Feeling Loved: A Novel Brief Self-Report Health Measure

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Context: There is need for a short validated self-report instrument for assessing the feeling of being loved. The Feeling Loved instrument asks: "Do you feel loved?" and "How loved do you feel?" as well as "Do you love yourself?" and "How much do you love yourself?" with 100 mm visual analogue scales assessing the continuous response options.

Objective: To assess convergent and discriminant validity and to explore psychometric structure for this novel self-report measure.

Design: Convergent validity comparators include: general mental health, perceived social support, perceived stress, depressive symptoms, and positive/negative emotion. Discriminant validity comparators include: gender, age, ethnicity, socioeconomic status, and body mass index. Latent class analysis techniques explore psychometric structure.

Setting: Baseline evaluation for a randomized controlled trial.

Participants: Community-recruited adults in Madison, Wisconsin.

Intervention: This validation study is based on pre-intervention data.

Main outcome measures: Strength of correlation with comparators is used to assess convergence and discrimination. Goodness-of-fit indicators assess latent class models.

Results: Of $n=412$ respondents, 92% answered positively to both Yes/No questions, and 59% self-rated ≥75/100 on both 0-to-100 VAS scales. Supporting convergent validity, highly significant ($p < 0.001$) Spearman's rho=ρ correlations of a summed Feeling Loved score were: mental health ($\rho=0.49$); social support ($\rho=0.46$); perceived stress ($\rho=-0.46$), depressive symptoms ($\rho=-0.31$), and both positive ($\rho=0.50$) and negative ($\rho=-0.43$) emotion. Significant associations were also found for personality indicators. Supporting discriminant validity, Feeling Loved scores did not correlate significantly with physical health ($\rho=-0.08$), body mass index ($\rho=0.01$), age ($\rho=0.06$), or income ($\rho=0.07$) (p values all ≥ 0.12). Latent class analysis models suggested a 3-class structure, with strong goodness-of-fit indicators.

Keywords: Construct validity, Love, Mental health, Social support, Surveys and questionnaires, Validation

(Explore 2019; 15:148–159 © 2018 Published by Elsevier Inc.)

INTRODUCTION

Philosophers, poets, writers and scholars across diverse disciplines have for ages extolled the virtues and importance of love.[1–5] Nevertheless, despite a plethora of scholarly work related to love, surprisingly little empirical research has explored the relationships of love with other domains of mental and physical health.[6–11] Compared to the very large number of studies of psychosocial domains including anxiety and depression, positive and negative emotion, perceived stress, social support, happiness and general self-rated mental and physical health, the paucity of research directed at whether and how the feeling of being loved might contribute to human health is lamentable. The relative lack of empirical evidence relating love to health may be due at least in part to a lack of well-validated measurement tools. This paper addresses this deficit by introducing a simple and novel measure of "Feeling Loved," along with preliminary evidence of construct validity.

Previous attempts to develop and validate self-report measures of love have most often been directed at assessing domains related to love between two people.[1,6,7,10,12,13] These measures tend to be multidimensional, addressing related domains such as trust, respect, passion, intimacy, caring, satisfaction, conflict and commitment.[6] Theoretical structures surrounding these measures vary widely, but usually recognize that conceptions and emotions related to love are complex, highly personal, and embedded within and influenced by social and cultural systems.[14,15] For example, a paper by Rykkje and colleagues describes love as "connectedness" with "others," relating "oneself" to other individuals, but also to "something larger than oneself."[16] One of the more fundamental notions that we found in our literature review was the distinction between the feeling of being loved by others versus the sense of loving oneself. As an example of this line of research, Gebauer and colleagues examined data on 1,519 research participants, and concluded that while individuals may state that they love their "favorite other"

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https://doi.org/10.1016/j.explore.2018.07.005

ISSN 1550-8307/$36.00

above themselves, their study data suggest that people tend to implicitly favor themselves.[17] This exemplifies the prevailing evolutionary theory on love, which maintains that interpersonal love serves as a social bond to enhance group survival, while love of oneself serves to directly promote individual survival and procreation.[18] A final example comes from a 2016 paper by Jacobson and Newman who found that responses to "You feel socially accepted" and "You feel loved and wanted" among adolescents with anxiety predicted depressive symptoms a decade later.[19] Nevertheless, despite a substantive literature exploring the domains and relationships of interpersonal love, there are few validated instruments that assess the feeling of being loved by oneself or by others, and none that consist of less than 5 items.

The current study was motivated by the need for a short and straightforward self-report questionnaire instrument able to assess both the sense of being loved by others and the feeling of loving oneself, which we feel are perhaps the 2 most important of many potential domains related to "love." To accomplish this objective, we created a 1-page, 2-domain, 4-item questionnaire comprised of two Yes/No domain questions: "Do you feel loved?" and "Do you love yourself?" which are each followed by an item assessing the underlying continuous dimensions of "How loved do you feel?" and "How much do you love yourself?" Responses are scored by marking an X on the corresponding horizontal 100mm visual analogue scales (VAS), which are labelled at the left end by "Not at all" and at the right end by "Very, very much." The 4 items are weighted equally, with 100 points for each "Yes" answer, and points on the 100mm VAS measures indicated by the Xs. Thus, the summed total score could range from 0 to 400. This Feeling Loved instrument was created *de novo* for use in a randomized controlled trial, and was informed by our reading of the literature, but did not benefit from any prior instrument development work.

The purpose of this study was to test out the Feeling Loved instrument in a sample large enough to look at basic psychometric performance and data structure, and to begin to assess construct validity. Cronbach and Meehl (1955) established the framework for assessing construct validity by requiring evidence of both convergent and discriminant validity.[20] Convergent validity is supported when data from two theoretically related instruments correlate in expected directions. Following Campbell, discriminant validity can be described as "the requirement that a test not correlate too highly with measures from which it is supposed to differ".[21] Campbell and Fiske (1959) expanded on Cronbach's construct validity framework by requiring *multiple* comparisons of both theoretically similar (convergent) and theoretically distinct (discriminant) traits, noting that such relationships can be assessed concurrently, or in a predictive fashion.[22] Given the historical importance of these foundational approaches to the assessment of construct validity, and the availability of multiple relevant comparators in the dataset at hand, we decided to focus this investigation on the convergent and discriminant properties of Feeling Loved, at a single point in time, and before randomization, so that the trial interventions could not impact the analysis.

