

Early social exposure and later affiliation processes within an evolving social network

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ABSTRACT

Keywords:

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Background: While short-term experiments have found that exposure to social contacts affects likeability, this study investigates its long-term effects on friendships in an emerging network.

Methods: One hundred psychology freshmen indicated whether they attended an introductory event before the start of the academic year to assess early exposure and reported on the friendships they formed with their peers at the beginning, middle, and end of their first semester.

Results: RSiena network models revealed that students taking part in the introductory event were more likely to form friendships throughout the first semester, but less likely to keep them.

Discussion: While early exposure to people in an emerging network might provide a head start for forming friendships for at least a semester, these friendships appear less stable than those of students who did not have that exposure.

Introduction

While similarities in people's personality characteristics are often seen as facilitating the development of friendships (e.g., Selfhout et al., 2010), other findings indicate that friendships can also be based on the familiarity induced by repeated exposure: Continued spatial propinquity (e.g., Festinger et al., 1950), or merely the presence of college peers (Moreland and Beach, 1992) facilitated liking and the formation of friendships within groups of students across timeframes such as a semester. Although the frequency and intensity of exposure might play a role, some laboratory studies have also shown that even single interactions make us like people more (Reis et al., 2011; Collins and Miller, 1994). But do these short-term interactions impact the development of long-term friendships?

This notion is supported by Back, Schmukle, and Egloff (2008), who found that randomly-assigned spatial closeness in only one early introductory university session was enough to increase liking ratings a year later. However, while short interactions might increase liking and thereby facilitate friendship formation, the timing of such interactions might also be vital: They might foster friendships particularly in the early stages of group formation, but might soon grow irrelevant as a group becomes more established (Finkel et al., 2015). It also remains unclear how the effects of short interactions on friendship selection might evolve in time: Are friendships established at that early moment

and are they then simply maintained across time? Are people who have early exposure more socially active, and therefore the people who are more likely to make new friends?

The present study explores the effects of observed early exposure on the creation and maintenance of friendships within a newly-evolving social network. This was done in a set-up, in which psychology freshmen, who are a de facto emerging network, were all invited by a student organisation to a two-day event before the start of the semester. Participants attending the event therefore had early exposure to each other, which is used in a model to predict changes in friendships early and late in the semester, while controlling for exposure during the semester, demographics, and personality traits.

Method

Participants and procedure

Before starting their university career, all 117 psychology freshmen at the University of Konstanz were invited to take part in an introductory event, which took place in the middle of October 2014. During this event, the students were introduced to each other and the university system. Six days later, at an introductory psychology lecture, all psychology freshmen were invited to participate in a social network study with biweekly questionnaires over the course of their first

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semester on social effects and risk behaviour (part of the SOZNET program; see Giese et al. (2019) for a detailed data description of the same dataset concerning peer perception and their actual alcohol consumption across the semester, while older cohorts of psychology freshmen networks are described in Hartung and Renner (2013) and Giese et al. (2017)). The University of Konstanz ethical review board approved the study. Given several problems in defining effect sizes and power for social network analyses (Stadtfeld et al., 2018), both the comparably large sample size by addressing all psychology freshmen and the repeated measurement design indicate sufficient power to detect typical friendship effects (Stadtfeld et al., 2018).

One-hundred students agreed to take part in this study. Questionnaires were delivered biweekly online via e-mail. The current research question focuses on three time points at the beginning, middle, and end of the semester to determine how friendship nominations evolved. The three points were selected based on timing and low attrition rates (0%, 1%, 4%, respectively). The baseline questionnaire at the beginning of the semester (distributed in the last week of October) assessed event attendance (82 % attended the event, 18 % did not), participants' age ($M = 21.06$; $SD = 5.42$), gender (21 % male, 79 % female), and traits such as personality. Friendship nominations and relative time spent with students from the same semester were assessed at all other time points, including the ones selected for this study in the middle (first week of December) and the end (first week of February) of the semester (see Table 1). Additional trait and health behaviour items were also assessed at each time point, but that data is irrelevant to this study.

Measures

Early exposure. In the baseline, the participants were asked whether they took part in the event before the semester ("Did you take part in the freshmen event?"; response options "yes" / "no").

Demographics. The participants were also asked to indicate their gender ("You are ... male/female") and age ("How old are you? I am ... years old."). Since the students' age distribution was skewed, for modelling purposes the participants were categorised as either regular freshmen (people younger than 21; 74 %) or older individuals. The different age groups present are due to the local student selection process, that considers both grade point averages and time passed since high school graduation.

