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Differential Associations Between Interpersonal Variables and Quality-of-Life in a Sample of College Students

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Abstract

Purpose: Humans are fundamentally social beings, and the relationships we form with others are crucial for our well-being. Research across a variety of domains has established the association between a variety of interpersonal factors and health outcomes, including quality-of-life. However, there is a need for a more integrative, holistic analysis of these variables and how they relate to one another.

Methods: Undergraduate students (N = 1,456) from four universities across the United States completed self-report measures of their quality-of-life and a variety of interpersonal factors identified as important predictors across the literature. We examined zero-order correlations between these measures and quality-of-life, estimated a path model to look at unique variance accounted for by each, and finally used network analysis to examine the network of direct and indirect associations among these variables and quality-of-life.

Results: Loneliness had the strongest association with quality-of-life across all analyses. When examining the unique association between quality-of-life and each interpersonal variable, six remained statistically significant: loneliness, social support, social connectedness, emotional intelligence, intimacy with one's romantic partner, and empathic concern. These results were supported by the network model, which found direct associations between quality-of-life and these six variables as well as indirect associations with all other interpersonal variables in the model.

Conclusions: Results from this research suggest that interpersonal factors in general, and loneliness in particular, are strongly associated with quality-of-life. Future research is needed to establish the direction of these effects and examine for whom these findings are generalizable.

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Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee (University of Washington Human Subjects Division - #47191) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

Keywords

interpersonal processes; loneliness; social isolation; quality of life; network analysis

Human beings have evolved such that our survival depends on the relationships we form with others (Bugental, 2000). Meta-analytic research has found that poor quality relationships are associated with increased risk of mortality equivalent to smoking 15 cigarettes daily (Holt-Lunstad & Smith, 2012; Holt-Lunstad, Smith, Baker, Harris, & Stephenson, 2015; Holt-Lunstad, Smith, & Layton, 2010). Despite the importance of relationships, however, the number of Americans who have no close relationships has tripled since 1984 (Mcpherson, Smith-lovin, & Brashears, 2006), and nearly half of American adults report “sometimes” or “always” feeling alone and isolated from others (Cigna, 2018). Similar patterns have been found outside of the United States (e.g., DiJulio, Hamel, Munana, & Brodie, 2018).

Several factors contribute to the association between poor quality relationships and risk of mortality. Interpersonal processes directly and adversely influence health-related biological processes by increasing activation in the hypothalamic-pituitary-adrenal (HPA) axis (Cacioppo, Cacioppo, Capitanio, & Cole, 2015). For example, lonely individuals are more likely to develop cardiovascular disease (Caspi, Harrington, Moffitt, Milne, & Poulton, 2006), have dysregulated immune functioning (Cole et al., 2007), and have higher levels of salivary cortisol (Cacioppo et al., 2000), all adverse physical outcomes linked to increased activation in the HPA axis (Cacioppo et al., 2015). Poor quality relationships contribute to mortality indirectly by increasing unhealthy behaviors such as poor medication adherence (DiMatteo, 2004) and less regular exercise (Hawkley, Thisted, & Cacioppo, 2009). Finally, socially isolated individuals are more likely to develop psychiatric disorders such as major depression (Cacioppo, Hughes, Waite, Hawkley, & Thisted, 2006), which, in turn, confer increased risk for mortality (Laursen, Munk-Olsen, Nordentoft, & Mortensen, 2007; Wulsin, Vaillant, & Wells, 1999). Through these mechanisms, interpersonal processes have the potential to play a substantial role in our health and overall quality-of-life (House, Landis, & Umberson, 1988).

Dozens of research programs across several disciplines (e.g., psychology, evolutionary biology, sociology) have sought to better understand the association between social relationships and indicators of well-being. Although much progress has been made, fundamental findings in the field are often quarantined within separate research traditions, resulting in a heterogeneous set of micro-theories and constructs that Duck and Perlman (1985) referred to as “a thousand islands” of separate research traditions (see also Berscheid, 1995). Although progress has been made in unifying these distinct traditions (Perlman & Duck, 2006), prominent scholars in the field have noted the continued need for “central organizing principles” that identify related constructs, integrate findings, and facilitate generalization across research disciplines (Reis, 2007).

The goal of unifying research on relationships and well-being has critical practical importance. To inform the development of interventions and public policies that target interpersonal correlates of quality-of-life, an understanding of which processes are most

important and how they relate to each other is needed. For example, in order to maximize efficiency and minimize patient suffering, would it be more beneficial for a psychotherapist to focus on improving the quality of one's romantic relationships or to engage them more with their broader social support network? Should public policy focus directly on targeting the subjective feeling of loneliness or programs that increase social support? If one process is targeted, how quickly and of what magnitude can we expect change in related processes?

