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Translation and cross cultural adaptation of the Persian Parental Care and Tenderness Scale with psychometric evaluation using factor and network analyses

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Abstract

Background: The Parental Care and Tenderness Scale (PCAT) assesses individual differences in activation of the parental care motivational system, but its psychometric properties have not been evaluated in Persian-speaking populations. This study adapted the PCAT into Persian and examined its structural validity, reliability, construct validity, and network organization among Iranian adults.

Methods: A two-phase cross-sectional psychometric study was conducted. Phase 1 included forward translation, face validity, expert content evaluation, backward-translation, and reconciliation with the original instrument. In Phase 2, 437 adults were randomly divided into exploratory factor analysis (EFA; n = 218) and confirmatory factor analysis (CFA; n = 219) subsamples. Reliability, exploratory graph analysis (EGA), and network analyses were conducted in the full sample, while convergent and divergent validity were examined in 149 participants with complete external-measure data.

Results: Content validity was acceptable. Parallel analysis supported five factors, and the five-factor EFA solution explained 53.33% of the variance (KMO = .790; Bartlett's $\chi^2(300) = 3133.67$, $p < .001$). The correlated five-factor CFA model outperformed alternative models, although global fit was suboptimal (CFI = .775, TLI = .746, RMSEA = .101, SRMR = .082). The total PCAT showed good internal consistency (α = .858; ordinal α = .898; ω = .901). EGA identified five dimensions, while network centrality showed stability. Parents and women reported higher PCAT scores than nonparents and men, respectively.

Conclusions: The Persian PCAT demonstrated promising reliability and multidimensional structure, although incomplete CFA replication and variable dimensional stability indicate a need for further cross-cultural replication and item refinement.

Keywords: Parenting; Psychometrics; Factor Analysis, Statistical; Surveys and Questionnaires; Cross-Cultural Comparison

Introduction

Infant-related cues appear to have distinctive motivational salience. Infant faces rapidly capture attention, even when they compete with other stimuli for processing resources (Brosch et al., 2007). The motivational value of infant faces has also been observed in both women and men, indicating that sensitivity to child-related cues cannot be reduced to maternal experience alone (Parsons et al., 2011). Neurocognitive evidence similarly suggests that infantile facial characteristics engage systems involved in reward, attention, and preparation for social interaction, providing a plausible basis for rapid caregiving responses (Kringelbach et al., 2016).

The parental care motivational system is relevant to parents and nonparents alike. Although direct parenting experience is expected to increase the frequency with which caregiving motives are activated, adults without children also show positive affective and attentional responses to infants (Senese et al., 2013). Experimental work has further shown that exposure to cues of vulnerability can increase behavioral carefulness, supporting the broader proposition that caregiving-related responses can be elicited by perceptual signals rather than by parental status alone (Sherman et al., 2009). These findings support the study of parental care as an individual-difference construct that varies continuously across adults.

Buckels et al. (2015) developed the Parental Care and Tenderness Questionnaire (PCAT) to measure such individual differences directly. The final instrument contains 25 items representing five related domains: Caring, Liking, Protection, Tenderness-Positive, and Tenderness-Negative (Buckels et al., 2015). In the original validation program, the total scale showed high internal consistency and temporal stability, while the five subscales also demonstrated strong reliability (Buckels et al., 2015). PCAT scores were associated with theoretically relevant responses to children, including the emotional intensity elicited by infant

images and the amount of time participants chose to view infant faces, supporting the construct and predictive validity of the measure (Buckels et al., 2015).

Subsequent work refined the conceptual organization of parental care motivation. Hofer et al. (2018) distinguished two broader motivational components, nurturance and protection, and showed that they can make different contributions to psychologically relevant outcomes. Nurturance is more closely tied to approach-oriented caregiving and responsiveness to children's emotional and practical needs, whereas protection reflects vigilance and readiness to defend children from harm (Hofer et al., 2018). This distinction is important psychometrically because it suggests that the PCAT can display both a coherent general structure and meaningful differentiation among facets.

Evidence from cross-cultural research also indicates that the PCAT structure is sufficiently robust to warrant adaptation beyond the original North American context, while still requiring direct evaluation in each language and culture. In an Italian sample of 946 adults, Castelli et al. (2023) reported high reliability and a factor pattern that closely reproduced the original five-domain structure. Their exploratory findings identified one comparatively strong factor together with four smaller factors, and additional confirmatory analyses supported the broader nurturance-protection distinction described in earlier work (Castelli et al., 2023). The Italian findings therefore support cross-cultural continuity in parental care motivation without implying that exact item-level functioning can be assumed across populations.

Cross-cultural adaptation is especially relevant for a construct embedded in family roles, emotional expression, and culturally shaped expectations about caregiving (Bornstein, 2012). Protective behavior, expressions of tenderness, willingness to sacrifice for children, and evaluations of child distress may all be influenced by local norms concerning family obligation

and acceptable caregiving behavior (Song et al., 2023). The literature has also shown that parental care motives are associated with broader social judgments and orientations, reinforcing the possibility that cultural context may shape the expression of these motives even when the underlying system is shared across populations (Kerry & Murray, 2018). Experimental and mediational work has also linked parenting motivation with broader social orientations, reinforcing the importance of distinguishing the caregiving construct from its downstream social correlates (Kerry & Murray, 2020).

Assessing the PCAT in Iran is important for conceptual as well as linguistic reasons. Parenting and caregiving are embedded within cultural systems that shape parental beliefs, socialization goals, emotional expression, autonomy, and expectations regarding appropriate responses to children's needs (Bornstein, 2012; Song et al., 2023). Accordingly, apparently similar caregiving behaviors or attitudes may carry different meanings or be expressed differently across sociocultural contexts, making direct cross-cultural evaluation particularly important for measures developed within a specific cultural setting (Bornstein, 2012; Epstein et al., 2015). This issue is especially relevant in Iran, where empirical studies have documented culturally embedded patterns in parent–child relationships, parenting expectations, and emotion socialization. Qualitative research with Iranian parents has shown that parenting practices are negotiated within ongoing cultural and social change, including tensions between established expectations concerning parental guidance and control and increasingly child-oriented approaches to parent–child interaction (Rahkar Farshi et al., 2019). Similarly, the cultural adaptation of an emotion-socialization parenting program in Iran identified culturally specific beliefs regarding children's emotions and required modifications to improve the appropriateness of the intervention for Iranian families (Havighurst et al., 2022). Recent psychometric research with Iranian parents has also

emphasized the importance of evaluating culturally embedded parental beliefs about children's emotions within the Iranian setting rather than assuming that instruments developed elsewhere retain identical measurement properties after translation (Azimi et al., 2025). These considerations are directly relevant to the PCAT because it assesses affective and motivational dispositions toward caring, liking, protection, and tenderness rather than observable parenting behavior alone (Buckels et al., 2015). Moreover, previous PCAT research has already indicated that its structure warrants direct examination when transferred across cultural and linguistic contexts (Castelli et al., 2023). Thus, a Persian translation alone cannot establish that PCAT items have equivalent meaning or that the proposed dimensional structure is reproduced in Iranian adults; cross-cultural adaptation requires empirical evaluation of the adapted measure's content and psychometric functioning in the target population (Epstein et al., 2015). Validation of the Persian PCAT is therefore necessary to determine whether parental-care motivation can be assessed reliably and meaningfully within the Iranian sociocultural context before the instrument is used to investigate individual differences among Persian-speaking adults.

The present study aimed to translate and culturally adapt the PCAT for Persian-speaking adults and to evaluate its psychometric properties in an Iranian sample. Specifically, the study examined the structural validity of the Persian PCAT using exploratory and confirmatory factor analyses, assessed its internal consistency, and evaluated convergent, divergent, and known-groups validity. In addition, exploratory graph analysis and item-level network analysis were used as complementary approaches to examine the organization of PCAT items, the stability of the identified dimensions, and the relative structural importance of individual items. Together, these analyses were intended to determine whether the Persian PCAT provides a reliable and psychometrically defensible assessment of parental-care motivation in the Iranian context.