Big 5 personality traits. To control for personality trait effects, the Big 5 were assessed via a validated German short form consisting of 2 items per trait (Rammstedt and John, 2007) on a 5-point scale from "disagree strongly" (1) to "agree strongly" (5). The mean score for each trait was

Table 1
Descriptive Statistics.

Characteristics	Beginning	Mid	End	Total
Average number of nominations	3.78	4.43	5.17	4.46
Average time spent with fellow students (SD)	3.98 (1.27)	3.75 (1.27)	3.57 (1.35)	3.77 (1.30)
Change: Number created friendships		156	165	
Change: Number lost friendships		88	74	
Change: Number maintained friendships		274	319	
Jaccard index		0.53	0.57	
% missing nomination changes		3.34	6.23	

Notes. Time spent with college peers has a possible range of 1 (not true) to 5 (exactly true) considering the statement "In the past two weeks, I spent most of my time with students from my semester". Standard deviations are written in brackets. Network changes are changes compared to the previous time point. The Jaccard index is an index of tie stability between two time points and is calculated by dividing the number of maintained nominations by the sum of all created, lost and maintained friendships. The indices presented show that the network is relatively stable.

established (neuroticism: $M = 3.02$, $SD = 0.96$; extraversion: $M = 3.57$, $SD = 0.83$; openness: $M = 3.81$, $SD = 1.05$; conscientiousness: $M = 3.60$, $SD = 0.79$; agreeableness: $M = 3.24$, $SD = 0.83$) and z-standardised for modelling purposes.

Relative time spent with college peers. At each time point, the participants were asked to report the relative amount of time they had spent with other psychology freshmen. This was assessed through their level of agreement to the statement: "In the past two weeks, I spent most of my time with students from my semester.", from "not true" (1) to "completely true" (5).

Friendship nominations. Likewise, at all three measurement points the participants were given a list with the names and photos of all the other participants who had agreed to take part in the study. Among other questions on relationships, they were asked to indicate all the people they were friends with ("Please select 'friend', if you are emotionally close to that person, could talk about personal issues, and ask for help."). Inconsistent answers on the relationship questions (e.g., a participant nominating a person as both a friend and someone they did not like) were coded as missing (a total of 49 nominations across all 3 time points).

Statistical analysis

In order to characterise the friendship network in the beginning of the semester—shortly after the event, a cross-sectional ERGM-model was established in the R-package *ergm* (Handcock et al., 2019; Hunter et al., 2008) comparing likelihoods of friendship nominations given both an individual's (ego) and a friendship candidate's (alter) event attendance status (via "nodemix"). In addition, it also contained converging structural network controls effects ("edges", "mutual", "two-path", and geometrically weighted out-degree distribution "gwodegree 1.75"). Likewise, differences in the control variables by event attendance at baseline were evaluated.

More importantly, this study scrutinised the effects of exposure by estimating how early exposure to people affects the creation and maintenance of friendships in a longitudinal stochastic actor-oriented model in RSiena (Version 1.2–3) (Ripley et al., 2018). This model evaluated whether early exposure in the pre-semester event is predictive for friendship changes between any two people in the network. To this end, the estimated effects of giving (activity) and receiving (popularity) friendship nominations, and the interaction of the two (homophily) were combined in a selection table to evaluate the total effect of friendship changes given an individual's (ego) and a friendship candidate's (alter) event attendance (Ripley et al., 2018). Relative time spent with peers, age, gender, and personality were controlled with popularity, activity, homophily, and where possible with squared popularity effects. To further tease apart the dynamics of friendship nominations, we then separated the effects of event attendance into the creation of new friendships and maintenance of old ones in a subsequent model. Finally, we tested the similarity of effects between the first and the second half of the semester to scrutinise the stability of our results (Lospinoso et al., 2011). Significant time differences were included in the model via dummy coded time variables. The final RSiena model converged both without ($Max_{convergence\ ratio} = 0.1383$, all $|t_{convergence}| \leq 0.0385$) and with differentiation of the creation and maintenance of friendships effects by exposure status ($Max_{convergence\ ratio} = 0.1536$, all $|t_{convergence}| \leq 0.0542$).

