



# Extraversion is associated with advice network size, but not network density or emotional closeness to network members

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## ABSTRACT

Friendship networks are instrumental to a whole range of outcomes including career success and personal wellbeing, and as such it is important to ask how social networks are shaped by personality variables. However, previous research examining how extraversion is associated with social network size and closeness to social network members has produced inconsistent findings. Here, we assessed how extraversion (HEXACO model) was associated with three key features of advice networks (size, density, and emotional closeness to network members) in a sample of 199 participants (17–75 years,  $M = 25$ ,  $SD = 11$ ; 146 women). We found that higher levels of extraversion (and its four facets: social self-esteem, social boldness, sociability, and liveliness) corresponded to a significantly larger advice network, but not greater network density, or greater emotional closeness to network members. The social manifestation of extraversion here seems to be operationalised in terms of a greater number of interactive advice partners, but no increased probability of ensuring that contacts are connected to each other, or of developing emotionally deep relationships with contacts.

## 1. Introduction

Friends, family, and acquaintances play an important role in an individual's physical and mental wellbeing, social capital, and organisational performance, inter alia (Berkman et al., 2000; Landis, 2016). Accordingly, researchers have been interested in examining how individual differences in personality could drive friendship formation and intensification. It might seem a reasonable hypothesis that extraversion should lead to larger social networks, given that the extraverted personality is more outgoing and sociable (e.g., Asendorpf & Wilpers, 1998; Harari et al., 2020). In line with this, Dutch adults (mainly non-students) who were more extraverted reported a greater number of people that they were close to and had seen recently, more contact with people within the last month, and a larger number of other friends and acquaintances (Pollet et al., 2011). Similarly, extraversion corresponded positively to the number of people in the social networks of student samples (Kalish & Robins, 2006; Selfhout et al., 2010; Swickert et al., 2002). Elsewhere, extraverts cited more friends, and were more likely to be cited as a friend (Feiler & Kleinbaum, 2015). However, extraversion does not unambiguously explain all aspects of social network size. A study of new students entering university for the first time found that extraversion corresponded to greater numbers of people cited as currently personally important in the first year, but not for the

few months subsequently studied (Asendorpf & Wilpers, 1998). In another large sample, extraversion was positively related to the size of the support group (the people that one would turn to in times of severe stress), but not to the size of the sympathy group (the larger group of people whose permanent loss would be upsetting) (Molho et al., 2016). In a further study of university undergraduates, there was no direct association between network size and extraversion, although network size was related to a measure of 'feeling enthusiastic' (Totterdell et al., 2008; see also Totterdell et al., 2004). Equally, in a study that sampled beyond the typical undergraduate cohort, the relationship between extraversion and network size was no longer statistically significant once participant age was controlled for (Roberts et al., 2008). It might be that social strategies, work opportunities, and life stages have larger effects on network size than extraversion, leading to inconsistent findings depending on the sample used (Totterdell et al., 2008).

The enhanced sociality of extraversion might also be related to other elements of the social network, such as greater social network density (calculated as the number of people within a network who know each other, relative to the theoretical maximum number who could know each other). Social network density is considered an important variable of study (DeLamater, 2006) and has implications for material and informational transmission between people, including the transmission of practices and diseases (Zelner et al., 2012). In denser networks, more of

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an individual's family and friends know each other, perhaps leading the individual to feel they are part of a close-knit social network. Bell (1991) found that, in a sample of adults from the United States, those with denser networks had significantly lower levels of loneliness, and suggested this may be because in denser networks, network members can better coordinate support when individuals are in need. If it is easier to develop new social relationships within a dense than sparse network, then this could mean that those who regularly seek new social relationships (i.e. extraverts) could be more likely to add contacts from dense than sparse networks, thereby creating a positive relationship between extraversion and network density. However, if extraverts have larger social networks, then they have more network members to connect before a network can be as dense as a smaller network, as network density is negatively associated with network size (Faust, 2006). Extraverted Australian students were more likely to report strong ties between network members, whereas the relationship between extraversion and network density was positive but not significant (Kalish & Robins, 2006).

