OXFORD

Social Forces, 2025, **104**, 250–269

https://doi.org/10.1093/sf/soae169

Advance access publication date 6 December 2024

Original Article

Strong ties, strong homophily? Variation in homophily on sociodemographic characteristics by relationship strength

David Kretschmer [1,*], Lars Leszczensky[2], Cassie McMillan [3]

[1]Nuffield College, University of Oxford, New Road, OX1 1NF Oxford, United Kingdom

[2]Goethe University Frankfurt, Faculty of Social Sciences, Institute of Sociology, Theodor-W.-Adorno-Platz 6, Frankfurt am Main, Germany

[3]Department of Sociology and Anthropology, School of Criminology and Criminal Justice, Northeastern University, 900 Renaissance Park, Boston, MA, United States of America

*Corresponding author: Nuffield College, University of Oxford, New Road, OX1 1NF Oxford, United Kingdom. Email: david.kretschmer@nuffield.ox.ac.uk

Social networks are segregated by sociodemographic characteristics such as gender, ethnicity, religion, and socioeconomic status. A key reason for this segregation is homophily, or people's preferences to associate with similar others. Homophily is documented for relationships of different strengths, ranging from marriage and close friendship to weaker acquaintanceships. But does sociodemographic homophily vary by relationship strength? While most researchers assume more pronounced sociodemographic homophily for strong than for weak relationships, theoretical expectations and empirical evidence are inconclusive. For instance, shared sociodemographic characteristics can come with joint experiences and identities that could facilitate the development of strong relationships. At the same time, however, matching personalities and attitudes may be necessary for forming strong relationships, so the superficial similarity that accompanies shared sociodemographic traits may only suffice for weak relationships. Based on these considerations, we test whether and how gender, ethnic, religious, and socioeconomic status homophily vary by relationship strength in over 600 school-based networks of more than 20,000 adolescents from Israel, England, Germany, the Netherlands, and Sweden. Using valued exponential random graph models, we find consistent evidence that strong tie homophily exceeds weak tie homophily. While adolescents are more likely to report strong ties with those who share their gender, ethnicity, religion, and socioeconomic status, homophily is less pronounced for weaker ties. Our finding suggests that it is crucial to consider the link between homophily and tie strength to understand the flow of information, resources, social support, and opportunities in social networks.

Key words: networks; relationship strength; sociodemographics; friendship; adolescence.

Introduction

One of the most consistent findings in the social sciences is that social relationships are segregated by sociodemographic characteristics such as gender, ethnicity, religion, and socioeconomic

Received: January 20, 2023. **Revised:** October 9, 2024. **Accepted:** November 20, 2024

status (McPherson, Smith-Lovin, and Cook 2001). Since social segregation affects a wide range of individual and collective outcomes (DiMaggio and Garip 2012), understanding its origins is a key task for social scientific research. Segregated neighborhoods, schools, and workplaces contribute to this clustering by restricting individuals' opportunities to meet people from different backgrounds than their own (Blau 1977; Verbrugge 1977). Moreover, people prefer to associate with similar others (McPherson et al. 2001; Rivera, Soderstrom, and Uzzi 2010). Research has documented this preference for similarity, or *homophily*, in different social relationships, including marriage, romantic relationships, friendships, and acquaintanceships (Kalmijn 1998; McPherson et al. 2001).

Yet while sociodemographic homophily appears to be ubiquitous (DiMaggio and Garip 2012:95), we do not know whether it is equally important for the formation of relationships of different strengths. Granovetter (1973:1361) defined the strength of a relationship, or tie, as a "combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie." In short, we have stronger ties with our best friends than with our other friends, and we are closer to our friends than we are to our acquaintances. But does sociodemographic homophily govern the formation of strong(er) and weak(er) relationships to a similar degree?

Examining whether sociodemographic homophily differs in strong and weak ties is important for two reasons, both of which are related to the fact that homophily is a major mechanism of segregation. First, relationships of different strengths serve varying functions and entail different resources (Kim and Fernandez 2023; McMillan 2022a). Strong ties tend to be emotionally close (Marsden and Campbell 1984), involve the sharing of resources (Wellman and Wortley 1990), and facilitate the enforcement of social norms (Coleman 1990). By contrast, weak ties encourage the spread of information, benefit people's success in labor markets, and encourage broader social change (Granovetter 1973). Given these different effects of strong and weak ties, considering variation in sociodemographic homophily by relationship strength can improve our understanding of how social inequality arises (DiMaggio and Garip 2012; Kim and Fernandez 2023). If sociodemographic homophily were more consequential for strong ties, this would increase solidarity, support, and the exchange of resources among sociodemographically similar people while allowing information to flow between groups through less homophilous weak ties. Conversely, if homophily were more consequential for weak ties, in-group members would be more necessary for obtaining information but less important for emotional and social support. Second, because homophily induces segregation, variation in homophily by relationship strength is consequential for the harmonious co-existence and integration of sociodemographic groups. Though not always sufficient (Khuu et al. 2023), strong intergroup ties are more effective at reducing prejudice than weaker connections (Davies et al. 2011). If strong ties were more homophilous than weak ties, the potential for close intergroup connections to develop and, once established, to reduce out-group prejudice would be limited. Advancing our knowledge of how sociodemographic homophily affects the formation of strong and weak ties can thus improve our understanding of intergroup dynamics.

However, there is no systematic evidence on whether and how sociodemographic homophily varies by relationship strength. In their review of tie-generating mechanisms, Rivera et al. (2010:94) conclude that "homophily more strongly affects attachment in intimate relations [and] close friendships than in casual ties." But this conclusion rests on only a handful of studies, about half of which examine adults' romantic relationships, showing that homophily is more pronounced for marriage than cohabitation and dating (e.g., Blackwell and Lichter 2004). Yet these relationships all represent strong and exclusive ties, which raises the question of whether the patterns identified for romantic relationships generalize to qualitatively different ties like friendship and acquaintanceship. The two studies cited by Rivera and colleagues that examine non-romantic relationships only consider gender homophily and rely on small, non-generalizable datasets (Van Duijn et al. 2003; Leenders 1996).

Concluding that sociodemographic homophily is *generally* stronger in strong ties than in weak ties thus seems premature. More recent studies cast further doubt on the generalizability of this conclusion. On the one hand, Windzio and colleagues (2013; 2014) found more pronounced ethnic and religious homophily in German children's stronger ties than their weaker connections. On the other hand, Hofstra et al. (2017) found ethnic segregation to be similar in native Dutch students' online Facebook networks and their stronger friendship networks and, similarly, DiPrete et al. (2011) found racial and socioeconomic homophily to be as frequent in broader acquaintance networks as in core networks in the U.S. Finally, examining adolescents' school networks in the U.S., McMillan (2022a) even found greater gender homophily in weak than in strong friendship ties and evidence of racial homophily only in weak ties but not in strong ties.

Given these inconclusive findings, we revisit the link between sociodemographic homophily and relationship strength by assessing the social ties of more than 20,000 adolescents embedded in 638 networks from five different countries: Israel, England, Germany, the Netherlands, and Sweden. Our analyses extend upon prior work in four ways. First, unlike previous research that studied one or, at most, two sociodemographic characteristics, we investigate sociodemographic homophily on four characteristics that are salient social boundaries: gender, ethnicity, religion, and socioeconomic status. Second, many of the previous network-analytical investigations of variation in homophily by relationship strength are case studies of single schools or university networks. By contrast, we analyze diverse samples of adolescents from a large number of schools in several countries. Third, we apply valued exponential random graph models explicitly designed to analyze networks that include ties of different strengths. This allows us to compare estimates of homophily in strong and weak ties within the same model and overcomes the methodological issues that arise when comparing coefficients across models. Like previous studies, we face the limitation that not all types of preferences can be empirically distinguished, as we detail below. However, whenever estimates of strong tie homophily exceed those of weak tie homophily or vice-versa, we can draw firm conclusions on the underlying preferences. Fourth, we analyze datasets that consider various indicators of tie strength. This increases the robustness of our findings and enables us to extend them beyond the dichotomy of strong and weak ties. Empirically, we find consistent evidence that strong tie homophily exceeds weak tie homophily across all data sets and sociodemographic characteristics.