To assess concurrent convergent validity, we hypothesized that Feeling Loved would correlate positively with perceived social support, mental health, and positive emotion, and would be negatively correlated with perceived stress, depressive symptoms and negative emotion. We expected that the feeling-loved-by-others domain would correlate most strongly with perceived social support and number of social contacts, and that the loving oneself domain would correlate more strongly with the mental health indicators of positive emotion, self-efficacy, stress and depressive symptoms. We expected that people displaying more agreeableness, openness, conscientiousness and extraversion would display higher levels of Feeling Loved, and those with higher neuroticism would feel less loved. To test discriminant validity, we hypothesized that: 1) Feeling Loved would not correlate to any appreciable degree with gender, age, ethnicity, socioeconomic status or laboratory-measured biomarkers, which we believe are theoretically unrelated to love, and 2) that none of the correlations of Feeling Loved with other psychosocial instruments would be so strong as to suggest that the instruments were measuring the same underlying domain.

To investigate the structural psychometric characteristics of Feeling Loved, we chose a specific finite mixture modeling approach known as latent class analysis (LCA), which allows for discovery and characterization of "latent classes" within the data structure. This method is particularly appropriate here, as it does not assume any specific data structure, but instead empirically discovers and statistically models individuals' Feeling Loved responses in relation to other responses variables, yielding best fit models unconstrained by prior findings or theoretical predictions. The LCA method was first proposed by Paul Lazarfeld and colleagues in the 1950s.[23] The specific model we derived follows the approach of Flaherty,[24] described more generally by Muthen.[25] The LCA model is a statistical method for discovering latent (not directly observed) subgroups (classes). Basically, LCA investigates heterogeneous data by evaluating and then minimizing associations among responses across a set of indicators. While LCA is somewhat similar to the more widely used factor analysis approach, it is based on conditional probabilities instead of factor loadings. In LCA, the pattern of item-response probabilities helps to identify latent classes with distinguishable interpretations; this concept of "latent class separation" is similar to the concept of "simple structure" in factor analysis. Based on the concepts of homogeneity and latent class separation, LCA can be a useful way to approach model selection when classical factor analysis yields conflicting fit criteria.

To summarize, this study is aimed at three basic goals: 1) assessing data distributions resulting from each of the four Feeling Loved items, 2) exploration of the psychometric structure of Feeling Loved data using LCA methodology, and 3) comparison of Feeling Loved data with several widely used and validated self-report instruments, aiming to assess convergent and discriminant validity.

METHODS

Setting

Data for this paper came from baseline evaluations for the MEPARI-2 trial (Meditation or Exercise for Preventing Acute Respiratory Infection) sponsored by the National Center for Complementary and Integrative Health at the U.S. National Institutes of Health.[26–28] The purpose of this trial was to assess whether 8 weeks of training in mindfulness meditation or

matched training in sustained moderate intensity exercise could lead to significant reductions of incidence, duration and severity of ARI illness, compared to an observational control.

Participants

The MEPARI-2 trial was carried out from 2012 to 2016 in four yearly cohorts of approximately n=100 people each. Inclusion criteria included: 1) age 30−69 years at entry, 2) history of at least one ARI episode per year, 3) do not exercise regularly or have meditation training, 4) score ≤14 points on the PHQ9 depression scale, and 5) willingness to adhere to protocol. Participants were recruited from the community in and near Madison, Wisconsin, USA. This research was approved and monitored by the University of Wisconsin's Institutional Review Board. Informed consent was obtained in writing.

Measures

The Feeling Loved questionnaire was administered at baseline, prior to randomized allocation, and then again at three time points over six months following intervention. To avoid potential confounding from the interventions, the current paper looks only at baseline data, obtained prior to randomization. Comparator instruments employed in this study are all widely used, with multiple published papers attesting to reliability and validity. These included the SF12 (12-item Short Form Survey) which assesses general mental and physical health,[29] the PHQ9 (9-item Patient Health Questionnaire) which assesses depressive symptoms,[30] the PSS10 (10-item Perceived Stress Scale) which assesses perceived stress,[31] the PANAS (Positive and Negative Affect Schedule), which assesses positive and negative emotion,[32] the Social Provisions Scale (SPS) which assesses perceived social support (16), and the Social Network Index, which enumerates the number of social contacts in each of several roles.[33] Several other validated questionnaire instruments were also used, including the Pittsburgh Sleep Quality Index (PSQI),[34] the Mindful Attention Awareness Scale (MAAS),[35] the Mindfulness Self-Efficacy Scale (MSES),[36] the Exercise Self-Efficacy Scale (ESES),[37] The Stanford Presenteeism Scale,[38] and the Big Five Inventory, which assesses personality traits of openness, neuroticism, extraversion, conscientiousness, and agreeableness.[39] Age, gender, race and ethnicity were assessed by self-report using standardized forms. Socioeconomic status was assessed by self-report, using highest level of education achieved and personal and household income as indicators. Finally, baseline values in the MEPARI-2 trial included laboratory assays of blood for hemoglobin A1c, which assesses blood sugar over time, high-sensitivity C-reactive protein, a measure of inflammation, and IL-6, IL-8 and IP-10, biomarkers linked to a number of immunological and inflammatory states associated with acute respiratory infection.[40−42]

Analyses

We selected Spearman's rank correlation coefficient (Spearman's rho) as our primary measure of association, as it allows for correlation assessment of nonparametric or skewed distributions. To assess associations with categorical variables (gender, ethnicity, race, household income, education) we used Kruskal-Wallis nonparametric testing. To test relative strength of observed correlations, we used Steiger's z-test,[43] originally developed for Pearson correlations, but also appropriate for comparing Spearman's rho coefficients.[44] These statistics were all calculated using SAS 9.4 statistical program. When missing value patterns satisfied Little's missing completely at random criteria,[45] data were imputed using Stata MICE multiple imputation methods.[46−48] Overall, less than 1% of data were missing.

