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The unstable social networks of students: Where does dissimilarity drive tie dissolution?

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Abstract

Social relations between demographically dissimilar people are less likely to last. But up till now, why relations with dissimilar friends, confidants, or even sport partners are less stable has remained unclear. We argue that the faster dissolution of ties to dissimilar others may stem from their weaker embeddedness in our social networks. We may feel less emotionally close to those who differ from us in key social dimensions such as gender, age, and education, and these alters may fulfill fewer roles (e.g., friend *and* study partner, or 'multiplexity'). Moreover, their dissimilarity may hinder their ability to form relations with others in our social network. In this contribution, we investigate the impact of ego-alter dissimilarity on the stability of friendships, confidants, and study and sport relations, while acknowledging multiplexity—recognizing that the same alter may serve different roles. We find that ego-alter age dissimilarity is associated with tie dissolution; relations are less stable and consistently so across emotional and instrumental network layers. Gender and education dissimilarity do not impact relationship stability among our sample of Dutch students. The better alters are embedded in ego's network, the more stable are their ties. Relational embeddedness (i.e., emotional closeness and role overlap) predominantly affects the stability of confidants and friendship relations; structural embeddedness (i.e., alters having ties to ego's other alters) predominantly affects the stability of study relations. This also explains why relations with differently aged alters are less stable.

KEYWORDS
embeddedness, homophily, multiplexity, tie dissolution

INTRODUCTION

Network homogeneity is a widely recognized phenomenon in which individuals within social networks tend to share the same sociodemographic features (Kossinets & Watts, 2009; McPherson et al., 2001; McPherson & Smith-Lovin, 1987). This homogeneity is often attributed to individuals (egos) actively searching for similar individuals (alters) to form relations with. Such selection processes are influenced by the segregated nature of social environments, which provides more opportunities to meet and interact with similar others (Mollenhorst et al., 2008, 2014); endogenous network mechanisms like triadic closure (i.e., befriending the friend of a friend); and homophily, a preference for similarity due to its familiarity and predictability. In the social network literature on the dissolution of social ties, or de-selection, one determinant has garnered considerable attention, namely ego-alter dissimilarity

(Jeroense et al., 2024; Paik et al., 2023; Tulin et al., 2021), because actively breaking relations with demographically dissimilar others may be an important additional mechanism leading to social segregation in networks.

Shared sociodemographic traits not only boost empathy, trust, and support (Ertug et al., 2022; Small, 2017) but also often coincide with common interests (Stark & Flache, 2012) and activities (Kao & Joyner, 2004). This would lead relations with similar others to be more stable. Tulin et al. (2021) argued that ties to demographically dissimilar alters are also more likely to be lost because maintaining dissimilar ties incurs higher costs. These costs would be higher because presumably these alters are less embedded in the network and there are less opportunities to meet up with dissimilar alters. According to Jeroense et al. (2024), ties to dissimilar alters may also dissolve faster because they generally are less emotionally close compared to ties to similar alters (see also Schneider et al., 2007). While previous studies found evidence that ties to dissimilar others—along the social dimensions gender, age, and ethnicity—decay faster (Jeroense et al., 2024; Oczlon et al., 2023; Tulin et al., 2021), they did not find that this could be explained by the emotional closeness of these individuals or their and embeddedness within the network. Thus, the question of *why* ties to dissimilar alters dissolve more rapidly has remained unanswered.

The aim of the present contribution is to further theorize on why dyadic dissimilarity drives tie dissolution and test novel explanations. Notably, previous research has predominantly focused on singular networks, comprised of confidants, practical helpers, or other close associates. Social network research shows, however, that social networks are often multilayered or "multiplex," with ego-alter relations (i.e., dyads) having multiple bases for interactions simultaneously (Verbrugge, 1979). We may have multiple ties to the same alter because this person fulfills different roles; for instance, the people we confide in may also be our sports partners. Crucially, we contend that the dynamics of network evolution, particularly the dissolution of ties due to dyadic dissimilarity, may vary depending on the specific basis for interaction (or role). In the present contribution, we distinguish between emotional roles (confidants and best friends) and instrumental roles (study and sport partnerships) (e.g., Ibarra & Andrews, 1993). We hereby build on prior studies that examined tie stability from a uniplex perspective (e.g., Fischer & Offer, 2020; Marin & Hampton, 2019).

We focus on the multiplex ego-centered social networks of university students in the Netherlands. Student life offers a unique empirical case for studying network dynamics: not only is this period understudied in the literature, but it also represents a pivotal period during which individuals actively build their networks (Stadtfeld et al., 2019). We will explore the dissolution of emotional ties (i.e., friendship) and instrumental ties (i.e., sports and study partnership) to alters. We will contrast these roles against the traditional "confidant" role, which, despite its prominence in the literature on tie de-selection (e.g., Jeroense et al., 2024; Small et al., 2015; Tulin et al., 2021), has been shown to be fulfilled by both ego's (emotionally) closest alters and non-close alters who are instrumentally valuable in terms of accessibility and possessing relevant knowledge about the topics individuals wish to discuss (Small, 2013).

Our demographic focus will be on dyadic dissimilarity related to gender, age, and educational level, as these factors are key social dimensions and identity markers along which social networks are known to be segregated (McPherson et al., 2001). Our main theoretical argument is that individuals in our social network who share key social demographic characteristics with us tend to be better embedded in our social network. This, in turn, is expected to enhance the stability of ties to similar alters. While this general argument is not new, we, crucially, will make a distinction between the impact of *relational* embeddedness (i.e., alters' emotional closeness to ego and the extent to which alters fulfill multiple social roles) and *structural* embeddedness (i.e., the extent to which ego's alters have ties among themselves) (Granovetter, 1992).

In summary, our central research questions read as follows:

1. To what extent do dyadic dissimilarities based on gender, age, and educational level drive tie dissolution among students?
2. To what extent can the impacts of dyadic dissimilarities on tie dissolution be explained by differences in alters' relational and structural embeddedness?
3. To what extent do the impacts of dyadic dissimilarities on tie dissolution, as well as the relational and structural embeddedness mechanisms, vary depending on the relationship role (i.e., confidant, best friend, sports partner, and study partner)?

In order to answer our research questions, we use new egocentric network data from the 'Sports and Friendships' study (Franken et al., 2023). This dataset comprises information on 3905 unique alters of 514 Dutch students, which were measured two or three times during the academic year 2022–2023. Uniquely, our data measure different types of salient social ties in student life: friendships, confiding, and sports and study partnerships. With a total of 7924 observations (at the alter-tie level), our data enable us to comprehensively study how different types of demographic dissimilarity affect social relations during student life, and to what extent dissimilarity effects and underlying (embeddedness) mechanisms vary across social network layers. All of this is done while considering multiple other substantial factors contributing to tie dissolution and accounting for a common methodological reason to observe 'tie loss' in survey research, namely that survey respondents simply forget to relist an alter (Fischer & Offer, 2020).

THEORY AND HYPOTHESES

Framework

In line with current models of social network dynamics (e.g., Feld et al., 2007; Small et al., 2015), we assume that personal networks change through individual agency, at least to a large extent.

Individuals are strategic in creating, maintaining, or terminating ties, but their decision-making is also limited by dynamic cultural contexts such as changing opportunity structures that either facilitate or impede social ties (Mollenhorst et al., 2014).

Prior studies have predominantly focused on relationship stability at the dyad level, either examining a single type of social relation (e.g., Jeroense et al., 2024, focused on confidants) or compiling various relationship roles into a singular, uniplex network (e.g., Tulin et al., 2021, focused on the social network composed of ego in relation to confidants and practical helpers). Yet social networks are multiplex, with dyadic relations often entailing multiple bases for interaction (roles, behaviors, or affiliations; Verbrugge, 1979) concurrently. We will argue that the impact of dyadic dissimilarity and alter's embeddedness on relationship stability may depend on the relationship role and in particular whether the ties between ego and alter are emotionally or instrumentally driven (e.g., Ibarra & Andrews, 1993).

Therefore, in this study, we shift our analytical focus from relationship dissolution at the dyad level to the dissolution of specific alter-ties. We define alter-ties as the role(s) of each alter in ego's social network (i.e., confidant, best friend, study partner, and/or sports partner). Ego's alters may have multiple, interdependent alter-ties, each vulnerable to dissolution if not actively maintained. We will hereafter refer to this as alter-tie dissolution.

General expectation

People tend to have and form social relations with others who share similarities, both in terms of demographic features such as age, gender, and ethnicity (Marsden, 1987) as well as in terms of values such as tastes and political views (Huber & Malhotra, 2017; Huston & Levinger, 1978; McPherson et al., 2001). These patterns are attributed to various mechanisms that may include a preference for similarity, endogenous network processes (e.g., transitivity), opportunity structures (Kossinets & Watts, 2009; Rivera et al., 2010), and social norms (Kalmijn, 1998). Recently, these arguments have been extended to explore the effects of demographic dissimilarity on tie de-selection.

Our general expectation is that dyadic similarity will play a similar role in alter-tie dissolution, albeit presumably weaker. Maintaining relations requires time and effort. If individuals neglect this investment, there is a higher likelihood that relations will fade away (Burt, 2002). Typically, relations with alters that are more costly or demanding and yield fewer benefits are the first to end. Readily observable dyadic dissimilarities, such as those based on gender and age, may signal dissimilarities in tastes and behavior and, consequently, may make one hesitant to start a relation with a dissimilar other in the first place. But if this hurdle is crossed and relations are formed, people may become more aware of their attitudinal and behavioral differences and of the relative high costs associated with maintaining relations with dissimilar others over time. Additionally, perceived peer norms against having ties with dissimilar others may cause these ties to falter more quickly (Jugert et al., 2013; Kalmijn, 1998).

Earlier research already found corroborative evidence that gender and age dissimilarity—but not educational dissimilarity—negatively impact relationship stability (Jeroense et al., 2024; Tulin et al., 2021). For the most part, we expect this pattern to also hold across various relationship roles at the alter-tie level. However, we also expect educational dissimilarity to drive tie dissolution in our sample of students, as educational experiences, interests, and goals are highly salient during this life phase and may be a critical identity marker. Educational level can be an important social class indicator, and students may be inclined to maintain relationships with others of similar educational backgrounds due to status considerations and value similarity (i.e., tastes, habits, and behaviors) (McPherson et al., 2001).

Our first hypothesis therefore reads:

> **H1.** Ego-alter dissimilarity in terms of (a) gender, (b) age, and (c) educational level increases the probability that ties to alters are dissolved.

The relational embeddedness of an alter, or the "personal relationships people have developed with each other through a history of interactions" (Nahapiet & Ghoshal, 1998, p. 244), is a strong predictor of tie dissolution. People typically choose to maintain relations with others who provide more support, who have undergone similar experiences (Small, 2017), who are perceived trustworthy (Jones & Shah, 2016), who share common interests (Stark & Flache, 2012), and who can provide pertinent information (Festinger, 1954). We expect similar others to have the edge on dissimilar others in these domains. This may explain why similar alters tend to be emotionally closer than dissimilar alters (Putnam, 2000) and, presumably, why ego is more likely to sustain ties to similar alters over time.

Similarity may not only increase the ease of communication and, consequently, emotional closeness between ego and alter but also create more conducive conditions for an alter to fulfill multiples social roles concurrently. Similarity may act as an important cue for shared behaviors. This would make two friends with a similar social background more likely to participate in shared hobbies (e.g., sports) or activities (e.g., studying) or engage in discussions about important matters. Conversely, similar individuals engaging in shared behavior are, presumably, more likely to develop friendships. For example, sports partners of the same gender may not only have more in common in terms of sports but also be more likely than partners of differing genders to share interests beyond sports. This, in turn, increases the probability that friendship will emerge from shared activities. Whether similarity leads to shared activities, or shared activities lead to selecting self-similar network partners, similarity is conducive for an alter to fulfill multiple roles.