Theoretical background

Homophily in adolescent school-based networks

Following recent work, we use the term "homophily" to describe people's *preferences* to associate with similar others (McFarland et al. 2014; Wimmer and Lewis 2010). Like our study, most previous work on homophily examines the social networks of *adolescents in schools*. Paired with methods from social network analysis, examining these social relationships offers the advantage of allowing one to factor in two mechanisms that are known to bias homophily estimates (Rivera et al. 2010). First, analyzing school-based networks provides knowledge of students' opportunity structures, making it possible to account for individuals' uneven chances to associate with members of different sociodemographic groups (Blau 1977). Second, with techniques from social network analysis, researchers can account for relational mechanisms, such as the tendency to become friends with one's friends' friends. Triadic closure and other relational mechanisms can amplify sociodemographic segregation, so failing to control for them overestimates homophily (Goodreau, Kitts, and Morris 2009; Wimmer and Lewis 2010). By accounting for opportunity structures and relational mechanisms, researchers can infer the extent to which homophily informs network patterns. Studies of adolescents' school-based friendship networks provide evidence for homophily with respect to race/ethnicity (Goodreau et al. 2009; Leszczensky and Pink 2015; Smith, Maas, and van Tubergen 2014), gender (Kretschmer 2024; Mehta and Strough 2009), religion (Kretschmer and Leszczensky 2022; Leszczensky and Kretschmer 2022; Leszczensky and Pink 2017; Simsek, van Tubergen, and Fleischmann 2022), and socioeconomic status (Malacarne

2017; McFarland et al. 2014). While gender emerges as the strongest divide in young people's social lives, findings are least consistent for homophily by socioeconomic status (Smith et al. 2014).

Sociodemographic homophily in relationships of different strength

Even though sociodemographic homophily is known to contribute to segregation in adolescents' social networks, its variation across social relationships of different strengths is less established. Following Granovetter (1973), the strength of a tie is a function of the time the parties in a relationship spend together, their intimacy, their emotional intensity, and the services they provide one another. Given these criteria, close friendships should represent particularly strong ties for adolescents, followed by other, less close friendships and weaker ties with acquaintances. In the following subsections, we discuss how strong and weak ties form and why the importance of sociodemographic homophily may differ for their creation.

How do strong and weak ties form?

Given Granovetter's (1973) criteria for differentiating strong from weak ties, it is reasonable to assume that most strong ties initially were weak ties that became stronger over time. For example, if two people are close friends, it is unlikely that their relationship was characterized by high emotional intensity and intimacy at its inception. Rather, the relationship began as a weak tie that developed into a strong connection. We therefore distinguish the formation of weak ties from the formation of strong ties and conceive of the latter as a promotion of an existing weak tie to a strong one.

For two reasons, people are likely to be more selective when promoting their weak ties to strong ties than when forming weak ties initially. First, because building and maintaining strong ties requires more time and emotional involvement, people can only engage in a relatively small number of strong ties. Therefore, strong ties will only develop when people are willing to invest larger efforts into a relationship. Second, given the higher intimacy of strong ties and the larger amount of time spent in them (Hansell 1984), people have an incentive to ensure that their strong ties persist over time and provide them with ongoing benefits, such as pleasant interactions or emotional support (Blackwell and Lichter 2004).

A key criterion of tie formation is similarity in relevant traits, which increases interpersonal attraction (Byrne 1971). If people are more selective when it comes to strong rather than weak ties, similarity in relevant traits should play a larger role in the promotion to strong ties than in the formation of weak ties. However, it is not clear whether the same traits are meaningful for the development of weak versus strong ties and how strongly these traits are correlated with sociodemographics. Jointly, these factors determine whether sociodemographic homophily is more pronounced for strong ties or for weak ties.

Why sociodemographic homophily might be stronger for strong ties

The principle that similarity breeds attraction suggests that people prefer relationships with sociodemographically similar peers. Furthermore, if similarity is more important for strong ties due to their greater selectivity, there should be stronger sociodemographic homophily in stronger relationships—at least as long as shared sociodemographics are meaningful for strong ties. This view predominates in the literature (Rivera et al. 2010), with many scholars assuming that sociodemographic homophily in strong ties exceeds sociodemographic homophily in weak ties (Granovetter 1973; Putnam 2000; Son and Lin 2012).

There are various reasons why sociodemographic similarity may be substantively meaningful for strong ties. First, people may consider shared sociodemographics themselves important for relationships. Given the greater importance of similarity in strong ties, this will favor sociodemographically similar peers' promotion to strong ties. Second, sociodemographic similarity may operate more indirectly, as sociodemographics may be related to and proxies of other meaningful traits. Peers who share a sociodemographic characteristic often have joint experiences and a common group identity (Ashmore, Deaux, and McLaughlin-Volpe 2004). For example, ethnic

minority members may share experiences of exclusion or cultivate a joint ethnic identity (Umaña-Taylor et al. 2014). This connection between shared sociodemographics and other shared traits may also favor the promotion of weak in-group ties to strong ties. Finally, sharing sociodemographic characteristics helps reduce the uncertainties and effort inherent in social interaction (Leszczensky and Pink 2015; Windzio and Bicer 2013). Aiming for harmonic and long-lasting strong ties, people's preference for sociodemographic similarity may therefore be particularly important for the promotion of weak ties to strong ties.

Why sociodemographic homophily might be stronger for weak ties

As argued above, sharing an ethnicity, gender, religion, or socioeconomic status implies some degree of similarity. Often, however, these commonalities may be only skin deep. For the promotion of weak to strong ties, other desirable traits such as matching personalities, compatible attitudes, or shared activities and interests may instead be more decisive. As many of these traits are not, or are only weakly, correlated with sociodemographics (Costa, Terracciano, and McCrae 2001; Foldes, Duehr, and Ones 2008; Goldberg et al. 1998), sociodemographics may facilitate the formation of weak ties but may be less important for their promotion to strong ties.

At first sight, this seems to suggest similar sociodemographic segregation in strong and weak ties. After all, if shared sociodemographics facilitate the formation of weak ties, sociodemographic similarity should characterize many weak ties. This predominance could then be reproduced among strong ties even if sociodemographics themselves do not impact the promotion of weak to strong ties. However, even if the skin-deep similarity of shared sociodemographics is *advantageous* for the formation of weak ties, it may become *disadvantageous* for their promotion to strong ties. This is because the formation of weak ties depends on various characteristics, ranging from shared sociodemographics to other desirable traits like matching personalities, attitudes, and activities. As youth are unlikely to find peers who exhibit all preferred characteristics, they must make trade-offs between different traits of interest when forming weak ties. For example, given sociodemographic homophily in weak ties, people may develop weak ties with peers who have similar sociodemographics but not necessarily other desirable traits. However, when shared sociodemographics are not present, attraction based on other desirable traits will be more decisive for the formation of weak ties. Accordingly, weak ties that connect sociodemographically dissimilar peers should link youth with other desirable traits more frequently than weak ties between sociodemographically similar peers. If these traits (rather than sociodemographics) determine which weak ties are later promoted to strong ties, sociodemographically similar weak ties will be disadvantaged for tie promotion. Accordingly, sociodemographic homophily may be weaker in strong ties than in weak ties. These considerations align with research showing that sociodemographic similarity strongly affects tie formation in the early stages of social encounters but loses its importance over time (Van Duijn et al. 2003; Schaefer and Kreager 2020).

Why sociodemographic segregation may be equivalent in strong and weak ties

Following the reasoning above, people may disproportionally promote either sociodemographically similar or sociodemographically dissimilar peers to strong ties. However, a third possibility is that people promote weak ties to strong ties *regardless of sociodemographic similarity*, resulting in similar levels of sociodemographic segregation in strong and weak ties.

This final outcome can result from two types of preferences. First, sociodemographic similarity may be disregarded in tie promotion *if strong and weak tie homophily are identical*. In this situation, people are content with their weak ties' sociodemographic similarity, as induced by weak tie homophily. Therefore, they see no further need to disproportionally promote sociodemographically (dis-)similar peers to strong ties, and the level of sociodemographic segregation in weak and strong ties will be equivalent. Second, if there is *no strong tie homophily* at all, sociodemographic similarity will also be disregarded for tie promotion and lead to similar levels of segregation in strong and weak ties.

Accordingly, observing similar sociodemographic segregation in strong and weak ties does not permit firm conclusions on the underlying preferences, because it can represent either identical levels of strong and weak tie homophily or the absence of strong tie homophily and, consequently, stronger weak tie homophily than strong tie homophily. If, by contrast, segregation in strong ties exceeds segregation in weak ties, this conclusively indicates that strong tie homophily exceeds weak tie homophily; and if segregation in weak ties exceeds segregation in strong ties, this indicates that weak tie homophily exceeds strong tie homophily.