The overarching goal of this research was to examine the associations among a set of transtheoretical interpersonal variables and quality-of-life. We did so by exploring (a) the direct, bivariate associations among well-established interpersonal variables and quality-of-life, (b) how these associations change when accounting for shared variance of the other interpersonal variables, and (c) the direct and indirect pathways through which these variables are associated with quality-of-life. We selected interpersonal variables across different theoretical frameworks that are posited to influence a health-related (e.g., psychopathology) or social functioning (e.g., sense of belonging) outcome. In doing so, we identified variables that were measured across different relationship types (e.g., romantic, non-romantic), time periods (e.g., lifetime, one-week), and domains (e.g., structural/subjective, state/trait), and also included converging constructs (e.g., social connectedness, loneliness) studied across different programs of research. First, we selected well-validated measures of *skills, abilities, and dispositions* seen as foundational to relational success, including emotional intelligence (the ability to regulate and understand emotions in oneself and others; Schutte et al., 2001), theory of mind/emotion recognition (the ability to attribute different mental states to oneself and others; Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), empathic concern (the degree to which one experiences sympathy and concern for others; Davis, 1983), and perspective taking (the ability to take another's point of view; Davis, 1983). Second, we selected measures of *behaviors* important to relational success, including the degree to which one engages in intimate interactions (i.e., involving vulnerability and responsiveness; Reis & Shaver, 1988) with a specific individual in their life and in general with others. Finally, we included measures of *perceived closeness across relational domains* including feelings of loneliness (e.g., a discrepancy between one's desired and perceived level of social engagement; Cacioppo et al., 2002), social connectedness (feelings of interpersonal closeness with others in general; Lee, Draper, & Lee, 2001), social support (the degree to which one perceives emotional and instrumental support in their relationships; Sherbourne & Stewart, 1991), and perceived intimacy with one's romantic partner. In doing so, we aimed to lay the groundwork for a transtheoretical analysis of the association between key interpersonal variables and quality-of-life that has the potential to inform clinical decision making, public policy, and future research.

Method

Participants and Procedure

Participants were 1,456 undergraduate students from four universities across the United States who participated in exchange for extra course credit. Prospective participants viewed a list of studies that they could participate in through their university's psychology subject pool. If they were interested in participating in our research, they followed a link to an

online information statement which described the purpose and procedures of the current research. Upon providing informed consent to participate, subjects were presented with an online battery of measures (described below), including questions pertaining to demographic information. Participants completed the survey using their personal computers in a location of their choice. Participant ages ranged from 18 to 41 (M = 19.69, SD = 2.35). The majority of participants identified as female (62%), white (57%), single/not in a relationship (59%), and born in the United States (77%). Data for this study were collected as part of a larger scale development project (Kuczynski et al., 2019) and selected for their centrality within the relationship science literature.

Measures

Quality-of-Life.—The World Health Organization Quality of Life – BREF (WHOQOL; World Health Organization Quality of Life Group, 1998) is a 26-item self-report measure of quality-of-life measured in four domains: physical health, psychological health, social relationships, and environment. Participants rate each item on a 5-point Likert scale ranging from 1 (*Very dissatisfied Not at all/Very poor Never*) to 5 (*Very satisfied/An extreme amount/Extremely/Completely/Very Well/Always*). The WHOQOL has been used cross-nationally and discriminates well between individuals expected to have different levels of quality-of-life, including individuals with medical diagnoses (Skevington, Lotfy, & O'Connell, 2004) and mental health diagnoses (Masthoff, Trompenaars, Van Heck, Hodiamont, & De Vries, 2006). The WHOQOL has also been used in previous research to measure quality-of-life as a function of interpersonal processes (e.g., loneliness; Gerino, Rollé, Sechi, & Brustia, 2017). An overall quality-of-life mean score was computed. Internal consistency in the current sample was strong (α = .92).

Fear-of-Intimacy.—The Fear-of-Intimacy Scale (FIS; Descutner & Thelen, 1991) is a 35-item self-report measure of anxiety regarding close, dating relationships. Participants rate each item on a 5-point Likert scale ranging from 1 (*Not at all characteristic of me*) to 5 (*Extremely characteristic of me*). Individuals with greater FIS scores are less comfortable with emotional closeness (Greenfield & Thelen, 1997), less satisfied with their relationships (Montesi et al., 2013), and engage in less intimate behaviors (emotional, sexual, etc.) with their romantic partner (Thelen, Vander Wal, Thomas, & Harmon, 2000) relative to individuals who score low on the FIS. An overall fear-of-intimacy score was computed as the sum of all items. Internal consistency in the current sample was strong (α = .93).

Loneliness.—The UCLA Loneliness Scale (UCLALS; Russell, 1996) is a 20-item self-report measure of loneliness. Participants rate each item on a 4-point Likert scale ranging from 1 (*never*) to 4 (*always*). Scores on the UCLALS are distinct from measures of depressed affect (Cacioppo, Hawkley, et al., 2006) and are associated with less rewarding social experiences (Cacioppo, J. T.; Norris, C. J.; Decety, J.; Monteleone, 2010), less social contact (Pinquart & Sörensen, 2003), and poor quality social relationships (Hawkley et al., 2008). An overall loneliness score was computed as the sum of all items. Internal consistency in the current sample was strong (α = .93).