We used Mplus Version 7.31 to conduct a specific finite mixture model which extends the latent class analysis model to include the two continuous visual analogue scale measures,

Table 1. Participant characteristics and associations with demographic and socioeconomic indicators

					Feel loved summary score		Feel loved VAS		Love yourself VAS	
		n	%		Mean (SD)	*p* value*	Mean (SD)	*p* value*	Mean (SD)	*p* value*
Gender	Female	312	76%		351 (61)	0.004	83 (21)	0.009	75 (21)	0.06
	Male	100	24%		332 (77)		78 (21)		70 (23)	
Ethnicity	Hispanic	24	6%		370 (32)	0.030	88 (14)	0.12	82 (20)	0.048
	Non-Hispanic	377	94%		344 (67)		81 (21)		74 (22)	
Race	White/Caucasian	348	85%		345 (65)	0.008	81 (21)	0.47	73 (22)	<0.001
	Non-Caucasian	52	13%		358 (67)		82 (22)		85 (19)	
	More than one race	11	3%		328 (76)		80 (22)		65 (27)	
Education	Some college	97	24%		352 (68)	0.010	84 (21)	0.020	78 (22)	0.010
	College graduate	315	76%		344 (64)		81 (21)		73 (22)	
Household Income	$0-$50,000	157	39%		339 (73)	0.52	79 (23)	0.035	74 (24)	0.41
	>$50,000	247	61%		352 (57)		84 (19)		74 (20)	
				IQR (25^{th}-75^{th})	**Feel loved summary score**		**Feel loved VAS**		**Love yourself VAS**	
	n	**Mean**	**SD**	**25^{th}**	**75^{th}**	***ρ*****	***p* value**	***ρ*****	***p* value**	***ρ*****	***p* value**
Age (yrs)	412	49.6	11.6	39.0	59.0	0.06	0.23	0.01	0.88	0.10	0.038
BMI (kg/m^2)	412	29.4	7.2	24.1	32.7	0.01	0.82	0.03	0.53	0.01	0.77
Hourly Income ($)	324	26.34	15.51	16.2	32.1	0.07	0.23	0.17	0.17	0.01	0.87

* Kruskal-Wallis nonparametric test **Spearman Rho correlations; Results of categorical comparisons bolded when *p* value < 0.01 VAS = 100 mm visual analog scale; SD, standard deviation; IQR, interquartile range (25^{th} percentile to 75^{th} percentile); BMI, body mass index

Table 2. Correlation of Feeling Loved scores to comparators

				IQR (25th - 75th)		Feel loved summary score		Feel loved VAS		Love yourself VAS	
	N	Mean	SD	25th	75th	ρ*	p value	ρ*	p value	ρ*	p value
Feel loved summary score	412	346	65	340	385	-	-	**0.84**	<0.001	**0.90**	<0.001
Feel loved VAS	412	82	21	70.5	99	**0.84**	<0.001	-	-	**0.58**	<0.001
Love yourself VAS	412	74	22	60	90	**0.90**	<0.001	**0.58**	<0.001	-	-
BFI - agreeableness	412	37.5	5.3	34.0	42.0	**0.32**	<0.001	**0.24**	<0.001	**0.31**	<0.001
BFI - conscientiousness	412	36.0	5.6	33.0	40.5	**0.28**	<0.001	**0.22**	<0.001	**0.28**	<0.001
BFI - openness	412	39.9	5.7	36.0	44.0	**0.18**	<0.001	**0.19**	<0.001	**0.14**	0.004
BFI - extraversion	412	27.1	6.3	23.0	32.0	**0.27**	<0.001	**0.24**	<0.001	**0.25**	<0.001
BFI - neuroticism	412	20.6	5.9	16.0	25.0	**−0.42**	<0.001	**−0.28**	<0.001	**−0.48**	<0.001
SF12 – physical Health	412	51.3	8.2	46.5	57.0	−0.08	0.12	−0.05	0.36	−0.10	0.037
SF12 – mental health	412	47.8	10.1	41.8	55.4	**0.49**	<0.001	**0.39**	<0.001	**0.49**	<0.001
SPS - social support	412	83.3	9.7	77.0	91.0	**0.46**	<0.001	**0.51**	<0.001	**0.35**	<0.001
SNI - network diversity	408	6.3	1.9	5.0	8.0	**0.18**	<0.001	**0.21**	<0.001	0.10	0.052
SNI - potential contacts	408	23.8	9.0	17.0	29.0	**0.21**	<0.001	**0.21**	<0.001	**0.16**	0.001
SNI - number of contacts	409	7.3	1.8	6.0	9.0	**0.14**	0.004	**0.20**	<0.001	0.05	0.36
PANAS - Positive emotion	412	34.8	7.1	31.0	40.0	**0.50**	<0.001	**0.45**	<0.001	**0.47**	<0.001
PANAS - Negative emotion	412	18.5	6.5	14.0	22.0	**−0.43**	<0.001	**-0.27**	<0.001	**−0.47**	<0.001
PSS 10 - Perceived stress	412	12.9	6.3	8.0	17.0	**−0.46**	<0.001	**-0.36**	<0.001	**−0.46**	<0.001
PHQ9 - depressive symptoms	412	2.7	2.8	0.0	4.0	**−0.32**	<0.001	**-0.24**	<0.001	**−0.33**	<0.001
PSQI - sleep quality**	405	5.9	3.4	3.0	8.0	**−0.21**	<0.001	**-0.16**	0.001	**−0.21**	<0.001
MAAS - mindful attention	412	4.2	0.8	3.6	4.8	**0.36**	<0.001	**0.27**	<0.001	**0.39**	<0.001
MSES - mindful self-efficiency	411	97.2	15.0	88.0	107.0	**0.51**	<0.001	**0.42**	<0.001	**0.50**	<0.001
ESES - exercise self-efficiency	411	113.6	38.5	89.0	142.0	**0.22**	<0.001	**0.19**	<0.001	**0.22**	<0.001
Stanford presenteeism	373	23.9	4.7	21.0	28.0	**0.40**	<0.001	**0.33**	<0.001	**0.41**	<0.001
HbA1c	411	5.6	0.7	5.3	5.8	0.02	0.65	0.01	0.78	0.07	0.18
hsCRP	412	3.5	4.8	0.7	4.4	0.06	0.24	0.05	0.29	0.07	0.19
IL-6 Serum	412	2.4	2.3	1.0	2.9	0.04	0.46	-0.00	1.00	0.08	0.11
IL-6 Nasal	410	2.0	2.9	0.6	2.3	0.03	0.50	0.01	0.90	0.03	0.54
IL-8	410	252.2	390.9	84.8	310.4	−0.03	0.57	−0.04	0.40	−0.02	0.75
IP-10	412	185.0	233.5	122.9	194.3	0.05	0.31	0.06	0.26	0.05	0.33

