Perceived Closeness to Multiple Social Connections and Attachment Style: A Longitudinal Examination

Abstract:

Throughout life people form multiple close connections. These connections play an important role, such as providing social and instrumental support. Despite this, relatively little is known about how and why closeness to multiple others changes over time. To fill this gap, we examined changes in perceived closeness to multiple social connections and used a well-studied relational individual difference—attachment style—to shed light on those changes. Multilevel analysis and different indexes revealed that attachment avoidance was associated with lower mean perceived closeness and greater fluctuations in perceived closeness over time. These associations were moderated by attachment anxiety, such that low levels of avoidance and anxiety (i.e., security) were associated with greater stability of perceived closeness. Our results demonstrate that perceived closeness in one's social connections tend to change, even over relatively short periods of time, and individual differences such as attachment style are important correlates of these changes.

Keywords: Adult Attachment, Close Relationships, Individual Differences, Interpersonal Relationships, Advanced quantitative methods

Article text:

Introduction

People yearn for social connections (Baumeister & Leary, 1995; Walton, Cohen, Cwir, & Spencer, 2012). Social connections can serve different functions, such as social comparison and influence (Bond et al., 2012; Jokisaari & Nurmi, 2012), fulfill various needs, such as providing emotional and instrumental support (Cacioppo, Fowler, & Christakis, 2009; Heaney & Israel, 2002), and have various beneficial outcomes, such as improved physical and mental health and greater longevity (e.g., Holt-Lunstad, Smith, & Layton, 2010; Kok et al., 2013).

Social connections are dynamic—they change over time in their structure and content (e.g., we meet new acquaintances or cut old ones off, relationships get weaker or stronger; Wrzus, Hänel, Wagner, & Neyer, 2013). Despite that, most existing research on social connections uses cross-sectional designs, which treats them as static (Snijders, 2011). This yields only a partial picture of one's social connections (e.g., certain relationships may not be overtly present at one time; Morgan, Neal, & Carder, 1997), potentially leading to biased findings regarding connections and their outcomes. Longitudinal designs overcome this limitation, allow the assessment of changes in social connections, and shed light on the directionality in relationship processes—which is why we adopted this approach here.

Social connections change over time due to factors such as life events and transitions (Kossinets & Watts, 2006), and the changes can be gradual or abrupt (e.g., Kumar, Novak, & Tomkins, 2010). These changes can be evaluated in two ways: (a) a trajectory or longitudinal trend over time (Curran, Obeidat, & Losardo, 2010), and (b) the degree of fluctuation or variation from the mean (Kernis, 2005). High versus low fluctuations of a construct can lead to different outcomes. For example, people with unstable self-esteem show more depressive symptoms than those with more stable self-esteem (Kernis, 2005).

To illustrate the significance of evaluating different indexes of change, we ask the reader to imagine four individuals, A, B, C, and D, being assessed on a certain construct X (see Figure 1). A typical cross-sectional, one-time assessment at Time 1 could lead to the incorrect conclusion that only person C differs from the others on X. Longitudinal methods provide three ways to further reveal how these individuals differ from each other. First, taking multiple measurements over time and extracting a mean level will show that B is different from A and D, while also increasing the reliability of the assessment (Ployhart & Vadenberg, 2010). Second, considering time and modeling trajectories will reveal that whereas B and C have the same mean, they have significantly different trends, with B increasing and C staying constant (Curran et al., 2010). This, however, still cannot reveal the difference between A and D, which have the same mean and same longitudinal trend. A third approach that considers fluctuations from the mean over time (Kernis, 2005) will show that A has greater stability than D. Our first goal in the current paper is to use a longitudinal design and all three indexes (mean level, trajectory, and fluctuations) to examine changes in one relational construct—perceived closeness.

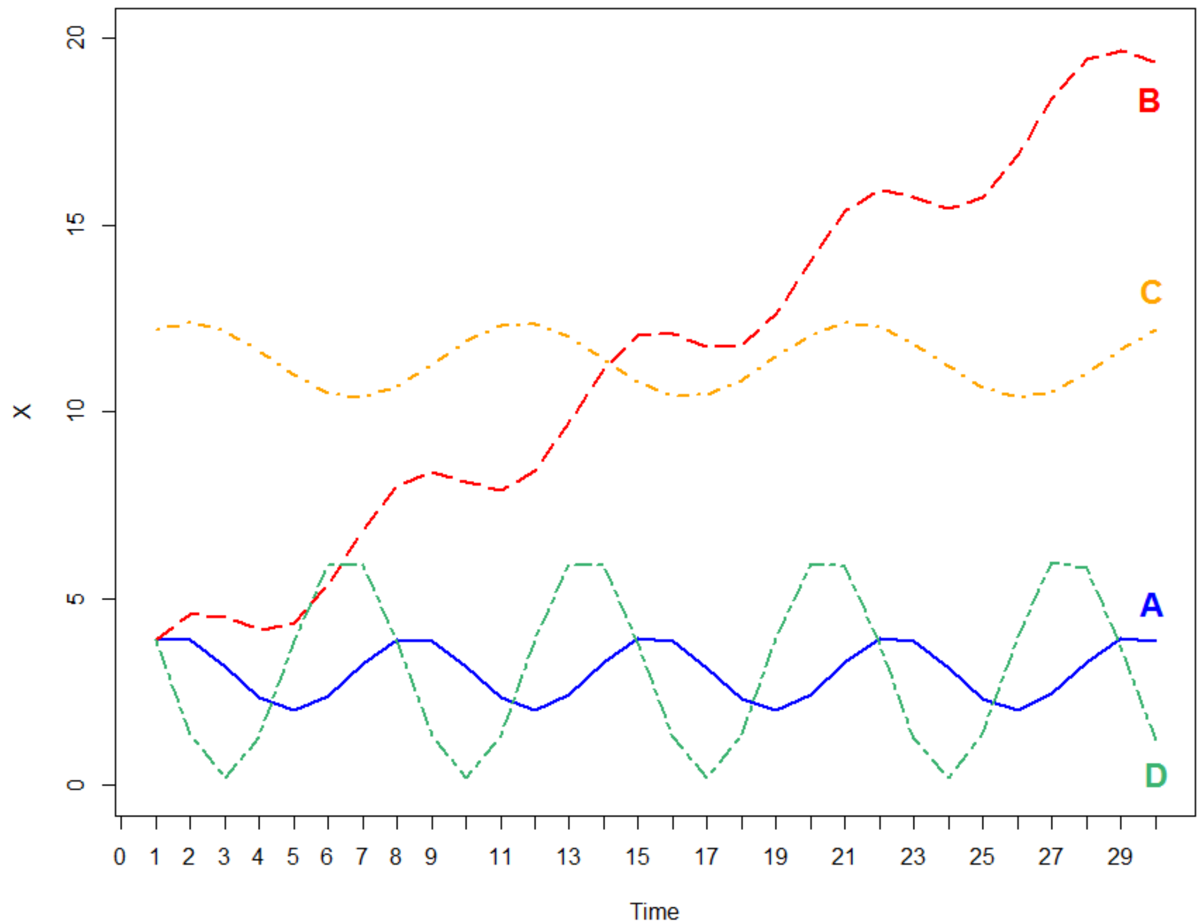

Figure 1. The values of four individuals on construct X over time.

