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# From neighbors to school friends? How adolescents' place of residence relates to same-ethnic school friendships

Hanno Kruse[a,*,1], Sanne Smith[b,1], Frank van Tubergen[b,c,e], Ineke Maas[b,d]

[a] University of Mannheim/MZES (Mannheim Centre for European Social Research) , A5 6, 68131 Mannheim, Germany
[b] Department of Sociology/ICS, Utrecht University, Padualaan 14, 3584 CH Utrecht, The Netherlands
[c] ERCOMER (European Research Centre on Migration and Ethnic Relations)/ICS, Utrecht University, Padualaan 14, 3584 CH Utrecht, The Netherlands
[d] Department of Sociology, VU University Amsterdam, De Boelelaan 1081, 1081 HV Amsterdam, The Netherlands
[e] Department of Sociology & Social Work, King Abdul Aziz University, Abdullah Suleiman Street, Al Jamiaa District 80200, Saudi Arabia

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ABSTRACT

This study examines to what extent adolescents' place of residence is related to the opportunities and the preferences to befriend same-ethnic classmates. Analyzing 3345 students within 158 German and Dutch school classes, we find that sharing a neighborhood provides additional meeting opportunities to become friends in class as adolescents are likely to befriend classmates who live nearby them or who live nearby a friend of them (propinquity mechanism). However, this hardly explains why adolescent friendship networks in school classes tend to be ethnically homogeneous. Also, we find no convincing evidence that an adolescent's preference for same-ethnic friends in class varies with the share of outgroup members in his/her neighborhood (exposure mechanism).



## 1. Introduction

A consistent observation over time and space is that friendship networks among adolescents are ethnically homogeneous: From weak to strong types of friendship; and from the Netherlands to Belgium and Germany, Israel and the United States, scholars find that adolescents befriend members of their own ethnicity more often than those of other ethnicities (Baerveldt et al., 2007; Eshel and Kurman, 1990; Hallinan, 1982; Wimmer and Lewis, 2010; Windzio and Bicer, 2013). This nearly universal phenomenon can be considered problematic for ethnically diverse societies as social boundaries between ethnic groups are argued to go hand in hand with negative interethnic attitudes, especially for majority group members (Pettigrew and Tropp, 2006).

The most important setting for adolescent (same-ethnic) friendship may well be the school context. It is here where adolescents spend much of their time interacting with peers. Previous studies examined whether same-ethnic friendship in schools depends on individual characteristics such as sex or socioeconomic status of adolescents (Baerveldt et al., 2004; Fischer, 2008), dyadic characteristics such as sharing similar tastes or opinions (Mayer and Puller, 2008; Smith et al., 2014; Stark and Flache, 2012), and context characteristics such as the percentage of same-ethnic peers in class (Goodreau et al., 2009; Moody, 2001; Kalter and Kruse, 2015). A recent interest in same-ethnic friendship research in this line of possible determinants has been adolescents' place of residence. Because neighborhoods are often ethnically homogeneous and because adolescents often attend schools nearby their homes, the neighborhood's ethnic composition can be held accountable for a potential lack of interethnic friendships in schools: Adolescents might hardly meet outgroup peers in school (Esser, 1986; Huckfeldt, 1983; Karsten et al., 2006; Mouw and Entwisle, 2006; Noreisch, 2007).

Adolescents' place of residence is also argued to relate to same-ethnic friendship choice above and beyond constraining the set of outgroup peers that are available as friends in school. The first argument posits that a neighborhood's ethnic composition affects its residents' same-ethnic friendship preferences. Relying on data of 1589 adolescents in 84 classes in the Netherlands, Vermeij et al. (2009) show that adolescents have a stronger tendency for having same-ethnic social relations in class when they are exposed to fewer ethnic outgroup members in their neighborhood, irrespective of the opportunities they have for same-ethnic friendships within class. In line with intergroup contact theory (Allport, 1954), they argue that getting to know outgroup members in the neighborhood reduces ethnic prejudice, and as such, stimulates adolescents to befriend beyond the boundaries of their own ethnic group in

* Corresponding author. Tel.: +49 621 1812024; fax: +49 621 1812021.
*E-mail address:* hkruse@mail.uni-mannheim.de (H. Kruse).
[1] These authors contributed equally to this work.

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school. We term this effect the *neighborhood exposure effect* on same-ethnic school friendship.

The second argument describes an effect that we term the *neighborhood propinquity effect* on same-ethnic school friendship. The propinquity effect is based on the idea that living in the same neighborhood leads to recurrent meeting opportunities between school peers. In line with Feld's theory of focused organization of social relations (1981), this recurrent meeting in the neighborhood is likely to increase chances of friendship between peers in the school context. When same-ethnic school peers are more often neighbors than interethnic school peers (due to residential segregation), it may consequently explain why adolescents have so many same-ethnic friends in school (Mouw and Entwisle, 2006). In this case, adolescents would not necessarily prefer so many same-ethnic friends, but happened to have befriended these same-ethnic peers due to their neighborhood propinquity.

In this paper we aim to test the neighborhood exposure and neighborhood propinquity effect simultaneously in order to get a better understanding of the importance of adolescents' place of residence for same-ethnic friendship formation in the school class context. Therefore, our research question reads: *How is adolescents' place of residence related to the tendency of having same-ethnic friends in school classes?*

The starting point of this study is to replicate the exposure effect as well as the propinquity effect on same-ethnic school friendship as there is hardly any research devoted to these relations. Replication of the exposure effect is especially important given the conclusions drawn from a closely related field of study: Studies generally find no evidence that mere interethnic exposure leads to less ethnic prejudice or more positive interethnic attitudes because superficial exposure lacks meaningful contact necessary to build positive interethnic experiences (for a review, see Pettigrew and Tropp, 2006). Neighborhood interethnic exposure does not automatically include actual interethnic contact, and as such, the finding that neighborhood interethnic exposure relates to strong positive interethnic contact such as friendship contrasts a large body of research. Therefore, corroboration of Vermeij and colleagues' study is necessary.

Furthermore, we want to test whether the two outlined neighborhood effects work independently of each other: Living close to school peers of a different ethnicity is closely correlated with the ethnic composition of a neighborhood. The exposure effect may therefore not hold when the propinquity effect is taken into account and vice versa. For example, any decrease in the tendency of same-ethnic school friendships with decreasing neighborhood segregation may be due to increased propinquity to outgroup school peers, and not necessarily because general interethnic exposure in the neighborhood reduces ethnic prejudice. In other words: When we observe lower tendencies for same-ethnic friendship in schools among students who live in less ethnically segregated neighborhoods, it is unclear if both propinquity and exposure mechanisms contribute to this observation. Alternatively, one effect may be a spurious effect of the other. The current study therefore provides valuable information on the relation between the ethnic composition of neighborhoods and same-ethnic school friendship by studying the exposure and propinquity effect of the neighborhood simultaneously.

Finally, our study contributes methodologically to the current state of literature in two ways. First, we test our hypotheses using the first wave German and Dutch data from the 'Children of Immigrants Longitudinal Survey in Four European Countries' (CILS4EU) project (Kalter et al., 2014). The CILS4EU dataset contains rich and representative sociometric and attribute data on 9376 students in 493 classes in 244 Dutch and German secondary schools. Not only can we replicate previous work on the subject and extend it to two countries, these data also provide improved measures of the neighborhood and same-ethnic friendship. Second, we account more fully for interdependencies in tie formation commonly found in (adolescent) friendship networks. Although residential segregation is not as pronounced in Germany and the Netherlands as it is in Great Britain or the United States, residential segregation is an issue of concern in Germany and the Netherlands (Musterd, 2005; Musterd and Van Kempen, 2009). For example, in 7% of the Dutch neighborhoods, immigrants make up more than 50% of the inhabitants (StatLine, 2013). Therefore, Germany and the Netherlands are suitable countries to study.

Previous research has used a varied terminology for the tendency for same-ethnic ties in friendship networks. Some scholars use the term 'ethnic homophily' to refer to the observed overrepresentation of same-ethnic friendships without distinguishing how they have developed (McPherson et al., 2001). Other scholars reserve it for the social-psychological preference for same-ethnic friends only (Wimmer and Lewis, 2010). Also, there are notions of 'baseline' versus 'inbreeding' homophily (McPherson et al., 2001), and 'gross' versus 'net' homophily (Moody, 2001) to tell apart the tendency for having same-ethnic friendships uncontrolled and controlled for a particular confounding concept of interest, respectively. We will use the term 'ethnic homophily' to refer to the theoretical concept of same-ethnic preferences. The term 'ethnic homogeneity' is used to denote the overrepresentation of same-ethnic friendships in social networks that we observe.