* Spearman Rho correlations, bolded when p value <0.01; ** Pittsburgh sleep quality index is reverse scored; VAS, 100 mm visual analog scale; SD, standard deviation; IQR, interquartile range (25th percentile to 75th percentile); HbA1C, hemoglobin A1C; hsCRP, high sensitivity C-reactive protein; IL-6, interleukin 6.

as well as the two dichotomous indicators. Details regarding this specific finite mixture model approach may be accessed in Flaherty,[24] also described more generally by Muthen[25] and by McLachlan and Peel.[49] To assess models based on the number of resulting classes, we used Akaike Information Criteria (AIC), sample size adjusted AIC, Bayesian Information Criteria (BIC), and Consistent AIC (CAIC).[50–52] The smaller the BIC, AIC, adjusted AIC, and CAIC, the better the model fit. We also compared improvement in incremental fit between class models (k classes vs k+1 classes) using two likelihood ratio tests: the Vouong-Lo-Mendel-Rubin likelihood ratio test (VLMR-LRT), and the Lo-Mendell-Rubin likelihood ratio test (LMR–LRT). These procedures provide a test of significance (p value) in the improvement in the incremental fit as the number of classes increases.[53] Decisions on the number of classes to be included are based on the following guiding criteria: 1) interpretability; 2) parsimony; 3) no significant improvement with additional classes as indicated by VLMR-LRT and LMR-LRT; 4) lowest Information Criteria scores (AIC, adjusted AIC, BIC, and CAIC); 5) Entropy>0.7; 6) average posterior probability in each class >0.75 and no more than 10% overlap/cross-membership between non-contiguous classes; and 7) at least 2.5% of the total sample size must reside in each class.[53]

RESULTS

Some 455 prospective participants were assessed for likelihood of adhering to protocol, 413 signed consent, and 412 completed baseline evaluation. Mean age was 49.7 years (standard deviation = 11.6 years); 76% were female; 85% identified as white/Caucasian. This was a highly educated sample, with 76% of the participants having completed college. Mean income was $26.34 (SD = $15.51) per hour. Mean body mass index was 29.4 (SD = 7.2; see Tables 1 and 2).

Response patterns demonstrated high levels of Feeling Loved, with 396 (96%) of people answering "Yes" to "Do you feel loved?" 388 (94%) of people answering "Yes" to "Do you love yourself?", and 380 (92%) answering positively to both questions. Some 59% self-rated ≥75/100 on both 0-to-100 VAS scales. Scores on the "loving oneself" VAS (mean = 74 (SD = 22), median = 80 points) were slightly lower than on the "loved by others" VAS (mean = 82 (SD = 21), median = 90 points). Participants' calculated Feeling Loved scores were

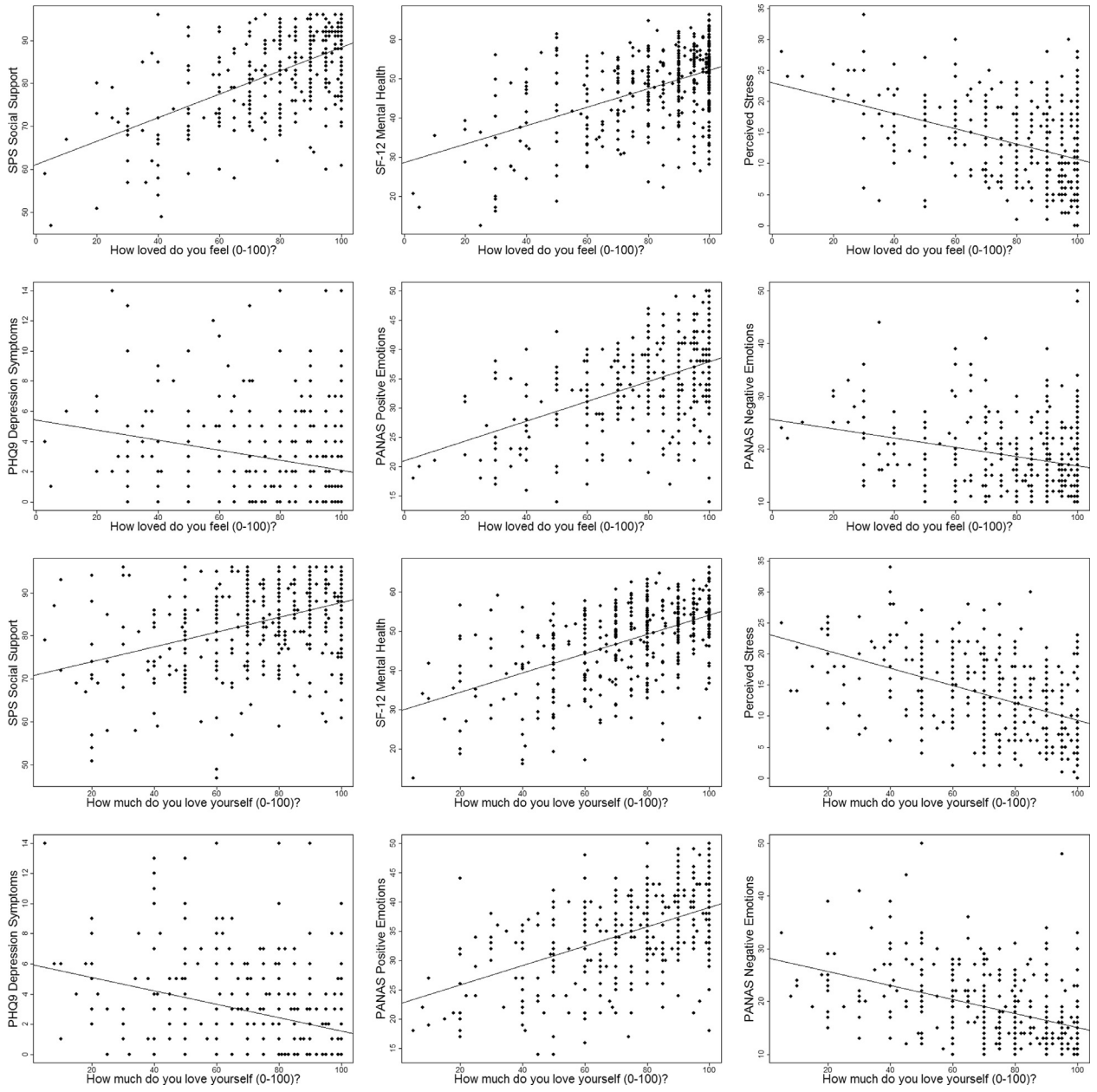

Fig. 1. Scatterplots of feeling loved domains with ain comparators.