Closeness is a central factor in interpersonal relationships (e.g., Mashek & Aron, 2004) and has been repeatedly identified as an important aspect of social connections (e.g., Eisenberger & Lieberman, 2004; Roberts & Dunbar, 2011). In this paper, we focus on perceived closeness, and for the sake of brevity refer to it as "closeness." We conceptualized closeness using two dimensions. The first focuses on the subjective emotions people have—the stronger one's feelings toward another person, the closer that person is thought to be (e.g., Korchmaros &

Kenny, 2001). The second dimension involves the number of functions the other person fulfills for the self (Lewin, 1948). These functions can manifest as different roles played (friend, mentor), different situations shared (traveling, working), or different needs satisfied (emotional, instrumental). The more roles played, situations shared, or needs satisfied, the closer the other is thought to be to the self. This degree of multiple social relations is termed multiplexity (Ferriani, Fonti, & Corrado, 2013). The two indexes (subjective closeness and multiplexity) are related to various outcomes such as social support (Heaney & Israel, 2002) and mental health (Kramer, 1996), highlighting the importance of closeness.

Although closeness is a general relationship characteristic, and everyone feels some level of closeness to their social connections, people differ on the amount of closeness in their social connections (Roberts & Dunbar, 2011). Social connections are not identical across people and do not necessarily provide the same outcomes and/or benefits for everyone (Kadushin, 2012). For example, people may vary in the number of social connections (e.g., Swickert, Rosentreter, Hittner, & Mushrush, 2002), chose disparate people to connect with (Van Zalk, Van Zalk, Kerr, & Stattin, 2011), or differ in the amount of benefits they reap from their social connections (e.g., Anderson, 2008) as a function of their personality. Importantly, the amount of closeness also tends to differ across people (e.g., Roberts & Dunbar, 2011). However, there is relatively little research on differences in closeness among social connections, especially research that is theory-driven. To ameliorate this, we employ here the framework of attachment theory—a theory focusing on individual differences and social relationships (Bowlby, 1969). The second goal of the paper is to examine how attachment style associates with perceptions of closeness in social connections over time.

Attachment Style

Adult attachment represents individual differences in people's approach to close relationships. It is often conceptualized as two orthogonal dimensions of avoidance and anxiety (Gillath, Karantzas, & Fraley, 2016). People high on avoidance have a low sense of trust and a strong preference to avoid intimacy and closeness, whereas those high on anxiety have a low sense of self-worth and a strong need for reassurance and support. People who are low on both dimensions—securely attached—have a high sense of self-worth and are comfortable with intimacy and closeness. Finally, those high on both anxiety and avoidance—fearful avoidants—have low self-worth, perceive others as cold and untrustworthy, and find relationships hard to form and maintain (Griffin & Bartholomew, 1994). Attachment styles have been shown in numerous studies to associate with various relational outcomes, emotion regulation, and mental and physical health (for a review see Gillath et al., 2016).

Attachment style has also been found to associate with closeness and its stability. Avoidant individuals report fears and discomforts regarding closeness, anxiously attached individuals have high closeness needs that are hard to fulfill, and secure individuals tend to report higher closeness and are theorized to fluctuate less in their closeness (Collins & Feeney, 2004; Feeney, 1999; Hazan & Shaver, 1987). Based on these associations, attachment styles likely associates with closeness and its stability in social connections.

Relatively little work has been done on the associations between attachment style and multiple social connections (Tavecchio & Van Ijzendoorn, 1987). Gillath, Johnson, Selcuk, and Teel (2011) found attachment security was associated with greater maintenance of relationships, and avoidance with lower maintenance and higher relationship dissolution. Regarding closeness, Rowe and Carnelley (2005) found attachment security was associated with greater closeness to social connections, and Gillath and Karantzas (2015) found attachment avoidance was associated with lower multiplexity. However, all of these were single phase studies, which failed to capture the dynamic fluctuations in social connections over time.

The Present Study

We used a longitudinal design to examine whether closeness in social connections changes, and if that change associates with attachment style. Specifically, we examined the associations between attachment avoidance and anxiety and (a) mean levels of closeness over the entire study (regardless of time), (b) changes in level of closeness over time (longitudinal trend), (c) fluctuations of closeness over time (stability), and (d) degree of multiplexity.

As closeness tends to increase as relationships lengthen (Berscheid, Snyder, & Omoto, 1989; Campbell, Lackenbauer, & Muise, 2006), we predicted that (a) closeness to a specific target would increase over time, across all attachment styles. Based on previous research regarding attachment style and social connections, we further hypothesized that (b) avoidance would associate with lower, whereas security would associate with higher, mean levels of closeness, and (c) security would associate with a greater increase in closeness over time. (d) Security would also associate with higher stability in closeness; whereas both avoidance and anxiety would associate with lower stability. (e) Attachment avoidance would associate with lower multiplexity.

Social connections are likely to differ from one another. Very close others may hold special importance or fulfill unique roles (Lang & Carstensen, 1994; Mikulincer & Shaver, 2007). Closeness experienced toward these people is likely to be more stable than closeness experienced to others. Whether closeness fluctuates or not could therefore depend on how close the person is to begin with. Therefore, we tested whether (f) the associations predicted above between attachment insecurity and closeness stability would depend on how close a person is to the participant.

Method

Participants

University students from the Midwestern United States (n = 121; 77 women), ages 18-38, 48% were in a romantic relationship, and 75% were Caucasian, received course credit for participating in the study. Five participants stopped after the baseline survey, so 116 were included in the analysis.[1] As the participants were our highest level of analysis, this is an adequate sample size for a medium or greater-sized effect of the variables in our multilevel models (see de Jong, Moerbeek, & van der Leeden, 2010; Scherbaum & Ferreter, 2009).

Procedure

Participants filled out a baseline online questionnaire assessing attachment style and demographics including years of education, socioeconomic status (SES), and whether or not in an exclusive romantic relationship. Then, once a week for ten weeks, participants were asked to complete a short online survey which included a name generator and closeness ratings.

Measures

Participants were asked to name ten people (targets) who play an important role in their life (Wellman name generator; Hogan, Carrasco, & Wellman, 2007), and rate their felt closeness to each target on a 7-point Likert scale ranging from 1 (*Don't feel close at all*) to 7 (*Feel very close*). Participants were free to name different people each week.

Adult attachment was assessed using the Experiences in Close Relationships inventory (ECR; Brennan, Clark, & Shaver, 1998), a 36-item scale tapping levels of avoidance (α = .89) and anxiety (α = .94). Participants rated the items on a 7-point Likert scale ranging from 1 (*Disagree strongly*) to 7 (*Agree strongly*).

Participants indicated their years of formal education, and current SES out of five responses of *Lower*, *Lower-middle*, *Middle*, *Upper-middle*, and *Upper* (coded as 1-5). Table 1 shows the means, standard deviations, and zero-order correlations.

