



Original Article

The costs of family and friends: an 18-month longitudinal study of relationship maintenance and decay[☆]

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Abstract

Evolutionary theory predicts that kin relations will be distinct from friendships, but recent studies have suggested a degree of similarity between these two types of relationships. In this longitudinal study, we examined the influence of kinship on the maintenance costs of social relationships. We followed 25 students over an 18-month period as they made the transition from school to university and examined the association between kinship, relationship maintenance and decay. The emotional intensity of friendships, in comparison to kin relations, was more sensitive to decreases in contact frequency and more sensitive to decreases in the number of activities done together. These results demonstrate that important differences between kin relations and friendships emerge when the relationships are considered longitudinally and suggest that the costs of maintaining friendships are much higher than the costs of maintaining kin relations.

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1. Introduction

The extent to which kin relations and friendships are distinct types of social relationships is currently a matter of intense debate. There are good evolutionary reasons to suggest that kin relations and friendships should have very different properties. Replication of genes into future generations can occur either through personal reproduction or the reproduction of individuals carrying the same genes. Hamilton's rule of kin selection states that a behaviour or trait will be favored by selection when $rB > C$, where C is the fitness cost to the actor, B is the fitness benefit to the recipient and r is the coefficient of genetic relatedness — the probability two individuals share the same genes by descent (Hamilton, 1964). Kin share a proportion of their genes

through descent, whereas friends do not. Thus, all other things being equal, more closely related individuals (with a higher r) should be favored over less closely related individuals (with a lower r) and kin favored over friends (with zero r).

The concept of inclusive fitness captured by Hamilton's rule has proved fundamental in explaining a wide range of behaviors in evolutionary biology, particularly in relation to cooperation and altruism (West, Griffin & Gardner, 2007). In humans, both in theoretical (Burnstein, Crandall & Kitayama, 1994; Kruger, 2003) and in real-life situations (Grayson, 1993; Hogan & Eggebeen, 1995; Shavit, Fischer & Koresh, 1994), people are more likely to provide support for kin than for friends and to provide support for kin who are more closely related than less closely related. People are also more likely to bear a genuine cost (physical pain) for kin than for friends, and for more closely related kin than for more distantly related kin (Madsen et al., 2007). Kin are more likely to provide material, emotional or practical help than friends, and this help is less contingent on the personal relationship between the two individuals than support provided by friends (Espinoza, 1999; Wellman & Wortley, 1990). In terms of the type of help provided to friends and kin, Tooby and Cosmides (1996) identified a crucial problem in friendships — how to assess the willingness of a friend to

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offer high-cost help at a time of great personal need. Indeed, people are more likely to provide high-cost help to kin than to friends and this help is less reciprocal (Essock-Vitale & McGuire, 1985; Stewart-Williams, 2007). Finally, on a psychological level, kinship — but not friendship — appears to be a fundamental social category that people code implicitly in the same way as they code for sex and age (Lieberman, Oum & Kurzban, 2008). This body of evidence suggests that, just as predicted by evolutionary theory, people do feel and act differently towards kin and friends.

However, other researchers have argued that in fact friendships, and especially some close friendships, are equivalent to kin relations. Thus Korchmaros and Kenny (2001, 2006) argued that emotional closeness mediates the relationship between kinship and altruism, and that close friends can become like close kin if they have high levels of emotional closeness and social interaction. Ackerman, Kenrick, and Schaller (2007) examined benevolent attitudes to strangers, friends and kin and found that women treat close friends like kin, whereas men treat close friends like strangers. Clark and Mills (1993) proposed that there are different fundamental norms that govern the giving and receiving of benefits. Close friends and close kin tend to have communal norms (with no obligation of reciprocation), and acquaintances and strangers tend to have exchange norms (with an obligation of reciprocity). Along similar lines, Fiske et al. (Fiske & Haslam, 2005; Fiske, 1992) argued that there are four basic modes of relating to others (communal sharing, authority ranking, equality matching and market pricing) and that it is these modes, rather than the distinction between kinship and friendship, that provides the fundamental building blocks of social interaction. Finally, friends actually tend to share more genes in common than non-friends do (Rushton & Bons, 2005), although the extent to which this may influence cooperation between friends is hotly disputed (see commentaries in Rushton, 1989). This body of research suggests that the nature of social relationships may be less determined by kinship than by other factors such as the precise nature of the relationship between the two individuals (Korchmaros & Kenny, 2001, 2006), gender differences (Ackerman et al., 2007) or the fundamental relationship type or mode of relating (Clark & Mills, 1993; Fiske, 1992).

In this study, we test whether kin relations really are distinct from friendships. We used longitudinal data on how student's social networks change during the transition from school to university to examine how kinship affects relationship maintenance and decay. The transition from school to university is a time of change in social networks, altering relationships both with friends (Cummings, Lee & Kraut, 2006; Oswald & Clark, 2003) and family members (Berman & Sperling, 1991; Pipp, Jennings, Shaver, Lamborn & Fischer, 1985). We used this period of change in social networks to test whether kin relations and friendships are distinct types of social relationships, with characteristic patterns of change over time.

Social relationships are not fixed, static entities but are prone to decay such that they become less close over time (Burt, 2000). To prevent this decay, and keep the relationship at a particular level of emotional intensity, active maintenance is required (Cummings et al., 2006; Oswald & Clark, 2003). If kin relations are a distinct type of social relationship, then we would expect kin to require less maintenance than friends to remain at a particular level of emotional closeness, due to the fact that kin share genes through descent, whereas friends do not. From an evolutionary perspective, genetic relatedness may provide the underpinning which provides a stable, lasting basis for kin relations, and because this genetic underpinning is not there for friendships, they may be more prone to decay over time. In contrast, if kin are not a distinct type of social relationship, then the patterns of decay, and the relationship maintenance required, should be influenced by the characteristics of the relationship itself, rather than kinship. Thus, for example, if close friends can become like kin in important ways, as has been argued (Ackerman et al., 2007; Clark & Mills, 1993; Korchmaros & Kenny, 2006), then close friends and kin should require similar levels of maintenance and show similar patterns of decay over time. Furthermore, well-established friendships may be more resistant to decay than more recently established friendships.