Results

Effects of early exposure

Friendships shortly after the event. As illustrated in Fig. 1, participants that attended the event (early exposure), were more central at the beginning of the semester. ERGM results supported this notion by showing that friendship nominations were altered by the event attendance

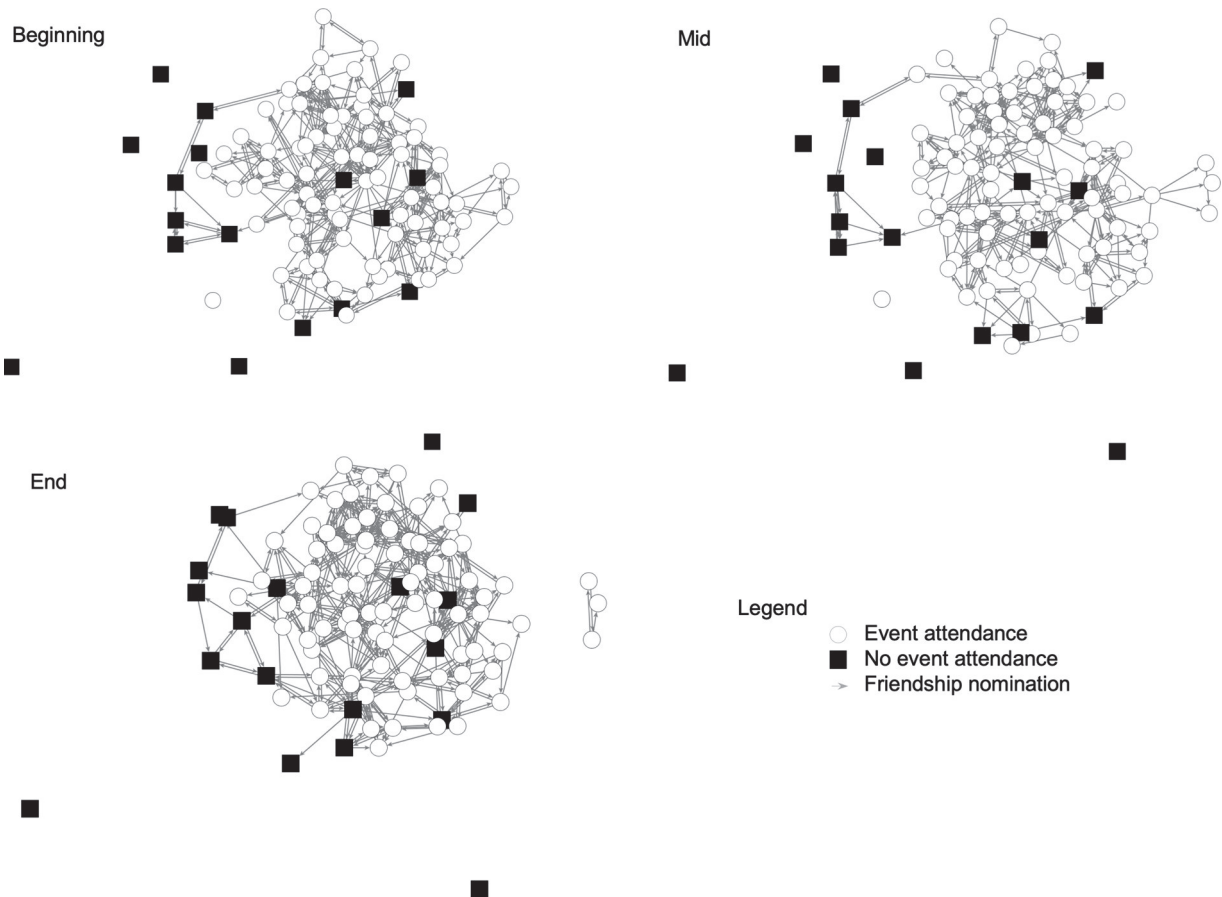


Fig. 1. Changes of the network composition and relationship to event attendance.

Notes. Individuals more central to the network are depicted more centrally in the figure. The distance between two peers uses a stress minimisation approach anchored by 80 % on the mean network across all time points and 20 % left for minimisation at a single time point (Brandes et al., 2012). Two outliers with no ties at all time points were moved closer to the network centre to ensure legibility of the figure.

