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Friendship Network Satisfaction: A multifaceted construct scored as a unidimensional scale

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Abstract

Although satisfying friendships are crucial for well-being throughout adulthood, measures of friendship satisfaction have been limited by: (1) item content relevant to children only, (2) a focus on single relationships rather than the friendship network, and (3) disagreement about the number of dimensions necessary to capture the construct. To overcome these limitations, we assembled an item pool from a number of existing measures, created additional items drawn from research on friendships, and then examined the structure and psychometric properties of those items in two online surveys of over 2000 respondents each. Factor analyses consistently identified two correlated factors—closeness and socializing—but bi-factor modeling revealed that scores on both subscales load strongly on a general factor, suggesting that the multifaceted content can be scored efficiently as a unidimensional composite. Analyses using item response theory (IRT) supported the creation of a reliable 14-item instrument that demonstrated adequate convergent and predictive validity. Thus, the Friendship Network Satisfaction (FNS) Scale is a psychometrically sound tool to advance research on friendships across the lifespan.

Keywords

Assessment; bi-factor model; friendship; satisfaction; social networks

In a mobile world, where marriages are less frequent (Eickmeyer et al., 2020) and careers often separate people from their families (Charles et al., 2008), friendships have been called "the defining relationship of our age" (Vernon, 2005, p. 1). When people have close friends, they tend to be physically healthier and experience greater life satisfaction (White et al., 2009). Loneliness, in contrast, is a reliable predictor of emotional distress and physical

illness, comparable to smoking in its association with mortality (Holt-Lunstad et al., 2015). It is not merely the presence of friends, but the quality of friendships that is associated with these outcomes: controlling for their number of friends, people report greater well-being when they feel satisfied with their friendships than when they feel less satisfied (Lewis et al., 2015; Saldarriaga et al., 2015).

Given the long history of scholarship on friendships, it might be expected that a reliable, psychometrically sound instrument for measuring satisfaction with those friendships would be well established. Yet, despite increasing recognition of the importance of friendships (e.g., Huxhold, 2019), measurement has lagged behind for several reasons. First, several instruments assessing satisfaction with friendships were developed for use with children, and thus include items that are inappropriate for assessing friendships between adults (e.g., "My friend and I go to each other's houses after school"; Bukowski et al., 1994). Second, existing instruments typically assess the quality of a single relationship (e.g., "your best friend"; Parker & Asher, 1993) rather than the quality of the friendship network as a whole. Finally, to date, the content and structure of the construct remains in dispute: there has been no consensus on the relevant dimensions on which friendships may be evaluated. To overcome these limitations, the goal of the research described here was to develop and validate a new self-report instrument for assessing satisfaction with adult friendships.

Best friends vs. friendship networks

Definitions of friendships have varied across researchers, with most identifying friendships as personal relationships that are voluntary, mutual, and enjoyable (e.g., Fehr & Harasymchuk, 2018, 2019; Lynch, 2015). Within that broad definition is space for a wide variety of relationships, from sibling-like intimates to pleasant acquaintances (Birditt & Antonucci, 2007; Granovetter, 1973). Yet despite this range of friendships, most available tools for assessing friendships focus narrowly on a single relationship, asking respondents to consider their "best friend," i.e. their favorite friendship.

Indeed, a best friendship can be long-lasting (Ledbetter et al., 2007), and, among adolescents, perceptions of a best friend's behavior can influence willingness to engage in activities like sex (Prinstein et al., 2003) and smoking (Harakeh et al., 2007). Nevertheless, an exclusive focus on best friends may be misleadingly narrow, because not everyone with friends can name a best one (Birditt & Antonucci, 2007). According to an online survey of over 10,000 respondents, people in the U.S. name an average of three people as their best friends (Snapchat.com, 2019). Assessments that force respondents to choose one primary friendship assume that such a relationship exists and ignore the other close, and likely influential, friendships in people's lives. Moreover, adults have many other types of friends within their social networks (Wang & Wellman, 2010), and each of these friendships may be of different quality and serve different functions. For example, when asked about the people with whom they discuss their most important problems, most respondents identify people who are *not* their best friends, either because these individuals possess expertise that their best friends lack, or because these individuals are available when their best friends are not (Small, 2013).

An alternative approach is to assess satisfaction with the entire friendship network. As Antonucci and colleagues have emphasized in their development of the Convoy Model (Kahn & Antonucci, 1980), people tend to maintain a set of ongoing relationships throughout their lives that vary in closeness but serve as regular sources of support, validation, and companionship (Antonucci et al., 2013). Understanding the social bases of well-being may require assessments that encompass the entirety of the friendship network as evaluated by the individual (Fuller et al., 2020).

Evaluating friendships: How many dimensions do you need?

To the extent that friendships serve multiple functions, a wide range of dimensions might serve as bases for evaluating them. One relevant dimension is *closeness*, defined as "a (probably) linear combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie" (Granovetter, 1973, p. 1361). All of the existing self-report instruments to evaluate friendships that we could identify include a closeness dimension (e.g., Fiori & Denckla, 2015).