Table 1.

Summary of Zero-Order Correlations, Means, and Standard Deviations for Participant Variables

	Variable	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*M*	*SD*
1.	Avoidance	—							3.12	1.11
2.	Anxiety	.19*	—						3.98	0.95
3.	Closeness	-.26**	.02	—					6.03	1.11
4.	Age	-.26**	-.13	.02	—				21.31	2.55
5.	SES	.05	.08	.27**	-.26**	—			3.05	0.89
6.	Education level	-.17	-.19*	-.01	.61***	-.15	—		15.61	1.66
7.	Total number of targets mentioned	.30**	.14	-.25**	-.12	-.06	.03	—	17.68	9.66

* $p < .05$. ** $p < .01$. *** $p < .001$

Data Analysis

Closeness mean level and trend analysis. We used multilevel modeling with the lme4 package (Bates, Maechler, Bolker, & Walker, 2014) in R (R Core Team, 2015) to examine the associations between attachment style, levels of closeness, and time. The data were represented with a three-level model: Weekly ratings of closeness (level 1) were nested within specific targets (level 2), which were nested within individual participants (level 3). We coded the data so that each specific target mentioned had his or her own identification, resulting in naming around 2,000 different targets. This structure enabled us to calculate the regression lines of closeness on the predictors for each target. Avoidance and anxiety were specified as level 3 predictors. Time (measured in weeks, coded according to week of the study) was included as a level 1 predictor. Since closeness could increase nonlinearly (see Orth, Robins, & Soto, 2010), the quadratic term of time was also included.

All predictor intercepts were specified as random. To decrease the number of model assumptions and increase precision of model results (Nezlek, 2001), the slopes were also randomized, but we fixed the slopes which had a variance of less than .01 to maximize model convergence. For all our multilevel models, we used full information maximum likelihood estimation which is relatively robust to missing data (Little, Jorgensen, Lang, & Moore, 2013). All predictor variables were grand-mean centered.

Closeness fluctuations analysis. Weekly fluctuations in closeness ratings to specific targets was assessed by computing the standard deviation (SD) of closeness scores over time for each target (M = 0.36, SD = 0.39, range: 0 – 3.54). We omitted targets who were only mentioned once. In the data, weekly fluctuations of targets (level 1) were nested within participants (level 2). Using this two-level model, instead of aggregating the SD’s across all targets, enabled us to examine how target characteristics (such as the number of times mentioned and mean closeness rating) were associated with fluctuations in closeness to the target.

Avoidance and anxiety were specified as level 2 predictors. In a separate model, the target's closeness mean (calculated as the average amount of closeness reported with regard to that member over the ten weeks; *M* = 5.82, *SD* = 1.26, range: 1-7) was included as a level 1 covariate. As this variable was negatively skewed (skewness = -1.56), we corrected for this using the procedure described in Tabachnick & Fidell (2001; p. 81), which involves reflecting, log-transforming, and re-reflecting the variable. This reduced its skewness to -0.48. We then grand-mean centered the variable. All other predictors were grand-mean centered. The predictor intercepts were specified as random, and again the slopes were randomized with the exception of those which had very low variance, for model convergence purposes.

Multiplexity analysis. In operationalizing multiplexity, we wanted to fully utilize our longitudinal design and emphasize our focus on stability and change over time (e.g., Minor, 1983). Instead of counting how many functions each social connection fulfills, we examined whether people consistently fulfilled the same function over time. To do that, we used the total number of individuals named as important by the participant over the ten weeks. We assumed the more names a participant generated over time, the less constantly each of these members was fulfilling the function of "being an important person" over that period. Because these were discrete count data, negative binomial regression with the MASS package (Venables & Ripley, 2002) in R (R Core Team, 2015) was used to examine the associations between attachment style and number of targets mentioned. We assumed the outcome variable had a negative binomial rather than a poisson distribution because the variance (93.33) was much larger than the mean (17.68), suggesting overdispersion (Agresti, 2007). This was later confirmed via a likelihood ratio test, which showed a negative binomial model fit the data better than a poisson model (χ^2 = 154.03, *df* = 1, *p* < .001).

In order to corroborate this analysis, we also ran a linear regression model using the same predictors and a log-transformation of the dependent variable.

Results

Closeness Mean Level and Trend Analysis

The intraclass correlation coefficient (ICC) was .56 for level 2 and .28 for level 3, indicating sufficient variability at the target and individual levels, respectively, and justifying the three-level model. In addition, the variance in closeness ratings accounted for by week (level 1) was .17, showing the ratings did differ on a weekly basis, supporting the longitudinal data collection.

Using the notation of Raudenbush and Bryk (2002), our model could be represented as

$$\text{Closeness}_{ijk} = \gamma_{000} + \gamma_{001}\text{Avoidance} + \gamma_{002}\text{Anxiety} + \pi_{100}\text{Time} + \pi_{200}\text{Time}^2 + u_{00k} + r_{0jk} + e_{ijk}$$

with u_{00k}, r_{0jk}, and e_{ijk} representing third, second, and first level error terms, respectively.

Results revealed that avoidance negatively associated with mean levels of closeness, γ_{001} = -0.19, *t*(7978) = -3.04, *p* = .002,[2] r_p(7986) = -.034 [-.056, -.012] (all CIs are 95% CIs), such that the higher one's avoidance, the lower was the person's closeness to targets over ten weeks, controlling for anxiety, time, and the quadratic term of time. Time positively associated with closeness, π_{100} = 0.02, *t*(7978) = 6.74, *p* < .001, r_p(7986) = .075 [.053, .097]. The quadratic term of time was negatively associated with closeness, π_{200} = -0.002, *t*(7978) = -2.56, *p* = .01, r_p(7986) = -.029 [-.051, -.007] (see Table 2). The linear effect of time when the (mean-centered) quadratic effect of time is present is actually the simple effect of linear time at the mean time (i.e., the line tangent to the quadratic curve when time = 0). That the linear time was positive in this context suggests the simple temporal slope is positive at the mean time point. The negative quadratic effect of time suggests that the simple linear effect of time becomes more negative (or less positive) as time progresses (i.e., a diminishing-returns or decelerating-effects model; see Figure 2). No other predictors were significant.

