1   Psychopathy, borderline personality disorder, and emotional processing in incarcerated

2   women

3   Annalise S Halverson[1] & Natalie Dowling[1,2]

4   [1] University of Chicago

5   [2] Department of Psychology

6   Author Note

7   Add complete departmental affiliations for each author here. Each new line herein

8   must be indented, like this line.

9   Enter author note here.

10   The authors made the following contributions. Annalise S Halverson:

11   Conceptualization, Writing - Original Draft Preparation, Writing - Review & Editing;

12   Natalie Dowling: Writing - Review & Editing, Supervision.

13   Correspondence concerning this article should be addressed to Annalise S Halverson,

14   Postal address. E-mail: asdh@uchicago.edu

Abstract

One or two sentences providing a **basic introduction** to the field, comprehensible to a scientist in any discipline. Two to three sentences of **more detailed background**, comprehensible to scientists in related disciplines. One sentence clearly stating the **general problem** being addressed by this particular study. One sentence summarizing the main result (with the words "**here we show**" or their equivalent). Two or three sentences explaining what the **main result** reveals in direct comparison to what was thought to be the case previously, or how the main result adds to previous knowledge. One or two sentences to put the results into a more **general context**. Two or three sentences to provide a **broader perspective**, readily comprehensible to a scientist in any discipline.

Keywords: keywords

Word count: X

27   Psychopathy, borderline personality disorder, and emotional processing in incarcerated

28   women
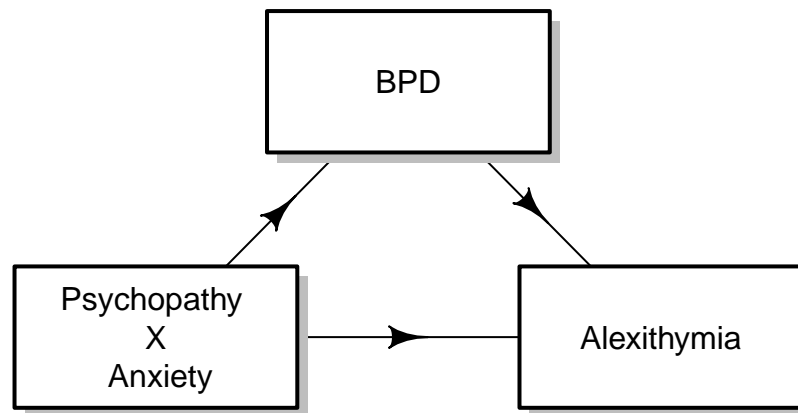
Introduction

Present Aims

Figure 1

(#fig:simple plot of mediation relationship)

Methods

32   We report how we determined our sample size, all data exclusions (if any), all

33 manipulations, and all measures in the study.

Participants

Measures

Procedure

Data analysis

We used R (Version 4.3.2; R Core Team, 2023) and the R-packages *diagram* (Version 1.6.5; Soetaert, 2020), *dplyr* (Version 1.1.4; Wickham, François, Henry, Müller, & Vaughan, 2023), *forcats* (Version 1.0.0; Wickham, 2023a), *ggformula* (Version 0.12.0; Kaplan & Pruim, 2023), *ggplot2* (Version 3.4.4; Wickham, 2016), *ggsci* (Version 3.0.0; Xiao, 2023), *kableExtra* (Version 1.4.0; Zhu, 2024), *lattice* (Version 0.21.9; Sarkar, 2008), *lubridate* (Version 1.9.3; Grolemund & Wickham, 2011), *MASS* (Version 7.3.60; Venables & Ripley, 2002), *Matrix* (Version 1.6.1.1; Bates, Maechler, & Jagan, 2023), *mediation* (Imai, Keele, & Tingley, 2010; Imai, Keele, Tingley, & Yamamoto, 2011; Imai, Keele, & Yamamoto, 2010; Imai & Yamamoto, 2013; Version 4.5.0; Tingley, Yamamoto, Hirose, Keele, & Imai, 2014), *mosaic* (Version 1.9.0; Pruim, Kaplan, & Horton, 2017; Pruim, Kaplan, & Horton, 2023), *mosaicData* (Version 0.20.4; Pruim et al., 2023), *mvtnorm* (Version 1.2.4; Genz & Bretz, 2009), *papaja* (Version 0.1.2; Aust & Barth, 2023), *plot.matrix* (Version 1.6.2; Klinke, 2022), *purrr* (Version 1.0.2; Wickham & Henry, 2023), *readr* (Version 2.1.4; Wickham, Hester, & Bryan, 2023), *readxl* (Version 1.4.3; Wickham & Bryan, 2023), *sandwich* (Zeileis, 2004, 2006; Version 3.1.0; Zeileis, Köll, & Graham, 2020), *shape* (Version 1.4.6; Soetaert, 2021), *stargazer* (Version 5.2.3; Hlavac, 2022), *stringr* (Version 1.5.1; Wickham, 2023b), *tibble* (Version 3.2.1; Müller & Wickham, 2023), *tidyr* (Version 1.3.0; Wickham, Vaughan, & Girlich, 2023), *tidyverse* (Version 2.0.0; Wickham et al., 2019), and *tinylabels* (Version 0.2.4; Barth, 2023) for all our analyses. Due to the nature of the project, it was determined most ethical to simply remove participants who were missing data for any of the required assessments. A total of 104 participants remained.