This 'relational multiplexity,' in turn, is expected to promote the stability of ties to alters, because during the contact individuals have in different social domains (network layers), they create an even richer shared history (Verbrugge, 1979). While to our knowledge

there is a dearth of research exploring how dyadic similarity is linked to relational multiplexity (but see Stoller et al., 2001), it is clear from the literature that alters with overlapping social roles are more likely to be maintained in ego's social network (Paik et al., 2023; Verbrugge, 1979). We therefore expect:

> **H2.** The effects of dyadic dissimilarity on alter-tie dissolution are partly mediated by alters' relational embeddedness, in terms of (i) emotional closeness and (ii) multiplexity.

If people have preferences to form ties to similar others, alters that are similar to ego are likely to find it easier to form relations with other alters of ego and thereby to become structurally embedded within the social network layers of ego. Maintaining a tie to an alter who is structurally well-embedded demands less effort. This is because individuals interact not only one-on-one but also within group contexts. Structural embeddedness reduces the temporal costs associated with maintaining individual relations. Moreover, dissolving relations with alters who are structurally well-embedded may yield high normative costs, as the loss of an alter who shares multiple social ties with ego may threaten the internal cohesion within the network. Structurally well-embedded alters may also hold greater value for ego, as in closed networks where ego's alters know and interact with each other, norms of exchange are more effectively conveyed and reinforced, and obligations and favors can be easily tapped into when necessary (Coleman, 1990).

Structural embeddedness has consistently been found to increase the probability that alters are maintained in ego's social network (e.g., Fischer & Offer, 2020; Marin & Hampton, 2019). However, in prior research, scholars assessed the structural embeddedness of alters by considering the shared social ties between ego and alter within one specific layer of the social network of ego (e.g., core discussion network; Jeroense et al., 2024; Tulin et al., 2021). Such measurement falls short in accounting for multiplexity in social networks and the potential for alters to share social ties with ego across different network layers. This measurement problem may even lie at the root of why previous scholars did not find that structural embeddedness explained the relationship between dissimilarity and relationship dissolution at the dyad level. We will take into account the possibility that ego and alters share social ties in different network layers. With this extended measurement of structural embeddedness, we expect to find corroborative evidence for the following hypothesis:

> **H3.** The effects of dyadic dissimilarity on alter-tie dissolution are partly mediated by alters' structural embeddedness in the different layers of ego's social network.

Role-specific expectations

We expect the strength of dissimilarity effects on tie dissolution to vary depending on the social role or alter-tie. We distinguish between emotional or affective roles (friendships) and more instrumental roles (study and sports partnerships) (e.g., Ibarra & Andrews, 1993). Relations with confidants may be both emotionally or instrumentally driven (Small, 2013). While the confidant network is thus somewhat ambiguous, it takes up a prominent place in the literature on tie (de-)selection and will therefore serve as a comparative benchmark.

For students, friendships are often the most salient, emotionally-based relationships (van Duijn et al., 2003). Friendships play a critical role in forming a new identity during student life, a period marked by a lot of changes (e.g., daily activities, social interactions, living arrangements). On the other hand, study and sports partnerships represent instrumental roles formed for specific purposes, such as academic collaboration or the pursuit of shared athletic interests and activities. These roles are task-oriented by nature, driven by shared goals and activities, and characterized by lower affective closeness (Clark & Reis, 1988). These partnerships furthermore yield important consequences for physical activity (Franken et al., 2022; Fujimoto et al., 2018) and academic outcomes and experiences (Stadtfeld et al., 2019).[1] Naturally, emotional and instrumental roles may intersect, for instance when our close friends are also our sports partners.

We expect dyadic similarity to aid the maintenance of emotional alter-ties, like friendships, in particular. Indeed, social network literature indicates that similarity more strongly affects the formation and maintenance of social relations, the more intimate those relations are (e.g., Burgess & Wallin, 1943; van Duijn et al., 2003). As an example, prior research shows that tendencies toward forming relations with same-gender others are prevalent within 'best friends' networks but less so when 'friends' were also considered (Leenders, 1996).

In contrast, instrumental roles are task-oriented and, as such, thrive on the collaborative aspects of the relationship (i.e., shared goals or activities). In this context, similarity is not expected to enhance the associated benefits. When pursuing instrumental goals, emotional closeness becomes less relevant. In line with this idea, Small (2013) discovered that when individuals seek out others to confide in, they do not necessarily seek individuals who are emotionally close but rather those who are instrumentally valuable in terms of accessibility and possessing relevant knowledge about the topics individuals wish to discuss.

Yet there could be instances where dyadic dissimilarity might still affect the continuity of instrumental roles. For sports partnerships, similarity on physical attributes like age and sex may be beneficial, since sports partners who are similar in these aspects may serve as more relevant comparison targets (Festinger, 1954). Also, similarity could prove beneficial, given that people of different ages and genders might have differing exercise preferences and goals (Pereira et al., 2021). In any case, shared educational backgrounds may not

[1]During our data collection, we asked respondents whether they enjoyed studying and participating in sports together to understand the importance of sports and study partnerships for students. Our data indicates that a majority of students find these activities enjoyable, with over 50% and 80% of respondents respectively indicating they "completely agree" or "agree" with the statements: "I enjoy studying together" and "I enjoy doing sports together."

be as crucial for maintaining sports partnerships. On the other hand, in study partnerships, shared educational backgrounds will likely foster effective cooperation.

Drawing on these considerations, we can formulate the following sub hypotheses:

> **H4a.** Gender dissimilarity has the weakest positive impact on the dissolution of study partnerships and the strongest positive impact on the dissolution of friendships and sports partnerships.

> **H4b.** Educational dissimilarity has the weakest positive impact on the dissolution of sports partnerships and the strongest positive impact on the dissolution of friendships and study partnerships.

We do not propose a hypothesis regarding the differential impacts of age dissimilarity. That is because we have no specific theoretical expectation on how this type of dissimilarity would differentially affect the dissolution of different alter-ties.

We argued that the greater relational and structural embeddedness of similar alters could partly explain the (presumed) stability of their ties to ego. However, given the varying nature of these alter-ties, we expect that the role of embeddedness in explaining tie stability will also differ depending on the specific social role. If embeddedness indeed affects tie stability differently in emotional versus instrumental ties, this could explain why previous studies did not find embeddedness to mediate the impact of dissimilarity on tie dissolution in the ambiguous core discussion network, which includes both emotionally and instrumentally based alters.

Emotional closeness likely plays a pivotal role in nurturing friendships. Establishing a deep emotional bond aligns with the fundamental qualities that underpin the concept of friendship. In contrast, instrumental roles focused on specific goals assumedly prioritize instrumental goals over emotional closeness. Consequently, we expect that the emotional closeness of alters will have the strongest impact on the maintenance of their friendships and the weakest impact on the maintenance of their sports and study partnerships. This leads to the following hypothesis:

> **H5.** The emotional closeness of alters has the strongest negative impact on the dissolution of friendships and the weakest negative impact on the dissolution of sports and study partnerships.

Alters who fulfill multiple social roles may both provide emotional benefits, such as empathy and affection, while also helping with instrumental needs, making the tie "diffuse and holistic" (Verbrugge, 1979), and more likely to create rich shared histories. We argue that preferences for multiplexity may be particularly prevalent in the friendship layer of ego's social network, as—again—especially emotional depth and shared life history are expected to drive friendships.

Concurrently, when individuals are connected via overlapping social roles, this grants individuals access to each other through various social contexts, thus enhancing opportunities for contact. Broadly speaking, while tie formation is more circumstantial and dependent on whom individuals get to meet, tie maintenance is more dependent on ego's and alters' willingness to make an effort to meet. In more instrumental layers of one's social network, decisions about tie maintenance—such as whether to continue engaging in shared sports or study activities—are more likely to be circumstantial (Dalen & Seippel, 2021). Conversely, in the friendship layer of ego's social network, decisions regarding tie maintenance are likely more dependent on ego's and alters' willingness to make intentional effort to arrange meet-ups. Therefore, meeting opportunities created by relational multiplexity likely are most conducive to the maintenance of instrumental roles (sports and study partnerships), and least conducive to the maintenance of friendships.

These two perspectives lead to the following contradictory hypotheses:

> **H6a.** Relational multiplexity has the strongest negative impact on the dissolution of friendships and the weakest negative impact on the dissolution of sports and study partnerships ('preference mechanism').

> **H6b.** Relational multiplexity has the strongest negative impact on the dissolution of sports and study partnerships and the weakest negative impact on the dissolution of friendships ('opportunity mechanism').

Assuming that the continuation of sports and study partnerships relies heavily on ongoing opportunities for interaction, and that these opportunities play a lesser role in the continuation of friendships, this would also imply that the role of an alter's structural embeddedness has the strongest (negative) impact on tie dissolution in the sports and study layer and the weakest impact in the friendship layer. After all, alters that are well-embedded in ego's social network bring ego and alters together with their shared ties, hence providing continued contact opportunities. Based on this, we formulate our last hypothesis:

> **H7.** Structural embeddedness has the strongest negative impact on the dissolution of sports and study partnerships and the weakest negative impact on the dissolution of friendships.

MATERIALS AND METHODS

Data

For this study, we collected unique longitudinal three-wave panel data during the academic year 2022–2023. Our survey included multiple name generator questions, to tap into ego's confidants,

study partners, best friends, and sports partners. Multiple name interpreter questions were used to assess attributes of alters. Details about our data collection procedure and our approach to measuring social networks can be found in Appendix A.

Overall, our working sample consists of 7924 observations: a unique combination of alter-tie (i.e., friend, confidant, study partner, or sport partner), alter, ego, and survey round. Alter-tie observations ($N_3 = 7924$) are nested within alters ($N_2 = 3905$), which, in turn, are nested within egos ($N_1 = 514$). We excluded alters who were identified as family members, amounting to 14% of all alters in our dataset, because non-kin ties are theoretically and empirically most relevant for studying the relationship between dyadic dissimilarity and tie dissolution. The literature indicates that kin ties are more stable (Fischer & Offer, 2020). Moreover, kinship strongly covaries with our independent variables. For example, parents naturally have large age gaps with ego, are more likely than ego's peers to be have a different educational level compared to ego, are often emotionally close to ego, and tend to be structurally well-embedded in ego's network (Brashears, 2013).

Table 1 shows the descriptive statistics of characteristics of these egos, (non-kin) alters and alter-ties. Access to our dataset and replication of our analyses is possible using our replication website: https://netchange.netlify.app/.

Measures

Dependent variable: Alter-tie dissolution

Our dependent variable is a binary indicator of whether an alter named in a specific name generator question at t was also named in the same name generator at $t+1$ (1 = no, 0 = yes). We label this variable "alter-tie dissolution." We acknowledge that alter-ties to alters who are not re-mentioned in the subsequent survey round's name generator might not necessarily be dissolved but rather that the respondent may simply have forgotten to mention the alter (in this social role) (Fischer & Offer, 2020). Therefore, in supplementary analyses, we account for this common error in name generator research (discussed below).