We subsequently ran models including the interaction terms of avoidance, anxiety, time, and quadratic term of time. The interactions were each tested separately and none was significant.[3]

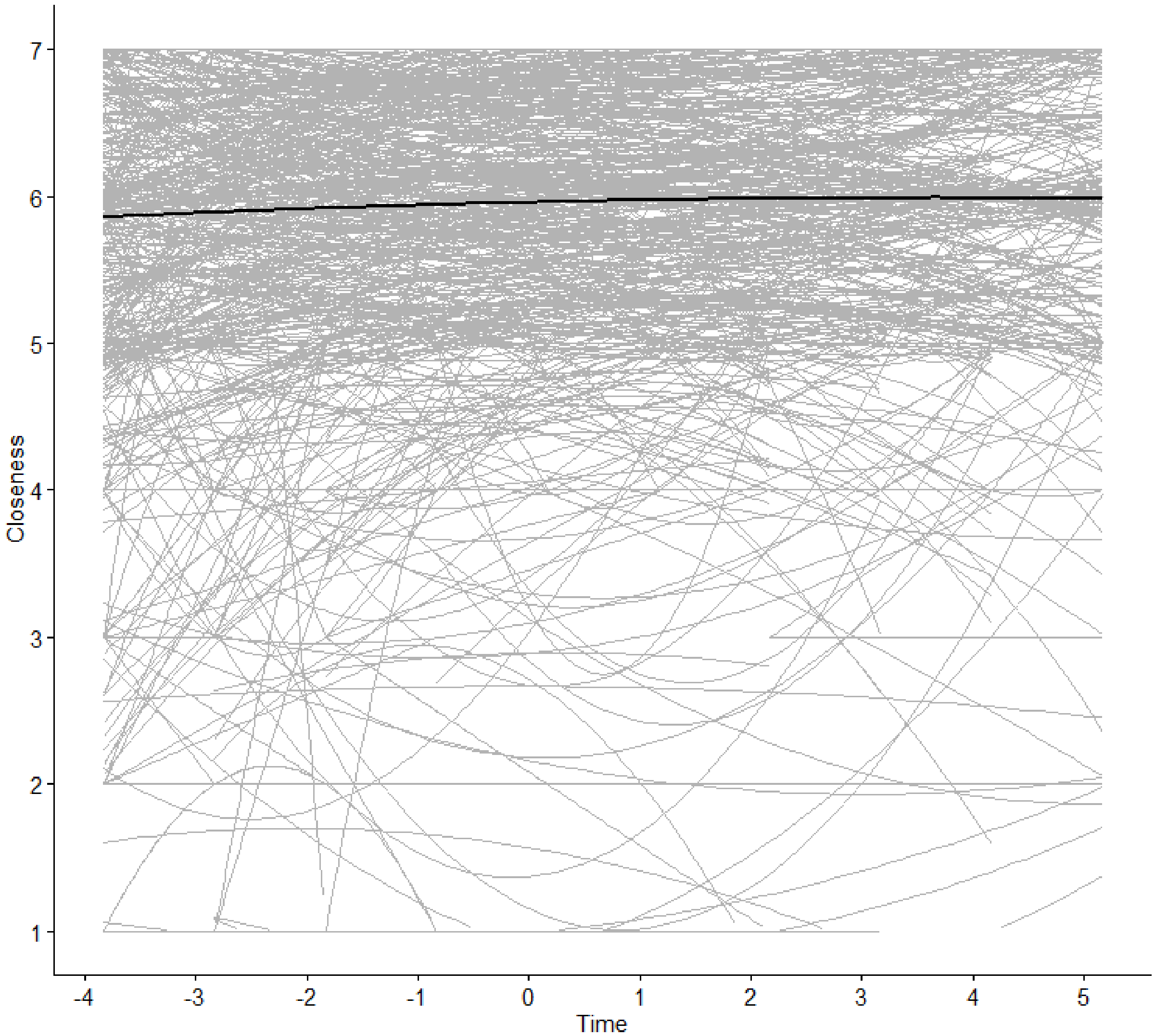

Figure 2. Regression slopes of closeness on time for individual targets (in gray) and averaged across all targets (in black) at the mean values of avoidance and anxiety. Avoidance, anxiety, and time are grand-mean centered.

Table 2.

Fixed Effects Coefficients for Closeness Mean Level and Trend Model.

Predictor	*df*	Coefficient (SE)	*t* value	*p* value	Partial Correlation		
					df	*r*	95% CI
	7978				7986		
Intercept, γ_{000}		5.96 (0.07)	89.85	< .001			
Avoidance, γ_{001}		-0.19 (0.06)	-3.04	.002		-.034	-.056, -.012
Anxiety, γ_{002}		0.09 (0.07)	1.31	.19		.015	-.007, .037
Time, π_{100}*		0.02 (0.003)	6.74	< .001		.075	.053, .097
Time^2, π_{200}*		-0.002 (0.001)	-2.56	.01		-.029	-.051, -.007

* Fixed slope

Closeness Fluctuations Analysis

The ICC for the level 2 model was .33, showing sufficient variability at the individual level. An initial model with only avoidance and anxiety as predictors (Closeness $SD_{ij} = \gamma_{00} + \gamma_{01}$Avoidance + γ_{02}Anxiety + $u_{0j} + r_{ij}$; with u_{0j} and r_{ij} representing second and first level error terms, respectively) revealed avoidance to positively associate with fluctuations in closeness, $\gamma_{01} = 0.04$, $t(7267) = 2.03$, $p = .04$, $r_p(7262) = .024$ [.001, .047], such that the higher one's avoidance, the more one's closeness to a specific target fluctuated over ten weeks. Anxiety showed the pattern of being positively associated with fluctuations, $\gamma_{02} = 0.04$, $t = 1.47$, $p = .14$, $r_p(7267) = .017$ [-.006, .040], such that the higher one's anxiety, the greater were one's fluctuations in closeness; however this association was not significant.

The next model included the target's mean level of closeness ratings (Closeness $SD_{ij} = \gamma_{00} + \gamma_{01}$Avoidance + γ_{02}Anxiety + β_{10}Target's closeness mean + $u_{0j} + r_{ij}$) as a covariate, which negatively associated with fluctuations, $\beta_{10} = -0.68$, $t(7255) = -10.18$, $p < .001$, $r_p(7266) = -.12$ [-.14, -.096], such that the closer the participant rated the target over ten weeks, the more stable the closeness ratings were. With this included, the association of avoidance became nonsignificant, $\gamma_{01} = -.01$, $t(7255) = -0.45$, $p = .65$, $r_p(7266) = -.005$ [-.028, .018], and anxiety became significant, $\gamma_{02} = 0.05$, $t(7255) = 2.61$, $p = .01$, $r_p(7266) = .031$ [.008, .054].

A third model with the interaction term of avoidance and anxiety ($\gamma_{00} + \gamma_{01}$Avoidance + γ_{02}Anxiety + γ_{03}Avoidance*Anxiety + $u_{0j} + r_{ij}$) and without covariates showed a significant interaction, $\gamma_{03} = 0.04$, $t(7264) = 2.00$, $p = .045$, $r_p(7266) = .023$ [.0005, .046]. Probing the interaction using Preacher, Curran, and Bauer's (2006) web calculator showed the association of avoidance with closeness fluctuations became significant when mean-centered anxiety scores were above -0.28. This suggests avoidance had a significant association only when anxiety was around and above average (see Figure 3). In other words, the more insecure people were (high on both dimensions, or fearful avoidant), the higher the fluctuations in closeness, and the more secure (low in both avoidance and anxiety) they were, the lower the fluctuations and greater the stability in their closeness.