Results

Descriptive statistics for the assessments of interest can be seen in Table **??**.

Table 1

Statistic	N	Mean	St. Dev.	Min	Max
PAIBOR_Total_Score	104	36.750	11.738	11	58
PCLR_Total_Score_Prorated	104	23.476	8.070	4.400	37.000
TAS_Total_Score	104	49.702	13.852	20	82
STAI_Trait_Anxiety	104	45.558	11.213	23	72

As seen in Figure 2, our distribution of PCL–R scores is left-skewed, with more participants falling on the higher end of the spectrum.

Warning: Removed 2 rows containing missing values (`geom_bar()`).

Warning: Removed 2 rows containing missing values (`geom_bar()`).

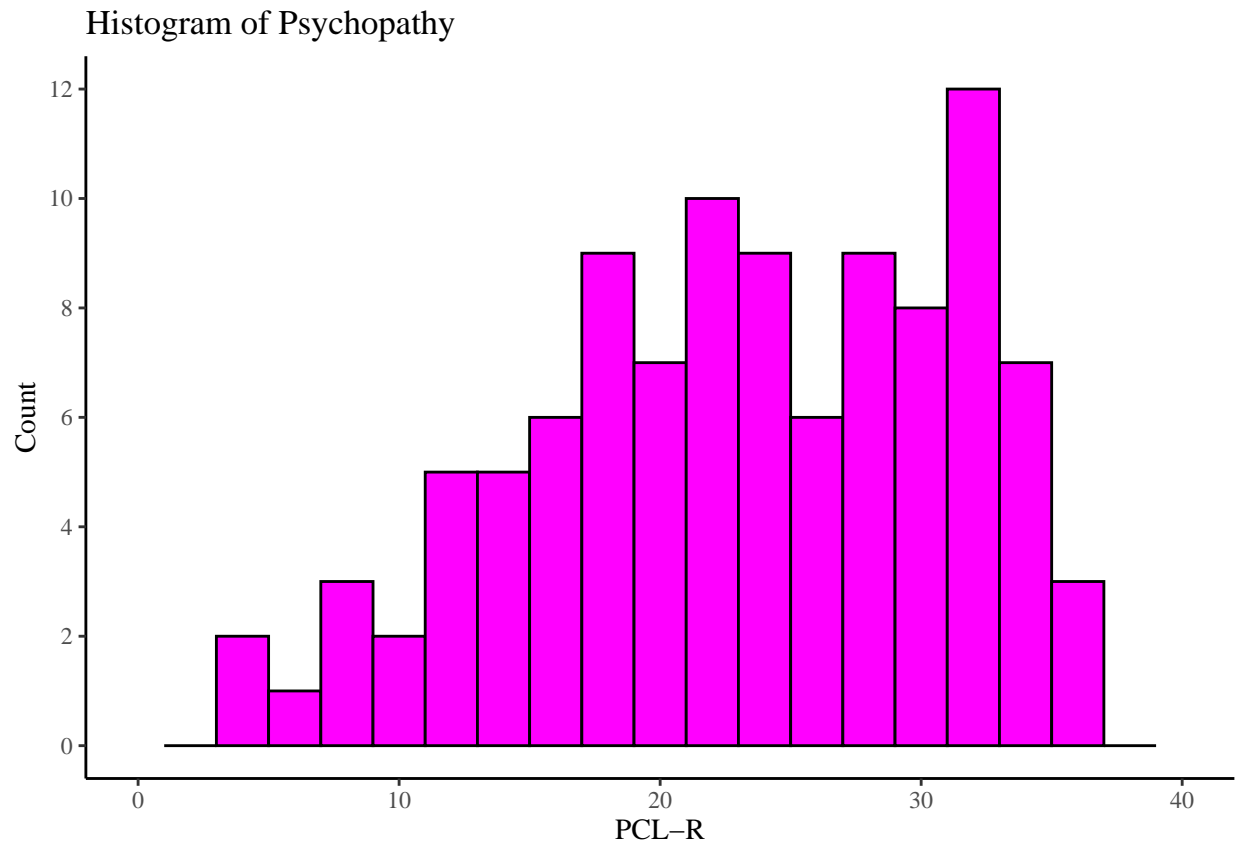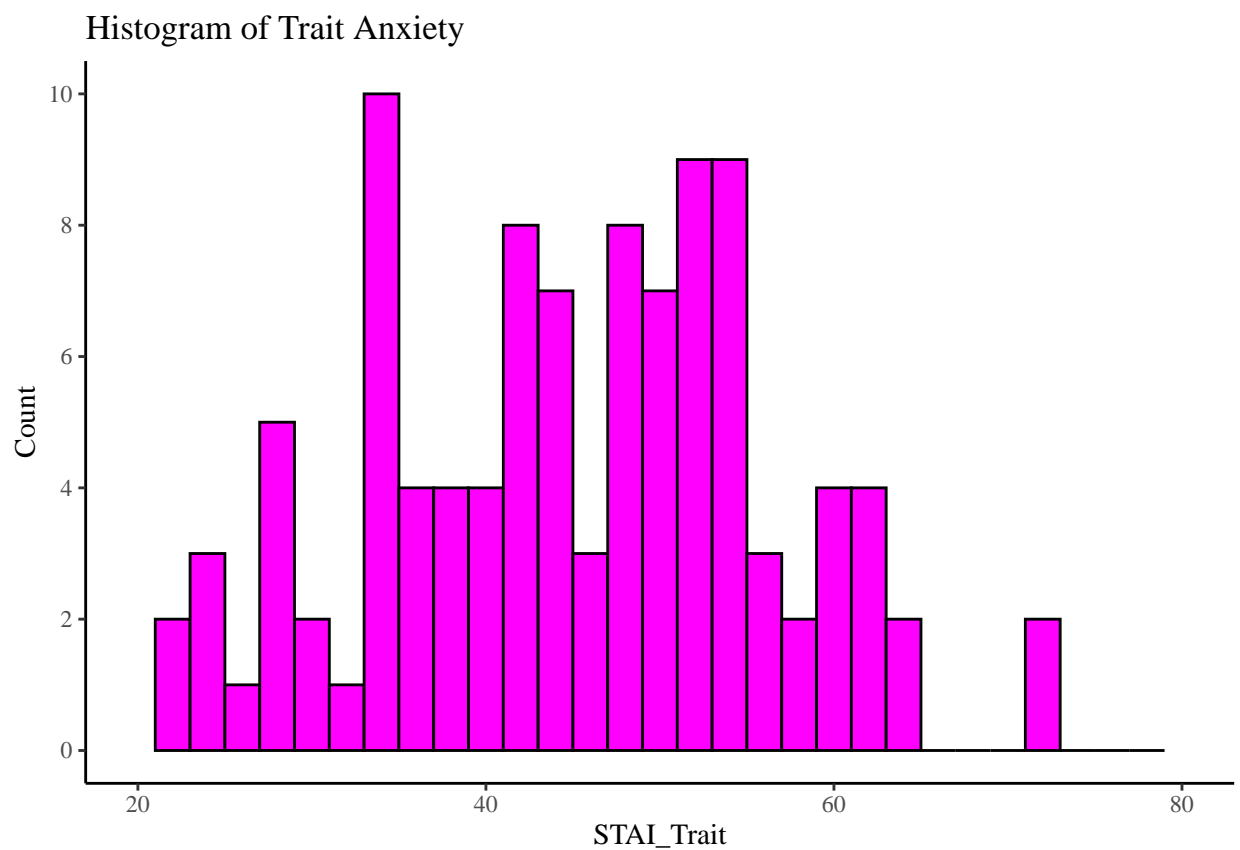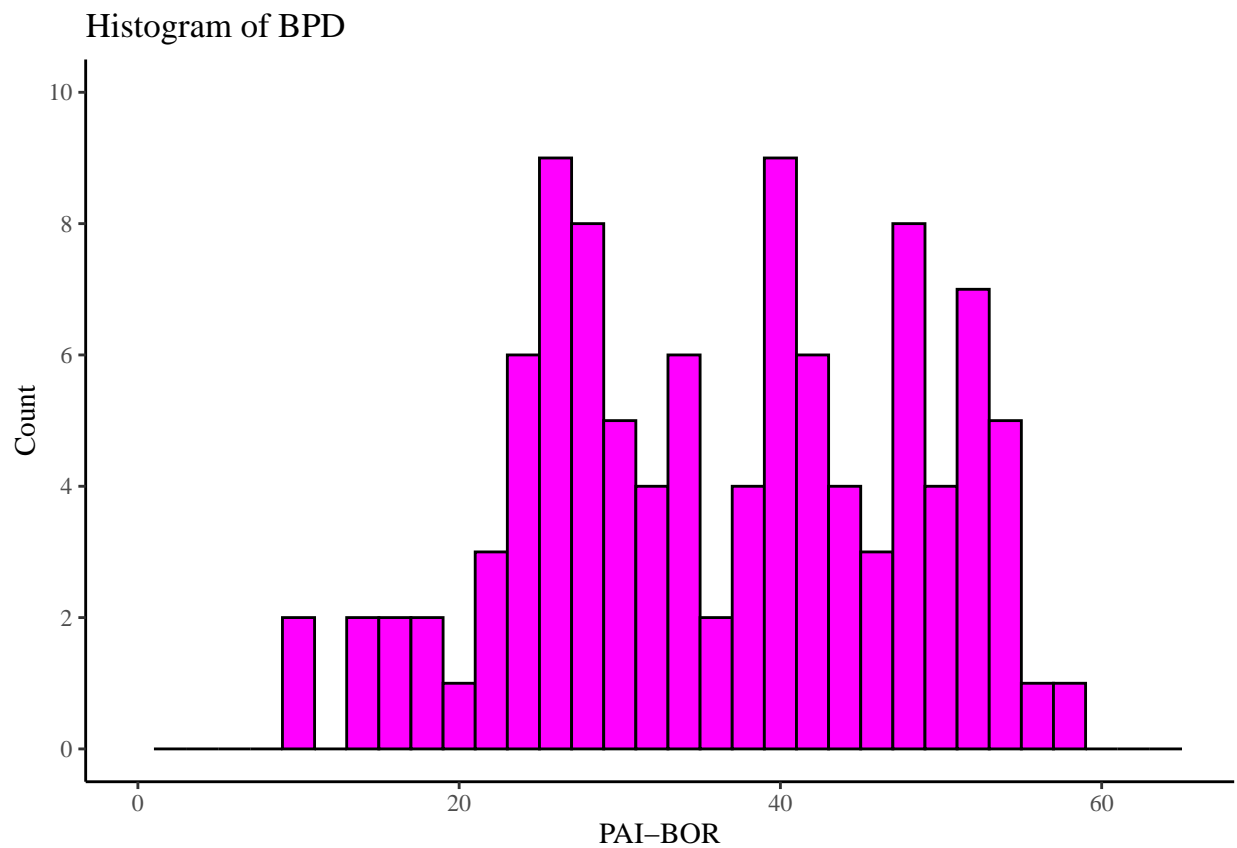*Figure 2*. Histogram of score distribution on the PCL–R.