Method

Study Design

A two-phase, cross-sectional psychometric validation design was used to translate, culturally adapt, and evaluate the Persian version of the PCAT. Phase 1 addressed linguistic and content adaptation, whereas Phase 2 examined the structural validity, internal consistency, construct validity, and item-level organization of the adapted scale. Study conducted from April 2025 to July 2026 in Kerman, Iran.

Participants

Participants were adults from Kerman Province, Iran. The participants were both parents and nonparents. The final data included 437 participants (230 women and 207 men), with an observed age range of 18 to 53 years ($M = 34.45$, $SD = 6.83$). Eligible parents had at least one child between birth and 10 years of age; nonparents included single adults and married adults without children. Additional inclusion criteria were education at or above the eighth-grade level and voluntary consent to participate.

Recruitment was performed in field-selected areas, neighborhoods, kindergartens, and primary schools in Kerman Province using stratified and cluster-based sampling procedures. After data screening, 437 complete PCAT protocols were retained. The analytic classification identified 309 parents, 127 nonparents, and one participant whose parental status could not be classified from the recorded marital-status label. Most participants reported middle socioeconomic status ($n = 373$, 85.4%), and bachelor's-level education was the most common educational category ($n = 173$, 39.6%).

Translation and Cultural Adaptation

Permission to translate and validate the PCAT in Persian was obtained from the original scale developer team before data collection. Following approval of the research proposal and receipt of the required ethical and institutional permissions, the original English version was translated into Persian (Forward Translation). This form is labeled as Form I. After that, Form I was translated into English as Backward translation and labeled as Form II. The back-translated version was compared with the source instrument, and the final Persian wording was established after confirmation from the original scale developer. Consequently, Forms I and II were compared with each other by using a team of psychologists and English tutors to develop Form III.

Form III was then presented to a sample of parents with at least one child aged 1 to 10 years to evaluate the clarity, simplicity, comprehensibility, and appropriateness of the item wording. Feedback from this qualitative face-validity stage was used to revise wording that participants considered unclear or difficult to understand. After this, the current study authors developed Form IV. Then, content validity was evaluated by 10 experts with relevant backgrounds in psychology, psychological measurement, and parenting research. Experts judged the necessity, relevance, clarity, and adequacy of item content. A Content Validity Ratio (CVR) and Content Validity Index (CVI) were calculated, and items were revised when expert feedback indicated that wording or content required clarification.

Demographic Questionnaire

A researcher-developed demographic questionnaire was used to obtain information on age, sex, marital and parental status, educational level, and perceived socioeconomic status.

Parental Care and Tenderness Scale

The Parental Care and Tenderness Scale (PCAT) was developed by Buckels et al. (2015) to assess individual differences in activation of the parental care motivational system among both parents and nonparents. The full form contains 25 items distributed across five five-item domains: Caring, Liking, Protection, Tenderness-Positive, and Tenderness-Negative (Buckels et al., 2015). Items 1 through 15 assess attitudes, preferences, caring responses, liking of children, and protective inclinations. Items 16 through 25 present hypothetical child-related situations and ask respondents to rate the degree of tenderness elicited by each situation.

Parenting Behaviours and Dimensions Questionnaire

The Parenting Behaviours and Dimensions Questionnaire (PBDQ) was developed by Reid et al. (2015) to assess contemporary parenting behaviours across six dimensions. The 33-item measure assesses Emotional Warmth, Punitive Discipline, Anxious Intrusiveness, Autonomy Support, Permissive Discipline, and Democratic Discipline (Reid et al., 2015). Responses are made on a six-point scale ranging from 1 (never) to 6 (always). Emotional Warmth, Autonomy Support, and Democratic Discipline are scored in the direct direction, whereas Punitive Discipline, Permissive Discipline, and Anxious Intrusiveness are reverse-oriented according to the scoring protocol used in the present study.Persian version of the PBDQ was translated and psychometrically evaluated by Ahmadboukani et al. (2022) in 329 Iranian parents of children aged 7–12 years. Confirmatory factor analysis supported the six-factor structure, and evidence of content, convergent, and divergent validity was reported. Internal consistency was also satisfactory, with Cronbach's $\alpha = .87$ and McDonald's $\omega = .88$ for the questionnaire (Ahmadboukani et al., 2022).

Behavioral Inhibition System/Behavioral Activation System Scales

The Behavioral Inhibition System/Behavioral Activation System (BIS/BAS) scales developed by Carver and White (1994) assess individual differences in behavioral inhibition and approach-related activation. The administered item set comprised 24 numbered statements, of which four items (1, 6, 11, and 17) served as fillers and were excluded from subscale scoring, leaving 20 scored items. Responses were recorded on a four-point scale: 1 (very true for me), 2 (somewhat true for me), 3 (somewhat false for me), and 4 (very false for me). In accordance with the supplied scoring instructions for the present dataset, items other than 2 and 22 were reverse-scored before subscale scores were computed.The Persian form of the BIS/BAS scales was psychometrically evaluated by Mohammadi (2008) in 188 students at Shiraz University. Exploratory factor analysis reproduced the four-factor structure of BIS, BAS Drive, BAS Reward Responsiveness, and BAS Fun Seeking, accounting for 47.98% of the total variance. Test–retest reliability and internal consistency were reported to be acceptable, and associations with anxiety and depression provided evidence relevant to convergent and divergent validity (Mohammadi, 2008). These findings provided initial support for the reliability and factorial validity of the Persian BIS/BAS scales in an Iranian sample.

Procedure

After the Persian PCAT had been finalized, a multistage stratified cluster-sampling procedure was used for participant recruitment. For sample-size planning, a ratio of 12 participants per PCAT item was adopted. Given the 25-item structure of the PCAT, a target of 300 parents was established for the parent group. An additional 173 adults without children, including married adults without children and unmarried adults, were targeted for the known-groups validity assessment.

Recruitment of parents was conducted across predefined geographic areas of Kerman Province. Of five areas, two were selected using cluster random sampling. Subsequently, 10 neighborhoods were randomly selected from a total of 25 neighborhoods within the selected areas. From these neighborhoods, two kindergartens and three primary schools were selected by cluster random sampling. Sixty parents were then randomly recruited from each selected kindergarten or school, yielding a planned parent sample of 300 participants. One parent from each participating family, either the father or the mother, was invited to complete the study questionnaires in person; the sampling plan sought equal representation of fathers and mothers (150 fathers and 150 mothers).

Eligible parents were informed about the study aims and procedures and provided informed consent before participation. They completed the Persian PCAT and, where applicable, the PBDQ and BIS/BAS measures. For the known-groups component, adults without children were recruited separately. This group included both married individuals without children and unmarried adults, who completed the Persian PCAT through the study's online data-collection procedure. Completed questionnaires were screened for missing data, response-range violations, and invalid or inconsistent responding. Following data screening, 437 participants with complete PCAT data were retained for the psychometric analyses.

Results

Phase 1: Translation and Cultural Adaptation

The translation and cultural-adaptation phase resulted in a finalized Persian version of the 25-item PCAT. After permission was obtained from the original developer, the English items were translated into Persian and reviewed for linguistic clarity and conceptual appropriateness. Feedback obtained during the target-population review was incorporated into the wording of the

Persian items. The revised version was then back-translated into English by a professional translator, compared with the original instrument, and finalized after confirmation from the scale developer. No item was removed during this phase.

Face Validity

Qualitative face validity was examined with members of the target population. Participants evaluated the clarity, simplicity, comprehensibility, relevance, and overall presentation of the translated items. Their feedback led to wording revisions intended to improve readability and ease of understanding; the source report specifically notes revision of Item 15. Following these revisions, the Persian PCAT was judged acceptable in terms of qualitative face validity.