Can a single dimension capture all of the important ways that evaluations of friendships can vary? Some scholars have argued for an alternative model that includes one dimension corresponding to closeness and a separate dimension corresponding to "mutual benefit, pleasure, and desirable outcomes" (Lynch, 2015, p. 10). According to this perspective, friendships can be satisfying if they are perceived as fun and enjoyable, regardless of whether they are also perceived as intimate and supportive (Reis, 2001). By proposing this second independent dimension, this view implies that individuals evaluate how they feel about their friendships independently from how they evaluate what they do with their friends (Saldarriaga et al., 2015).

These are not the only available models. Aristotle himself postulated three types of friendships: friendships of the good (i.e., close friendships), friendships of enjoyment or pleasure, and friendships of utility (i.e., friendships that provide benefits like status or resources); some scholars have adopted this tripartite model in their own research (Vernon, 2005). Others have developed scales that attempt to assess four dimensions (e.g., quality, quantity, conflict, and satisfaction; Demir et al., 2015), six (e.g., symmetrical reciprocity, agency, enjoyment, instrumental aid, similarity, communion; Hall, 2012), or even eight separate and distinct friendship functions (Sharabany, 1994).

Clearly there is no scholarly consensus on what it means to be satisfied with one's friendships. Yet, despite these disagreements, we are aware of no attempt to evaluate competing models empirically. Progress in assessing experiences with friendships requires that scholars agree "on a precise set of defining features" (Fehr, 1996, p. 7), and then determine whether these features must be assessed with multiple dimensions or whether the construct can be treated as essentially unidimensional (Reise et al., 2007).

Rather than pose a priori hypotheses about what a scale to measure satisfaction with adult friendships should look like, as others have already done, our goal was to assess the wide range of dimensions proposed by prior scholars and evaluate empirically—for the first time

—how these dimensions relate to each other. In this way, we adopt a data-driven, inductive approach to developing a scale that contrasts with the theory-driven, deductive approaches that have informed prior work (Tellegen & Waller, 2008). Thus, these analyses ask whether the multiple facets of friendship satisfaction that have been proposed are in fact empirically independent.

Overview of the current studies

In light of the importance of friendships for well-being and the lack of consensus about how to assess them, the goal the current research was to develop and validate a psychometrically sound self-report instrument for measuring satisfaction with friendship networks. The research proceeded in two phases. First, we reviewed prior assessment tools and existing theory, assembling a large set of items to assess the full range of potentially relevant content. Second, we conducted two online surveys of over 2000 respondents each: one to evaluate the structure of the items we assembled and identify a manageable number of non-redundant items, and a second to replicate and refine that structure and evaluate convergent and predictive validity with other scales assessing related constructs.

A central question for this research is whether or not satisfaction with friendships can be assessed with a single score. To date, existing friendship scales have usually been described as multidimensional, requiring researchers to compute separate scores for separate subscales. Aside from being cumbersome, a problem with this approach is that subscales may be correlated and scores on two or more subscales may load predominantly on a single, general factor (Reise et al., 2010), leaving little unique variance to be accounted for by the subscales (Rodriguez et al., 2016). In other words, many scales that appear to be multidimensional may be essentially unidimensional (Gustafsson & Aberg-Bengtsson, 2010).

To evaluate that possibility, we planned to analyze data from both studies using *exploratory bi-factor models* (Reise, 2012; Waller, 2018). Bi-factor models enable researchers to estimate a multidimensional model and then directly evaluate the incremental value of the individual subscales after accounting for a general factor (Mansolf & Reise, 2016). Prior research has established that the bi-factor model is a valuable analytic tool for understanding the reliability and interpretability of total and subscale scores (Rodriguez et al., 2016). Because unidimensional scales are easier to administer, score, and interpret, our aim was to develop a scale that acknowledges the multifaceted *content* of friendship while still allowing for the sum of all items to be treated as a unidimensional composite score.

Study 1

Method

Data sources—In October 2019, an existing panel of individuals in the United States who had provided prior consent received an invitation to participate in an online survey. Recruitment was designed to yield a sample with demographic characteristics proportionate to the 2018 American Community Survey and 2010 U.S. Census (United States Census Bureau, 2020). Of those responding to the invitation, 3,417 completed all survey questions

(with no missing data). To maximize the integrity of the data, engagement checks were inserted randomly throughout the survey to monitor if participants were attending to the content of each item (e.g., "Please select 'Somewhat Agree' here"). Participants who failed any of the engagement checks were excluded from the sample, leaving 2,159 qualified participants. Of these, 16 participants who did not identify a binary gender were excluded, leaving a final analytic sample of 2,143 respondents.

Completing the survey took approximately 20 minutes. Respondents were compensated with cash, rewards points, or discounts. All procedures were approved by the local Institutional Review Board.

Sample characteristics—The demographic characteristics of the Study 1 sample are presented in Table 1, along with relevant characteristics from census data. As the table reveals, these characteristics closely matched census data, lending confidence that our sample is representative of the United States as a whole.

