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**Outgroup friendships and social influence in the development of adolescent attitudes
towards secondary outgroups**

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Outgroup friendships and social influence in the development of adolescent attitudes towards secondary outgroups

Abstract

Having outgroup friends not only improves attitudes towards the (primary) outgroup, but potentially also towards other (secondary) outgroups. This 'secondary-transfer effect' is attributed to the generalization of intergroup contact, but it may also reflect social influence as friends shape each other's outgroup attitudes. In three studies (two empirical, one simulation), we applied stochastic actor-oriented models to longitudinal network data representing friendships between adolescents. Across Studies 1 ($n = 812$) and 2 ($n = 2,559$), we found no evidence that having more primary outgroup friends was associated with a change in secondary outgroup attitudes; instead, adolescents' attitudes became more similar over time to those of their primary outgroup friends. Study 3, a simulation, further showed that social influence can lead to either more positive or more negative attitudes towards secondary outgroups. Thus, friendships with primary outgroup members may have negative implications for secondary outgroups when those friends hold more negative attitudes. We discuss how social influence can advance research on the generalization of intergroup contact effects.

Keywords: secondary transfer effect, intergroup contact, social influence, prejudice, social network analysis

Outgroup friendships and social influence in the development of adolescent attitudes towards secondary outgroups

Positive intergroup contact experiences – especially in the form of friendships – are associated with more positive attitudes towards outgroups (Allport, 1954; Pettigrew, 1997). However, in contemporary super-diverse societies, befriending members of each and every single outgroup in a given social context is often not feasible (Titzmann & Jugert, 2019; Vertovec, 2007). This limitation of intergroup contact as a way to improve wider intergroup relations can be mitigated by the generalization of intergroup contact effects from one, primary, outgroup to one or more, secondary outgroups (Boin et al., 2021; Brylka et al., 2016; Tausch et al., 2010), a phenomenon termed the secondary transfer effect of intergroup contact (STE). Research on the STE has, for example, shown that, among Germans, positive contact with foreigners is not only linked to more positive attitudes towards foreigners but also to more positive attitudes towards gay people (Pettigrew, 2009). In essence, secondary transfer effects indicate that positive contact with one outgroup can have positive implications for other outgroups. Secondary transfer effects can, however, also be negative. Van Laar et al.'s (2005) study comparing effects of randomly assigned same-race vs mixed-race roommates found that contact with Asian American roommates tended, especially for White respondents, to make attitudes towards other outgroups more negative (they also found typical positive STEs for Black and Latino roommates). Two other longitudinal studies also found tentative evidence of negative STEs (Henschel & Köttling, 2023; Kauff et al., 2023).

What has been neglected in this literature (until very recently, see Bracegirdle et al., 2022; Zingora et al., 2020) is social influence – a prominent process in social interactions

whereby peoples' attitudes are shaped by the attitudes of significant others, including friends (Flache et al., 2017). Social influence may provide a hitherto unexplored process by which contact with one outgroup leads to changes in attitudes toward other outgroups. Crucially, social influence may be associated with both more positive and more negative attitudes.

Specifically, social influence may lead to more positive secondary outgroup attitudes when a person (ego) has primary outgroup friends with more positive secondary outgroup attitudes than ego. Similarly, social influence may lead to more negative secondary outgroup attitudes when primary outgroup friends hold more negative secondary outgroup attitudes than ego. For example, if friend A from outgroup A has more positive attitudes toward outgroup B than ego, ego's attitudes toward outgroup B are expected to become more positive over time. In contrast, if friend A from outgroup A has more negative attitudes toward outgroup B than ego, ego's attitudes toward outgroup B are expected to become more negative over time. Therefore, our first aim was to investigate whether social influence could explain why having primary outgroup friends is associated with attitudes towards secondary outgroups.

As well as applying a social influence perspective to the study of secondary-transfer effects, we were motivated to address another puzzle in the literature. Recently, researchers have started applying longitudinal social network analysis to study intergroup contact, due to its multiple benefits compared to other methods (Bracegirdle et al., 2022; Khuu et al., 2023; Van Zalk et al., 2013; Wölfer & Hewstone, 2017; Zingora et al., 2020; Zingora & Flache, 2025). This research led to a surprising finding: having outgroup friends was not linked to more positive intergroup attitudes once social influence (i.e., ingroup

friends' attitudes) was accounted for (for a meta-analysis, see Zingora, 2024). However, who influences whom is still unclear. Some studies reported social influence from ingroup but not from outgroup friends (Bracegirdle et al., 2023), implying that having outgroup friends is not associated with outgroup attitudes. Others found influence of outgroup friends' attitudes with regard to generalized prejudice (Zingora & Flache, 2025).

To reconcile these seemingly inconsistent findings, we propose that primary outgroup friends' attitudes are less strongly associated with ego's attitudes toward the primary outgroup, while still being related to attitudes toward other outgroups. This is consistent with the idea that statements about one's own group may be discounted as ingroup-serving (Judd et al., 2005; Wallace et al., 2020), whereas evaluations of other groups may be perceived as less self-interested by comparison (Brandt et al., 2009). Friends generally may shape one another's outgroup attitudes (for a mini meta-analysis, see Zingora, 2024), and they might continue doing so if they are not perceived as being biased. Consistent with this research goal, our analyses focus on secondary outgroup attitudes.

The aims of our research were twofold. First, we aimed to examine if, through social influence, primary outgroup friends' attitudes towards secondary outgroups are longitudinally associated with ego's attitudes towards those secondary outgroups, beyond the effects of having secondary outgroup friends. We studied groups based on ethnicity, which is the major source of diversity in many societies (e.g., Dinesen et al., 2020). We also explored whether social influence processes differ between ethnic majority and minority adolescents. Second, we aimed to explore when social influence has more positive or negative implications for intergroup relations, by investigating the impact of friends whose outgroup attitudes were either positive or negative. To this end, we conducted two

empirical studies using longitudinal social network data from secondary schools in the Netherlands (Study 1) and Germany (Study 2). We then simulated hypothetical experiments based on the effects observed in Studies 1 and 2 (Study 3). These agent-based simulations allowed us to systematically vary conditions—such as the number of outgroup friends, the strength of social influence, and the initial valence of attitudes—across a much broader range than would be feasible or ethical in experimental designs. Although simulations remain simplified representations of social processes, even when grounded in empirical data, they help reveal how individual-level effects can combine in complex ways, sometimes producing unexpected macro-level outcomes. As such, they provide a valuable tool for theory building in social psychology (Hedström & Ylikoski, 2010; Mason et al., 2007). We focused on interethnic friendships during adolescence because adolescents' attitudes towards ethnic outgroups are more malleable than adults' attitudes (Wölfer et al., 2016) and because adolescents are especially motivated to adopt the attitudes of significant peers and friends (Juvonen & Galván, 2008).

The generalization of intergroup contact effects

Numerous cross-sectional studies (Brylka et al., 2016; Lissitsa & Kushnirovich, 2018; Lolliot et al., 2012; Schmid et al., 2012; Vezzali, Di Bernardo, et al., 2018, 2019; Zingora & Graf, 2019) and several longitudinal and experimental studies (Jasinskaja-Lahti et al., 2020; Meleady & Forder, 2019; Pettigrew, 2009; Tausch et al., 2010) have shown that positive contact with a member of the primary outgroup can improve attitudes towards secondary outgroups not involved in the contact, the secondary transfer effect of intergroup contact (Pettigrew, 2009). However, some studies failed to find evidence of the STE or only found STEs for specific combinations of primary and secondary outgroups (Barr & Bracchitta, 2015;

Cernat, 2019; Meeusen et al., 2017; Sharp et al., 2011; Vezzali, Di Bernardo, et al., 2018).

Social influence may help explain why associations between having outgroup friends and attitudes towards secondary outgroups vary.

Intergroup friendship has been considered to have special importance for intergroup contact research as it involves long-term positive exposure to outgroup members (for meta-analyses, see Davies et al., 2011; Pettigrew, 1997). Intergroup friendship typically involves intimacy, frequent interaction, and self-disclosure (Turner & Feddes, 2011), characteristics not necessarily present in other forms of positive interaction between members from different groups. Schools provide opportunities to experience this ideal form of (and other forms of) intergroup contact between peers. In the context of the secondary transfer effect, research found that friendship with a primary outgroup member was linked to more positive attitudes towards secondary outgroups (Tausch et al., 2010; Vezzali, Birtel, et al., 2019; Vezzali, Turner, et al., 2018). However, several studies did not find links between having primary outgroup friends and secondary outgroup attitudes under certain conditions, such as specific model specifications or group combinations (Meeusen et al., 2017; Schmid et al., 2012; Sharp et al., 2011; Tausch et al., 2010). These results may reflect social influence among friends (Zingora & Flache, 2025). If primary outgroup friends hold diverse attitudes towards secondary outgroups (some positive, some negative), social influence processes may be associated with corresponding variation in adolescents' attitudes towards these outgroups. Thus, prior assumptions that outgroup friends are always associated with more positive secondary outgroup attitudes may have been overly optimistic.

Social Influence

Peers, particularly friends, constitute an important source of social influence (Jaccard et al., 2005; Paluck, 2011; Wentzel et al., 2004). Adolescents value their friends (Rivas-Drake et al., 2019; Van Zalk et al., 2013), spend a lot of time together, and share relationships characterized by intimacy and frequent interaction (Newcomb & Bagwell, 1995). In such relationships, adolescents have been found to adopt friends' attitudes for multiple reasons; for example, because they are frequently observed (Bandura, 1977), because they are perceived as a reliable representation of reality (Hardin & Tory, 1996), and to avoid social exclusion (Crandall et al., 2002).

Research has shown that adolescents' outgroup attitudes become more similar over time to their friends' outgroup attitudes (Bohman & Kudrnac, 2022; Bracegirdle et al., 2026; Hjern et al., 2018; Van Zalk et al., 2013; Zingora et al., 2020). Although prior research has found patterns consistent with social influence in adolescents' attitudes and behaviors (DeLay et al., 2016; Rivas-Drake et al., 2019; Schaefer et al., 2022; Steglich et al., 2006; Van Zalk et al., 2013; Weerman, 2011; Zingora & Flache, 2025), adolescents' outgroup attitudes may not become equally similar over time to those of all friends. In particular, primary outgroup, secondary outgroup, and ingroup friends may show differential associations with adolescents' outgroup attitudes.

People typically expect others to exhibit ingroup favouritism in their evaluations of social groups (Judd et al., 2005). Accordingly, ingroup attitudes may be perceived as biased. Prior research indicates that perceiving an opinion as biased is associated with lower source credibility and reduced persuasiveness, beyond associations with trustworthiness, expertise, or likability (Wallace et al., 2020). This suggests that even primary outgroup friends, who are typically perceived positively, might be perceived as biased in favour of their own group and

thus have a reduced impact on primary outgroup attitudes. These arguments are supported by prior research, which documented no social influence processes of primary outgroup friends on attitudes towards their own group (Bracegirdle et al., 2023). To illustrate, if Mark (Dutch) has a friend called Hans (German), Hans may not influence Mark's attitudes towards German people, because Hans would be perceived as biased in favour of German people.

In comparison, patterns consistent with social influence may still emerge for attitudes towards secondary outgroups. Research suggests that, when forming impressions of a person, people tend to rely more on information from independent third parties than on information provided by the person (Brandt et al., 2009). If friends' attitudes are not discounted due to perceived bias, friends should remain influential, as is the case for other types of attitudes and behaviors like academic drive (Zingora & Flache, 2025). Thus, primary outgroup friends should continue to exert social influence on attitudes toward secondary outgroups—even if their influence regarding their own group is weaker—because their attitude toward secondary outgroups should be perceived as less biased. Following the previous example, if Mark (Dutch) has a friend called Hans (German), Hans may influence Mark's attitudes towards Polish people, because Hans would not be perceived as biased in favour of Polish people.

While prior evidence suggests that ingroup friends' attitudes are strongly aligned with adolescents' attitudes (as shown in social-network studies by Bracegirdle et al., 2023; Zingora & Flache, 2025), it remains theoretically and practically important to estimate the role of outgroup friends— particularly when their prevailing attitudes diverge from those of ingroup peers. Although, ingroup friends are not central to secondary transfer effects (Pettigrew, 2009; Tausch et al., 2010) or to our research questions, we nevertheless control

for their association with the development of secondary outgroup attitudes. For instance, in settings of ethnic conflict, primary outgroup friends may transmit more negative secondary outgroup attitudes, whereas in more cooperative environments, they might serve as conduits of tolerance. Thus, identifying who becomes more similar to whom in intergroup settings helps disentangle whether associations between having primary outgroup friends and secondary outgroup attitudes are related to direct intergroup contact, broader social influence, or both. This distinction can inform targeted interventions by identifying which peer groups are associated with more inclusive attitudes, and under what conditions. It can also advance theory by highlighting boundary conditions under which different peer groups influence intergroup attitudes, and adds methodological value by simultaneously modeling multiple sources of social influence within networks.

Positive and Negative Social Influence

Social influence implies that adolescents could adopt attitudes that are more positive or negative than their own. Accordingly, having primary outgroup friends does not necessarily correspond to more positive secondary outgroup attitudes through social influence. Being friends with a primary outgroup member may also be associated with less positive secondary outgroup attitudes if primary outgroup friends hold more negative attitudes toward the secondary outgroup than one's own attitudes. Thus, social influence may be associated with more positive or more negative outcomes, depending on the valence of outgroup friends' attitudes.

The potential for either positive or negative social influence has significant implications for the interpretation of STE research. We cannot be certain that documented STEs are attributable to having outgroup friends per se or to having outgroup friends with

positive (or negative) secondary outgroup attitudes. Prior research has primarily tested STEs of ethnic majority members' contact with ethnic minority group members (Brylka et al., 2016; Jasinskaja-Lahti et al., 2020; Zingora & Graf, 2019) who are likely to have more positive attitudes towards other minorities than ethnic majority members (Verkuyten, 2005; Wolsko et al., 2006), although this is not uniformly the case. Ethnic majority members with more primary outgroup friends could, thus, be exposed to friends with more positive, or more negative secondary outgroup attitudes than those without primary outgroup friends. Given, however, that minorities tend to have more positive attitudes towards other minorities than ethnic majority members, at least in some cases, prior research might have overlooked the possibility that the correlation between outgroup contact and attitudes towards secondary outgroups may be due to having primary outgroup friends with positive secondary outgroup attitudes. We also cannot rule out that non-significant STEs reported in prior research (Barr & Bracchitta, 2015; Cernat, 2019; Sharp et al., 2011) were, in fact, due to negative social influence effects cancelling out the positive effects of outgroup contact. In a similar vein, Van Laar et al.'s (2005) puzzling finding of a negative association between White Americans' contact with an Asian-American primary outgroup and secondary outgroup attitudes (towards other ethnic minorities) could reflect social influence processes from the Asian-American roommates having worse secondary-outgroup outgroup attitudes. Therefore, if primary outgroup friends do exert social influence over secondary outgroup attitudes, we could not reliably interpret the STE without accounting for social influence.