Social Connectedness.—The Social Connectedness Scale (SCS; Lee & Robbins, 1995) is an 8-item self-report measure of perceived social connectedness. Participants rate each item on a 6-point Likert scale ranging from 1 (*Strongly Agree*) to 6 (*Strongly Disagree*). The SCS is used frequently with student samples (Lee & Robbins, 2000) and is associated with one's level of social support (Lee & Robbins, 1998), self-reported well-being and mental health (Brown, Hoye, & Nicholson, 2012), and perceived stress in college students (Lee, Keough, & Sexton, 2002). An overall social connectedness score was computed by reverse scoring and taking the sum of all items. Internal consistency in the current sample was strong (α = .96).

Social Support.—The Medical Outcomes Study Social Support Survey (SSS; Sherbourne & Stewart, 1991) is a 19-item self-report measure of perceived social support across four domains: emotional/informational, structural, affectionate, and positive social interaction. Participants rate each item on a 5-point Likert scale ranging from 1 (*None of the time*) to 5 (*All of the time*). The SSS has demonstrated strong psychometric properties in college student samples (Giangrasso & Casale, 2014) and is associated with mental and physical health, loneliness, and level of family functioning (Sherbourne & Stewart, 1991). An overall social support score was computed by transforming the mean across all items to a 0 – 100 score. Internal consistency in the current sample was strong (α = .96).

Emotional Intelligence.—The Schutte Self-report Emotional Intelligence Test (SSEIT; Schutte et al., 1998) is a 33-item self-report measure of emotional intelligence that emphasizes emotional expression, appraisal, regulation, and use of emotions. Participants rate each item on a 5-point Likert scale ranging from 1 (*Strongly disagree*) to 5 (*Strongly agree*). Scores on the SSEIT are negatively associated with alexithymia (Schutte et al., 1998) and positively associated with subjective well-being (Sánchez-Álvarez, Extremera, & Fernández-Berrocal, 2016) and relationship satisfaction (Schutte et al., 2001). An overall emotional intelligence score was computed as the sum of all items. Internal consistency in the current sample was strong (α = .92).

Theory of Mind.—The Reading the Mind in the Eyes Test (RMET; Baron-Cohen et al., 2001) is a 36-item measure of the degree to which participants can infer one's emotional state from their facial expression. Participants view a photograph of the eye region of an individual's face and select an emotion word (e.g., irritated, relieved) from four response options, only one of which is a correct response. Scores on the RMET successfully differentiate between individuals expected to differ in their theory of mind abilities, providing support for the construct validity of the RMET. For example, individuals with a diagnosis of Autism Spectrum Disorder tend to score lower than those without the diagnosis (Baron-Cohen et al., 2015); a similar pattern was found for those with a diagnosis of schizophrenia compared to those without the diagnosis (Bora, Yucel, & Pantelis, 2009). Others have noted, however, that the RMET may more closely resemble a measure of emotion recognition than theory of mind (Oakley, Brewer, Bird, & Catmur, 2016). An overall theory of mind score is computed by computing the total number of correct responses. Internal consistency in the current sample was acceptable (α = .78).

Intimacy with romantic partner.—The Miller Social Intimacy Scale (MSIS; Miller & Lefcourt, 1982) is a 17-item self-report measure of intimacy experienced in a particular romantic relationship. Only those participants who indicated currently being in a romantic relationship (n = 597) responded to the MSIS. Participants rate each item on a 10-point Likert scale ranging from 1 (*Very rarely*) to 10 (*Almost Always*). Scores on the MSIS are associated with relationship satisfaction (Anderson & Emmers-Sommer, 2006) and engagement in self-disclosure after experience stress (Miller & Lefcourt, 1983), and are higher in those who are married versus those who are not (Miller & Lefcourt, 1982). An overall intimacy score was computed as the sum of all items. Internal consistency in the current sample was acceptable (α = .92).

Intimacy with chosen individual.—The Functional Analytic Psychotherapy Intimacy Scale (FAPIS; Leonard et al., 2014) is a 14-item self-report measure of intimacy-related behaviors with a particular chosen individual (e.g., friend, family member, romantic partner). The majority of participants chose a friend (45%), a parent (34%), or a sibling (16%), with only 1% choosing a romantic partner. Participants rate each item on a 7-point Likert scale ranging from 0 (*Not at all*) to 6 (*Completely*). Scores on the FAPIS are positively associated with perceived social support and social skills (Leonard et al., 2014) and are sensitive to change following a dyadic intervention to increase intimate relational functioning (Kanter, Kuczynski, Tsai, & Kohlenberg, 2018). A total scale score was computed as the sum of all items. Internal consistency in the current sample was acceptable (α = .92).

Awareness, Courage, and Responsiveness.—The Awareness, Courage, and Responsiveness Scale (ACRS; Kuczynski et al., 2019) is a 24-item self-report measure of behaviors fundamental to the development of relational intimacy. Participants rate each item on a 7-point Likert Scale ranging from 1 (*Never true*) to 7 (*Always true*). The ACRS demonstrated strong psychometric properties in the initial validation sample, including strong factor structure and measurement invariance. An overall mean score was computed. Internal consistency in the current sample was strong (α = .93).