The data are similarly inconsistent when it comes to the relationship between extraversion and emotional closeness to others. Some studies have reported that extraversion relates positively to emotional closeness to friends (e.g., Berry et al., 2000; Neyer & Asendorpf, 2001), and to the amount of support anticipated from others (Asendorpf & Wilpers, 1998; Stokes, 1985). However, extraversion was not related to reports of higher levels of satisfaction with the support received from the people in one's social network, nor to the perceived availability of people to discuss problems with (Swickert et al., 2002), nor to the relationship-relevant variables of interpersonal affect or succorance (Ashton et al., 1998). Dutch adults (mainly non-students) who were more extraverted were no more or less emotionally close on average to the people that they knew best (Pollet et al., 2011). Indeed, people reported lower average emotional closeness to others if they had larger overall social networks (Pollet et al., 2011; Roberts et al., 2009), perhaps because investing in larger numbers of people means that less investment can be made in each relationship, resulting in a quality-quantity trade-off (Dunbar, 2018).

Given the discrepancies in previous research, and the limited attention paid so far to personality and network density (Kalish & Robins, 2006), we examined the relationship between extraversion and social networks in a preregistered study (<https://osf.io/q8my3>). Unlike much other research, we assessed extraversion under the HEXACO model (Lee & Ashton, 2018) rather than the Big Five; HEXACO as a model of personality is gaining traction within the field (de Vries et al., 2016). Further, we went beyond previous work, which has not, to our knowledge, examined the impact of narrow traits on the social network dimensions of interest to us, by examining the impact of the four narrow traits of HEXACO extraversion (social self-esteem, social boldness, sociability, and liveliness) in finer detail. We collected data on three important features of social networks, namely, social network size, density, and emotional closeness to network members. The impact of extraversion on network density, in particular, has been little explored beyond a study of first-year Psychology undergraduate students (Kalish & Robins, 2006). Our predictions were that extraversion would correspond to a larger social network (Hypothesis 1), greater network density (Hypothesis 2), and lower emotional closeness to others (Hypothesis 3).

## 2. Materials and methods

### 2.1. Sample size

We pre-registered a target sample size of between 100 and 200 participants, which was informed by our previous work ( $n = 117$ , Pollet et al., 2011), and took into account the constraints of collecting data during the available 6-week time period. A sample size of 100–200 would provide 80% power at  $p = .05$  to detect an effect of

$$R^2 = 0.102\text{--}0.053.$$

### 2.2. Participants

Our survey recorded data from a participant only once they completed the final page of the survey ( $n = 200$ ). One participant did not input any answers, leaving a final sample of 199 (146 women; 163 British, 36 'Other' nationality [27 not specified, 8 American, 1 preferred not to say]). Participants were aged 17–75 ( $M = 25$  years,  $SD = 11$  years; 8 provided no age and their age was replaced with the mean age for analysis). There were 90 participants aged under 20, 78 aged 20–29, 11 aged 30–39, 11 aged 40–49, 5 aged 50–59, 1 aged 60–69, and 3 aged 70–75. Participants were recruited mainly through a university student research participation scheme, a university open day, and social media.

### 2.3. Materials

#### 2.3.1. GENSI

In order to collect participant data, we used an amended version of GENSI (Graphical Ego-centred Network Survey Interface, Stark & Krosnick, 2017; Stulp, 2020), a visually-interactive interface designed for social network reporting. Data quality can be enhanced by the use of such visually-interactive methods (Tubaro et al., 2014), something that is particularly important for social network data collection online (Matzat & Snijders, 2010).

#### 2.3.2. Advice network

Participants were presented with the following standard text to generate an advice network (McPherson et al., 2006): "From time to time, most people discuss important matters with other people they trust. These important matters may be personal or social. The people with whom you discuss important matters may be friends, family or co-workers. Looking back over the last six months, who are the people with whom you discussed matters important to you over the telephone, text or in person?". Participants who listed < 10 people were prompted: "You have not entered 10 people. Are you sure that there is no one else with whom you discuss important matters? If so, please click 'Next' to continue. If there is someone else, please enter the name and click 'add person'." We used a limit of 10 network members so as not to overburden participants. Participant workload increases rapidly with larger networks: a 10-member network has 45 possible ties, while a 20-member network has 190. 66% of our participants listed < 10 network members, suggesting that this network size limitation did not unduly restrict our dataset. A study of internet-based data collection of social networks found that most people listed between 1 and 10 people in response to 4 different network-generating questions (including one specifically on advice network), despite being allowed to enter up to 30 names, and supplied full additional information only in relation to a total of about 5 network members (Manfreda, Vehovar, & Hlebec, 2004).