Measures—To assemble an initial pool of potential items, we conducted a literature search on the online PsychInfo and PsychArticles databases using keywords "friendship," "friends," "measurement," "scale," and "satisfaction," identifying published instruments used to assess satisfaction with a friendship or a set of friendships. The product of this search was 337 statements. We also drew upon ideas highlighted by the existing literature to generate 111 new items. The result was an initial list of 448 potential items representing 16 different content areas (all items and their sources are provided in Online Supplemental Table S.1).

The authors reviewed each item, revised the wording where necessary to ensure that all items referred to the entire friendship network rather than a single relationship (e.g., "My friend makes me laugh" to "My friends make me laugh"), and eliminated those that failed to meet nine criteria (e.g., in cases where 2 or more items had identical or nearly identical content, only one version of the item was retained and the others were omitted; items calling for an evaluation of the respondent, rather than the friendship network, and items referring specifically to children's friendships, were omitted; the nine rules guiding item reduction are provided in Online Supplemental Table S.2).

This process resulted in 157 unique items derived from 13 published scales and representing all 16 of the content domains identified in the original item pool. Online Supplemental Table S.3 lists the content domains and the number of items representing each domain in the original and final lists. For each of the 157 items, participants were asked to rate their agreement with each statement on a 6-point scale from 0 (Not at all Agree) to 5 (Completely Agree).

Analysis strategy—Before conducting any analyses, the dataset was first divided randomly in half ($N = 1,072$ and $N = 1,071$). The first half was used for exploratory analyses and the second half was used for confirmatory analyses.

Preliminary review and exploratory factor analyses.—Our preliminary aim was to explore the factor structure of the 157 items. Toward this end, we used the *psych* package in R, evaluating eigenvalues and scree plots (Costello & Osborne, 2005), and item grouping using clustering (Revelle, 2019) and the BassAckward method (Goldberg, 2006). BassAckward is a hierarchical, top-down design in which successive factor analyses are performed, beginning with one factor and then increasing the number of factors, with the goal of identifying the likely number of correlated factors. Results from these analyses were used to decide on the number of factors to be specified in exploratory factor analysis (EFA) models. Given the findings from initial exploratory analyses, EFA was used to evaluate alternative dimensional structures. After determining the most appropriate factor structure, EFA was then used to identify the most parsimonious set of items that captured the factor structure of satisfaction with the friendship network. EFA models were estimated with oblique rotations, i.e. "promax" (Costello & Osborne, 2005) and minimum residuals extraction. The model that fit best was used in all subsequent procedures (Kyriazos & Stalikas, 2018). Because item responses were relatively normally distributed, we used Maximum Likelihood (ML) to estimate model fit (Costello & Osborne, 2005). Following the initial item reduction, the procedures described above were once again applied to the reduced item set.

Exploratory bi-factor modeling.—When the preliminary solution from EFA models includes multiple correlated factors, it is appropriate to examine whether each factor should be scored separately or whether the sum of scores on the multiple factors can be scored on a common scale and treated as a single dimension (Reise, 2012; Reise et al., 2007; Rodriguez et al., 2016). To evaluate the degree of unidimensionality within correlated factors, the bi-factor model assumes a general factor that accounts for the "commonality shared by the facets [i.e. the sub-groups] and therefore all items" while simultaneously measuring the unique variance accounted for by each sub-group, over and above the general factor (Chen et al., 2013, p. 1033). For a given set of items, bi-factor modeling can thus be used to evaluate the potential gains of scoring subscales or whether a total score is sufficient (Reise, 2012; Rodriguez et al., 2016).

In these analyses, the bi-factor model was estimated with the Schmid-Leiman procedure (Mansolf & Reise, 2016) in the *psych* package in R, as this has been the "dominant approach to exploratory bifactor modeling" (Reise, 2012, p. 670). The *omega* function in the *psych* package provides several important indices to evaluate bi-factor models. Omega hierarchical (OmegaH) is the percent of variance in the unit-weighted composite attributable to a general factor. When OmegaH is high, the unit-weighted total scores are said to be "essentially unidimensional" in the sense that the reliable variance in unit-weighted composite scores is influenced primarily by a single source (Rodriguez et al., 2016). OmegaH was evaluated using conventional standards for reliability (e.g., >0.70). Omega hierarchical subscale (OmegaHS) estimates whether there is any reliable variance left in subscale scores over and above the reliable variance in general factor scores, i.e. the reliability of group factor scores after removing variance associated with the general factor. Lastly, explained common variance (ECV) estimates the ratio of common variance explained by a general factor to the common variance explained by the general plus group factors, where factors are assumed

to be uncorrelated; it is also a pure measure of the degree of unidimensionality. When all common variance is due to a general factor (i.e., ECV = 1.0), the scale scores are perfectly unidimensional; as ECV approaches zero, scores reflect multiple uncorrelated dimensions. Together, these three indices help to determine whether scale scores should be computed for the entire item set (i.e., a unidimensional scale) or whether scoring subscales is more appropriate (i.e., a multidimensional scale).