Empathic Concern.—The Interpersonal Reactivity Index (IRI; Davis, 1980) Empathic Concern subscale is a 7-item self-report measure of one's tendency to experience feelings of concern and compassion for others undergoing challenges. Participants rate each item on a 5-point Likert scale ranging from 1 (*Does not describe me well*) to 5 (*Describes me very well*). Scores on the IRI empathic concern subscale are positively associated with related constructs such as emotional intelligence (Schutte et al., 2001), mental well-being (Shanafelt et al., 2005), and relationship satisfaction (Péloquin & Lafontaine, 2010) and negatively associated with constructs presumed to measure lack of empathy (e.g., psychopathy Glenn, Iyer, Graham, Koleva, & Haidt, 2009). An overall empathic concern score was computed as the sum of all items. Internal consistency in the current sample was acceptable (α = .77).

Perspective Taking.—The Interpersonal Reactivity Index (IRI; Davis, 1980) Perspective Taking subscale is a 7-item self-report measure of one's ability to take others' perspective. Participants rate each item on a 5-point Likert scale ranging from 1 (*Does not described me*

well) to 5 (*Describes me very well*). Scores on the perspective taking subscale are associated with conflict style (Corcoran & Mallinckrodt, 2000), patient satisfaction in medical encounters (Blatt, Lelacheur, Galinsky, Simmens, & Greenberg, 2010), and measures of interpersonal functioning (e.g., loneliness; Davis, 1983). An overall perspective taking score was computed as the sum of all items. Internal consistency in the current sample was acceptable ($\alpha = .77$).

Data Analytic Strategy

We took a three-pronged approach to analyzing these data for the purpose of addressing our three aims and evaluating whether our findings were stable across different analytic techniques. We used R version 3.5.2 (R Core Team, 2018) for all analyses. First, we computed zero-order correlations and associated 99% confidence intervals between quality-of-life and each of our interpersonal variables, which provided a preliminary understanding of the degree to which each variable is associated with quality-of-life, not accounting for the shared covariance with other interpersonal variables. To minimize type I errors, we used an α-level of .01 and compared *p*-values against a Sidak corrected value (Šidák, 1967) to maintain this criterion at the family-wise level.

Second, using the lavaan R package (version 0.6.2; Rosseel, 2012), we used path modeling to estimate the unique association of each interpersonal variable with quality-of-life. This analysis helps answer the question, “What is the association between quality-of-life and each interpersonal variable after taking the effect of all other variables into account?” Full information maximum likelihood (FIML) was used to estimate all model parameters and all variables were standardized prior to the analysis.

Although the path model expanded upon the zero-order correlations by estimating conditionally independent associations (i.e., unique variance accounted for by each variable), a major limitation is that both sets of analyses estimated bivariate (i.e., direct) relationships and thus failed to capture a more complex system of associations among the variables. In other words, these analyses provide an understanding of the different ways in which each interpersonal variable is directly associated with quality-of-life but fail to illustrate clearly how the covariance among these variables results in a larger, transtheoretical system of associations. To complement and expand upon the path analysis, network analysis was used to model the conditionally independent pathways – both direct *and* indirect – through which the interpersonal variables were associated with quality-of-life.

Specifically, we estimated a Gaussian Graphical Model (GGM), which depicts the interpersonal variables as existing within a complex network of associations with each other and with quality-of-life. Variables within the GGM are referred to as *nodes* and the associations between them as *edges* (Epskamp, Waldorp, Mõttus, & Borsboom, 2018). For this research, we estimated a partial correlation network using the graphical least absolute shrinkage and selection operator (LASSO; Friedman, Hastie, & Tibshirani, 2008; Tibshirani, 1996) as implemented in the qgraph R package (version 1.6.2; Epskamp, Cramer, Waldorp, Schmittmann, & Borsboom, 2012). LASSO estimation differs from other estimation techniques in several ways. Most notably, it uses a penalized maximum likelihood solution to estimate a model that contains fewer edges than other estimation techniques while still

explaining the data well (i.e., accurately reproducing the observed pattern of correlations). As such, it uses regularization rather than statistical significance to determine the presence and absence of associations. In the current research, several models with varying levels of sparseness (i.e., connections between nodes) were estimated and a final model was selected using the Extended Bayesian Information Criterion (EBIC; Chen & Chen, 2008). A tuning parameter (γ) of 0.5 was used for model selection, which prioritizes the reduction of Type I error.

We estimated three centrality indices for each node in the network (i.e., strength, betweenness, and closeness centrality), which quantify the features of the relationship between individual nodes and the remainder of the network. Strength centrality refers to how strongly connected a given node is in the network and is computed by taking the sum of the absolute edge weights connected to each node. Betweenness centrality refers to the extent to which a node facilitates (i.e. mediates) the flow of information throughout the network and is computed by counting how often a given node is on the shortest path between every combination of two other nodes. Closeness centrality refers to the average distance from a given node to all other nodes in the network, with high closeness indicating a shorter average distance (Opsahl, Agneessens, & Skvoretz, 2010). The qgraph R package (Epskamp et al., 2012) was used for these analyses.