The place of affinal kin (relatives acquired through marriage) in this picture is somewhat unclear. Whilst affinal kin do not share genes by common descent, they do have a shared genetic interest in the offspring produced by a marriage (Hughes, 1988). This common interest may lead affinal kin to be treated like genetic kin (Burton-Chellew, M. N. & Dunbar, R.I.M., unpublished data). In this study, therefore, we examined whether genetic and affinal kin have different patterns of relationship maintenance and decay.

Two important components of relationship maintenance are interaction (doing activities together) and supportiveness and self-disclosure (which at a minimum involves communication between relationship partners; Oswald & Clark, 2003). The number of different activities done together (the *multiplexity* of the relationship) is an indicator of relationship strength (Wellman & Wortley, 1990), and relationships with high multiplexity tend to be more resistant to decay over time (Degenne & Lebeaux, 2005). Communication frequency is strongly associated with the emotional intensity of the relationship (Hill & Dunbar, 2003; Mok, Wellman & Basu, 2007; Roberts & Dunbar, *in press*) and the probability of ego receiving support from an alter (Kana'iaupuni, Donato, Thompson-Colon & Stainback, 2005). Thus, multiplexity and communication frequency were used in this study as indicators of relationship maintenance behaviors. Both of these activities take time, and as time is limited, having to maintain social relationships in this way may act as a constraint on the number of relationships that can be maintained at a particular level of emotional intensity (Dunbar, 2008; Roberts, 2010; Roberts, Dunbar, Pollet & Kuppens, 2009).

This study extends previous work in this area in three main ways. First, much of the work examining the distinctiveness of friendship or kinship has been based on asking people how they would respond to hypothetical situations (e.g., Burnstein et al., 1994; Kruger, 2003) or based on cross-sectional, one-off measures of particular properties of relationships with kin or friends (e.g., Ackerman et al., 2007; Korchmaros & Kenny, 2006). Ours is a longitudinal study, with measures of the students' communication patterns and activities done with network members over a period of 18 months. Thus we are able to track how relationships change over time, rather than simply examining properties of the relationship at one point in time. Second, we tracked how the students' entire 'active' network changed with the transition from school to university — this includes all relatives and all friends with whom the participant feels that they have a genuine personal relationship with (Roberts et al., 2009). The majority of previous studies on relationship maintenance and decay have examined only a small number of emotionally close ties (e.g., Wellman, Wong, Tindall & Nazer, 1997) or focused on specific relationships such as close friendships or relationships with parents (Cummings et al., 2006; Oswald & Clark, 2003; Pipp et al., 1985). In contrast, we have measures of how relationships with close and distant kin, and close and distant friends, changed over the course of 18 months.

Finally, we focus on the emotional intensity of the tie, rather than simply whether or not the tie was present or absent at particular waves of the study (Burt, 2000). In reality, ties do not just appear and disappear, but gradually increase or decrease in closeness over time. Thus, we took emotional closeness, measured on a 1–10 scale, as an indication of the emotional intensity of the relationship. This measure is simple for the participants to answer for a large number of network members, and the measure (or a similar one) has been used in a number of previous studies (e.g., Cummings et al., 2006; Hill & Dunbar, 2003; Jeon & Buss, 2007; Korchmaros & Kenny, 2001, 2006; Roberts et al., 2009). Furthermore, emotional closeness has been shown to be the most reliable indicator of tie strength, as compared to other measures such as the duration of the relationship, frequency of contact or type of relationship (Marsden & Campbell, 1984).

In brief, we recruited 30 students in their last year of school and elicited their active personal network at the beginning of the study (t_1) and then at two further time points: 9 months (t_2) and 18 months (t_3). At 4 months into the study, the students finished school. We followed the same network members named at t_1 through the 18 months of the study and examined the impact of multiplexity and communication frequency on relationship decay over time. Specifically, we examined the role of kinship in affecting how much maintenance (i.e., cost in time and effort) is required to sustain a relationship at a particular level of emotional intensity. Our reasoning, based on evolutionary theory, is that kin relations and friendships are distinct

types of social relationships, and thus kin relations will require less maintenance than friendships. Specifically, we tested two hypotheses:

Hypothesis 1. The emotional closeness of friendships over time, as compared to that of kin relations, is more sensitive to changes in frequency of contact.

Hypothesis 2. The emotional closeness of friendships over time, as compared to that of kin relations, is more sensitive to changes in the number of different activities performed together.

2. Methods

2.1. Participants

Thirty students who were in the final year of secondary school were recruited for the study. The students were invited to a meeting where the details of the study were explained and volunteers to take part in the study sought. The first 30 students who confirmed they wished to take part in the study formed the participants. In compensation for participating in the study, students were given a mobile phone, with an 18-month contract from a major mobile operator in the UK. The line rental for the mobile phone was paid for, and this line rental included 500 free voice minutes per month and unlimited free text messages.