Item response theory (IRT).—To evaluate the performance of each remaining item, we applied IRT, a model-based measurement approach that estimates the probability of different item responses by participants (Caprara et al., 2005). Given that items were polytomous, we estimated the Graded Response Model (GRM; Samejima, 1973). The GRM estimates a parameter known as item discrimination which reflects the ability of an item to differentiate between individuals who are higher or lower on the latent trait (greater discrimination = more valuable item).

Expert review.—Once the initial set of items was reduced, we forwarded the reduced set of items to 11 experts in research on friendships, other interpersonal relationships, and/or social networks and asked for their review and feedback (see Kyriazos & Stalikas, 2018). Eight of the 11 experts responded to our request.

Focus groups.—We organized two focus groups to solicit views about the reduced list of items. One group was comprised of eight young adults (ages 18–24) and the other was comprised of seven middle-aged and older adults (ages 39–70).

Confirmatory factor analysis.—Once exploratory analyses were completed using the first randomly split half of the Study 1 dataset, the second half was used to conduct confirmatory factor analyses on the final model (Bonifay, 2015). The confirmatory factor analysis (CFA) allowed us to replicate the hypothesized factor structure and the bi-factor model.

Results

Preliminary item review and exploratory factor analysis

Using the first half of our randomly split dataset, we initially explored the dimensional structure of the 157 items, focusing on eigenvalues, item clustering, and BassAckward methodologies, as well as correlations among items. This review identified three clear factors (eigenvalues = 64.85, 22.67, 3.84). We then used EFA to estimate alternative models for the 157 items and found that a model with three factors best represented the overall structure. After excluding items that loaded less than .56 on any dimension, we inspected polychoric correlations among all remaining items. When two items were highly correlated, we retained the one that loaded more strongly on its factor. Finally, we examined items for ceiling and floor effects (i.e., skew). In the interests of retaining a range of items with different levels of difficulty, we compared the factor loadings of items with similar levels of skew, retaining those with higher factor loadings. Together, this series of preliminary analyses reduced our initial list to 52 items.

These 52 items were then reexamined using clustering (iclust) and BassAckward methods, each of which identified two clear factors. We then examined the scree plot of eigenvalues, which identified three factors with eigenvalues of 22.91, 7.34, and 2.02. We used EFA to compare three separate models for the 52 items: a unidimensional model, a two-factor model, and a three-factor model. Once again, the three-factor model best represented the overall structure, explaining 60% of the common item variance.

Examining the items loading on each factor led us to characterize them as Closeness (30 items with loadings ranging from .61 to .85, e.g. "I confide my deepest concerns in my friends"), Socializing (11 items with loadings ranging from .56 to .84, e.g. "I spend a lot of time socializing with friends"), and Negativity (11 items with loadings ranging from .66 to .81, e.g. "I get into fights with my friends"). Deleting the 18 items with the lowest loadings on each factor left us with 34 items.

The Closeness and Socializing factors were strongly and positively correlated ($r = .64$). The Negativity factor, however, was weakly correlated with Closeness ($r = -.14$) and with Socializing ($r = .26$). In light of the relative independence of the Negativity items, we dropped the 11 Negativity items from the scale, leaving a two-factor solution for the 23 remaining items. To identify items especially relevant to the constructs of closeness or socializing, all previously eliminated items were then reconsidered. Eight items were revived through this process, resulting in 31 items.

Bi-factor modeling

We applied the bi-factor model to these 31 items, assuming one general dimension with two sub-group factors. OmegaH for the general factor was .73, with ECV of 65%. OmegaHS was 0.35 for closeness and 0.28 for socializing. This suggests that the general factor scores are reliable according to conventional reliability criteria (.70). In contrast, the subscale scores are far less reliable, accounting for little unique variance above and beyond the general factor. Thus, while two group factors emerged, the presence of a reliable general factor suggests that the items can be summed to create a meaningful unidimensional score (see Rodriguez et al., 2016).

Item response theory (IRT)

Given that the scale was determined to be essentially unidimensional, the GRM was estimated for these 31 items, providing a slope estimate for each item. The slope estimate captures the extent to which responses to the item differentiate between individuals who scored higher or lower on the latent trait assessed by the entire scale. The 8 items with the lowest slopes (i.e., slope < 1.5) were eliminated, and 3 additional items were eliminated because they had lower slopes than remaining items with nearly identical content. Each of the remaining 20 items had good discriminability.

Expert review and focus groups

These 20 items were distributed for review by our expert panel and our two focus groups. Comments from these reviewers primarily addressed item clarity, applicability to our construct, conciseness, and comprehensiveness. As a result of these reactions, we eliminated

8 additional items, leaving 12 items capturing two correlated factors: Closeness (8 items) and Socializing (4 items).