Mixed evidence on sociodemographic homophily and relationship strength

Despite the common assumption that homophily is more pronounced for strong than weak ties (e.g., Rivera et al., 2010), empirical evidence is limited. Most work that documented higher levels of homophily in stronger relationships only considered *gender* homophily (e.g., Leenders 1996, Van Duijn et al., 2003, Stehlé et al. 2013). However, gender might be a unique case. Particularly in adolescence, gender is strongly associated with joint interests, and youth may prefer to discuss issues surrounding romantic interests and sexuality with strong same-gender ties. Therefore, it is questionable whether findings for gender also extend to other sociodemographic characteristics.

Evidence is less conclusive for sociodemographics other than gender. Research on race and ethnicity, the only other characteristic investigated across multiple studies, provides mixed results. While one study suggests stronger homophily in strong ties (Windzio and Bicer 2013), one finds mixed results (Hofstra et al. 2017), one reports similar homophily in strong and weak ties (DiPrete et al. 2011), and one documents homophily only in weak but not in strong ties (McMillan 2022a).

Moreover, many previous studies that considered differences in homophily by relationship strength either relied on small, localized samples or did not use the network-analytical tools necessary to fully account for opportunity structures and other network mechanisms. While Leenders (1996), Van Duijn et al. (2003), and Stehlé et al. (2013) used network data and methods, they focused on single university or school networks, thus providing case studies with limited generalizability. By contrast, the studies by DiPrete et al. (2011) and Hofstra et al. (2017) considered a wider variety of settings but cannot account for the possibility that weak and strong ties are formed in contexts with different opportunity structures. Studies that used both large-scale data and network-analytical methods appropriate to investigating differences in homophily by relationship strength (McMillan 2022a; Windzio and Bicer 2013; Windzio and Wingens 2014) provided mixed evidence of variation in homophily by relationship strength.

Data

To examine whether homophily varies by relationship strength, we use three datasets that jointly comprise the school networks of more than 20,000 adolescents from England, Germany, Israel, the Netherlands, and Sweden. The data in all five countries include sociometric information on adolescents' in-school relationships of different strengths.

Children of Immigrants Longitudinal Survey in Four European Countries (CILS4EU)

CILS4EU is a longitudinal study of adolescents in England, Germany, the Netherlands, and Sweden (Kalter et al. 2016; Kalter, Kogan, and Dollmann 2019). We use the first wave of the CILS4EU study, which randomly sampled schools in 2010–2011, oversampling those with a high proportion of students from an immigrant background. Within each school, CILS4EU surveyed all students from two randomly selected classrooms in grade nine (average age: 14–15). In addition to a questionnaire on individual characteristics, the first wave included sociometric questions on students' social relationships within the classroom. As its key strength, the CILS4EU data assesses relational patterns across many diverse communities from multiple countries. With 18,716 students in total, the CILS4EU data is the largest dataset we use.

Friendship and Identity in School survey (FIS)

FIS is a longitudinal survey on the social relationships and identities of native- and immigrant-origin adolescents in Germany (Leszczensky et al. 2022). Data was collected in nine schools in Germany's most populous federal state of North-Rhine Westphalia. Our analysis relies on the first wave of data, which was collected in 2012. FIS assessed both students' sociodemographic characteristics and their social networks, and unlike the other datasets, it also captured cross-classroom ties. This is a key strength of the FIS data, as it more accurately identifies students' in-school social networks. In each participating school, FIS surveyed all students in the fifth, sixth, and seventh grades, who were about 11–14 years old. 1668 students participated in the first wave of data collection.

Student Integration Survey (SIS)

SIS is an Israeli study that targeted all schools with a minimum share of 5% Arab and Jewish students at the school level (Shwed, Kalish, and Shavit 2018).[1] Within schools, students from all grades were surveyed, resulting in a sample of students from fourth to eleventh grade (9–17 years old). Data was collected in 2013–2015, with students answering questions about both their own characteristics and their relationships with classmates. A total of 2613 students participated. Interactions between students were measured on multiple dimensions, for example, querying whether they talk with each other during breaks, visit each other outside of school, or tell each other personal things. This represents a key strength of the SIS data because it allows an assessment of a wider range of relationship strengths than is possible in the other datasets.

Variables

Networks and relationship strength

In all datasets, relationships were measured as directed ties, so ties could but did not have to be reciprocated to be included in the analysis. In the CILS4EU data, sociometric data was collected at the classroom level, i.e., students could indicate ties to classmates only. Students were permitted to nominate up to five *friends,* one *best friend*, and all the classmates they *often spend time with outside of school*. In the FIS data, students could nominate not only classmates but also cross-classroom peers within the same grade. Respondents could nominate up to ten *friends,* one *best friend*, and up to ten students they *spend time with outside of school.*

For both the CILS4EU and the FIS data, we consider a student to have a *strong* tie to another student if the respondent indicated that the peer was either their *single best friend* or if they reported spending time outside of school with the peer *and* considered them a friend. We consider a student to have a *weak tie* to another student if the respondent either spent time with the peer outside of school or nominated them as a friend.

In the SIS data, students rated *all* their classmates along six dimensions. Students indicated whether they a) "trust them", b) "tell them about personal things", c) "visit them at home", d) "talk/chat with them on the phone", e) "meet with them outside school", and f) "play with or talk to them during breaks". For each dimension, students could indicate to "not do so", "do so, but not very often", or "do so very often". Following Shwed et al. (2018), we use these indicators to create a numeric scale of relationship strength ranging between zero and twelve. Each dimension contributes a score of zero if students indicated to "not do so", a score of one if they indicated to "do so, but not very often", and a score of two if they indicated to "do so very often". We use this scale to differentiate four levels of relationship strength: strongest ties with a score of 10–12, strong ties with a score of 7–9, weak ties with a score of 3–6, and weakest ties with a score of 1–2.

Sociodemographic characteristics

Measurement of sociodemographic characteristics occasionally varied across the different datasets. In the following, we give an overview of all our measures; we provide additional details in the supplementary material (section A).

Table 1. Information on the CILS4EU, FIS, and SIS samples.

	CILS4EU	FIS	SIS
# Respondents	18,716	1668	2613
# Respondents in Analytical Sample (after listwise deletion)	16,763	1526	2454
# Schools	480	9	25
# Networks	952	26	132
Average Network Size	17.61	58.69	18.48
# Weakest Ties per Respondent	-	-	5.31
# Weak Ties per Respondent	1.76	3.63	5.56
# Strong Ties per Respondent	1.70	1.88	1.86
# Strongest Ties per Respondent	-	-	2.00
Proportion Strong Ties among All Ties	49.1%	34.1%	12.6%
Proportion Strongest Ties among All Ties	-	-	13.6%

Gender. In all three datasets, students could self-identify as either male or female, which we used to construct a binary indicator.

Ethnicity. The CILS4EU and FIS datasets provide data on the country of birth of students, their parents, and their grandparents. Based on these responses, we categorize students' ethnicity following standard procedures (Dollmann, Jacob, and Kalter 2014). In the SIS survey, we infer students' ethnicity from the languages spoken at home.[2] This allows us to differentiate between Hebrew, Russian, Arabic, Amharic, and a residual category of other ethnic backgrounds.

Religion. In the CILS4EU and FIS data, students could indicate their religious affiliation. We differentiate between no religion, Christianity, Islam, Hinduism, Buddhism, Judaism, Sikhism, and a residual category of other religions. The SIS study does not provide information on the religious affiliations of students or their parents but does include grandparents' religious affiliations. We use this information to infer students' religious affiliations, differentiating between Jewish, Muslim, Christian, and a residual category of other religious groups.

Socioeconomic status. In the CILS4EU and FIS data, we derive students' socioeconomic status from their parents' occupational status as measured on the International Socioeconomic Index (ISEI) scale. We took the maximum of the mother's and the father's ISEI scores and differentiated low socioeconomic status (lower third of the ISEI distribution), medium socioeconomic status (middle third), and high socioeconomic status (upper third). Information on parental occupational status is not available in the SIS data, so we approximate socioeconomic status by the *number of cars* students indicated their families own. We contrast students whose families have no car, one car, and more than one car.