The sample included 15 males and 15 females, aged 17 to 19 years old. The mean \pm S.D. age was 18.1 ± 0.48 years old. All the participants lived in the same large city in the UK ('City A'). City A is an ethnically diverse city, and in keeping with this diversity, 17 of the participants were white, 11 were of Pakistani origin and two were of black African origin. Of the 30 participants who started the study at t_1 , 29 (96.7%) completed the questionnaire at t_2 and 25 (83.3%) did so at t_3 . All the analysis in this study was based on the 25 participants who completed the questionnaires at all three time points, as the analysis was based on the change in emotional closeness from t_1 to t_3 . These 25 participants consisted of 12 males and 13 females. In terms of ethnic group, 15 were white, seven were of Pakistani origin and two of black African origin. On average, the participants had lived in City A for 15.5 years at t_1 (mean \pm S.D. months in City A at t_1 : 186.83 ± 50.65).

At Month 4 of the study, participants took their final exams at school ('A levels') and left the school. Of the 25 participants included in this analysis, after finishing school, six of the participants stayed in City A and worked, not going to university. Eight of the participants went to university in City A, which has two large universities. The remaining 11 participants went to universities elsewhere in England.

2.2. Social network questionnaire

Participants first provided demographic information, including age, gender, ethnic origin and length of time living

in City A. They then listed all their known and living relatives. Participants listed the nature of their relationship for each relative: genetic, adoptive, step or by marriage (affinal). Unless explicitly stated, all these types of relations are referred to as *kin*. Participants listed all unrelated individuals ‘for whom you have contact details and with whom you consider that you have some kind of personal relationship (friend, acquaintance, someone you might interact with on a regular basis at school, work or university)’. They were specifically instructed *not* to list people they would not consider to be a member of their social network, such as work contacts, unless they felt that they have a genuine personal relationship with them. These unrelated individuals are termed *friends*. The use of this term is not meant to imply anything about the strength of the relationship between the participant and the network member.

To help prompt their memory, the participants were asked to look through any lists of addresses or phone numbers that they may have (e.g., address books, email address book, contacts list in mobile phone). Participants were asked how emotionally close they felt to each network member on a scale of 1–10, where 10 is someone ‘with whom you have a deeply emotional relationship’. Participants also listed how many days ago they made contact with each network member (*days to last contact*). Given that participants may have difficulty in providing an accurate estimate of their general frequency of communication with each network member, days to last contact was used to provide a convenient proxy for this frequency. This measure has been used successfully in previous studies (Hill & Dunbar, 2003; Pollet, Kuppens & Dunbar, 2006). Participants were then asked what activities they had done with the network member in the last 12 months at *t1* and in the last 6 months at *t2* and *t3*. The activities listed were sport or physical activity (e.g., football, keep fit, mountain biking), leisure activity (e.g., shopping, shopping, going to cinema, going to see a gig), social activity (e.g., going to the pub, going round to their flat/house, meeting at a social event), work activity (e.g., going to classes or lectures, studying together, working together) and going on holiday (going away for more than one night). Participants indicated with a simple ‘yes’ or ‘no’ whether or not they had participated in each of these activities. The answers were then summed to give an *activity score*, which ranged between 0 (no activities) and 5 (all activities). Participants were also asked to provide the gender of all network members. Finally, the participants were asked how long they had known the friend in months. This information was not collected for kin, as it was assumed that time known for kin was synonymous with the participant’s age.

After completing all the information about their network members, participants were asked two questions designed to distinguish those strong relationships in the inner core of the personal network, from the weaker relationships with family and friends. The participants were asked to list the initials of ‘all individuals from whom you would seek advice, support

or help from in times of severe emotional or financial distress’. Participants were also asked, *in addition* to the network members listed in response to the first question, to list individuals ‘whose death you would find personally devastating’. These two questions have previously been used to establish the ‘support group’ and ‘sympathy group’ layers, respectively (Buys & Larson, 1979; Dunbar & Spoor, 1995). In this study, these support group and sympathy group were combined and referred to as the *inner* network layer. The *outer* layer of the network encompasses all network members listed in the questionnaire, but not named in response to either the support group or sympathy group question. The complete questionnaire is available on request from the corresponding author. The questionnaire was completed by the participants at Month 1 (*t1*), Month 9 (*t2*) and Month 18 (*t3*). At *t2* and *t3*, the initials, gender and nature of the family relationship of all the network members listed at *t1* were provided, to aid recall and ensure that the participants provided updated information for all the network members listed at *t1*.

2.3. Statistical analysis

To examine how emotional closeness between the participants and network members changed over time, we used hierarchical linear modeling, also known as multilevel modeling. In this study, the 1217 network members were clustered within the 25 participants, and thus these network members cannot be treated as independent samples in an ordinary least squares regression analysis (Bryk & Raudenbush, 1992). Multilevel analysis is a modified form of multiple linear regression designed to deal with data with a hierarchical clustering structure and has been extensively used in analysis of personal network data (e.g., Gierveld & Perlman, 2006; Van Duijn, van Busschbach & Snijders, 1999; Wellman & Frank, 2001).

In this study, we followed the model selection and structure detailed by Van Duijn et al. (1999). The dependent variable in Models 1 to 5 was the change in emotional closeness between *t1* and *t3*, calculated as emotional closeness at *t3* minus emotional closeness at *t1*. Thus positive values indicate a closer relationship between two individuals at *t3* than at *t1*. The predictor variables included in the models were kinship, change in activity score between *t1* and *t3*, and change in days to last contact between *t1* and *t3*. Change in activity score and change in days to last contact were calculated as the value at *t3* minus the value at *t1*. Thus positive values for changes in activity score indicate the two individuals were doing more types of activities together at *t3* than at *t1*. Positive values for days to last contact indicate that the two individuals had a longer number of days to last contact at *t3* than at *t1* (i.e., that they are in less frequent contact at *t3*). Because we used the change in emotional closeness between *t3* and *t1* as the dependent variable in the main models, only network members for whom this information was provided were included in the analyses.