Confirmatory factor analysis

These 12 items were first subjected to the same exploratory procedures described previously (including iclust and BassAckward). The eigenvalues for Closeness and Socializing were 12.35 and 1.57 respectively, with the remaining eigenvalues less than 1.0. Reliability estimates from the bi-factor model provide support for a strong general factor as indicated by an OmegaH of 0.79 and an OmegaH of 0.23 for Closeness and 0.21 for Socializing. The general factor explained 75% of the common variance among the composite scores (ECV = .75), supporting the appropriateness of scoring the items as a unidimensional scale. The correlation between the factor scores from the unidimensional model and the general factor scores from the bi-factor model was .99, further indicating that little is gained by scoring subscales separately.

Using the second half of the randomly split dataset ($N = 1,071$), the final analysis for Study 1 then confirmed the structure of this 12-item scale, identifying two correlated factors: Closeness, comprised of 8 items (loadings ranged from .72 to .87) and Socializing, comprised of 4 items (loadings ranged from .64 to .91). However, the bi-factor model better represented the data (CFI = .978; SRMR = 02; RMSEA = .068 [CI: .06 to .076]).

Discussion

Given the range of content on prior scales measuring satisfaction with friendships (Bukowski et al., 1994; Mendelson & Aboud, 1999; Parker & Asher, 1993), Study 1 sought to aggregate that content, evaluate its underlying structure, and identify items that capture the range of content while still being scorable as a unidimensional scale. This process yielded several noteworthy findings. First, factor analyses revealed that items about negative aspects of friendships (like conflict, criticism, and teasing) and items about positive aspects of friendships load on separate factors, and these factors are weakly and negatively correlated with each other. Thus, positive and negative evaluations of friendships may be relatively independent, just as positive and negative evaluations of other relationships (e.g., marriage) have been found to be independent (Rogge et al., 2017). In the interest of developing an instrument that can be used to generate a single score, this finding motivated dropping negative items from the scale. Second, these analyses revealed that positive evaluations of friendships that have been described by separate subscales on prior instruments loaded on only two correlated but distinct factors: Closeness, capturing items related to intimacy, validation, and support, and Socializing, capturing items related to enjoyment and shared activities. Finally, bi-factor modeling revealed that the two facets of satisfaction with friendship networks could be adequately scored as a unidimensional scale. That is, after accounting for the general satisfaction factor, the two separate factors accounted for little additional variance in responses to the items. Our confidence in these results is strengthened by the fact that they emerged in exploratory analyses on half of the sample and then were replicated in analyses on the second half of the sample.

Study 2

Establishing a replicable structure for evaluations of friendship networks leaves several questions unanswered. Can the items remaining at the end of Study 1 be improved in terms of their psychometric properties? How much variance does the resulting scale share with existing scales that assess related constructs (convergent validity), and how much does the resulting scale account for variance in theoretically relevant outcomes (predictive validity)? Addressing these questions was the goal of Study 2.

Method

Data sources—Using the same procedures as in Study 1, a new independent sample was solicited for Study 2. Of respondents receiving invitations to participate in Study 2, 3,699 completed all items (with no missing data). The 2,000 respondents who passed all engagement checks comprised the Study 2 sample. Completing the survey took approximately 20 minutes. Respondents received compensation in the form of cash, rewards points, or discounts. All procedures for Study 2 were approved by the local Institutional Review Board.

Sample characteristics—The demographic characteristics for Study 2 are presented in Table 1. As the table reveals, the sample characteristics of the Study 2 respondents closely mirrored the characteristics of the Study 1 sample.

Measures

Satisfaction with the friendship network.—A total of 33 items were administered to assess satisfaction with friendship networks: 12 items from Study 1, plus 21 new items created in response to comments and suggestions from expert reviewers and focus groups. (The new items are presented in Online Supplemental Table S.4). Nearly all new items reflected changes to wording or language rather than new content as our goal was to determine whether modifications to existing items would yield items with better psychometric properties. As in Study 1, items were phrased in the form of statements and respondents were asked to rate their agreement with each on a 6-point scale from 0 (Not all Agree) to 5 (Completely Agree).

Convergent validity measures.—To evaluate whether satisfaction with friendship networks, as measured by the new scale, is related to but still empirically distinct from other constructs related to evaluations of social relationships, we examined correlations between the new scale and scores on three existing scales: the *Perceived Partner Responsiveness Scale* (12 items; Reis et al., 2017), the *Basic Psychological Needs Scale* (14 items; La Guardia et al., 2000), and the *Social Intimacy Scale* (17 items; Miller & Lefcourt, 1982). For each of these scales, items were reworded when necessary to ensure that all referred to best or closest friends. To evaluate whether our new scale simply assesses the availability of social connections, respondents also responded to the *UCLA Loneliness Scale* (8 items; Russell, 1996).

Predictive validity measures.—To evaluate whether scores on the new measure correlate with measures of other constructs in expected ways, seven published scales assessing potential correlates of satisfaction with friendship networks were administered: the *Personal Well-Being Index* (8 items; International-Wellbeing-Group, 2013), the *Satisfaction with Life Scale* (5 items; Diener et al., 1985), the *Rosenberg Self-Esteem Scale* (10 items; Rosenberg, 1965), the *Couples Satisfaction Index* (16 items; Funk & Rogge, 2007), the *Subjective Happiness Scale* (4 items; Lyubomirsky & Lepper, 1999), the *Family Satisfaction Scale* (10 items; Olson, 1982), and the *Perceived Stress Scale* (4 items; Cohen et al., 1983). In general, we expected that respondents indicating greater satisfaction with their friends on the new scale would score higher on all of these measures of well-being, and lower on perceived stress.