To examine the stability of the edge weight estimates in our final model, we computed 95% bootstrapped confidence intervals around the estimate for each pair of nodes using the bootnet R package (version 1.1.0; Epskamp et al., 2018). To examine stability of the parameter estimates in our final model, we computed the CS-coefficient, which is an estimate of the maximum proportion of cases in the original data that can be dropped while maintaining, with 95% confidence, a correlation with the original centrality parameter estimate of .70. Per Epskamp, Borsboom, and Fried (2018), we used a cut-off of .50 (i.e., more than 50% of original cases dropped) to indicate sufficient stability of each centrality parameter estimate.

We also conducted a “shortest paths analysis” between each interpersonal variable and quality-of-life using Dijkstra’s (1959) algorithm, which represents the minimum number of “steps” (i.e., edges) needed to get from one node to another, accounting for the strength of each edge. In this way, the entire network can be viewed as a “roadmap” that includes all possible routes to quality-of-life from each interpersonal variable, with the shortest path highlighting the quickest route (Isvoranu et al., 2017). The qgraph R package (Epskamp et al., 2012) was used for these analyses.

Results

Zero-order correlations

We computed zero-order correlation coefficients between quality-of-life and each interpersonal variable, all of which were significant at the Šidák corrected α-level of .0009 (see Table 1 for the full list of zero-order correlations and their associated 99% confidence intervals). Of the eleven variables included in this research, loneliness ($r = -.65$, $CI.99_{.99} = [-.69, -.61]$) and social support ($r = .61$, $CI_{.99} = [-.56, .65]$) had the strongest associations

with quality-of-life. Loneliness and social support were not statistically distinguishable, however, loneliness was distinguishable from all other variables, including the third strongest, social connectedness (r = .55, $CI_{.99}$ = [.51, .60]). The weakest associations were with empathic concern (r = .21, $CI_{.99}$ = [.14, .27]), perspective taking (r = .19, $CI_{.99}$ = [.12, .25]), and theory of mind (r = .12, $CI_{.99}$ = [.06, .19]).

Path Model

The just-identified path model converged after 56 iterations of full information maximum likelihood estimation. Standardized path coefficients in the model (see Figure 1) represent the degree to which quality-of-life is expected to vary as each interpersonal variable varies, with larger values indicating a stronger association. A similar pattern emerged in the path model as in the zero-order correlations, with smaller values overall after adjusting for shared variance among the interpersonal variables. After correcting for family-wise error using the Šidák correction (Šidák, 1967), loneliness (β = −.348, p < .0009) again emerged as having the strongest association with quality-of-life, followed this time by emotional intelligence (β = .278, p< .0009). These results suggest that, conditional on all other variables in the model, quality-of-life is expected to increase by .348 standard deviations for each standard deviation decrease in loneliness. Other statistically significant paths in this model include social support (β = .109), social connectedness (β = .097), intimacy with one's romantic partner (β = .252), and empathic concern (β = .106). Confidence intervals around the path estimates suggest that the top three strongest associations (loneliness, emotional intelligence, and intimacy with one's romantic partner) are not statistically distinguishable.

Network Analysis

A graphical depiction of the estimated network structure (GGM) can be found in Figure 2A. Results suggested that our edge weight estimates were stable (see supplementary materials). Consonant with the previous two analyses, quality-of-life was directly associated with loneliness, intimacy with one's romantic partner, social support, social connectedness, emotional intelligence, and empathic concern. Quality-of-life was also indirectly associated with the remaining interpersonal variables with each variable at most two steps away from quality-of-life. The shortest paths analysis (Figure 2B) highlights the strongest (i.e., most direct, accounting for edge weights) path of each interpersonal variable to quality-of-life. Of the six direct paths to quality-of-life, four were identified as the shortest path in this analysis: loneliness, intimacy with one's romantic partner, emotional intelligence, and empathic concern. Social support and social connectedness were more strongly connected to quality-of-life via their association with loneliness than their direct path.

Centrality estimates of each node (Figure 3) provide an assessment of the overall relationship between individual nodes and the remainder of the network (Opsahl et al., 2010). Strength (CS[r = .70] = .75) and closeness (CS[r = .70] = .60) met our criterion for stability, but betweenness (CS[r = .70] = .44) did not (see supplementary materials for further details). Thus, we only interpret strength and closeness centrality here. Loneliness had the largest strength and closeness centrality, suggesting that it is strongly connected within the network. Conversely, intimacy with one's chosen individual had the lowest strength and closeness centralities, suggesting that it is not as strongly connected.

Interestingly, quality-of-life had the highest closeness centrality of all variables in the model, indicating that it is centrally located within the network, illustrating its strong association with the interpersonal variables included in this research.