66 ## Warning: Removed 1 rows containing missing values ('geom_bar()').

Histogram of BPD

67

68 ## Warning: Removed 1 rows containing non-finite values ('stat_bin()').

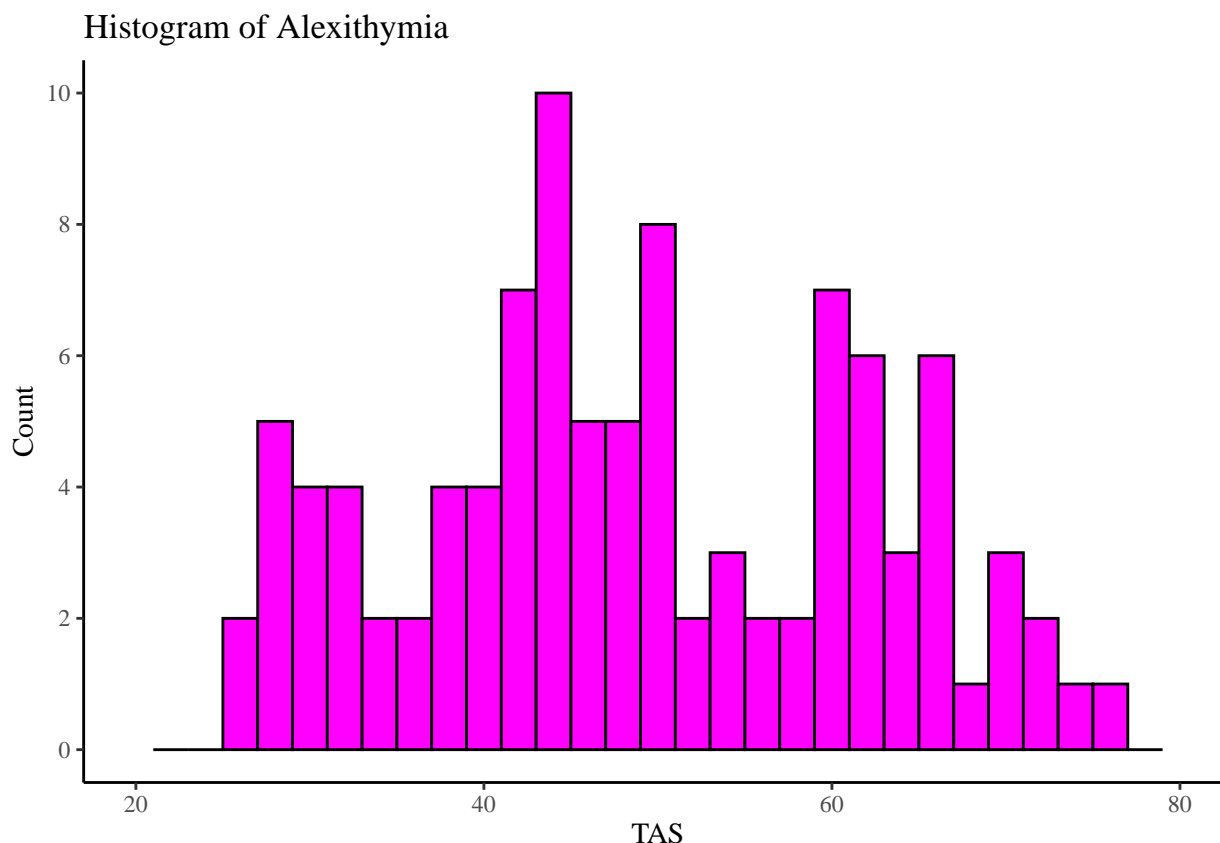69 ## Warning: Removed 2 rows containing missing values ('geom_bar()').