Social Network Approach and Agent-Based Simulations

In schools, adolescents are linked to each other via relationships, and these links represent a social network of students. Relationships, especially friendships, function as

channels along which adolescents can influence each other (Bracegirdle et al., 2022; Geven et al., 2013; Leszczensky & Pink, 2020; I. J. Raabe et al., 2019; Steglich et al., 2006; Zingora et al., 2020; Zingora & Flache, 2025). Networks are not merely collections of dyadic interactions—they constitute macro-level structures that shape and constrain individual-level processes such as the formation of intergroup friendships and the development of outgroup attitudes. For example, the likelihood of forming a primary outgroup friendship is related to the broader network structure, individual opportunity, existing connections, structural tendencies (e.g., if two people in a network share a common friend, they are more likely to become friends themselves), and randomness (Snijders et al., 2010). To fully capture these interdependent dynamics, data from all network members must be modeled as part of an interconnected network. In practice, some nodes or ties may be missing (e.g., due to absences or nonparticipation), which can reduce accuracy. In our case, the missing rate was reasonably low; such data were successfully used for SAOM before, which minimizes this concern (Leszczensky & Pink, 2020; Stark, 2015).

In this research, we employ stochastic actor-oriented modeling (SAOM) in Studies 1 and 2 to analyze the co-evolution of friendships and secondary outgroup attitudes. SAOM is particularly suited for modeling dynamic, interdependent networks (Snijders et al., 2010; Steglich et al., 2010). Consider a simplified example: Mark (Dutch majority student) and Hans (German minority student)—are initially not friends, and Hans holds more positive attitudes towards a secondary outgroup (e.g., Polish people) than Mark. At a later time point, they become friends, and Mark's secondary outgroup attitudes have improved. SAOM can estimate various processes that could theoretically explain changes in the network and attitudes. These include that: (1) the students first became friends and then their attitudes became more similar to each other (social influence); (2) having more

outgroup friends is associated with positive change in secondary outgroup attitudes (intergroup contact); (3) the attitude change occurred independently, but people tended to befriend those with similar attitudes (homophily); (4) students may become more similar in attitudes from reasons unrelated to social influence or intergroup contact, and may become friends because they have friends in common; and (5) or other contextual factors. SAOM helps us see which of these processes is supported by the data, without making causal claims in an experimental sense.

SAOM has several other advantages. It models relational interdependence (the observations in social networks are not independent of each other), accounts for the active role of individuals in shaping their social worlds, and draws on self-reported relational data, which tend to be more accurate than externally inferred ties (Veenstra et al., 2013). It also improves statistical power by analyzing relationships rather than treating individuals as independent observations (Wölfer & Hewstone, 2017). However, these advantages come with assumptions about the underlying processes—for example, that ties (e.g., friendships) are durable states rather than events, that network evolution follows a Markov process, meaning that only the current state of the network influences decisions and that there is no strategic planning, and that actors (here, students) have agency in initiating ties and, thus, selecting friends (Snijders et al., 2010). A more detailed discussion of SAOM's assumptions and limitations is available in Snijders et al. (2010), Steglich et al. (2010), and Wölfer and Hewstone (2017); specifically in the context of adolescent development, see Veenstra (2013). These assumptions are reasonable in the context of adolescent peer networks in schools (Steglich et al., 2006; Veenstra et al., 2013).

To complement SAOM, we also use agent-based modeling (ABM)—a simulation-based approach that builds on the SAOM estimates from the first two empirical studies—in Study 3. ABM allows us to explore the macro-level implications of micro-level processes (Flache & Fernandes, 2021), such as how intergroup friendship and social influence might contribute to the network-wide development of secondary outgroup attitudes. Hedström and Ylikoski (2010) have described features of SAOM and ABM as ideal for testing mechanisms or processes in social sciences. ABM is particularly valuable when applied to complex systems like adolescent networks, where influence and relationships affect each other, are constantly changing, and are shaped by multiple interacting processes—including the development of attitudes themselves (Snijders et al., 2010; Veenstra et al., 2013; Wölfer & Hewstone, 2017; Zingora, 2024). Whereas SAOM allows us to test which processes take place in adolescent social networks, the ABM simulation approach enables us to capture the implications of these simultaneous processes for the development of the wider network and the spread of outgroup attitudes, and to further advance theory by generating hypotheses for future research (Flache et al., 2017; Mason et al., 2007; Smith & Conrey, 2007).

ABM complements statistical inference by allowing us to simulate hypothetical but theoretically meaningful scenarios using empirically grounded parameters obtained through SAOM (Steglich & Snijders, 2022) in Studies 1 and 2. For example, we can examine how different baseline distributions of secondary outgroup attitudes (e.g., on average negative vs. positive attitudes in the network) affect the spread of secondary outgroup attitudes, given the empirically detected strength of social influence and intergroup friendship. Additionally, it is possible to examine how secondary outgroup attitudes develop when primary outgroup friends hold different attitudes as compared to the mean secondary outgroup attitudes of their ingroup friends. Although these simulations are theoretical, they

help us understand the macro-level implications of micro-level processes empirically estimated by the SAOM.

Together, SAOM and ABM provide a powerful combination: SAOM estimates the processes of attitude and friendship change using real-world longitudinal data, while ABM simulates the emergent, macro-level outcomes of these processes under various conditions. This integration advances theory by linking micro-level processes and macro-level consequences and allows us to assess how robust social influence dynamics are across different structural and attitudinal contexts.

Overview

We tested the following two directional hypotheses. Studies 1 and 2 investigated positive intergroup contact (having outgroup friends) and social influence effects on secondary outgroup attitudes among ethnic majority group members.

H1 (secondary transfer effect of contact): The number of primary outgroup friends will be positively associated with developing more positive attitudes towards the secondary outgroup over time.

H2 (social influence): Attitudes towards the secondary outgroup will become more similar to primary outgroup friends' attitudes towards the secondary outgroup over time.

We additionally tested two exploratory hypotheses:

H3 (Study 2): Do the secondary transfer effect of contact and the social influence effect on secondary outgroup attitudes differ between ethnic majority and minority group members?

H4 (Study 3): How do patterns consistent with social influence vary for adolescents with negative, neutral and positive attitudes towards secondary outgroups when their primary outgroup friends hold negative, neutral or positive attitudes?

Study 1

In Study 1, using secondary analysis of two-wave data from the Netherlands, we investigated the development of Dutch ethnic majority adolescents' attitudes towards Moroccans (the secondary outgroup), and contact with and social influence of friends from other (i.e., non-Moroccan) ethnic minority groups (primary outgroup members). We chose to study attitudes towards Moroccans because Moroccans are the second-largest ethnic minority group in the Netherlands (419,272 of approximately 2.53 million non-Western population, about 16.6%; Statista, 2024).

The primary outgroup included peers from various ethnic outgroups, but we did not include ethnic groups that could be perceived as similar to either Moroccans or Dutch. We took this precaution to decrease the chances that adolescents could perceive ethnicities included in the primary outgroup as an ingroup or the secondary outgroup. To guide these decisions, we combined theoretical criteria (shared history and language similarity) with empirical insights on perceived similarity among ethnic groups in the Netherlands (Schalk-Soekar et al., 2004) and broader cross-national cultural distance patterns (Minkov & Kaasa, 2022). Our selection of similar backgrounds to the Moroccan background was informed by shared history (i.e., countries that were part of the Ottoman Empire), language similarity, and findings suggesting that even geographically distant parts of the Ottoman Empire, such as Morocco and Turkey, tend to be perceived similarly by the Dutch population (Schalk-Soekar et al., 2004). This resulted in excluding adolescents from some ethnic backgrounds

(i.e., Iraq, Iran, Afghanistan, Kurdistan, Algeria, Egypt, Syria, Bosnia and Herzegovina, Albania; for more details, see Supplemental Material A). Turks, who could be perceived as a similar outgroup to Moroccans but constituted a large ethnic group themselves within the Netherlands, were studied as a monolithic primary outgroup in a robustness check and were thus also excluded (for the results concerning Turks, see Supplemental Material F). We considered potentially similar ethnicities to the Dutch to be Western countries (i.e., Western and Southern Europe, the US, Australia, and New Zealand; for more details, see Supplemental Material A; Minkov & Kaasa, 2022). This approach led us to construct a primary outgroup that was sufficiently numerous in the data and reasonably dissimilar to either the ingroup or a secondary outgroup (for more details, see Supplemental Material A).

Methods

Materials used in this study, including R code, can be found here:

https://osf.io/esczh/?view_only=a0d5364c2f934221815987c013200620

Sample and Procedure

We analyzed data from a publicly available dataset: The Arnhem School Study (TASS; Stark & Flache, 2012). TASS is a large dataset that has been used to test the longitudinal association between intergroup contact and interethnic attitudes (Munniksmas et al., 2013), the identification of influential peers (Zingora et al., 2020), and the generalization of attitudes from individuals to groups (Stark et al., 2013). However, to the best of our knowledge, TASS has not been used to study the secondary transfer effect. Adolescents ($N = 1,314$, 12-13 years old, 46% female) completed an online questionnaire in their school's computer lab under a teacher's supervision. Data were collected in 58 classrooms nested in 11 schools.

The assessment of statistical power in longitudinal social network data cannot be assessed with traditional methods due to interdependence in the data. Nevertheless, the unit of analysis in the social network analysis is a tie, such as friendship between two people, and not a single participant. A higher number of ties than respondents in the data increases statistical power and precision (Wölfer & Hewstone, 2017). Sample sizes similar to or smaller than the sample size in Study 1 have been frequently used to investigate social influence, and the statistical power related to this sample size is considered sufficient (Stark, 2015; Steglich et al., 2006; Zingora et al., 2020).

Of the four available waves, we analyzed the second (December 2008) and third (June 2009) waves. We did not use data from the first wave (September 2008), because it was collected just two weeks after adolescents transferred to a new school comprising new classmates; we judged this to be insufficient time for the formation of new friendships, and its use risked that the meaning of friendships might differ between the first and other waves. Some students may have transferred together, but as we could not verify whether such ties persisted or changed, we excluded this wave to focus on relationships that had stabilized within the new school. Prior research showed that friendship networks of just-acquainted adolescents are unstable and need about three months to stabilize (Selfhout et al., 2010). The second wave was collected four months after the transition to secondary school, thus adolescents had time to form friendships. An additional fourth wave was collected but not all schools participated and many students transferred between classes, therefore we did not use the fourth wave. Previous research has successfully used these two selected waves from the TASS data (e.g., Zingora et al., 2020).

Following commonly recommended practice (Ripley et al., 2025), we excluded 24 classrooms out of 58. We excluded classrooms as follows: (1) classrooms (13) in which more than 30% of students were missing at either wave (because a high number of missing values causes problems in model estimation; Ripley et al., 2024); (2) classrooms (3) in which there was an insufficient amount of change in successive networks (Jaccard index values equal or lower than .2) or in attitudes towards Moroccans (no change in a network), because some change is necessary for the estimation (Ripley et al., 2024); (3) classrooms (5) in which there were no primary outgroup members, which made it impossible to test our hypotheses; and (4) classrooms (3) whose inclusion led to non-convergence of the models (models that do not converge are unreliable and cannot be interpreted). This resulted in a final sample of 34 classrooms ($N_{total} = 812$, $n_{majority} = 540$, $n_{ethnic-minority} = 100$, $n_{Moroccan} = 30$, $n_{turkish} = 79$, $n_{remaining} = 50$); the mean number of ethnic-minority students per classroom was 2.86 (range 0-6). Given the exclusions based on (1) to (4), it was impossible to compare results in the full versus the restricted sample.

Measures

Intergroup attitudes. Respondents were asked to indicate their attitudes toward Moroccans using four items (honest, friendly, smart, and helpful) on a scale that ranged from 1 (*totally disagree*) to 7 (*totally agree*) (Feddes et al., 2009). The scores on these four items were averaged ($\alpha = .97$).

Friendship network. The names of all classmates were presented on a screen and adolescents were asked to indicate whom they consider to be a “best friend”. To obtain each respondent’s complete within-classroom friendship network the number of friendship nominations was not limited (Stark, 2018) (see Table 1 for the mean number of friends).

Ethnicity. If both parents were born in the Netherlands, adolescents were considered Dutch. If one parent was born outside of the Netherlands, the foreign-born parent's ethnicity was ascribed to an adolescent. If both parents were born outside of the Netherlands, the ethnicity of the mother was ascribed to a participant (Dollman et al., 2014). We studied contact with and influence of the following groups: (1) ethnic minority friends who represented *the primary outgroup* (excluding Dutch, Moroccan, Turkish, and other ethnicities that could be perceived as similar to Dutch or Moroccans; see Supplemental Material A for more details); (2) Moroccans, *the secondary outgroup*; (3) Dutch, *the ingroup*; (4) Turkish (see robustness check), and (5) remaining friends (i.e., students who did not belong to the Dutch ingroup, or the primary or secondary outgroups).

Gender. Adolescents were asked to indicate whether they were girls or boys (0 = girl, 1 = boy).

Analysis

We used Stochastic-Actor-Oriented-Models (SAOMs) for our analysis (Snijders et al., 2010; Steglich et al., 2006). Using longitudinal data (from the second to the third wave), we studied the processes behind the development of the networks and attitudes on an inter-individual level. Changes in the network (i.e., changes in the friendship relationships) and attitudes to Moroccans were dependent variables. SAOMs model network change from the perspective of actors (i.e., the students in a classroom) and simulate the changes within the network in a sequence of numerous small steps. In each step, an actor has an opportunity to change their attitudes or create, maintain, or dissolve a friendship tie. After each step, a simulated network is updated by the decision of a student and informs a student next in line about the status of the network. Adolescents' simulated decisions are based on the network

structure and characteristics of students and their peers, given the effects that could specify the processes responsible for the changes in the network and attitudes. The SAOM then estimates and tests which effects are most consistent with the observed changes in the network and attitudes. We used the RSiena package implemented in R to conduct the analyses (Ripley et al., 2025).

Although we used SAOM in all three studies, there is a significant difference between the first two studies and Study 3. SAOM can be regarded as an agent-based simulation model typically used for the statistical estimation of effects hypothesized to be responsible for the changes in actual longitudinal social network data (Snijders et al., 2010). We applied SAOM in this fashion in Studies 1 and 2. In Study 3, we used SAOM to simulate *hypothetical* scenarios. Thus, while simulations in Studies 1 and 2 were used for statistical inference, simulations in Study 3 were used for generative purposes and understanding the effects and their consequences for developing attitudes. Although both approaches have their benefits for social-psychological research, especially when multiple people interact (Smith & Conrey, 2007), we combined their strengths within this paper (Steglich & Snijders, 2022).