Samples for the analysis

We can only assess the importance of two students sharing sociodemographic characteristics if information on both students' sociodemographics is available. Therefore, we exclude all students from the analysis who have missing values on at least one of the sociodemographic characteristics. This excludes 10% of students in the CILS4EU data, 9% of students in the FIS data, and 6% of students in the SIS data. Table 1 provides basic information on our three samples for the analysis.

With 17.6 and 18.5 students, respectively, the average network size is similar in the CILS4EU and SIS data. It is higher in the FIS data (58.7 students), which provides grade- rather than classroom-level networks. In the FIS data, 34.1% of all ties are strong rather than weak, while

almost half of all ties (49.1%) are strong ties in the CILS4EU data.[3] In the SIS data, we categorize 13.6% of ties as the strongest ties, 12.6% as strong ties, 37.8% as weak ties, and 36.0% as the weakest ties.

Method: Valued Exponential Random Graph Models

Exponential random graph models (ERGMs) are a statistical method to jointly model the different processes responsible for the structure of cross-sectional networks (Robins et al. 2007). ERGMs are usually estimated based on Markov Chain Monte Carlo (MCMC) simulations and compare the properties of empirically observed networks to those of the simulated networks to assess whether the properties of the observed network statistically differ from what can be expected by chance. This ensures that all ERGM estimates account for opportunities and constraints to tie formation due to the size of different sociodemographic groups within networks. As a multivariate method, ERGMs can model co-occurring network processes, identifying the strength of homophily on a given sociodemographic characteristic *net* of homophily on other characteristics and relational mechanisms like reciprocity and triadic closure.

Traditionally, ERGMs have been limited to evaluating binary social networks, where ties are either *present* or *absent*. However, recent generalizations of ERGMs allow for analyzing networks where ties are assigned different values by attaching numerical measures that indicate each tie's level of strength (Krivitsky 2012). We apply these *valued* ERGMs to assess whether there are variations in sociodemographic homophily across ties of different strengths. For the CILS4EU and the FIS data, we test for such variations by using two recently developed parameters: one for homophily in *weak ties* and one for homophily in *strong* ties (McMillan 2022b). Each parameter captures the degree to which sharing a sociodemographic characteristic affects the likelihood of weak and strong ties, respectively. Contrasting the coefficients of these parameters allows us to assess whether sociodemographic homophily is more pronounced in strong or weak ties. For the SIS data, we generalize this approach by including four homophily parameters, one for each level of relationship strength. In all analyses, we treat the different relationship strengths as nominal categories, separately estimating homophily coefficients for each level of relationship strength.[4]

Model specification

For each network from our three datasets, we estimate four valued ERGMs, one for each sociodemographic characteristic (gender, ethnicity, religion, or socioeconomic status). In each model, we assess variations in strong versus weak tie homophily for that characteristic. Each of these models also includes controls for homophily on the three remaining sociodemographics. For these controls, we do not differentiate between strong and weak tie homophily to avoid convergence problems in some of the networks.

Additionally, all models account for two well-established relational mechanisms, *reciprocity* and *triadic closure*. Reciprocity captures tendencies for sent ties to be returned by the receiver. We measure reciprocity with a *mutuality* effect weighted by the value of the weaker tie connecting the pair. Triadic closure refers to the tendency to become friends with one's friends' friends. We capture triadic closure with the *transitiveweights* effect, an extension to the *transitive triplets* effect for valued ERGMs. To ensure conservative estimates of triadic closure, we follow the same specification applied in previous work (i.e., the transitiveweights(min, max, min) specification; McMillan 2022b).

In all datasets, we further account for the baseline frequencies of weak and strong ties relative to the number of peers in the network, using *nonzero* and *sum* parameters in the CILS4EU and FIS data and *equalto* parameters for all four levels of tie strength in the SIS data. In combination, these parameters are akin to a constant in a classic regression model. Finally, the FIS dataset also provides information on students' classrooms, the elementary schools they attended, and the neighborhoods where they live. We account for whether sharing the same classroom, elementary school, and neighborhood shapes students' network ties to consider whether more frequent

interaction, previous close interaction, and residential proximity affect the formation of strong and weak ties.

Estimation

We estimated separate valued ERGMs for each sociodemographic characteristic and network from each dataset. In the CILS4EU data, the individual classroom networks are small, so we combined the two classrooms surveyed in most schools to improve power and convergence.[5] This results in a total of 638 networks; 480 are from the CILS4EU data, 26 are from FIS, and 132 are from SIS.

We only report results for converged ERGMs, as indicated by the internal ERGM convergence assessment and the trace and density plots from the network simulations (Hunter et al. 2008). We also excluded results from ERGMs with severe multicollinearity (Duxbury 2021). For ethnicity, religion, and socioeconomic background, we can include 86–87% of the CILS4EU networks, 96% of the FIS networks, and 82–86% of the SIS networks. For gender homophily, the proportion of networks included in the analysis is lower (74–84% across the three datasets). Non-convergence predominantly results from the (almost) complete absence of relationships across sociodemographic boundaries for strong, weak, or both kinds of ties, particularly in the case of gender. In the supplementary material (section D), we provide a more comprehensive discussion of the reasons for non-convergence and ascertain that it does not bias our findings.

We use a random-effects multivariate meta-analysis to aggregate coefficients across networks in each dataset (An 2015). We conduct two statistical tests to evaluate differences between strong and weak tie homophily. First, we apply a Wald test to compare the coefficients for strong and weak tie homophily from the meta-analysis. Second, we apply a binomial sign test to assess whether the probability that strong tie homophily exceeds weak tie homophily is higher than the probability that weak tie homophily exceeds strong tie homophily. Across networks, this nonparametric test compares the observed signs of the difference between strong and weak tie homophily with the expected distribution of signs under each hypothesis.

An important and undesirable feature of these analyses is that we can only draw firm conclusions on how homophily varies by tie strength if estimates of strong and weak tie homophily differ but not if they are equivalent. This is because estimates of strong and weak tie homophily are based on observed levels of segregation in both types of ties (controlled for covariates and network processes). However, as explained previously, segregation can be equivalent in strong and weak ties either because strong tie homophily equals weak tie homophily or because strong tie homophily is absent. Therefore, if estimates of strong and weak tie homophily are equivalent, this can reflect either type of preference, and our analyses cannot determine whether weak tie homophily exceeds strong tie homophily or is identical to it. However, when estimates of strong tie homophily exceed those of weak tie homophily, we can conclude that strong tie homophily is stronger than weak tie homophily. Similarly, if weak tie homophily estimates exceed strong tie homophily estimates, we can conclude that weak tie homophily is more pronounced.

Results

Descriptive analysis

Figure 1 provides a descriptive overview of how homophily differs by relationship strength in the three datasets. The top panel refers to the CILS4EU data, the middle panel to the FIS data, and the bottom panel to the SIS data. For each dataset and sociodemographic characteristic, Fig. 1 displays the average proportion of all peers in the network who share the sociodemographic characteristic, as well as the average proportion of ties that connect students who report the same characteristic, separately for strong and weak ties. If the proportion of ties to students with the same sociodemographic exceeds the network proportion of peers holding the characteristic, this suggests sociodemographic homophily.

The top panel of Fig. 1 shows that ethnic, gender, religious, and socioeconomic homophily are prevalent in the CILS4EU data. For all characteristics, the proportion of strong and weak ties

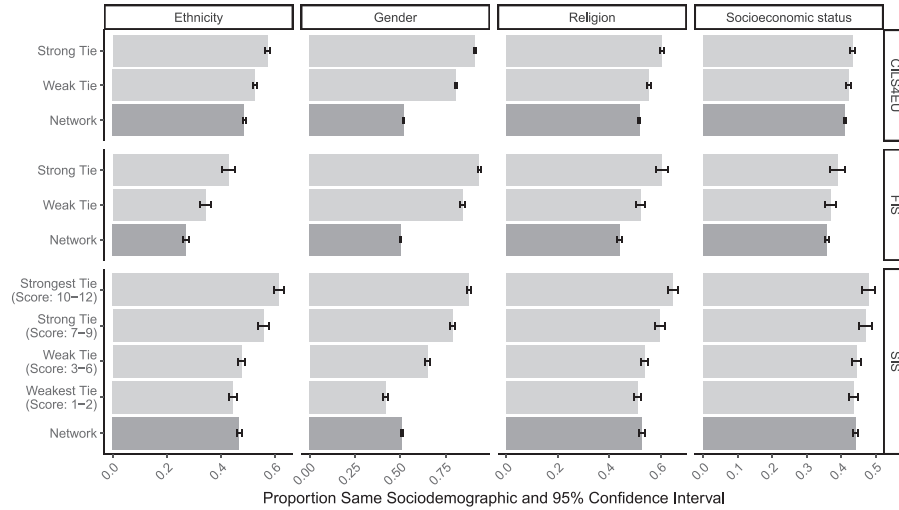

Figure 1. Proportion of strong and weak ties that link students sharing sociodemographic characteristics in the CILS4EU, FIS, and SIS data.

that connect students sharing the characteristic is higher than the proportion in the network. Furthermore, strong ties are more likely to connect students who share a sociodemographic characteristic than weak ties, indicating that homophily increases with relationship strength.