Main predictors

Social roles of alters were categorized as *best friend*, *confidant*, *study partner*, and/or *sports partner* (1 = yes, 0 = no). Respondents were asked about their own and their alters' demographic characteristics. They specified the gender of alters ("male," "female," or "other"), their age range (<18, 18–21, 22–25, 26–30, 31–40, >40 years old), and the highest level of education they have either completed or are currently pursuing (spanning from "primary education" to "research university"). We constructed measures of *dissimilarity* for gender and education (1 = different, 0 = same). For age, we computed the *age difference* between the ego and the alter. The age of the alters was initially converted into a continuous scale ranging from 16 to 45, with intermediate age categories assigned the midpoint value within their respective ranges (e.g., 26–30 was assigned a value of 28). Subsequently, we calculated the absolute difference between ego's and alter's age.[2,3]

We used two time-varying indicators to measure alters' relational embeddedness. First, we measured the *emotional closeness* of the alter by asking respondents how close they were to each alter at t. This measure ranged from 1 (not close) to 4 (very close). Second, we measured relational *multiplexity* by assigning to alter-roles the number of additional social roles alter fulfilled at time t, which ranged from 0 to 3.

We computed the *structural embeddedness* of an alter for each social role (network layer) separately. This involved dividing the number of other alters fulfilling the particular social role who, according to the ego, shared a (very) close relationship with the alter, by the total count of alters fulfilling that role. Measures of structural embeddedness ranged from 0 (not embedded) to 1 (fully embedded). If an alter was the sole member of the network layer, an embeddedness score could not be computed, and we assigned a value of 0. For each alter-tie, we assigned a structural embeddedness score in its *focal* network layer accordingly. Additionally, for alters fulfilling multiple roles (multiplex alters), we calculated the mean of structural embeddedness scores across the *other* roles.

Within our models, we control for various substantive accounts for alter-tie dissolution at the levels of the ego, alter, and alter-tie. For the theoretical rationale and the measurement of these control variables, we refer to Appendix B.

Analytical strategy

We begin by discussing descriptive data on our students' multiplex networks. Next, we analyze the predictors of alter-tie dissolution. Last, we discuss additional analyses that aim to understand some unexpected findings, and we report on models in which we corrected for the possibility that ties to non-renamed alters were not broken but simply forgotten (see robustness paragraph).

Model assessment

We use logit models to model our dichotomous tie dissolution variable, a common technique in studies on de-selection (e.g., Fischer & Offer, 2020; Marin & Hampton, 2019). To account for the nesting

[2]Given the narrow age range of our respondents (i.e., egos), the impact of relative age differences cannot be disentangled from the impact of absolute age differences.

[3]We used alternative operationalizations of age dissimilarity. We first assigned each ego to an age category (e.g., 22–25). We then used (a) a dichotomous measure, representing whether ego and alter fall in the same age category; (b) an ordinal measure representing the distance between the age categories of ego and alter; and (c) our original measure, modified so that the age difference for ego-alter pairs in the same age category was set to 0. Our findings were consistent under these alternative models (see our replication website).

TABLE 1 Descriptive statistics of egos of Cohort II of the "Sports and Friendships" study, their non-kin alters, and alter-ties.

	Count	Min.	Max.	Mean	SD
Ego-level					
Age	514	17	32	21.88	2.49
Gender (1 = yes, 0 = no)					
Man	514	0	1	0.23	
Woman	514	0	1	0.76	
Other	514	0	1	0.01	
Education (1 = yes, 0 = no)					
University of applied sciences	514	0	1	0.15	
Research university	514	0	1	0.85	
Education year					
First year	514	0	1	0.24	
Second year	514	0	1	0.20	
Third year or above	514	0	1	0.56	
In a romantic relationship (1 = yes, 0 = no)	514	0	1	0.46	
Extraversion	514	1	5	3.16	0.88
Financial restrictions	514	0	3	0.49	0.57
Life-course transitions experienced					
Study (i.e., starting, switching, dropping out)	514	0	1	0.11	
Residential change	514	0	1	0.18	
Alter-level					
Age	3905	16	45	22.16	3.39
Gender (1 = yes, 0 = no)					
Man	3905	0	1	0.31	
Woman/other	3905	0	1	0.69	
Education					
Primary education	3905	0	1	0.00	
Pre-vocational education	3905	0	1	0.00	
Secondary vocational education	3905	0	1	0.04	
Senior general secondary education	3905	0	1	0.01	
Pre-university education	3905	0	1	0.05	
University of applied sciences	3905	0	1	0.22	
Research university	3905	0	1	0.67	
Years known by ego	3905	0	15	4.40	4.23
Geographical proximity					
Same house	3905	0	1		
Same municipality	3905	0	1		
Outside municipality or farther	3905	0	1		
Emotional closeness[a]	3905	1	4	3.01	0.90
Same gender	3905	0	1	0.74	
Same education	3905	0	1	0.58	
Age difference in years	3905	0	26	2.29	2.65
Multiplexity (no. of additional relational roles)[a]	3905	0	3	0.53	0.77
Alter-tie-level					
Social role					
Confidant	7924	0	1	0.23	
Best friend	7924	0	1	0.38	
Sports partner	7924	0	1	0.20	
Study partner	7924	0	1	0.19	
Structural embeddedness in focal network layer	7924	0	1	0.38	0.37
Structural embeddedness in other network layers	7924	0	1	0.12	0.18
Network (layer) size	7924	1	5	3.90	1.21
Observation period					
Wave 1 → wave 2	7924	0	1	0.62	
Wave 2 → wave 3	7924	0	1	0.38	
Renamed at $t+1$ in same generator	7924	0	1	0.58	

[a]Values may vary depending on the observation period. We describe the first observation for each alter.

structure of our data, we use a multilevel model that takes into account the interdependency (i.e., correlated errors) of alter-ties within dyads and of alters reported by the same respondent (Snijders & Bosker, 2012). That is, we introduce random intercepts for the ego level and alter level.

Our modeling approach follows an iterative procedure, starting with the null model (M0), including only random terms for the ego and alter levels. We computed variance partition coefficients (VPC; Goldstein et al., 2002) to discern how individual variance in alter-tie dissolution is distributed across the levels of analysis. VPCs are calculated at the ego (E) and alter (A) levels under the latent variable method (Snijders & Bosker, 2012), where the constant quantity $\pi^2/3$ substitutes the lowest-level variance:

$$\mathrm{VPC}_E = \sigma_E^2 / \left(\sigma_E^2 + \sigma_A^2 + \pi^2/3\right),$$

$$\mathrm{VPC}_A = \left(\sigma_E^2 + \sigma_A^2\right) / \left(\sigma_E^2 + \sigma_A^2 + \pi^2/3\right),$$

where σ^2 represents the variance at the specific level.

According to our null model (see Table 2), the correlation in dissolution probabilities between alter-ties of the same ego is approximately 0.06, while for the same dyad, it is approximately 0.30. A likelihood ratio test, comparing our null model to a model without random terms, show that a statistically significant portion of the variance is situated at the ego level and alter level.

Notably, there remains a substantial amount of unexplained variance (70%) in alter-tie dissolution, not accounted for by the dyad or ego level. We included the social role (with "confidant" as the

TABLE 2 Results of multilevel logit models predicting alter-tie dissolution.

	M0	M1	M2	M3	M4	M5	M6	M7	M8
1. (Intercept)	−0.21 (0.04)***	−0.71 (0.08)***	−0.67 (0.08)***	0.21 (0.19)	2.33 (0.24)***	0.16 (0.19)	2.28 (0.24)***	2.38 (0.25)***	4.92 (0.46)***
2. Best friend		−0.24 (0.08)**	−0.22 (0.08)**	−0.25 (0.08)**	−0.34 (0.08)***	−0.26 (0.08)***	−0.32 (0.08)***	−0.50 (0.11)***	−1.90 (0.49)***
3. Sports partner		1.30 (0.09)***	1.27 (0.09)***	1.38 (0.10)***	1.00 (0.10)***	1.36 (0.10)***	1.05 (0.10)***	1.11 (0.13)***	−2.18 (0.50)***
4. Study partner		1.52 (0.09)***	1.50 (0.09)***	1.51 (0.10)***	1.05 (0.10)***	1.52 (0.10)***	1.15 (0.10)***	1.03 (0.13)***	−2.24 (0.49)***
5. Wave 2–3		0.04 (0.07)	−0.05 (0.07)	0.03 (0.08)	0.06 (0.08)	0.01 (0.08)	0.05 (0.08)	0.06 (0.08)	0.04 (0.08)
6. Different gender			−0.20 (0.08)*	−0.13 (0.10)	−0.03 (0.09)	−0.15 (0.10)	−0.04 (0.09)	−0.54 (0.15)***	−0.06 (0.09)
7. Different education			0.08 (0.08)	−0.19 (0.09)*	−0.16 (0.09)	−0.16 (0.09)	−0.15 (0.09)	0.02 (0.14)	−0.14 (0.09)
8. Age difference			0.20 (0.04)***	0.17 (0.05)***	0.13 (0.04)**	0.16 (0.04)***	0.13 (0.04)**	0.17 (0.06)**	0.10 (0.04)*
9. Multiplexity					−0.17 (0.04)***		−0.19 (0.05)***	−0.21 (0.05)***	−0.56 (0.11)***
10. Emotional closeness					−0.65 (0.05)***		−0.63 (0.05)***	−0.63 (0.05)***	−1.23 (0.12)***
11. Str. embeddedness focal layer						−0.16 (0.03)***	−0.14 (0.03)***	−0.13 (0.03)***	−0.07 (0.09)
12. Str. embeddedness other layers						−0.23 (0.04)***	0.01 (0.05)	0.00 (0.05)	0.08 (0.08)
13. Different gender: best friend								0.82 (0.18)***	
14. Different gender: sports partner								0.46 (0.21)*	
15. Different gender: study partner								0.56 (0.20)**	
16. Different education: best friend								−0.05 (0.16)	
17. Different education: sports partner								−0.45 (0.19)*	
18. Different education: study partner								−0.13 (0.20)	
19. Age difference: best friend								0.15 (0.08)	
20. Age difference: sports partner								−0.27 (0.09)**	
21. Age difference: study partner								−0.14 (0.10)	
22. Emotional closeness: best friend									0.32 (0.14)*
23. Emotional closeness: sports partner									0.71 (0.15)***
24. Emotional closeness: study partner									0.84 (0.15)***
25. Multiplexity: best friend									0.24 (0.13)
26. Multiplexity: sports partner									0.59 (0.15)***
27. Multiplexity: study partner									0.48 (0.14)***
28. Str. embed. focal layer: best friend									0.06 (0.10)
29. Str. embed. focal layer: sports partner									−0.03 (0.11)
30. Str. embed. focal layer: study partner									−0.27 (0.11)*
31. Str. embed. other layers: best friend									−0.17 (0.11)
32. Str. embed. other layers: sports partner									−0.10 (0.12)
33. Str. embed. other layers: study partner									0.06 (0.12)

TABLE 2 (Continued)

	M0	M1	M2	M3	M4	M5	M6	M7	M8
Akaike information criterion	10,434.53	9781.14	9746.31	9647.03	9368.72	9586.24	9353.54	9313.62	9229.13
Bayesian information criterion	10,455.47	9829.99	69816.09	9835.42	9571.07	9788.59	9569.85	9592.72	9529.17
Log likelihood	−5214.27	−4883.57	−4863.16	−4796.51	−4655.36	−4764.12	−4645.77	−4616.81	−4571.57
Num. obs.	7924	7924	7924	7924	7924	7924	7924	7924	7924
Num. groups: ego:alterid	3905	3905	3905	3905	3905	3905	3905	3905	3905
Num. groups: ego	514	514	514	514	514	514	514	514	514
Var: ego:alterid (Intercept)	1.13	1.40	1.29	1.18	0.77	1.04	0.77	0.78	0.71
Var: ego (Intercept)	0.29	0.36	0.34	0.26	0.26	0.26	0.27	0.27	0.26
VPC_A	0.30	0.35	0.33	0.31	0.24	0.28	0.24	0.24	0.22
VPC_E	0.06	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06

Note: Logit coefficients. Standard error within parentheses. Only explanatory variables of interest are shown, excluding controls. All coefficients not shown are available on our replication website.