A SAOM can capture changes in a network, such as friendships among adolescents, and an outcome, such as attitudes towards a secondary outgroup. This kind of analysis comprises two intertwined parts. The *network dynamics part* captures effects that influence tie formation, maintenance, and dissolution (e.g., a tendency to reciprocate friendships or befriend friends of friends). In the *attitudes dynamics part*, we examined effects that could influence the development of secondary outgroup attitudes, especially the contact and social influence effects (e.g., overall tendency to increase or decrease one's attitudinal score). We assessed convergence and calculated four goodness-of-fit tests, which indicate

whether we selected effects that accurately represent both network and attitude evolution (see Supplemental Material B).

To estimate contact and social influence effects of primary outgroup friends, we used a dyadic covariate (Bracegirdle et al., 2022). A dyadic covariate represents a matrix of all students in which the relationships of interests are valued 1 and all other relations are 0. We tested our hypotheses using a dyadic covariate that captured whether a pair of classmates included a Dutch student and a student belonging to the primary outgroup (valued 1). All other links in this dyadic covariate were 0.

However, to accurately estimate the contact and social influence effects of primary outgroup friends on Dutch adolescents' attitudes towards Moroccans, we had to additionally control for contact and social influence of friends from all other potential groups (including the Dutch ethnic ingroup). For this purpose, we created four additional dyadic covariates for each ethnic group that we distinguish in this study (see the Ethnicity measure for more details). Next to the dyadic covariate for primary outgroup friends, we thus accounted for contact and influence effects of friends (1) from ***the ingroup*** (i.e., Dutch); (2) from ***the secondary outgroup*** (i.e., Moroccan ethnicity) and; (3) from the group ***'remaining friends'*** (i.e., students who did not belong to the Dutch ingroup, primary or secondary outgroups; see Ethnicity measure for more details). We included these additional groups solely for modeling purposes. By controlling for friendship and influence from all relevant groups in the network, we ensured that the estimated effects for primary outgroup friends reflected only those friendships, rather than with other group influences. However, the effects associated with these additional groups should not be interpreted—particularly in cases where group sizes were small and estimates were based on very few friendships. In

a robustness check, we examined contact and influence effects of: (4) friends from ***another primary outgroup*** (i.e., Turkish ethnicity).

To test the effect of outgroup contact on secondary outgroup attitudes (i.e., H1), we investigated whether the number of primary outgroup friends (i.e., friends from ethnic minority groups other than Moroccans) was longitudinally associated with the development of attitudes towards the secondary outgroup (i.e., Moroccans). A significant positive effect would support H1 that contact with a primary outgroup is associated with more positive attitudes to the secondary outgroup.

To test the effect of social influence (i.e., H2), we estimated whether Dutch students' attitudes towards the secondary outgroup became more similar to the attitudes of their primary outgroup friends. More details on the operationalization of social influence can be found in Supplemental Material C.

We controlled for a variety of tendencies that should affect changes in friendships and attitudes (e.g., reciprocity). All effects are listed in Supplemental Material D, which contains a technical description and interpretation of each effect reported in this article. Crucially, we controlled for homophily based on secondary outgroup attitudes, which enabled us to separate social influence (i.e., one's friends' attitudes influence one's own attitudes) from a tendency to select friends with similar attitudes (i.e., attitudinal homophily). We also controlled for classroom size and the number of peers who belonged to the Dutch majority, Turkish or Moroccan minorities, or other-ethnic minority groups.

Aggregating classroom-level effects into general estimates requires accounting for differences between classrooms and schools. For this reason, we applied a recently developed approach that enables us to estimate random coefficients for network models

(Koskinen & Snijders, 2023). We conducted the analysis using a Bayesian estimation method. We estimated contact and social influence effects as random. We report posterior means (effect sizes as log odds), posterior standard deviations, 95% credibility intervals (which refer to the probability that an estimate falls within a particular interval), and posterior p -values.

Results and discussion

Descriptive Statistics

Descriptive statistics of the majority sample are shown in Table 1. Descriptive statistics of the primary outgroup adolescents can be found in Supplemental Material E.

Table 1

Means, standard deviations, and correlations of friendship variables at T1 and attitudes towards Moroccans at T1 and T2 in Dutch majority respondents (Study 1).

Variable	M	SD	1	2	3	4
1. Ingroup friends T1	3.61	3.07				
2. Ethnic minority friends T1	0.56	0.85	.19**			
3. Moroccan friends T1	0.09	0.37	.02	.02		
4. Attitudes towards Moroccans						
T1	3.95	1.33	-.01	-.04	.14**	
5. Attitudes towards Moroccans						
T2	3.83	1.26	-.02	-.04	.12**	.41**

Note. M and SD denote mean and standard deviation, respectively. T1 and T2 denote Wave 1 and Wave 2, respectively. Attitudes towards Moroccans ranged from 1 (*negative*) to 7 (*positive*).

* indicates $p < .05$. ** indicates $p < .01$.

Attitudes towards Moroccans were, on average, neutral at T1 (a difference from the scale midpoint of 4, $t(500) = -0.81$, $p = .420$) and slightly negative at T2 (a difference from the scale midpoint of 4, $t(501) = -2.97$, $p = .003$). These findings align with previous research on intergroup relations, which generally have reported neutral to slightly positive attitudes toward outgroups (e.g., findings from similar-aged respondents in England, Germany, the Netherlands, and Sweden; Wölfer et al., 2018) but also, in some cases, slightly negative ones (Eckstein et al., 2021). The size of the correlation between attitudes towards Moroccans at T1 and T2 ($r = .41$, $p < .01$) and the result of the t-test ($t(1025.6) = 1.74$, $p = .08$) indicate some fluctuations in individual attitudes but not a significant shift in attitudes on a network level. This finding aligns with prior research, which has reported similar correlations (e.g., Van Zalk et al., 2013) and showed that attitudes of adolescents are still developing (T. Raabe & Beelmann, 2011).

Dutch students had a mean of 3.61 ($SD = 3.07$) ingroup friends and 0.56 ($SD = 0.85$) primary outgroup friends. This aligns with prior research that reported a similarly low number of outgroup friends and comparatively high number of ingroup friends (Bracegirdle et al., 2023; Khuu et al., 2023). This means that about every second Dutch student had a primary outgroup friend, providing sufficient variation and a number of ties through which influence could occur. The total number of friends is higher as Dutch students could have friends among peers who did not belong to ingroup, a primary or a secondary outgroup.

Hypotheses Testing: Outgroup Contact and Social Influence Effects on Secondary Outgroup Attitudes

The SAOM showed no effect of the number of ethnic-minority friends (our measure of primary outgroup contact) on attitudes towards Moroccans (secondary outgroup;

estimate = -.18, *SD* = .13, *p* = .166), providing no support for H1 (secondary transfer effect of contact hypothesis). However, Dutch students attitudes toward Moroccans become more similar to the attitudes of their ethnic minority friends (*estimate* = 3.95, *SD* = .33, *p* < .001), supporting H2 (social influence hypothesis).

In a robustness check, we examined contact and social influence of another primary outgroup – Turkish people – on attitudes towards the secondary outgroup – Moroccans. We tested contact and social influence effects of ethnic minority and Turkish friends on students' attitudes towards Moroccans in the same model for control purposes. As was the case for the influence of minority friends, the number of Turkish friends (alternative primary outgroup) was unrelated to Dutch students' attitudes towards Moroccans (secondary outgroup; *estimate* = -.23, *SD* = .29, *p* = .418), providing again no support for H1 (contact hypothesis). However, Dutch students attitudes toward Moroccans become more similar to the attitudes of their Turkish friends (*estimate* = 2.13, *SD* = .41, *p* < .001), providing further support for H2 (social influence).

Adolescents did not tend to form friendships based on the similarity in secondary outgroup attitudes (attitude homophily) but tended to befriend peers with the same ethnicity (ethnic homophily), while controlling for various other structural effects. This implies that Dutch adolescents' attitudes towards Moroccans changed in the direction of their primary outgroup friends (consistent with social influence), and this influence in a network was not restricted by a preference for friends with similar attitudes. Table 2 illustrates effects used for the hypotheses testing, robustness checks, as well as homophilous tendencies.

Table 2

Main effects from the SAOM

				Credibility interval	
	Estimate	<i>SD</i>	Posterior <i>p</i> -value	From	To
Hypothesis 1: Secondary transfer effect of contact					
Number of ethnic-minority friends	-.18	.13	.166	-.44	.09
Number of Turkish friends	-.23	.29	.418	-.95	.20
Hypothesis 2: Social influence of primary outgroup					
Social influence of ethnic-minority friends	3.95***	.33	<.001	3.08	4.39
Social influence of Turkish friends	2.13***	.41	<.001	1.45	2.80
Homophily (selection) tendencies					
Attitudes towards the secondary outgroup	-.06	.15	.705	-.36	.18
Ethnicity	.29***	.08	<.001	.13	.44

Note. SD indicates the standard deviation of an estimate. The effect is significant if the credibility interval does not contain zero. *** $p < .001$. The complete SAOM results, as well as a discussion of several other effects, can be found in Supplemental Material F.

Summary

In Study 1, we found that having primary outgroup friends was not associated with more positive attitudes towards the secondary outgroup, Moroccans, among Dutch-majority adolescents (contrary to H1); thus, we found no evidence of a STE. We did, however, find strong support for the hypothesis that primary outgroup friends' attitudes are

associated with Dutch-majority students' secondary outgroup attitudes in ways consistent with social influence (and in line with H2). Our findings thus suggest that primary outgroup friends' *attitudes* towards other outgroups – rather than the *number* of primary outgroup friends – are longitudinally associated with attitude change towards the secondary outgroup. In this study, the investigation of social influence supports the conclusion that having minority friends from other ethnic groups is linked to the development of attitudes towards a different ethnic minority group, Moroccans. We reached this conclusion by investigating not only a potential effect of intergroup contact, but also one of social influence.

In Study 1, we opted to study a mix of nationalities as the primary outgroup, ensuring a sufficiently large number of observations of intergroup friendships. While the Turkish minority constituted a monolithic group large enough to allow for focused analysis, this group might be perceived as being similar to the Moroccan minority in the Dutch context (e.g., being perceived more negatively than other groups; Verkuyten & Thijs, 2010). As such, using Turkish individuals as the primary outgroup could blur the distinction between primary and secondary outgroups and complicate the interpretation of secondary transfer effects. Nevertheless, an additional analysis treating the Turkish outgroup as the primary outgroup yielded similar findings to those obtained when using other ethnic minority friends as the primary outgroup (see Supplemental Material F).

The ability to examine friendships with individuals of Turkish background as a primary outgroup also informed our decision to explore attitudes toward Moroccans. Since Turks constitute a slightly larger minority group than Moroccans in the Netherlands, the

data provided more opportunities to analyze friendships involving Turks, enabling us to conduct a robustness check with Turks as the primary outgroup.

Lastly, we acknowledge that two control effects showed unexpected directions, consisting of negative intergroup contact and social influence effects. These effects were included for technical reasons and control purposes, and their interpretation should be approached with caution as they were based on a severely limited number of observations and they should be interpreted as conditional effects (for more details, see Supplemental Material F).

Study 2

In Study 2, we sought to replicate, preregister, and extend the findings reported in Study 1. The use of a new dataset enabled us to explore whether the two effects of interest, the STE and the social influence of primary outgroup friends on secondary outgroup attitudes, differ between majority and ethnic minority students. We also sought to increase the generalizability of the Study 1 findings, by showing that they could also be found: in a different national context (Germany); using a different combination of outgroups (friendship with Turks and attitudes towards Poles); and with different types of adolescent friendship networks (larger, grade- instead of classroom-level networks). We also used more time points (three rather than two waves) because increasing the number of time points improves the estimation of longitudinal relationships between variables. We decided to study friendships with Turkish minority students as the primary outgroup because they comprise one of the largest ethnic minority groups in Germany (1,544,480; Destatis, 2025) and the largest ethnic minority group in the dataset. We chose to study attitudes towards Poles (i.e., the secondary outgroup), because they are one of the largest ethnic groups in

Germany (864,980; Destatis, 2025), and a salient ethnic minority group, and because this measure was available in the data (Destatis, 2025). In this study, when we refer to the majority group we mean German-majority adolescents, and when we refer to the minority, we mean adolescents who did not belong to the German-majority or to the Turkish or Polish minority groups. We re-tested H1 and H2 from Study 1, and tested a new H3, that either the secondary transfer effect of contact or the social influence effect on secondary outgroup attitudes would differ between ethnic majority and minority group members.

Methods

We preregistered Study 2 on OSF (https://osf.io/34ykr/?view_only=94fd343bd86949d1af1c0ed33f591cd4). Deviations from the preregistration can be found in Table H1 in Supplemental Material G.

Materials used in this study, including R code, can be found here: https://osf.io/esczh/?view_only=a0d5364c2f934221815987c013200620

Data access can be applied for at DeZIM Research Data Center (<https://datasearch.fdz.dezim-institut.de/item/de.dezim/5bb95fb7-9483-4390-9594-59563a43eac8>).

Sample and procedure

We analyzed the Friendship and Identity in School data (Leszczensky et al., 2020). Data were collected from 2,928 adolescents ($M_{\text{age}} = 12.6$) across 10 schools (29 grades; all 5th, 6th, and 7th grade students were selected in each school) in Germany. We excluded four grades that were causing convergence problems, which resulted in an analytic sample of 25 grades across the 10 schools ($N = 2,559$, $n_{\text{majority}} = 741$, $n_{\text{turks}} = 589$, $n_{\text{poles}} = 149$, $n_{\text{other}} = 821$,

$n_{\text{ethnicity_missing}} = 259$, 47% female). Wave 1 data were collected in May 2013, Wave 2 in February 2014, and Wave 3 in November 2014. As we noted for Study 1, a similar sample size has been frequently used to study social influence in longitudinal social network analysis and is considered sufficient for statistical power (e.g., Leszczensky & Pink, 2020).

Measures

Intergroup attitudes. Respondents were asked to indicate how much they like several outgroups, including Poles, using a scale from 1 (*very much*) to 5 (*not at all*). Responses were recoded so that higher values referred to more positive attitudes. Respondents could also select 6 (*I do not know*); these responses were treated as missing. For a similar measure, see Nesdale et al. (2005).