Discussion

In this study, we examined the associations between key interpersonal variables and self-reported quality-of-life in a sample of undergraduate students. First, we estimated direct, bivariate associations. Then, we examined how these associations changed when controlling for the other interpersonal variables using a simple path model. Finally, we used network analysis to model the complex direct and indirect associations between these variables and quality-of-life. These analyses provide us information about the unconditional and conditional associations among interpersonal and quality-of-life variables while also allowing us to examine whether there is convergence in findings across different methods.

Across all three analyses, interpersonal processes were strongly associated with quality-of-life, accounting for more than half (56.5%) of its total variance. Loneliness, social support, and social connectedness had the strongest bivariate associations with quality-of-life. When covarying the shared effects of the other interpersonal variables, six variables remained significantly associated with quality-of-life: loneliness, social support, social connectedness, emotional intelligence, intimacy with one's romantic partner, and empathic concern. The network model, which uses regularization rather than statistical significance to identify existing associations, also converged on these findings, identifying the same set of interpersonal variables as uniquely associated with quality-of-life. These results suggest that the other variables in the model are associated with quality-of-life through their association with these six interpersonal variables.

The direct association between loneliness and quality-of-life is consistent with prior research that documents the importance of loneliness in health-related outcomes (e.g., Cacioppo, Hawkley, & Thisted, 2010; Cacioppo, Hughes, et al., 2006) and suggests that lonelier individuals, all else being equal, have poorer quality-of-life. Conversely, social support and feelings of social connectedness appear to have a direct, positive association such that individuals higher in these variables report greater quality-of-life. Interestingly, our shortest path analysis suggests the possibility that these variables may be more strongly associated with quality-of-life through their association with loneliness than through their direct association with quality-of-life; a possibility that should be further examined using methods that more directly assess the strength and statistical significance of indirect effects (e.g., Preacher & Hayes, 2004). Independent of these variables, individuals who report greater intimacy with their romantic partner also report greater quality-of-life, which is consistent with prior research on relationship satisfaction (e.g., Berry & Williams, 1987). The direct, negative association between empathic concern and quality-of-life is in opposition to its positive zero-order correlation found in this research. This negative conditional association was relatively weak and may be the result of a methodological artifact (e.g., collider bias; Elwert & Winship, 2014). Nevertheless, it is possible that, after accounting for its association with other interpersonal variables, empathic concern has some cost for quality of life, or is associated with other unassessed variables that have such a cost. For example,

people who experience distressing events demonstrate more empathic concern for those in a similar position (e.g., Batson et al., 1996; c.f., Ruttan, McDonnell, & Nordgren, 2015) and the experience of distressing events is likely to be associated with poorer quality-of-life.

Other variables that are not directly associated with quality-of-life may still be indirectly associated via their association with other variables. For example, individuals high in fear-of-intimacy report greater levels of loneliness and lower intimacy with their romantic partner, both of which are risk factors for poor quality-of-life. These findings are consistent with prior research that documents the behavioral and emotional consequences of heightened sensitivity to social threats (e.g., fear-of-intimacy) for lonely individuals (Cacioppo & Hawkley, 2010). It is thus possible that interventions that target fear-of-intimacy (e.g., Maitland et al., 2016) may have beneficial effects on one's overall quality-of-life (although more research is needed to establish the direction of these effects).

Limitations and Future Directions

The current study includes several limitations. First, the data are cross-sectional, prohibiting causal interpretations of our findings. Loneliness may have high strength centrality, for example, because it causes changes on the nodes connected to it (out-strength), because connected nodes cause changes in loneliness (in-strength), or because of their mutual association with a third variable (Epskamp, Waldorp, et al., 2018). It is also possible that node centrality is function of heterogeneous node variance rather than meaningful associations with other nodes (Terluin, De Boer, & De Vet, 2016). In the current study, node variance was not significantly correlated with closeness ($r = -.18$, $p = .58$) or strength ($r = .26$, $p = .42$), suggesting that differences in variance are unlikely to have driven these findings. Relatedly, the effects estimated in the current study do not necessarily correspond with within-subjects effects (Epskamp, Waldorp, et al., 2018). For example, it is possible that loneliness motivates us to seek social connections (Cacioppo & Cacioppo, 2014), which may produce a positive within-subjects association, but that individuals higher in loneliness are also less socially connected on average, thus producing a negative between-subjects association, as was found in the current study. Although previous research has documented temporal precedence for the effect of loneliness on health-related outcomes (e.g., Cacioppo et al., 2010), future research employing longitudinal and experimental methodology is needed to disentangle these possibilities in the context of the current findings.

Second, it can be argued that several variables included in the present research only show associations with each other because they represent functionally similar constructs. For example, the strongest association in the network model was that between loneliness and social connectedness. Is this a true association between related but distinct constructs, or is loneliness simply the inverse of social connectedness? Although research suggests there is a real difference (e.g., Cacioppo, Fowler, & Christakis, 2009), factor analytic research is needed to clarify the distinction. Examination of zero-order correlations (see supplementary materials) does not suggest that these variables are simply the inverse of each other).

Third, our sample was a young, majority white convenience sample of undergraduate students in the United States. As such, findings may not generalize to individuals with different cultural backgrounds or with different social structures than those in our sample.