Analytic strategy—As in Study 1, the sample for Study 2 was randomly split into two separate samples ($N = 1,000$ each). The first half was used for exploratory analyses and the second for confirmatory analyses. We used similar analytic procedures as in Study 1. Specifically, we used item clustering methods, EFA, IRT, and CFA (see Study 1 description of analytic methods). Additionally, to evaluate convergent and predictive validity, Pearson correlations were estimated between total scores on the final version of the scale and each of the other measures administered in the online survey.

Results

Evaluating new items

EFA was used to compare the factor loadings of the 21 newly created items with the 12 items retained from Study 1. Of the new items, 17 either did not load onto either factor strongly, or loaded less strongly than items with similar content retained from Study 1. All of these items were eliminated. Four of the new items did load more strongly on the Socializing factor than items from Study 1; these items were added to the scale and 2 items from Study 1 with overlapping content and lower factor loadings were dropped. The result was a 14-item scale.

Factor structure: Final scale

To determine whether the factor structure of the items matched the structure obtained in Study 1, we applied EFA to the final set of 14 items. The items and their factor loadings are presented in Table 2. The final exploratory model resulted in a Closeness factor (8 items with loadings from .72 to .87) and a Socializing factor (6 items with loadings from .64 to .91). The eigenvalues for these two factors were 9.41 and 1.10, with the remaining eigenvalues noticeably under 1.0. The two factors correlated at .77, explaining 72% of the common variance among the items. Coefficient alpha for these 14 items is .96.

Next, we evaluated the bi-factor model. OmegaH for the general factor was .86 while OmegaHS was .18 for closeness and .16 for socializing; Explained Common Variance = 82%. As with Study 1, results from the bi-factor model suggest the data are unidimensional enough to justify the use of IRT.

Item response theory (IRT)

Drawing upon principles for explaining the dimensionality (i.e., internal structure) of a psychological scale (Reise et al., 2007; Toland et al., 2017), we examined three different GRM IRT models for the 14 items: (1) A standard unidimensional graded response model (with each item representing the same, common latent trait); (2) A bi-factor graded response model with orthogonal group factors; (3) A reduced bi-factor graded response model (with marginal slopes), which included a general, primary trait that explained the items while accounting for other specific traits. The reduced model, unlike the bi-factor graded response model, produces a single slope estimate for each item, such that the multidimensionality is not partitioned out, but rather marginalized (Toland et al., 2017).

Item slopes in the unidimensional model ranged from 1.49 to 4.03, with an average slope of 2.90. In the bi-factor model, all general factor slopes ranged from 1.49 to 4.35, with an average slope of 3.38. Lastly, item slopes in the reduced bi-factor model ranged from 1.37 to 4.29, with an average slope of 2.70. Thus, regardless of the specific measurement model we considered, slopes for our items are much higher than a 1.0 slope value viewed as acceptable (Revicki et al., 2015), indicating that the 14 items are highly discriminating.

Confirmatory factor analysis: Final scale

Using the second randomly split half of the Study 2 dataset ($N = 1000$), we performed a CFA on the final 14 items, comparing three models: a one-factor model, a two-correlated factor model, and a bi-factor model (with two groups). This enabled us to validate the final structure identified by exploratory processes. Table 3 presents model fit indices: Chi-Square, CFI, SRMR, RMSEA, and RMSEA (confidence intervals). Comparisons of model fit provide clear evidence of the superiority of the bi-factor model. The model fit for the bi-factor model was: CFI = .979; SRMR = .02; RMSEA = .067; [CI: .06 to .074].

Testing convergent validity

To evaluate whether ratings of satisfaction with friendship networks are related to but still empirically distinct from other evaluations of social relationships, we examined the correlations between the new scale and four existing scales. To be considered redundant, these scales would need to correlate with the new scale at .85 or higher (Henseler et al., 2014). In fact, each of the existing scales correlated in the expected direction with the final version of the new scale, but none of the correlations crossed that threshold: Perceived Partner Responsiveness Scale ($r = .69$, $p < .01$); Basic Psychological Needs Scale ($r = .51$, $p < .01$); Miller's Social Intimacy Scale ($r = .61$, $p < .01$); UCLA Loneliness Scale ($r = -.22$, $p < .01$).

Testing predictive validity

As a final test of validity, we examined how total scores on the final scale correlate with outcomes with which satisfaction with friendship networks ought to be associated. Indeed, the new scale was significantly positively associated with scores on the Personal Well-being Index ($r = .44$, $p < .01$), the Satisfaction with Life Scale ($r = .38$, $p < .01$), the Rosenberg Self-Esteem Scale ($r = .19$, $p < .01$), the Couples Satisfaction Index (for respondents indicating they were in a romantic relationship; $r = .31$, $p < .01$), the Subjective Happiness

Scale ($r = .30$, $p < .01$), and the Family Satisfaction Scale ($r = .36$, $p < .01$). As expected, scores on the new scale were also significantly negatively associated with Perceived Stress Scale ($r = -.16$, $p < .01$).