#### 2.3.3. Emotional closeness

Participants responded to the question "How close is your relationship with each person?" by using the GENSI interface to drag each person listed into the appropriate box (labelled: 'Extremely close', 'Very close', 'Moderately close', 'A little close', or 'Not at all close'), which we recoded on a 1–5 scale (higher score = greater closeness) (cf similar scales in e.g. Kenny & Acitelli, 2001).

#### 2.3.4. Network density

Participants indicated which network members knew one another by using the GENSI interface to draw ties between the people they listed. Network density is the number of ties that exist in an individual's network as a proportion of the number of ties that would exist if all network members knew each other, and is operationalised from 0 to 1

(0 = no/1 = all network members know each other).

### 2.3.5. Extraversion

Participant personality was assessed with the extraversion scale of the HEXACO 100 item model (Lee & Ashton, 2018), consisting of 16 items on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The scores for extraversion and its four facets showed good reliability, with Cronbach's  $\alpha$  calculated as 0.88 (extraversion), 0.82 (social self-esteem), 0.79 (social boldness), 0.78 (sociability), and 0.75 (liveliness) (see also Lee & Ashton, 2018 for reliability and validity).

### 2.4. Procedure

The study was approved by the University ethics committee. Participants completed the survey online, using GENSI. They provided informed consent and basic socio-demographic information, then nominated network members, categorised those members in terms of emotional closeness, and indicated which members knew each other. Finally, participants completed the extraversion scale, and then the 20-item UCLA Loneliness scale (Russell, 1996). Loneliness is not considered here, given focus and space constraints, but the data, additional analyses, and all our materials are provided on the OSF (<https://osf.io/w2umt/>).

### 2.5. Analysis

Following the pre-registration (<https://osf.io/q8my3>), we carried out a series of ordinary least squares (OLS) regressions in R 4.01 (R Core Development, 2019), where we considered extraversion as a predictor of three key variables: number of network members, network density, and mean emotional closeness. We added additional demographic variables (gender, age, nationality) to examine whether any effect of extraversion would be upheld with the inclusion of these control variables. We also included the number of network members (when examining network density and emotional closeness), and network density (when examining emotional closeness), because larger networks tend to be sparser and have lower closeness ratings to alters (Roberts et al., 2009). Checks on regression assumptions did not indicate particular causes for concern. As an additional robustness check, we conducted bootstrapping on the standardised regression coefficients with 10,000 samples. We assumed the effects were robust if the 95% confidence intervals did not include 0. Additional descriptive statistics, analyses, findings, and checks are shown on the OSF (<https://osf.io/w2umt/>).

## 3. Results and discussion

Hierarchical OLS regression analyses demonstrated that, in line with Hypothesis 1, higher extraversion predicted a greater number of network members (Table 1). Furthermore, in separate OLS regression analyses, all four facets of extraversion (liveliness, sociability, social boldness, social self-esteem) were positively and significantly associated with the number of network members (Fig. 1). Given the items used to assess extraversion (e.g., "I rarely express my opinions in group meetings", reverse-scored, and "I enjoy having lots of people around to talk with"), it is perhaps of little surprise to find that participants who scored higher on these also reported that they had discussed important matters with more people in the preceding six months (i.e. the question in our network generator). Indeed, differences between extraverts and introverts in terms of self-disclosure, talkativity, or flexibility, could all contribute to differences between extraverts and introverts in terms of the size of their advice network that we assessed, and which might differ from other conceptualisations of one's number of friends. We were not able to consider the issue of causality, although we suggest that extraversion drives advice network size rather than vice versa, given the stability of personality over time (Roberts & DelVecchio,

**Table 1**

Hierarchical OLS regressions with number of network members as dependent variable (standardised coefficients and concomitant test statistics).  $N = 199$ .