$^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$.

reference category) and the period of observation (between waves 1 and 2 or between waves 2 and 3) as fixed effects (Model 1). These effects absorb a significant portion (7%) of the unexplained variance (VPC_E=0.07; VPC_A=0.35), thereby supporting our approach of modeling alter-ties within dyads. Building upon this, we incrementally increase model complexity, including dyadic dissimilarity (in Model 2); our controls (M3); relational and structural embeddedness, both separately (M4 and M5, respectively) and together (M6); the interaction between dissimilarity and social role (M7); and the interaction between embeddedness and social role (M8).

Average marginal effects

Evaluating mediation within nonlinear (probability) models presents challenges, unlike the straightforward decomposition of predictors into direct and indirect effects found in linear models (Breen et al., 2013). We circumvent this by computing average marginal effects (AME), which allows for the comparison of effects across models. AMEs represent the average change of the probability that the outcome equals 1 (i.e., an alter-tie is dissolved), for a one-unit change in the explanatory variable of interest. Since our model consists of a fixed and random part, we take both parts into account when calculating predicted outcomes.

For dichotomous variables, we compute the marginal effect (ME) for each respondent by comparing the change in the predicted value between the reference category and the category of interest, or more formally:

$$\text{ME} = f(X \mid x_1 = 1) - f(X \mid x_1 = 0),$$

where $f(X)$ is the predicted outcome, given the set of covariates X; x_1 is one of the covariates; and x is the value of x_1.

For continuous variables, we take the partial derivative of $f(X)$ at the point where x_1 is x:

$$\text{ME} = f'^{(X \mid x_1 = x)},$$

and

$$f'(X) = \frac{\partial f(X)}{\partial x_1}.$$

AMEs represent the mean of MEs across all respondents in our dataset, with their observed set of covariates. For all AMEs, we report the bootstrap-generated 95% confidence intervals.

We calculate AMEs for different models, including those without mediator variables ("base model") and those with mediator variables included ("extended model"). We define the average marginal mediation effect (AMME) as the AME-difference between the extended and base model, averaged across 500 bootstrap iterations (Tolsma, 2023). AMMEs represent the portion of the AME of a predictor that is accounted for by the mediator(s) included in the extended model.

Finally, we want to assess the extent to which dyadic dissimilarity and relational and structural embeddedness have a different impact on alter-tie dissolution across social roles. In nonlinear (probability)

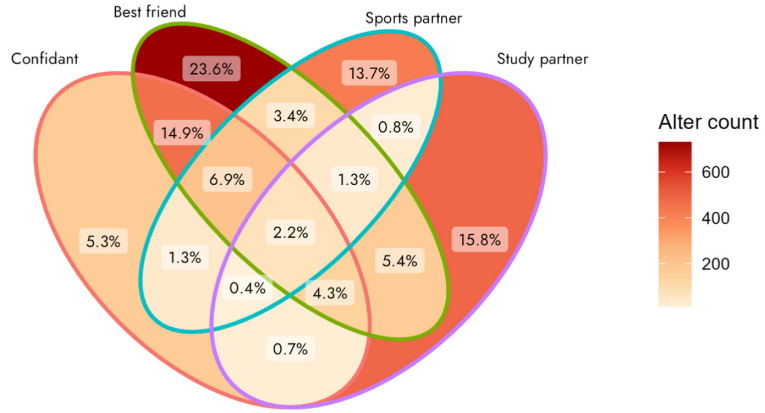

FIGURE 1 Venn diagram illustrating the overlap of social roles of alters observed in students' multiplex social networks at wave 1 ($N_2 = 3104$). For a picture of wave 2, see our replication website.

models, the significance and direction of the estimated interaction effects (on the logit) do not necessarily match the significance and valence of the ME of the interaction term on the probability (Ai & Norton, 2003; Karaca-Mandic et al., 2012). We therefore computed marginal interaction effects (MIE):

$$\text{MIE} = \frac{\partial f^2(X)}{\partial(x_1)\partial(x_2)}.$$

We then calculated the average marginal interaction effect (AMIE) to test our interaction hypothesis. The AMIE represents how the AME of a predictor variable, x_1, changes with a 1-unit change in the moderator variable, x_2, on average across all respondents in our dataset.

Calculating MEs is a computational challenge. Because no package offers an off-the-shelf solution for calculating AMME and AMIEs, let alone for models including random components, we followed the (numerical) approach described by Tolsma (2023).

RESULTS

Descriptive results

The 514 included egos reported a total of 3905 (unique) non-kin alters over the academic year. Notably, best friends were disproportionately represented, accounting for 38% of all alter-tie observations (see Table 1). This was followed by confidants (23%), sports partners (20%), and study partners (19%).

We observed considerable overlap of different social roles (see Figure 1). On average, alters were members of 1.53 layers of the social network of ego. Multiplexity was most prevalent among confidants, who, on average, shared an *additional* 1.30 roles with ego, followed by—in order—sports partners (0.98), best friends (0.89), and study partners (0.83).

A significant proportion of confidants (78%) was identified as best friends. This was also observed among sports (45%) and study partners (41%), though to a lesser extent. Conversely, only 15% of all confidants were uniplex. Thus, university students' confidants appear to act as very strong, emotionally-based alters.[4] This contrasts with prior research showing that nearly half of the core discussion network consists of individuals whom ego does not consider important but who are relevant for the topics ego wishes to discuss or who are readily accessible to discuss important matters (Small, 2013). These descriptive results on role overlap in the core discussion network align with previous accounts suggesting that among single, young adults—a large proportion of the student population—friends are the primary confidants, a patterns that significantly decreases during the marital and parenthood phases (van Duijn et al., 2003; Weiss & Lowenthal, 1975).

Out of the 7924 alter-ties observed at time t, 58% were renamed in the repeated same name generator question at $t+1$, approximately 5 months later. The rate of alter-tie dissolution varied across different social roles. Best friends displayed the highest likelihood of being retained (69%), followed by confidants (68%), sports partners (43%), and study partners (38%).

The higher tie dissolution among study partners may be due to these relationships being constrained by institutional boundaries, such as being in the same class or course for only one or two semesters. If this were the major driver of the dynamics of study partnerships, we would expect these partnerships to occur exclusively among students of the same educational level. However, 31% of all observed study ties were to alters with a different educational background than ego; a significant proportion (compared to 37% in best friends nominations). This suggests that study partnerships often extend beyond institutional boundaries. Students do not solely collaborate with classmates or cohort members; they also study with individuals they meet in other contexts, such as when they meet at the library or when working on homework with friends or roommates.

Figure 2 describes the relationship between demographic (dis) similarities and alter-tie maintenance. Considering all social roles simultaneously (panel A), we find no substantial difference in dissolution rates between same versus different gender and education ties. However, ties of same-age alters are clearly more likely to be

[4]Confidants were the highest in emotional closeness of all tie types ($M = 3.64$, $SD = 0.64$; see our replication website), even if we only consider uniplex ties ($M = 3.22$, $SD = 1.02$).

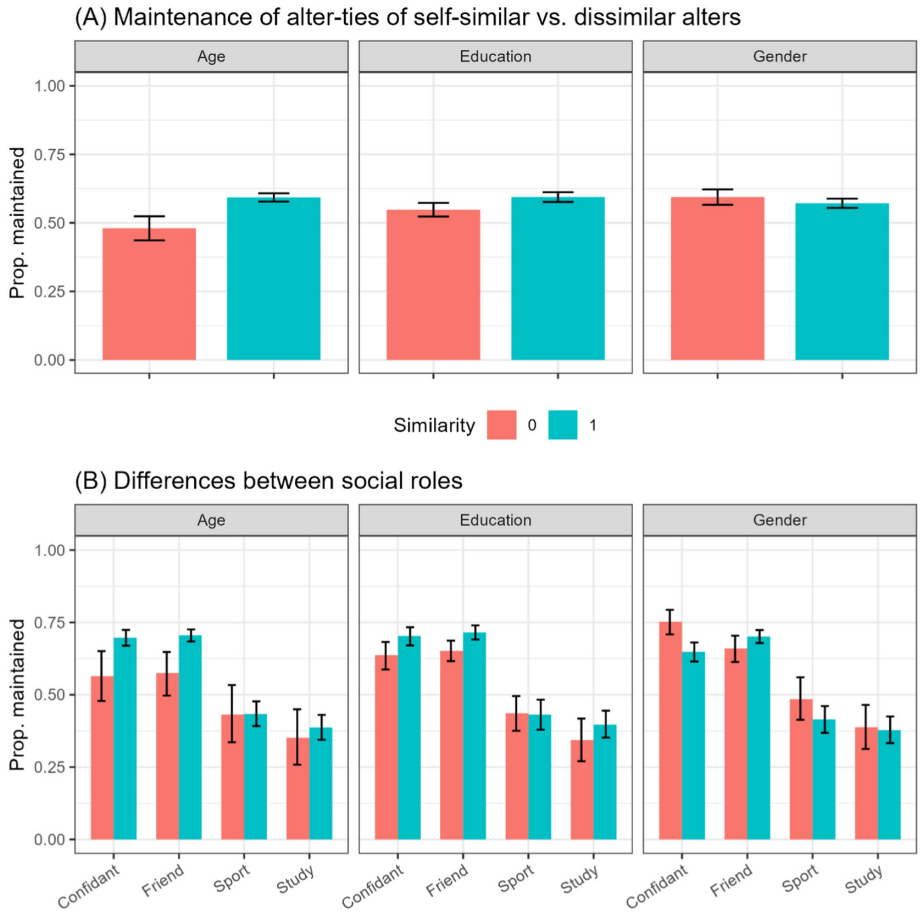

FIGURE 2 Relationship between (dis)similarity and alter-tie maintenance. Alter-tie maintenance proportions presented (A) for all alter-tie observations, with disaggregation by (B) social role. For descriptive clarity, we categorized age similarity dichotomously: An age difference <4 years indicates a similar alter (17% of alters); an age difference ≥4 years indicates a dissimilar alter (83% of alters). Error bars reflect 95% Clopper-Pearson confidence intervals (Clopper & Pearson, 1934).

maintained. A more nuanced view emerges when we break down the association by social role (panel B). Specifically, age dissimilarity is positively related with higher tie dissolution among best friends and confidants, and educational dissimilarity among friends. Somewhat surprisingly, gender dissimilarity is even positively linked to confidant maintenance.

We know that educational institutions are key social hubs for students. The tendency to maintain ties particularly with those of the same educational background may be due to individuals attending the same university or being in the same study cohort. Although we lack specific data on these factors, we observe that over 30% of alters with the same educational background as ego live outside ego's municipality, over 20% have an age difference of 3 years or more, and about 15% have been known for at least 4 years by ego. Alters with different educational backgrounds than ego are more likely to live farther away, have larger age gaps, and have been known for longer. However, the percentages for these metrics in same-education alters are still high in absolute terms. This suggests that many same-education alters likely attend different universities (as students typically live near their university), come from different cohorts, and have been known to the ego before their university studies.

Figure 3 illustrates the bivariate relationships between our variables of interest, among all alter-tie observations (panel A) and disaggregated by social role (panel B). The relational and structural embeddedness of alters negatively relates to the probability of alter-tie dissolution: ties to alters who are emotionally closer, who have greater role overlap (multiplexity), and who share more ties with ego are dissolved less often. Also, in line with our theoretical rationale, age and educational dissimilarity are fairly consistently related to weaker embeddedness. However, in contrast, gender dissimilarity is negatively related to embeddedness only within the confidant layer.