Content Validity

Content validity was evaluated by 10 experts drawn from psychology, psychological measurement, and parenting-related research. Experts rated item necessity, relevance, and clarity. Item-level Content Validity Ratio (CVR) values ranged from .90 to 1.00, and item-level Content Validity Index (CVI) values ranged from .60 to 1.00. Items 2 and 8 had the lowest CVI values (.60). The mean item-level CVR was .972 and the mean item-level CVI was .88. Expert comments were used to revise wording and grammar where necessary.

Table 1. *Content Validity Index and Content Validity Ratio for the Persian PCAT Items*

Item	CVI	CVR	Item	CVI	CVR
1	0.80	0.90	14	0.80	1.00
2	0.60	1.00	15	1.00	1.00
3	1.00	1.00	16	1.00	0.90
4	1.00	1.00	17	1.00	1.00
5	1.00	0.90	18	0.80	1.00
6	0.80	1.00	19	0.80	0.90
7	0.80	1.00	20	0.80	1.00
8	0.60	0.90	21	1.00	1.00

9	1.00	1.00	22	0.80	1.00
10	1.00	1.00	23	0.80	0.90
11	1.00	1.00	24	1.00	1.00
12	0.80	1.00	25	1.00	1.00
13	0.80	0.90			

Note. CVI = Content Validity Index; CVR = Content Validity Ratio. Scale-level values were calculated as the mean of the 25 reported item-level values (CVI = .88; CVR = .972).

These translation, face-validity, and content-validity findings established the finalized Persian PCAT that was subsequently evaluated in Phase 2 using factor-analytic, reliability, validity, EGA, and network analyses.

Statistical Analysis

All analyses were conducted in RStudio using the psych, lavaan, semTools, EGAnet, qgraph, bootnet, networktools, and related R packages. Prior to analysis, data were screened for coding accuracy, missingness, response ranges, and demographic inconsistencies. PCAT Items 2, 5, 8, 11, and 14 were reverse-scored on the 1–5 response scale before computation of the total and five subscale scores. In accordance with the study scoring protocol, items comprising PBDQ Punitive Discipline, Anxious Intrusiveness, and Permissive Discipline were reverse-scored, whereas all BIS/BAS items except Items 2 and 22 were reverse-scored; filler Items 1, 6, 11, and 17 were excluded from BIS/BAS scoring. The 437 participants with complete PCAT data were randomly divided using a fixed reproducible seed into independent EFA (n = 218) and CFA (n = 219) subsamples. EFA was conducted on the polychoric correlation matrix using minimum-residual extraction and oblimin rotation. Factorability was evaluated with the Kaiser–Meyer–Olkin statistic and Bartlett's test of sphericity, and parallel analysis was used to determine the number of factors. CFA was subsequently conducted in the independent confirmatory subsample

with ordinal indicators using the WLSMV estimator and theta parameterization. Correlated five-factor, one-factor, and second-order models were compared using χ^2, CFI, TLI, RMSEA with confidence intervals, and SRMR, with standardized factor loadings, latent correlations, composite reliability, average variance extracted, and HTMT also examined.

The full PCAT sample (N = 437) was used for reliability, exploratory graph analysis (EGA), network analysis, and known-groups analyses. Internal consistency was assessed using Cronbach's α, standardized α, ordinal α, and ω, supplemented by corrected item–total correlations and α-if-item-deleted statistics. EGA was estimated with a graphical LASSO network and walktrap community detection, and 1,000 parametric bootstrap replications were used to evaluate dimensional frequency, structural consistency, and item stability. The item network was estimated with EBICglasso using a tuning parameter of .50; node strength, one-step expected influence, betweenness, closeness, bridge strength, and bridge expected influence were examined, and network accuracy and stability were evaluated with 1,000 nonparametric edge-weight bootstrap samples and 1,000 case-dropping bootstrap samples, including correlation-stability coefficients for strength and expected influence. Measurement invariance across gender and parent status was tested using ordinal multi-group CFA. When an item category was empty in one group, that category was minimally collapsed with an adjacent category across both groups for that item only, and all such recoding was restricted to the invariance analyses and documented separately. Convergent and divergent validity analyses were based on the 149 participants with complete PBDQ and BIS/BAS data and included Pearson and Spearman correlations, Benjamini–Hochberg false-discovery-rate adjustment, and reliability-corrected correlations as sensitivity estimates. Known-groups validity was examined using gender and parent-status comparisons, Cohen's d, and supplementary factorial models with age adjustment.

Phase 2: Psychometric Evaluation

The full psychometric sample comprised 437 participants. The mean age was 34.45 years (SD = 6.83; observed range = 18-53). Women represented 52.6% of the sample (n = 230) and men 47.4% (n = 207). The analytic parental-status variable classified 309 participants as parents and 127 as nonparents, with one unclassified record. PCAT total and subscale distributions and internal consistency estimates are shown in Table 2. The total score demonstrated good internal consistency (alpha = .858; ordinal alpha = .898; omega total = .901). Raw subscale alpha coefficients ranged from .658 for Protection to .801 for Caring, whereas ordinal alpha coefficients ranged from .728 to .855. Item-level descriptives and item diagnostics are reported in Supplementary Table S1, and the full-sample polychoric correlation heatmap is shown in Supplementary Figure S4.

Table 2. *Sample Characteristics, PCAT Descriptive Statistics, and Reliability*

Panel A. Sample characteristics

Characteristic	Value
Age, years	34.45 (6.83); range 18–53
Sex: Female	230 (52.6%)
Sex: Male	207 (47.4%)
Parent status: Parent	309 (70.7%)
Parent status: Nonparent	127 (29.1%)
Parent status: Unclassified	1 (0.2%)
Education: Grade 8/middle school	15 (3.4%)
Education: High school diploma	106 (24.3%)
Education: Associate degree	78 (17.8%)
Education: Bachelor's degree	173 (39.6%)
Education: Master's degree	59 (13.5%)
Education: Doctoral degree	6 (1.4%)
Socioeconomic status: Low	34 (7.8%)
Socioeconomic status: Middle	373 (85.4%)
Socioeconomic status: High	30 (6.9%)

Panel B. PCAT descriptive statistics and reliability

Scale	n	M	SD	α	αord	ωt
Total	437	3.81	.55	.858	.898	.901
Caring	437	4.01	.70	.801	.855	.856
Liking	437	3.81	.73	.702	.761	.768
Protection	437	3.83	.64	.658	.728	.761
Tenderness +	437	3.99	.92	.737	.821	.825
Tenderness −	437	3.43	1.00	.735	.797	.813

Note. α = Cronbach's alpha; Ord. α = ordinal alpha; ωt = omega total. Percentages are based on N = 437. The observed age range was 18–53 years; six cases exceeded the protocol-specified upper age limit of 45 years and were retained in the completed analyses.

Exploratory Factor Analysis

The EFA subsample contained 218 participants. Sampling adequacy was acceptable (KMO = .790), and Bartlett's test of sphericity was significant, chi-square(300) = 3133.67, $p < .001$. Parallel analysis selected five factors, which together accounted for 53.33% of the common item variance in the minimum-residual oblimin solution. The broad loading pattern corresponded to Caring, Liking, Protection, Tenderness-Positive, and Tenderness-Negative (Table 3). Several local deviations were evident: PCAT10 cross-loaded on Caring (.515) and Protection (.487), PCAT13 had a comparatively modest primary loading (.364), and PCAT15 and PCAT21 did not show a salient loading of .30 or greater. Global exploratory fit was mixed (RMSR = .043, RMSEA = .112, 90% CI [.104, .121], TLI = .704). The parallel-analysis plot, EFA polychoric correlation heatmap, and exploratory factor diagram are provided in Supplementary Figure S1, Supplementary Figure S2, and Supplementary Figure S3, respectively.