Results are similar for the grade-level networks in the FIS data presented in the middle panel of Fig. 1. The proportion of weak ties among peers who share a sociodemographic characteristic exceeds the proportion in the grade-level network for all characteristics. Furthermore, the proportion of strong ties connecting peers with the same sociodemographic exceeds the proportion of weak ties.

The bottom panel of Fig. 1 assesses the SIS data and investigates whether the link between relationship strength and sociodemographic homophily persists beyond the strong and weak tie dichotomy. According to Fig. 1, sociodemographic homophily rises monotonically with tie strength. For all sociodemographics, the strongest ties are the most likely to connect individuals with similar characteristics. Additionally, strong ties connect similar peers more frequently than weak ties, and weak ties are more likely to connect peers with the same characteristics than the weakest ties. All our descriptive results thus point towards stronger sociodemographic homophily in stronger ties than weaker ones.

Multivariate results from valued ERGMs

To account for the role alternative network mechanisms play in shaping network patterns, we next turn to our multivariate valued ERGM analyses. Figure 2 shows the results for the CILS4EU, FIS, and SIS data, and full model results are reported in Tables B1-B3 in the supplementary material (section B). For the CILS4EU and the FIS data, Fig. 2 displays estimates of *strong tie homophily* and *weak tie homophily* for each sociodemographic characteristic, estimated from our random-effects multivariate meta-analyses. Differences between strong and weak tie homophily are assessed with Wald and binomial sign tests and are statistically significant ($p < .05$) unless otherwise indicated.

The results from Fig. 2 suggest that, in the CILS4EU and FIS data, homophily defines both strong and weak ties across the sociodemographic characteristics ($p < .05$). Only for socioeconomic status in the FIS data, there is no indication of weak tie homophily, and the coefficient for strong tie homophily fails to reach statistical significance.

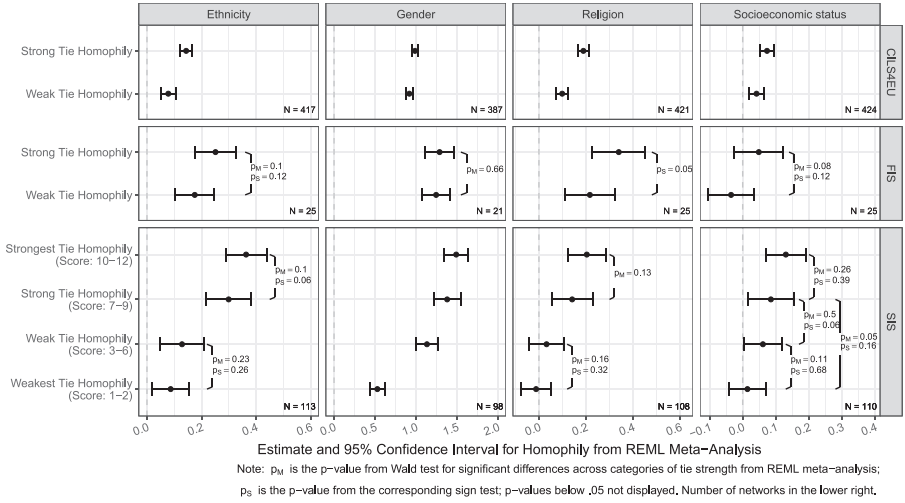

Figure 2. Homophily in strong and weak ties from meta-analyses of valued ERGMs in the CILS4EU, FIS, and SIS data.

Furthermore, we find evidence that homophily is more pronounced in strong ties than weak ties across both datasets. In the CILS4EU data, strong tie homophily is significantly larger than weak tie homophily for all sociodemographic characteristics ($p < .05$ in the Wald and binomial sign tests). For example, students are 15% more likely to nominate a same-ethnic than an inter-ethnic peer as a strong tie ($\beta = .14$, SE = .01, $p < .001$). Weak ties also tend to connect same-ethnic youth, but this tendency is less pronounced as respondents are only 8% more likely to nominate a same-ethnic peer as a weak tie ($\beta = .08$, SE = .02, $p < .001$).

In the FIS data, point estimates also suggest stronger homophily in strong ties for ethnicity, religion, and socioeconomic background. Based on the Wald tests, differences between strong and weak tie homophily are statistically significant at $p < .05$ for religious homophily and at $p < .1$ for ethnic and socioeconomic status homophily. The p-values of the corresponding binomial sign tests are slightly larger ($p = .05$ for religious homophily, and $p = .12$ for ethnicity and socio-economic status). Given the small number of networks in the FIS data, this is not surprising. For gender homophily, our meta-analyses suggest almost identical levels of homophily in strong and weak ties. The binomial sign test, however, supports more pronounced strong tie homophily than weak tie homophily for gender in the FIS data ($p < .05$). Apart from this inconsistency, all results across both datasets and all sociodemographic characteristics suggest stronger levels of homophily in strong than weak ties.

Differentiating homophily across four levels of relationship strength, the lower part of Fig. 2 shows results from the valued ERGMs for the SIS data. For all sociodemographics, results demonstrate a positive, monotonic relation between homophily and relationship strength. For religion and socioeconomic status, the weakest ties are characterized by little or no homophily, but strong ties exhibit substantial homophily for all characteristics. Differences in homophily between adjacent levels of tie strength are not always statistically significant, but homophily in the strongest ties for all characteristics exceeds homophily in the weak and weakest ties ($p < .05$ in both Wald and sign tests). Homophily in strong ties also exceeds homophily in the weakest ties consistently for all characteristics but socioeconomic status ($p < .05$). We also find similar links between homophily and relationship strength if we focus on ties between Jewish and Arab students only, an important social boundary in the Israeli context.[6] Overall, the SIS findings support the results from the CILS4EU and FIS data, while also demonstrating that the

link between homophily and relationship strength transcends beyond the dichotomy of strong versus weak ties.

Robustness checks

We conducted several robustness checks to probe our finding of stronger homophily in strong ties. We summarize the main results here and discuss them in detail in the supplementary material (section C).

To test for scaling bias due to the aggregation of network-level estimates in our meta-analyses, we calculated average marginal effects (section C1; Duxbury and Wertsching 2023).[7] These estimates also suggest stronger homophily in strong than weak ties. Results are also robust to a more restrictive cutoff for multicollinearity (section C2) and to estimating strong and weak tie homophily simultaneously for all sociodemographics (section C3).

Across all datasets, we continue to find stronger homophily in strong ties when employing alternative operationalizations of ties of different strengths (section C4). This also holds when we include further indicators of residential proximity or restrict ourselves to measures of tie strength unrelated to residential proximity to account for potential confounding by residential segregation (section C5). Differences between strong and weak tie homophily also persist when we estimate them in separate models (section C6) and when we compare homophily in *all ties* to homophily in strong ties (section C7).

We find consistent trends towards stronger homophily in strong ties in all countries when differentiating by country in the CIL4EU data (section C8). When considering variations in the homophily coefficients across networks in the same dataset (section C9), we find little evidence of heterogeneity in the CILS4EU and the FIS data but consistent between-network variation in the SIS data. This may reflect that the SIS data cover a broader age and grade range than the other datasets and schools of different types and ethnoreligious composition.

Discussion

People's social networks are segregated by sociodemographic characteristics, which is often explained by *homophily*, or individuals' preferences for similar interaction partners (McPherson et al. 2001). Yet while the distinction between strong and weak ties is one of the most prominent concepts in sociology, we continue to lack systematic evidence on whether homophily varies by the strength of social relationships.