We also examined whether the following control variables made a significant contribution to the models: gender of participant (male; female), ethnic group of participant (white; Pakistani; or black African), participant location at t_2 (City A; not City A), destination after school (university; not university), how many months the participant had lived in City A at t_1 , the gender of the network member (male; female), type of kinship (genetic; step; or affinal), the number of months the participant had known the network member (friends only).

To build the models, we started with an empty model, including only the intercept and the error term for all levels. This gives an indication of the amount of variance present at the two levels. We then used a forward selection procedure (Bryk & Raudenbush, 1992) involving three steps: (i) adding fixed explanatory variables (including interaction terms between them); (ii) adding cross-level interaction terms; (iii) adding random slopes and covariance's between the random slopes. In all models, maximum likelihood estimation was used, rather than restricted maximum likelihood, as this allows comparison of the deviance of different models (Tabachnick & Fidell, 2007). We used Schwarz's Bayesian criterion (BIC) to compare the deviances of the different models. The BIC compares the goodness of fit of the models, whilst correcting for the number of parameters used (Kuha, 2004). The difference in deviance of two models can be used as a test statistic with a χ^2 distribution, with the number of different parameters as the degrees of freedom (Hayes, 2006). In order to create the most parsimonious models possible, variables were only included in the models if they significantly improved the goodness of fit of the models, as assessed by the BIC. An unstructured covariance structure was used, which makes no assumptions about the pattern of covariance between the slopes and the intercept.

Change in activity score and change in days to last contact were group mean centered — that is, a mean score was calculated for each participant, and the individual network members' scores centered around this participant mean. This corrects for individual differences in contact frequency and

activity score. The variables were then Z-transformed, to allow for comparability across variables. The participant means for change in activity score and change in days to last contact were also Z-transformed and included in the model, even if they did not significantly reduce the variance, in order not to discard the effects at the participant level (Tabachnick & Fidell, 2007). An alpha level of 0.05 was used for all statistical tests and all tests were two tailed.

3. Results

3.1. Network properties and emotional closeness change

The 25 participants who completed all three waves of data collection named 1288 network members at t_1 , of whom 499 were kin (431 genetic, 21 step, 47 affinal) and 789 were friends. Due to incomplete information provided on the questionnaires, data on emotional closeness change from t_1 to t_3 was available for 1217 (94.5%) network members of this initial sample. All the analysis, including calculation of the mean scores reported below, was carried out on these 1217 network members, which consisted of 479 kin (413 genetic, 20 step, 46 affinal) and 738 friends.

At t_1 , the mean \pm S.D. size of the inner layer of the network was 11.92 ± 6.06 , made up of 6.00 ± 3.41 kin and 5.92 ± 4.14 friends. The mean size of the outer layer was 36.00 ± 26.67 , made up of 12.79 ± 15.72 kin and 22.79 ± 16.60 friends. Thus, the total network size was 47.59 ± 29.92 , consisting of 18.79 ± 16.81 kin and 28.71 ± 18.54 friends. The mean scores for emotional closeness, days to last contact and activity score for each layer of the network and relationship type are presented in Table 1. There was an increase in days to last contact over the course of the study for kin and for friends at both the inner and outer layers of the network. However, there was a more pronounced decrease in closeness and activity for friends as compared to kin.

A simple multilevel model, including only kinship as a predictor variable, demonstrated a significant effect of kinship on emotional closeness change over time (Table 2, Model 1).

Table 1

Means (and standard deviations) for number of days to last contact, activity score (summed number of activities, out of five) and emotional closeness (1–10, where 10 is very close) for the three time points in the study

Layer and variable	Kin			Friends		
	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3
<i>Inner layer</i>						
Days to last contact	6.25 (9.12)	12.20 (19.04)	15.56 (25.92)	2.95 (4.65)	21.41 (24.42)	46.84 (36.89)
Activity score	2.45 (0.82)	2.12 (1.03)	1.99 (0.88)	2.94 (0.67)	2.04 (1.00)	1.65 (0.73)
Emotional closeness	8.23 (1.04)	8.26 (1.16)	8.16 (1.16)	7.90 (1.08)	7.08 (1.15)	6.58 (1.63)
<i>Outer layer</i>						
Days to last contact	177.41 (306.7)	136.10 (214.59)	206.92 (297.97)	25.18 (23.59)	77.74 (58.98)	158.62 (97.55)
Activity score	1.35 (1.13)	0.96 (0.93)	1.07 (1.06)	1.81 (0.61)	0.90 (0.58)	0.78 (0.57)
Emotional closeness	5.02 (2.23)	5.24 (2.04)	5.28 (2.11)	4.84 (1.22)	4.18 (1.11)	4.15 (1.37)

Means are given for layer and relationship type.

Values were calculated using the mean value for each participant for each cell, rather than a simple mean of all network members. This allows for the correct calculation of the standard deviation.

Table 2

Multilevel regression models predicting change in emotional closeness from relationship type, change in activity score and change in contact frequency