Table 3. *Oblimin-Rotated Exploratory Factor Loadings for the Persian PCAT*

#	Caring	Liking	Protection	T+	T−
1	**.50**	.19	.06	.25	.02
2	.01	**.67**	.03	.08	-.02
3	**.62**	.14	-.05	.23	.05
4	-.07	.02	**.46**	.19	.01
5	.15	**.61**	.31	-.18	.16
6	**.81**	-.00	.05	-.05	.08
7	.06	.01	**.82**	.01	.04
8	-.05	**.75**	-.13	.10	-.02
9	-.18	.08	**.62**	.27	.02
10	**.52**	-.03	.49	.11	-.07
11	.38	**.51**	-.10	.04	-.01
12	.05	-.03	**.85**	-.02	.05
13	**.36**	.21	.29	.17	.04
14	-.12	**.38**	.22	-.08	.13
15	.09	**-.28**	.16	-.02	.16
16	.13	-.05	.08	**.66**	.03

#	Caring	Liking	Protection	T+	T−
17	.05	-.03	-.03	.03	**.78**
18	.16	-.19	-.14	.17	**.55**
19	.07	-.01	.12	**.48**	.32
20	.11	.02	.06	**.64**	-.03
21	.05	-.03	-.09	**.28**	.21
22	-.10	.06	.07	**.68**	.16
23	-.13	.07	.03	.04	**.84**
24	.08	.02	.06	-.03	**.79**
25	.08	.14	-.05	**.51**	.07

Note. N = 218. Polychoric correlations, minimum-residual extraction, and oblimin rotation were used. Loadings are ordered as Caring, Liking, Protection, Tenderness-Positive, and Tenderness-Negative; the largest absolute loading for each item is bolded. T+ = Tenderness-Positive; T− = Tenderness-Negative.

Confirmatory Factor Analysis

The independent CFA subsample contained 219 participants. Among the prespecified models, the correlated five-factor model fit better than the one-factor and second-order models, but its absolute fit remained below conventional standards: chi-square(265) = 521.60, $p < .001$, CFI = .775, TLI = .746, RMSEA = .101, 90% CI [.090, .111], and SRMR = .082 (Table 4). Standardized loadings were statistically significant for 24 of 25 items and ranged from .333 to .891 among those significant indicators; PCAT15 had a negligible, nonsignificant loading on Protection (lambda = .035, p = .614). Composite reliability ranged from .550 (Protection) to .858 (Caring), and AVE ranged from .455 (Liking) to .587 (Caring). Standardized loadings, latent correlations, and HTMT coefficients are presented in Supplementary Table S2. The standardized CFA diagram is shown in Figure 1.

Table 4. *Confirmatory Model Fit and Factor-Level Reliability*

Panel A. Model fit comparison

Model	χ^2(df)	CFI	TLI	RMSEA [90% CI]	SRMR
5-factor correlated	521.60 (265)	.775	.746	.101 [.090, .111]	.082
1-factor	1159.89 (275)	.498	.452	.148 [.139, .157]	.128
Second-order	655.19 (270)	.751	.723	.105 [.095, .116]	.096

Panel B. Composite reliability and average variance extracted

Factor	CR	AVE
Caring	.858	.587

Factor	CR	AVE
Liking	.644	.455
Protection	.550	.554
Tenderness Positive	.775	.522
Tenderness Negative	.798	.552

Note. All chi-square tests were $p < .001$. CFA used ordinal WLSMV estimation. AVE = average variance extracted.

---------- Insert Figure 1 Here----------

Figure 1 . *Standardized Correlated Five-Factor CFA Model of the Persian PCAT*

Note. Confirmatory subsample n = 219. Standardized factor loadings are displayed; residual terms were omitted from the plotted R output for visual clarity.

Measurement Invariance

Ordinal multi-group models required category collapsing for PCAT7, PCAT9, PCAT10, and PCAT13 in the gender analysis and for PCAT5 and PCAT13 in the parent-status analysis because an extreme response category was empty in one group. The gender configural model showed CFI = .772, TLI = .742, RMSEA = .098, and SRMR = .076; the parent-status configural model showed CFI = .766, TLI = .735, RMSEA = .097, and SRMR = .075. Because adequate configural fit was not established, subsequent equality-constrained models were treated as descriptive sensitivity analyses rather than as evidence of measurement invariance. Full fit sequences, recoding details, and group-specific parameters are reported in Supplementary Table S3, with the gender and parent-status fit plots in Supplementary Figure S5 and Supplementary Figure S6, respectively.

Exploratory Graph Analysis and Network Structure

EGA was conducted on all 437 participants and identified five empirical dimensions (TEFI = -18.974). Across 1,000 parametric bootstrap samples, five dimensions were the modal solution (40.6%), followed by four dimensions (35.4%); the median dimensionality was five. Structural consistency varied considerably across dimensions (.086-.800), indicating that some communities were substantially less stable than others. The five-community solution largely reproduced the

theoretical domains, although PCAT9 and PCAT15 were assigned to the Caring-dominant community rather than Protection, and PCAT21 was assigned to the Tenderness-Positive community rather than Tenderness-Negative. Item stability was particularly low for PCAT15 (.209) and PCAT9 (.371). Item-level community membership and key network centrality indices are summarized in Table 5, with detailed EGA bootstrap results in Supplementary Table S4. The EGA network is shown in Figure 2, and the EGA correlation heatmap appears in Supplementary Figure S7.

Table 5. *EGA Community Membership and Principal Network Centrality Indices*

#	Th.	EGA	Stab.	Strength	EI	Bridge EI
1	C	C	.931	.922	.922	.375
2	L	L	.926	.883	.629	.012
3	C	C	.931	.964	.964	.274
4	P	P	.734	.506	.461	.040
5	L	L	.917	1.200	1.054	.348
6	C	C	.931	1.043	.978	.244
7	P	P	.734	1.024	1.024	.179
8	L	L	.925	.822	.656	-.023
9	P	C	.371	.866	.800	.500
10	C	C	.667	1.281	1.149	.534
11	L	L	.827	.963	.953	.471
12	P	P	.734	1.111	1.111	.354
13	C	C	.685	.924	.924	.419
14	L	L	.898	.401	.401	.102
15	P	C	.209	.369	.078	-.035
16	T+	T+	1.000	.998	.958	.308
17	T−	T−	.564	.818	.818	.145
18	T−	T−	.491	.858	.751	.121
19	T+	T+	1.000	1.045	1.045	.371
20	T+	T+	1.000	.730	.730	.332
21	T−	T+	.733	.549	.541	.294
22	T+	T+	1.000	1.016	1.016	.329
23	T−	T−	.564	1.066	1.066	.333
24	T−	T−	.564	1.091	1.040	.259
25	T+	T+	1.000	.768	.768	.390

Note. Item numbers correspond to PCAT items. C = Caring; L = Liking; P = Protection; T+ = Tenderness-Positive; T− = Tenderness-Negative; EI = expected influence. EGA community labels were assigned according to the predominant theoretical content of each empirical community.

----------Insert Figure 2 here----------

Figure 2. *Exploratory Graph Analysis Network of the Persian PCAT*

Note. Full sample N = 437. Communities were estimated from a graphical LASSO network using walktrap community detection.

In the EBICglasso network, the strongest edge connected PCAT7 and PCAT12 (weight = .536), followed by PCAT17-PCAT24 (.362), PCAT3-PCAT6 (.360), and PCAT10-PCAT13 (.355). PCAT10 had the highest node strength (1.281) and expected influence (1.149). Other comparatively central nodes included PCAT12, PCAT23, PCAT5, PCAT19, and PCAT24. PCAT15 was the least central item (strength = .369; expected influence = .078), followed by PCAT14 on strength (.401). Bridge expected influence was highest for PCAT10 (.534), PCAT9 (.500), and PCAT11 (.471). Case-dropping stability was strong for strength (CS = .751) and acceptable-to-strong for expected influence (CS = .673). The regularized network and standardized centrality profile are shown in Figures 3 and 4; complete centrality, bridge-centrality, strongest-edge, and stability results are provided in Supplementary Table S5. Edge-weight accuracy and case-dropping centrality-stability plots appear in Supplementary Figure S8 and Supplementary Figure S9, respectively.