Histogram of Alexithymia

⁷⁰

⁷¹   Figure 3 shows a moderate correlation between PsychopathyXAnxiety and

⁷² Alexithymia.

⁷³   Figure 4 shows a moderate to strong correlation between PsychopathyXAnxiety and

⁷⁴ BPD.

⁷⁵   All assessment scores (including the interactive term) were standardized. Mediation

⁷⁶ analyses with bootstrapping were conducted to test the primary hypothesis. Unlike other

⁷⁷ methods, bootstrapping is not limited by the assumption of normality. The interaction

⁷⁸ term of PCL–R Total Score and STAI Trait Anxiety was entered as the predictor, and

⁷⁹ PAI-BOR Total Score was entered as the mediating term. Total Score on the TAS was our

⁸⁰ outcome variable. A significant Average Causal Mediation Effect (ACME) would

⁸¹ demonstrate support of our hypothesis. Summary tables (figure out how to include this

⁸² info) show that the ACME is significant and the Average Direct Effect (ADE) disappears.
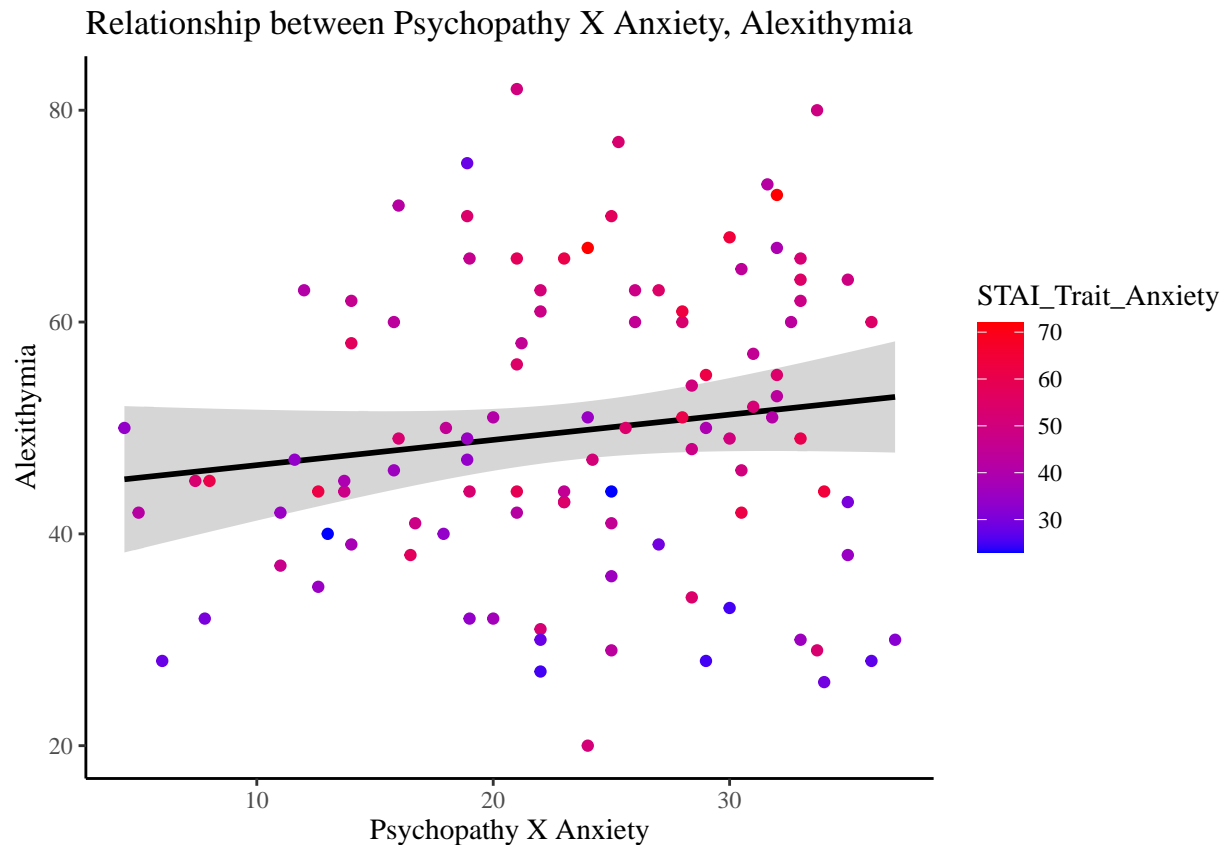
Figure 3. Scatterplot demonstrating relationship between the interactive term of psychopathy and trait anxiety with alexithymia in our sample of incarcerated women.

83 This implies full causal mediation by BPD on the relationship between

84 PsychopathyXAnxiety and Alexithymia.

85   In order to run a mediation analysis, one must ensure significant relationships exist

86 between predictor and outcome, predictor and mediator, and mediator and outcome.