Future research would benefit from recruiting a more racially, socioeconomically, and geographically diverse sample that allows for a more nuanced understanding of the role of cultural differences in these findings.

Fourth, our data are limited to self-reported outcomes which may be influenced by a number of biases in responding (e.g., van de Mortel, 2008). Although many of the variables examined in the current research reflect subjective perceptions (e.g., loneliness; Peplau & Perlman, 1979), the current work would be meaningfully expanded upon by employing multiple methods of measurement to disentangle bias and any potential method variance. For example, the internal consistency coefficients of the scales used to measure empathic concern ($\alpha = .77$), perspective taking ($\alpha = .77$), and theory of mind ($\alpha = .78$) were relatively low compared to other scales used in the current research. Although these values fall within a generally accepted range of internal consistency (Nunnally & Bernstein, 1994; Streiner, 2003) and were either comparable to (empathic concern and perspective taking) and larger than (theory of mind) previous psychometric analyses of these scales (e.g., Davis, 1980; Voracek & Dressler, 2006), it nevertheless limits our ability to make meaningful inferences about these variables (Cook & Beckman, 2006).

Lastly, our work was exploratory. To protect against spurious findings, we used a conservative criterion for all analyses (a Šidák adjusted α-level for the first two analyses and regularization for the network model). Nonetheless, caution should be exercised until research with separate samples replicate the current findings.

Conclusions

This study examined the association between quality-of-life and eleven well-established interpersonal variables. All variables were significantly associated with quality-of-life at the bivariate level and six remained significant after controlling for shared variance. Results from the network analysis suggest four key paths to quality-of-life through loneliness, intimacy with one's romantic partner, emotional intelligence, and empathic concern. Loneliness had the strongest association with quality-of-life across all analyses. Overall, this research suggests that interpersonal factors in general, and loneliness in particular, are strongly associated with quality-of-life.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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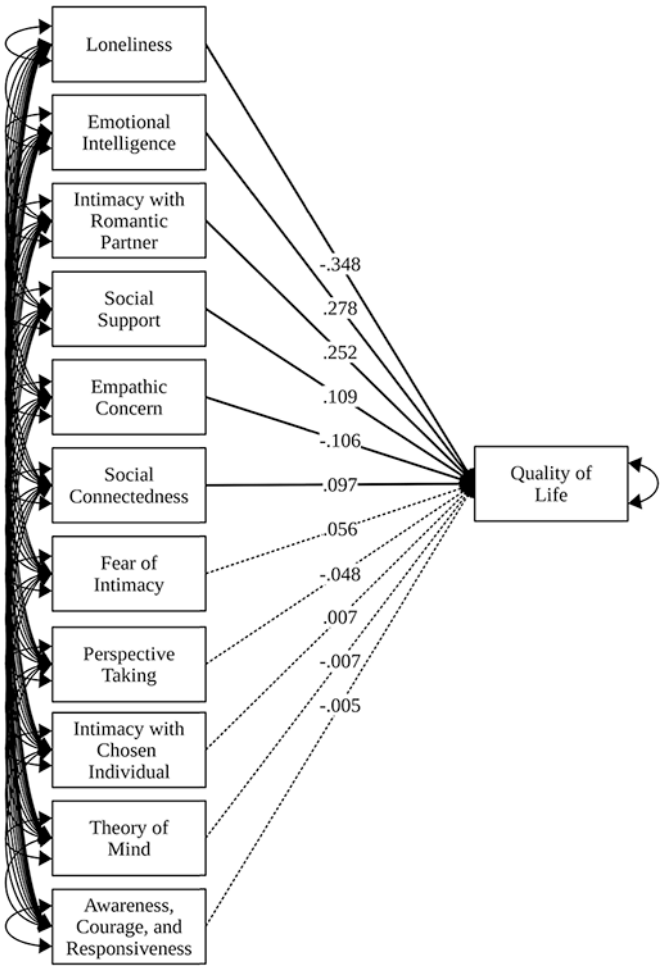

Figure 1.

Path model of the association between each interpersonal variable and quality-of-life. Path coefficients represent standardized effect sizes. Dashed lines indicate that the association is not statistically significant ($p > .01$).