[Insert Figure 3 here]

Figure 3 *EBICglasso Regularized Partial-Correlation Network of the Persian PCAT*

Note. Full sample N = 437. Nodes represent PCAT items; edges represent regularized partial associations. Items are grouped by the five theoretical PCAT domains.

[Insert Figure 4 here]

Figure 4. *Standardized Node Strength and Expected Influence in the Persian PCAT Network*

Note. Centrality values are standardized z scores derived from the full-sample EBICglasso network.

Convergent and Divergent Validity

External-validity analyses were based on the 149 participants with complete PCAT, PBDQ, and BIS/BAS data. After false-discovery-rate correction, the PCAT total score correlated

positively with Emotional Warmth (r = .308, q = .001), Autonomy Support (r = .270, q = .005), and Democratic Discipline (r = .291, q = .002), and negatively with the reverse-scored Anxious Intrusiveness score (r = -.315, q = .001) and the reverse-scored Permissive Discipline score (r = -.211, q = .029). The association with reverse-scored Punitive Discipline was not significant (r = .101, q = .304). Among the BIS/BAS dimensions, the total PCAT score was associated with BAS Reward Responsiveness (r = .299, q = .002), whereas BAS Drive, BAS Fun Seeking, and BIS were not significantly related to the total score after FDR correction. The principal correlation matrix is presented in Table 6; exact Pearson and Spearman statistics and reliability-corrected correlations are provided in Supplementary Table S6, and the Pearson correlation heatmap is shown in Supplementary Figure S10.

Table 6. *Correlations of PCAT Scores With Parenting and BIS/BAS Dimensions*

Panel A. Parenting Behaviours and Dimensions Questionnaire

PCAT score	EW	PD-R	AI-R	AS	Perm.	DD
Total	.31	.10	-.32	.27	-.21	.29
Caring	.14	-.11	-.25	.14	-.20	.14
Liking	.39	.30	-.15	.31	-.01	.32
Protection	.20	.00	-.39	.19	-.18	.27
T+	.21	.04	-.25	.23	-.15	.20
T−	.17	.09	-.15	.10	-.20	.14

Panel B. BIS/BAS scales

PCAT score	Drive	Fun	Reward	BIS
Total	.05	.15	.30	-.02
Caring	.18	.21	.18	.01
Liking	-.07	.04	.09	-.18
Protection	.25	.25	.23	.07
T+	-.00	.08	.28	-.03
T−	-.04	.06	.24	.06

Note. N = 149. Entries are Pearson correlations. FDR-adjusted q values and exact significance levels are reported in Supplementary Table S6. EW = Emotional Warmth; PD-R = reverse-scored Punitive Discipline; AI-R = reverse-scored Anxious Intrusiveness; AS = Autonomy Support; Perm. = reverse-scored Permissive Discipline; DD = Democratic Discipline. For reverse-scored PBDQ domains, higher scores indicate lower endorsement of the original negatively oriented behavior. T+ = Tenderness-Positive; T− = Tenderness-Negative.

Known-Groups Validity

Women scored higher than men on the PCAT total score (M = 3.89 vs. 3.72, d = .32, q = .003), Caring (d = .36, q = .001), Protection (d = .26, q = .011), and Tenderness-Negative (d = .28, q = .006). Gender differences in Liking and Tenderness-Positive were not significant after FDR correction. Parents scored higher than nonparents on the total score (M = 3.89 vs. 3.62, d = .51, q < .001) and on all five subscales (absolute d = .24-.45, all q <= .020). Full group comparisons are reported in Supplementary Table S7. In age-adjusted factorial sensitivity models, parent status remained significant for the total score and Liking but not for the other four subscales, while gender remained significant for the total score, Caring, Protection, Tenderness-Positive, and Tenderness-Negative; the detailed factorial results are shown in Supplementary Table S8.

Discussion

The present study translated and culturally adapted the PCAT for Persian-speaking adults and evaluated its psychometric performance using complementary latent-variable and network approaches. The Phase 1 procedures yielded a Persian version that was judged understandable by target respondents and broadly acceptable by experts, although Items 2 and 8 had comparatively low item-level CVI values of .60. In Phase 2, the total PCAT score showed good internal consistency across raw, ordinal, and omega estimates, but the evidence for the original five-factor structure was mixed. Parallel analysis and EGA each recovered five dimensions at the sample level, yet the confirmatory five-factor model did not achieve satisfactory global fit, and several items showed weak or unstable functioning across analytic frameworks.

At the broad structural level, the five EFA dimensions were readily interpretable as Caring, Liking, Protection, Tenderness-Positive, and Tenderness-Negative, which is consistent with the organization reported in the original PCAT development work (Buckels et al., 2015). The recovery

of five communities by EGA also converged with this broad organization. Similar cross-cultural continuity was reported in the Italian adaptation, where the five PCAT domains were largely reproduced in a different linguistic context (Castelli et al., 2023).

The confirmatory evidence, however, argues against describing the Persian five-factor structure as fully replicated. The correlated five-factor model performed better than the one-factor and second-order alternatives, but CFI and TLI were low and RMSEA was approximately .10. This pattern, together with the heterogeneous EGA stability coefficients, suggests that the five-domain representation captures meaningful organization while leaving substantial local misfit. This qualification is important because prior PCAT work has also emphasized that broader nurturance and protection processes may coexist with more specific facets rather than forming a perfectly simple structure (Hofer et al., 2018).

Item 15 emerged as the clearest source of concern. It showed an almost zero CFA loading, weak corrected item-total association, low EGA stability, reassignment outside the expected Protection community, and the lowest network centrality. Removing it increased the raw Protection alpha from .658 to approximately .729. PCAT14 also showed relatively weak item-total and network performance, whereas PCAT9 changed EGA community despite loading meaningfully on Protection in the factor analyses. These converging indicators suggest that future Persian revisions should prioritize cognitive interviewing and item-level scrutiny rather than simply removing items on the basis of a single statistic.

Reliability was strongest for the total score, for which alpha was .858, ordinal alpha was .898, and omega total was .901. These values are somewhat lower than the very high total-score reliability reported in the original validation and the Italian adaptation, but they still support consistent measurement at the aggregate level (Buckels et al., 2015; Castelli et al., 2023). Subscale

reliability was less uniform, particularly for Protection, reinforcing the need for caution when interpreting individual facet scores in the current Persian form.

The network findings added item-level information that was not evident from global factor fit alone. PCAT10 occupied the most central position by both strength and expected influence, and it also showed the largest bridge expected influence. PCAT12, PCAT23, PCAT5, PCAT19, and PCAT24 were also prominent nodes. These items span caring, liking, protection, and tenderness content, which is consistent with the view that parental care motivation comprises related but functionally differentiated tendencies rather than a single narrow response pattern (Schaller, 2018; Hofer et al., 2018).

The strongest network edge linked PCAT7 and PCAT12, both Protection items, while other strong edges occurred within Tenderness-Negative and Caring content. This local clustering supports substantive coherence within several domains. At the same time, the EGA bootstrap distribution was not sharply concentrated on five dimensions: a four-dimensional solution appeared in more than one third of bootstrap samples. The low structural consistency of the Caring-dominant community and the low stability of PCAT15 and PCAT9 indicate that dimensional boundaries remain uncertain in this sample. Network centrality should therefore be interpreted as a description of the estimated item system rather than as evidence that central items are causal drivers of parental-care motivation.