87 Results for these preliminary analyses can be seen in some table somewhere.

88   There is a significant relationship between predictor (psychopathy and anxiety

89 interaction) and outcome (alexithymia). However, this effect goes away when adding BPD

90 as a mediator. This suggests that the presence of BPD acts as a mechanism through which

91 the predictor influences the outcome. The significant, full mediation effect we observed

92 suggests that a portion of the total effect of the predictor on the outcome is explained by

Table 2

Preliminary Regression Results

	Dependent variable:		
	P-O Path	P-M Path	M-O Path
	(1)	(2)	(3)
PsychopathyXAnxiety	0.373***	0.660***	
	(0.092)	(0.074)	
BPD			0.471***
			(0.087)
Constant	−0.000	−0.000	−0.000
	(0.091)	(0.074)	(0.087)
Observations	104	104	104
R^2	0.139	0.436	0.222
Adjusted R^2	0.131	0.431	0.214
Residual Std. Error (df = 102)	0.932	0.755	0.887
F Statistic (df = 1; 102)	16.501***	78.905***	29.024***

Note: *p<0.1; **p<0.05; ***p<0.01

Table 3

Simple Linear Regression Results

	Dependent variable:			
	TAS Total	Factor 1	Factor 2	Factor 3
	(1)	(2)	(3)	(4)
PsychopathyXAnxiety	0.373***	0.418***	0.291***	0.197**
	(0.092)	(0.090)	(0.095)	(0.097)
Constant	−0.000	−0.000	−0.000	0.000
	(0.091)	(0.090)	(0.094)	(0.097)
Observations	104	104	104	104
R^2	0.139	0.174	0.085	0.039
Adjusted R^2	0.131	0.166	0.076	0.030
Residual Std. Error (df = 102)	0.932	0.913	0.961	0.985
F Statistic (df = 1; 102)	16.501***	21.551***	9.463***	4.140**

Note: *p<0.1; **p<0.05; ***p<0.01

Table 4

Multiple Linear Regression Results

	Dependent variable:			
	TAS Total	Factor 1	Factor 2	Factor 3
	(1)	(2)	(3)	(4)
PsychopathyXAnxiety	0.111	0.096	0.036	0.154
	(0.116)	(0.110)	(0.121)	(0.130)
BPD	0.398***	0.487***	0.386***	0.066
	(0.116)	(0.110)	(0.121)	(0.130)
Constant	−0.000	−0.000	−0.000	0.000
	(0.087)	(0.082)	(0.090)	(0.097)
Observations	104	104	104	104
R^2	0.228	0.308	0.169	0.041
Adjusted R^2	0.213	0.294	0.153	0.022
Residual Std. Error (df = 101)	0.887	0.840	0.921	0.989
F Statistic (df = 2; 101)	14.949***	22.477***	10.273***	2.182