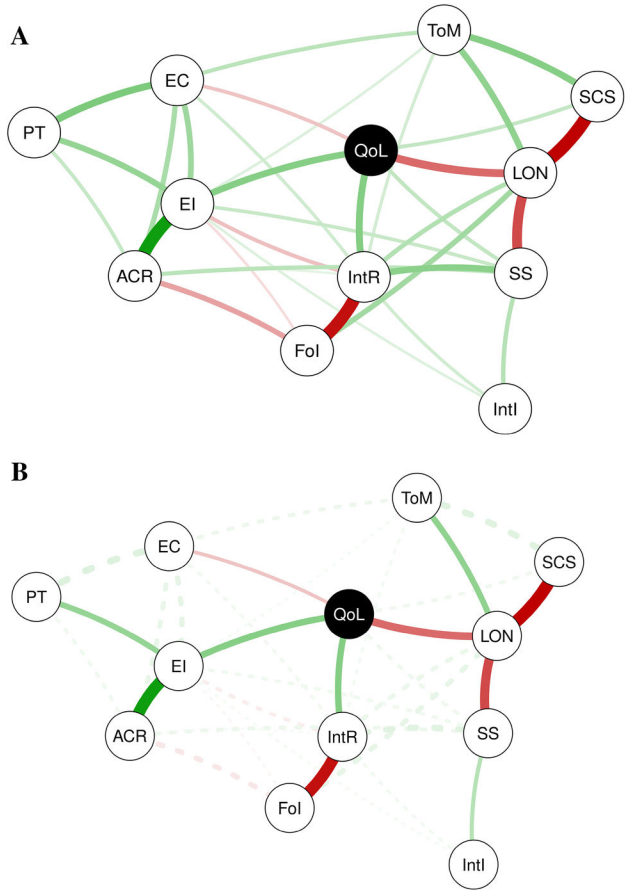

Figure 2.

(A) Network estimated via the graphical LASSO depicting regularized partial correlations between interpersonal variables in quality-of-life. Edge thickness represents the strength of each association. Green edges represent positive associations. Red edges represent negative associations. (B) Network depicting the shortest paths between each interpersonal variable and quality-of-life. Dashed lines represent connections in the network that do not lie on the "shortest" path. ACR = Awareness, Courage, and Responsiveness; EC = Empathic Concern; EI = Emotional Intelligence; FoI = Fear-of-Intimacy; IntR = Intimacy with one's romantic partner; IntI = Intimacy with one's chosen partner; LON = Loneliness; PT = Perspective Taking; QoL = Quality-of-Life; SCS = Social Connectedness; SS = Social Support; ToM = Theory of Mind

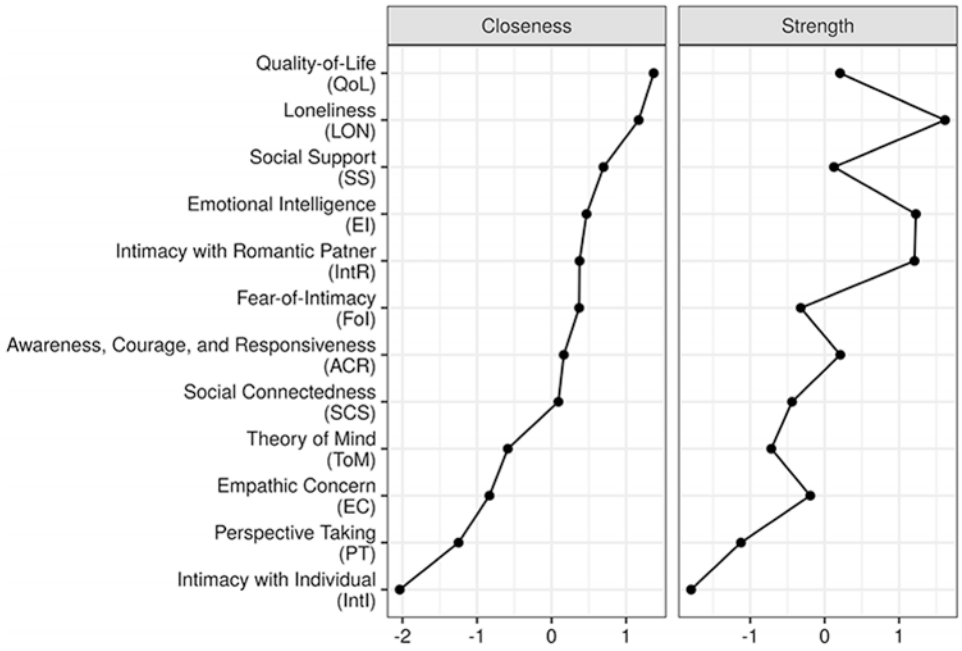

Figure 3.
Strength and closeness centrality for each node, in standardized units.

Table 1

Zero-order correlations and associated 99% confidence intervals between interpersonal variables and quality-of-life arranged in descending order by absolute magnitude of the estimate

Interpersonal Variable	*M*	*SD*	Lower	Estimate (*r*)	Upper
Loneliness	45.03	10.94	−.689	−.652	−.611
Social Support	96.70	20.95	.565	.609	.650
Social Connectedness	36.58	10.10	.506	.555	.600
Emotional Intelligence	120.30	16.51	.479	.529	.576
Intimacy with Romantic Partner	142.93	21.67	.432	.513	.587
Awareness, Courage, and Responsiveness	5.11	0.78	.394	.450	.502
Fear-of-Intimacy	83.14	21.83	−.483	−.429	−.372
Intimacy with Chosen Individual	61.16	15.31	.284	.345	.403
Empathic Concern	26.09	4.60	.142	.208	.271
Perspective Taking	24.31	4.56	.122	.188	.252
Theory of Mind	22.96	5.72	.057	.124	.190

Note. All estimates are statistically significant at the Šidák corrected α-level of .0009.