The external correlation pattern provided partial rather than uniform evidence of convergent validity. Positive associations of PCAT scores with Emotional Warmth, Autonomy Support, and Democratic Discipline were directionally consistent with convergence between caregiving motivation and supportive parenting behavior (Reid et al., 2015). The associations involving the reverse-scored negative PBDQ domains were more complex: because higher

reverse-scored values represent lower endorsement of the original negative behavior, the negative PCAT associations with Anxious Intrusiveness and Permissive Discipline do not provide straightforward convergent evidence. Accordingly, the PBDQ findings support selective convergence while also identifying relationships that require replication and careful examination of scoring direction.

Divergent validity was also qualified rather than absolute. The total PCAT score was essentially unrelated to BIS and BAS Drive, but it showed a positive association with BAS Reward Responsiveness. Several PCAT subscales, especially Protection, also correlated with BAS dimensions. This pattern does not imply construct equivalence: the BIS/BAS scales index broad reward and inhibition sensitivities, whereas the PCAT targets child-specific caregiving motivation (Carver & White, 1994). The association with reward responsiveness may be especially plausible given prior evidence that infant cues can be experienced as motivationally rewarding, but the present data support relative distinctiveness rather than complete independence from general approach systems (Buckels et al., 2015).

Known-groups results were broadly consistent with earlier PCAT studies. Parents scored higher than nonparents on the total score and all five subscales in the unadjusted comparisons, paralleling prior evidence that parenthood is associated with stronger chronic activation of parental-care motives (Buckels et al., 2015; Castelli et al., 2023). Women also scored higher on the total score and several domains. The Italian study similarly found higher total, Caring, and tenderness scores among women, although it did not find a gender difference in Protection, whereas Protection was higher among women in the present Iranian sample (Castelli et al., 2023). Age-adjusted analyses attenuated several parent-status differences, indicating that demographic composition contributes to some of the observed known-group effects.

The measurement-invariance analyses place an additional constraint on between-group interpretation. Several items required category collapsing because an extreme category was unobserved within a subgroup, and the configural models did not show adequate global fit. Consequently, the observed gender and parent-status mean differences should be viewed as supportive descriptive evidence rather than definitive proof that latent PCAT scores are strictly comparable across these groups.

Practical Implications

The Persian PCAT provides a structured means of studying parental-care motivation in Iranian adults, including both parents and adults without children. The total score is currently the most psychometrically defensible summary because it showed strong reliability and coherent relationships with parenting-related constructs. The instrument may therefore be useful in research on preparedness for parenthood, caregiving motivation, family psychology, reproductive attitudes, and individual differences in responses to children. It should not yet be used as a diagnostic or stand-alone clinical decision instrument, and interpretation of individual Protection scores should be cautious until the performance of Item 15 and related items has been replicated or refined.

The item-level network results also provide a practical map for future scale refinement. Highly central items can be retained as informative indicators of the interconnected caregiving system, whereas structurally weak or unstable items can be prioritized for qualitative review. These centrality results should be used for measurement refinement rather than interpreted as intervention targets because the network was estimated from cross-sectional self-report data.

Limitations and Future Directions

Several limitations qualify the findings. First, the study was cross-sectional and relied entirely on self-report, preventing conclusions about temporal stability, causal processes, or

correspondence with observed caregiving behavior. Second, recruitment was concentrated in Kerman Province, limiting generalization to the wider Iranian population. Third, only 149 participants completed the external PBDQ and BIS/BAS measures, so convergent and divergent validity estimates were based on a substantially smaller subset than the structural analyses. Fourth, parents substantially outnumbered nonparents, and one parental-status record could not be classified from the available demographic label.

Fifth, six analyzed age records exceeded the protocol-specified upper age limit of 45 years because the completed analytic pipeline retained rather than excluded those observations. Future preregistered replications should resolve eligibility discrepancies before analysis. Sixth, global CFA fit was inadequate and measurement-invariance configural models also fit poorly, while some ordinal response categories were empty within subgroups and required collapsing for invariance estimation. These issues limit strong claims about exact replication of the original factor structure and about latent mean comparability across gender or parental status.

Future research should replicate the Persian PCAT in an independent and more geographically diverse sample, conduct cognitive interviews around Items 15, 14, 9, 21, and the low-CVI Items 2 and 8, and evaluate revised wording before item deletion is considered. Item-response-theory and differential-item-functioning analyses would help distinguish local item problems from broader dimensional misspecification. Test-retest reliability, longitudinal prediction, behavioral responses to infant stimuli, and prospective parenting outcomes would provide stronger evidence of temporal and criterion validity. Replication of EGA and network results in an independent sample is also needed before the present centrality hierarchy is treated as stable.

Conclusion

The Persian adaptation of the PCAT demonstrated good reliability for the total score, meaningful associations with parenting-related constructs, and theoretically coherent parent and gender differences. EFA and EGA recovered a broadly five-dimensional organization, and the network analysis identified stable centrality estimates and interpretable within-domain connections. At the same time, poor CFA fit, uneven subscale reliability, unstable item assignments, weak performance of PCAT15, and unresolved measurement-invariance concerns indicate that the five-factor Persian structure should be regarded as provisionally supported rather than conclusively established. The current version is therefore promising for research use, particularly at the total-score level, while further item refinement and independent replication are needed before strong cross-group or subscale-level applications are warranted.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the University of Social Welfare and Rehabilitation Sciences, Tehran, Iran (approval number IR.USWR.REC.1403.121). All research procedures were conducted in accordance with the guidelines and regulations of this ethics committee. All participants were informed about the study aims and procedures and provided informed consent before participation.

Consent for publication

Not applicable.

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Authors' contributions

Sara Faraji: Conceptualization, methodology, resources, software, supervision, formal analysis, writing the original draft, and reviewing and editing the manuscript.

Mohammadreza Davoudi: Investigation, Formal analysis, writing the original draft, and reviewing and editing the manuscript.

Abbas Pourshahbaz: Reviewing and editing the manuscript.

Fereshte Momeni: writing the original draft, project administration, conceptualization, and reviewing and editing the manuscript.

All authors read and approved the final manuscript.

Data availability

The raw data supporting the conclusions of this study are available from the corresponding author,

Fereshte Momeni (fe.momeni@uswr.ac.ir), upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