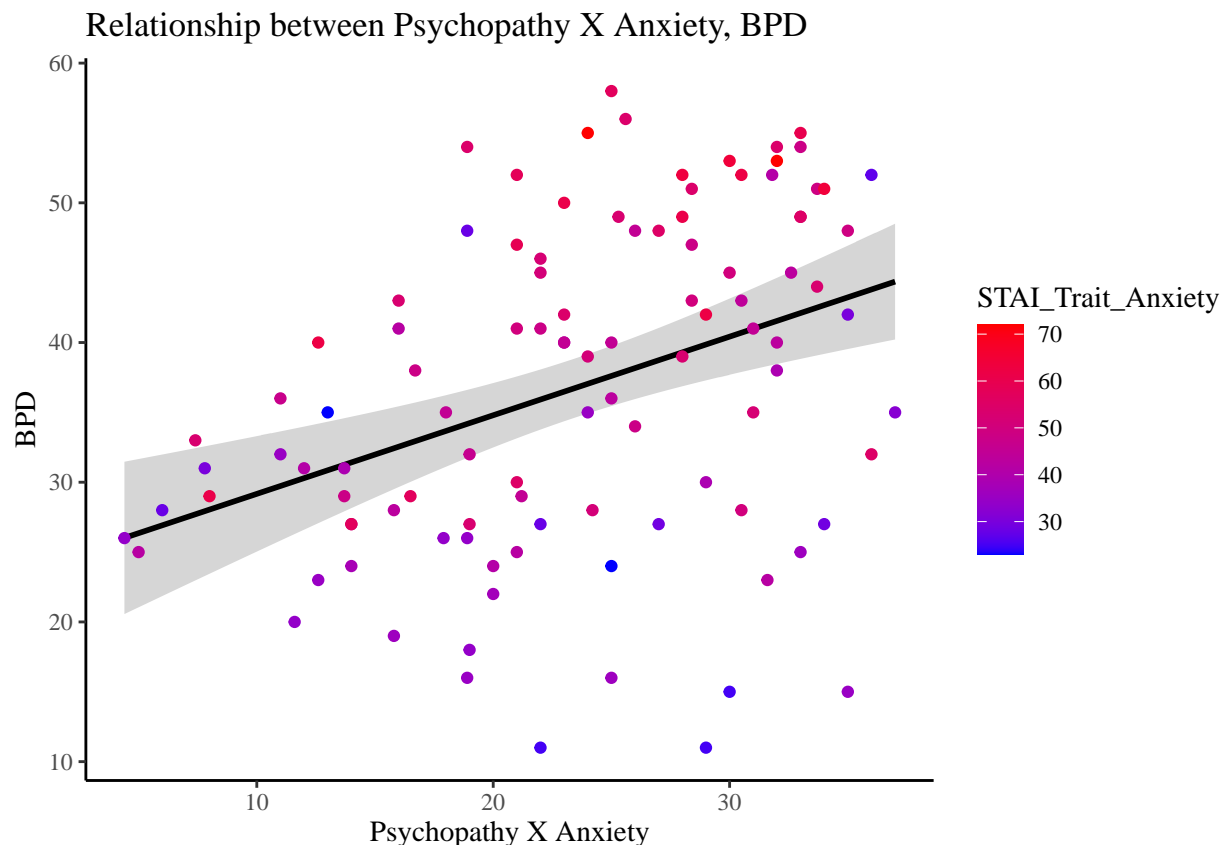*Note:* *p<0.1; **p<0.05; ***p<0.01

Figure 4. Scatterplot demonstrating relationship between the interactive term of psychopathy and trait anxiety with borderline personality disorder in our sample of incarcerated women.

93   the mediator.

94   Three subfactors defined in the TAS are believed to compose alexithymia: difficulty

95   identifying feelings (Factor 1), difficulty describing feelings (Factor 2), and

96   externally-oriented thinking (Factor 3). As we collected subfactor scores for every

97   participant, we decided to conduct an exploratory analysis to get a sense of what specific

98   parts of emotional processing psychopathy and BPD may be impacting. We found that,

99   replacing the total TAS score for Factor 1 and Factor 2, the significant mediation effect

100 remained in tact. However, designating Factor 3 as an outcome left us with an insignificant

101 model. The change in significant effect when replacing for specific factors of TAS suggests

the mediation effect may depend on specific aspects or dimensions of alexithymia. I would like to suggest some possible interpretations for this below:

It is possible that BPD symptoms uniquely impact certain dimensions of the outcome variable. When considering what each of the three factors represent, it may be plausible that BPD would affect factors 1 and 2 – addressing emotional comprehension and recognition – and not 3, as BPD may be more closely associated with internalizing features. More research that addresses the role of BPD on externally-oriented thinking is required here to draw firmer conclusions.

It is without a doubt that the relationship between psychopathy, anxiety, BPD, and alexithymia is multifaceted and complex. Our results should be further interpreted with caution and a unique sample such as this one may lead to skewed distributions.

Additional factors and moderators warrant further exploration. Other relevant comorbidities – such as PTSD – may influence the heterogeneous mediation pathway seen here in a way that could explain the nuanced relationships further. Further, it would certainly be worthwhile to break down BPD further to understand what specific mechanisms of this disorder might be at play in this relationship. We did not have sufficient data to conduct a factor analysis, but it may be useful as the personality disorder can be diagnosed in 256 unique ways, according to the DSM-V.

The heterogeneity of this mediation effect is certainly cause for future research. This information can guide the development of targeted interventions or strategies based on specific factors that are most influenced by the mediation process. This changes in significance emphasize the need for careful and nuanced interpretation, taking into account the specific characteristics and dynamics at play for each factor within the composite variables.

Discussion

References

Aust, F., & Barth, M. (2023). *papaja: Prepare reproducible APA journal articles with R Markdown.* Retrieved from https://github.com/crsh/papaja

Barth, M. (2023). *tinylabels: Lightweight variable labels.* Retrieved from https://cran.r-project.org/package=tinylabels

Bates, D., Maechler, M., & Jagan, M. (2023). *Matrix: Sparse and dense matrix classes and methods.* Retrieved from https://CRAN.R-project.org/package=Matrix

Genz, A., & Bretz, F. (2009). *Computation of multivariate normal and t probabilities.* Heidelberg: Springer-Verlag.

Grolemund, G., & Wickham, H. (2011). Dates and times made easy with lubridate. *Journal of Statistical Software*, *40*(3), 1–25. Retrieved from https://www.jstatsoft.org/v40/i03/

Hlavac, M. (2022). *Stargazer: Well-formatted regression and summary statistics tables.* Bratislava, Slovakia: Social Policy Institute. Retrieved from https://CRAN.R-project.org/package=stargazer

Imai, K., Keele, L., & Tingley, D. (2010). A general approach to causal mediation analysis. *Psychological Methods*, *15*(4), 309–334. Retrieved from http://imai.princeton.edu/research/BaronKenny.html

Imai, K., Keele, L., Tingley, D., & Yamamoto, T. (2011). Unpacking the black box of causality: Learning about causal mechanisms from experimental and observational studies. *American Political Science Review*, *105*(4), 765–789. Retrieved from http://imai.princeton.edu/research/mediationP.html

Imai, K., Keele, L., & Yamamoto, T. (2010). Identification, inference, and sensitivity analysis for causal mediation effects. *Statistical Science*, *25*(1), 51–71. Retrieved from http://imai.princeton.edu/research/mediation.html