Model number and description	Model 1 (Kinship only)	Model 2 (Activity score and last contact)	Model 3 (Interactions with kinship and random slopes)	Model 4 (Inner layer at <i>t</i> 1)	Model 5 (Outer layer at <i>t</i> 1)
Intercept	0.56 (0.22)*	0.39 (0.21)	0.13 (0.58)	−0.15 (0.24)	0.28 (0.30)
Kinship (0=kin; 1=friend)	−1.34 (0.12)***	−1.05 (0.13) ***	−0.78 (0.33)*	−0.99 (0.39)*	−0.85 (0.04)*
Change in activity score ^a		0.43 (0.06)***	0.15 (0.10)	−0.04 (0.12)	0.26 (0.14)
Change in days to last contact ^a		−0.20 (0.05)***	−0.12 (0.06)*	−0.22 (0.51)	−0.12 (0.06)
Mean activity score (by ego)		0.23(0.19)	0.20(0.16)	0.22 (0.14)	0.20 (0.19)
Mean last contact (by ego)		−0.05 (0.21)	−0.08 (0.17)	−0.28 (0.26)	−0.12 (0.22)
<i>Kinship</i> × <i>Last contact</i> (H1)			−0.34 (0.12)**	−1.27 (0.51)**	−0.34 (0.13)*
<i>Kinship</i> × <i>Activity score</i> (H2)			0.41 (0.12)**	0.63 (0.17)***	0.23 (0.16)
Random slopes (kinship)					
Covariance between intercept and slopes			−0.97 (0.43)*	−0.50 (0.37)	−1.32 (0.63)*
Variance of slopes			2.12 (0.73)**	2.14 (0.94)*	2.52 (0.98)*
Deviance (BIC)	4059.92	4014.19	3897.63	1088.02	2850.27

t2.16 The table shows parameter estimates (and standard errors). Interactions in italics refer to hypotheses being tested.

t2.17 The following control variables did significantly improve the fit of Models 3, 4 and 5, as assessed by the BIC and were therefore not included in the final models: gender of participant, ethnic group of participant, participant location at *t*2, destination after school, how many months the participant had lived in City A at *t*1, the gender of the network member and type of kinship.t2.18 ^a Group mean centered.t2.19 * *p*<.05.t2.20 ** *p*<.01.t2.21 *** *p*<.001.

Over the 18 months of the study, there was an increase in emotional closeness to kin (mean±S.E.: 0.51±0.08) and a decrease in emotional closeness to friends (−1.17±0.08). Including a variable indicating whether the kin was genetic or other type (step or affinal) did not significantly improve the goodness of fit of the model, as assessed by the BIC, and did not affect any of the significance levels. Thus this variable was not included in Model 1.

3.2. Effects of change in activity score and days to last contact on change in emotional closeness

Model 2 demonstrates the effect of changes in activity score, and changes in days to last contact, on changes in emotional closeness. An increase in activity score was significantly associated with an increase in emotional closeness between *t*1 and *t*3. Furthermore, a decrease in days to last contact was significantly associated with an increase in emotional closeness. Thus participants who were in more frequent contact with network members at *t*3 than at *t*1 tended to feel emotionally closer to those network members.

To examine whether the length of the friendship influenced these patterns, Model 2 was repeated on friends only and the number of months the participant had known the friend included as a control variable. As with Model 2, changes in activity score [*b*=0.56, *t* (562.40)=7.69, *p*<.001] and changes in days to last contact [*b*=−0.47, *t* (568.76)=−3.85, *p*<.001] were significantly associated with changes in emotional closeness. However, months known was not significantly associated with changes in emotional closeness [*b*=0.05, *t* (558.63)=0.85, *p*=.40], did not influence the significance of the other variables and did not significantly improve the goodness of fit of the model. Thus the impact of

changes in activity score and contact frequency on changes in emotional closeness were not influenced by the number of months the participant had known the friend.

Model 3 directly examines the two hypotheses being tested, by including in the model the interactions between kinship and activity score, and kinship and days to last contact. Both interactions were significant, demonstrating that the kinship status of the relationship (kin or friend) significantly affected the impact of changes in activity score and days to last contact on change in emotional closeness. Thus both hypotheses are supported — the effect of changes in activity score and contact frequency on changes in emotional closeness was greater for friendships than for kin relations. With increased days to last contact between *t*1 and *t*3 (i.e., reduced frequency of contact), there was a decrease in emotional closeness to friends, but no decrease in emotional closeness to kin (Fig. 1A). Similarly, with a reduced number of activities being performed together between *t*1 and *t*3, there was a decrease in emotional closeness to friends, but not to kin (Fig. 1B). Model 3 also included the random slopes for kinship, which demonstrated that the effects of kinship on changes in emotional closeness over time varied significantly between participants in the study.

3.3. Effects of network layer

In Models 4 and 5, we repeated the analysis carried out in Model 3, but for the inner and outer layers of the network separately. For the inner layer, the two interactions between kinship and changes in activity score and kinship and days to last contact were both still significant. This reveals that even the very closest friends are not equivalent to kin, in that changes in contact frequency or number of activities