Friendship network. Each participant was given a numbered list of all students in the same year group (i.e., grade) and could nominate up to ten friends (Leszczensky et al., 2015). We constructed social networks based on these nominations (see Table 3 for the mean number of friends). In this study, respondents were invited to nominate a maximum of ten friends, compared with Study 1, in which the number of nominations was unlimited; however, in Study 1, only 0.05% of Dutch students nominated more than 10 friends.

Ethnicity. We used a pre-prepared measure of ethnicity available in the dataset. The measure was based on the country of birth of the adolescents, parents, and grandparents in line with Leszczensky et al. (2015; for a similar approach, see Dollman et al., 2014). Respondents were categorized as ethnic majority German if they, their parents, and their grandparents were born in Germany. Adolescents who were born abroad or whose parents or grandparents were born abroad were categorized as ethnic minority based on the country of origin. If only one parent or grandparent was born abroad, a participant was

coded as belonging to that country. If both parents were born abroad, an adolescent was coded as belonging to the maternal country. Students belonging to small ethnic groups were grouped together based on similar geographical locations of the country of origin (e.g., Southern Europe). For further information, see Dollman et al. (2014). For the details about the ethnic composition of the sample, see Supplemental Material H.

Ethnic minority membership. Based on ethnicity, we created a dummy variable representing ethnic minority (coded as 1) and ethnic majority (coded as 0) members. Since we wanted to investigate the difference in outgroup contact and social influence effects on both the majority and minorities excluding primary and secondary outgroups, those students with Polish or Turkish ancestry were treated as missing.

Gender. Adolescents were asked to indicate whether they were a girl or a boy (1 = girl, 2 = boy).

Dyadic covariates. As in Study 1, we estimated contact and social influence effects using dyadic covariates. We created four dyadic covariates to capture whether each pair of classmates included: (1) a student from *the ingroup* (i.e., German); (2) a student from *the primary outgroup* (i.e., Turks); (3) a student from *the secondary outgroup* (i.e., Poles); (4) students labeled as '*remaining friends*' (i.e., friends who did not belong to the ingroup, Polish or Turkish outgroups).

Analysis

As in Study 1, we applied SAOMs using RSiena and estimated the same effects to test both contact and social influence effects. We also examined distinct effects on majority and minority students. For this purpose, we included interactions between ethnic minority

membership and the contact and social influence effects (i.e., friendship with and social influence of primary outgroup, secondary outgroup, and ingroup friends).

In this study, we employed a different analytical approach that accounts for differences in the estimates across networks because an increase in network size (grade vs. classroom) resulted in an extreme requirement of computational power. Thus, we analyzed grades within schools separately, then combined the results in a meta-analysis (Snijders & Baerveldt, 2003) using the metafor package and Knapp and Hartung distribution. This resulted in analyzing 25 grades grouped into 10 groups, based on the school which they attended.

The estimated model was similar to the model used in Study 1 with two differences: (1) the network function was different in order to fit the new data (network function should fit the specific data to reflect the changes of a network; for all included effects and their technical description, see Supplemental Material I); and (2) we differentiated between the effects of primary outgroup contact and social influence on secondary outgroup attitudes for ethnic majority and minority students. In all models, we estimated contact and social influence effects of primary outgroup (Turkish) friends on change in secondary outgroup (Polish) attitudes for ethnic majority (German) and ethnic minority (other ethnic group) students. Solely for control and modeling purposes, we also included contact with and social influence of ingroup, secondary outgroup (i.e., Polish) and remaining friends (remaining friends did not belong to an ingroup, Polish or Turkish peers). The effects related to these groups should not be interpreted because they might be based on a limited number of observations. We could not fully estimate such a complicated model for each set of grades nested within schools, thus we adjusted the model for four of the ten schools. If the model

did not converge, we dropped the effects (i.e., constrained them to zero) that were causing non-convergence until convergence was reached, aiming to retain the effects of contact with and social influence of the primary outgroup, including the interaction with ethnic minority membership (a more detailed description is provided in Supplemental Material J). When effects were dropped, we tested whether such effects were significant using a score-type test, which allows us to test parameters without estimating them (Ripley et al., 2025). We found that dropping some effects did not cause biased results (see Supplemental Material J for more details).

Results and discussion

Descriptive statistics are shown in Table 3. German majority students had a mean of 2.23 ($SD = 2.20$) ingroup friends and 0.67 ($SD = 1.12$) Turkish primary outgroup friends; ethnic minority students had a mean of 0.34 ($SD = 0.75$) ingroup friends and 1.03 ($SD = 1.54$) Turkish primary outgroup friends. As compared to Study 1, both majority (e.g., at T1, a difference from the scale midpoint of 3, $t(438) = 7.31, p < .001$) and minority (e.g., at T1, a difference from the scale midpoint of 3, $t(450) = 7.24, p < .001$) respondents in Study 2 were slightly positive about the outgroup. This provided us with a different context for testing our hypotheses. The number of ingroup and outgroup friends again resembles Study 1 and previous research (Bracegirdle et al., 2023; Khuu et al., 2023; Van Zalk et al., 2013) as well as slightly positive attitudes (Wölfer et al., 2018).

Table 3

Means, standard deviations, and correlations of friendships and secondary outgroup attitudes for ethnic majority and minority respondents (Study 2).

Variables	Ethnic majority		Ethnic minority		1	2	3	4	5	6	7
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>							
1. Ingroup friends T1	2.23	2.20	0.34	0.75		.25**	.03	.22**	-.03	.01	-.06
2. Remaining friends T1	1.51	1.63	2.78	2.78	.13**		.28**	.13**	.04	.05	-.04
3. Primary outgroup friends T1	0.67	1.12	1.03	1.54	.08*	.19**		.13**	.08	.00	.00
4. Secondary outgroup friends T1	0.31	0.58	0.28	0.57	.02	.25**	.16**		.21**	.10**	.03
5. Attitudes towards Poles T1	3.44	1.25	3.47	1.37	-.07	-.04	-.07	.25**		.45**	.37**
6. Attitudes towards Poles T2	3.65	1.14	3.44	1.29	-.08	.001	.01	.13**	.50**		.50**
7. Attitudes towards Poles T3	3.68	1.19	3.52	1.23	-.03	-.03	.03	.18**	.46**	.53**	

Note. *M* and *SD* denote mean and standard deviation, respectively. Correlations are shown above the diagonal for the majority sub-sample

and below the diagonal for the minority sub-sample. Attitudes were measured as 'liking' each group on a scale from 1 (*not at all*) to 5 (*very much*). Ethnic majority = German, ethnic minority = ethnic minority other than Turkish or Polish, primary outgroup = Turkish, secondary outgroup = Polish.

* indicates $p < .05$. ** indicates $p < .01$.

Hypotheses Testing: Outgroup Contact and Social Influence Effects on Secondary Outgroup Attitudes

Our results showed that the number of primary outgroup friends (our measure of primary outgroup contact) was not longitudinally associated with a change in secondary outgroup attitudes (*estimate* = -.04, *SD* = .04, *p* = .883), thus, we found no support for H1 (secondary transfer effect of contact hypothesis). However, adolescents' secondary outgroup attitudes became more similar over time to those of their Turkish primary outgroup friends (*estimate* = 1.80, *SD* = .52, *p* = .007), supporting H2 (social influence hypothesis). The complete SAOM results can be found in Supplemental Material J.

We found no direct effect of ethnic minority membership on secondary outgroup attitudes (*estimate* = -.12, *SD* = .11, *p* = .295), indicating that attitudes of people ethnic majority (German) and minority adolescents (excluding Turkish and Polish) towards Polish people developed similarly. Moreover, as the non-significant interaction effects indicated, neither the contact (*estimate* = -.04, *SD* = .08, *p* = .682) nor the social influence (*estimate* = -2.21, *SD* = 1.35, *p* = .139) effect varied as a function of adolescents' ethnic majority vs. minority group membership, addressing exploratory H3.

Adolescents did not tend to form friendships based on the similarity in secondary outgroup attitudes (attitudes homophily) but rather tended to befriend peers with the same ethnicity (ethnic homophily). Again, in support of H2 (social influence hypothesis), we found support that adolescents' secondary outgroup attitudes became more similar to those of their primary outgroup friends, rather than friendships being formed based on similarity in these attitudes. Table 4 presents the effects used for hypotheses testing, homophilous tendencies, and heterogeneity across the investigated networks (Q statistic). The Q-statistic

indicated that the effects did not significantly vary across networks, with the exception of ethnic homophily.

Table 4

Main effects from the SAOM

	Estimate	SD	N	Q(df)
Hypothesis 1: Secondary transfer effect of contact				
Number of primary outgroup friends	-.04	.04	10	4.40(9)
Hypothesis 2: Social influence of primary outgroup				
Social influence of primary outgroup friends	1.80**	.52	10	1.22(9)
Hypothesis 3: Moderation by majority/minority status				
Number of primary outgroup friends x minority	-.04	.08	9	3.86(8)
Social influence of primary outgroup friends x minority	-2.21	1.35	9	2.15(8)
Homophily (selection) tendencies				
Attitudes towards the secondary outgroup	-.05	.06	9	4.18(8)
Ethnicity	.13**	.03	10	30.32(9)***

Note. SD indicates the standard deviation of an estimate. N represents the number of networks used to calculate a given effect. Q(df) represents the heterogeneity of an effect, with degrees of freedom in parentheses. We reported different information as compared to the SAOM results in Study 1 due to using a different analytical approach. The complete SAOM

*results, additional details, and a discussion of other effects can be found in Supplemental Material J. ** $p < .01$, *** $p < .001$.*

Summary

As in Study 1, we found no significant longitudinal association between primary outgroup contact and secondary outgroup attitudes (contrary to H1), but adolescents' attitudes became more similar to those of their primary outgroup friends, consistent with the social influence hypothesis (H2). This was the case for both ethnic majority and minority adolescents (H3). Thus, both German and ethnic-minority adolescents' attitudes toward Polish people became more similar to their Turkish friends' attitudes, but not as a function of the number of Turkish friends. These effects were found while controlling for key tendencies such as selecting friends with similar attitudes. Thus, Study 2 replicated and extended the findings reported in Study 1.

Study 3

In Study 3, we *simulated* and contrasted various hypothetical scenarios of how simulated majority-group adolescents' (henceforth, simply adolescents') secondary outgroup attitudes would change based on the effects we observed in Studies 1 and 2 (Kretschmer & Leszczensky, 2021; Ripley et al., 2025). Specifically, our aim was to assess the exploratory hypothesis, H4: How do patterns consistent with social influence vary for adolescents with negative, neutral and positive attitudes towards secondary outgroups when their primary outgroup friends hold negative, neutral or positive attitudes. In addition, we sought to: (1) assess the size of the social influence effect; (2) identify scenarios in which secondary outgroup attitudes would improve, remain similar, or worsen as a function of social influence and adolescents' and primary outgroup friends' initial secondary-outgroup

attitudes; and (3) explore theoretical implications of the empirical findings reported in Studies 1 and 2, as well as potential unintended consequences of social influence, such as polarization (i.e., the emergence of groups with markedly different attitudes).

Methods

Materials used in this study, including R code, can be found here:

https://osf.io/esczh/?view_only=a0d5364c2f934221815987c013200620

Sample and procedure

We used the first analyzed wave in Study 1 (T1; corresponding to the second wave of the original dataset), comprising 34 classes. Only adolescents with primary outgroup friends at T1 could be subject to social influence processes; thus, we studied changes in secondary outgroup attitudes within this subsample (N = 209). We retained whole networks to capture network changes and to account for the fact that students with primary outgroup friends may also be subject to social influence processes from friends with various backgrounds (e.g., ingroup or secondary outgroup friends). We report simulations based on Study 2, that produced similar findings, in Supplemental Material K.

Measures

We used the same measures and variables as in Study 1 (and, as reported in Supplemental Material K for Study 2). In the simulations, we used the complete set of estimates from Study 1.

Analysis

To examine whether patterns consistent with social influence vary for adolescents with negative, neutral and positive attitudes when their primary outgroup friends hold

negative, neutral or positive attitudes, we experimentally contrasted hypothetical scenarios in which we activated or deactivated the social influence effect, to assess its effect on changes in secondary outgroup attitudes. By comparing scenarios with a deactivated (control condition) versus activated (experimental condition) social influence effect, we could estimate the size of the social influence effect. Moreover, we inspected how the social influence of primary outgroup friends varied as a function of adolescents' and their primary outgroup friends' initial attitudes towards the secondary outgroup. Adolescents' reactions to social influence might depend on their own or their outgroup friends' initial attitudes, or a combination thereof. For example, adolescents might be reluctant to adopt extremely negative attitudes (Zingora et al., 2020). Thus, we inspected whether and in what direction adolescents' secondary outgroup attitudes hypothetically shift in relation to the social influence effect, depending on the valence of adolescents' initial attitudes. To do this, we investigated scenarios using the following design: 2 (social influence: activated vs. deactivated) x 3 (initial attitudes of primary outgroup friends: positive vs. neutral vs. negative) x 3 (initial attitudes of adolescents: positive vs. neutral vs. negative).

Group-level differences do not necessarily show up at the level of individual friendships. While the ingroup and primary outgroup may differ on average in their attitudes toward a secondary outgroup, variation within each group means that individual friendships may not reflect these differences. For example, on average, minority students might have more positive attitudes towards other ethnic minority groups than majority students, but a randomly chosen majority student might still have more positive attitudes than a minority friend. In Study 1, for instance, the mean difference in secondary outgroup attitudes between the majority respondents and their primary outgroup friends was .56, and the standard deviation was 1.70, showing that there was variation across respondents

in the valence of their secondary outgroup attitudes, with some having more positive (or less negative) attitudes than their friends, and others the reverse. This assumption was reflected in our simulations, because we simulated distributions to indicate the prevalence of positive, neutral, or negative attitudes at T1 rather than fixing attitudes to certain values. The exact shape of these simulated attitudes is presented in Figure 1.

Simulations were based on empirical data and estimates, providing an empirical anchor. We used the first wave of the empirical data to serve as a starting point for our simulations. This allowed us to examine counterfactual what-if scenarios, in which we simulated how secondary outgroup attitudes change across different scenarios. The difference between experimental and control conditions was that social influence was disabled in the control condition (i.e., the corresponding parameter was fixed to zero). Because Studies 1 and 2 yielded no evidence of secondary transfer effects of contact, we respected this in Study 3. The simulations were based on the full set of model parameters, with non-significant effects fixed to zero.

To compare experimental conditions and scenarios, we used a one-sample t-test. When social influence was activated, we expected adolescents to develop more positive secondary outgroup attitudes if outgroup friends' attitudes were more positive (or less negative) than the attitudes of adolescents, and to become more negative if outgroup friends' attitudes were more negative (or less positive) than those of adolescents.