Multivariate analyses of alter-tie dissolution

For reasons of parsimony, we only discuss results with respect to the average marginal (mediation/interaction) effects of interest in the main text, but a summary of our multilevel logit model results can be found in Table 2.

While AMIEs provide a clear *causal* interpretation, they lack a *descriptive* interpretation regarding the sign and significance of AMEs across social roles. Moreover, in our interaction models, covariates

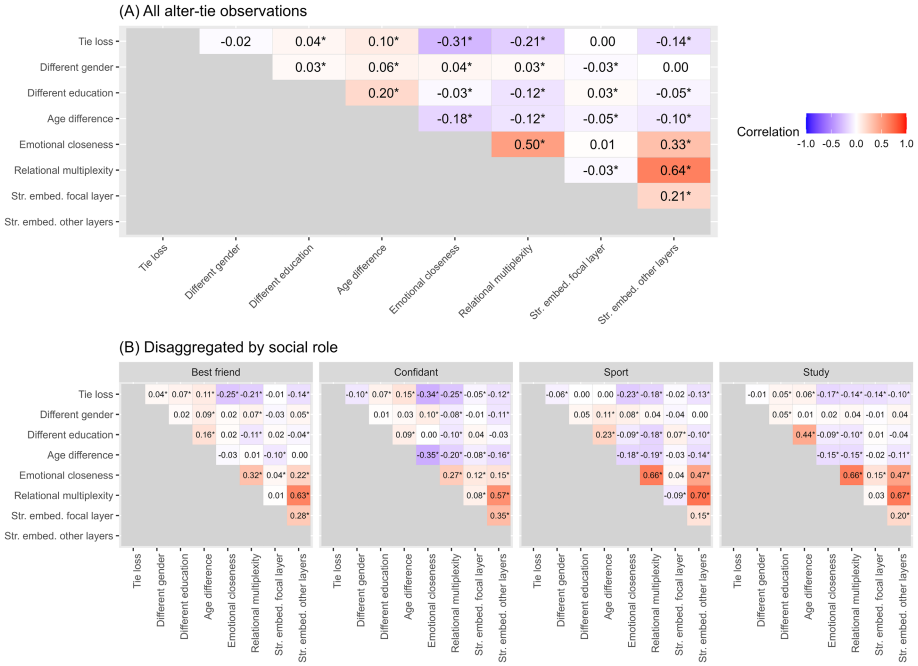

FIGURE 3 Correlation plots. Correlation between variables of interest, among all alter-tie observations (panel A) and disaggregated by social role (panel B). Further disaggregation between multiplex and uniplex alters can be found on our replication website. $^{*}p < 0.05$.

are assumed to have similar dissolution effects across social roles. To relax this assumption—and to facilitate the interpretation of our AMIEs below—we also estimated models and computed AMEs for each network layer separately (see Appendix C, Figures C1–C4).

Does dyadic dissimilarity drive alter-tie dissolution?

Figure 4 shows the AMEs of dyadic dissimilarities calculated from our base model (M3), which includes dyadic dissimilarities and all our control variables. Only age dissimilarity significantly enhances the probability of alter-tie dissolution (AME = 0.014, SE = 0.004). On average across all respondents in our dataset, a 1-year increase in the age difference between ego and alter drives a 1.4 percentage point increase in the probability of alter-tie dissolution. This effect is substantial, given the observed distribution of age differences among alters in our data ($M = 2.29$; SD = 2.65) and its range (0 to 26 years). Therefore, hypothesis 1, positing that dyadic dissimilarity induces the dissolution of alter-ties, finds support solely within the context of age dissimilarity.

Is this explained by alters' level of embeddedness?

Figure 4 also summarizes the AMEs of dyadic dissimilarities derived from our models that additionally included relational embeddedness (M4), structural embeddedness (M5), and both factors simultaneously (M6) into the explanatory model. It further illustrates the AMMEs of relational and structural embeddedness.

The age dissimilarity effect is partly mediated by relational embeddedness (AMME = 0.003, SE = 0.000). Accounting for relational embeddedness reduces the impact of age dissimilarity on tie dissolution by approximately 22% (0.003/0.0136 × 100). Similarly, the AMME of structural embeddedness is positive and significant (AMME = 0.001, SE = 0.000), reducing the AME of age dissimilarity by around 7% (0.001/0.0136 × 100). Relational and structural embeddedness are interrelated (see Figure 3). However, structural embeddedness has no additional role in explaining the age dissimilarity effect, above and beyond relational embeddedness. The AME of age dissimilarity when controlling for relational embeddedness (M4) remains unchanged after also introducing structural embeddedness into the explanatory model (M6). These findings support hypothesis 2, suggesting that weaker relational embeddedness explains partly why alter-ties of dyadically dissimilar alters are dissolved more quickly, at least within the context of age dissimilarity. Conversely, hypothesis 3, suggesting an (additional) explanatory role for structural embeddedness in the dissimilarity-tie dissolution relation, is rejected.

While we observe (negatively) significant AMMEs for gender and education, the AMEs of gender and education themselves do not deviate from zero in any of our models, and we therefore refrain from further interpreting the mediation pathways.

Do dissimilarity effects differ across social roles?

The left panel of Figure 5 shows the AMEs of dissimilarities calculated from Model 7, in which we introduced the interactions between dissimilarity and social role. The right panel shows the AMIE, which indicate how the AME of a dissimilarity changes across various social roles when compared to confidants, which serve as the reference category.

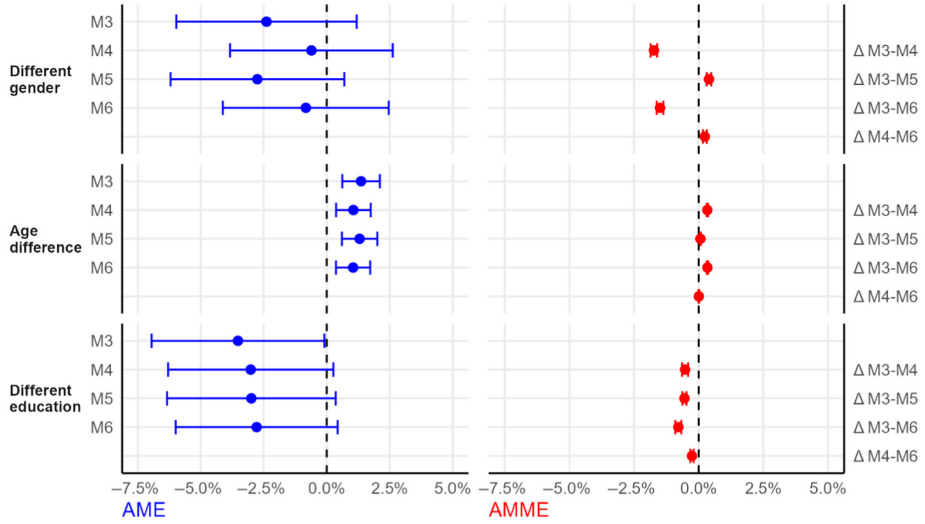

FIGURE 4 Average marginal (mediation) effects. Blue points (left panel) reflect average marginal effects (AME) of dyadic dissimilarities on alter-tie dissolution probabilities, derived from our models (see Table 2). Red points (right panel) reflect the average marginal mediation effects (AMME), calculated as the cross-model differences in bootstrapped estimates of AMEs, averaged over bootstrap samples ($N = 500$). Effects are transformed to percentages. Error bars reflect 95% bootstrapped confidence intervals. The average of bootstrapped AME estimates (not shown) closely resemble model-observed AMEs, indicating an absence of bias.

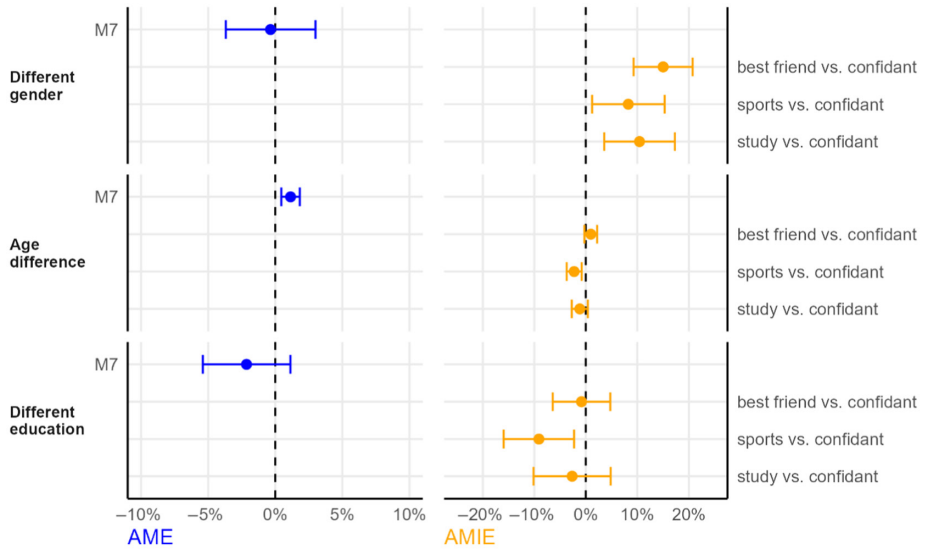

FIGURE 5 Average marginal (interaction) effects. Blue points (left panel) reflect average marginal effects (AME) of dyadic dissimilarities on alter-tie dissolution probabilities, derived from our Model 7 (see Table 2). Orange points (right panel) reflect the average marginal interaction effects (AMIE). Effects are transformed to percentages. Error bars reflect 95% bootstrapped confidence intervals.

We observe a 15 percentage point increase in the AME of gender dissimilarity among best friends, relative to confidants (AMIE = 0.150, SE = 0.029). For sports partners, this increase is 8 percentage points (AMIE = 0.083, SE = 0.036), and for study partners, it is 10 percentage points (AMIE = 0.104, SE = 0.035). Analyzing the network layers separately (Appendix C) reveals a significant *negative* tie dissolution effect of gender dissimilarity among confidants (AME = −0.071, SE = 0.012; Figure C1), while no significance is observed in other social roles. These patterns are in line with our descriptive results reported in Figure 2B. We must reject hypothesis 4a, which expected the (positive) impact of gender dissimilarity to be most pronounced in friendships and least in study partnerships.

In sports partnerships, age dissimilarity has a notably weaker positive impact on tie dissolution than among confidants (AMIE = −0.023, SE = 0.007). Moreover, the AME of educational dissimilarity was significantly lower in sports partners compared to confidants (AMIE = −0.091, SE = 0.035). Surprisingly, among sports partners, the educational dissimilarity effects is even significantly negative (AME = −0.078, SE = 0.034; Figure C3). We must thus reject

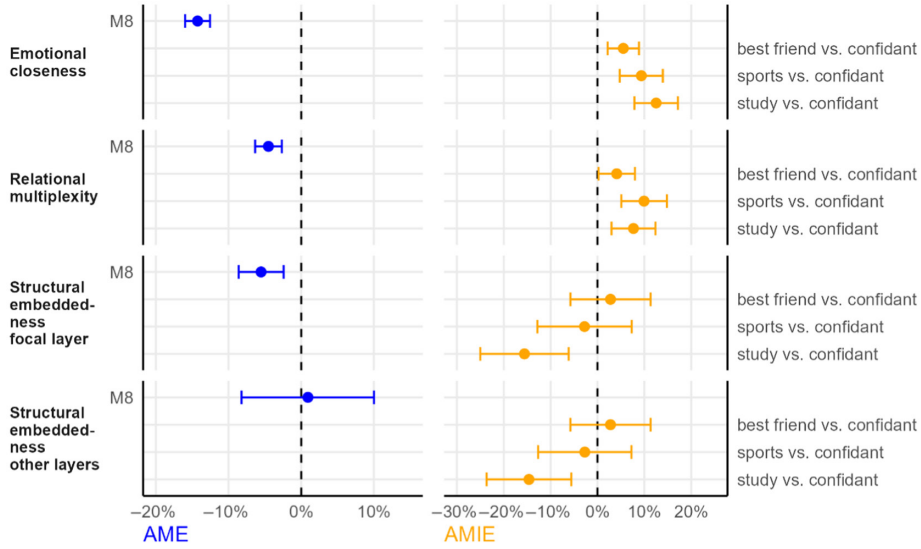

FIGURE 6 Average marginal (interaction) effects. Blue points (left panel) reflect average marginal effects (AME) of dyadic dissimilarities on alter-tie dissolution probabilities, derived from our Model 8 (see Table 2). Orange points (right panel) reflect the average marginal interaction effects (AMIE). Effects are transformed to percentages. Error bars reflect 95% bootstrapped confidence intervals.

hypothesis 4b, which stated that having a different educational level would have the strongest positive impact on the dissolution of study partnerships and friendships.