## 2. Theory

Friendship formation in general has been studied extensively and several theoretical mechanisms have been proposed to explain how friendship choice comes about (Wimmer and Lewis, 2010). In general, we follow an established research tradition that argues same-ethnic friendship to be the outcome of the *preferences* for same-ethnic friends over interethnic friends and the *opportunities* to meet same-ethnic peers in comparison to interethnic peers.

### 2.1. Friendship preferences and the neighborhood exposure mechanism

In line with previous work on homophily, it is argued that adolescents generally strive to befriend similar peers instead of dissimilar peers as they provide social resources, such as moral support and social affirmation (McPherson et al., 2001). Assuming that ethnicity signals or entails specific attitudes, beliefs or interests, it is usually argued that adolescents prefer same-ethnic friendships over interethnic friendships because they expect or find a better match between themselves and members of their group in comparison to members of other groups (Baerveldt et al., 2007; Moody, 2001; Wimmer and Lewis, 2010).

The strength of ethnic homophily, however, is likely to vary among individuals. Whereas ethnic similarity may be an essential friendship requisite for some, ethnicity may not be the characteristic that signals similarity and good friendship to others. The social surrounding, that is the neighborhood, may shape an adolescent's interethnic attitudes in such a way that he/she is more or less willing to choose an interethnic friend.

More interethnic contact in neighborhoods diminishes ethnic prejudice due to increasing opportunities for adolescents to positively experience ethnic outgroup members according to intergroup contact theory (Allport, 1954). As a consequence of reduced ethnic prejudice, peers from another ethnic group may be considered to be not too different after all, or at least not different from a negative perspective. For example, consider two students A and B in the same ethnically diverse school class. Student A lives in an ethnically diverse neighborhood and has interethnic contact when

she plays outside, works in the local supermarket, or babysits for the neighbors who are from a different ethnic group. Going to an ethnically diverse school provides thus familiar interethnic interaction with the result that student A would have little reservation to make interethnic friends in class. Student B, however, lives in a neighborhood with mostly members of his own ethnic group. As such, he may solely interact with same-ethnic classmates because student B is hesitant to engage in non-familiar interaction with ethnic outgroup classmates.

Vermeij et al. (2009) showed evidence for the neighborhood exposure mechanism. They find that adolescents living in neighborhoods with more ethnic outgroup members have a weaker tendency to have same-ethnic friends in school, which results in less ethnic homogeneity in friendship networks observed in school. Although interethnic exposure in neighborhoods can be considered superficial contact, neighborhoods with more outgroup members provide at least more possibilities for interethnic contact than neighborhoods with more ingroup members (Semyonov and Glikman, 2009). Going back to our example, we do not necessarily know if student A really has positive interethnic neighborhood contact, but student A has at least a higher likelihood for it than student B because student B has no opportunity to engage in positive interethnic neighborhood contact in the first place. As such, we aim to replicate Vermeij and colleagues' study by testing that *the larger the share of ethnic outgroup members in the neighborhood is, the weaker the tendency to have same-ethnic friends in class (H1).*

### 2.2. Friendship opportunities and the neighborhood propinquity mechanism

A second set of mechanisms responsible for the prevalence of same-ethnic friendships can be referred to as opportunities for same-ethnic friendship. The chances of meeting same-ethnic peers within schools have been conceptualized as the size of the ethnic ingroup within schools and as the propinquity of adolescents to same-ethnic peers (Wimmer and Lewis, 2010). As we focus on same-ethnic friendship within school classes while taking the class ethnic composition into account (i.e., the relative size of ethnic groups), we will only elaborate on the propinquity aspect and take the class composition as given.[2]

Propinquity refers to the possibilities adolescents have to interact within a given context and these are generally facilitated by any entity through which social behavior is structured, also known as foci (Feld, 1981). Examples of foci within schools that facilitate recurrent meeting of individuals are sharing a class or extracurricular activities like sports and arts clubs (Moody, 2001). These foci lead to more contact between peers above and beyond the opportunity structure for same-ethnic friendship in school. The more frequently school peers meet, the more likely a friendship between them becomes because recurrent encounters let adolescents spend more time together or may even signify a shared interest that adolescents hold.

Neighborhoods can also function as foci around which friendships in school develop. We refer to this as the *neighborhood propinquity mechanism.* For example, peers from the same neighborhood may share the same way to school, or participate in the same activities in a sports club or youth center close to their place of residence. Therefore, friendship between adolescents from the same neighborhood is more likely than friendship between adolescents who only share the same school. Mouw and Entwisle (2006) showed that a propinquity effect of the neighborhood is very local: Only school peers that live very nearby are likely to become friends in school. Therefore, we consider a classmate that lives less than five minutes away to be a neighbor. For example, section a in Fig. 1 shows an adolescent (A), that has a classmate living nearby (B) and a classmate not living nearby (C). Because living nearby stimulates friendship, A is more likely to befriend B than C. We test that *classmates who are neighbors are more likely to be friends than classmates who are not neighbors (H2).* We refer to this effect as the direct neighborhood propinquity effect.

In Europe, many studies have shown evidence for substantial and even increasing ethnic residential segregation (Logan, 2006; Musterd and De Vos, 2007). As a consequence, the neighborhood propinquity effect may amplify the ethnic homogeneity of friendship networks in school classes. After all, in ethnically segregated neighborhoods, it is to be expected that classmates who live close by are more likely from the same ethnic group than those who do not live close by. Therefore, we examine if the direct neighborhood propinquity effect partly explains the tendency of adolescents to have same-ethnic friends in class. We test the hypothesis that *befriending neighbors explains the tendency of adolescents to have same-ethnic friends in class (H3)*, assuming that neighbors are more often same-ethnic than interethnic due to residential segregation.

Adolescents, and people in general, get introduced to a subset of potential friends through the friends they made on an earlier occasion: Friendship formation is not an independent process as friendships form conditional on the already existing network structure (Goodreau et al., 2009; Moody, 2001; Mouw and Entwisle, 2006). As such, initial friends can be considered as foci as well (Feld, 1981). Due to initial friendship choice and that of their friends, particular peers are met more often than others, which results in those peers being more likely to become friends than others with whom an adolescent does not share friends. Consequently, friends of friends are often friends as well. This is known as triadic closure and is shown in section b of Fig. 1: A is likely to mention C as a friend, because both are friends with B.

Mouw and Entwisle (2006) argued and showed that endogeneity in networks is not restricted to the school class setting. If it is the case that friends of friends are often friends, it should apply to geographical closeness as well. As friends are likely to spend time at each other's house, they may also become more likely to meet their friend's neighbors more often. The same mechanism of shared foci and increasing opportunities to meet may then also hold for classmates who are neighbors of friends. For example, section c of Fig. 1 shows that A is friends with B. Being friends with B may increase the time A spends in B's neighborhood. As such, A is likely to become friends with C as C lives close to B. We test, therefore, that *adolescents are more likely to befriend a school peer who is a neighbor of a friend than a school peer who is not a neighbor of a friend (H4).* This effect will be referred to as the indirect neighborhood propinquity effect. Note that this effect is different from the direct propinquity effect (section a, Fig. 1) because friendship between A and B is not necessarily caused by being neighbors. In addition, this effect is also different from a common triadic closure effect (section b of Fig. 1) because friendship between B and C is not necessary for A and C to become friends.

The indirect neighborhood propinquity effect could partly explain same-ethnic friendship within class if a neighborhood effect functions like a 'snowball effect'. Consider a girl making an initial same-ethnic friend (who may or may not be a neighbor). This initial same-ethnic friend introduces her intentionally or unintentionally to his or her neighbors, who are likely to be same-ethnic too if neighborhoods are ethnically homogeneous. Transitive closure through the neighborhood may as such lead to increasingly ethnically homogeneous friendship networks. Therefore, we test the hypothesis that *befriending neighbors of friends explains the tendency of adolescents to have same-ethnic friends in class (H5).*

[2] The relation of neighborhood and school/class compositions is a question by itself addressing adolescents' school choices which would go far beyond the scope of this paper.