Results and discussion

Figure 1 shows how secondary outgroup attitudes would change as a function of, first, social influence and, second, the initial secondary outgroup attitudes of both adolescents and their outgroup friends. The three distributions shown horizontally in the

nine panels from left to right in Figure 1 differentiate between the prevailing valence of primary outgroup friends' attitudes: prevailing positive attitudes (left three panels); neutral attitudes (middle three panels); and negative attitudes (right three panels). The three distributions shown vertically in the panels from top to bottom in Figure 1 differentiate between the prevailing valence of majority students' own attitudes: prevailing positive attitudes (top three panels); neutral attitudes (middle three panels); and negative attitudes (bottom three panels).

Within each of the nine panels of Figure 1, we present two color-coded density plots illustrating distributions of attitudes based on the control condition (social influence deactivated, in blue) and the experimental condition (social influence activated, in orange). The X-axis represents the range of attitudes, while the Y-axis shows the density, that is, how concentrated or frequent the values are along the attitude scale. Above each plot, we report the overlap between the control and experimental conditions using kernel density estimations (Pastore, 2018). This overlap illustrates a comparison of two what-if scenarios – *what* percentage of adolescents would develop similarly *if* they were influenced by their primary outgroup friends or not.

To address H4 (variation in social influence by adolescents' and friends' initial attitude valence), we conducted a series of t-tests to inspect differences between conditions. We analyzed simulated data and almost all tests resulted in low *p*-values. Thus, we pay special attention to the differences in means between conditions. The comparison of the experimental condition (social influence activated) and the control condition (social influence deactivated) showed that adolescents' attitudes shifted in the direction of their primary outgroup friends' attitudes. More specifically, the top three horizontal panels in

Figure 1 display majority adolescents with initially positive attitudes. If these adolescents were subjected to social influence (experimental condition – social influence activated, orange) as compared to no social influence (control condition – social influence deactivated, blue), 42% would have different, less positive, outgroup attitudes when their primary outgroup friends' attitudes were negative (i.e., the most contrasting valence), ($t(208) = -27.46, p < .001$) and 33% would have different, less positive, attitudes when their primary outgroup friends' attitudes were neutral, ($t(208) = -10.65, p < .001$). If, however, adolescents and their friends both had initially positive attitudes (i.e., matched positive valence of adolescents and friends' secondary outgroup attitudes), attitudes would be different, more positive, for 22% of adolescents, while attitudes would remain mostly benign and peak at the mean attitude score ($M = 4.89$, 7-point scale), indicating that adolescents and their friends would become even more similar to each other, ($t(208) = 5.98, p < .001$). Thus, social influence was especially pronounced if students and primary outgroup peers had initial attitudes that differed in valence (i.e., adolescents held positive secondary outgroup attitudes, whereas their primary outgroup friends held negative attitudes).

The middle horizontal panels in Figure 1 display adolescents with initially neutral attitudes. In the case of social influence, 44% would have different, less positive, attitudes if primary outgroup friends' attitudes were negative, ($t(208) = -22.10, p < .001$), and 33% would have different, more positive, attitudes if their primary outgroup friends' attitudes were positive, ($t(208) = 22.30, p < .001$). If, however, adolescents and their friends both had initially neutral attitudes (i.e., matched neutral valence of adolescents and friends' secondary outgroup attitudes), the mean attitude (representing the distribution of attitudes in a network) would become even more homogenous and neutral than initially. The distribution of attitudes would be different for only 25% of the adolescents. Similarly, as in

the case of positive attitudes, adolescents would become even more similar to each other if they were subjected to social influence, and their attitudes would peak at a mean value of 3.55 ($t(208) = 2.83, p = .005$). Again, social influence was especially pronounced if students and primary outgroup peers had initial attitudes that differed in their valence.

The bottom three panels in Figure 1 display adolescents with initially negative attitudes. In the case of social influence, 39% of adolescents would have different, mostly more positive, attitudes if their primary outgroup friends' attitudes were positive (i.e., the most contrasting in valence), ($t(208) = 25.78, p < .001$), and 43% would have different, mostly more positive, attitudes if primary outgroup friends' attitudes were neutral, ($t(208) = 16.33, p < .001$). Similarly to the case of both positive and neutral attitudes, if adolescents and their friends both had initially negative attitudes (i.e., matched negative valence of adolescents and friends' secondary outgroup attitudes), mean attitudes would remain mostly neutral in the experimental and control conditions; however, attitudes would become even more homogenous in the experimental condition and different for 22% of adolescents as compared to a control condition, ($t(208) = -5.64, p < .001$). Once again, we found that social influence was especially pronounced if students and primary outgroup peers had initial attitudes that differed in their valence.

Finally, we conducted two series of tests to examine whether patterns consistent with social influence differed depending on whether friends held initially positive, neutral, or negative attitudes, and whether these patterns varied across adolescents with initially positive, neutral, or negative attitudes. In every comparison, it is possible that some adolescents were affected by friends with more negative or more positive attitudes. Therefore, we calculated absolute changes between experimental and control conditions for

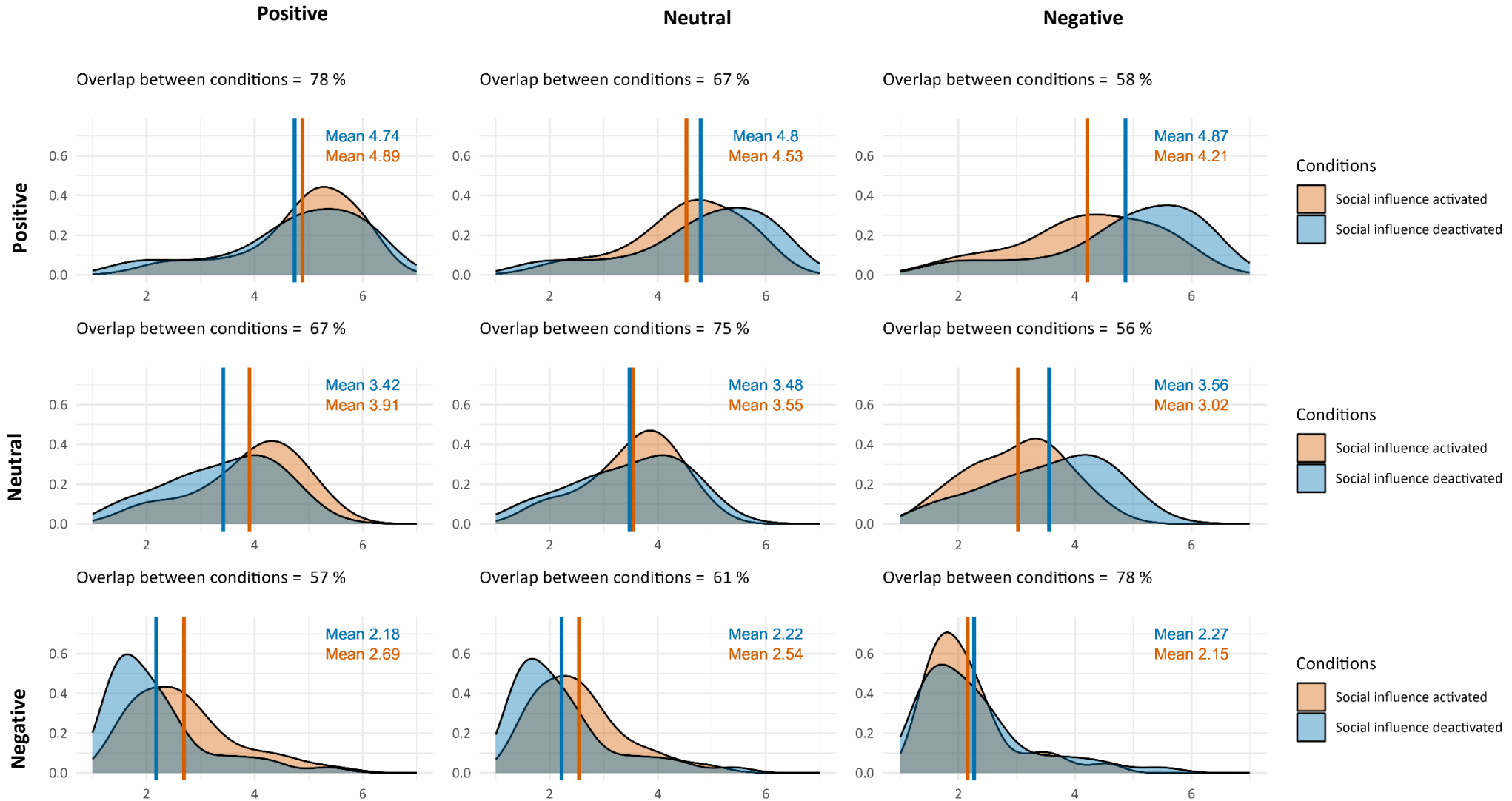
each combination of adolescents' and friends' attitudes. To test whether friends with different-valence attitudes were differentially *influential*, we combined conditions in which friends' attitudes were either positive, neutral, or negative. Combining these conditions simplified the interpretation of our results. We also calculated Cohen's d to identify whether the effect size was negligible, small, medium, or large. Adolescents' attitudes changed more when their friends had negative or positive attitudes, and to the smallest extent when friends' attitudes were neutral (friends' attitudes positive, $M = .45$, vs neutral, $M = .36$; $t(208) = 7.58, p < .001, d = .51$, medium; friends' attitudes positive, $M = .45$, vs negative, $M = .48$; $t(208) = -2.76, p = .006, d = -.17$, negligible; friends' attitudes neutral, $M = .36$, vs negative, $M = .48$; $t(208) = 12.09, p < .001, d = .75$, medium). To test whether friends with different-valence attitudes were differentially *influenced*, we combined conditions in which adolescents' attitudes were either positive, neutral, or negative. We found that adolescents with positive and neutral attitudes changed their attitudes in the direction of friends' average attitudes, while the change in attitudes of adolescents with negative attitudes was the smallest (friends' attitudes positive, $M = .46$, vs neutral, $M = .46$; $t(208) = -.40, p = .691, d = -.02$, negligible; friends' attitudes positive, $M = .46$, vs negative, $M = .37$; $t(208) = 8.53, p < .001, d = .52$, medium; friends' attitudes neutral, $M = .46$ vs negative, $M = .37$; $t(208) = -7.99, p < .001, d = -.51$, medium).

Figure 1

Simulation of change in secondary outgroup attitudes among majority adolescents as a function of having ethnic minority friends (Study 1)

Initial distribution of secondary outgroup attitudes in the primary outgroup friends

Initial distribution of secondary outgroup attitudes in the majority



Summary of Study 3

In Study 3, we provided a more detailed picture of how intergroup friendships within a classroom (or a grade, for Study 2; see Supplemental Material K) could theoretically affect adolescents' secondary outgroup attitudes. We found that what mattered most was not whether adolescents or their friends held positive or negative views, but the size of the initial difference between them. Change in adolescents' attitudes was largest when attitudes were opposed (e.g., positive vs. negative), smaller when one was neutral, and minimal when they were similar (addressing H4). Across all simulations, 22% to 44% of majority adolescents showed changes in their attitudes in ways consistent with social influence from primary outgroup friends. The experimental manipulations translated into medium-sized mean differences between conditions (Cohen's $d = .51-.75$). Simulations based on the data and results reported in Study 2 yielded very similar findings (see Supplemental Material K). We again highlight that these simulations are hypothetical, although based on empirical data.

Thus, Study 3 illustrates that: (1) social influence of primary outgroup friends could, in principle, be associated with substantive changes in adolescents' attitudes towards secondary outgroups; (2) adolescents' attitudes changed in the direction of their primary outgroup friends' attitudes, and the largest changes were observed with larger differences in initial attitudes; and (3) we did not discover any unintended consequences of social influence such as polarization (i.e., the emergence of groups with markedly different attitudes).

General Discussion

Many societies are becoming increasingly diverse, reflected in various social settings, including schools. Within schools, adolescent students from different backgrounds have the opportunity to interact with members of different ethnic, racial and other social groups, which could have significant implications for their outgroup attitudes. Building on the concepts of secondary transfer effects of intergroup contact (STE, Pettigrew, 2009), this work has addressed two key theoretical puzzles. First, it advances understanding of the processes behind STEs, providing robust evidence that social influence – rather than contact alone – is consistent with these effects. Second, it reconciles conflicting findings in the literature (Bracegirdle et al., 2023; Zingora & Flache, 2025), by showing evidence that outgroup friends exert social influence on attitudes toward secondary outgroups, even if their impact on attitudes toward their own group is limited. By bridging insights from intergroup contact theory and social network analysis, our research offers a novel perspective on attitude change in multicultural environments.

Our three studies point towards a novel explanation for the secondary transfer effect – namely, social influence, whereby people’s attitudes to secondary outgroups changed not due to having *friends* from the primary outgroup, but due to the *attitudes* that those primary outgroup friends hold towards secondary outgroups. Two empirical studies consistently demonstrated that having friends from one (primary) outgroup was not associated with more positive attitudes toward other (secondary) ethnic outgroups. Instead, adolescents’ attitudes to secondary outgroups aligned with those of their primary outgroup friends over time, albeit not necessarily for the better (if primary outgroup friends hold more negative secondary outgroup attitudes than an individual themselves, then those attitudes become more negative). In all three tests, we found support for the social

influence hypothesis and no support for the effect of contact (one additional test yielding similar findings is reported in Supplemental Material F as a robustness check for Study 1).

Furthermore, Study 3 revealed that social influence can have theoretically important implications for the development of outgroup attitudes, not only on an individual level but also at the macro-level, such as within entire schools (i.e., across classrooms or grade levels). This was especially pronounced if students and primary outgroup peers had initially very different attitudes (e.g., positive versus negative). Together, these studies highlight that intergroup friendships might have a significant effect on the development of attitudes toward various outgroups, primarily due to processes in line with social influence rather than having intergroup friendships per se.

Intergroup contact and social influence

The potential of intergroup contact to improve intergroup attitudes would be greatly enhanced if its effects were not limited to one specific outgroup. Extensive research on this potential has, however, sometimes yielded non-significant correlations between intergroup friendship with members of the primary outgroup and attitudes toward secondary outgroups (Adesokan, 2014; Cernat, 2019; Meeusen et al., 2017; Vezzali, Di Bernardo, et al., 2018). This suggests that contact with one outgroup is not consistently associated with more positive attitudes toward other outgroups. The present research demonstrates that this inconsistency can be explained by social influence, as contact may result in more positive outgroup attitudes only if outgroup friends have more positive attitudes than individuals themselves hold.