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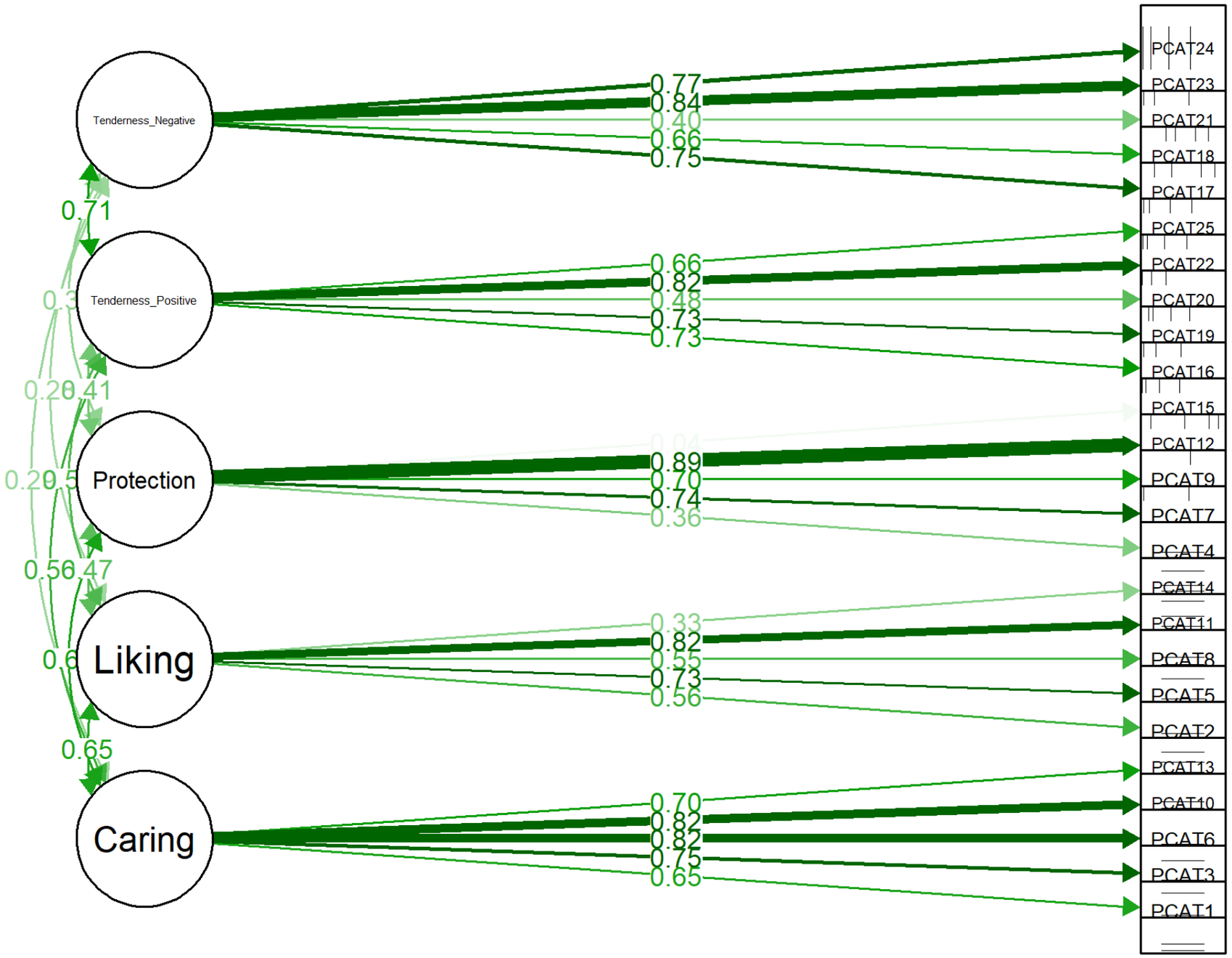

Tenderness_Negative
Tenderness_Positive
Protection
Liking
Caring
0.71
0.3
0.20
0.41
0.29
0.5
0.56
0.47
0.6
0.65
0.77
0.84
0.40
0.66
0.75
0.66
0.82
0.48
0.73
0.73
0.04
0.89
0.70
0.74
0.36
0.33
0.82
0.55
0.73
0.56
0.70
0.82
0.82
0.75
0.65
PCAT24
PCAT23
PCAT21
PCAT18
PCAT17
PCAT25
PCAT22
PCAT20
PCAT19
PCAT16
PCAT15
PCAT12
PCAT9
PCAT7
PCAT4
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PCAT5
PCAT2
PCAT13
PCAT10
PCAT6
PCAT3
PCAT1

Figure 1

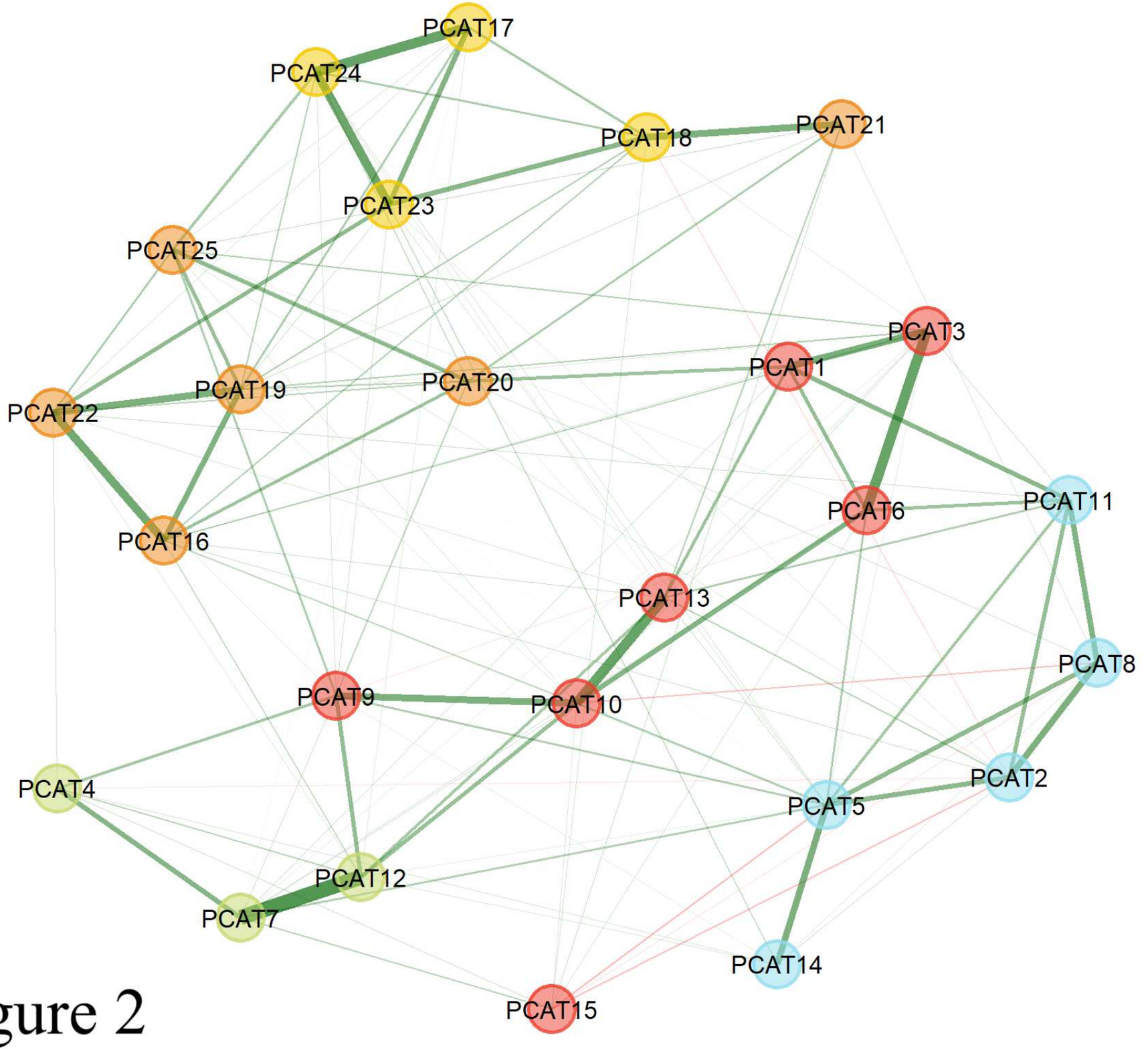

PCAT17
PCAT24
PCAT18
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PCAT25
PCAT3
PCAT1
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PCAT16
PCAT13
PCAT8
PCAT9
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5