Do embeddedness effects differ across social roles?

Figure 6 illustrates the AMEs of relational and structural embeddedness and the AMIEs with social role, calculated from Model 8. Relationally well-embedded alters—those emotionally closer (AME = −0.143, SE = 0.009) and with greater role overlap (AME = −0.045, SE = 0.009)—and structurally well-embedded alters—particularly within the focal network layer (AME = −0.055, SE = 0.016)—are less likely to have alter-ties ended.

In line with our descriptive results (Figure 3B), emotional closeness exerts the strongest negative impact on alter-tie dissolution among confidants, followed by best friends (AMIE = 0.055, SE = 0.017), sports partners (AMIE = 0.094, SE = 0.023), and study partners (AMIE = 0.0125, SE = 0.024). This contradicts hypothesis 5, which suggested the closeness-effect to be most pronounced among best friends. However, considering prior research indicating that confidants can be both emotionally close core-network members and relatively weak yet instrumental relations (Small, 2013),[5] this outcome is not entirely surprising. It suggests that our close, core-network confidants tend to be stable, while those less close and more likely to serve instrumental purposes are more volatile. Still, our findings align with our theoretical idea that the impact of emotional closeness on the continuation of ties is more pronounced in more emotionally intimate relations (best friends) compared to relations serving instrumental goals (sports and study partners).

Multiplexity also has the strongest negative impact on alter-tie dissolution among confidants, followed by best friends (AMIE = 0.041, SE = 0.020), study partners (AMIE = 0.077, SE = 0.024), and sports partners (AMIE = 0.100, SE = 0.025). The finding that especially confidant maintenance is bolstered by multiplexity is not surprising, given our descriptive finding that multiplex confidants are often best friends (see Figure 1)—stable alters in whom individuals tend to keep confiding. Furthermore, we observe a pattern where multiplexity affects alter-tie maintenance mostly in emotional roles, and to a lesser extent in instrumental roles, hence echoing the rationale behind hypothesis 6a.

Last, we find that the negative impact of structural embeddedness—particularly in the focal network layer—on alter-tie dissolution becomes stronger when comparing study partners to confidants (AMIE = 0.156, SE = 0.048), but not when comparing best friends or sports partners to confidants. These findings align partially with hypothesis 7, suggesting that structural embeddedness is related to the maintenance of instrumental roles in particular.

Robustness checks

Do gender dissimilarity effects on confidant loss depend on ego's gender?

We discovered that gender-dissimilar confidants are less likely to be dissolved than their gender-similar counterparts, contrary to our theoretical expectations and prior empirical findings (Jeroense et al., 2024). This may be attributed to men generally receiving more socioemotional benefit from cross-gender confiding relations than

[5]This is also reflected in our data, with (uniplex) confidants showing the greatest variation in emotional closeness of all social roles (see our replication website).

women (Barstead et al., 2013), leading to men confiding in women more frequently and consistently. Notably, in our sample, men were more likely than women to have gender-dissimilar confidants, with 45% of men's and 27% of women's confidants being of the opposite gender. However, further analyses examining tie dissolution in the confidant layer specifically revealed that gender-dissimilar confidants were more stable for both male and female students (see our replication website).

Accounting for forgetting

Measuring tie dissolution is compounded by a "foundational" issue in egocentric network research (Perry et al., 2018, p. 251): "the inability to distinguish real network change from reporting error." A methodological concern is that respondents often simply forget to rename alters (Fischer & Offer, 2020). During wave 3 of the "Sports and Friendships" study, when alters listed in wave 2 were not renamed in any of the name generators of wave 3, respondents were asked to provide reasons for not including these alters once more. One of the explanations respondents could give was that they simply forgot to mention the alter again. 19% of the non-relisted alters were simply forgotten.

We estimated a new model using data on alter-ties measured between waves 2 and 3 ($N_3 = 281$, $N_2 = 1859$, $N_3 = 2985$), incorporating a more stringent measure of alter-tie dissolution; alter-ties of alters 'simply forgotten' were categorized as maintained. Our findings remain largely unchanged (see Appendix D, Table D1).

DISCUSSION

Research shows that social networks are dynamic, and that the dissolution of ties is far from random, partly because ties differ in relationship benefits and maintenance costs. One factor that has received special attention as a driving force behind tie dissolution is dyadic dissimilarity, because the (potential) tendency for individuals to break ties with those who are dissimilar may drive processes of segregation in social networks, organizations, and societies at large. While prior studies have demonstrated that ties with dissimilar alters dissolve more quickly, they have not succeeded in providing explanations for this.

Our findings indicate that dyadic dissimilarity generally does not drive tie dissolution, at least not consistently across demographic dimensions and relationship layers. We only found one ground of dissimilarity to consistently induce the dissolution of alter-ties, namely age. However, we found notable differences between social roles, which highlights the importance of taking a social network perspective and acknowledging the multilayeredness of social networks.

In line with previous research, we found that age dissimilarity drives confidant loss, but in contrast to this research, we find that confiding ties with different gender alters are not more often, but less often dissolved (Jeroense et al., 2024; Tulin et al., 2021). This was observed even after we accounted for potential partner effects, measured through the relationship status of ego. This surprising pattern may be unique to the student population, as the composition and dynamics of their core discussion networks could differ from those of adults. The literature suggests that gender-dissimilar confidants offer more socioemotional benefits for men than for women, which might explain why we observed more gender-dissimilar confidants among male students than among female students and why for men gender-dissimilar confidants are more stable than similar confidants. However, also among women we observed greater stability of gender-dissimilar confidants compared to gender-similar confidants. This may be explained by the unique position of male confidants in their social network, a factor that has been theorized to enhance tie stability (Jeroense et al., 2024). We invite future research to explore this proposition.

The positive effect of age dissimilarity on alter-tie loss was most pronounced in best friends. This finding echoes our theoretical idea that a preference for similarity—due to similar others generally being perceived as more empathic and trustworthy, and due to them having shared experiences—is mostly pronounced in more emotional ties, and less so in instrumental ones.

Earlier studies found that alters with a different educational background are not lost more frequently from core discussion networks (Jeroense et al., 2024; Tulin et al., 2021). Our findings echo this: even among students, educational dissimilarity does not lead to alter-tie dissolution. Not in any of the examined social network layers. Evidently, the dissimilarity in educational backgrounds does not play a role in driving network de-selection. Ties formed with others with a different educational background may provide alternative values that outweigh the potential maintenance costs of dissimilarity. When individuals recognize behavioral or attitudinal differences, they may actively address and overcome potential maintenance costs by working through these differences over time.

We assumed that certain similarities, such as on gender and age, would contribute to the maintenance of sports partnerships. Additionally, we assumed that educational similarity would stabilize study partnerships. However, these assumptions were not supported by our data. If anything, it appeared that sports partners with different educational levels were more likely to be maintained.

Potentially, this may have to do with the context or foci within which individuals have sporting relations. Some social sports contexts are 'heavy' or demanding, based on their formal organizational structures, facilities, and their rules and expectations. Other contexts may be deemed 'light,' such as when people participate in sports in informal groups or go to the gym together. While sports relations within heavy (e.g., club-sport) settings are expected to be more stable, these settings may also bring together individuals across social divides (Putnam, 2000), such as those with different educational backgrounds. More fundamentally for the study of egonets, this emphasizes the necessity of measuring the specific foci of activity binding individuals together in different network layers.

Naturally, adding name interpreter questions should be carefully weighed against issues of survey length, complexity, and monotonicity. Mixed methods approaches could help identify key network types and multiplexity. For example, following the name generator questions, researchers might ask respondents to identify other important types of relationships (role-focused) or inquire about additional alters not listed and their respective roles (alter-focused).

The relational embeddedness that comes from close, multiplex relationships was found to bolster alter-tie maintenance. Additionally, alters' structural embeddedness that comes from shared social ties with ego across ego's social network layers drove up alter-tie maintenance. We were better able to explain tie loss because multiplexity and shared social ties beyond the focal network layer exerted additional effects on tie de-selection beyond that of traditional measures of relational embeddedness (closeness) and structural embeddedness (shared ties within the focal layer).

We theorized that embeddedness could explain in part why alter-ties of dissimilar alters are lost more quickly, and this assumes that dissimilarity relates negatively to embeddedness. We observed a generally weak bivariate association, and it is therefore not surprising that we found few mediation effects. Yet, in line with our theory, we found that alter-ties marked by greater age gaps decayed faster, partly due to their weaker relational embeddedness, but contrary to our theory, not because of their weaker structural embeddedness within ego's broader social network. We did not find this for other demographic dimensions.

Previous research on inter- and intra-ethnic friendships among young adolescents has shown mixed results regarding the link between dyadic similarity and relationship quality. Some studies have found a positive relation (e.g., Kisfalusi, 2016) while others have not (e.g., Oczlon et al., 2023). Our descriptive findings demonstrate that the relationship between dyadic similarity and relationship quality is highly complex, depending not only on the specific quality indicator used but also on the combination of demographic dimensions and network types. This highlights the need for a deeper understanding of how similarity affects relationship quality, and how this depends on the type of demographic trait, the specific tie type, and the stage of life.

Notably, research also shows that while similar individuals tend to be emotionally closer, they also have more conflict, a factor that may lead ties to dissolve (Schneider et al., 2007). In other words, similarity increases opportunities for both positive and negative contact. Potentially, the positive indirect effects of similarity on tie stability, via enhanced emotional closeness, are offset by the greater proclivity to have conflicts. Unfortunately, our data did not include measures of negative contact. A good avenue for future research is to include next to presumably positive tie types (e.g., friendship, sports partnerships), also negative interactions (e.g., avoidance, antipathy, aggression; Kros et al., 2021), for instance using an additional name interpreter question.

We further theorized how relational multiplexity impacts network dynamics. We demonstrated that positive effects on alter-tie maintenance of multiplexity were most prevalent among emotional roles rather than in instrumental roles, and thus that multiplexity likely bolsters tie maintenance primarily through relational depth or 'holism and diffusion' (Verbrugge, 1979) rather than through the provision of additional opportunities for tie maintenance through encounters in various network layers or foci of activity.

To conclude, processes of tie dissolution have been argued to be fundamentally different from tie formation processes: tie formation likely depends much on circumstantially meeting, while tie continuation likely depends more on individuals' willingness to keep investing in a relationship (Tulin et al., 2021). Our findings support this notion but also add nuance in that this is highly dependent on the type of alter-tie or the social role of an alter. In alter-ties centered on emotional matters, such as our friends, tie continuation is mostly driven by factors bolstering relational embeddedness. Conversely, in instrumental alter-ties, tie continuation seems to rely more on mutual contacts that facilitate the circumstantial interactions between ego and alter that aid in preventing the tie from decaying.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in DANS Data Station Social Sciences and Humanities at https://doi.org/10.17026/SS/GODKDR.

