Appendix A.

Exploratory Factor Analysis (EFA) of the EmpathiSEr-P Scale: Final Three-Factor Solution

This appendix contains further details regarding the final three-factor solution from the EFA of the EmpathiSEr-P scale. EFA was conducted using **Principal Axis Factoring (PAF)** and an **oblique rotation method (Direct Oblimin).**

PAF was chosen over Principal Component Analysis (PCA) because the goal was to identify underlying latent constructs (i.e., psychological dimensions of empathy) rather than merely reduce data into uncorrelated components. While PCA treats all variance (common, unique, and error) as meaningful, PAF focuses only on shared variance among items, which is more appropriate for construct identification.

Direct Oblimin rotation was used instead of an orthogonal method like Varimax because the dimensions of empathy such as cognitive, emotional, and behavioural aspects, are theoretically expected to be correlated rather than independent. Oblique rotation allows for these correlations to emerge in the factor solution, enabling a more accurate and psychologically meaningful representation of the underlying factor structure.

SPSS 29 was used for conducting this analysis.

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Kaiser-Meyer-Olkin (KMO) measure and Bartlett Test of Sphericity

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.860
Bartlett's Test of Sphericity	Approx. Chi-Square	1647.348
	df	190
	Sig.	<.001

The overall **Kaiser-Meyer-Olkin (KMO)** measure of sampling adequacy was 0.860, which is classified as *"meritorious"* according to Kaiser's criterion. The KMO statistic evaluates the proportion of variance among variables that might be common variance, i.e., variance that could be explained by underlying factors. Values above 0.80 are considered excellent, indicating that the data are highly suitable for factor analysis and that patterns of correlations are compact enough to yield reliable factors.

Bartlett's Test of Sphericity assesses whether the observed correlations between items are significantly different from zero (i.e., whether the correlation matrix significantly differs from an identity matrix). An identity matrix is one in which variables are completely uncorrelated, which would make factor analysis inappropriate. In simpler terms, Bartlett's test checks whether there is enough shared variance among items to justify reducing the dataset into underlying latent factors. A statistically significant result (typically $p < .05$) indicates that the correlations between variables are sufficiently large for factor analysis to proceed. In this study, Bartlett's Test of Sphericity was statistically significant, $X^2(190) = 1647.348$, $p < .001$, meaning that the items were meaningfully interrelated and thus suitable for uncovering a factor structure.

Communalities

Communalities

	Initial	Extraction
emp_p1	.338	.283
emp_p2	.451	.422
emp_p5	.221	.120
emp_p7	.508	.506
emp_p8	.437	.401
emp_p9	.260	.244
emp_p10	.460	.561
emp_p11	.704	.667
emp_p12	.671	.594
emp_p13	.402	.433
emp_p14	.339	.418
emp_p15	.288	.314
emp_p20	.524	.543
emp_p21	.361	.378
emp_p22	.569	.552
emp_p23	.501	.480
emp_p25	.292	.311
emp_p28	.232	.199
emp_p34	.216	.165
emp_p16	.537	.674

Extraction Method: Principal Axis Factoring.

Communalities in PAF represent the proportion of an item's variance that is explained by the common factors, i.e., the shared variance among items, excluding unique variance and measurement error. PAF focuses specifically on the variance that is common across items, making it more appropriate for identifying underlying latent constructs such as empathy dimensions. In this analysis, the initial communalities reflect the estimated shared variance, while the extracted communalities show how much of that shared variance is accounted for by the final three-factor solution. Higher extracted communalities (e.g. > .40) suggest that the items are well-represented by the factors identified in the EmpathiSEr-P scale.