We studied social influence by applying longitudinal social network analysis, specifically stochastic actor-oriented modeling (SAOM) (Steglich et al., 2006). Prior research

that relied on the benefits of SAOM showed no association between intergroup friendship and outgroup attitudes among similar-aged students in schools (Bracegirdle et al., 2023; Khuu et al., 2023; Van Zalk et al., 2013; Zingora et al., 2020; for a meta-analysis, see Zingora, 2024), and this was due to using an approach that could account for social influence between friends (i.e., students' attitudes changed in the direction of friends' average attitude; Zingora, 2024). Our research helps reconcile inconsistencies in prior findings on the social influence of outgroup friends (Bracegirdle et al., 2023; Zingora & Flache, 2025). We specified that outgroup friends can shape attitudes toward another (secondary) outgroup in ways consistent with social influence, while outgroup friends may not yield influence over attitudes toward their own group.

We do not, however, argue that the effect of social influence is always sanguine. As illustrated in Study 3, patterns consistent with social influence may be associated with more positive attitudes when friends' attitudes are more positive, but with less positive attitudes when friends' attitudes are more negative than those held by adolescents. This implies that when two friends become more similar over time, one of the two may end up with less positive attitudes. More research is needed to uncover how to achieve a lasting *improvement* in, and not merely change of, outgroup attitudes in schools.

Implications and future directions

From a practical standpoint, it would be ideal if positive intergroup contact with a member, or members, of one outgroup always led to more positive attitudes towards a range of other outgroups and if, at worst, intergroup friendship with a primary outgroup member simply caused no change in secondary outgroup attitudes. Yet, since, at least among adolescents, evidence implies that outgroup friends do exert social influence over

one's secondary outgroup attitudes, the worst-case scenario of having outgroup friends would be that contact with primary outgroup members, in which one learned of their attitudes toward the secondary outgroup, in fact was related to a worsening of secondary outgroup attitudes. This scenario is realistic as illustrated by Van Laar et al.'s (2005) finding that white American university students with Asian American peer roommates developed more negative attitudes toward African Americans (Asian Americans were more prejudiced against African Americans than other ethnic groups). Thus, it is crucial that those involved in implementing school interventions are aware of both baseline attitudes and social influence processes in order to avoid unintended consequences, which could result in a worsening of outgroup attitudes.

We encourage researchers to investigate further the potential of social influence for improving outgroup attitudes. So-called network interventions use the knowledge of how outcomes are distributed among network members (e.g., students in a school), ideally taking into account the dynamic nature of their relationships, to spread desirable outcomes (Valente, 2012). Our findings could inform such school interventions, which would capitalize on social influence to spread positive outgroup attitudes.

We echo the recommendations to employ approaches such as SAOM to study social phenomena (Dovidio et al., 2017; Mason et al., 2007; Smith & Conrey, 2007; Veenstra et al., 2013, 2018; Wölfer & Hewstone, 2017). We argue that researchers can capitalize on social network methodology and use it to study the consequences of intergroup friendships on outgroup attitudes, enabling the investigation of patterns consistent with social influence alongside intergroup contact. To study the effects of different forms of intergroup contact – such as friendship, studying in the same classroom, or playing on the same athletic team –

researchers could benefit from studying the dynamic nature of intergroup contact and positioning intergroup contact in a broader context, such as a school. While social influence could be a major force shaping adolescents' outgroup attitudes, its application is not straightforward since social influence is not always associated with more positive outgroup attitudes in the whole group, and the changes on an individual level might differ from the changes on a group level (Flache et al., 2017). More research is thus needed to investigate the full potential of using positive social influence to spread positive attitudes among adolescents.

Most studies that examined intergroup contact effects on outgroup attitudes and applied longitudinal social network analysis focused on adolescents (Bracegirdle et al., 2023; Khuu et al., 2023; Van Zalk et al., 2013; Zingora, 2024; Zingora et al., 2020). This is also true of our investigation. Peer influence is especially strong in adolescence (Steinberg & Monahan, 2007), and results might not replicate for adults. Therefore, we encourage researchers to conduct future studies with different age groups and in different social environments, such as the workplace. To researchers who do not currently apply social network analysis, we recommend that future research on STEs goes beyond contact with outgroup members by including measures of the (perceived or actual) attitudes of primary outgroup members towards the secondary outgroups in question. We look forward to seeing more studies in the future that consider both intergroup contact and social influence as viable means to reducing prejudice and improving intergroup relations.

Limitations

Although we replicated our findings across two empirical studies set in different national contexts – the Netherlands and Germany – and the findings reported in both

studies were remarkably consistent (even though we used different-sized networks, applied slightly different measures and investigated attitudes towards different ethnic groups in the two studies), additional evidence of the reliability and generalizability of our findings is desirable. It would be interesting to test our hypotheses further in more varied contexts and with different outgroups that are not based only on ethnicity (e.g., studying how intergroup friendship relates to attitudes towards religious or sexual minorities). The context of our studies is arguably similar (both are European, both deal with attitudes to ethnic minorities), and similar studies in non-European, and also non-Western settings would be valuable.

We studied intergroup friendship and its effect on outgroup attitudes in the context of schools. Although peers are a crucial socialization factor, especially for adolescents, this does not preclude influence from different sources, such as the family (Miklikowska, 2017). Future research could benefit from combining relevant influences and studying how different sources of social influence interact in forming outgroup attitudes of not only adolescents, but also those of a range of different age groups.

Although our agent-based models were grounded in empirical findings, their implications remain theoretical. They allowed us to explore the broader implications of our empirical results and examine how micro-level processes, such as friendship influence, could shape macro-level patterns of secondary outgroup attitudes across different contexts. We encourage future research to test empirically the hypotheses and dynamics generated by these simulations.

In this research, we set boundaries for social networks to be a classroom (Study 1) and a school-grade (Study 2), enabling us to study social influence in these contexts. Both studies yielded similar results, strengthening our conclusions. Although adolescents typically

have most friends among classmates, they also maintain important relationships outside of school, and the age of peers may further shape friendship formation and influence processes (Kerr et al., 2006; Kiesner et al., 2004). Future research should examine whether our findings replicate in broader or more age-diverse networks, such as school-wide networks.

Finally, although we benefited from the longitudinal nature of our data and a state-of-the-art analytical method, we cannot infer causality from either a non-experimental design, or an experimental simulation with hypothetical actors and scenarios. SAOM tests how individual decisions are guided by tendencies, such as social influence, which is similar to testing changes within individuals (Steglich et al., 2010). ABM, in contrast, tests how such individual-level decision rules aggregate to produce emergent patterns at the macro level, allowing researchers to explore simulated group dynamics under different assumptions (Flache & Fernandes, 2021). There is thus clearly a need for future research using different methods, especially experiments, and specifically experimentally-manipulated networks, to address causality.

Conclusions

In this research, we conducted, first, two longitudinal social network studies that found that having primary outgroup friends from one ethnic group was not associated with more positive attitudes toward secondary ethnic outgroups. Rather, we found evidence consistent with social influence, whereby adolescents' attitudes towards secondary ethnic outgroups became more similar to those held by their primary outgroup friends. Next, using an agent-based modeling simulation technique, we illustrated that social influence can have consequences for the development of adolescents' outgroup attitudes even when

inspecting macro-level changes (i.e., changes in the whole classroom or school grade).

Although having outgroup friends is not associated with more positive outgroup attitudes, outgroup friends might still shape attitudes towards secondary outgroups. We hope that our research not only throws new light on plausible novel processes involved in secondary-transfer effects of intergroup contact (Pettigrew, 2009), but also opens new avenues for studying intergroup contact and social influence.

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Supplemental Material to

Outgroup friendships and social influence in the development of adolescent attitudes towards secondary outgroups

Authors

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Supplemental Material A

Construction of ethnic minority peers in Study 1

We did not include adolescents from Muslim countries that could potentially be perceived as similar to Morocco or Turkey (i.e., Iraq, Iran, Afghanistan, Kurdistan, Algeria, Egypt, Syria, Albania). Potentially similar countries were considered to be countries with historically similar backgrounds within the Ottoman Empire. Such similarity is attested, for instance, by commonalities in the predominant language. We also avoided including ethnicities that could be perceived as very similar to Dutch (i.e., the ingroup). Thus, we did not include adolescents from predominantly white and Western countries (i.e., Western and Southern Europe, the US, Australia, and New Zealand). We only included adolescents from other countries and adolescents from Eastern Europe, because although Eastern Europeans are predominantly white, Eastern Europeans are often objects of prejudice and discrimination in the Netherlands, which indicates that they are perceived as a distinct group compared to Dutch-origin adolescents (McGinnity & Gijsberts, 2018). A complete list of ethnic groups of those adolescents who were labeled as other-ethnic adolescents is as follows: American Samoa, Angola, Bangladesh, Belarus, Bolivia, Bosnia and Herzegovina, Brazil, China, Columbia, Croatia, The Czech Republic, Dominican Republic, Democratic Republic of Kongo, Dutch Antilles, Ethiopia, Georgia, Ghana, Hongkong, Indonesia, Israel, Malaysia, Nepal, Nigeria, Poland, Romania, Russia, Serbia, Singapore, Slovenia, Somalia, Sri-Lanka, Suriname, Ukraine, and Venezuela.

To further explore the consequences of creating a primary outgroup consisting of various ethnic groups, we inspected differences in secondary outgroup attitudes at T1 of the four largest ethnic groups: students with a background from China, Indonesia, Dutch

Antilles, and Suriname (constituting 59% of the sample). In a series of t-tests, we found no significant difference between these subsamples (p -values ranged between .105 and .978).

Supplemental Material B

Goodness of fit and convergence in Study 1

Goodness of fit. To assess goodness of fit, we estimated one multigroup object and calculated goodness of fit tests. If a p -value diverges from zero, it indicates that we captured to some extent particular distributions of network characteristics. In particular, we inspected whether our model generated appropriate indegree ($p = .276$), outdegree ($p = .296$), geodesic distributions ($p = .067$) and triad census ($p = .014$).

Convergence. Bayesian multilevel analysis is based on an interactive process; we ran 9350 iterations. We used this number of iterations to reach convergence. We investigated whether the effect converged towards stable values across iterations. We assessed $\hat{R}$ (Ripley et al., 2024). According to the guidelines (Gelman et al., 2014), effects of interest reached the best convergence at a different number of iterations (ideally lower than 1.05). Thus, we considered the analysis to converge whereby a combined convergence was best for all friendship and social influence effects ($\hat{R}$ was estimated to be a maximum of 1.21 for each effect). This happened after 5000 iterations.

At certain points, each effect reached a perfect convergence ($\hat{R}$ about 1.05). This enabled us to conduct a robustness check when we contrasted these perfectly converged effects with our solution. Table B1 describes comparisons between the original estimates reported in the manuscript (and in Supplemental Material G) and estimates that yielded the best convergence. Different effects reached the best convergence after a different number of iterations. Therefore, while original estimates are based on the same number of iterations, best-converged estimates are based on a different number of iterations. This

analysis confirmed the reliability of our findings since these perfectly converged effects were highly similar to our solution.

Table B1

The outgroup contact and the social influence effect of ethnic minority (primary outgroup described in the manuscript) and Turkish-origin friends on the development of attitudes towards Moroccans.

	Random		Estimate	SD	Best convergence	Original estimate
<i>Behavioral dynamics</i>						
The STE of friendship with ethnic minority adolescents	RE		-.18	.13	5000	-.18
Social influence of other-ethnic-origin friends	RE		3.95***	.33	5000	3.95***
The STE of friendship with Turkish-origin adolescents	RE		-.16	.29	4000	-.23
Social influence of Turkish-origin friends	RE		2.14***	.38	4000	2.13***
Friendship with ingroup adolescents	RE		-.02	.07	4000	-.01
Friendship with secondary outgroup adolescents	RE		-.78***	.26	4000	-.77***

Friendship with the rest of outgroup adolescents	RE		-.27	.18	4000	-.28*
Social influence of ingroup friends	RE		1.50***	.36	4000	5.79***
Social influence of secondary outgroup friends	RE		5.67***	.47	4000	5.10***
Social influence of the remaining friends	RE		-1.95***	.88	4000	-2.00***

Note. *SD* denotes standard deviation. The 'Best convergence' column represents a number of iterations after which we reached the best convergence of a particular effect. This particular number of iterations was dropped. The original estimate represents an estimate reported in the article (i.e., solution when 5000 iterations were excluded). The best value of $\hat{R}$ for the influence of the rest of the outgroup adolescents was 1.34. Since this is only a control effect, we do not consider it to be a problem. RE denotes random effect.

Supplemental Material C

Alternative conceptualizations of social influence

SIENA enables us to test different operationalizations of social influence, which might be colinear; thus, researchers should always use only one (Ripley et al., 2024). According to the score-type test (i.e., a test that contrasts different effects without estimating them; Ripley et al., 2024), the average similarity effect yielded the most accurate representation of social influence present in the data. We thus estimated whether adolescents' attitudes towards the secondary outgroup became more similar to the average secondary outgroup attitudes of their primary outgroup friends, which would support the social influence hypothesis.

Supplemental Material D

Technical Description of Effects in Study 1

Table D1

Technical description of effects, including SIENA terminology

Effect	Effects as labeled in the article	RSIENA terminology	Explanation
Alter's total of dyadic covariate W	Number of [group] friends*	totWAlt	Tendency for target adolescents with more [group] friends to develop more positive attitudes towards a secondary outgroup.
Average similarity weighted by dyadic covariate	Social influence of [group] friends*	avSimW	Tendency for target adolescents to adopt an average attitude of their [group] friends
Main covariate effect	The number of [group] classmates*	effFrom	An effect of the number of [group] classmates on the development of secondary outgroup attitudes
	The number of classmates	effFrom	An effect of the number of classmates on the development of secondary outgroup attitudes
Outdegree (density)	Density	density	Tendency to form new friendship ties
Reciprocity	Reciprocity	recip	Tendency to reciprocate friendship ties
Transitive reciprocated triplets effect	Transitive reciprocated triplets	transRecTrip	Tendency to have reciprocated friendship ties to friends of friends
Covariate-alter or covariate-related popularity	Attitudes towards the secondary outgroup alter	altX	A tendency of adolescents to prefer friends with higher values of a covariate
	[group] alter*	altX	A tendency of adolescents to prefer friends with higher values of a covariate
	Gender alter	altX	A tendency of adolescents to prefer friends with higher values of a covariate

Covariate-ego or covariate-related activity	Attitudes towards the secondary outgroup ego	egoX	A tendency of adolescents to nominate more peers as friends depending on adolescents' values of a covariate
	[group] ego*	egoX	A tendency of adolescents to nominate more peers as friends depending on adolescents' values of a covariate
	Gender ego	egoX	A tendency of adolescents to nominate more peers as friends depending on adolescents' values of a covariate
Covariate-related similarity	Attitudes towards the secondary outgroup homophily	simX	A preference to select friends with similar secondary outgroup attitudes
Same covariate (or covariate-related identity)	Gender homophily	sameX	A preference for friends with the same value on a covariate
	Ethnic homophily	sameX	A preference for friends with the same value on a covariate
Linear shape	Linear shape	linear	Potential trends in the data toward lower or higher values on the dependent variable
Quadratic shape	Quadratic shape	quad	The tendency of adolescents with very positive or very negative attitudes to develop even more extreme attitudes
Geometrically weighted edgewise shared partners	Geometrically weighted edgewise shared partners	gwespFF	Tendency to befriend the friends of friends (transitive)
In-degree related popularity effect	Indegree popularity	inPop	Tendency of adolescents to nominate friends who have already had many friendship nominations
Out-degree related popularity effect	Outdegree popularity	outPop	Tendency of adolescents to nominate friends who nominate many friends

Note. Group represents, for example, ingroup or primary outgroup friends.