Many researchers assume that homophily based on sociodemographic characteristics like gender, religion, ethnicity, and socioeconomic status is more pronounced in strong ties than in weak ties (e.g., Granovetter 1973, Putnam 2000; Son and Lin 2012). However, both theoretical expectations and empirical evidence are mixed. Some prior work suggests that strong tie homophily exceeds weak ties homophily (e.g., Rivera et al. 2010), while other perspectives suggest that weak tie homophily is more pronounced (e.g., McMillan 2022a) or that both are similar (e.g., DiPrete et al. 2011). To resolve the question of how sociodemographic homophily varies with tie strength, we examined differences in gender, ethnic, religious, and socioeconomic homophily across strong versus weak ties. We did so by applying valued exponential random graph models to the in-school friendship networks of more than 20,000 adolescents surveyed across five countries and three datasets.

Our results paint a consistent picture across all datasets and all sociodemographic characteristics. While sociodemographic homophily characterizes both strong and weak ties, homophily in strong ties consistently exceeds homophily in weak ties. This finding holds despite the different operationalizations of relationship strength and sociodemographic characteristics as well as contextual and cultural differences across countries. Furthermore, we find that differences in homophily extend beyond the dichotomy of strong and weak ties, with homophily rising

monotonically with increasing relationship strength. Overall, our study provides robust evidence that sociodemographic homophily is more pronounced in adolescents' strong ties than their weak ties.

Limitations

Although our findings provide comprehensive evidence of the connection between homophily and relationship strength, there are some limitations. In two of the three datasets, we could only differentiate between stronger and weaker *friendships* but not assess whether homophily defines other types of relationships, such as more casual acquaintanceships. However, our more differentiated analysis of the Israeli SIS data suggests a positive association between relationship strength and homophily beyond the strong versus weak friendship dichotomy. But not all insights from the Israeli context may be transferable to other countries, as ethnoreligious tensions are particularly severe in Israel. Unlike in the other samples, we also found heterogeneity in the difference between strong and weak tie homophily across networks in the Israeli data. Still, the fact that, in aggregate, we find stronger homophily in strong than in weak ties across all countries suggests a universal pattern that transcends national specificities.

It is also important to acknowledge that our theoretical interest is in differences of *preferences* (i.e., homophily) across ties of different strengths, while our analyses provide estimates of these preferences based on *observed social ties* rather than direct *preference measures*. Social network approaches are well-suited to inferring preferences from observed network data because they control for potential confounding factors, including opportunity structures, relational processes, and homophily on other characteristics. However, given the various mechanisms and constraints that affect social networks, there remains a residual risk that measures of the link between relationship strength and similarity in observed ties do not capture the impact of preferences alone. This can happen in small networks in particular, where constraints to tie formation can prevent people from fully realizing their friendship preferences.

Furthermore, because all our estimates are based on observed social ties, they jointly capture preferences and their behavioral implications for tie formation. If, as we find, strong tie homophily exceeds weak tie homophily, weak ties with sociodemographically similar peers are particularly likely to be promoted to strong ties. Among weak ties, this leaves a surplus of sociodemographically dissimilar peers—more than suggested by preferences for weak tie homophily alone. Accordingly, the behavioral implications of tie formation can result in a larger gap in sociodemographic similarity between observed strong and weak ties than the corresponding gap in preferences. Therefore, our estimates may differ from those obtained from analytical approaches that measure preferences independent of their behavioral implications.

A final problem with inferring preferences from observed ties is that, under certain conditions, different types of preferences cannot be distinguished empirically. In our study, *identical estimates of strong and weak tie homophily* can reflect two distinct situations: first, that strong and weak tie homophily are indeed identical; and second, that strong tie homophily is absent. In both situations, people would disregard sociodemographic similarity in the promotion of weak to strong ties. This implies similar estimates for both types of preferences, rendering them indistinguishable in analyses of observed ties. As we consistently find larger estimates of strong tie homophily than of weak tie homophily (rather than similar estimates), our results allow us to conclude that sociodemographic homophily increases with relationship strength. However, we could not have drawn similarly firm conclusions if our analyses had provided identical estimates of strong and weak tie homophily.

Avenues for future research

These issues with inferring preferences from observed ties suggest that future research should rely on a broader range of methodological approaches to study how homophily varies with relationship strength. Social network analysis could, for example, be complemented with multifactorial survey experiments that assess preferences for fictional interaction partners based both

on their sociodemographics and tie strength. This approach can capture homophily independent of actual tie formation processes. Therefore, it can isolate preferences from their behavioral implications and separate preferences that are confounded in observed ties.

Our finding that homophily differs by relationship strength also raises important questions about the underlying mechanisms. Crucially, while our results suggest that similarity in sociodemographics more strongly affects strong ties than weak ties, it remains unclear *why* this is the case. On the one hand, our results could reflect that the link between sociodemographics and the characteristics adolescents prefer in their strong ties—such as personality traits, attitudes, and interests—is not as weak as previously suggested. On the other hand, it may be that *other* traits that are closely linked to sociodemographics, like shared experiences and common group identities, are more decisive for strong ties. Our analyses cannot distinguish between these two explanations, so future research should aim to shed further light on this question.

A third question for future research concerns *heterogeneity* in the link between homophily and relationship strength. While our study focused on *commonalities* across sociodemographics, theorizing potential *differences* between gender, religion, ethnicity, and socioeconomic status in future research seems worthwhile. For example, strong tie homophily may be particularly pronounced for *gender*, as interests and activities strongly overlap with gender, and as discussing sensitive issues regarding sexuality and romantic relationships may require strong same-gender ties. By contrast, our findings suggest the smallest difference between strong and weak tie homophily for socioeconomic status. At least partially, this finding may reflect that socioeconomic status did not strongly shape tie formation in the contexts we studied, but these patterns could differ in networks with greater socioeconomic diversity.

Furthermore, the link between homophily and relationship strength may differ by people's age and the context of relationship formation. Focusing on the in-school ties of *adolescents*, our study leaves open the question of whether our findings can be generalized to other age groups and contexts. After all, adolescence is a unique period in people's lives, and the emergence of gender, ethnic, and religious identities may carry distinct consequences for tie formation during this period (Umaña-Taylor et al. 2014). Also, schools are only one of the contexts in which adolescents form social ties. Still, it is important to understand the development of adolescents' in-school relationships since they affect people's long-term trajectories (e.g., Kornienko and Rivas-Drake 2022).

Finally, our findings differ from those in McMillan's (2022a) recent study on tie formation among adolescents in the U.S. In contrast to our findings, McMillan detected more pronounced gender and racial homophily in weak ties than strong ties. Concerning race, McMillan (2022a) suggested that limited racial diversity in her sample may have been responsible for a lack of racial homophily in strong ties. Indeed, our analyses of more ethnically diverse networks document stronger ethno-racial homophily in strong than weak ties. Different findings concerning gender may reflect the younger age of adolescents in our sample. McMillan (2022a, p. 297) speculated that the lower gender homophily she finds among strong ties may indicate the nomination of romantic partners among older adolescents. This is less likely to occur in our younger samples. Still, future research that more directly addresses these potential mechanisms would be helpful for understanding the conditions under which strong tie homophily exceeds weak tie homophily and vice-versa.

Implications

Our finding of stronger homophily in strong than in weak ties has important implications for how resources and information spread in networks. Strong ties are more likely than weak ties to provide social support and access to material resources (Coleman 1990). Thus, the strong homophily in strong ties and its link to segregation suggests that the benefits of these relationships should remain concentrated within sociodemographic groups. This can further entrench inequalities when power and resources vary by socioeconomic status, gender, religion, and ethnicity. By contrast, since weaker social connections facilitate the flow of information (Granovetter 1973),

weak intergroup ties may be crucial for encouraging social mobility by introducing those from disadvantaged groups to new opportunities that can help them get ahead.

Another implication of our finding is that the extent to which intergroup contact can improve outgroup attitudes is likely to be limited. Though not universally so (Khuu et al. 2023), strong intergroup ties can be beneficial for developing positive intergroup attitudes (Davies et al. 2011). Yet our results suggest that homophily is more pronounced in strong than weak ties, making strong ties less likely than weak ties to cross sociodemographic boundaries. Therefore, the potential of intergroup contact for improving intergroup relations is limited by the fact that the most consequential cross-group relationships are those that are the least likely to emerge.