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APPENDIX A

DATA COLLECTION AND SOCIAL NETWORK MEASUREMENT PROCEDURE

Data of the Dutch 'Sports and Friendships' study (Franken et al., 2023) were collected for this study. The overarching aim of this study was to explore the evolution of multiple dimensions of students' social relations throughout student life and its consequences for their sports participation and academic experiences and outcomes. The study was piloted among a small cohort of first-year students ($N = 89$) enrolled at a research university or university of applied sciences of a major Dutch city in the academic year 2021–2022. During the next academic year (2022–2023), the study was refined and conducted among a large sample of university students from all year groups ($N = 655$).

We obtained student contact information from the university sports center of students who, during their online registration, had given permission to be approached for scientific research. In our main cohort, this amounted to roughly 50% of all students who enrolled for a university sports center membership and approximately 10% of the entire student body, totaling more than 5000 Dutch-speaking students.

Exclusions comprised participants from the pilot cohort and those who had previously opted out, yielding a list of 5227 students. These students were sent invitations via mail for questionnaire wave 1 at the start of the academic year in September 2022. Questionnaires were delivered in Dutch and were administered via LimeSurvey (Schmitz, 2020). To increase response rates, we raffled off 10 annual subscriptions at the sports center for the next academic year. To enhance exposure, an invite was posted on the university sports center's smartphone app, which is used for registering for sports courses and booking gym sessions. Two reminders were sent. 1135 students filled out the questionnaire, and 15 students opted out (response rate = 0.22).

In January 2023, after the first semester, 1116 respondents who had listed at least one network partner in the first questionnaire were sent an invitation for a second questionnaire (wave 2). Of those, 608 respondents completed it, resulting in a response rate of 0.54. Respondents were given 5 Euro vouchers after completing wave 2. In July 2023, just before the summer break, a third and last questionnaire was administered among previous participants. To promote response, we raffled off five annual subscriptions at the sports center. 420 respondents completed it (response rate = 0.38).

The questionnaires assessed various social network dimensions via multiple name generator questions, multiple attributes of alters and ego-alter dyads, dynamic measures of life-course transitions, and much more. More details on the study design and specific questions asked are documented in the codebook. The study was approved by the Ethics Committee Social Science of Radboud University.

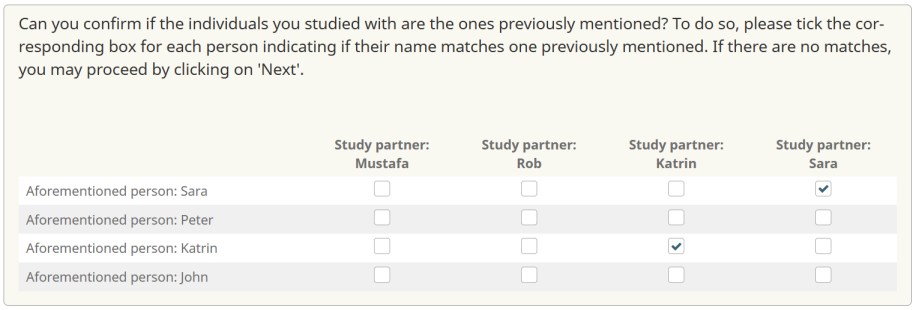

FIGURE A1 Screenshot of the Computer-Assisted Personal Interviewing interface used by a hypothetical 'Sports and Friendships' respondent to match alters after the 'study network' name generator.

The anonymized data used for this paper, along with the codebook, have been deposited in the research data repository DANS (Data Archiving and Networked Services) Data Station Social Sciences and Humanities (Franken et al., 2023).

In our sample, female students make up 76% of respondents (see Table 1), while among all students enrolled at the university sports center at the time our data collection started, approximately 63% were female. Our survey participants are slightly younger ($M = 21.88$, $SE = 2.49$) compared to the average student age of around 23. Students from research universities were overrepresented in our sample, which is not surprising given that roughly 80% of students enrolled at the university sports center at the time of our data collection studied at a research university. Importantly, we do not observe selective panel attrition based on factors such as gender, educational institution type (research university vs. university of applied science), or study year.

A.1. | Measuring personal networks

The 'Sports and Friendships' study used an extended egocentric name generator method to delineate respondents' personal network and collect information about alters. It asked respondents to name the people whom they were connected to in four ways: (1) confiding or discussing important matters, (2) studying together, (3) being friends, and (4) doing sports and exercise together. The four name generator questions administered were (translated freely from Dutch):

1. "Most people discuss important personal matters with others. When you look back on [period], who were the most important people you discussed important issues with? Please provide up to five names (their first name and the first letter of their last name). If you would like, you can also provide nicknames, as long as you know who they are for future reference. Please fill in one name per box."
2. "We would also like to ask about the people you study with, such as those you collaborate with on a project or do homework with. When you think back on [period], who were the most important people you have studied with? For each person, please fill in one box."
3. "We are curious about your friendships. The people you can count as your best friends are often few and far between. Who would you count as your best friends?[6] You can name up to five. Please fill in one person per box."
4. "Some people mainly exercise alone, while others exercise with others. If you look back on [period], who are your most important sports partners? Please provide up to five names, entering one person per box."

In response to each name generator, respondents provided the names of up to five alters.

For wave 1 (September 2022), respondents were asked to reflect on the social relations (confidants, best friends, study partners, and sports partners) they had in the 6 months before the previous summer holiday. In wave 2 (January 2023) and wave 3 (July 2023), they were asked to reflect on their social relations from the previous semester.

Following each name generator, participants were asked to rate the closeness of the relationship between the listed alters. After that, respondents completed an adjacency matrix to indicate which pairs of names referred to the same alter (see Figure A1). In waves 2 and 3, following the four name generators, respondents filled out an adjacency matrix that indicated whether alters listed at that moment were the same as alters listed previously. Name interpreter questions were asked to obtain additional information about the alters and dyadic relationships.

In wave 3, we expanded the measurement of social networks. In cases where a person listed as an alter in wave 2 did not reappear in *any* of the name generators of wave 3, we asked the respondent why this person was not renamed (cf. Fischer & Offer, 2020). The survey instrument offered the following answer categories:

1. I simply forgot to mention this person again.
2. There hasn't been an opportunity for us to be in touch.
3. Our relationship changed.

[6]The concept of friendship is inherently ambiguous, both for the respondent and the researcher (Kitts & Leal, 2021). Respondents tend to use loose definitions of friendships when asked to enumerate their friends, as opposed to the more specific definition they apply to 'best friends' (Leenders, 1996). We measured "best friends" to address this ambiguity and ensure a clearer understanding among respondents regarding the type of friends we wanted them to list. Additionally, literature suggests that the number of true (best) friends people maintain typically lies between one and eight (Hallinan, 1974). A focus on best friends thus also justified capping our name generator question at five entries, with the aim to reduce response burden.

4. Another reason: [open-ended text].

If respondents selected answer 3, "our relationship changed," the survey prompted them to choose an additional explanation from the following options:

1. One or both of us has moved.
2. One of us has undergone a major life transition (such as quitting studies, entering/ending a relationship, having a child, etc.).
3. One of us has health issues.
4. We have drifted apart/the relationship has faded.
5. We had disagreements or fights.
6. The relationship has changed in another way: [open-ended text].

APPENDIX B

MEASUREMENT OF AND RATIONALE BEHIND CONTROL VARIABLES

B.1 | EGO-LEVEL

We included in our models ego covariates for their potential association with alter-tie dissolution probabilities. We controlled for ego's *gender* (1 = man; 0 = woman and other), *age* (continuous, in years), and *educational level* (1 = research university; 0 = vocational university).

To account for differential preferences for maintaining alter-ties, we controlled for *extraversion*, expecting extraverted individuals to lose fewer ties (Mund et al., 2018; Selfhout et al., 2010). Our data includes a two-item scale at wave 1 to measure extraversion (items are listed in the codebook). Respondents were also asked how often they experienced having to miss out on activities or outings with friends because they could not afford them financially. This was categorized on a scale from "never" (coded 0) to "always" (coded 3), to take into account the financial resources that may be required to maintain alter-ties (Cornwell, 2015).

We also controlled for *life-course transitions* experienced by students, as these may cause them to report more alter-tie losses (Bidart & Lavenu, 2005; Mollenhorst et al., 2014; Small et al., 2015). In wave 1, respondents were asked about their current study program and study year, their main occupation prior to their studies (e.g., secondary or tertiary education, a gap year, or employment), their housing situation and place of residence 6 months prior to the previous summer break, as well as their current residence. In wave 2, respondents were again asked about their housing situation and whether they were still enrolled in the same study program. Based on this information, we controlled for the experience of transitions in *study* (1 = yes, 0 = no) and *housing* (1 = yes, 0 = no). Since these transitions were not measured between waves 2 and 3, ties observed in that period were given a value of 0 on these variables.

B.2 | ALTER-LEVEL

We controlled for alter's *gender* (1 = man; 0 = woman and other), *age* (in years), and *educational level*. Age was divided into answer categories; we re-coded it by taking the midpoint of the range. Educational level was assessed on a 7-category ordinal scale spanning from "primary education" to "research university," and we treated this as a continuous variable in our models. We further controlled for *relationship duration*, ranging from 0 ("under one year")—15 ("over fifteen years"). Dummy variables were made for *geographical proximity*: (1) "same house," (2) "same municipality," and (3) "different municipality or farther away". In line with previous research, we expect alters that have been known for longer durations and who are more proximate are more likely to maintain alter-ties (Marin & Hampton, 2019).

B.3 | TIE-LEVEL

Additionally, we controlled for the *size* of the network layer in which an alter-tie exists, calculated as the number of alters in the particular network layer at time *t*. Dropping alter-ties in larger networks may be less costly, and the time and energy required to sustain large personal networks may come at the cost of maintaining single alter-ties.

Finally, we incorporated *observation periods* into our analyses to address potential period-specific effects, or variations in alter-tie dissolution rates between waves 1–2 (coded 0) and waves 2–3 (coded 1).

APPENDIX C

AMEs PER SOCIAL ROLE

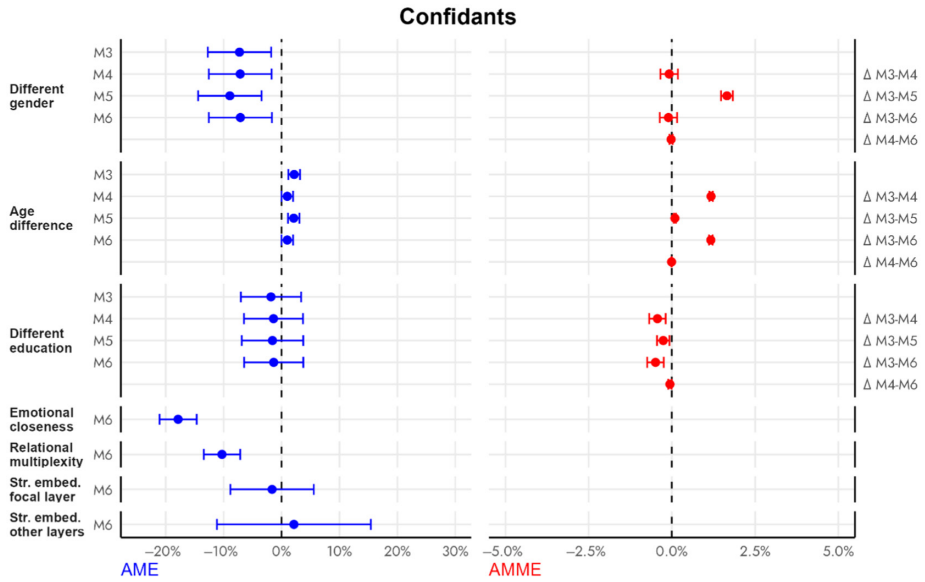

FIGURE C1 Average marginal (mediation) effects in the confidant layer. Blue points (left panel) reflect average marginal effects (AME) of dyadic dissimilarities on tie dissolution probabilities. Red points (right panel) reflect the average marginal mediation effects (AMME), calculated as the cross-model differences in bootstrapped estimates of AMEs, averaged over bootstrap samples ($N = 500$). Effects are transformed to percentages. Error bars reflect 95% bootstrapped confidence intervals. The average of bootstrapped AME estimates (not shown) closely resemble model-observed AMEs, indicating an absence of bias.