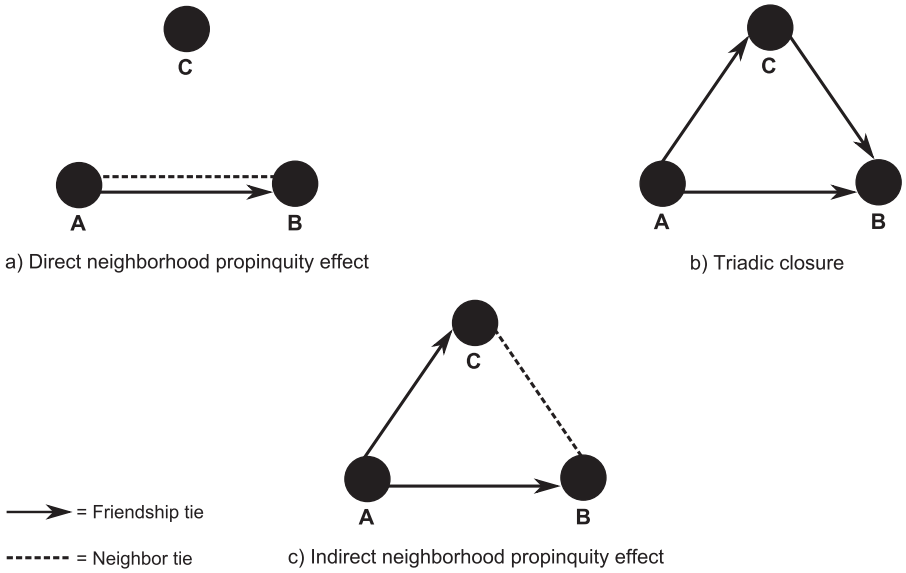


**Fig. 1.** (a) Direct propinquity effect, (b) triadic closure, and (c) indirect propinquity effect.

### *2.3. A simultaneous examination of the neighborhood exposure and propinquity mechanism*

The question arises if superficial contact in neighborhoods may actually be so influential as to influence ethnic homophily. When reexamining the arguments of the independent neighborhood exposure effect and neighborhood propinquity effect, it is plausible to posit that the neighborhood exposure effect may be at least partly driven by the neighborhood propinquity effect. Previous research has shown evidence for residential ethnic segregation (Logan, 2006; Musterd and De Vos, 2007; Semyonov and Glikman, 2009) and adolescents often attend nearby schools to minimize traveling time, to join neighborhood acquaintances in the same school or, in the case of some countries, to comply to legal obligations (e.g., fixed school placement areas in the U.S. or England) (Esser, 1986; Huckfeldt, 1983; Karsten et al., 2006; Mouw and Entwisle, 2006; Noreisch, 2007). As such, it is likely that general interethnic exposure in the neighborhood is related to having interethnic neighbors that go to the same school and are in the same class. Seemingly weaker ethnic homophily may in that case be actually due to more frequent outgroup contact because of neighborhood propinquity effects, and not necessarily because of a change in preferences due to the neighborhood exposure effect. Conversely, the propinquity effect may be driven by the exposure effect. In order to examine if one of the neighborhood effects on same-ethnic friendship preferences is not a spurious effect of the other, we test the hypothesis that *the exposure and propinquity effect on the tendency of adolescents to have same-ethnic friends in class exist independently from each other (H6).*

Fig. 2 summarizes our theoretical arguments. Note that the solid squares are what we observe and can measure, whereas the dashed squares are the theorized mechanisms. First, we examine previously researched relations of exposure and propinquity with same-ethnic friendship in school classes independently. Second, we test both mechanisms simultaneously.

## 3. Data

We use school class network data from the first wave of the "Children of Immigrants Longitudinal Survey in Four European Countries" (CILS4EU) (Kalter et al., 2014). The CILS4EU data cover information related to various dimensions of adolescent immigrants' integration into Western European host societies. It is based on nationally representative school sampling in four European countries, namely England, Germany, the Netherlands and Sweden.[3] In this analysis we examine only data from Germany and the Netherlands as we have reliable neighborhood data from these countries. The first wave data were collected in 2010/2011 and comprise a total of $N_{students} = 9376$ interviews in $N_{classes} = 493$ classes and $N_{schools} = 244$ schools for these two countries. All students were asked to report their best friends within the school class with a maximum of five nominations. This information constructs the friendship networks that are to be modeled.

Neighborhood data have not been collected within the CILS4EU project. Therefore, we use external data sources, and, in lack of a single internationally comparable data source, we rely on country-specific information on the ethnic composition of neighborhoods in which adolescents reside. Information on the ethnic composition in Dutch neighborhoods is based on official statistics published by the Dutch Bureau of Statistics (StatLine, 2013). The neighborhood is the smallest geographical unit available in the Netherlands and is defined by municipalities. On average, a neighborhood contains ~650 households. Previous Dutch research has often relied on a larger geographical unit, that is, the four digit postal code (among which Vermeij et al., 2009). Neighborhoods defined by the municipality are argued to be more meaningful contexts to people than postal code areas are (Vervoort et al., 2011a). Buildings within these local neighborhoods are often similar in style and age, and hence, inhabitants have often a similar socioeconomic status. Furthermore, neighborhoods are surrounded by natural borders such as water ways, main roads and train tracks.

For the German case, we follow other recent studies (Lersch, 2013; Sager, 2012) and base our neighborhood measure on data from the private geomarketing company 'Microm'. Their data on immigrant proportions in neighborhoods is based on onomastic methods: The ethnic origins of residents' first and family names were thereby used as a proxy for their own ethnic background (Humpert and Schneiderheinze, 2000). Microm offers information

[3] Schools with a high immigrant proportion are oversampled.

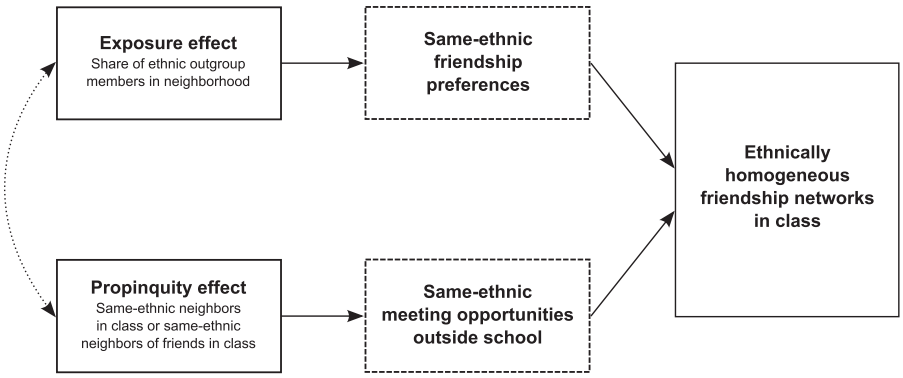


**Fig. 2.** Theoretical arguments.

on a so-called 'eight-digit postal code level' with an average size of ~700 households.

## 4. Methods and measures

We analyze friendship by applying exponential random graph models (ERGMs from here on) to our school class friendship network data.[4] The estimation process of ERGMs operates on the network level, that is, it counts a specific tie constellation in an empirical network (e.g. the number of mutual ties present), and compares these counts to those obtained from simulated networks to examine how likely a hypothesized tie-generating mechanism is (e.g., there are more or fewer mutual ties than expected at random). Applying this method allows us to examine same-ethnic friendship formation while taking into account other network-structural characteristics such as the availability of same- versus interethnic dyadic pairings or higher order structural effects such as triadic closure (for more general information about ERGMs and their functioning, see Robins et al. (2007) or Lusher et al. (2013)). Instead of analyzing single classes, we opted for school-wise models.[5] Estimating school-wise instead of class-wise models proves to be helpful in finding informative estimates due to more variation in ethnic background and neighborhood composition on the student level.

The data structure calls for a two-step procedure in the analysis, as proposed by Snijders and Baerveldt (2003): We first apply the same ERGM to each empirical school network separately. Secondly, we summarize school-specific results by using a meta-analysis to investigate our proposed hypotheses above and beyond the single-school case.

### 4.1. Within-school ERGMs

We apply an identical model setup to each of the empirical school networks. As class networks within the same school are disconnected from each other by study design (see Kruse and Jacob, 2014), we rule out between-class ties, assuming the tie-generating mechanisms to be similar across classes and schools (cf. De la Haye et al., 2011; Dijkstra et al., 2011; Svensson et al., 2012; Van Zalk et al., 2013).[6] The outdegree was constrained to 5, as adolescents could nominate no more than 5 friends in class.

The theoretical concept of ethnic homophily is captured by a statistic that sums all friendship nominations in which the sender of a nomination (ego) and the receiver of a nomination (alter) are both from the majority group (*both majority*) and one that counts those ties in which ego and alter are both from the same immigrant minority group (*same minority*). The reference group consists as such of friendships between majority and immigrant minority adolescents, and friendships between immigrant adolescents with a different immigrant background. We categorize the immigrant background of students according to their parents' and grandparents' birth country. If at least one of the students' grandparents or parents was born in a foreign country, we categorize the student as having an immigrant background. Ethnicity based on (grand)parental birth countries is the most objective and comparable operationalization across countries and is common in European research, where the most salient minority groups are first and second generation immigrants (Castles and Miller, 2003), with third generation immigrants also growing in numbers.