mean = 346 (SD = 65) with a median = 365 (out of a possible 400 points). The Feeling Loved Summary Score was strongly correlated with "loving oneself" VAS ($\rho = 0.90$) and "loved by others" VAS ($\rho = 0.84$); however, the "loving oneself" VAS and "loved by others" VAS results were not as strongly correlated to each other ($\rho = 0.58$). Distributions of the summed score and each VAS domain were skewed rightward, providing rationale for using Spearman's rho as the correlation coefficient for comparison to other instruments (see Fig. 1 and Tables 1 and 2).

As hypothesized, we found statistically significant and reasonably strong correlations between Feeling Loved data and many comparator instruments, all in expected directions and all consistent with predictions (Fig. 1 and Table 2). Higher Feeling Loved scores were associated with higher levels of mental health, social support, positive emotion, self-efficacy (including presenteeism at work), mindfulness, and sleep quality (where lower numbers represent better sleep). As expected, lower Feeling Loved scores were associated with higher levels of perceived stress, depressive

Table 3. Latent Class Analysis Fit Measures

Class	Entropy	BIC	AIC	Adj BIC	CAIC
1	-	7731.784	7707.658	7712.745	7737.784
2	0.915	7326.811	7282.580	7291.906	7337.811
3	0.905	7256.340	7192.004	7205.569	7272.340
4	0.927	7237.239	7152.798	7170.602	7258.239

	Likelihood ratio tests	
Model contrast	**VLMR − LRT[a]**	**LMR - LRT[b]**
Class 1 vs 2	435.07, p <0.001	421.09, p < 0.001
Class 2 vs 3	10.57, p = 0.002	97.34, p = 0.003
Class 3 vs 4	49.206, p = 0.029	47.62, p = 0.031

Feeling loved LCA classes	N	Mean	SD	Minimum	25th %tile	Median	75th %tile	Maximum
Low	36	193.2	89.0	40	137	195	271	305
Moderate	78	306.9	45.2	180	300	320	333	355
High	298	374.7	19.3	250	360	375	390	400

AIC, Akaike information criteria; BIC, Bayesian information criteria; adjAIC, sample size adjusted AIC; CAIC, Consistent AIC; VLMR − LRT = Vuong-Lo-Mendell-Rubin; LMR = Lo-Mendell-Rubin adjusted likelihood ratio test.

symptoms, and negative emotion. As predicted, Spearman's rho comparing perceived social support (SPS) to the loved-by-others VAS ($\rho = 0.51$) was higher than that for the loving-oneself VAS ($\rho = 0.35$; $p = 0.0001$ Steiger test for differences in ρ). However, the loving-oneself VAS correlated more strongly with mental health measures than did the loved-by-others VAS: SF12 mental health with loving-oneself ($\rho = 0.49$) and with loved-by-others ($\rho = 0.39$); PSS10 ($\rho = -0.46$ vs. $\rho = -0.36$); PHQ9 ($\rho = -0.33$ vs. $\rho = -0.24$), and both PANAS positive ($\rho = 0.47$ vs. $\rho = 0.45$) and negative emotion ($\rho = -0.47$ vs. $\rho = -0.27$; $p < 0.0001$ Steiger test for difference in ρ).

The "Big Five" personality traits correlated with summed Feeling Loved scores: agreeableness ($\rho = 0.32$); conscientiousness ($\rho = 0.28$), extraversion ($\rho = 0.27$); and openness ($\rho = 0.18$); with reversed findings for neuroticism ($\rho =$ -0.42). Loving-oneself appeared to be slightly more correlated with agreeableness, conscientiousness and extraversion than loved-by-others, with slightly higher correlation of openness with loved-by-others. The largest difference between Feeling Loved domains was for neuroticism, which correlated with loving-oneself at $\rho =$ -0.484, and to a lesser extent with loved-by-others at $\rho =$ -0.275 ($p < 0.0001$ Steiger test).

Supporting discriminant validity, Feeling Loved scores did not "correlate too highly" [21] with comparators that we consider to be theoretically distinct domains. Social support measures (SPS and SNI) correlated with loved-by-others with Spearman rhos ranging from 0.20 to 0.51, higher than the rhos of 0.05 to 0.35 correlating SPS and SNI to loving oneself, but not so high as to suggest that loved-by-others is simply another social support measure. Similarly, the loving-oneself VAS scores correlated significantly with several relevant mental health domains, but in no case were rhos greater than 0.50. Notably, the summed Feeling Loved score and both constituent domains (loved-by-others, loving-oneself) did not correlate with age, income, BMI, SF-12 physical health or any of the laboratory biomarkers. There were significant associations with gender (women felt slightly more loved), race (non-whites loved themselves a bit more) and education (college graduates had slightly lower scores), but differences in Feeling Loved scores were not large.

Multivariate LCA models suggested a 3-class structure, with reasonably strong goodness-of-fit indicators (see Table 3). Compared to a 2-class or 4-class model, the selected 3-class model had equally strong fit as judged by Entropy, Bayesian Information Criteria (BIC), Akaike Information Criteria (AIC), and Adjusted and Consistent AIC (Adj AIC; CAIC). Incremental fit, as judged by both Vuong-Lo-Mendell-Rubin and Lo-Mendell-Rubin likelihood ratio tests, increased significantly when going from two to three classes, but was not substantively improved with a 4-class model. All three LCA classes had adequate numbers of participants: High Love ($n = 298$), Moderate Love ($n = 78$), and Low Love ($n = 39$). Following the LCA analysis, we tentatively propose a total summed Feeling Love score of 200 to separate Low and Moderate Love categories, and a score of 380 to separate Moderate and High Love categories (Table 3). In this sample, there was no overlap between the High Love (>380) and the Low Love (<200) score categories, but that there was considerable overlap in the middle category, with a number of people who were assigned to Low and High Love classes (by LCA sorting) occupying the 200−380 mid-range (Moderate Love) Feeling Loved summed score category.