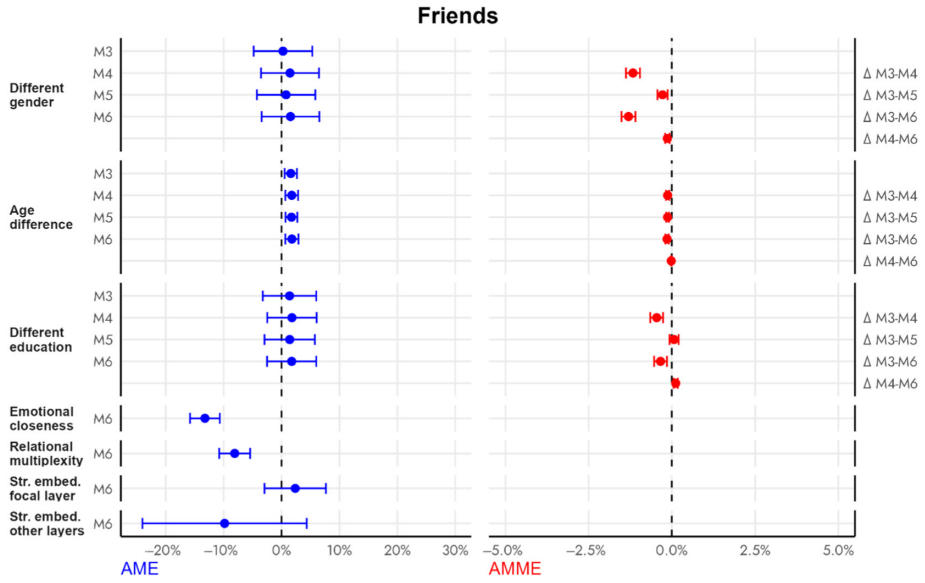

FIGURE C2 Average marginal (mediation) effects in the friendship layer. AME, average marginal effect; AMME, average marginal mediation effect.

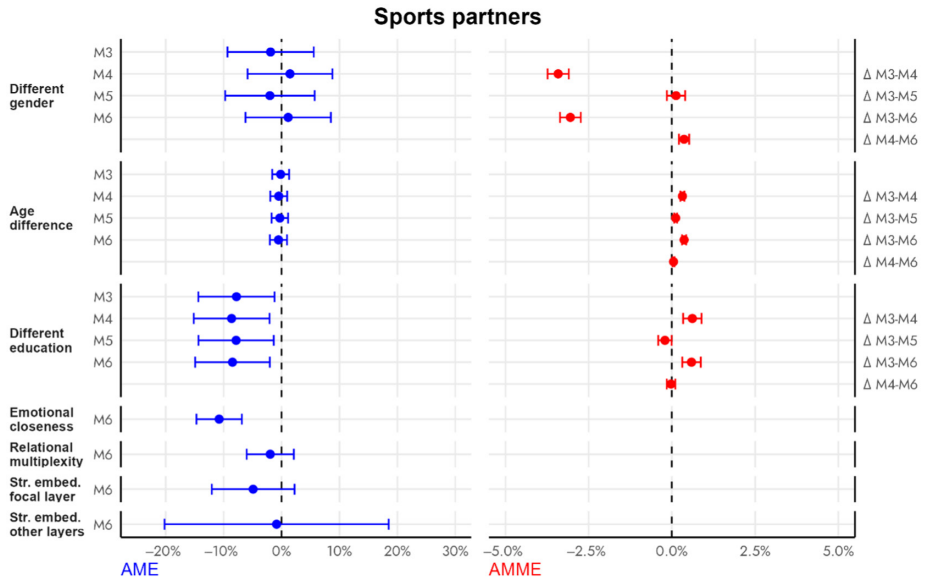

FIGURE C3 Average marginal (mediation) effects in the sports layer. AME, average marginal effect; AMME, average marginal mediation effect.

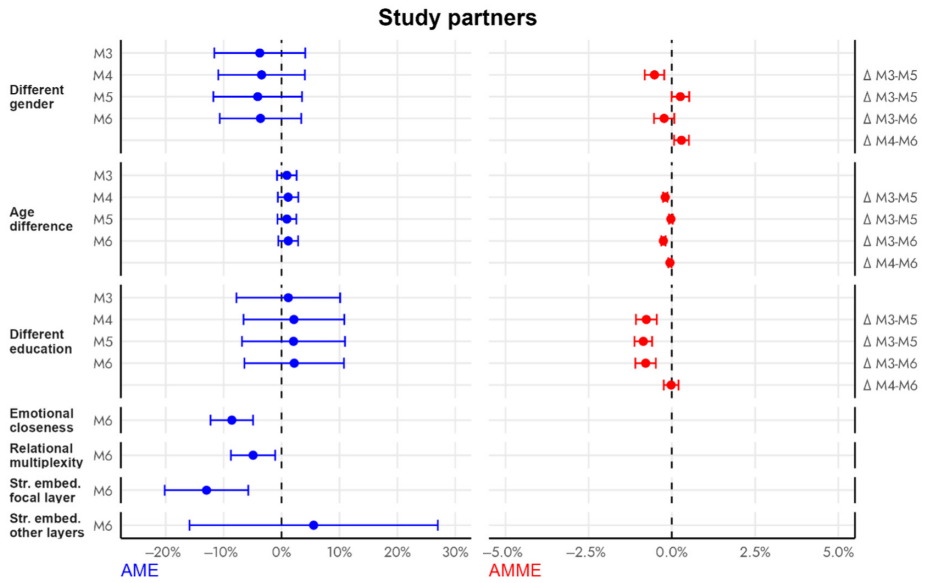

FIGURE C4 Average marginal (mediation) effects in the study layer. AME, average marginal effect; AMME, average marginal mediation effect.

APPENDIX D

ACCOUNTING FOR FORGOTTEN ALTERS

TABLE D1 Results of multilevel logit models predicting alter-tie dissolution, counting alter-ties of alters "simply forgotten" as maintained.

	M0	M1	M2	M3	M4	M5	M6	M7	M8
1. (Intercept)	−0.78 (0.06)***	−1.32 (0.12)***	−1.33 (0.14)***	−1.07 (0.34)**	0.75 (0.45)	−1.10 (0.35)**	0.71 (0.46)	0.72 (0.47)	4.15 (0.82)***
2. Best friend		−0.32 (0.13)*	−0.30 (0.14)*	−0.32 (0.14)*	−0.36 (0.14)**	−0.31 (0.14)*	−0.34 (0.14)*	−0.37 (0.21)	−2.75 (0.88)**
3. Sports partner		0.97 (0.16)***	0.91 (0.16)***	0.91 (0.17)***	0.71 (0.17)***	0.97 (0.17)***	0.78 (0.17)***	0.87 (0.26)***	−3.52 (0.88)***
4. Study partner		1.65 (0.16)***	1.56 (0.16)***	1.52 (0.17)***	1.26 (0.17)***	1.62 (0.18)***	1.38 (0.18)***	1.50 (0.26)***	−2.65 (0.82)**
5. Different gender			−0.07 (0.13)	0.14 (0.20)	0.19 (0.19)	0.13 (0.20)	0.18 (0.20)	−0.29 (0.29)	0.20 (0.20)
6. Different education			0.11 (0.13)	−0.26 (0.15)	−0.30 (0.15)*	−0.25 (0.15)	−0.30 (0.15)*	0.08 (0.25)	−0.27 (0.15)
7. Age difference			0.25 (0.06)***	0.17 (0.08)*	0.18 (0.08)*	0.16 (0.08)*	0.18 (0.08)*	0.19 (0.11)	0.15 (0.08)
8. Multiplexity					−0.05 (0.08)		−0.14 (0.10)	−0.18 (0.10)	−0.72 (0.19)***
9. Emotional closeness					−0.54 (0.10)***		−0.52 (0.10)***	−0.53 (0.10)***	−1.30 (0.21)***
10. Str. embeddedness focal layer						−0.16 (0.06)**	−0.13 (0.06)*	−0.12 (0.06)*	−0.00 (0.16)
11. Str. embeddedness other layers						−0.06 (0.07)	0.13 (0.08)	0.13 (0.08)	0.30 (0.15)*
12. Different gender: best friend								0.79 (0.32)*	
13. Different gender: sports partner								0.49 (0.35)	
14. Different gender: study partner								0.54 (0.34)	
15. Different education: best friend								−0.39 (0.29)	
16. Different education: sports partner								−0.45 (0.33)	
17. Different education: study partner								−0.60 (0.34)	
18. Age difference: best friend								0.25 (0.14)	
19. Age difference: sports partner								−0.33 (0.17)	
20. Age difference: study partner								−0.01 (0.16)	
21. Emotional closeness: best friend									0.45 (0.25)
22. Emotional closeness: sports partner									0.95 (0.27)***
23. Emotional closeness: study partner									0.97 (0.25)***
24. Multiplexity: best friend									0.62 (0.24)**
25. Multiplexity: sports partner									0.81 (0.26)**
26. Multiplexity: study partner									0.60 (0.25)*
27. Str. embeddedness focal layer: best friend									0.19 (0.20)

(Continues)

TABLE D1 (Continued)

	M0	M1	M2	M3	M4	M5	M6	M7	M8
28. Str. embeddedness focal layer: sports partner									−0.23 (0.20)
29. Str. embeddedness focal layer: study partner									−0.29 (0.19)
30. Str. embeddedness other layers: best friend									−0.42 (0.21)*
31. Str. embeddedness other layers: sports partner									−0.16 (0.21)
32. Str. embeddedness other layers: study partner									−0.06 (0.21)
Akaike information criterion	3775.54	3534.78	3519.17	3506.70	3463.32	3502.03	3460.48	3453.23	3416.39
Bayesian information criterion	3793.54	3570.78	3573.18	3650.73	3619.35	3658.07	3628.51	3675.28	3656.44
Log likelihood	−1884.77	−1761.39	−1750.58	−1729.35	−1705.66	−1725.02	−1702.24	−1689.62	−1668.19
Num. obs.	2985	2985	2985	2985	2985	2985	2985	2985	2985
Num. groups: ego:alterid	1859	1859	1859	1859	1859	1859	1859	1859	1859
Num. groups: ego	281	281	281	281	281	281	281	281	281
Var: ego:alterid (Intercept)	0.97	1.46	1.44	1.41	1.29	1.43	1.34	1.38	1.35
Var: ego (Intercept)	0.28	0.38	0.36	0.35	0.40	0.36	0.40	0.41	0.43
VPC_A	0.27	0.36	0.35	0.35	0.34	0.35	0.34	0.35	0.35
VPC_E	0.06	0.07	0.07	0.07	0.08	0.07	0.08	0.08	0.08

Note: Logit coefficients. Standard error within parentheses. Only explanatory variables of interest are shown, excluding controls. All coefficients not shown are available on our replication website.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$.