avoid. To summarize, if researchers want to further the current theoretical understanding of balance mechanisms in natural settings, we propose three avenues for future research. First, further research needs to analytically distinguish between a singular balance promoting effect and multiple distinct ones to uncover the underlying mechanisms of structural balance theory. Second, building on our proposed ego perspective, researchers need to develop more precise arguments about the direction of relationships and how this directionality may or may not induce cognitive or structural strain. Third, we deem it fruitful to further develop potential interaction effects between balance mechanisms and, for example, individual attributes.

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Declarations of Interest

none.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.socnet.2022.03.006.

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