Model:	DV: number of network members			
	(1)	(2)	(3)	(4)
Extraversion	0.324***	0.324***	0.345***	0.354***
Gender (Female → Male)		-0.054	-0.030	-0.029
Age			-0.147*	-0.149*
Nationality (Other → British)				-0.039
R <sup>2</sup>	0.105	0.108	0.128	0.130
Adjusted R <sup>2</sup>	0.100	0.099	0.115	0.112
Residual Std. Error (df)	0.946 (198)	0.947 (197)	0.938 (196)	0.940 (195)
F Statistic (df)	23.156*** (1, 198)	11.883*** (2, 197)	9.620*** (3, 196)	7.271*** (4, 195)

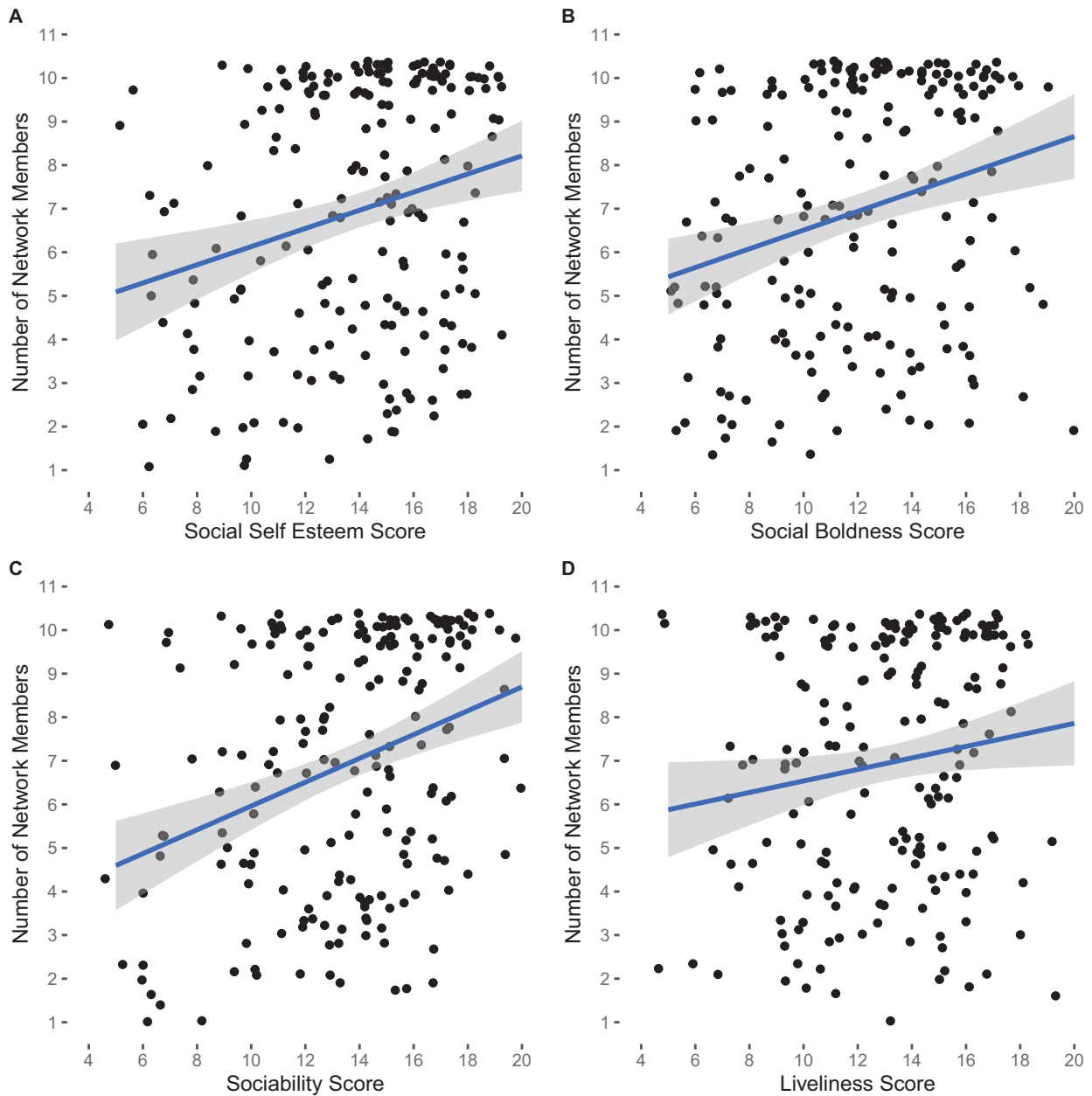
\*  $p < .05$ .

\*\*\*  $p < .001$ .

2000), and the previous demonstration that personality shapes network size (Asendorpf & Wilpers, 1998). Longitudinal studies are better able to address questions of causality, and one limitation of our study is its cross-sectional (and self-reported) nature, although a great many studies of social networks use such a design (Wrzus et al., 2013).