($\chi^2(3) = 79.5, p < 0.001$): Students attending the event were about 6 times as likely to nominate another attending fellow student compared to ones who did not attend the event ($b = 1.78, OR = 5.93, p < 0.001$). Similarly, non-attending students were more likely to nominate an attending student than the reverse being true ($b = 1.37, OR = 3.94, p < 0.001$). Moreover, nominations amongst non-attending students were more likely than a nomination of a non-attender by an attender ($b = 1.70, OR = 5.50, p < 0.001$). While the personality traits and demographical characteristics were not systematically different between attenders and non-attenders (all $p > 0.114$, Table S1) at the beginning of the semester, different exposure is also reflected by the fact that the attenders indicated to have spent more time with other fellow students in the beginning of the semester ($t(20.08) = -4.88, p < 0.001, d = -1.43$, Table S1).

Overall-changes in friendships. Table 1 shows descriptive statistics of the main study variables and changes in the friendship network (details by event group are presented in Supplement S2). The evolution of the network is also portrayed in Fig. 1. As shown, the number of nominations increased across the semester and those students who attended the event were more central in the network at all time points. Controlling for other dynamics, selecting non-attenders of the event as friend compared to attenders was overall less likely ($b = -0.68, OR = 0.51, p < 0.001$, obtained from Supplement S3), while there was a general homophily effect based on event attendance ($b = 1.08, OR = 2.94, p < 0.001$, obtained from Supplement S3). Combining these effects to describe ego-alter selection (Table 2), the selection of a non-attender as a friend of an attender was particularly unlikely compared to non-selection ($b = -0.77, OR = 0.46, p < 0.001$) and compared to selection amongst attenders ($b = 0.87, OR = 2.39, p < 0.001$).

Creating new friendships. Differentiating newly created and maintained friendships (Table 2), students attending the event were more active than non-attenders in creating friendships to both peers who did ($b = 3.41, OR = 30.15, p < 0.001$) as well as peers who did not attend the event ($b = 1.70, OR = 5.45, p = 0.011$). However, individuals attending the event were more likely to create friendships with students who also attended the event: Given the choice between an individual attending vs. not attending the event, attenders were estimated to be about 5 times more likely to create a friendship with a fellow attender ($b = 1.63, OR = 5.11, p < 0.001$). There were no clear preferences found between attenders and non-attenders as friendship candidates for people who did not attend the event.

Maintaining old friendships. In general, students who did not attend the event were more likely to maintain the friendship nominations they gave to others from the network than students who did attend the event ($b = 4.36, OR = 78.05, p < 0.001$; obtained from Supplement S4), regardless of the peers' event status (see also Table 2, bottom row). The friendships of students not attending the event were therefore shown to be more stable than the attenders' friendships.

Effects of control variables

The effects of all variable parameters on the selection of friendships are shown in Supplement S4. No significant temporal differences emerged in the event effects for the first and the second half of the semester (overall $\chi^2(df = 37, N = 100) = 46.48, p = 0.137$), while the effects of some control variables diverged and were accounted for in the final model. None of the controls changed the effects of the event status

Table 2

Selection table for the overall selection, creation, and maintenance of friendships given an individual's (ego) and a potential other's (alter) attendance at the event.

		Overall								
		alter								
		event			no event			difference		
		Est	95% CI	Exp()	Est	95% CI	Exp()	Est	95% CI	Exp()
ego	event	0.10	[0.01; 0.19]	1.11	-0.77	[-1.14; -0.39]	0.46	0.87	[0.43; 1.31]	2.39
	no event	0.21	[-0.10; 0.52]	1.23	0.42	[-0.06; 0.89]	1.52	-0.21	[-0.76; 0.34]	0.81
	difference	-0.11	[-0.47; 0.26]	0.90	-1.19	[-1.79; -0.58]	0.31			
		Creation								
		alter								
		event			no event			difference		
		Est	95% CI	Exp()	Est	95% CI	Exp()	Est	95% CI	Exp()
ego	event	0.85	[0.61; 1.09]	2.34	-0.78	[-1.36; -0.20]	0.46	1.63	[0.97; 2.30]	5.11
	no event	-2.55	[-3.56; -1.55]	0.08	-2.48	[-3.54; -1.41]	0.08	-0.08	[-1.02; 0.86]	0.93
	difference	3.41	[2.91; 4.63]	30.2	1.70	[0.39; 3.00]	5.45			
		Maintenance								
		alter								
		event			no event			difference		
		Est	95% CI	Exp()	Est	95% CI	Exp()	Est	95% CI	Exp()
ego	event	-0.89	[-1.26; -0.52]	0.41	-0.32	[-1.24; 0.60]	0.73	-0.57	[-1.64; 0.50]	0.57
	no event	3.62	[1.99; 5.25]	37.2	3.37	[1.96; 4.79]	29.2	0.24	[-1.69; 2.18]	1.27
	difference	-4.50	[-6.45; -2.55]	0.01	-3.69	[-5.45; -1.93]	0.02			