Imai, K., & Yamamoto, T. (2013). Identification and sensitivity analysis for multiple causal mechanisms: Revisiting evidence from framing experiments. *Political Analysis*,

154   *21*(2), 141–171. Retrieved from http://imai.princeton.edu/research/medsens.html

155 Kaplan, D., & Pruim, R. (2023). *Ggformula: Formula interface to the grammar of*

156   *graphics.* Retrieved from https://CRAN.R-project.org/package=ggformula

157 Klinke, S. (2022). *Plot.matrix: Visualizes a matrix as heatmap.* Retrieved from

158   https://CRAN.R-project.org/package=plot.matrix

159 Müller, K., & Wickham, H. (2023). *Tibble: Simple data frames.* Retrieved from

160   https://CRAN.R-project.org/package=tibble

161 Pruim, R., Kaplan, D. T., & Horton, N. J. (2017). The mosaic package: Helping students

162   to 'think with data' using r. *The R Journal*, *9*(1), 77–102. Retrieved from

163   https://journal.r-project.org/archive/2017/RJ-2017-024/index.html

164 Pruim, R., Kaplan, D., & Horton, N. (2023). *mosaicData: Project MOSAIC data sets.*

165   Retrieved from https://CRAN.R-project.org/package=mosaicData

166 R Core Team. (2023). *R: A language and environment for statistical computing.* Vienna,

167   Austria: R Foundation for Statistical Computing. Retrieved from

168   https://www.R-project.org/

169 Sarkar, D. (2008). *Lattice: Multivariate data visualization with r.* New York: Springer.

170   Retrieved from http://lmdvr.r-forge.r-project.org

171 Soetaert, K. (2020). *Diagram: Functions for visualising simple graphs (networks), plotting*

172   *flow diagrams.* Retrieved from https://CRAN.R-project.org/package=diagram

173 Soetaert, K. (2021). *Shape: Functions for plotting graphical shapes, colors.* Retrieved from

174   https://CRAN.R-project.org/package=shape

175 Tingley, D., Yamamoto, T., Hirose, K., Keele, L., & Imai, K. (2014). mediation: R package

176   for causal mediation analysis. *Journal of Statistical Software*, *59*(5), 1–38. Retrieved

177   from http://www.jstatsoft.org/v59/i05/

178 Venables, W. N., & Ripley, B. D. (2002). *Modern applied statistics with s* (Fourth). New

179   York: Springer. Retrieved from https://www.stats.ox.ac.uk/pub/MASS4/

180 Wickham, H. (2016). *ggplot2: Elegant graphics for data analysis.* Springer-Verlag New

181   York. Retrieved from https://ggplot2.tidyverse.org

182 Wickham, H. (2023a). *Forcats: Tools for working with categorical variables (factors).*

183   Retrieved from https://CRAN.R-project.org/package=forcats

184 Wickham, H. (2023b). *Stringr: Simple, consistent wrappers for common string operations.*

185   Retrieved from https://CRAN.R-project.org/package=stringr

186 Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L. D., François, R., . . .

187   Yutani, H. (2019). Welcome to the tidyverse. *Journal of Open Source Software*, *4*(43),

188   1686. https://doi.org/10.21105/joss.01686

189 Wickham, H., & Bryan, J. (2023). *Readxl: Read excel files.* Retrieved from

190   https://CRAN.R-project.org/package=readxl

191 Wickham, H., François, R., Henry, L., Müller, K., & Vaughan, D. (2023). *Dplyr: A*

192   *grammar of data manipulation.* Retrieved from

193   https://CRAN.R-project.org/package=dplyr

194 Wickham, H., & Henry, L. (2023). *Purrr: Functional programming tools.* Retrieved from

195   https://CRAN.R-project.org/package=purrr

196 Wickham, H., Hester, J., & Bryan, J. (2023). *Readr: Read rectangular text data.* Retrieved

197   from https://CRAN.R-project.org/package=readr

198 Wickham, H., Vaughan, D., & Girlich, M. (2023). *Tidyr: Tidy messy data.* Retrieved from

199   https://CRAN.R-project.org/package=tidyr

200 Xiao, N. (2023). *Ggsci: Scientific journal and sci-fi themed color palettes for 'ggplot2'.*

201   Retrieved from https://CRAN.R-project.org/package=ggsci

202 Zeileis, A. (2004). Econometric computing with HC and HAC covariance matrix estimators.

203   *Journal of Statistical Software*, *11*(10), 1–17. https://doi.org/10.18637/jss.v011.i10

204 Zeileis, A. (2006). Object-oriented computation of sandwich estimators. *Journal of*

205   *Statistical Software*, *16*(9), 1–16. https://doi.org/10.18637/jss.v016.i09

206 Zeileis, A., Köll, S., & Graham, N. (2020). Various versatile variances: An object-oriented

207   implementation of clustered covariances in R. *Journal of Statistical Software*, *95*(1),

208   1–36. https://doi.org/10.18637/jss.v095.i01

209   Zhu, H. (2024). *kableExtra: Construct complex table with 'kable' and pipe syntax.*

210   Retrieved from https://CRAN.R-project.org/package=kableExtra