Discussion

Study 1 established that a range of positively-phrased statements about friendships load onto two correlated factors. Nevertheless, when we form a composite score, the composite still primarily reflects a single common dimension. Building on feedback received from content experts and focus groups, Study 2 refined and further confirmed this structure, evaluating existing and additional items with IRT. As a result of this analysis, some items with high face validity (e.g., "My friends respect me") were nevertheless deleted because they were not as discriminating as retained items. Other items were added that loaded more strongly onto the Socializing factor. The results supported a final set of 14 items that: (1) capture the content of the two factors (closeness and socializing), (2) discriminate between higher and lower responses on the overall scale, and (3) can be captured by a single general factor.

Although scores on the new scale correlated positively with scores on measures of related constructs, in no case did the new scale share more than half its variance with an existing scale, indicating that the new scale is indeed measuring a unique construct. The new scale also correlated in the expected direction with theoretically predicted outcomes. People who report greater satisfaction with their friendship networks report greater well-being and life satisfaction, higher quality relationships with intimate partners and family members, and higher self-esteem. In sum, the product of this research is a new, psychometrically sound, unidimensional scale assessing satisfaction with friendship networks—the Friendship Network Satisfaction (FNS) Scale. (See the Appendix for the final version of the scale).

General discussion

People are happier and healthier when they have friends (Holt-Lunstad et al., 2015; White et al., 2009), especially when they are satisfied with their friendships (Lewis et al., 2015). But what does it mean to evaluate friendships as satisfying? To judge by the prior literature, there is no consensus answer, reflecting the fact that existing measures of satisfaction with friendships vary widely in content and structure. The goal of the two studies described here was to clarify the construct of friendship satisfaction, and to use that clarity as the basis for a new instrument for assessing satisfaction with friendship.

Across two nationally representative samples of over 2000 respondents each, the results were consistent and clear. Although available multidimensional friendship scales have calculated up to eight separate subscales to measure evaluations of friendships (Demir et al., 2015; Mendelson & Aboud, 1999), we find that the variance among positively-phrased items diverse in content can be captured successfully with two factors—closeness and socializing. More importantly, bi-factor modeling indicates that scores on these specific factors share most of their variance with a single general factor. As Van der Maas et al. (2011) cautioned in their discussion of statistical dimensionality, "this should not be mistaken for evidence that a single ability is in play. It merely means that individual differences in performance

can be reasonably described by a scalar variable" (p. 353). In other words, although the content of evaluations of friends may in fact be multidimensional, in practice evaluations of friendships may be treated as unidimensional without any substantial loss of information.

This finding has precedent in relationship science. Half a century ago, Weiss (1980) recognized that specific evaluations of marital relationships tended to be overwhelmed by a spouse's general feelings about the marriage, a process he termed sentiment override. A similar process appears to be taking place when people are asked to evaluate their friendships. Although they are capable of responding to separate items about their experience of trust, support, enjoyment, etc., those responses are largely driven by their overall degree of positive feelings about their friends. This means that existing multidimensional scales assessing friendships may be creating distinctions among subscales that have little practical significance.

Yet these studies also highlighted distinctions that do have practical significance. Negative sentiments toward friends are not merely the opposite of positive sentiments; Study 1 revealed that responses to negative items were relatively independent from responses to positive ones. Nor is loneliness the opposite of satisfaction with friends; Study 2 revealed that the correlation between the new scale and the well-validated UCLA Loneliness Scale was small (but still significant), indicating that feelings of loneliness can vary widely among people with high-quality (and low-quality) friendships. It appears that perceptions of conflict or isolation are not incompatible with satisfying friendships, and here again there are parallels in the marital literature, where positive and negative feelings about a marriage have been found to be relatively independent as well (Fincham & Linfield, 1997; Rogge et al., 2017). This then is a direction for further refining the assessment of friendships: not distinguishing among the ways that people can like their friends, but understanding how relationships with friends can be satisfying and fall short at the same time.

Although the fact that the bi-factor structure described here replicated across two large, nationally representative samples supports the robustness of our findings, several limitations of these studies qualify our conclusions. First, the data described here were obtained via online surveys. Every effort was made to increase the integrity of these data, including deleting all respondents who failed to meet the most stringent engagement checks. Nevertheless, it will require further study to evaluate how the new instrument performs in face-to-face interviews, or in populations that lack access to internet. Second, without longitudinal data we cannot draw conclusions about test-retest reliability. Finally, although the new instrument proved reliable and valid in the sample as a whole, further analyses are required to evaluate whether the properties of the new scale generalize across specific sub-populations (e.g., gender, race, ethnicity, sexual orientation) and across non-English speaking cultures and nationalities.