In order to further assess and understand the Feeling Loved class structure, we looked at mean difference scores among comparator measures across LCA-derived classes. Figs. 2, 3 and 4 display those mean differences (with 95% confidence intervals) between low and medium, medium and high, and low and high Feeling Loved classes. Looking at these forest plots, it appears that scores of virtually all comparator domain instruments vary in expected directions among the three Feeling Loved classes.

DISCUSSION

We expect that most people would agree that love is important, and that both the sense of being loved by others and the feeling of loving oneself are potentially meaningful. What is not known is how Feeling Loved relates to other psychosocial domains, and whether there may be influences on physical health or function. Starting in the 1980s, studies have reported that self-reported general health is a significant predictor of mortality, and that

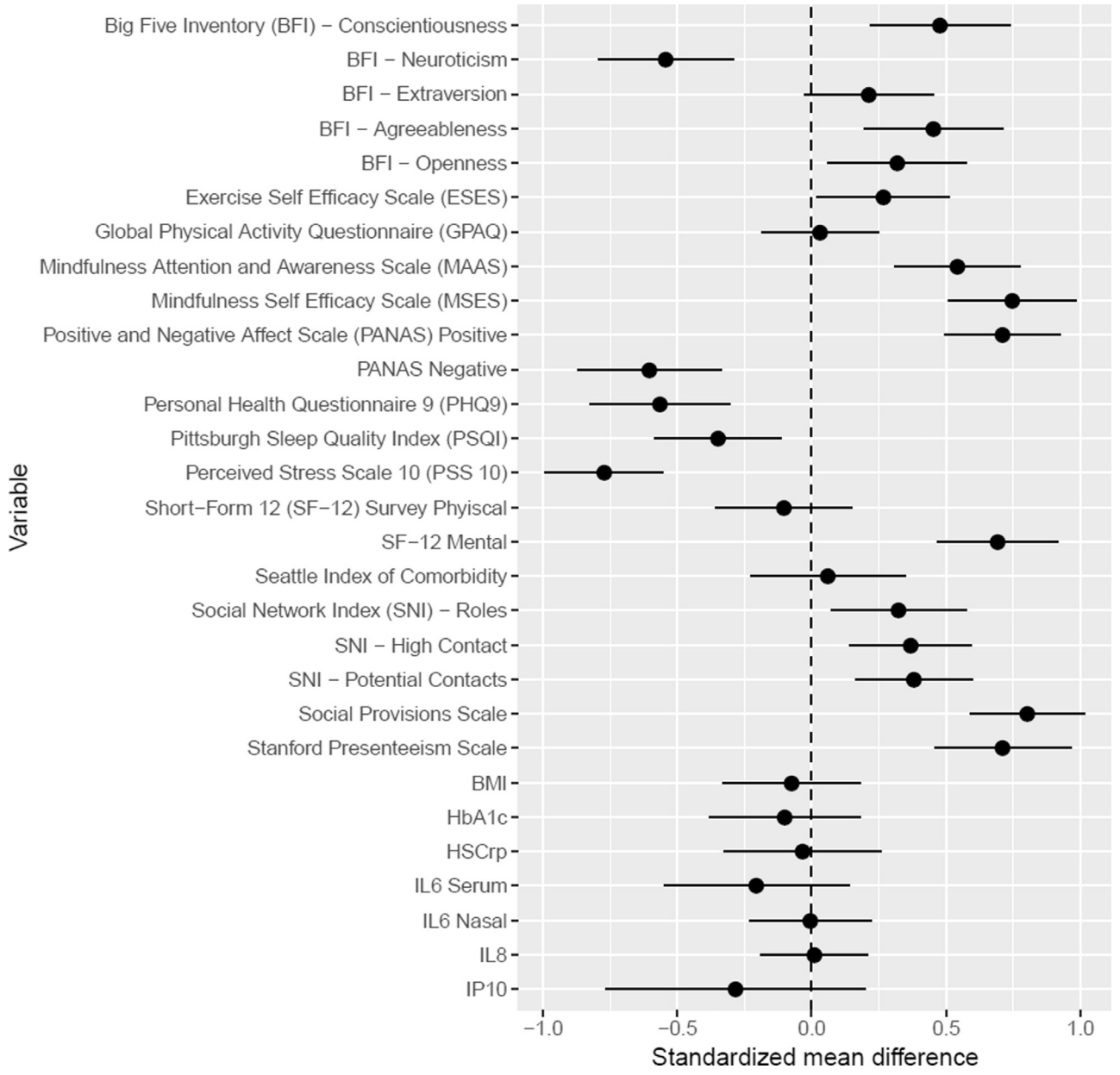

Fig. 2. Factors distinguishing low and high love classes.
Error bars represent 95% confidence intervals.

even single-item assessments can predict subsequent quality of life, daily function, hospitalization, and mortality.[54,55] A number of studies have suggested that perceived social support may be not only a statistical predictor of mortality, but may serve as a protective mechanism or pathway towards enhanced health and longevity.[56–62] A number of other domains theoretically related to the sense of being loved by others, or of loving oneself, have been examined. Several of these are accompanied by research using validated instruments, including: loneliness,[63–65] social isolation,[66–68] self-compassion,[69–71] self-esteem,[72–74] and the need to belong.[75,76] Social support, social isolation, and loneliness have all been linked to mortality.[57–64] Given this background, we find it remarkable that the sense of Feeling Loved has not been properly examined as an entity in and of itself, that there are no simple validated instruments available, and that no studies that we can find have rigorously looked at love as a potential predictor of – or causal pathway towards – mental and physical health, functional capacity, and perhaps longevity.