There are around 100 countries from which children of immigrants in our data originate. Most of these immigrant groups are so small, that the adolescents from these groups hardly ever meet a same-ethnic peer in class. Therefore, we collapse small immigrant groups in the categories Non-Western and Western immigrants. Western immigrant countries are European countries and countries where the dominant language is English (e.g., the US, Australia and New Zealand). We are able to differentiate between the largest immigrant groups. These are Turks, immigrants from the Former Soviet Union (FSU), Poles, immigrants from the Former Yugoslavian Republic (FYR), other Western and other Non-Western immigrants in Germany; and Turks, Moroccans, Surinamese, Antilleans/Arubans, other Western and other Non-Western immigrants in the Netherlands. A friendship in which ego has a Turkish background and alter a Moroccan background, for example, would therefore not count as a same-ethnic friendship. The *same minority* variable is as such best interpreted as the averaged ethnic homophily of immigrants. Collapsing the other Western and other Non-Western immigrants implies an underestimation of immigrant ethnic homophily, because same-ethnic pairs in these groups can be interethnic pairs as well.[7]

Propinquity is also measured with two variables, that is, *direct* and *indirect propinquity*. The *direct propinquity* mechanism is captured by a network statistic that counts all ties in which at least one of the two students reported to live within a 5-min walking distance to the other. Students' reports of classmates living close by might

[4] All analyses were carried out in "R (v.3.0.2)" and made foremost use of the "statnet (v.2014.2.0)" library (Handcock et al., 2008).

[5] In more than 80% of all sampled schools data of two or more classrooms per school are available.

[6] We included a network statistic in the model that identifies all between-class ties and fixed its coefficient value at negative infinity.

[7] We repeated our analysis by separating Western and non-Western immigrant homophily from immigrant homophily to examine if our results are robust. The conclusions on our hypotheses are the same as for the analyses shown.

account better for spatial boundaries such as railway tracks, lakes or bigger highways, than an objective measure of spatial distance between students' homes (cf. Mouw and Entwisle, 2006). We thus assume that ego and alter live close to each other (i.e., direct propinquity) if at least one of them reported to live within a 5-min walking distance to the other. Indirect propinquity is operationalized as the sum of all ties in which alter lives within a 5-min walking distance to a friend of ego. It is possible that adolescents only report their class peers to be neighbors *if* they are friends. Given the fact that 79% of all neighbor nominations are directed at non-friends, we assume that such a possible bias is not problematic in our study.

The ethnic composition of a neighborhood is measured using *the proportion of immigrants in the neighborhood*.[8] Both the German and the Dutch neighborhood data refer to individuals, not households, and thus include children in their counts. The proportions of immigrants enter the model as an ego-effect interacting with the same-ethnic statistic (including its main effect), thus measuring whether adolescents living in neighborhoods with high immigrant proportions send more (for immigrants) or fewer (for natives) ingroup nominations than adolescents living in neighborhoods with lower proportions.

Besides these main covariates of interest, several further network statistics enter the models as controls. The general tendency for adolescents to nominate peers as friends is represented by the variable *edges*, counting all friendship nominations present in a network. Even though we are not specifically interested in the degree to which adolescents have friends, it is necessary to include this measure as it functions as a model intercept.

We also control for lower and higher order balancing mechanisms commonly found in adolescent friendship networks (Goodreau et al., 2009; Moody, 2001; Mouw and Entwisle, 2006; Wimmer and Lewis, 2010). First, *reciprocity* is measured by a statistic counting all mutual friendship nominations. Transitivity, that is, students' tendency to befriend friends of their friends, is measured by capturing shared friends. Empirically, we see that friendship nominations in which ego and alter share too many friends are less common than structures in which ego and alter share some friends. The underlying theoretical idea here is that friendships generate a positive but decreasing marginal utility. The 'geometrically weighted edge-wise shared partner' (*GWESP*) measure captures the tendency that shared friends increase the likelihood of friendship and thus offers a better model fit and minimizes problems with model convergence (Hunter, 2007; Hunter et al., 2008). Similarly, we also include geometrically weighted indegree and outdegree parameters (*GWIDegree* and *GWODegree*) to capture the tendency to send friendship nominations and receive friendship nominations.

We additionally control for sex homophily by including a network statistic into the model that counts all ties in which ego and alter have the *same sex*, as having the same sex has repeatedly been shown to be one of the strongest predictors for friendships between adolescents (McPherson et al., 2001; Poulin and Pedersen, 2007; Shrum et al., 1988). For the same reason, we include a variable accounting for the *difference in socioeconomic status*. We measure the socioeconomic status by using the 2008 4-digit International Standard Classification of Occupations code (ISCO-08) in combination with the International Socio-Economic Index of occupational status ranking (ISEI-08) (Ganzeboom et al., 1992). The ISEI measure relies on parental job information provided by the parents if available, and otherwise on information provided by the adolescents. We take the highest ISEI score in the household for each student and include a statistic counting all ties present in the network weighted by the absolute difference between ego and alter's parental ISEI score into our model. For all dyadic variables (same ethnicity, same sex, and difference in socioeconomic status), we additionally include *sender* and *receiver* effects to control for sociality and popularity effects.

114 missing values on individual neighborhood data in Germany were imputed using the sociometry items (5.4% of country total, no missings in the Netherlands). Adolescents with missing neighborhood data were assigned the neighborhood data of the peers that were nominated living within a 5-min distance. If no peers lived nearby, the average neighborhood values of the school were imputed. Missing values on other attribute data was so low (<5%) that we did not impute data.

**Table 1**
Goodness of fit.

| | % schools with GOF-ratio < 2 | Mean GOF-ratio over schools | Max. GOF-ratio |
|---|---|---|---|
| M1 | 94.52 | 0.53 | 2.58 |
| M2 | 94.62 | 0.54 | 2.43 |
| M3 | 94.46 | 0.55 | 2.57 |
| M4 | 94.53 | 0.55 | 2.47 |
| $N_{student}$ | | 3345 | |
| $N_{class}$ | | 158 | |
| $N_{school}$ | | 89 | |

### 4.2. Meta-analysis

We summarize the school-network specific ERGM results in a meta-analysis following Snijders and Baerveldt (2003). We calculate weighted least squares estimates for all model coefficients based on our school-specific coefficient estimates and their respective standard errors. As such, schools with more precise coefficients contribute more to the averaged coefficient over schools than schools with coefficients that are characterized by more uncertainty.

Some schools had to be excluded from the analysis a priori, due to unit non response or other data problems.[9] Further, only those school-specific ERGM coefficients entered the meta-analysis where estimation of all model setups turned out to be successful. One requirement is therefore, that in- and outgroup nominations had been possible in at least one class in a school. This means that there should be at least 2 majority and 2 minority students in one of the classes. These data requirements are similar to those of previous studies (Lubbers, 2003; Smith et al., 2014).

Further, we exclude the ERGM results of schools where the universally applied model set up did not fit the data well. We examined *t*-ratio's for convergence and checked if the absolute values corresponding to our estimates were close to zero. Estimates that did not satisfy this condition (at least one *t*-ratio > .2) were excluded from the analysis. Goodness of fit (GOF) was examined by simulating networks based on the modeled coefficients and by comparing the simulated values for the edgewise-shared partner, outdegree, and geodesic distance statistics with the respective observed

[8] We make the assumption that the measure reflects outgroup members to natives, and ingroup members to immigrants. Even though not every immigrant is an ingroup member to immigrants (e.g., a Chinese neighbor is not an ingroup member to a Turkish adolescent), we will use the share of immigrants in the neighborhood instead of a measure like the share of outgroup members for the following reason. Natives have very low values on a share of outgroup members in the neighborhood, whereas immigrants have very high values. These skewed data resulted into very high coefficients and unreliable results.

[9] The school class networks had to match the following conditions to be considered: (1) at least 75% of the students participated in the network survey; (2) class size of at least 10 students; (3) no more than 10% of all nominations are invalid; and (4) no more than 4 students in class have never (been) nominated in any of the network-related items.