Notes. The table resembles the log odds for the probabilities of creating/maintaining a friendship vs. status quo given the event attendance of both the decision maker (ego) and any potential friendship candidate (alter), all else being constant. The differences test the log odds ratio preference for students attending the event vs. students not attending, given the event attendance of either ego (rows) or alter (columns). Estimates are a combination of popularity, activity, and homophily effects (Supplement S3/S4) weighted by the group indicator variable following the procedure suggested by Ripley and colleagues (2018) to form selection tables and estimate standard errors.

in either significance or substantial size, irrespective of significant temporal differences in the control variables (see Supplement S4). In addition to the effects of the network structure and some personality traits, similarity in age ($b = 0.62$, $OR = 1.87$, $p = 0.006$) particularly increased the likelihood of friendship selection across time points. The effects of relative time spent with peers remained inconclusive.

Discussion

In replication of Back and colleagues (2008), the exploration of a social network showed that early exposure (e.g., Reis et al., 2011) predicts modelled friendship changes in everyday settings across the timespan of a semester. Early exposure increased the likelihood of creating new friendships for at least a few months, even if exposure during the semester and pre-existing friendships in the network are controlled for. While overall this gave rise to an advantage for having friends when being early exposed, the relative instability of these early-exposed friendships can be rationalised with the investment model of relationships (Rusbult and Buunk, 1993): Since students attending the event had plenty of opportunities to form alternative friendships in the future, they might be less inclined to maintain specific friendships.

All these findings indicate that early exposure may facilitate friendship formation by structuring with whom students will interact during the course of the semester (see Feld, 1981). By focusing on those who are already familiar, a set of peers might be formed from which future friends could be recruited. This preference could be explained for instance by a reluctance to have uncertain interactions with unknown interaction partners (Bornstein, 1989; Campbell and McKeen, 2011), or by a limit to the number of relationships one is willing to entertain (see Roberts et al., 2009).

This interpretation implies that future studies should scrutinise the impact that the size of the group having early exposure has on the effects. In this study, a large number of people went to the event. However, if only a few are exposed to each other early, the set of known individuals may not be sufficiently large and alternative friends might be explored more readily. Furthermore, it remains unclear how intense the early exposure needs to be to have a lasting effect. Moreover, such effects seem rather unlikely in a well-established friendship network (Bornstein, 1989; Finkel et al., 2015). Finally, this current study is not experimental. Even though the results resemble the findings of random assignment (Back et al., 2008) and some possible confounds were controlled for also by using a model of temporal change, we cannot infer causality. However, due to the effects of exposure on inclusion in a network, random assignment to a non-exposed control does not seem ethically acceptable, so that effects of non-exposure are hard to experimentally evaluate.

In conclusion, early exposure in newly-created groups may preselect who people will befriend for longer periods of time, but may render these friendships less stable. Opportunities for getting to know each other should therefore be evenly distributed when new groups are established to minimise isolation.