The study presented here is only a first step in that direction. Not satisfied with existing measures, we created a short and simple measure of Feeling Loved. We then embedded it within an existing study, allowing efficient data generation and perhaps shielding results from the types of bias that might have occurred if participants had been thinking of the study as focused on the Feeling Loved instrument. We achieved a sufficiently large sample for initial psychometric evaluation, gathered data using a

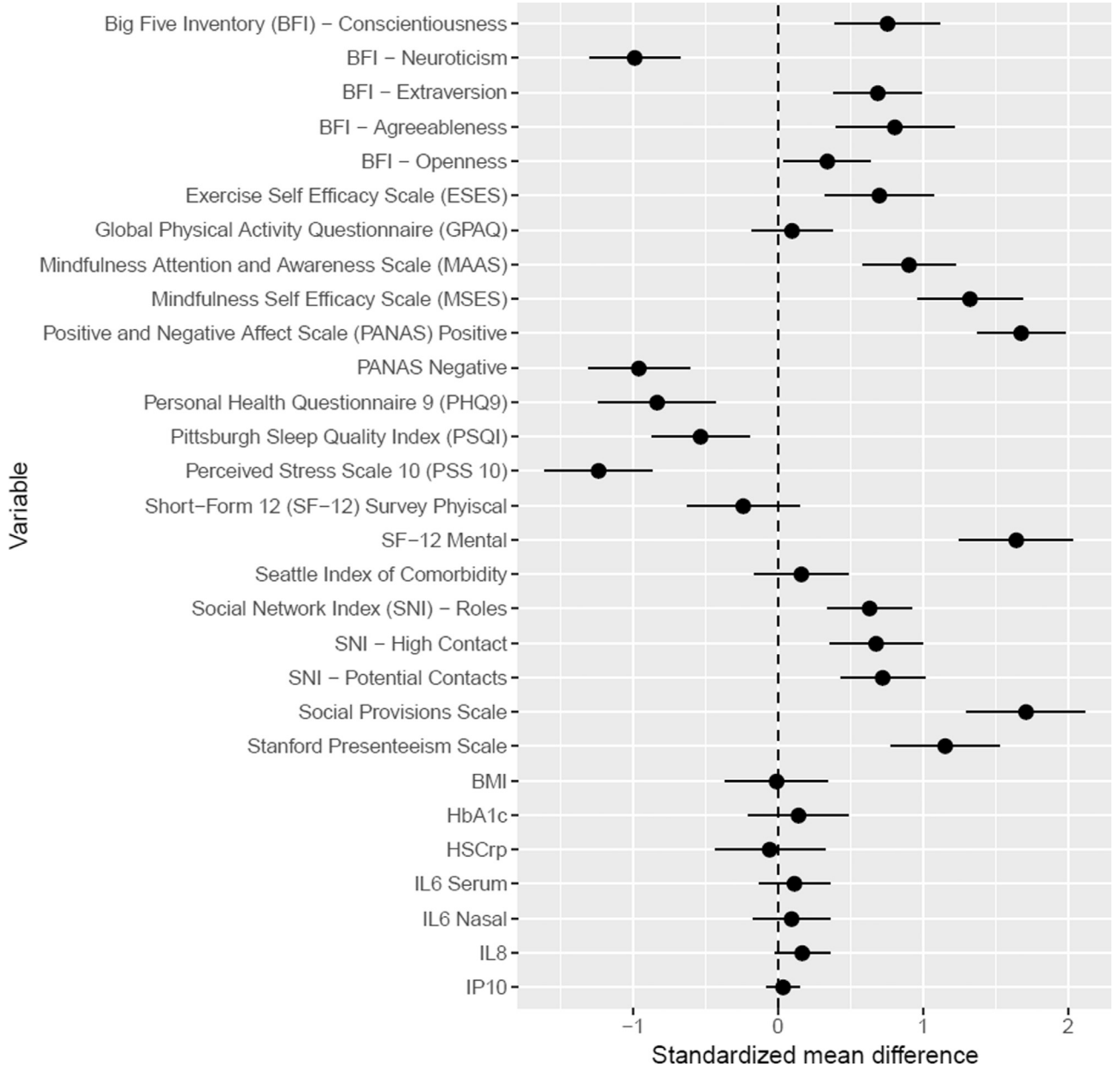

Fig. 3. Factors distinguishing medium and high love classes
Error bars represent 95% confidence intervals.

wide variety of comparator instruments, and had very little missing data. We believe that the results shown here demonstrate both convergent and discriminant validity, and provide some evidence of construct validity. The multivariate LCA suggests that people responding to the Feeling Loved questionnaire fall into one of three classes (Low, Moderate and High love), and that the comparator instrument domains vary across those classes in ways that theory would have predicted.

Our data suggest a high pattern of Feeling Loved, with more than 92% of people answering "Yes" to both introductory questions, and with 64% of people scoring above 350 points on the 0 to 400 summed scale. We expect that at least some of this rightward skew may be due to our sample selection. In general, these were healthy and economically advantaged people living in Madison, Wisconsin, who were willing and able to enter a health study with substantive time and energy commitments. Lack of regular exercise was an inclusion requirement, and the average BMI of 29.4 for our participants was slightly higher than national averages, but self-reported general mental and physical health on the well-validated SF-12 were very close to national norms.[29] People with high levels of depressive symptoms were excluded. We did not have *a priori* hypotheses regarding gender, race or ethnicity, and do not have firm conclusions regarding the observed tendency of women to report slightly higher senses of