**Table 2**
Descriptive statistics of balanced model population.

| | Germany | | the Netherlands | | Total | |
|---|---|---|---|---|---|---|
| | Mean | s.d. | Mean | s.d. | Mean | s.d. |
| Immigrant background | 0.564 | | 0.396 | | 0.502 | |
| Turkish | 0.157 | | 0.035 | | 0.112 | |
| FSU | 0.073 | | 0.000 | | 0.046 | |
| Polish | 0.057 | | 0.000 | | 0.036 | |
| FYR | 0.046 | | 0.000 | | 0.029 | |
| Moroccan | 0.000 | | 0.039 | | 0.015 | |
| Surinamese | 0.000 | | 0.046 | | 0.017 | |
| Antillean | 0.000 | | 0.027 | | 0.010 | |
| Other Western | 0.116 | | 0.094 | | 0.108 | |
| Other Non-Western | 0.116 | | 0.155 | | 0.130 | |
| Friendship nominations | 3.758 | 1.343 | 3.485 | 1.327 | 3.657 | 1.343 |
| Majority | 3.746 | 1.317 | 3.515 | 1.302 | 3.642 | 1.315 |
| Minorities | 3.767 | 1.362 | 3.439 | 1.364 | 3.671 | 1.370 |
| Classmates living close | 2.028 | 2.013 | 1.033 | 1.289 | 1.659 | 1.843 |
| Majority | 1.929 | 1.938 | 1.036 | 1.279 | 1.528 | 1.732 |
| Minorities | 2.104 | 2.067 | 1.028 | 1.305 | 1.789 | 1.939 |
| Immigrants in neighborhood | 0.102 | 0.079 | 0.110 | 0.123 | 0.105 | 0.098 |
| Majority | 0.076 | 0.062 | 0.086 | 0.098 | 0.080 | 0.080 |
| Minorities | 0.123 | 0.085 | 0.146 | 0.147 | 0.129 | 0.107 |
| Male | 0.528 | | 0.500 | | 0.518 | |
| Majority | 0.535 | | 0.514 | | 0.526 | |
| Minorities | 0.522 | | 0.480 | | 0.510 | |
| Socioeconomic status (ISEI) | 43.791 | 19.428 | 54.128 | 19.944 | 47.646 | 20.246 |
| Majority | 47.993 | 18.439 | 55.742 | 19.091 | 51.500 | 19.124 |
| Minorities | 40.461 | 19.554 | 51.554 | 21.000 | 43.691 | 20.606 |
| Immigrants at school | 0.563 | 0.155 | 0.397 | 0.134 | 0.501 | 0.168 |
| Majority | 0.509 | 0.148 | 0.366 | 0.122 | 0.445 | 0.154 |
| Minorities | 0.604 | 0.147 | 0.444 | 0.138 | 0.557 | 0.162 |
| $N_{student}$ | 2104 | | 1241 | | 3345 | |
| $N_{class}$ | 98 | | 60 | | 158 | |
| $N_{school}$ | 58 | | 31 | | 89 | |

*Note.* Data are not weighted for sampling design.

values using statnet's built-in GOF command for ERGMs (Goodreau et al., 2008). GOF-ratio's larger than 2 indicate an unsatisfying goodness of fit (Robins et al., 2009) and also these school networks were excluded from the analyses. Table 1 indicates that most school networks met this requirement, that the mean GOF-ratio is relatively low, and that the GOF-ratios are maximally 0.6 points larger than 2. Lastly, when standard errors in one of the model setups exceed 5 or coefficient sizes exceed ±10, it is also highly likely that the model setup did not fit the observed network or that the network is an outlier. We exclude these schools from our meta-analysis. After these exclusions, we analyze 89 schools and refer to this sample as the 'balanced model population'.

Table 2 shows the descriptive statistics of the individual attributes of adolescents in the balanced model population that we use in our analyses. Values are shown in total, separately for Germany and the Netherlands, and separately for the majority and minorities. Note that Table 2 does not show representative data, but is merely a description of the data we work with. The descriptive statistics between countries and groups show mostly similar values, but some differences are notable. For example, minorities have higher proportions of immigrants in their neighborhood and school class, which is already an indication of neighborhood and school segregation. Also, note that the average share of immigrants in the neighborhood is 11% even though minorities make up 50% of the balanced sample. Higher immigrant shares in school than in the neighborhood are to be expected because schools with a higher share of immigrant students are oversampled in the CILS4EU data and school classes are small units that receive pupils from multiple larger unit neighborhoods. In addition, the percentage of immigrants is generally higher among adolescents than among older people and so schools have higher proportions of immigrants than neighborhoods. Finally, self-selection of Muslim immigrant children into Islamic or Christian schools instead of secular schools (Van Kessel, 2000) and overrepresentation of immigrant children in lower educational tracks (Dijkstra et al., 1997) may account for the discrepancy between the ethnic composition of schools and neighborhoods.

### 4.3. Interpretation of mediating effects: Simulations

We hypothesize that propinquity in the neighborhood (partly) explains why adolescents tend to choose same-ethnic friends in class. A standard method to answer mediation questions like ours would be to compare coefficients between models with and without the hypothesized mediator. Comparisons of coefficient sizes across different ERGM setups are a rather unreliable indication for mediating effects, however. As ERGMs are in the family of logistic models, the size of coefficients between models may be dependent on the explained variance within these models (Mood, 2010).

A more promising approach, instead, is to make use of network simulations that are based on the coefficients derived in the between-school meta-analyses. Here, we suggest to compare the formation of same-group friends that would result from the empirically observed scenario (i.e., number of schools, school sizes, and actor attributes are as empirically observed in the balanced school sample) to those that would result from a counterfactual scenario where all class peers live apart from each other such that a propinquity effect would be completely absent.[10] We quantify

[10] The setup of this counterfactual scenario is as follows: almost all actor attributes follow the empirically observed distributions, namely actors' sex, and their social and ethnic background. The only difference is that we set the dyadic covariate of propinquity to zero for all dyads. Due to this latter setup adjustment the contribution of a propinquity effect to actors' tie formation will be zero. Any difference in same-ethnic estimates between the empirical and counterfactual scenario would therefore

**Table 3**
Proportion of ingroup members among class peers who (do not) live within a 5-min walking distance for majority and minority students.

| | Germany | | | the Netherlands | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | Living close | Not living close | $p$ | Living close | Not living close | $p$ | Living close | Not living close | $p$ |
| Majority | 0.529 | 0.486 | .008 | 0.681 | 0.628 | .010 | 0.587 | 0.540 | .000 |
| Minorities | 0.216 | 0.175 | .000 | 0.151 | 0.143 | .666 | 0.201 | 0.168 | .001 |

*Note.* Data are not weighted for sampling design.

the tendency for same-ethnic friendship in terms of each simulated network's measure $\alpha$. The measure $\alpha$ is defined as the logged ratio of the odds of ingroup friends versus ingroup non-friends divided by the odds of outgroup friends versus outgroup non-friends. Whereas the lack of a short and clear-cut interpretation of $\alpha$ is clearly a shortcoming of the measure, it has one major advantage: $\alpha$ conveniently controls for relative sizes of the different groups in the school classes, thus allowing us to compare the tendency for same-ethnic friends across different networks and scenarios (see also Moody, 2001; Mouw and Entwisle, 2006).[11]

To arrive at a reliable comparison we conduct 250 simulation runs per scenario.[12] Within each simulation run we first generate school-specific networks based on the laid out setups of each scenario. All simulations thereby rely on a model configuration that includes propinquity effects (for the exact configuration refer to Section 5) with the coefficients derived in the between-school meta-analyses. To guarantee comparability to the empirical networks we constrain students' outdegree to a maximum of 5 in all simulations. Once the school-specific networks are simulated we then determine each network's $\alpha$ and take its mean value over all schools, thus ending up with one (mean) $\alpha$ value per simulation run. Proceeding as such, we finally end up with 250 (mean) $\alpha$ values per scenario. By comparing the distributions of $\alpha$ across different scenarios we can infer whether propinquity effects partly explain why adolescents tend to choose same-ethnic friends in school classes.

## 5. Results

### 5.1. Descriptive results

Linear estimations of the empirical distribution of $\alpha$ across different neighborhood compositions are depicted in Fig. 3. In both countries (Germany left, the Netherlands right), majority and minority adolescents show mainly positive levels of $\alpha$ implying that the odds of forming a tie in the ingroup are higher than those of forming one in the outgroup. The regression slopes indicate that there is variation in $\alpha$ across neighborhood compositions. Majority $\alpha$ rises with the immigrant percentage in adolescents' neighborhoods, both in Germany and the Netherlands. For immigrant $\alpha$, there is no clear-cut trend across neighborhoods with varying ethnic compositions. These bivariate effects seem to contradict contact theory, the finding of Vermeij et al. (2009), and our hypotheses (H1, H3, and H5). Note however, that $\alpha$ is not a direct measure of ethnic homophily, as it solely captures observed ethnic homogeneity net of relative group size effects (i.e., it captures a tendency for same-group friends). It is not controlled for other important variables that may also affect same-ethnic friendship in school classes. To arrive at a more informative proxy for ethnic homophily we will therefore have to turn to the explanatory analyses where we additionally control for propinquity mechanisms, structural network mechanisms, and other important control factors.

Table 3 provides a first indication that propinquity mechanisms could explain why adolescents tend to befriend same-ethnic peers (H3 and H5). We see that both in Germany and in the Netherlands students have a higher ingroup share among those classmates who live close by than among those who do not live close by. Of the classmates that live within a 5-min distance, 59% is on average same-ethnic for majority members, whereas 54% is so of the peers who live further away. For immigrants, 20% of the peers that live nearby are same-ethnic, compared to 17% of the peers that live further away. Both differences are significantly different from zero.