Figure 2

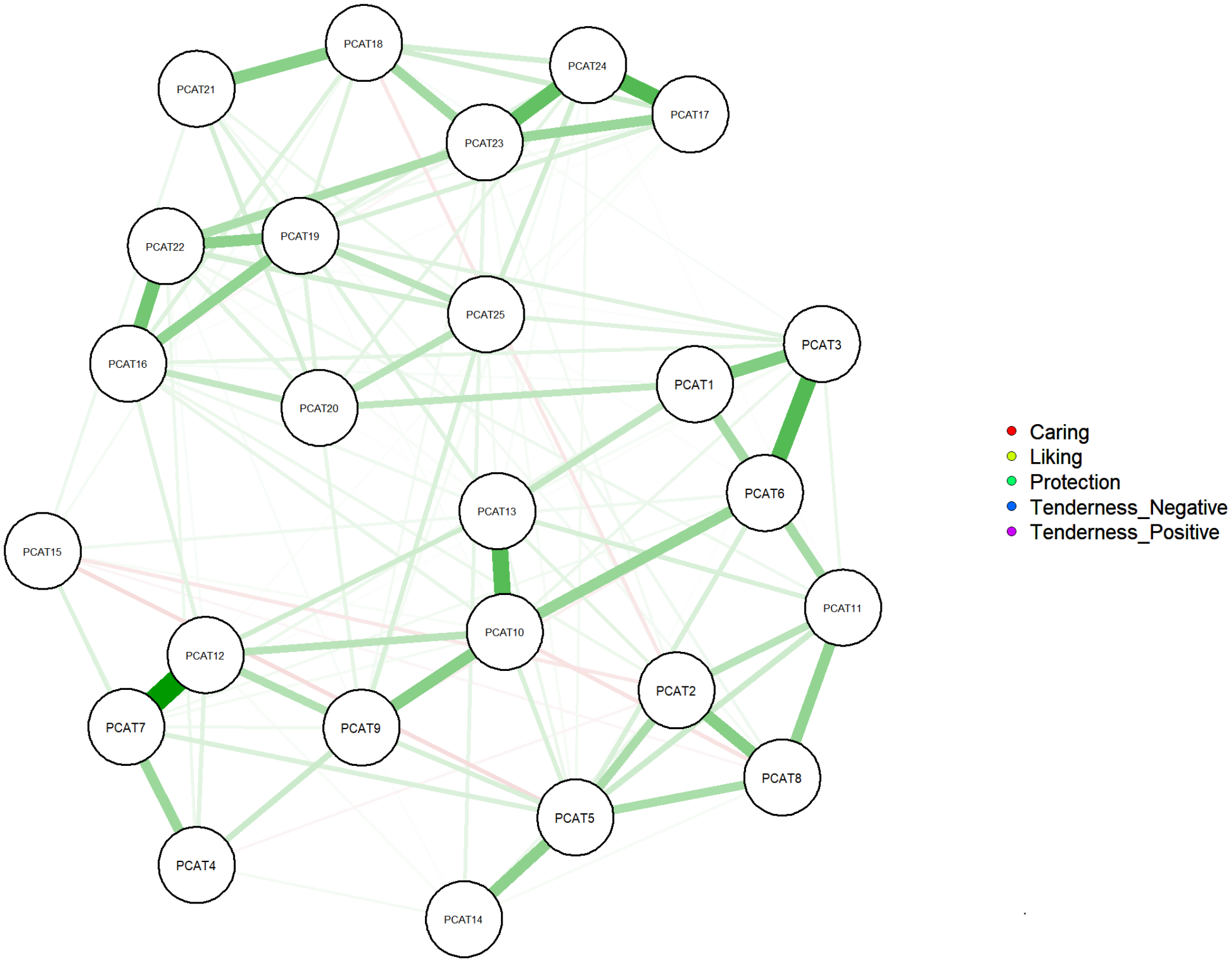

PCAT18
PCAT21
PCAT24
PCAT17
PCAT23
PCAT22
PCAT19
PCAT25
PCAT16
PCAT3
PCAT1
PCAT20
PCAT6
PCAT13
PCAT15
PCAT11
PCAT10
PCAT12
PCAT2
PCAT7
PCAT9
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PCAT4
PCAT14
Caring
Liking
Protection
Tenderness_Negative
Tenderness_Positive

Figure 3

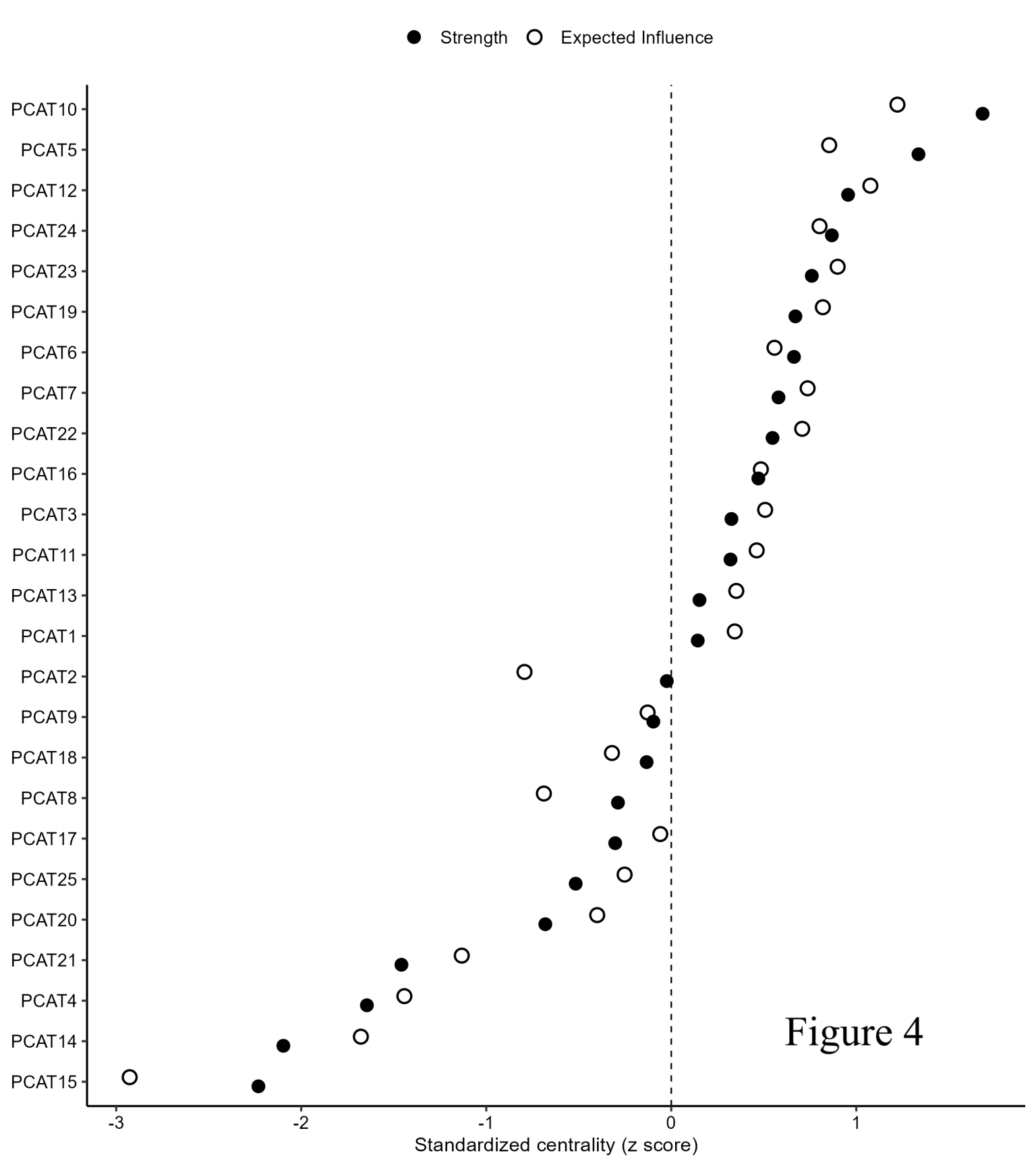

Strength
Expected Influence
PCAT10
PCAT5
PCAT12
PCAT24
PCAT23
PCAT19
PCAT6
PCAT7
PCAT22
PCAT16
PCAT3
PCAT11
PCAT13
PCAT1
PCAT2
PCAT9
PCAT18
PCAT8
PCAT17
PCAT25
PCAT20
PCAT21
PCAT4
PCAT14
PCAT15
-3
-2
-1
0
1
Standardized centrality (z score)

Figure 4

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendix1.docx
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