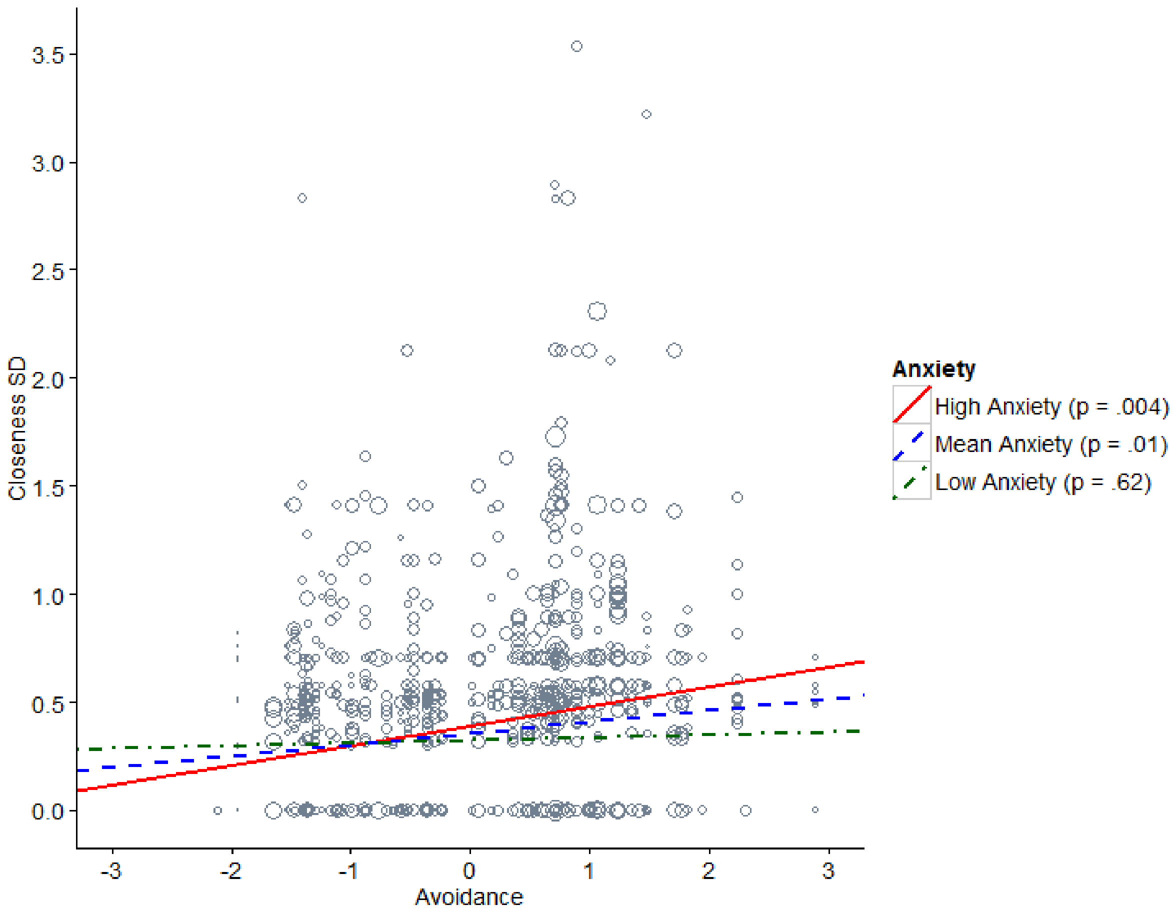

Figure 3. Hierarchical linear regression slopes of closeness SD on avoidance at different values of anxiety. Avoidance and anxiety are both grand-mean centered. For anxiety, values of one SD above and below the mean (zero) were used to designate high and low. Larger data points reflect larger mean-centered anxiety values.[4]

A fourth model included the target's mean level of closeness as a covariate (γ_{00} + γ_{01}Avoidance + γ_{02}Anxiety + γ_{03}Avoidance*Anxiety + β_{10}Target's closeness mean + u_{0j} + r_{ij}), and the interaction term of avoidance and anxiety decreased in significance, γ_{05} = 0.01, $t(7261)$ = 0.83, p = .41, $r_p(7265)$ = .010 [-.013, .033] (see Table 3).

We also ran an additional model including the interaction term of avoidance, anxiety, and target's mean level of closeness, but this interaction was not significant.[3]

Table 3.

Fixed Effects Coefficients for Closeness Fluctuations Model.

Model	Predictor	*df*	Coefficient (SE)	*t* value	*p* value	Partial Correlation		
						df	*r*	95% CI
1		7265				7267		
	Intercept, γ_{00}		0.36 (0.02)	16.19	< .001			
	Avoidance, γ_{01}*		0.04 (0.02)	2.03	.04		.024	.001, .047
	Anxiety, γ_{02}*		0.04 (0.02)	1.47	.14		.017	-.006, .040
2		7255				7266		
	Intercept, γ_{00}		0.50 (0.03)	16.93	< .001			
	Avoidance, γ_{01}*		-0.01 (0.02)	-0.45	.65		-.005	-.028, .018

	Anxiety, γ_{02}*		0.05 (0.02)	2.61	.01		.031	.008, .054
	Target's closeness mean, β_{10}		-0.68 (0.07)	-10.18	< .001		-.12	-.14, -.096
3		7264				7266		
	Intercept, γ_{00}		0.36 (0.02)	15.93	< .001			
	Avoidance, γ_{01}*		0.05 (0.02)	2.45	.01		.029	.0006, .052
	Anxiety, γ_{02}*		0.04 (0.02)	1.50	.13		.018	-.005, .041
	Anxiety*Avoidance, γ_{03}*		0.04 (0.02)	2.00	.045		.023	.0005, .046
4		7261				7265		
	Intercept, γ_{00}		0.49 (0.03)	17.14	< .001			
	Avoidance, γ_{01}*		0.01 (0.02)	0.60	.55		.007	-.016, .030
	Anxiety, γ_{02}*		0.05 (0.02)	2.41	.02		.028	.005, .051
	Anxiety*Avoidance, γ_{03}*		0.02 (0.02)	0.83	.41		.010	-.013, .033

Target's closeness mean, β_{10}	-0.67 (0.06)	-10.44	< .001	-.12	-.14, -.099

* Fixed slope

Multiplexity Analysis

For the negative binomial model, results showed that for every one unit increase in avoidance, the total number of targets reported (skewness = -0.57, kurtosis = 1.91, range: 10-77) was multiplied by 1.15 times (odds ratio, [1.07, 1.23]), $t(109) = 3.61$, $p < .001$; controlling for anxiety. According to Cohen (1988), this odds ratio amounts to a small effect. Anxiety had no significant association (see Table 4). An additional model including the interaction term of avoidance and anxiety amongst the other predictors showed no significant interaction.

For the log-transformed regression model, avoidance was positively associated with the total number of targets, $B = 0.10$, $t(109) = 2.86$, $p = .005$, $r_p(109) = .26$ [.082, .43]. No other predictors were significant (see Table 5). An additional model with the interaction term of avoidance and anxiety showed no significant association.[3]

Table 4.

Negative Binomial Regression Analysis for Total Number of Targets Mentioned.