Supplemental Material E

Descriptive Statistics of Primary Outgroups in Study 1

Table E1

Means, standard deviations, and correlations of friendship and secondary outgroup attitudes variables in primary outgroup adolescents

Variables	Turkish origin adolescents		Ethnic minority adolescents		1	2	3	4	5	6	7
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>							
1. Outgroup friends in total	3.27	3.97	4.35	4.15		.92**	.53**	.37**	.36**	-.01	.10
2. Dutch friends	1.78	2.61	3.39	3.33	.95**		.20*	.31**	.10	-.07	.08
3. Turkish friends	1.78	1.93	0.50	1.09	-.01	-.03		.30**	.37**	.09	.12
4. Ethnic minority friends	0.75	1.02	0.81	1.02	.62**	.48**	.13		.15	.22*	.04
5. Moroccan friends	0.32	0.71	0.19	0.55	.46**	.34**	-.05	-.05		.12	0
6. Attitudes towards Moroccans T1	4.12	1.63	4.15	1.48	.15	.11	.03	.14	.16		.44**
7. Attitudes towards Moroccans T2	4.08	1.41	4.01	1.35	-.01	-.06	.14	.13	-.01	.29*	

Note. *M* and *SD* denote mean and standard deviation, respectively. Correlations for the Turkish-origin sub-sample are shown above, and those for the other-ethnic origin sub-sample below, the diagonal.

* indicates $p < .05$. ** indicates $p < .01$.

Supplemental Material F

Complete SAOM results

As illustrated in Table F1, Dutch ingroup friends influenced Dutch majority adolescents' attitudes towards Moroccans ($estimate = 5.79, SD = .38, p < .001$), but the number of Dutch ingroup friends was not associated with attitudes towards Moroccans ($estimate = -.01, SD = .07, p = .849$). Dutch-majority adolescents had no preference for friends with similar attitudes towards Moroccans, as shown by the non-significant secondary outgroup attitudes homophily effect ($estimate = -.06, SD = .15, p = .705$). The ethnic homophily effect further showed that Dutch adolescents preferred same-ethnicity over other-ethnicity friends ($estimate = .29, SD = .08, p < .001$).

SAOM also produced counterintuitive findings related to contact with Moroccans and the influence of remaining friends. Both the number of Moroccan friends ($estimate = -.77, SD = .27, p < .001$) and social influence by Moroccan friends ($estimate = 5.10, SD = .33, p < .001$) were associated with attitudes towards Moroccans. The effect of friendship with Moroccans on attitudes towards Moroccans was unexpectedly negative and social influence of Moroccans was unexpectedly significant, which might be due to the low number of friendships observed between Dutch and Moroccan adolescents. Furthermore, social influence of remaining friends was negative ($estimate = -2.00, SD = .96, p = .003$), indicating that friends became more dissimilar with time; we have no explanation for this unexpected finding. We replicated our findings related to our hypotheses in a model in which we dropped these effects, indicating that these effects had no impact on the effects testing our hypotheses.

We built statistical models to test the consequences of having friends from a primary outgroup. To completely distil the effects of contact with a primary outgroup and social influence of primary outgroup friends on attitudes towards secondary outgroup, we had to test all potential combinations of friends' group memberships (e.g., ingroup, secondary outgroup). This approach improved the accuracy of our analyses; however, the effects related to sources of social influence other than a primary outgroup should not be interpreted for two main reasons. First, all reported effects are conditional and should be interpreted as such. We found a negative effect of contact with Morrocans on attitudes towards Morrocans only when estimating other effects, including a strong social influence effect of Morrocans. Hence, the number of Moroccan friends may be related to developing more positive attitudes towards Moroccans. In a similar vein, the negative social influence of remaining friends was found only after taking into account the positive influences of all kinds of other friends. Second, unexpected results were only observed when estimating effects based on a very small number of friendships (e.g., number of Moroccan friends, $M = 0.09$, $SD = 0.37$; the number of remaining friends, $M = .18$, $SD = .48$). Therefore, these effects were included for technical reasons and control purposes, and their interpretations should be approached with caution, as they were used solely for control purposes, should be interpreted as conditional effects, and were often based on a limited number of observations.

Dutch alter effect, Turk, Moroccan, and minority ego effects were not included because they were causing problems with convergence and served only control purposes.

Table F1

Contact and social influence effects of Turkish and ethnic minority friends on Dutch students attitudes towards Moroccans.

					Credibility	
					interval	
	Random	Estimate	SD	Posterior <i>p</i> -value	From	To
Effects used for testing the hypotheses						
<i>Attitude dynamics</i>						
Number of Turkish friends	RE	-.23	.29	.418	-.95	.20
Number of minority friends	RE	-.18	.13	.166	-.44	.09
Social influence of Turkish friends	RE	2.13***	.41	<.001	1.45	2.80
Social influence of minority friends	RE	3.95***	.33	<.001	3.08	4.39
Controls						
<i>Network dynamics</i>						
Density	RE	-2.58***	.13	<.001	-2.81	-2.30
Reciprocity	FE	.93***	.07	<.001	.78	1.06
Transitive reciprocated triplets	RE	.21***	.03	<.001	.15	.28
Indegree popularity	RE	.001	.03	.95	-.05	.05
Outdegree activity	RE	.03	.02	.08	-.005	.07

Attitudes towards the secondary outgroup alter	RE	-.04*	.02	.028	-.07	-.004
Attitudes towards the secondary outgroup ego	RE	.05	.04	.291	-.04	.13
Attitudes towards the secondary outgroup homophily	RE	-.06	.15	.705	-.36	.18
Gender homophily	RE	.95***	.07	<.001	.81	1.10
Dutch ego	RE	-.26***	.08	<.001	-.43	-.11
Ethnic homophily	RE	.29***	.08	<.001	.13	.44
Minority alter	RE	.23	.07	<.001	.09	.36
Turks alter	RE	-.17	.13	.212	-.43	.09
Moroccans alter	RE	-.10	.13	.382	-.35	.21
The number of classmates	FE	-.94***	.28	<.001	-1.47	-.40
The number of Turkish classmates	FE	-.03	.03	.362	-.09	.03
The number of other-ethnic classmates	FE	-.04	.05	.347	-.15	.05
The number of Moroccan classmates	FE	.09	.08	.292	-.09	.24
<i>Attitude dynamics</i>						
Linear shape	FE	-.30***	.07	<.001	-.45	-.17

Quadratic shape	FE	.22**	.07	<.001	.09	.36
Number of ingroup friends	RE	-.01	.07	.849	-.17	.12
Number of Moroccan friends	RE	-.77***	.27	<.001	-1.25	-.26
Number of remaining friends	RE	-.28	.17	.102	-.67	.02
Social influence of ingroup friends	RE	5.79***	.38	<.001	4.87	6.41
Social influence of Moroccan friends	RE	5.10***	.33	<.001	4.48	5.79
Social influence of remaining friends	RE	-2.00**	.96	.003	-3.78	-.62
The number of classmates	FE	.51	.27	.060	-.02	1.06
The number of Turkish classmates	FE	.02	.02	.345	-.03	.07
The number of minority classmates	FE	.02	.04	.555	-.06	.10
The number of Moroccan classmates	FE	-.06	.06	.302	-.17	.05

Note. The “Random” column indicates whether the effect was estimated as random (RE) or not (FE). *SD* indicates the standard deviation of an estimate. The effect is significant if the credibility interval does not contain zero. *** $p < .001$, ** $p < .01$, * $p < .05$.

Supplemental Material G

Deviations from preregistration of Study 2

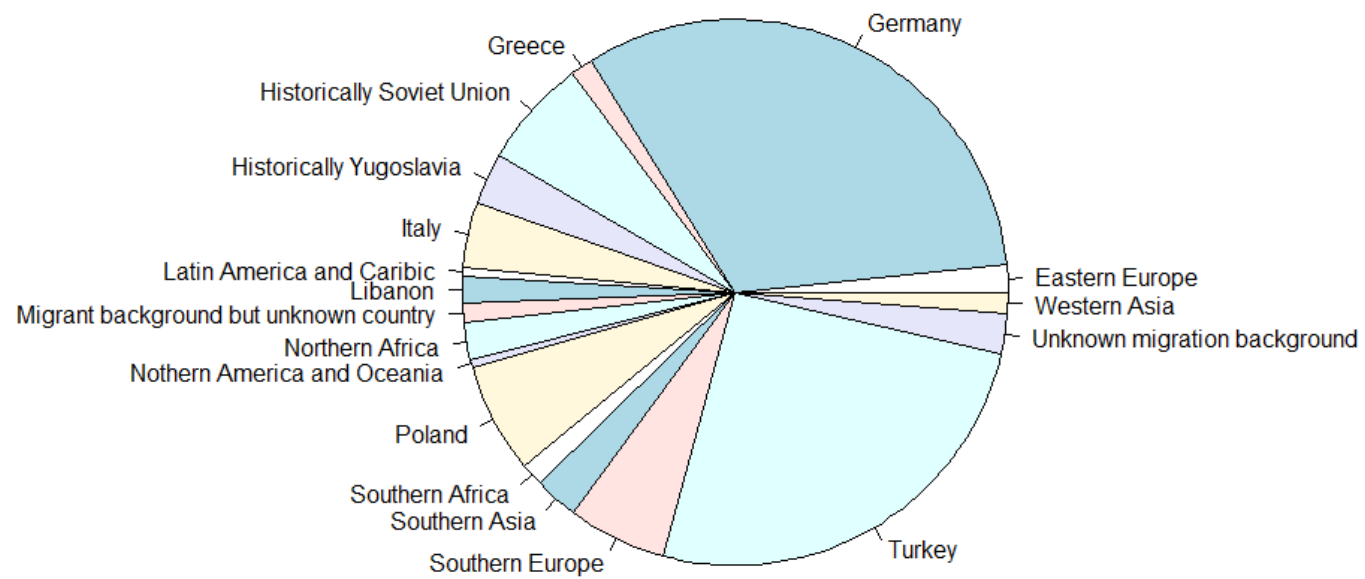
Table G1

Deviations from the preregistration (Study 2)

Changes in	Preregistered	Deviation
Analysis	Bayesian estimation – same as in Study 1	We analyzed grades nested within the school separately and then combined the results within a meta-analysis. The alternative approach was chosen because a Bayesian approach requires extreme computational demands. The higher computational demands in Study 2 compared to Study 1 are likely due to larger networks.
Missing values	We preregistered to drop grades with more than 30% missing values.	Employing meta-analysis instead of the Bayesian approach enabled us to have more control over classrooms that were causing non-convergence. Consequently, we did not drop any grade automatically but identified and dropped those causing problems with the convergence.
One secondary outgroup	We preregistered to study two secondary outgroups	Due to the high complexity of the model and due to a change in the analysis, we decided to investigate attitudes towards one outgroup instead of two. Including attitudes towards two outgroups into the same model would make this model too complicated and cause problems with convergence. We decided to study attitudes towards Poles as it is a large and important minority in the German context.

Supplemental Material H

Ethnic background in Study 2



Supplemental Material I

Technical Description of Effects in Study 2

Table I1

Technical description of effects, including SIENA terminology

Effect	Effects as labeled in the article	RSIENA terminology	Explanation
Alter's total of dyadic covariate W	Number of [group] friends*	totWAlt	Tendency for target adolescents with more [group] friends to develop more positive attitudes towards a secondary outgroup.
Average similarity weighted by dyadic covariate	Social influence of [group] friends*	avSimW	Tendency for target adolescents to adopt an average attitude of their [group] friends
Main covariate effect	The number of [group] classmates*	effFrom	An effect of the number of [group] classmates on the development of secondary outgroup attitudes
	The number of classmates	effFrom	An effect of the number of classmates on the development of secondary outgroup attitudes
	Belonging to majority or minority	effFrom	An effect of belonging to majority or minority on the development of secondary outgroup attitudes
Interaction between alter's total of dyadic covariate W and main covariate effect	Interaction between number of [group] friends and belonging to majority or minority	totWAlt x effFrom	A difference in the effect of the number of [group] friends on the development of secondary outgroup attitudes between majority and minority
Interaction between average similarity weighted by dyadic covariate and main covariate effect	Interaction between social influence of [group] friends and belonging to majority or minority	avSimW x effFrom	A difference in the effect of the tendency to adopt an average attitude of their [group] friends on the development of secondary

			outgroup attitudes between majority and minority
Outdegree (density)	Density	density	Tendency to form new friendship ties
Reciprocity	Reciprocity	recip	Tendency to reciprocate friendship ties
Transitive reciprocated triplets effect	Transitive reciprocated triplets	transRecTrip	Tendency to have reciprocated friendship ties to friends of friends
Covariate-alter or covariate-related popularity	Attitudes towards the secondary outgroup alter	altX	A tendency of adolescents to prefer friends with higher values of a covariate
	[group] alter*	altX	A tendency of adolescents to prefer friends with higher values of a covariate
	Gender alter	altX	A tendency of adolescents to prefer friends with higher values of a covariate
Covariate-ego or covariate-related activity	Attitudes towards the secondary outgroup ego	egoX	A tendency of adolescents to nominate more peers as friends depending on adolescents' values of a covariate
	[group] ego*	egoX	A tendency of adolescents to nominate more peers as friends depending on adolescents' values of a covariate
	Gender ego	egoX	A tendency of adolescents to nominate more peers as friends depending on adolescents' values of a covariate
Covariate-related similarity	Attitudes towards the secondary outgroup homophily	simX	A preference to select friends with similar secondary outgroup attitudes
Same covariate (or covariate-related identity)	Gender homophily	sameX	A preference for friends with the same value on a covariate
	Ethnic homophily	sameX	A preference for friends with the same value on a covariate
Linear shape	Linear shape	linear	Potential trends in the data toward lower or higher values on the dependent variable
Quadratic shape	Quadratic shape	quad	The tendency of adolescents with very

			positive or very negative attitudes to develop even more extreme attitudes
Geometrically weighted edgewise shared partners	Geometrically weighted edgewise shared partners	gwespFF	Tendency to befriend the friends of friends (transitive)
In-degree related popularity effect	Indegree popularity	inPop	Tendency of adolescents to nominate friends who have already had many friendship nominations
Out-degree related popularity effect	Outdegree popularity	outPop	Tendency of adolescents to nominate friends who nominate many friends

Note. Group represents, for example, ingroup or primary outgroup friends.