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References

- Back, M.D., Schmukle, S.C., Egloff, B., 2008. Becoming friends by chance. *Psychol. Sci.* 19, 439–440. <https://doi.org/10.1111/j.1467-9280.2008.02106.x>.
- Bornstein, R.F., 1989. Exposure and affect: overview and meta-analysis of research, 1968–1987. *Psychol. Bull.* 106, 265–289. <https://doi.org/10.1037/0033-2909.106.2.265>.
- Brandes, U., Indlekofer, N., Mader, M., 2012. Visualization methods for longitudinal social networks and stochastic actor-oriented modeling. *Soc. Networks* 34, 291–308. <https://doi.org/10.1016/j.socnet.2011.06.002>.
- Campbell, D.W., McKeen, N.A., 2011. Alexithymia tendencies and mere exposure alter social approachability judgments. *J. Pers.* 79, 335–358. <https://doi.org/10.1111/j.1467-6494.2010.00687.x>.
- Collins, N.L., Miller, L.C., 1994. Self-disclosure and liking: a meta-analytic review. *Psychol. Bull.* 116, 457–475. <https://doi.org/10.1037/0033-2909.116.3.457>.
- Feld, S.L., 1981. The focused organization of social ties. *Am. J. Sociol.* 86, 1015–1035.
- Festinger, L., Schachter, S., Back, K., 1950. *Social Pressures in Informal Groups: a Study of Human Factors in Housing*. Stanford Univ.Pr, Stanford, CA.
- Finkel, E.J., Norton, M.I., Reis, H.T., Ariely, D., Caprariello, P.A., Eastwick, P.W., Frost, J.H., Maniaci, M.R., 2015. When does familiarity promote versus undermine interpersonal attraction? A proposed integrative model from erstwhile adversaries. *Perspect. Psychol. Sci.* 10, 3–19. <https://doi.org/10.1177/1745691614561682>.
- Giese, H., Stok, F.M., Renner, B., 2017. The role of friendship reciprocity in university freshmen's alcohol consumption. *Appl. Psychol. Heal. Well-Being* 9, 228–241. <https://doi.org/10.1111/aphw.12088>.
- Giese, H., Stok, F.M., Renner, B., 2019. Perceiving college peers' alcohol consumption: temporal patterns and individual differences in overestimation. *Psychol. Health* 34, 147–161. <https://doi.org/10.1080/08870446.2018.1514118>.
- Handcock, M.S., Hunter, D.R., Butts, C.T., Goodreau, S.M., Krivitsky, P.N., Morris, M., 2019. *ergm: Fit, Simulate and Diagnose Exponential-Family Models for Networks*.
- Hartung, F.-M., Renner, B., 2013. Perceived and actual social discrimination: the case of overweight and social inclusion. *Front. Psychol.* 4. <https://doi.org/10.3389/fpsyg.2013.00147>.
- Hunter, D.R., Handcock, M.S., Butts, C.T., Goodreau, S.M., Morris, M., 2008. *ergm: A Package to Fit, Simulate and Diagnose Exponential-Family Models for Networks*. *J. Stat. Softw.* 24 nihpa54860.
- Lospinoso, J.A., Schweinberger, M., Snijders, T.A.B., Ripley, R.M., 2011. Assessing and accounting for time heterogeneity in stochastic actor oriented models. *Adv. Data Anal. Classif.* 5, 147–176. <https://doi.org/10.1007/s11634-010-0076-1>.
- Moreland, R.L., Beach, S.R., 1992. Exposure effects in the classroom: the development of affinity among students. *J. Exp. Soc. Psychol.* 28, 255–276. [https://doi.org/10.1016/0022-1031\(92\)90055-O](https://doi.org/10.1016/0022-1031(92)90055-O).
- Rammstedt, B., John, O.P., 2007. Measuring personality in one minute or less: a 10-item short version of the Big five Inventory in English and German. *J. Res. Pers.* 41, 203–212. <https://doi.org/10.1016/j.jrp.2006.02.001>.
- Reis, H.T., Maniaci, M.R., Caprariello, Pa, Eastwick, P.W., Finkel, E.J., 2011. Familiarity does indeed promote attraction in live interaction. *J. Pers. Soc. Psychol.* 101, 557–570. <https://doi.org/10.1037/a0022885>.
- Ripley, R.M., Snijders, T.A.B., Boda, Z., Vörös, A., Preciado, P., 2018. *Manual for RSiena Version 4.0 (version September 10, 2018)*. University of Oxford; Department of Statistics; Nuffield College, Oxford, England.
- Roberts, S.G.B., Dunbar, R.I.M., Pollet, T.V., Kuppens, T., 2009. Exploring variation in active network size: constraints and ego characteristics. *Soc. Networks* 31, 138–146. <https://doi.org/10.1016/j.socnet.2008.12.002>.
- Rusbult, C.E., Buunk, B.P., 1993. Commitment processes in close relationships: an interdependence analysis. *J. Soc. Pers. Relat.* 10, 175–204. <https://doi.org/10.1177/026540759301000202>.
- Selfhout, M., Burk, W., Branje, S., Denissen, J., van Aken, M., Meeus, W., 2010. Emerging late adolescent friendship networks and big five personality traits: a social network approach. *J. Pers.* 78, 509–538. <https://doi.org/10.1111/j.1467-6494.2010.00625.x>.
- Stadtfeld, C., Snijders, T.A.B., Steglich, C., van Duijn, M., 2018. Statistical power in longitudinal network studies. *Sociol. Methods Res.*, 004912411876911. <https://doi.org/10.1177/0049124118769113>.