Predictor	*df*	Coefficient (SE)	*t* value	*p* value	Odds Ratio (95% CI)
	109				
Intercept		2.24 (.20)	11.24	< .001	9.38 (6.41, 13.76)
Avoidance		0.14 (.04)	3.61	< .001	1.15 (1.07, 1.23)
Anxiety		0.05 (.04)	1.19	.23	1.05 (.97, 1.14)

Table 5.

Linear Regression Analysis for Log-Transformed Total Number of Targets Mentioned.

Predictor	*df*	Coefficient (SE)	*t* value	*p* value	Partial Correlation		
					df	*r*	95% CI
	109				109		
Intercept		2.32 (0.18)	12.74	< .001			
Avoidance		0.10 (0.04)	2.86	.005		.26	.082, .43
Anxiety		0.04 (0.04)	1.01	.32		.10	-.092, .28

Discussion

Although many scholars portray the nature of social connections as dynamic, relatively few studies support this proposition and even fewer investigate factors associated with their changes (Snijders, 2011). Using a longitudinal design and three indexes of perceived closeness (mean level, trajectory, and fluctuations), we found that perceived closeness in social connections increased nonlinearly (significant trajectory) and fluctuated over time, and these fluctuations as well as the mean levels were associated with attachment style.

These findings qualify cross-sectional studies showing closeness tends to increase as relationships extend (e.g., Campbell et al., 2006; Gore, Cross, & Morris, 2006). Using our design and three indexes provided us with several advantages over existing research. First, the mean level of perceived closeness showed significant variance, both across participants and across the targets named by them, evidenced by the ICC's of our model. This implies that people differ in the closeness they feel toward social connections, and even within the same person, there is variation in that closeness depending on the specific other. Perceived closeness seems to depend on the characteristics of each individual and on the quality of each relationship.

Second, this perceived closeness increased over time for the average participant, which suggests that as the relationship lengthens, at least in the case of others important to the individual, something happens that make people become closer. Over time, people may interact more (Moreland & Beach, 1992), have more opportunities for disclosure (Reis & Shaver, 1988), or get to know each other better, leading to fewer misunderstandings and conflicts (e.g., Reis, Clark, & Holmes, 2004), all of which may increase closeness in even those who are insecure. Importantly, we found that this increase in closeness was nonlinear and would eventually level off, and even decline over a long period of time, suggesting the increase in closeness has a ceiling effect.

Third, perceived closeness also exhibited fluctuations, which varied across participants and targets. This indicates over time, closeness to social connections waxes and wanes, and the amount of fluctuations differs across people. Furthermore, even within one person the fluctuation amount depended on the target. Specifically, we found highly close connections to have greater stability in closeness. This further supports the idea that perceived closeness is the outcome of both the individual's characteristics and the relationship's quality. The analysis also sheds light on the nature of the association (closeness being positively associated with stability), which the other two indexes of closeness could not. Finally, our study monitored perceived closeness in numerous social connections rather than focusing on just one relationship (e.g., Korchmaros & Kenny, 2001), allowing us to evaluate relationship quality (mean level of closeness) and discover the association between it and fluctuations in closeness.

We also examined whether personality traits, specifically attachment style, were associated with changes in perceived closeness. As expected, we found that attachment avoidance negatively associated with the mean level of closeness. These findings are in line with cross-sectional research on social connections and closeness (Rowe & Carnelley, 2005), and also fit with more general findings of lower closeness in romantic relationships among avoidants (e.g., Tucker & Anders, 1998). Anxiety, however, did not show a significant association with the mean level of closeness. Our longitudinal design let us go beyond previous findings and investigate the directionality of the effects (Park & Epstein, 2013). As attachment style was measured initially, and perceived closeness was assessed thereon for ten weeks, our findings suggest the direction of the association between attachment and closeness is from attachment to closeness rather than the opposite. In addition, it is possible that if attachment style was assessed each week as closeness was, it would have fluctuated in similar ways. Future studies using experimental designs should be used to further determine directionality.

We also found that attachment avoidance positively associated with fluctuations in closeness to social connections. This was qualified by an interaction with anxiety, such that the association between avoidance and fluctuations was significant only among those who were highly anxious. Anxiety also showed the pattern of positively associating with greater fluctuations in closeness, which suggests insecurity in general is increasing variations in closeness. In other words, securely attached people showed the highest stability. The high fluctuations of insecure people could have been the result of their greater sensitivity to environmental cues (e.g., Gillath, Giesbrecht, & Shaver, 2009) or the fact that they have fewer highly close others (Rowe & Carnelley, 2005), which we found to be more stable. So although insecure people may have some very close others who act as security-providing attachment figures, they would have relatively fewer of those relationships and hence a greater overall amount of closeness fluctuations in their social connections.

We also found that attachment avoidance associated with lower multiplexity. For avoidant people, more individuals were nominated as “important others” during ten weeks. (This is separate from closeness as the correlation between the number of targets nominated and mean closeness did not reach significance. In other words, avoidants nominated more targets overall, but less of these targets were rated as highly close to them.) This could suggest that each individual fulfills fewer roles or functions of an “important other.” As avoidants tend to be more self-reliant and less trusting of others (Hazan & Shaver, 1987), it is reasonable that they would spread their social needs among more people rather than depend on a few. This finding provides further support, using a different social construct (multiplexity), to the negative association between avoidance and closeness.

Across the different indexes, we found fewer significant associations of anxiety with closeness. This may be because anxious people have been shown to exhibit ambivalence toward close figures (e.g., Bartz et al., 2010). The association between anxiety and closeness may be more complicated than that of avoidance and closeness.

Limitations

First, we did not find an association between closeness trajectory and attachment style. This might be due to the short time frame of our study, as previous research on individual differences and closeness tend to use longer time frames, such as months or years (e.g., Feldman, Gowen, & Fisher, 1998). Second, the amount of closeness fluctuations may depend on how long the two people have known each other. Closeness to new friends may be less stable than closeness to friends who have stayed for several years.

Conclusion

Despite these limitations, our findings show that perceived closeness on its various indexes changes over time, and attachment style, mainly avoidance, associates with lower mean levels of closeness, greater fluctuations in closeness, and lower multiplexity. The current findings highlight the importance of assessing change in social connections and their characteristics, seeing how individual differences associate with these characteristics and change, and extend the knowledge on attachment styles, perceived closeness, and social connections.[5]

Footnotes

[1]Excluded participants did not differ from the rest on age, $t(119) = 0.85$, $p = .40$, gender, $X^2(2, N = 121) = 0.08$, $p = .96$, SES, $X^2 (4, N = 121) = 4.17$, $p =.38$, years of education, $X^2(9, N = 121) = 13.35$, $p = .15$, whether or not in an exclusive romantic relationship, $X^2(1, N = 121) = 0.9$, $p = .34$, attachment anxiety, $t(119) = -0.98$, $p = .33$, and avoidance, $t(119) = -0.42$, $p = .68$.

[2]P values were obtained using the cftest function from the multcomp package (Hothorn, Bretz, & Westfall, 2008) in R.