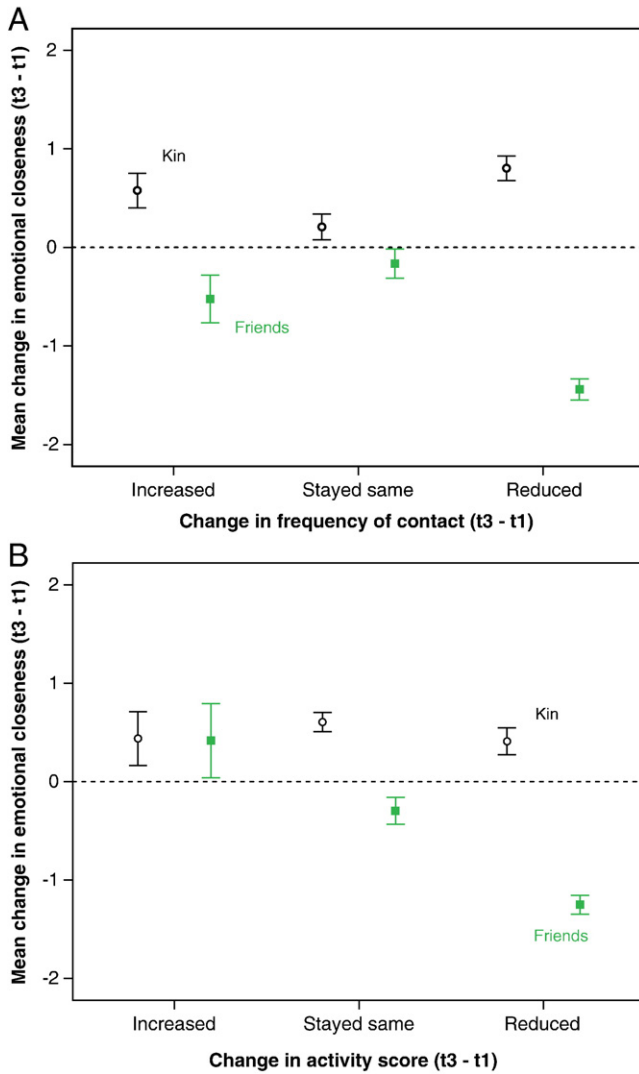


Fig. 1. Mean (and standard error) change in emotional closeness from Time 3 to Time 1 by (A) change in contact frequency and (B) change in activity score. Kin are shown with open circular markers and friends with filled square markers. Increased activity score reflects a greater number of different types of activities performed together over the last 6 months. The graphs plot change in contact frequency and activity score as a categorical variable for illustrative purposes; continuous variables were used for analysis in the models. Fig. 2(A) plots change in contact frequency rather than change in days to last contact (the variable used in the models) so as to allow consistency in the x-axis with (B).

ated with emotional closeness change over time and whether they affected the interactions between kinship and activity score and kinship and days to last contact. For Models 3, 4 and 5, gender of participant, ethnic group of participant, participant location at t_2 , participant destination after school, how long the participant had lived in City A, gender of network member and type of kinship did not significantly improve the fit of the models and did not affect any of the significance levels. All these control variables were therefore not included in the final models. Thus the results demonstrating the difference between kinship relations and friendships were robust to the effect of these potentially confounding control variables, both for the network as a whole and for the inner and outer layers separately.

3.5. Timing of changes

An important question that arises from these results is the causal relationship between changes in time to last contact or activity score and changes in emotional closeness. Broadly, there are three possibilities: (i) decreased emotional closeness from t_1 to t_2 may lead to decreased contact and activity in t_2 to t_3 ; (ii) decreased contact and activity from t_1 to t_2 may lead to decreased closeness in t_2 to t_3 ; (iii) the decrease in contact and activity may happen alongside the decrease in closeness, within the same time period.

To examine these possibilities, we ran a series of models and below we simply present the key interactions between kinship and last contact and between kinship and activity score (Table 3). Model 6 is identical to Model 3 and simply provides the reference point for the other four models. Changes in emotional closeness were significantly associated with an interaction between kinship and changes in last contact (Model 7) or changes in activity score (Model 8) within the same time period. There were no significant interactions in Models 9 and 10, which examined how changes in emotional closeness from t_1 to t_2 affect changes in activity and contact from t_2 to t_3 (and vice versa). This suggests that changes in last contact and activity score are temporally closely linked to changes in emotional closeness, at least at the scale of the 9-month intervals between waves of data collection. This might indicate that causality is bidirectional (changes in activity affect changes in closeness, and vice versa). However, it remains possible that there is a consistent causal direction, but that the time scale involved is much shorter than the 9-month interval available for analysis. Unfortunately, disentangling the direction of causality on such a fine scale would require much finer grained data than are available in the present study.

4. Discussion

This study examined the distinction between kin relations and friendships by looking at how these types of social relationships changed during the transition from school to university. The two hypotheses tested in this study were both

performed together affect the level of emotional closeness to these friends differentially to the effect they have on kin. In the outer layer of the network, the interaction between kinship and changes in days to last contact was still significant, but the interaction between kinship and changes in activity score was not significant.

3.4. Control variables

Several control variables were included in additional models, to examine whether they were significantly associ-

Table 3

Multilevel regression models predicting change in emotional closeness (EC) from relationship type, change in activity score (activity) and change in days to last contact (contact)

Interaction of variable with kinship (K)	Model 6 (EC change <i>t</i> 1 to <i>t</i> 3)	Model 7 (EC change <i>t</i> 1 to <i>t</i> 2)	Model 8 (EC change <i>t</i> 2 to <i>t</i> 3)	Model 9 (EC change <i>t</i> 1 to <i>t</i> 2)	Model 10 (EC change <i>t</i> 2 to <i>t</i> 3)
K×Changes in contact (<i>t</i> 1 to <i>t</i> 3)	<i>−0.34 (0.12)**</i>				
K×Changes in activity (<i>t</i> 1 to <i>t</i> 3)	<i>0.41 (0.12)**</i>				
K×Changes in contact (<i>t</i> 1 to <i>t</i> 2)		<i>−0.73 (0.16)***</i>			<i>−0.09 (0.11)</i>
K×Changes in activity (<i>t</i> 1 to <i>t</i> 2)		<i>0.04 (0.11)</i>			<i>0.05 (0.15)</i>
K×Changes in contact (<i>t</i> 2 to <i>t</i> 3)			<i>−0.15 (0.09)</i>	<i>0.05 (0.15)</i>	
K×Changes in activity (<i>t</i> 2 to <i>t</i> 3)			<i>0.34 (0.10)**</i>	<i>−0.10 (0.11)</i>	

t3.10 The table shows parameter estimates (and standard errors).

t3.11 Interactions highlighted in italics indicate models predicting change in emotional closeness from change in activity and contact variables during the same time period. Only the interactions, rather than the full models, are presented in the table.

t3.12 **p*<.05.

t3.13 ** *p*<.01.

t3.14 *** *p*<.001.

supported. First, the emotional intensity of friendships, as compared to kin relations, was more sensitive to decreases in contact frequency between the participant and the friend. Second, the emotional intensity of friendships, as compared to kin relations, was more sensitive to decreases in the number of activities performed together in the preceding time period. These results were not affected by including control variables such as gender of participant or network member, ethnic group or destination of participant after school in the models. Thus, when followed over the course of 18 months, kin relations and friendship showed important differences. Friendships required more maintenance — in terms of communication and performing activities together — than kin relations to sustain at particular levels of emotional intensity.