Note, the differences between same-ethnic and interethnic neighbors shown in Table 3 are relatively small despite their significance. Also, they are more pronounced in Germany than they are in the Netherlands. It is therefore questionable if a general tendency to form friendships due to propinquity could explain the tendency of adolescents to befriend same-ethnic peers in school classes.

### 5.2. Explanatory results

In order to test our hypotheses we turn to the results of the multivariate ERGMs. Tables 4 and 5 show the results of the between-school meta-analysis for Germany and the Netherlands, respectively. We report unstandardized mean coefficient estimates that provide an uncertainty-weighted average of the school-specific coefficients of four different ERGM setups. The Fisher test shows if there is at least one school with a significant positive (as indicated by "+") or negative effect (as indicated by "−"). Each setup reveals different information about how the adolescent's neighborhood affects the ethnic composition of their friendships in school classes.

We set up Model 1 as our baseline model to find out about the general level of same-ethnic friendship throughout all schools of the balanced sample when controlling for other friendship formation mechanisms. The same-ethnic effects are positive, both for the majority ($b_{Germany} = .295$, $p \leq .01$ ; $b_{the\ Netherlands} = .326$, $p \leq .01$), as well as for minority adolescents ($b_{Germany} = .324$, $p \leq .01$ ; $b_{the\ Netherlands} = .183$, $p \leq 1$). This means that, compared to an interethnic tie, a same-ethnic friendship is $e^{.295} \approx 1.34$ times and $e^{.326} \approx 1.39$ times more likely for a majority group student in Germany and the Netherlands, respectively. Same-ethnic friendship is $e^{.324} \approx 1.38$ times and $e^{.183} \approx 1.20$ higher for an adolescent with minority group background in Germany and the Netherlands, respectively. Results with respect to the control variables are in line with previous findings about friendship formation in school classes: Friendship nominations are rather sparse as the negative edges effect suggests. Also, the effects of reciprocity and transitivity (*GWESP*) show that friendships tend to be reciprocated and triadic structures tend to be closed. Besides significant same-ethnic effects, we also see positive effects of having the same sex and somewhat weaker – but marginally significant ($p < .1$) – evidence for friendships occurring more often within the same socioeconomic status group than across.

be indication for an actual contribution of the propinquity effect to the overall level of same-ethnic estimates.

[11] Note, however, that due to the assumption of interdependence between tie formation mechanisms it is impossible to provide the strictly isolated contribution of one single tie formation mechanism, as, for example, for other model types predicted probabilities would do. A comparison of the same-ethnic effects in the presence and complete absence of a propinquity effect therefore actually yields the contribution of the propinquity mechanism while simultaneously accounting for the interdependency between all tie formation mechanisms included in the model.

[12] All simulations are carried out based on the built-in simulation function for ERGM results provided in the statnet package (Handcock et al., 2008).

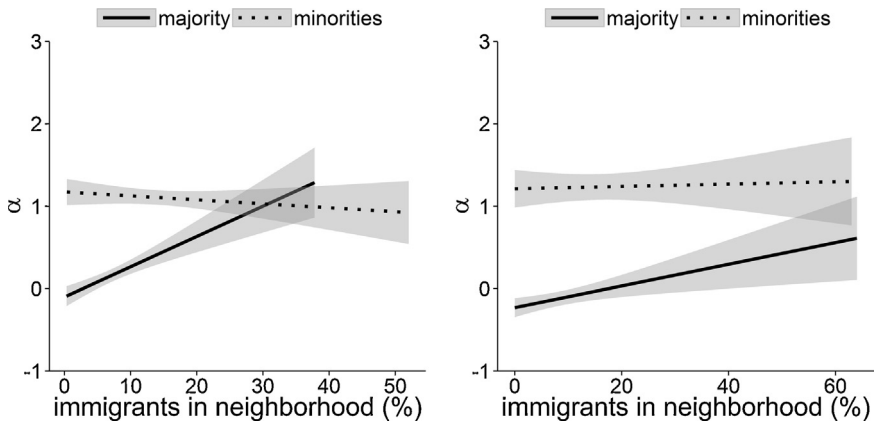


**Fig. 3.** Tendency for same-ethnic-group friends in school classes ($\alpha$) across different neighborhood compositions. Linear trends with 5%-confidence intervals in gray; left: Germany, right: the Netherlands.

In Model 2 we introduce our measures of direct and indirect propinquity. Tables 4 and 5 reveal, in line with hypotheses 2 and 4, that adolescents are more likely to nominate classmates living close by as friends than classmates living further away. Furthermore, they are more likely to nominate someone as a friend if he/she lives close to another friend. Note that the triadic indirect propinquity effect is positively significant net of the other triadic control variable (*GWESP*). The observed indirect propinquity effect should therefore not be thought of as an artifact that would result from the general tendency to close triadic structures.

If we compare the same-ethnic coefficients from model setups 1 and 2, we get a first impression of whether or not propinquity can (partly) explain the tendency of adolescents to have same-ethnic friends. The same-ethnic effects among majority and minority adolescents between Models 1 and 2 decrease only slightly. The reduction of same-ethnic effects may be underestimated due to rescaling effects, however. Significant effects of direct and indirect neighborhood propinquity friendship imply that their inclusion to the model adds to the explained variance of friendship. The more variance is explained, the larger the coefficients are, which in turn may mask the reduction in the same-ethnic coefficients. Therefore, we turn to simulations of same-ethnic friendship to make further inference. Throughout all simulated scenarios, we use the parameter estimates obtained from the meta-analyses of Model 2 (Tables 4 and 5) to simulate scenario-specific sets of synthetic networks.

Fig. 4 reports the distribution of the 250 (mean) values of $\alpha$ for each of the scenarios (combined for the two countries). Neighborhood propinquity seems to contribute a little to ethnic homogeneity (net of group size effects) in friendships in class: The distribution of $\alpha$ in the empirically observed scenario is slightly above the distribution following the counterfactual scenario where propinquity effects are completely absent (*scenario a*). This finding holds both for majority group students and for minority group students. There is a slight decrease noticeable in $\alpha$, but it is very small. As such, we do not find strong evidence for hypotheses 3 and 5.

It might be rather puzzling to find no effect of propinquity on same-ethnic friendship given that propinquity was found to be conducive to friendship formation in general. There are two possible explanations for this: Either same-ethnic adolescents simply

**Table 4**
Pooled meta-analysis results of schoolwise ERGMs in Germany.

| | M1 | | | M2 | | | M3 | | | M4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | beta[a] | s.e. | | beta[a] | s.e. | | beta[a] | s.e. | | beta[a] | s.e. | |
| Density | −4.228*** | 0.109 | − | −4.381*** | 0.116 | − | −4.192*** | 0.150 | − | −4.312*** | 0.135 | − |
| Reciprocity | 2.175*** | 0.063 | + | 2.148*** | 0.063 | + | 2.179*** | 0.065 | + | 2.149*** | 0.063 | + |
| GWIndegree | 0.805*** | 0.122 | + | 0.907*** | 0.127 | + | 0.785*** | 0.023 | + | 0.879*** | 0.127 | + |
| GWOutdegree | 0.860*** | 0.224 | + | 0.850*** | 0.221 | + | 1.011*** | | + | 0.978*** | 0.228 | + |
| GWESP | 0.883*** | 0.029 | + | 0.872*** | 0.029 | + | 0.881*** | | + | 0.869*** | 0.030 | + |
| Boy ego | 0.127 | 0.079 | + | 0.129* | 0.078 | + | 0.143* | 0.117 | + | 0.149* | 0.083 | + |
| Boy alter | −0.014 | 0.052 | | 0.003 | 0.053 | | −0.015 | 0.102 | | −0.001 | 0.054 | |
| Same sex | 0.759*** | 0.033 | + | 0.763*** | 0.034 | + | 0.781*** | 0.115 | + | 0.788*** | 0.036 | + |
| SES ego | 0.003* | 0.002 | + | 0.003* | 0.001 | + | 0.003 | 0.002 | + | 0.002 | 0.002 | + |
| SES alter | −0.002 | 0.001 | − | −0.002 | 0.001 | − | −0.001 | 0.001 | − | −0.002 | 0.001 | − |
| Difference SES | −0.002** | 0.001 | − | −0.002* | 0.001 | − | −0.002** | 0.001 | − | −0.002* | 0.001 | − |
| Majority ego | 0.019 | 0.069 | | 0.031 | 0.068 | | 0.014 | 0.072 | | 0.015 | 0.075 | |
| Majority alter | −0.184*** | 0.069 | − | −0.175** | 0.070 | − | −0.181** | 0.063 | − | −0.172** | 0.073 | − |
| Both majority | 0.295*** | 0.072 | + | 0.280*** | 0.077 | + | 0.224* | 0.131 | + | 0.138 | 0.130 | + |
| Same minority | 0.324*** | 0.048 | + | 0.318*** | 0.049 | + | 0.143 | 0.113 | | 0.174 | 0.137 | |
| Propinquity | | | | 0.498*** | 0.040 | + | | | | 0.504*** | 0.040 | + |
| Indirect propinquity | | | | 0.303*** | 0.042 | + | | | | 0.293*** | 0.044 | + |
| Prop. immig. neighb. ego | | | | | | | −0.007 | 0.004 | − | −0.009* | 0.006 | − |
| Both majority × prop. immig. neighb. ego | | | | | | | −0.003 | 0.014 | | 0.005 | 0.014 | |
| Same minority × prop. immig. neighb. ego | | | | | | | 0.015 | 0.010 | + | 0.012 | 0.012 | |
| $N_{school}$ | 58 | | | 58 | | | 58 | | | 58 | | |

*Note.* Data are not weighted for sampling design.