Not all previous research has found this relationship between extraversion and network size (see Introduction), and there are perhaps two systematic sources of variation that could help to explain the discrepancies. First, some studies elicit social networks with reference to frequency of contact (e.g. Feiler & Kleinbaum, 2015; Roberts et al., 2008), while others rely on some sort of evaluation of the importance or quality of the relationship (e.g. Asendorpf & Wilpers, 1998; Molho et al., 2016). Although frequency of contact generally corresponds to emotional closeness, it is not identical (Hill & Dunbar, 2003), and assessing these different things in slightly different ways could generate different estimations of network size. Second, the homogeneity in the sample will be important; the impact of extraversion will be more apparent where there are fewer other differences between participants. Accordingly, we believe that our finding that network size increases with extraversion (and its facets) will be apparent in any fairly homogeneous sample, but might be obscured with increasing environmental and contextual differences between people in the sample. For instance, if some people have work that provides them with larger networks of contacts, this could reduce or obscure an impact of extraversion on network size. In this context, we would note one limitation of the text used to generate the network, namely, that it asked for people to recount interactions via the telephone, text, or in person. Although this wording is taken from previous research, it omits increasingly common forms of communication such as email, something which could be impactful in particular given that introverted people are more likely to prefer email communication (Hertel et al., 2008), and although it is perhaps unlikely that someone would correspond with an advice network member exclusively by email, future research might consider updating this method of obtaining network members.

Advice network size decreased with age, at a rate of a little under 1 advice network member for every couple of decades of age (Table 1). A meta-analysis of research on social networks and age found that personal and friendship networks declined by about one person per decade, while global social networks (i.e. counting all social relationships) increased to the mid-20s, then decreased (Wrzus et al., 2013). This reduction with age might be attributed to a range of influences including transition to parenthood, relocation, loss of a spouse, cohort differences in characterisations of friendships, and a greater focus with age on higher-quality relationships (Wrzus et al., 2013). Further, friendship and personal networks tend to be larger when estimated



**Fig. 1.** Simple regression scatter plot grids (jitter added) showing the significant positive bivariate correlations between the facets of extraversion and the number of social network members ( $n = 199$ ). A:  $r = 0.23$ , 95% CI [0.10, 0.36],  $p < .01$ ; B:  $r = 0.26$ , 95% CI [0.13, 0.39],  $p < .01$ ; C:  $r = 0.33$ , 95% CI [0.20, 0.45],  $p < .01$ ; D:  $r = 0.15$ , 95% CI [0.01, 0.28],  $p < .05$ .

**Table 2**

Hierarchical OLS regressions with social network density as outcome variable (standardised coefficients and concomitant test statistics). Sample includes only those participants who listed  $\geq 3$  network members, thereby allowing calculation of network density.  $N = 182$ .

Model:	DV: Network density				
	(1)	(2)	(3)	(4)	(5)
Extraversion	0.069	0.074	0.073	0.065	0.060
Number of Network Members		-0.020	-0.019	-0.013	-0.011
Gender (Female → Male)			-0.019	-0.025	-0.026
Age				0.037	0.037
Nationality (Other → British)					0.026
R <sup>2</sup>	0.014	0.014	0.015	0.019	0.021
Adjusted R <sup>2</sup>	0.008	0.004	-0.001	-0.003	-0.006
Residual Std. Error (df)	0.567 (181)	0.568 (180)	0.569 (179)	0.570 (178)	0.571 (177)
F Statistic (df)	2.483 (1, 181)	1.320 (2, 180)	0.937 (3, 179)	0.878 (4, 178)	0.765 (5, 177)

**Table 3**

Hierarchical OLS regressions with emotional closeness as outcome variable (standardised coefficients and concomitant test statistics). Sample size decreases at Step 3 because 17 of the participants listed < 3 network members and so were excluded from network density calculations.