Total Variance Explained

Total Variance Explained

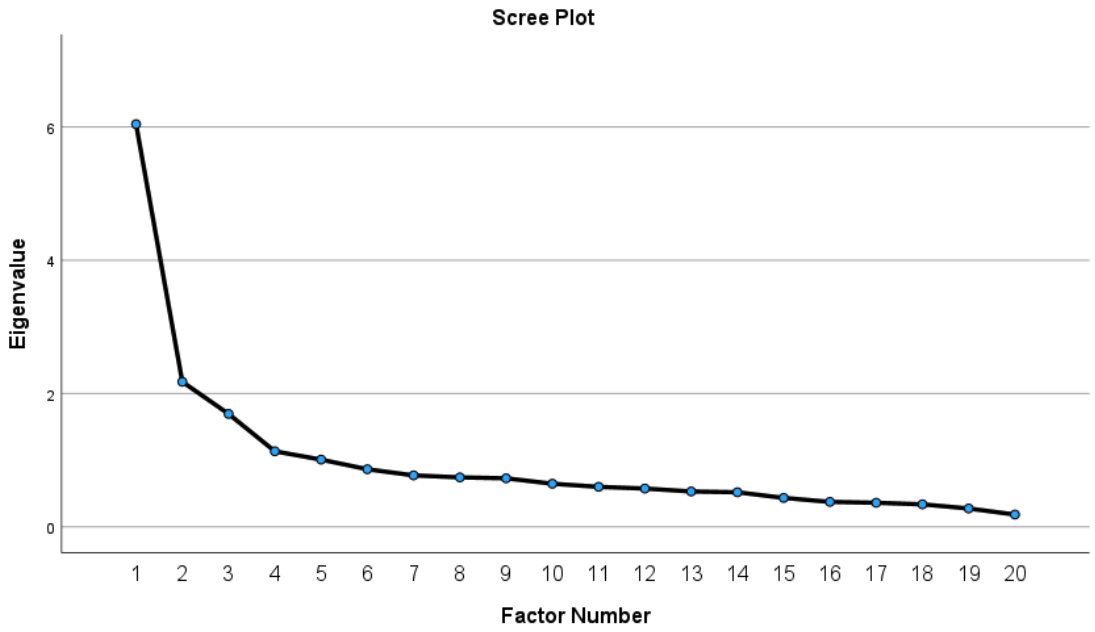
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	6.042	30.208	30.208	5.528	27.639	27.639	5.124
2	2.176	10.881	41.089	1.571	7.853	35.492	3.202
3	1.694	8.471	49.560	1.165	5.825	41.316	1.673
4	1.133	5.667	55.227				
5	1.009	5.043	60.271				
6	.864	4.320	64.591				
7	.772	3.861	68.452				
8	.742	3.710	72.162				
9	.728	3.641	75.804				
10	.647	3.234	79.038				
11	.600	3.001	82.039				
12	.575	2.873	84.912				
13	.531	2.654	87.566				
14	.519	2.594	90.160				
15	.434	2.172	92.332				
16	.375	1.874	94.206				
17	.361	1.806	96.012				
18	.338	1.689	97.701				
19	.275	1.376	99.077				
20	.185	.923	100.000				

Extraction Method: Principal Axis Factoring.

a. When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.

Total Variance Explained refers to the proportion of common variance in the data accounted for by each factor extracted during the EFA. This table displays the eigenvalues and the percentage of variance explained by each factor after extraction, i.e., the amount of shared variance among items that each factor captures. It also presents the cumulative variance, showing how much of the total common variance is explained by the solution as a whole. A higher cumulative variance indicates a more comprehensive and effective factor structure. In this study, the final three-factor solution explains 49.56% of the total common variance, suggesting that the factors adequately capture the underlying structure of the EmpathiSEr-P scale.

Scree Plot



Scree Plot is a visual tool used in EFA to help determine the optimal number of factors to retain. It displays the eigenvalues associated with each factor on the y-axis, plotted against the factor number on the x-axis. The key point of interest in the scree plot is the “elbow” or inflection point, the point at which the slope of the curve noticeably levels off. Factors above this elbow typically have higher eigenvalues and are considered meaningful, while those below represent smaller amounts of variance and are often interpreted as noise or less substantive factors. In this study, the scree plot suggested two to four factor solutions, as the curve began to flatten after the fifth factor, supporting the choice of the final factor structure of the EmpathiSEr-P scale.

Factor Matrix

Factor Matrix[a]

	Factor		
	1	2	3
emp_p1	-.507		
emp_p2	.617		
emp_p5			
emp_p7	.655		
emp_p8	.569		
emp_p9	-.361	.325	
emp_p10	-.488	.438	.362
emp_p11	.793		
emp_p12	.743		
emp_p13		.445	-.411
emp_p14	-.378	.438	
emp_p15			-.486
emp_p20	.689		
emp_p21	-.405	.415	
emp_p22	.719		
emp_p23	.678		
emp_p25	-.335	.442	
emp_p28	-.400		
emp_p34	-.334		
emp_p16	.542	.313	-.531

Extraction Method: Principal Axis Factoring.

a. 3 factors extracted. 9 iterations required.