Directions for future research

A unidimensional scale to assess satisfaction with friendship networks offers an efficient tool for elaborating on the antecedents and consequences of satisfying friendships. With respect to antecedents, the current findings highlight the importance of examining predictors of friendship satisfaction that are not likely to be subsumed within the construct. To that

end, research might explore how reports of more concrete elements of friendships, such as the quantity of friends or the specific situations in which people seek out their friends, contribute to more or less satisfying friendships. With respect to consequences, longitudinal research will be vital for examining not only how satisfaction with friends develops over the lifespan, but also the personal and social characteristics that predict different patterns of change. Finally, armed with a measure of friendship satisfaction that has psychometric properties similar to those of widely used measures of marital satisfaction (e.g., Funk & Rogge, 2007) and family satisfaction (Zabriskie & Ward, 2013), researchers may also use the new tool to begin to compare the relative and interactive influence of each of these important social relationships on health and well-being.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

APPENDIX

Appendix

Friendship Network Satisfaction Scale

Please rate how much you agree with each of the following statements about your friends, including best friends, close friends, and other friends with whom you have had contact (either in person, by phone, online, etc.) during the past year.

0	1	2	3	4	5
Not at all Agree	Hardly Agree	Somewhat Agree	Pretty much Agree	Very much Agree	Completely Agree

1. I feel close to my friends

2. It is hard to imagine my life without my close/best friends

3. My friends celebrate my good news

4. I have fun with my friends

5. I have meaningful conversations with my friends

6. I like to hang out with my friends

7.   My friends understand me

8.   When I have a problem, I can talk to my friends about it

9.   I spend a lot of time socializing with my friends

10.   My friends and I go out and do things together

11.   My friends and I eat together often

12.   I attend social events with my friends

13.   I spend free time with my friends

14.   I socialize with a lot of different people

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Table 1.

Demographics of Study 1 and Study 2.

Variable	Study 1		Study 2		Census Targets[a]
	N	*%*	*N*	*%*	*%*
Age					
18–24 years	220	10.3	234	11.7	12.9
25–34 years	378	17.6	397	19.9	19.6
35–44 years	372	17.4	353	17.7	17.8
45–54 years	387	18.1	361	18.1	18.2
55–64 years	431	21.1	375	18.8	18.3
65+ years	355	16.6	280	14	13.3
Gender					
Male	1019	47.6	980	49	49
Female	1124	52.4	1020	51	51
Race/Ethnicity					
White/Caucasian	1420	66.3	1283	64.1	63.8
Hispanic/Latino	319	14.9	326	16.3	16.3
Black/African American	258	12	237	11.9	12.2
Asian or Pacific Islander	87	4.1	98	4.9	4.9
Other	59	2.8	56	2.8	2.8
Annual Household Income					
<$30,000	365	17	340	17	16.5
$30,000–$49,999	332	15.5	300	15	14.8
$50,000–$74,999	359	16.8	346	17.3	16.8
$75,000–$99,999	330	15.4	298	14.9	14.5
$100,000–$149,999	380	17.7	354	17.7	17.9
>$150,000	377	17.6	362	18.1	19.7
Education					
<High School	32	1.5	33	1.7	—
High School Diploma	375	17.5	313	15.7	—
Some College	535	25	497	24.9	—
College Degree	732	34.2	757	37.9	—
Post Graduate Degree	464	21.7	395	19.8	—

[a]Age and gender were derived from the 2010 United States decennial Census. Income and race/ethnicity were derived from the 2018 American Community Survey (ACS).

Table 2.

Final Friendship Network Satisfaction (FNS) Scale.

Item	Mean	SD	Factor Loadings	
			Factor 1	Factor 2
Closeness				
I feel close to my friends	3.19	1.42	.82	.10
It is hard to imagine my life without my close/best friends	3.14	1.55	.78	.05
My friends celebrate my good news	3.36	1.40	.73	.12
I have fun with my friends	3.58	1.35	.75	.11
I have meaningful conversations with my friends	3.24	1.45	.88	.01
I like to hang out with my friends	3.33	1.43	.71	.17
My friends understand me	3.15	1.40	.88	−.01
When I have a problem, I can talk to my friends about it	2.99	1.49	.85	.01
Socializing				
I spend a lot of time socializing with my friends	2.46	1.49	.21	.66
My friends and I go out and do things together	2.90	1.53	.26	.64
My friends and I eat together often	2.51	1.59	.01	.83
I attend social events with my friends	2.62	1.59	−.05	.90
I spend free time with my friends	2.66	1.55	.09	.81
I socialize with a lot of different people	2.39	1.60	.00	.72

Table 3.

Confirmatory factor analysis (CFA) model fit.

Model	Chi-Square	CFI	SRMR	RMSEA	RMSEA Confidence Intervals
One Factor	1729.31	.88	.05	.15	.14–.15
Two Correlated Factors	(df = 77) 686.85	.96	.03	.09	.08–.10
Bi-Factor (Two Group factors)	(df = 76) 341.87 (df = 63)	.98	.02	.07	.06–.07