[a] Unstandardized mean coefficient estimate according to Snijders and Baerveldt (2003).

* $p$-value < .1; ** $p$-value < .05; *** $p$-value < .01; +: right-sided Fisher test score < 0.025; −: left-sided Fisher test score < 0.025.

**Table 5**
Pooled meta-analysis results of schoolwise ERGMs in the Netherlands.

| | M1 | | | M2 | | | M3 | | | M4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | beta[a] | s.e. | | beta[a] | s.e. | | beta[a] | s.e. | | beta[a] | s.e. | |
| Density | −4.905*** | 0.166 | − | −5.068*** | 0.187 | − | −4.889*** | 0.196 | − | −5.027*** | 0.204 | − |
| Reciprocity | 2.164*** | 0.086 | + | 2.144*** | 0.086 | + | 2.161*** | 0.087 | + | 2.146*** | 0.087 | + |
| GWIndegree | 1.452*** | 0.141 | + | 1.599*** | 0.148 | + | 1.451*** | 0.144 | + | 1.585*** | 0.149 | + |
| GWOutdegree | 1.969*** | 0.267 | + | 1.980*** | 0.268 | + | 2.096*** | 0.276 | + | 2.108*** | 0.278 | + |
| GWESP | 1.076*** | 0.031 | + | 1.063*** | 0.031 | + | 1.077*** | 0.032 | + | 1.064*** | 0.031 | + |
| Boy ego | 0.194* | 0.114 | + | 0.194* | 0.109 | + | 0.226** | 0.115 | + | 0.219** | 0.109 | + |
| Boy alter | −0.041 | 0.067 | | −0.049 | 0.074 | | -0.050 | 0.069 | | −0.056 | 0.075 | |
| Same sex | 0.595*** | 0.033 | + | 0.628*** | 0.039 | + | 0.609*** | 0.034 | + | 0. *** | 0.041 | + |
| SES ego | −0.004*** | 0.002 | | −0.004** | 0.002 | | −0.004*** | 0.002 | | −0.004** | 0.002 | |
| SES alter | 0.003** | 0.001 | + | 0.003** | 0.001 | + | 0.003** | 0.001 | + | 0.003** | 0.001 | + |
| Difference SES | −0.002* | 0.001 | | −0.001 | 0.001 | | −0.002* | 0.001 | | −0.001 | 0.001 | |
| Majority ego | −0.069 | 0.096 | | −0.069 | 0.095 | | −0.062 | 0.100 | | −0.067 | 0.101 | |
| Majority alter | −0.133* | 0.077 | − | −0.144* | 0.076 | − | −0.128 | 0.078 | − | −0.150** | 0.076 | − |
| Both majority | 0.326*** | 0.067 | + | 0.316*** | 0.065 | + | 0.322*** | 0.085 | + | 0.298*** | 0.091 | + |
| Same minority | 0.183* | 0.106 | + | 0.163* | 0.099 | + | 0.165 | 0.180 | | 0.162 | 0.182 | |
| Propinquity | | | | 0.605*** | 0.049 | + | | | | 0.614*** | 0.050 | + |
| Indirect propinquity | | | | 0.477*** | 0.096 | + | | | | 0.471*** | 0.098 | + |
| Prop. immig. neighb. ego | | | | | | | −0.001 | 0.004 | | −0.002 | 0.004 | |
| Both majority × prop. immig. neighb. ego | | | | | | | −0.005 | 0.010 | | −0.002 | 0.010 | |
| Same minority × prop. immig. neighb. ego | | | | | | | 0.008 | 0.008 | | 0.005 | 0.007 | |
| $N_{school}$ | 31 | | | 31 | | | 31 | | | 31 | | |

*Note.* Data are not weighted for sampling design.
[a] Unstandardized mean coefficient estimate according to Snijders and Baerveldt (2003).
*$p$-value < .1; **$p$-value < .05; ***$p$-value < .01; +: right-sided Fisher test score < 0.025; −: left-sided Fisher test score < 0.025.

do not live as close to each other as common wisdom might suggest (i.e., low levels of residential segregation) or propinquity is not such a strong driver of friendship formation when compared to the other tie generating mechanisms. Given the former applies, that is low levels of residential segregation being responsible, we should observe a rise in same-ethnic friendship if residential segregation was higher. In order to find out whether this is actually the case, we conduct yet another set of simulations based on a second counterfactual scenario that assumes extreme residential segregation. Like before, all simulations rely on the coefficient estimates from Model 2. The scenario is set up as follows. The number of schools, school sizes and actor attributes follow the empirically observed setup except for the dyadic covariate of propinquity: Here, all same-ethnic class peers are now assumed to be living close by and all outgroup class peers are not. Fig. 4 corroborates that propinquity has little explanatory power in same-ethnic friendship within school classes because there are simply few same-ethnic peers who live nearby. The outlined counterfactual scenario (*scenario b*) shows clearly higher levels of $\alpha$ than the scenario that is empirically observed. This suggests that it is not the relative importance of the tie formation mechanism of propinquity as such but the rather low empirical level of ethnic segregation that is responsible for the negligible impact of propinquity on the tendency for same-ethnic friends. Note, however, that this is merely an indication, as scenarios a and b are counterfactual, thus not empirically observed. Even though the share of immigrants in a neighborhood range between 0 and 52% in Germany and 76% in the Netherlands, we do not observe as many same-ethnic peers living nearby as we simulate.

With the third model setup (Model 3) we test the neighborhood exposure mechanism (H1). We add the proportion of immigrants in ego's neighborhood to the baseline model (*prop. immig. neighb.*

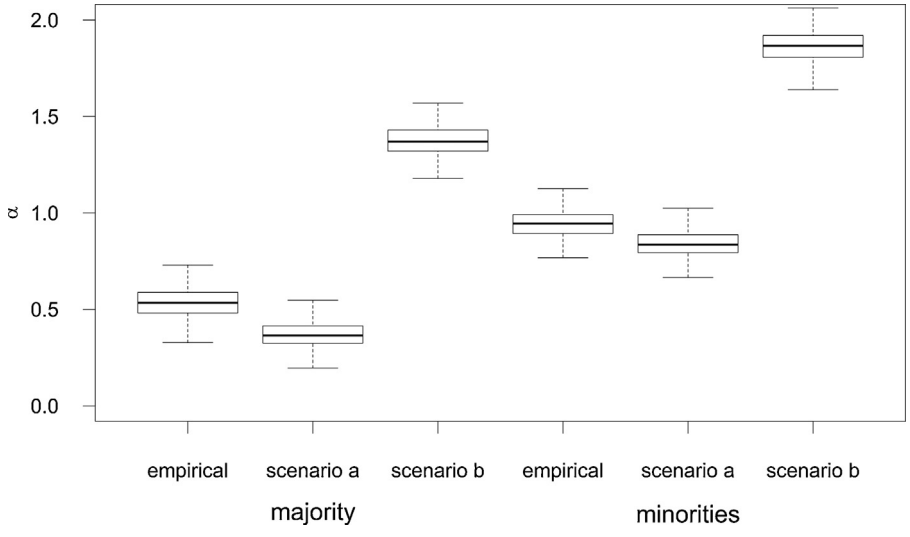


**Fig. 4.** Tendency for same-ethnic-group friends in school classes ($\alpha$). Simulated networks based on the empirical school population in Germany and the Netherlands; where propinquity effects are completely absent (scenario a); where all same-ethnic peers live close by (scenario b).

**Table 6**
Between-school-network variability of the exposure and propinquity effects.

| | $N_{school}$ with significant effect | | $N_{school}$ total |
|---|---|---|---|
| | beta < 0 | beta > 0 | |
| Propinquity | 1 | 42 | 89 |
| Indirect propinquity | 3 | 34 | 89 |
| Both majority × prop. immig. neighb. ego | 6 | 1 | 89 |
| Same minority × prop. immig. neighb. ego | 4 | 5 | 89 |

*Note.* Data are not weighted for sampling design.