Importantly, these findings applied to the very closest friends named by the participants, as well as to more distant friends. Thus there were significant interactions between kinship and days to last contact, and kinship and activity score in the model irrespective of whether we considered only the inner layer of the network (Model 4) or the entire network (Model 3). If, as has been argued (Ackerman et al., 2007; Clark & Mills, 1993; Korchmaros & Kenny, 2001, 2006), close friends with high levels of emotional intensity and frequent interaction can come to resemble close kin in important ways, we may expect the close friends in the inner layer of the network to show similar patterns of relationship decay as kin and be somewhat resistant to declines in contact frequency and activities performed together. This is in line with early theorizing that best friendships are somehow self-sustaining and do not need active maintenance to survive (Wright, 1984). Instead, this study reveals that even these very closest friends require active maintenance (contact and performing activities together) to maintain a high level of emotional closeness, and without this maintenance these relationships are prone to decay. In contrast, kin in the inner layer of the network require much less maintenance to keep them at relatively high levels of emotional closeness.

These results provide an important contribution to the current debate on how distinct kin relations are to friendships. The use of longitudinal data in this study may help resolve some ambiguities in current findings, where some researchers find that kin relations do appear to be a distinct type of social relationship (Kruger, 2003; Stewart-Williams, 2007), whereas others argue that the distinction between kin and friendships is less clear cut (Ackerman et al., 2007; Korchmaros & Kenny, 2001). When examined at a single point in time, and depending on what is being measured, kin relations and friendship may appear to be similar. As Korchmaros and Kenny (2006, p. 37) note, ‘people can be just as, and even more, close emotionally to non-kin than kin’. At the beginning of this study, in line with previous results (Dunbar & Spoors, 1995; Plickert, Cote & Wellman, 2007; Roberts, Wilson, Fedurek & Dunbar, 2008), the participants named both kin and friends in the inner layer of the social network and rated them highly in terms of emotional closeness (Table 1). Similarly, people do receive a substantial amount of emotional and material support from close friends (Fischer, 1982; Plickert et al., 2007). However, this study showed that when followed over time, these friendships tend to be less stable and have higher maintenance costs than kin relations.

Communicating with others, and doing activities together, takes time and the amount of time an individual will be able to devote to these activities will inevitably be limited, as time is an inelastic resource (Nie, 2001). Thus, these maintenance costs may act as an important constraint on the number of relationships an individual can maintain at a particular level of emotional intensity at any one time. Previous research has shown that there are both time and cognitive constraints on social network size (Dunbar, 2008; Milardo, Johnson & Huston, 1983; Roberts, 2010; Stiller & Dunbar, 2007). These constraints appear to produce an upper bound to active network size of around 150, with the size of the kin network constraining the size of the friendship network (Roberts et al., 2009). The results of this study suggest that these constraints may act more strongly on

friendships, as compared to kin relations. Despite modern forms of communication technology such as email, social network sites and mobile phones, the majority of an individual's communication still tends to be limited to a relatively small number of others, rather than being spread more evenly across the social network as a whole (Marlow, 2009; Reid & Reid, 2006). How people allocate their time and effort across their social network is likely to be a critical factor in terms of the size and type of the network they can maintain and how individual relationships within the network strengthen or decrease in closeness over time.

These results also have important implications for the current debate about the extent to which in modern society, with the decline of the traditional nuclear family (Popenoe, 1993), friendships can, to some extent, replace kin relations (Fehr, 1996). Whilst some researchers have argued that the decline of the nuclear family is a cause for alarm (Davies, 1993; Popenoe, 1993), others have argued that individuals are creating 'families of choice' — a supportive network of friends, lovers and chosen kin, underpinned by a friendship ethic (Stacey, 1996; Weeks, Donovan & Heaphy, 2001). Whilst Weeks et al. primarily focus on non-heterosexual relationships, they argue that the development of families of choice is part of a wider reshaping of both heterosexual and non-heterosexual relationships. The results of this study suggest that, whilst at any given point in time friends may be an adequate replacement for kin, over time friendships are much more prone to decay than kin. Thus friendships may not in all cases be an adequate substitute for the long-term relationships, support and non-reciprocal, high-cost, help provided by kin.

There were a number of limitations of the current study which may be addressed in future research. First, the sample size was relatively limited. However, the attrition rate was exceptionally low for a study of this nature, with 25 of the 30 students initially recruited completing all three waves of data collection. High attrition rates in longitudinal studies can lead to serious consequences in terms of drawing valid conclusions from the data (Jeličić, Phelps & Lerner, 2009). Furthermore, use of multilevel modeling allowed full use to be made of the data, with the analysis being carried out at the level of the 1217 network members rather than aggregating data to the level of the 25 participants.

Second, the participants were also all of a similar age, and going through a particular type of transition — moving from school to university. However, the results are broadly in line with other studies which have examined different types of transitions such as moving house, retirement or having a baby (Van Duijn et al., 1999). Even amongst individuals not undergoing these transitions, there is considerable turnover in social networks (Van Duijn et al., 1999; Wellman et al., 1997). Overall, both for those undergoing transitions and those in more stable life stages, kin relations tend to be more stable than friendships (for a review of these studies, see Burt, 2000). Thus, we expect the finding that friendships are more costly to maintain over time than kin relations, and

more likely to decay than kin relations, would hold for different age groups and amongst groups of people undergoing different types of transitions as well as amongst those in more stable circumstances.