Factor Matrix shows the factor loadings, which represent the correlations between each item and the extracted factors before rotation. These loadings indicate the extent to which each item is associated with each underlying factor. Higher absolute values (typically above 0.4) suggest a stronger relationship between the item and the factor. However, because this matrix reflects unrotated loadings, the interpretation may be less clear if multiple factors are present and items load on more than one factor. For this reason, rotated solutions (e.g., pattern matrix) is generally used for final interpretation. This unrotated factor matrix is included for completeness and to illustrate how items initially aligned with the emerging factor structure prior to rotation.

Pattern Matrix

Pattern Matrix[a]

	Factor		
	1	2	3
emp_p1	-.469		
emp_p2	.650		
emp_p5		.318	
emp_p7	.708		
emp_p8	.668		
emp_p9		.377	
emp_p10		.743	
emp_p11	.762		
emp_p12	.724		
emp_p13			-.604
emp_p14		.672	
emp_p15			-.557
emp_p20	.685		
emp_p21		.618	
emp_p22	.719		
emp_p23	.648		
emp_p25		.493	
emp_p28		.316	
emp_p34		.346	
emp_p16			-.704

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 7 iterations.

Pattern Matrix presents the rotated factor loadings from the EFA, showing the unique contribution of each item to each factor after rotation (in this case, direct oblimin). These loadings represent the partial regression coefficients of each item on the factors, indicating the strength and direction of the relationship while controlling for other factors. Higher absolute values (commonly above 0.3) suggest that an item strongly loads on that factor, meaning it is a good indicator of the underlying construct represented by that factor. Because direct oblimin rotation allows factors to correlate, the pattern matrix provides a clearer and more interpretable structure by separating overlapping variance between factors. The pattern matrix is typically used to decide which items belong to which factors, aiding in interpreting and naming the factors. In the above matrix, Factor 1 was named as Cognitive empathy, factor 2 as Empathic Responses, and factor 3 as Affective empathy.

Structure Matrix

Structure Matrix

	Factor		
	1	2	3
emp_p1	-.510	.331	
emp_p2	.649		
emp_p5		.334	
emp_p7	.694		
emp_p8	.625		
emp_p9	-.305	.451	
emp_p10		.716	
emp_p11	.807	-.447	
emp_p12	.761	-.419	
emp_p13			-.636
emp_p14		.628	
emp_p15			-.549
emp_p20	.707		-.331
emp_p21		.610	
emp_p22	.742	-.355	
emp_p23	.687	-.334	
emp_p25		.525	
emp_p28	-.341	.405	
emp_p34		.392	
emp_p16	.442		-.751

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

Structure Matrix displays the correlations between each item and the extracted factors in the EFA. While the pattern matrix provides a clear simple structure with items loading distinctly on single factors, the structure matrix often shows cross-loadings because it represents the total correlations between items and factors, including shared variance from factor inter-correlations. In other words, even if an item loads primarily on one factor in the pattern matrix, it can still correlate moderately with other factors in the structure matrix due to factor correlations allowed by the oblique rotation method. This difference highlights why the pattern matrix is generally preferred for determining factor membership, whereas the structure matrix offers insight into the broader relationships among items and factors.

Factor Correlation Matrix

Factor Correlation Matrix

Factor	1	2	3
1	1.000	-.424	-.184
2	-.424	1.000	.000
3	-.184	.000	1.000

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

The Factor Correlation Matrix shows the degree of correlation between the extracted factors in the final solution. Since an oblique rotation method (Direct Oblimin) was used in the analysis, it allows the factors to be correlated rather than assuming they are completely independent (as in orthogonal rotations). The values in this matrix indicate how much the factors relate to each other. For example, a moderate to high correlation suggests that the constructs measured by the factors may share some underlying conceptual overlap, which is expected in psychological constructs like empathy. This correlation structure justifies the use of oblique rotation, as it reflects the theoretical assumption that different dimensions of empathy (e.g., cognitive, emotional, behavioural) are related but not identical.