[3]Additional analyses including other covariates are displayed in the Supplementary Materials.

[4]Due to our design (targets had from 2 to 10 data points, ranging from 1 to 7), the smallest possible SD of closeness was 0, and the next smallest value was 0.316227766. This accounts for the gap in data points between the two positions on the Y axis.

[5]Data and analysis program code files are provided through the Open Science Framework (Lee & Gillath, 2016).

References:

Agresti, A. (2007). *An introduction to categorical data analysis* (2nd ed). Hoboken, NJ: Wiley.

Anderson, M. H. (2008). Social networks and the cognitive motivation to realize network opportunities: A study of managers' information gathering behaviors. *Journal of Organizational Behavior*, *29*, 51-78.

Bartz, J. A., Zaki, J., Ochsner, K. N., Bolger, N., Kolevzon, A., Ludwig, N., & Lydon, J. E. (2010). Effects of oxytocin on recollections of maternal care and closeness. *Proceedings of the National Academy of Sciences*, *107*, 21371-21375.

Bates, D., Maechler, M., Bolker, B. & Walker, S. (2014). lme4: Linear mixed-effects models using Eigen and S4. R package version 1.1-7, <URL: http://CRAN.R-project.org/package=lme4>.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*, 497-529.

Berscheid, E., Snyder, M., & Omoto, A. M. (1989). The Relationship Closeness Inventory: Assessing the closeness of interpersonal relationships. *Journal of Personality and Social Psychology*, *57*, 792-807.

Bond, R. M., Fariss, C. J., Jones, J. J., Kramer, A. D., Marlow, C., Settle, J. E., & Fowler, J. H. (2012). A 61-million-person experiment in social influence and political mobilization. *Nature*, *489*, 295-298.

Bowlby, J. (1969). *Attachment and loss: Vol. 1. Attachment.* New York: Basic Books.

Brennan, K. A., Clark, C. L., & Shaver, P. R. (1998). Self-report measurement of adult attachment: An integrative overview. In J. A. Simpson & W. S. Rholes (Eds.), *Attachment theory and close relationships* (pp. 46-76). New York: Guilford.

Cacioppo, J. T., Fowler, J. H., & Christakis, N. A. (2009). Alone in the crowd: The structure and spread of loneliness in a large social network. *Journal of Personality and Social Psychology, 97*, 977-991.

Campbell, L., Lackenbauer, S. D., & Muise, A. (2006). When is being known or adored by romantic partners most beneficial? Self-perceptions, relationship length, and responses to partner's verifying and enhancing appraisals. *Personality and Social Psychology Bulletin*, *32*, 1283-1294.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences.* Hillsdale, NJ: Erlbaum.

Collins, N. L., & Feeney, B. C. (2004). An attachment theory perspective on closeness and intimacy. In D. J. Mashek & A. Aron (Eds.), *Handbook of closeness and intimacy* (pp. 163-187). Mahwah, NJ:Erlbaum.

Curran, P. J., Obeidat, K., & Losardo, D. (2010). Twelve frequently asked questions about growth curve modeling. *Journal of Cognition and Development, 11,* 121-136.

de Jong, K., Moerbeek, M., & van der Leeden, R. (2010). A priori power analysis in longitudinal three-level multilevel models: an example with therapist effects. *Psychotherapy Research*, *20*, 273-284.

Eisenberger, N. I., & Lieberman, M. D. (2004). Why rejection hurts: A common neural alarm system for physical and social pain. *Trends in Cognitive Sciences*, *8*, 294-300.

Feeney, J. A. (1999). Issues of closeness and distance in dating relationships: Effects of sex and attachment style. *Journal of Social and Personal Relationships*, *16,* 571-590.

Feldman, S. S., Gowen, L. K., & Fisher, L. (1998). Family relationships and gender as predictors of romantic intimacy in young adults: A longitudinal study. *Journal of Research on Adolescence*, *8*, 263-286.

Ferriani, S., Fonti, F., & Corrado, R. (2013). The social and economic bases of network multiplexity: Exploring the emergence of multiplex ties. *Strategic Organization*, *11*, 7-34.

Gillath, O., Giesbrecht, B., & Shaver, P. R. (2009). Attachment, attention, and cognitive control: Attachment style and performance on general attention tasks. *Journal of Experimental Social Psychology*, *45*, 647-654.

Gillath, O., Johnson, D. K., Selcuk, E., & Teel, C. (2011). Comparing old and young adults as they cope with life transitions: The links between social network management skills and attachment style to depression. *Clinical Gerontologist*, *34*, 251-265.

Gillath, O., & Karantzas, G. (2015). Insights into the formation of attachment bonds from a social network perspective. In V. Zayas & C. Hazan (Eds.), *Bases of adult attachment* (pp. 131-156). New York, NY: Springer.

Gillath, O., Karantzas, G., & Fraley, R. C. (2016). *Adult attachment: A concise introduction to theory and research.* Academic Press, USA.

Gore, J. S., Cross, S. E., & Morris, M. L. (2006). Let's be friends: Relational self-construal and the development of intimacy. *Personal Relationships*, *13*, 83-102.

Griffin, D., & Bartholomew, K. (1994). Interpersonal relations and group processes-models of the self and other: Fundamental dimensions underlying measures of adult attachment. *Journal of Personality and Social Psychology*, *67,* 430-445.

Hazan, C., & Shaver, P. (1987). Romantic love conceptualized as an attachment process. *Journal of Personality and Social Psychology*, *52*, 511-524.

Heaney, C. A, & Israel, B. A. (2008). Social networks and social support. In K. Glanz, F. M. Lewis, & B. K. Rimer (Eds.), *Health behavior and health education* (4th ed., pp. 189-210). San Francisco, CA: Jossey-Bass.

Hogan, B., Carrasco, J. A., & Wellman, B. (2007). Visualizing personal networks: working with participant-aided sociograms. *Field Methods*, *19*, 116-144.

Hothorn, T., Bretz, F., & Westfall, P. (2008). Simultaneous inference in general parametric models. *Biometrical Journal*, *50*, 346-363.

Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: a meta-analytic review. *PLoS medicine*, *7*, e1000316.

Jokisaari, M., & Nurmi, J. -E. (2012). Getting the right connections? The consequences and antecedents of social networks in newcomer socialization. In C. Wanberg (Ed.), *The Oxford handbook of organizational socialization* (pp. 78-96). New York, NY: Oxford University Press.

Kadushin, C. (2012). *Understanding social networks: Theories, concepts, and findings*. Oxford University Press, USA.

Kenny, D. A. (2004). Correlation and causality (Rev. ed.). Retrieved from http://davidakenny.net/doc/cc_v1.pdf

Kenny, D. A., Kashy, D. A., & Cook, W. L. (2006). *Dyadic data analysis*. New York: Guilford Press.

Kernis, M. H. (2005). Measuring self-esteem in context: The importance of stability of self-esteem in psychological functioning. *Journal of Personality*, *73*, 1569-1605.