Model:	DV: Mean emotional closeness to network members					
	(1)	(2)	(3)	(4)	(5)	(6)
Extraversion	-0.022	-0.119	-0.098	-0.098	-0.068	-0.067
Number of Network Members		0.299***	0.273***	0.273***	0.251**	0.250**
Density			-0.063	-0.063	-0.048	-0.047
Gender (Female → Male)				-0.001		0.023
Age					-0.136	-0.137
Nationality (Other → British)						-0.010
N	199	199	182	182	182	182
R <sup>2</sup>	0.0005	0.081	0.066	0.066	0.085	0.085
Adjusted R <sup>2</sup>	-0.005	0.071	0.050	0.045	0.059	0.054
Residual Std. Error (df)	1.000 (198)	0.961 (197)	0.923 (179)	0.925 (178)	0.918 (177)	0.921 (176)
F Statistic (df)	0.096 (1, 198)	8.636*** (2, 197)	4.195** (3, 179)	3.129* (4, 178)	3.296** (5, 177)	2.734* (6, 176)

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .

from student compared with non-student populations, perhaps adding to the age effects we noted (Wrzus et al., 2013).

Extraversion was not a significant predictor of network density (Table 2: Model 1,  $\beta = 0.069$ ,  $t(198) = 1.625$ ,  $p = .27$ ) and thus Hypothesis 2 was unsupported. Our results suggest that the social manifestation of extraversion does not directly translate into creating relationships between one's key contacts. Notably, it is harder to have a dense network if your network is large, because larger networks must have more ties between network members in raw data terms in order to maintain an equivalent density to smaller networks. Indeed, in our sample, density was significantly and negatively related to the number of network members ( $r = -0.36$ ,  $p < .01$ , 95% CI [-0.48, -0.23]). However, even controlling for this (Table 2, Model 2), extraversion did not significantly predict network density. One limitation of our study was that we capped the number of network members at 10. This had the advantage of not overburdening our unpaid participants, but for greater clarity, we could instead have asked people to list all contacts within a particular category. We would thus be cautious about generalising our null findings of a relationship between extraversion and network density prior to further explorations of this area.

We predicted in Hypothesis 3 that extraversion would correspond negatively to average emotional closeness, reflecting a quality-quantity relationship trade-off where those with larger networks are less close to network members (Dunbar, 2018), but did not find any evidence for this (Table 3). Indeed, participants who reported more network members also reported greater average emotional closeness to them (Table 3, Model 2). One limitation of an analysis of participants' mean emotional closeness to network members is that it could obscure any evidence of extraversion's effects on social networks, if extraversion were associated with greater emotional closeness to only one's best friends. Thus, if an extraverted respondent provided closeness ratings of 5,5,5,5,1,1, and an introverted respondent provided ratings of 3,3,3,4,4,5, then the markedly different pattern of closeness at the level of individual network members would be obscured by the identical mean closeness (3.67 for both networks). However, we ruled out this possibility via a multilevel analysis of the ability of extraversion to predict emotional closeness, with individual network members at Level 1 clustered by participants at Level 2. This model did not perform better than a null model ( $\chi^2(1) = 1.87$ ,  $p = .172$ ; see supplementary analyses, <https://osf.io/w2umt/>). Further research is needed to tease out the variables that can produce positive (e.g., Berry et al., 2000; Neyer & Asendorpf, 2001), negative (Pollet et al., 2011; Roberts et al., 2009), or null relationships (our results; Pollet et al., 2011) between extraversion and emotional closeness to network members, perhaps focussing on size and type of the social network, participant age, and method of

assessment of emotional closeness.

In conclusion, and consistent with several previous studies (see Introduction), extraversion and its four facets (liveliness, sociability, social boldness, social self-esteem) were significantly and positively associated with network size. However, there was no significant effect of extraversion on the extent to which people in the networks knew each other (network density) or on emotional closeness to network members. Thus, while the greater sociability of extraverts translates into a broader set of social ties, it does not necessarily result in extraverts developing more intense emotional connections with network members. Future research could examine whether this is due to the socialising style of extraverts, or inherent trade-offs between network size and emotional closeness (Dunbar, 2018; Roberts et al., 2009). Future research should also compare data from samples from other cultures, where extraversion might be associated with different consequences (Lucas et al., 2000).

#### CRediT authorship contribution statement

**C. Malcolm:**Methodology, Software, Formal analysis, Investigation, Data curation, Writing - original draft, Visualization.**T.K. Saxton:**Writing - original draft, Writing - review & editing.**K. McCarty:**Methodology, Software.**S.G.B. Roberts:**Writing - review & editing.**T.V. Pollet:**Conceptualization, Methodology, Software, Formal analysis, Writing - review & editing, Supervision.

#### Declaration of competing interest

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#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.paid.2020.110311>.

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