Cronbach's Alpha Values

This section reports Cronbach's alpha values for the overall EmpathiSEr-P scale and its individual subscales. Cronbach's alpha is a measure of internal consistency, indicating how closely related a set of items are as a group. It is commonly used to assess the reliability of a scale. Alpha values range from 0 to 1, with higher values suggesting greater reliability. A commonly accepted guideline is:

- ≥ .90 = Excellent
- .80 – .89 = Good
- .70 – .79 = Acceptable
- < .70 = May indicate limited internal consistency (depending on context and number of items)

In this study, cognitive empathy and empathic responses subscales demonstrated good reliability, supporting the consistency of items within each construct. The alpha of 0.680 for the affective empathy factor is considered acceptable given that it comprises only three items, and reliability coefficients tend to be lower with fewer items.

EmpathiSEr-P Scale:

Case Processing Summary

		N	%
Cases	Valid	229	100.0
	Excluded[a]	0	.0
	Total	229	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.851	20

Cognitive Empathy Subscale of EmpathiSEr-P Scale:

Case Processing Summary

		N	%
Cases	Valid	229	100.0
	Excluded[a]	0	.0
	Total	229	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.887	9

Affective Empathy Subscale of EmpathiSEr-P Scale:

Case Processing Summary

		N	%
Cases	Valid	229	100.0
	Excluded[a]	0	.0
	Total	229	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.680	3

Empathic Responses Subscale of EmpathiSEr-P Scale:

Case Processing Summary

		N	%
Cases	Valid	229	100.0
	Excluded[a]	0	.0
	Total	229	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.736	8

Descriptive Statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
SE_Prac_Total_3Fac_PAF	229	2.55	7.00	5.3212	.71580
SE_Prac_Cog_3Fac_PAF	229	2.44	7.00	5.4731	.90386
SE_Prac_Affec_3Fac_PAF	229	2.13	7.00	5.5961	.85113
SE_Prac_ER_3Fac_PAF	229	1.00	7.00	4.1325	1.33129
EQ_Total	229	.08	1.90	1.0538	.34157
IRI_Total	229	1.50	4.57	3.3395	.52230
IRI_PerspectiveTaking	229	1.29	5.00	3.7567	.66022
IRI_EmpathicConcern	229	1.00	5.00	3.8022	.76207
IRI_Fantasy	229	1.43	5.00	3.2832	.75935
IRI_PersonalDistress	229	1.00	4.86	2.5159	.75394
EmpaD_total	229	2.09	7.00	5.5629	1.01721
EmpaD_EmotionalAndPT	229	1.00	7.00	5.6492	1.22233
EmpaD_PersonalExp	229	1.00	7.00	4.9738	1.36263
EmpaD_SelfAwareness	229	2.33	7.00	5.7831	.97684
npi_total	229	.00	.92	.2427	.21646
NPI_EE	229	.00	1.00	.1794	.23697
NPI_LA	229	.00	1.00	.2893	.30723
NPI_GE	229	.00	1.00	.2559	.29083
sins_1	229	1.00	7.00	2.3319	1.49967
BIDR_Total	227	1.75	7.00	4.3395	.96563
BIDR_SDE	227	1.63	7.00	4.2930	1.09382
BIDR_IM	227	1.13	7.00	4.3860	1.20684
Empathy	229	.00	100.00	76.6594	21.31730
Compassion	229	.00	100.00	74.6769	21.54311
Humour	229	21.00	100.00	80.8603	17.87352
Valid N (listwise)	227				

This section presents descriptive statistics for the EmpathiSEr-P subscales as well as the established empathy-related scales used to assess convergent and discriminant validity. The table includes:

- **Mean**: Indicates the average score for each subscale across all participants. Higher means suggest a greater presence of the measured construct (e.g., cognitive empathy, empathic responses).
- **Standard Deviation (SD)**: Reflects the amount of variation in scores. Larger SDs indicate greater variability in how participants responded.
- **Minimum and Maximum**: Show the observed range of scores in the sample.

These statistics help assess the general distribution and central tendency of empathy scores across different dimensions and instruments. They also offer preliminary insight into whether the scores are approximately normally distributed, an assumption relevant for many statistical analyses.