Knowles, J. E. (2014, May 17). Fun with merMod objects [Web log post]. Retrieved from http://jaredknowles.com/journal/2014/5/17/mixed-effects-tutorial-2-fun-with-mermod-objects

Kok, B. E., Coffey, K. A., Cohn, M. A., Catalino, L. I., Vacharkulksemsuk, T., Algoe, S. B., Brantley, M., & Fredrickson, B. L. (2013). How positive emotions build physical health perceived positive social connections account for the upward spiral between positive emotions and vagal tone. *Psychological Science*, *24*, 1123-1132.

Korchmaros, J. D., & Kenny, D. A. (2001). Emotional closeness as a mediator of the effect of genetic relatedness on altruism. *Psychological Science*, *12*, 262-265.

Kossinets, G., & Watts, D. J. (2006). Empirical analysis of an evolving social network. *Science*, *311*, 88-90.

Kramer, M. W. (1996). A longitudinal study of peer communication during job transfers the impact of frequency, quality, and network multiplexity on adjustment. *Human Communication Research*, *23*, 59-86.

Kumar, R., Novak, J., & Tomkins, A. (2010). Structure and evolution of online social networks. In P. S. Yu, J. Han, & C. Faloutsos (Eds.), *Link mining: Models, algorithms, and applications* (pp. 337-358). New York: Springer.

Lang, F. R., & Carstensen, L. L. (1994). Close emotional relationships in late life: Further support for proactive aging in the social domain. *Psychology and Aging*, *9*, 315-324.

Lewin, K. (1948). *Resolving social conflicts*. New York, USA: Harper & Brothers.

Lee, J., & Gillath, O. (2016, April 9). Perceived Closeness to Multiple Social Connections and Attachment Style. Retrieved from osf.io/vzqg8

Little, T. D., Jorgensen, T. D., Lang, K. M., & Moore, E. W. G. (2014). On the joys of missing data. *Journal of Pediatric Psychology*, 39, 151-162.

Marin, A. & Wellman, B. (2011). Social network analysis: An introduction. In J. Scott & P. J. Carrington (Eds.), *The Sage handbook of social network analysis* (pp. 2-25). London, United Kingdom: Sage Publications.

Mashek, D. J., & Aron, A. (2004). *Handbook of closeness and intimacy.* Mahwah, NJ: Lawrence Erlbaum Associates.

Mikulincer, M., & Shaver, P. R. (2007). *Attachment in adulthood: Structure, dynamics, and change.* New York, NY: Guilford Press.

Minor, M. J. (1983). New directions in multiplexity analysis. In R. S. Burt & M. J. Minor (Eds.), *Applied network analysis* (pp. 223-244). Beverly Hills, CA: Sage.

Moreland, R. L., & Beach, S. R. (1992). Exposure effects in the classroom: The development of affinity among students. *Journal of Experimental Social Psychology*, *28*, 255-276.

Morgan, D. L., Neal, M. B., & Carder, P. (1997). The stability of core and peripheral networks over time. *Social Networks*, *19*, 9-25.

Nezlek, J. B. (2001). Multilevel random coefficient analyses of event- and interval-contingent data in social and personality psychology research. *Personality and Social Psychology Bulletin*, *27*, 771–785.

Orth, U., Robins, R. W., & Soto, C. J. (2010). Tracking the trajectory of shame, guilt, and pride across the life span. *Journal of Personality and Social Psychology*, *99*, 1061-1071.

Paccagnella, O. (2006). Centering or not centering in multilevel models? The role of the group mean and the assessment of group effects. *Evaluation Review*, *30*, 66-85.

Park, W., & Epstein, N. B. (2013). The longitudinal causal directionality between body image distress and self-esteem among Korean adolescents: The moderating effect of relationships with parents. *Journal of Adolescence*, *36*, 403-411.

Ployhart, R. E., & Vandenberg, R. J. (2010). Longitudinal research: The theory, design, and analysis of change. *Journal of Management*, *36*, 94-120.

Preacher, K. J., Curran, P. J., & Bauer, D. J. (2006). Computational tools for probing interaction effects in multiple linear regression, multilevel modeling, and latent curve analysis. *Journal of Educational and Behavioral Statistics*, *31*, 437-448.

R Core Team (2015). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Thousand Oaks, CA: Sage.

Raudenbush, S. W., & Liu, X. (2001). Effects of study duration, frequency of observation, and sample size on power in studies of group differences in polynomial change. *Psychological Methods*, *6*, 387–401.

Reis, H. T., Clark, M. S., & Holmes, J. G. (2004). Perceived partner responsiveness as an organizing construct in the study of closeness and intimacy. In D. J. Mashek & A. Aron (Eds.), *Handbook of closeness and intimacy* (pp. 201–225). Mahwah, NJ: Erlbaum.

Reis, H., & Shaver, P. (1988). Intimacy as an interpersonal process. In S. Duck (Ed.), *Handbook of personal relationships: Theory, research, and interventions* (pp. 367-389). Oxford, England: John Wiley & Sons.

Roberts, S. G., & Dunbar, R. I. (2011). Communication in social networks: Effects of kinship, network size, and emotional closeness. *Personal Relationships*, *18*, 439-452.

Rowe, A., & Carnelley, K. B. (2003). Attachment style differences in the processing of attachment–relevant information: Primed–style effects on recall, interpersonal expectations, and affect. *Personal Relationships*, *10*, 59-75.

Scherbaum, C. A., & Ferreter, J. M. (2009). Estimating statistical power and required sample sizes for organizational research using multilevel modeling. *Organizational Research Methods*, *12*, 347-367.

Snijders, T. A. B. (2011). Network dynamics. In J. Scott & P. J. Carrington (Eds.), *The Sage handbook of social network analysis* (pp. 501-513). London, United Kingdom: Sage Publications.

Swickert, R. J., Rosentreter, C. J., Hittner, J. B., & Mushrush, J. E. (2002). Extraversion, social support processes, and stress. *Personality and Individual Differences*, *32*, 877-891.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Boston, MA: Allyn and Bacon.

Tavecchio, L. W., & Van Ijzendoorn, M. H. (1987). *Attachment in social networks: Contributions to the Bowlby-Ainsworth attachment theory.* Amsterdam, The Netherlands: Elsevier Science Publishers B. V.

Tucker, J. S., & Anders, S. L. (1998). Adult attachment style and nonverbal closeness in dating couples. *Journal of Nonverbal Behavior*, *22*, 109-124.

Van Zalk, N., Van Zalk, M., Kerr, M., & Stattin, H. (2011). Social anxiety as a basis for friendship selection and socialization in adolescents' social networks. *Journal of Personality*, *79*, 499-526.

Venables, W. N. & Ripley, B. D. (2002). *Modern applied statistics with S* (4th ed). NY: Springer.

Walton, G. M., Cohen, G. L., Cwir, D., & Spencer, S. J. (2012). Mere belonging: the power of social connections. *Journal of Personality and Social Psychology*, *102*, 513-532.

Wrzus, C., Hänel, M., Wagner, J., & Neyer, F. J. (2013). Social network changes and life events across the life span: A meta-analysis. *Psychological Bulletin*, *139*, 53-80.