*ego*), as well as its interactions with both being of the majority group and both being of the same minority group (*both majority*prop. immig. neighb. ego, same minority*prop. immig. neighb. ego*). In terms of effect directions the multivariate analyses are in line with an exposure effect following the contact hypothesis: whereas the immigrant proportion in the neighborhood affects majority homophily negatively in both countries (GE: −.007 − .003 = −.01; NL: −.001 − .005 = −.006), it has a positive effect on minority homophily (GE: −.007 + .015 = .08; NL: −.001 + .008 = .007). This finding contrasts the bivariate findings shown earlier in Fig. 3, which underlines the importance to control for alternative mechanisms of tie formation. However, the evidence that majority or minority members with varying exposure to immigrants in the neighborhood vary in the strength of ethnic homophily is very weak and marginal, as the interaction effects are not consistently significant and very small.[13] Hence, the results show no convincing evidence for a neighborhood exposure effect on the tendency of adolescents to befriend same-ethnic peers.

In the fourth model setup (Model 4) we conduct a combined test of both propinquity-related and preference-related mechanisms to test whether they each exert an independent effect on friendship formation. Results are in line with the models of separate tests: Direct and indirect propinquity are robust predictors of friendship within school classes but hardly explain same-ethnic friendship, and the proportion of immigrants in the neighborhood does not have a relevant effect on same-ethnic friendship. We do not find evidence for hypothesis 6 that the exposure and propinquity effects affect same-ethnic friendship independently because we find little evidence for these effects in the first place.

Lastly, we examine the between-school variance of the propinquity and exposure coefficients. It is especially important to further examine the small effect of neighborhood exposure as it may be due to exposure effects being significantly positive in some, but significantly negative in other classes so that the effects counterbalance each other. Table 6 shows the number of schools with significant positive and negative propinquity and exposure effects for all schools. It reveals that an exposure effect is rarely significant in any school and it can be either negative or positive. The propinquity effect, in contrast, is significantly positive in about half of the schools and the indirect propinquity effect in a third of the schools.

## 6. Conclusions

The aim of this study was to examine how the neighborhood's ethnic composition is related to adolescent same-ethnic friendships in German and in Dutch school classes. More specifically, we investigated whether and how neighborhoods can influence friendship choices apart from determining the mere availability of friendship possibilities within school classes.

Our results corroborate the previous U.S. finding that adolescents are more likely to be friends in school if they live close to each other (Mouw and Entwisle, 2006). Further, we established that this effect also applies to classmates who live close to another class friend. Our results are based on data of adolescents nominating classmates who live within a 5-min distance. It is plausible that this measure is biased toward friends being nominated as neighbors (i.e., if adolescents are not friends, they do not know if they are neighbors), but such a bias seems relatively limited as 79% of the neighbor nominations go to non-friends. Because a 5-min distance refers to a small local area and because German and Dutch school classes are relatively small (∼20 students), adolescents seem to know who lives close by regardless of being friends or not. This is in line with Banerjee and colleagues' study (2014) that reported people being surprisingly accurate in identifying network characteristics (i.e., central persons in networks) above and beyond friendship ties.

The effects of direct and indirect neighborhood propinquity imply that ethnic segregation in the neighborhood has the potential to explain the tendency for same-ethnic friends: Adolescents may have so many same-ethnic friends in class, because same-ethnic peers are more likely to meet in the neighborhood than peers with a different ethnic background. With the use of simulations, however, we could show that the neighborhood propinquity effects do not lead to a much higher same-group tendency, most likely because there are too few same-ethnic adolescents within a class that live close to each other (in our case, a 5-min distance). This is in line with Mouw and Entwisle's study (2006), who also did not find that propinquity explains individual variation in same-ethnic friendship *within* schools. The propinquity effect seems to be very local, and school classes include students from larger areas.

The lack of evidence for a mediation effect of neighborhood propinquity does not mean, however, that ethnic residential segregation can be neglected. The local neighborhood has the potential to amplify same-ethnic school friendship because, generally speaking, propinquity is such a strong driver of school friendship: In a hypothetical situation of complete segregation (all same-ethnic classmates are neighbors, all interethnic classmates are not), our simulation analysis showed that the tendency to have same-ethnic friends would be amplified by a factor of almost 3. This suggests that, currently, there has been too little overlap between residential segregation in students' local area and their school class peers. Increasing levels of residential segregation would be detrimental to interethnic friendship in class, however, as it would increase the number of same-ethnic neighbors who have a higher chance of becoming friends over interethnic non-neighbors. Because we make use of simulations, we do not empirically observe the counterfactual scenario to support this claim fully, but we at least provide a convincing indication how residential segregation can hamper interethnic friendship at school above and beyond influencing the opportunity structure for interethnic friendship in school. Future research should repeat our analysis in countries with more pronounced levels of ethnic segregation and more student residential propinquity to empirically validate our results from simulations. Mouw and Entwisle (2006) already tested the propinquity effect in a country with higher levels of residential segregation (USA), but also students in their data lived too far away from each other for propinquity to explain same-ethnic friendship within schools.

Repeating our study in different countries with possibly higher levels of residential segregation will not only provide an improved test of our simulated results, but it would also provide more insight into the generalizability of our results. Germany and the

[13] The *same minority* effect is noticeably larger in Model 1 compared to Model 3 in Germany. This reflects that the slope of the *same minority* effect is steeper in neighborhoods without immigrants than the slope of the overall *same minority* effect in Germany. Because the interaction effect is insignificant, however, we do not conclude that minority homophily depends on the share of immigrants in the neighborhood.

Netherlands are both countries with free school choice, school variation in religious and pedagogical principles, and a tracked educational system. Therefore, adolescents do not necessarily attend the most nearby school, but a school that fits them (or their parents) in their educational achievement, religious adherence, or pedagogical opinions. Our study of two countries increases the generalizability of results in comparison to studies in one country (Mouw and Entwisle, 2006; Vermeij et al., 2009), but our results do not readily translate to countries with a comprehensive school system or limited school choice through the use of catchment area rules.

Besides creating meeting opportunities with ethnic outgroup peers, outgroup exposure in the neighborhood may also dampen preferences for same-ethnic friendship. At first sight, our descriptive analyses show the opposite. Turning to multivariate analyses (that adequately account for alternative tie formation mechanisms such as triadic closure) results are actually in line with the exposure effect. However, the evidence in favor of a neighborhood exposure effect is very small and marginal. This suggests that exposure to immigrants in the neighborhood does not reduce prejudice to such an extent that native adolescents make interethnic friends like intergroup contact theory would predict (Allport, 1954). In contradiction to Vermeij et al. (2009), we find as such no convincing evidence that the exposure to outgroup members in the neighborhood weakens ethnic homophily in friendships in school classes.

One possible explanation for the lack of evidence in favor of an exposure effect may be found in two opposite mechanisms working simultaneously. It could be that some of the outgroup exposure in neighborhoods coincides with actual positive outgroup contact, whereas it leads to feelings of interethnic threat in other cases. These effects may cancel each other out, resulting in a small and irrelevant effect. Another explanation for not finding evidence for the neighborhood exposure mechanism may be that exposure has no effect at all as it is a superficial form of interethnic contact. On the school level, we found that there are few schools where neighborhood exposure has a significant effect, so we recommend future research to explore conditions that trigger contact and competition theory mechanisms on the student level. Preferably, such research can further dive into the causality of this relation using longitudinal data as well.

In addition, we suggest future research to further examine the links between neighborhood exposure, neighborhood contact, ingroup attitudes and ingroup friendship. There is some research dedicated to the first three steps in this sequence of exposure, contact, and attitudes, but it is not yet clear if this also translates into interethnic friendship (be it in schools or in another context), which is a more intense 'interethnic behavior' than an interethnic attitude. For example, Moody (2001) did provide evidence that shared extra-curricular activities help to build positive relations between adolescents of different racial backgrounds and Vervoort et al. (2011b) showed that mere exposure to outgroup members in class leads to more negative interethnic attitudes, whereas actual positive outgroup contact in the form of interethnic friendship in class leads to positive interethnic attitudes.

In sum, this study found no convincing evidence that the neighborhood would explain same-ethnic friendship preferences in school classes in Germany and the Netherlands. Nevertheless, our results do suggest that residential segregation has the potential to increase same-ethnic friendships in school classes not because exposure to more outgroup neighbors makes adolescents less homophilous, but because adolescents have the tendency to befriend classmates who live nearby and who live nearby friends. In conclusion, it is important for scholars and policy makers alike to realize that different sources of segregation can depend on each other.

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