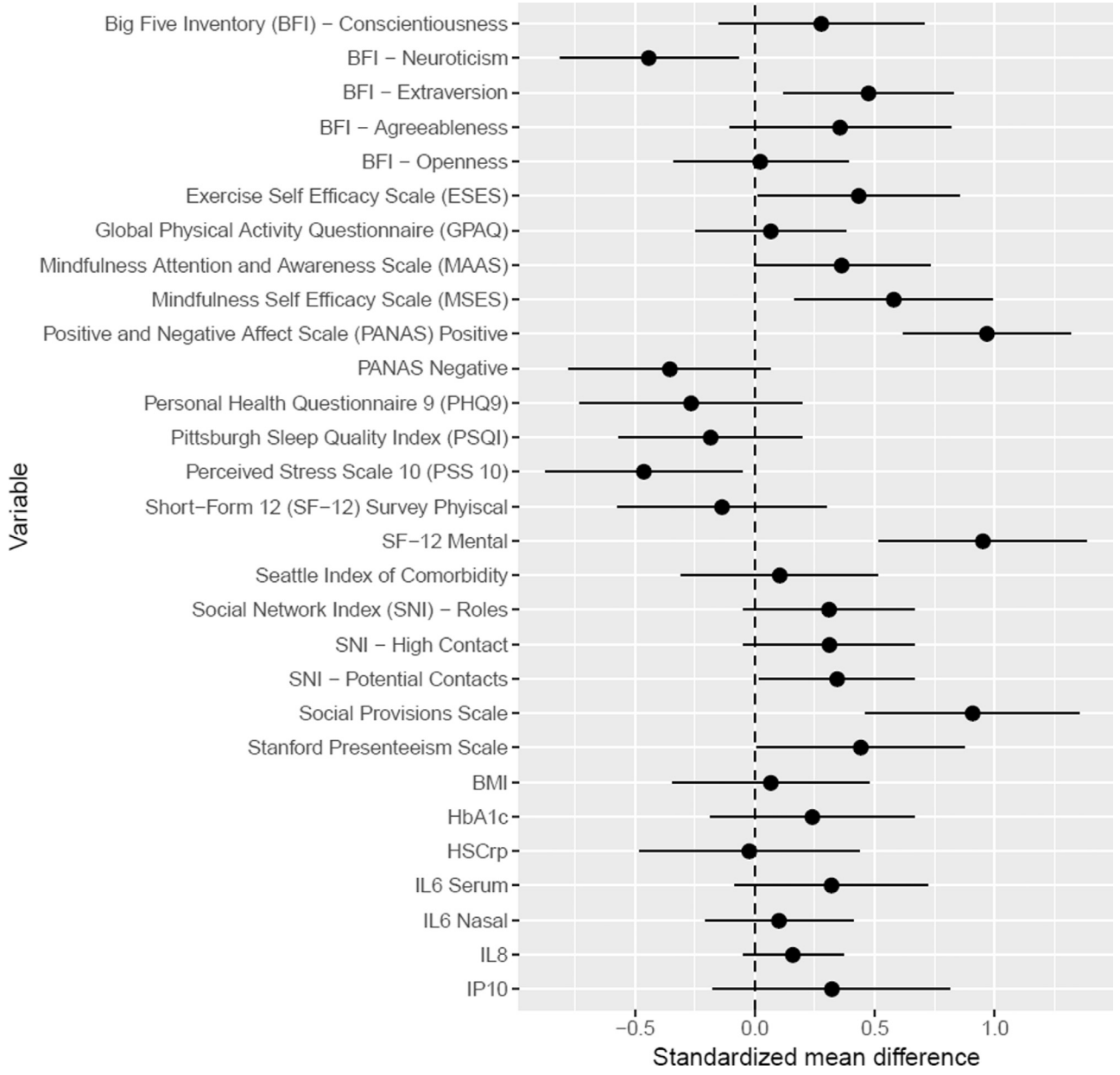

Fig. 4. Factors distinguishing low and medium love classes
Error bars represent 95% confidence intervals.

Feeling Loved than men, or of non-whites to report slightly higher feelings of loving themselves, but do note that both of these findings are consistent with previous literature.[77,78] Neither men nor minorities were well represented in this study. Future work will be needed.

The people in this study lived in or near Madison, Wisconsin, and were recruited for a particular research study, and hence cannot be considered a generalizable or representative sample. We cannot predict with confidence whether the relationships observed or the latent classes found will be replicated in other populations. It is quite possible that more disadvantaged or less healthy populations would display lower Feeling Loved scores, which might impact the correlations we found, or the coefficients supporting the 3-class LCA structure. For example, future research might very well impact the 200-point cutoff distinguishing the low and moderate love classes, or the 380-point cutoff separating the moderate and high love classes. It is possible that similar analyses of larger data sets or from different populations would suggest 2 or 4 classes rather than 3. Until further work is accomplished, we suggest interpreting Feeling Loved scores as representing underlying continuous domains rather than categorical classes. It is also quite possible that evidence could emerge to support a differential item weighting scheme. However, until such evidence emerges, we suggest providing equal

weight to each of the 4 items, following the principle of parsimony.

There are a number of limitations of this study. For example, this is a cross-sectional sample supporting concurrent but not predictive validity. Causality cannot be inferred. Virtually all significant associations were with other self-report instruments, prone to a variety of potential biases, such as social desirability, or the effect of transient mood.[79,80] The Feeling Loved questionnaire assesses only two of several domains that could be considered to be within the dominion of love, and cannot be considered a comprehensive or complete measure of love. The domain, item and scoring rubric employed here is only one of many legitimate ways that love could be assessed. We did not pre-specify exactly what we meant by "Feeling Loved" and "loving oneself," and have no detailed theoretical framework to frame our findings. When answering the questionnaire, participants were free to interpret item meanings in any way that they wanted. For example, when answering the "Do you feel loved?" question, we expect that some participants may have been thinking of a husband or wife, lover, friend, parent, or child, and that others may have been thinking of a pet, and that still others may have been thinking of a religious or spiritual entity, or "something larger than oneself."[16] Although this lack of definition is a limitation, we believe it is also a strength, especially if one considers that the internal feeling or sense of being loved is the domain being investigated, and not the external entity to which one attributes the feeling. A questionnaire that asked respondents to rate various possible sources and strengths of Feeling Loved might be useful, but would have its own limitations.

This work represents initial efforts only. We have provided some evidence of concurrent construct validity, both convergent and discriminant, but did not assess reliability, or responsiveness, and do not yet have any evidence supporting predictive, criterion, or nomological validity. Whether the Feeling Loved instrument will best serve the purposes of predictive, discriminative or evaluative research[81,82] is as yet unknown. Whether and to what degree the sense of Feeling Loved or loving oneself is stable over time (trait) versus responsive to situation or intervention (state) is also unknown. Whether "Feeling Loved" is a consequence, cause, or non-causal correlate of the various domains of mental, physical and social health is unknown, but this could serve as a fruitful line of future research. To support such work, we have made Feeling Loved available online at: http://www.fammed.wisc.edu/feeling-loved/. There is no licensing or user fee, but we do ask that researchers register their intended use, so we can track this instrument's future trajectory.

CONCLUSIONS

The sense of Feeling Loved may represent an important psychosocial domain related to human health. The Feeling Loved instrument provides a tool to facilitate research in this direction. The data portrayed here support construct validity by providing evidence of convergent and discriminant validity. Comparator instruments correlated with Feeling Loved in expected directions and magnitudes. Latent class analysis methods support a coherent 3-class internal structure. Feeling Loved may prove to be a useful measure for psychological, social, and human health studies.

SUPPLEMENTARY MATERIALS

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.explore.2018.07.005.

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