Finally, in the social network questionnaire we did not collect information on whether the unrelated network members were friends or romantic partners. These two categories of network members may have quite different patterns of decay, with friends showing a more steady decay over time (Cummings et al., 2006; Oswald & Clark, 2003) and romantic partners a much steeper decline in emotional closeness if the relationship breaks down (Field, Diego, Pelaez, Deeds & Delgado, 2009; Moller, Fouladi, McCarthy & Hatch, 2003). Furthermore, going away to university may place existing relationships under particular strain, due to an increase in the costs of maintaining the relationship and increased exposure to possible alternative partners (Rusbult, 1983). Whilst this is an interesting area to explore in future studies, the results of this study cannot solely be explained by the influence of romantic relationships, as opposed to friends, for two reasons. First, participants named on average 29 friends at *t*1, and thus the influence of one romantic partner on the overall results is likely to be minimal. Second, when the gender of the network member was included as a control variable it did not significantly improve the goodness of fit of the models (Table 2). Thus the results were not influenced by whether the unrelated network member was the same sex as the participant, or the opposite sex.

There are at least three possible reasons why kin relations may be more stable than friendships. In this study, we have assumed that due to genetic relatedness, and norms governing kinship which arise from this relatedness, kin relations are treated differently to friendships and that feeling close to kin is thus less contingent on personal interactions than friendships. There is considerable support for this position: for example, support to kin is less contingent on the personal relationship than support for friends (Espinoza, 1999; Kruger, 2003; Salaff, Fong & Wong, 1999; Wellman & Wortley, 1990) and people are willing to pay a higher physical cost to assist more closely related kin (Madsen et al., 2007).

A second possibility, however, is that kin are less costly to maintain and more stable than friends due to the network structure in which they are embedded. Kin tend to have ties with each other, simply through the fact that they are part of the same family, and thus the overall social network is dense, in that many of the possible ties in the network are present. In contrast, participants' friends tend to have fewer ties between themselves, and thus the network tends to be less dense (Mok et al., 2007; Roberts, 2010). This difference in density may in itself lead to higher maintenance costs, as the indirect links that can help support kin relations (particularly through 'kin-keepers'; Leach & Braithwaite, 1996) are less likely to be present in friendships. This study did not collect data on links between network members and thus could not assess the role of network density in maintenance costs directly.

Close friends tend to have more links with each other than more distant friends (Fischer & Shavit, 1995; Granovetter, 1983) and if decay is due to density effects, we may expect to see less decay in these close friends. However, in this study, there was still a distinction between kin and friends in the inner layer of the network (that containing the close friends), suggesting that the effects of density may be less important than kinship itself. The empirical literature is ambivalent on this issue, with Feld (1997) finding that high density leads to less relationship decay, Wellman et al. (1997) finding no effect of density and Lubbers et al. (2010) finding high density actually leads to more relationship decay. However, none of these studies explicitly examined the relationship between type of relationship (kinship vs. friendship), density, relationship maintenance and decay. Further research would benefit from examining density measures of the network explicitly alongside kinship as possible factors in relationship decay.

One final issue to consider is the fact that participants are likely to have known their family for longer than their friends and that this difference in relationship history may cause friends to be more costly to maintain. Thus, a long relationship history may provide a kind of buffer against the relationship declining in emotional closeness. Our results show that, at least in the case of friends, the length of time known did not affect patterns of relationship decay; friends who had known each other for a long time showed the same patterns of decay as more recent friendships. Although this does not rule out differences between family and friends being at least partly due to differences in relationship history, including co-residence, it does suggest that relationship duration is unlikely to be the sole factor influencing relationship strength. This issue could usefully be explored further in future studies.

In terms of the distinction between different types of kin, Hamilton's rule is typically defined in terms of shared genes through common descent. In this study, genetic kin and non-genetic kin (affinal and step) had statistically indistinguishable patterns of relationship maintenance and decay. This supports the argument of Hughes (1988) that the proper focus for inclusive fitness is actually shared genetic interest in the cohort that is about to reproduce, rather than shared genetic interest in a past ancestor. This may result in people behaving in a similar way towards genetic and affinal kin. Given the limited focus on affinal kin in previous research, this is a topic that would merit further attention.

If the difference between kin relations and friendship is underpinned by differences in genetic relatedness, rather than network effects, cross-culturally we may expect to see similar patterns of relationship decay and high maintenance costs of friends, as compared to kin. Kinship has long been a topic of interest to anthropologists (see review by Peletz, 1995) and there have been many detailed studies of social networks in non-Western cultures (e.g., Adams, Madhavan & Simon, 2002; Kana'laupuni et al., 2005; Schweizer, 1997;

Wellman, 1999). However, as far as we are aware, there have been few — if any — systematic, detailed studies comparing relationship maintenance and decay between friends and kin in non-Western cultures. Thus whether the findings of this study apply cross-culturally must be a matter for future empirical work. Our prediction, given the fundamental importance of inclusive fitness in evolutionary theory, is that they would.

In conclusion, this study demonstrated important differences between kin relations and friendships. The emotional intensity of friendships is more sensitive to decreases in the frequency of communication and to decreases in the number of activities done together, as compared to kin relations. Thus friendships are more costly to maintain than kin relations, and more prone to decay over time. These maintenance costs may act as a constraint on the number of relationships — and in particular on the number of friendships — that can be maintained at any given level of emotional intensity. Therefore, although friendships and kin relations can appear similar when measured cross-sectionally, they in fact tend to have very different trajectories of change over time.


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