Endnotes

1. This condition applies to a minority of schools in Israel (43 at the time the study started in 2013). These are either multicultural schools with students from secular families of above-average socioeconomic background or local Hebrew schools in mixed neighborhoods recruiting from families that are more secular, but of below-average socioeconomic backgrounds. Despite their selectivity, these are the only schools in which interethnic and interreligious tie-formation processes can occur, and more than half of them participated.
2. The SIS data does not provide information on the country of origin/ethnicity of students, their parents, or grandparents.
3. The proportion of strong ties in the CILS4EU data is higher because students could only nominate a maximum of five friends, many of whom also spent time with the respondent outside of school.
4. To estimate valued ERGMs, it is necessary to specify a reference distribution to inform the assignment of tie weights in the simulated networks. We specified valued ERGMs with a binomial reference distribution.
5. In the valued ERGM analyses, we forced between-classroom ties to be absent as students could not nominate peers from other classrooms.
6. Only the ethnic group of Arab students is religiously heterogeneous, and only the religious group of Jewish students is ethnically heterogenous. Thus, religious homophily estimates mostly capture variation within the group of Arab students and ethnic homophily estimates mostly capture variation within the group of Jewish students. However, additional models limited to ties between Jewish (any ethnicity) and Arab (any religion) students also find evidence for stronger homophily in stronger ties (see supplementary material, section C10).
7. We thank Scott Duxbury for providing us with code to calculate average marginal effects for valued ERGMs, an extension of his previous work (Duxbury 2021).

About the authors

David Kretschmer is a Postdoctoral Prize Research Fellow at Nuffield College, University of Oxford. His research interests comprise intergroup relations, social network analysis, and immigrant social and cultural integration. He is currently working on the interplay of gender and religion in shaping the social integration of Muslim youth in Europe. His work has been published in *Social Forces*, *Social Networks*, the *European Sociological Review*, and other outlets.

Lars Leszczensky is a professor of sociology with a focus on network research at Goethe University Frankfurt/Main. His research examines the causes and consequences of social networks, particularly regarding integration, ethnoreligious segregation, and intergroup relationships. His work has appeared in *American Sociological Review, Social Forces, Social Networks, and Sociological Methods & Research*, among other outlets.

Cassie McMillan is an assistant professor of sociology and criminology at Northeastern University. Her research focuses on social networks, youth crime, substance use, and social inequality. In

particular, she is interested in developing and applying network methods that can further our understanding of adolescent delinquency. Her recent work appears in *American Journal of Sociology*, *Criminology*, and *Social Networks*.

Acknowledgments

CILS4EU research project funded in the NORFACE ERA NET Plus Migration in Europe program. The authors acknowledge support by the state of Baden-Württemberg through bwHPC and the German Research Foundation (DFG) through grant INST 35/1597-1 FUGG.

Supplementary Material

Supplementary Material is available at *Social Forces* online.

Funding

This research was supported by a grant from the German Research Foundation (DFG/LE 3446/1-1).

Conflicts of interest

None declared.

Data Availability

CILS4EU data are available in the GESIS Data Archive for the Social Sciences, at https://doi.org/10.4232/cils4eu.5656.3.3.0. FIS data are available at the DeZIM Research Data Center, at https://doi.org/10.34882/dezim.fis.c.1.0.0. SIS data are available at https://arab-jewish-integration.tau.ac.il/index.php/research.

References

An, Weihua. 2015. "Multilevel meta network analysis with application to studying network dynamics of network interventions." *Social Networks* 43:48–56. https://doi.org/10.1016/j.socnet.2015.03.006.

Ashmore, Richard D., Kay Deaux, and Tracy McLaughlin-Volpe. 2004. "An organizing framework for collective identity: Articulation and significance of multidimensionality." *Psychological Bulletin* 130: 80–114. https://doi.org/10.1037/0033-2909.130.1.80.

Blackwell, Debra L., and Daniel T. Lichter. 2004. "Homogamy among dating, cohabiting, and married couples." *Sociological Quarterly* 45:719–37. https://doi.org/10.1111/j.1533-8525.2004.tb02311.x.

Blau, Peter 1977. *Inequality and Heterogeneity: A Primitive Theory of Social Structure*. New York: Free Press.

Byrne, Donn E. 1971. *The Attraction Paradigm*. New York: Academic Press.

Coleman, James S. 1990. *Foundations of Social Theory*. Cambridge: Harvard University Press.

Costa, Paul T., Antonio Terracciano, and Robert R. McCrae. 2001. "Gender differences in personality traits across cultures: Robust and surprising findings." *Journal of Personality and Social Psychology* 81: 322–31. https://doi.org/10.1037/0022-3514.81.2.322.

Davies, Kristin, Linda R. Tropp, Arthur Aron, Thomas F. Pettigrew, and Stephen C. Wright. 2011. "Cross-group friendships and intergroup attitudes: A meta-analytic review." *Personality and Social Psychology Review* 15:332–51. https://doi.org/10.1177/1088868311411103.

DiMaggio, Paul, and Filiz Garip. 2012. "Network effects and social inequality." *Annual Review of Sociology* 38:93–118. https://doi.org/10.1146/annurev.soc.012809.102545.

DiPrete, Thomas A., Andrew Gelman, Tyler Mccormick, Julien Teitler, and Tian Zheng. 2011. "Segregation in social networks based on acquaintanceship and trust." *American Journal of Sociology* 116: 1234–83. https://doi.org/10.1086/659100.

Dollmann, Jörg, Konstanze Jacob, and Frank Kalter. 2014. *Examining the Diversity of Youth in Europe. A Classification of Generations and Ethnic Origins Using CILS4EU Data (Technical Report), MZES Working Paper Nr. 156*.

Van Duijn, Marijtje A.J., Evelien P.H. Zeggelink, Mark Huisman, Frans N. Stokman, and Frans W. Wasseur. 2003. "Evolution of sociology freshmen into a friendship network." *Journal of Mathematical Sociology* 27:153–91. https://doi.org/10.1080/00222500305889.

Duxbury, Scott W. 2021. "Diagnosing multicollinearity in exponential random graph models." *Sociological Methods and Research* 50:491–530. https://doi.org/10.1177/0049124118782543.

Duxbury, Scott W., and Jenna Wertsching. 2023. "Scaling bias in pooled exponential random graph models." *Social Networks* 74:19–30. https://doi.org/10.1016/j.socnet.2023.02.003.

Foldes, Hannah J., Emily E. Duehr, and Deniz S. Ones. 2008. "Group differences in personality: Meta-analyses comparing five U.S. racial groups." *Personnel Psychology* 61:579–616. https://doi.org/10.1111/j.1744-6570.2008.00123.x.

Goldberg, Lewis R., Dennis Sweeney, Peter F. Merenda, and John Edward Hughes. 1998. "Demographic variables and Perssonality: The effects of gender, age, education, and ethnic/racial status on self-descriptions of personality attributes." *Personality and Individual Differences* 24:393–403. https://doi.org/10.1016/s0191-8869(97)00110-4.

Goodreau, Steven M.S.M., James A. Kitts, and Martina Morris. 2009. "Birds of a feather, or friend of a friend? Using exponential random graph models to investigate adolescent social networks." *Demography* 46:103–25. https://doi.org/10.1353/dem.0.0045.

Granovetter, Mark S. 1973. "The strength of weak ties." *American Journal of Sociology* 78:1360–80. https://doi.org/10.1086/225469.

Hansell, Stephen. 1984. "Cooperative groups, weak ties, and the integration of peer friendships." *Social Psychology Quarterly* 47:316. https://doi.org/10.2307/3033634.

Hofstra, Bas, Rense Corten, Frank van Tubergen, and Nicole B. Ellison. 2017. "Sources of segregation in social networks: A novel approach using Facebook." *American Sociological Review* 82:625–56. https://doi.org/10.1177/0003122417705656.

Hunter, David R., Mark S. Handcock, Carter T. Butts, Steven M. Goodreau, and Martina Morris. 2008. "Ergm: A package to fit, simulate and diagnose exponential-family models for networks." *Journal of Statistical Software* 24:nihpa54860. https://doi.org/10.18637/jss.v024.i03.

Kalmijn, Matthijs. 1998. "Intermarriage and homogamy: Causes, patterns, trends." *Annual Review of Sociology* 24:395–421. https://doi.org/10.1146/annurev.soc.24.1.395.

Kalter, Frank, Anthony F. Heath, Miles Hewstone, Janne O. Jonsson, Matthijs Kalmijn, Irena Kogan, and Frank van Tubergen 2016. *Children of Immigrants Longitudinal Survey in Four European Countries (CILS4EU) – Full Version. Data File for On-site Use*. GESIS Data Archive, Cologne, ZA5353 Data File Version 2.3.0.