Supplemental Material J

Investigation of dropping effects in meta-analysis and complete SAOM results from Study 2

School grades were grouped into 10 groups based on belonging to the same school. Using these groups enabled us to test more complex models. In the meta-analysis reported in the main article, we combined results across these groups. Initial models did not automatically converge due to some control effects. To address this, we conducted score-type tests to assess whether dropping each control effect significantly worsened model fit. A significant decline in fit would indicate that a control effect was important and should be retained; a non-significant decline would indicate that the effect could be safely excluded. In each case, dropping an effect did not significantly worsen the fit, indicating that a dropped effect was non-significant (School-grades Group 1: $X^2 = .48$, $p = .923$; School-grades Group 2: $X^2 = 4.26$, $p = .235$; School-grades Group 3: $X^2 = 1.2$, $p = .754$; School-grades Group 4: $X^2 = 8.16$, $p = .042$).

As an additional check, we conducted a meta-regression comparing school-grade groups for which some control effects were dropped to those for which they were retained. We focused on differences in the estimated effects of the number of primary outgroup friends and the social influence of primary outgroup friends on the development of secondary outgroup attitudes. Using the *metafor* package in R, we tested four key effects corresponding to our hypotheses. The associations were non-significant (contact with primary outgroup friends: $b = .08$, $SE = .37$, $p = .827$; social influence of primary outgroup friends: $b = .82$, $SE = 1.53$, $p = .594$; contact with primary outgroup friends x ethnic minority: $b = .08$, $SE = .54$, $p = .885$; social influence of primary outgroup friends x ethnic minority: $b =$

-3.42, SE = 3.89, $p = .380$). These findings indicate that the results remained stable regardless of excluding some control effects.

Because some groups contained more school grades than others, we also tested whether the number of school grades per group was associated with effect size. Again, the associations were non-significant (contact with primary outgroup friends: $b = .04$, SE = .29, $p = .886$; social influence of primary outgroup friends: $b = 1.25$, SE = 1.44, $p = .356$; contact with primary outgroup friends x ethnic minority: $b = -.21$, SE = .43, $p = .628$; social influence of primary outgroup friends x ethnic minority: $b = -.87$, SE = 3.82, $p = .820$). This shows that the investigated effects were consistent regardless of the number of school grades included in each group.

All effects used in SAOM models are presented in Table J1. We present the effects used to test the hypotheses about the STE and the social influence of primary outgroup adolescents at the beginning of the table. We also present effects that were included for control purposes. Table J1 also contains the number of grade groups that were used for the effect estimation. We also report Q-tests for heterogeneity, which indicate whether an effect significantly varied across grade groups. Q-tests showed that the effects that were used for testing the hypotheses did not vary across grade groups. This also indicates that grade-level findings did not differ between grade groups in which we constrained some effects to zero and grade groups in which we did not constrain an effect. Some reported values differ between Table F1 (Study 1) and Table J1 (Study 2), such as the Q statistics (Study 2). The reason is a different analytical approach as described in the Analysis part of Study 2.

As illustrated in Table J1, secondary outgroup attitudes became more similar to the attitudes of ingroup friends, indicating social influence (*estimate* = 1.33, *SD* = .54, *p* < .05), but the number of ingroup friends was not associated with attitudes towards the secondary outgroup, indicating no effect of ingroup contact (*estimate* = -.02, *SD* = .02, *p* > .05). Adolescents had no preference for friends with similar attitudes towards the secondary outgroup, as shown by the non-significant secondary outgroup attitudes homophily effect (*estimate* = -.05, *SD* = .06, *p* > .05). The ethnic homophily effect further showed that adolescents preferred the same ethnicity over other ethnicity friends (*estimate* = .13, *SD* = .03, *p* < .01).

Table J1

The effect of contact with and social influence of primary outgroup friends on secondary outgroup attitudes.

	Estimate	<i>SD</i>	N	Q(df)
Effects used for testing the hypotheses				
Social influence of primary outgroup friends	1.80**	.52	10	1.22(9)
Number of primary outgroup friends	-.04	.04	10	4.40(9)
Minority	-.12	.11	10	4.00(9)
Social influence of primary outgroup friends x minority	-2.21	1.35	9	2.15(8)
Number of primary outgroup friends x minority	-.04	.08	9	3.86(8)
Controls				

Network dynamics

Density	-2.34***	.07	10	59.71(9)***
Reciprocity	2.00***	.06	10	28.41(9)***
Transitive reciprocated triplets	-.10***	.02	10	25.09(9)**
Geometrically weighted edgewise shared partners (GWESPff)	1.71***	.06	10	37.44(9)***
Indegree popularity	-.04*	.01	9	27.98(9)**
Outdegree popularity	-.13***	.01	10	26.45(9)***
Secondary outgroup attitudes alter	.02	.01	10	10.75(9)
Secondary outgroup attitudes ego	.001	.01	10	6.94(9)
Secondary outgroup attitudes homophily	-.05	.06	9	4.18(8)
Gender alter	.02	.01	10	8.19(9)
Gender ego	.02	.03	10	34.16(9)***
Gender homophily	.37***	.02	10	13.06(9)
Ethnic homophily	.13**	.03	10	30.32(9)***

Behavioral dynamics

Linear shape	.29***	.05	10	12.37(9)
Quadratic shape	.04	.02	10	4.31(9)
Social influence of secondary outgroup friends	1.21	1.04	6	1.91(5)
Number of secondary outgroup friends	-.10	.06	8	1.80(7)
Social influence of ingroup friends	1.33*	.54	8	4.20(7)
Number of ingroup adolescents friends	-.02	.02	10	3.20(9)
Social influence of remaining friends	1.02 ⁺	.50	10	4.51(9)

Number of remaining adolescents friends	-.003	.02	10	5.66(9)
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Note. *** $p < .001$, ** $p < .01$, * $p < .05$, + $p < .10$. SD denotes standard deviation. N represents the groups (i.e., grades nested within schools) employed for an effect estimation; the maximum number is 10.

Supplemental Material K

Simulation (Study 3) based on Study 2

Generally, the simulations based on Study 2 yielded similar findings to the simulations based on Study 1 reported in the manuscript (see Figure K1 and Table K1).

More specifically, the top row in Figure K1 displays participants with initially positive attitudes. If these participants were subjected to social influence (experimental condition) as compared to no social influence (control condition), 52% would have different, mostly more negative, attitudes when their primary outgroup friends' attitudes were neutral, and 61% would have different, mostly more negative, attitudes when their primary outgroup friends' attitudes were negative. If participants and their friends had initially positive attitudes, 31% of participants would have different attitudes. In contrast, attitudes would peak at the median attitude ($M = 4.27$ on a scale from 1 to 5), indicating that participants and their friends would become even more similar to each other. Here, in contrast to the main article, we report medians rather than means. This decision was motivated by the skewed nature of the data and our aim to highlight an alternative measure, which yielded similar conclusions.

The middle row in Figure K1 displays participants with initially neutral attitudes. In the case of social influence, 57% would have different, mostly more positive, attitudes when their primary outgroup friends' attitudes were positive, and 50% would have different, mostly more negative, attitudes if primary outgroup friends' attitudes were negative. If both participants and their friends had initially neutral attitudes, the mean attitude would be similar. However, the distribution of attitudes would be different for 32% of participants. Similarly, as in the case of positive attitudes, participants would become even more similar

to each other if they were subjected to social influence and their attitudes would peak at a mean value of 3.34.

The bottom row in Figure K1 displays participants with initially negative attitudes. In the case of social influence, 56% of participants would have different, mostly more positive, attitudes when primary outgroup friends' attitudes were positive, and 44% would have different, mostly more positive, attitudes when primary outgroup friends' attitudes were neutral. Similarly to the case of both positive and neutral attitudes, if both participants and their friends had initially negative attitudes, mean attitudes would be similar in the experimental and control conditions; however, attitudes would become even more homogenous in the experimental condition and different for 23% of participants.

Figure K1

Simulation of change in secondary outgroup attitudes in majority adolescents as a function of having Turkish-origin friends based on Study 2

Initial distribution of secondary outgroup attitudes in the primary outgroup friends

Initial distribution of secondary outgroup attitudes in the majority

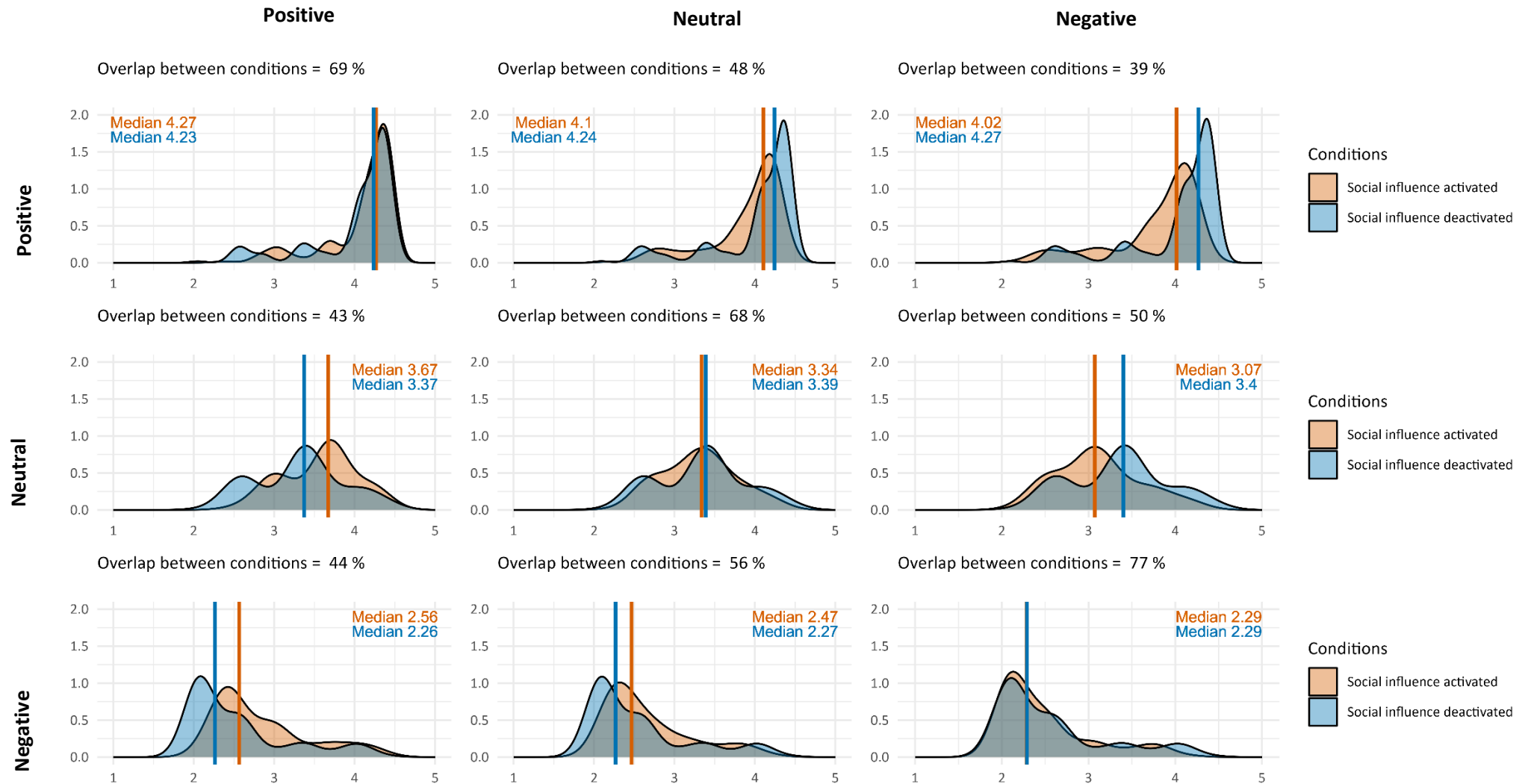


Table K1

Differences in secondary outgroup attitudes between simulated conditions based on Turkish-origin friends in Study 2

Prevalent attitudes among target adolescents	Prevalent attitudes among primary outgroup adolescents					
	Positive		Neutral		Negative	
	V_{Wilcoxon}	Δ	V_{Wilcoxon}	Δ	V_{Wilcoxon}	Δ
Positive	50836***	.03	7622.5***	-.14	556.5***	-.25
Neutral	62211***	.30	26355**	-.05	2051***	-.33
Negative	63856***	.30	53156***	.20	17931***	-.002

Note. The rows represent scenarios that differed in the prevalent attitudes among target adolescents. The columns represent scenarios that differed in the prevalent attitudes among primary outgroup adolescents. The table shows V_{Wilcoxon} and the difference in medians (Δ) for each comparison. Concerning Δ , we compared the experimental to the control condition; a positive difference means that attitudes were more positive in the experimental than control condition, and a negative difference means that attitudes were more negative in the experimental than the control condition. *** $p < .001$, ** $p < .01$, * $p < .05$

Additional information about the simulation approach in Study 3

The STE and social influence effects shape secondary outgroup attitudes against the background of other dynamics that influence network structure and also secondary outgroup attitudes. For instance, in Study 2, we found a positive linear shape effect, which represents a tendency of secondary outgroup attitudes to generally improve, regardless of attitudes of primary outgroup adolescents. This could make a comparison of secondary outgroup attitudes at T1 with attitudes at T2 unclear; although, for instance, secondary outgroup attitudes might worsen due to the social influence effect, a comparison between

attitudes at T1 and T2 could be non-significant due to other effects. Thus, we refrained from comparing how attitudes developed in a scenario to attitudes at T1. Instead, we contrasted a control condition to an experimental condition or, in the case of social influence assessment, we compared how attitudes would develop as a function of target and primary outgroup adolescents' attitudes.

The validity of our approach to experimentally simulate the prevalent valence of adolescents' secondary outgroup attitudes was further supported by the fact that there was no homophily in terms of secondary outgroup attitudes in Study 1 or 2. It is possible that similar attitudes facilitate friendship creation and thus such attitudes affect the network structure. However, since the network structure was not affected by secondary outgroup attitudes in our two empirical studies, we could manipulate the valence of these attitudes without threatening the validity of the network structure.

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