Kalter, Frank, Irena Kogan, and Jörg Dollmann. 2019. "Studying integration from adolescence to early adulthood: Design, content, and research potential of the CILS4EU-DE data." *European Sociological Review* 35:280–97. https://doi.org/10.1093/esr/jcy051.

Khuu, Thoa V., David R. Schaefer, Adriana J. Umaña-Taylor, and Allison M. Ryan. 2023. "The limitations of intergroup friendship: Using social network analysis to test the pathways linking contact and intergroup attitudes in a multigroup context." *Socius* 9. https://doi.org/10.1177/23780231231161048.

Kim, Minjae, and Roberto M. Fernandez. 2023. "What makes weak ties strong?" *Annual Review of Sociology* 49:177–93. https://doi.org/10.1146/annurev-soc-030921-034152.

Kornienko, Olga, and Deborah Rivas-Drake. 2022. "Adolescent intergroup connections and their developmental benefits: Exploring contributions from social network analysis." *Social Development* 31:9–26. https://doi.org/10.1111/sode.12572.

Kretschmer, David. 2024. "Gender segregation in the friendship networks of Muslim youth in Germany: The role of chastity norms." *Ethnic and Racial Studies*. 1–27. https://doi.org/10.1080/01419870.2024.2399725.

Kretschmer, David, and Lars Leszczensky. 2022. "In-group bias or out-group reluctance? The interplay of gender and religion in creating religious friendship segregation among Muslim youth." *Social Forces* 100:1307–32. https://doi.org/10.1093/sf/soab029.

Krivitsky, Pavel N. 2012. "Exponential-family random graph models for valued networks." *Electronic Journal of Statistics* 6:1100–28. https://doi.org/10.1214/12-EJS696.

Leenders, Roger Th.A.J. 1996. "Evolution of friendship and best friendship choices." *Journal of Mathematical Sociology* 21:133–48. https://doi.org/10.1080/0022250X.1996.9990177.

Leszczensky, Lars, and David Kretschmer. 2022. "Religious friendship preferences of Muslim and non-Muslim students in German schools: Bright boundaries everywhere or contingent on the proportion of Muslim classmates?" *Social Networks* 68:60–9. https://doi.org/10.1016/j.socnet.2021.04.005.

Leszczensky, Lars, and Sebastian Pink. 2015. "Ethnic segregation of friendship networks in school: Testing a rational-choice argument of differences in ethnic Homophily between classroom- and grade-level networks." *Social Networks* 42:18–26. https://doi.org/10.1016/j.socnet.2015.02.002.

Leszczensky, Lars, and Sebastian Pink. 2017. "Intra-and inter-group friendship choices of Christian, Muslim, and non-religious youth in Germany." *European Sociological Review* 33:jcw049. https://doi.org/10.1093/esr/jcw049.

Leszczensky, Lars, Sebastian Pink, David Kretschmer, and Frank Kalter. 2022. "Studying youth' group identities, intergroup relations, and friendship networks: The friendship and identity in school data." *European Sociological Review* 38:493–506. https://doi.org/10.1093/ESR/JCAB052.

Malacarne, Timothy. 2017. "Rich friends, poor friends: Inter–socioeconomic status friendships in secondary school." *Socius* 3:1–13. https://doi.org/10.1177/2378023117736994.

Marsden, Peter V., and Karen E. Campbell. 1984. "Measuring tie strength." *Social Forces* 63:482–501. https://doi.org/10.1093/sf/63.2.482.

McFarland, Daniel A., James Moody, David Diehl, Jeffrey A. Smith, and Reuben J. Thomas. 2014. "Network ecology and adolescent social structure." *American Sociological Review* 79:1088–121. https://doi.org/10.1177/0003122414554001.

McMillan, Cassie. 2022a. "Strong and weak tie Homophily in adolescent friendship networks: An analysis of same-race and same-gender ties." *Network Science* 10:283–300. https://doi.org/10.1017/nws.2022.24.

McMillan, Cassie. 2022b. "Worth the weight: Conceptualizing and measuring strong versus weak tie Homophily." *Social Networks* 68:139–47. https://doi.org/10.1016/j.socnet.2021.06.003.

McPherson, Miller, Lynn Smith-Lovin, and James M. Cook. 2001. "Birds of a feather: Homophily in social networks." *Annual Review of Sociology* 27:415–44. https://doi.org/10.1146/annurev.soc.27.1.415.

Mehta, Clare M., and Jo Nell Strough. 2009. "Sex segregation in friendships and normative contexts across the life span." *Developmental Review* 29:201–20. https://doi.org/10.1016/J.DR.2009.06.001.

Putnam, Robert D. 2000. *Bowling Alone: The Collapse and Revival of American Community*. New York: Simon & Schuster.

Rivera, Mark T., Sara B. Soderstrom, and Brian Uzzi. 2010. "Dynamics of dyads in social networks: Assortative, relational, and proximity mechanisms." *Annual Review of Sociology* 36:91–115. https://doi.org/10.1146/annurev.soc.34.040507.134743.

Robins, Garry, Pip Pattison, Yuval Kalish, and Dean Lusher. 2007. "An introduction to exponential random graph (P*) models for social networks." *Social Networks* 29:173–91. https://doi.org/10.1016/j.socnet.2006.08.002.

Schaefer, David R., and Derek A. Kreager. 2020. "New on the block: Analyzing network selection trajectories in a prison treatment program." *American Sociological Review* 85:709–37. https://doi.org/10.1177/0003122420941021.

Shwed, Uri, Yuval Kalish, and Yossi Shavit. 2018. "Multicultural or assimilationist education: Contact theory and social identity theory in Israeli Arab–Jewish integrated schools." *European Sociological Review* 34:645–58. https://doi.org/10.1093/esr/jcy034.

Simsek, Müge, Frank van Tubergen, and Fenella Fleischmann. 2022. "Religion and intergroup boundaries: Positive and negative ties among youth in ethnically and religiously diverse school classes in Western Europe." *Review of Religious Research* 64:1–33. https://doi.org/10.1007/s13644-021-00473-y.

Smith, Sanne, Ineke Maas, and Frank van Tubergen. 2014. "Ethnic Ingroup friendships in schools: Testing the by-product hypothesis in England, Germany, the Netherlands and Sweden." *Social Networks* 39:33–45. https://doi.org/10.1016/j.socnet.2014.04.003.

Son, Joonmo, and Nan Lin. 2012. "Network diversity, contact diversity, and status attainment." *Social Networks* 34:601–13. https://doi.org/10.1016/j.socnet.2012.06.006.

Stehlé, Juliette, François Charbonnier, Tristan Picard, Ciro Cattuto, and Alain Barrat. 2013. "Gender Homophily from spatial behavior in a primary school: A Sociometric study." *Social Networks* 35: 604–13. https://doi.org/10.1016/j.socnet.2013.08.003.

Umaña-Taylor, Adriana J., Stephen M. Quintana, Richard M. Lee, William E. Cross, Deborah Rivas–Drake, Seth J. Schwartz, Moin Syed, Tiffany Yip, Eleanor Seaton, Sabine French, George P. Knight, Carol Markstrom, and Robert M. Sellers. 2014. "Ethnic and racial identity during adolescence and into young adulthood: An integrated conceptualization." *Child Development* 85:21–39. https://doi.org/10.1111/cdev.12196.

Verbrugge, Lois M. 1977. "The structure of adult friendship choices." *Social Forces* 56:576–97. https://doi.org/10.1093/sf/56.2.576.

Wellman, Barry, and Scot Wortley. 1990. "Different strokes from different folks: Community ties and social support." *American Journal of Sociology* 96:558–88. https://doi.org/10.1086/229572.

Wimmer, Andreas, and Kevin Lewis. 2010. "Beyond and below racial Homophily: ERG models of a friendship network documented on Facebook." *American Journal of Sociology* 116:583–642. https://doi.org/10.1086/653658.

Windzio, Michael, and Enis Bicer. 2013. "Are we just friends? Immigrant integration into high- and low-cost social networks." *Rationality and Society* 25:123–45. https://doi.org/10.1177/1043463113481219.

Windzio, Michael, and Matthias Wingens. 2014. "Religion, friendship networks and home visits of immigrant and native children." *Acta Sociologica* 57:59–75. https://doi.org/10.1177/0001699313481226.

Social Forces, 2025, 104, 250–269
https://doi.org/10.1093/sf/soae169
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