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Psychometric Properties of the Polish Version of the Perth Emotional Reactivity Scale

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Abstract

The Perth Emotional Reactivity Scale (PERS) is a 30-item self-report questionnaire that assesses the *ease of activation*, *intensity*, and *duration* of negative and positive emotions. Our study aimed to introduce and validate the Polish version of the PERS. The study was performed on a sample of 491 people (349 females and 142 males) aged 18–84 ($M = 24.78$, $SD = 10.96$). The factor structure was verified with confirmatory factor analysis. Convergent and divergent validity were assessed based on the relationship between the PERS and markers of anxiety, depression, and stress. For assessing criterion validity, we conducted a set of multiple regression analyses to examine whether PERS scores could predict significant variance in these mental health symptoms. We examined discriminant validity by conducting a second-order exploratory factor analysis of PERS scores and anxiety, depression, and stress symptoms. Our results indicated strong factorial validity, conforming to the intended 6-factor (subscale) structure. As expected, all PERS subscales correlated in expected directions with markers of anxiety, depression, and stress symptoms. The PERS showed good discriminant validity in terms of measuring an emotional reactivity construct across positive and negative emotions that was separable from people's current level of distress. Internal consistency reliability was also good. Overall, the Polish version of the PERS appears to have good psychometric properties as a comprehensive measure of emotional reactivity.

Keywords Affective style · Emotion · Emotional reactivity · Psychometric properties · Psychopathology

Introduction

Emotional reactivity (or affective style) is a trait comprised of one's typical (1) ease/speed of activation, (2) intensity, and (3) duration of emotional responses. These three characteristics of emotional reactivity apply to both negative and positive emotions, such as sadness and happiness (Becerra & Campitelli, 2013; Preece et al., 2019).

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Emotional reactivity can be assessed in laboratory settings via psychophysiological methods (Kuo et al., 2016) or questionnaires; however, psychophysiological methods can be too impractical and expensive for some clinical or research purposes (e.g. for psychological assessments during psychotherapy, screening in busy clinical wards, or study designs requiring large numbers of participants). Thus, having self-report questionnaire options for assessing emotional reactivity is crucial.

Traditionally, the majority of questionnaire measures of emotional reactivity have assessed the construct in terms of negative emotions only (e.g. the Emotion Reactivity Scale by Nock et al., 2008), or without separating these three separate characteristics (ease of activation, intensity and duration), such as the Emotional Reactivity subscale of the Formal Characteristic of Behaviour–Temperament Inventory (Cyniak-Cieciura et al., 2018), the Emotion Intensity Scale (Bachorowski & Braaten, 1994), the Emotionalizing subscale of the Bermond–Vorst Alexithymia Questionnaire (Vorst & Bermond, 2001), the Affect Intensity Measure (Larsen & Diener, 1987), or the Emotional Reactivity and Perseveration Scale (Boyes et al., 2017; Ripper et al., 2018).

For assessing the ease of activation, intensity, and duration of an emotional response separately for positive and negative emotions, the 30-item Perth Emotional Reactivity Scale (PERS) was recently developed (Becerra & Campitelli, 2013; Becerra et al., 2019; Preece et al., 2019). Originally created in English, the PERS consists of six intended 5-item subscales: positive-activation (e.g. *I tend to get happy very easily*), positive-intensity (e.g. *When I'm joyful, I tend to feel it very deeply*), positive-duration (e.g. *When I'm happy, the feeling stays with me for quite a while*), negative-activation (e.g. *I tend to get upset very easily*), negative-intensity (e.g. *If I'm upset, I feel it more intensely than everyone else*), and negative-duration (e.g. *Once in a negative mood, it's hard to snap out of it*). These subscales can also be combined into two valence-specific composite scores, a general negative reactivity scale and a general positive reactivity scale, as overall markers of emotional reactivity for the negative or positive domains, respectively. Moreover, based on this questionnaire, the Perth Emotional Reactivity Scale–Short Form (PERS–S) was later developed, which repeats the structure of the PERS but consists of 18 items (Preece et al., 2019).

The original English versions of the PERS, and its short form the PERS–S, have so far demonstrated strong psychometric properties (Becerra et al., 2019; Preece et al., 2019). Moreover, these questionnaires to date shown strong psychometric properties in different language versions, including the Iranian (Mousavi Asl et al., 2020) version of the PERS, as well as the Turkish (Balaban & Bilge, 2021), Polish (Larionow & Mudło-Głagolska, 2022), and Russian (Larionov et al., 2021) versions of the PERS–S. Our aim in this study is to introduce and validate a Polish version of the PERS.

In factor analysis, the PERS is characterized by an intended 6-factor structure (with the six subscales as factors), which has had the best fit indices in most papers (Balaban & Bilge, 2021; Becerra et al., 2019; Larionov et al., 2021; Larionow & Mudło-Głagolska, 2022; Mousavi Asl et al., 2020; Preece et al., 2019). The three factors within each valence domain tend to correlate very highly (thus supporting the coherence of ease of activation, intensity, and duration of emotions as core components of the emotional reactivity construct), but models where they are separated still support the statistical value of separating into these subscale domains. The convergent and

divergent validity of the PERS has also been consistently supported in past work, indicating that a profile characterized by high negative reactivity and low positive reactivity tends to be associated with increased psychopathology (e.g. depression and anxiety) symptoms, poorer emotion regulation abilities, and poorer well-being (Balaban & Bilge, 2021; Becerra et al., 2019; Larionov et al., 2021; Larionow & Mudło-Głagolska, 2022; Mousavi Asl et al., 2020; Preece et al., 2019). In a Polish context, Larionow and Mudło-Głagolska, (2022) recently published a Polish version of the PERS–S, finding it to have strong psychometric properties.

Current studies highlight the role of emotional reactivity traits in the development of psychopathology. Gross and Jazaieri, (2014), for example, stressed problematic emotional intensity (referring to either too large or too small an emotional response) and duration (occurring when emotions are either too short or too long for a particular situation) as characteristics of various forms of psychopathology. Linehan, (1993) discussed emotional vulnerability (emotional reactivity) as a major component of emotion dysregulation in borderline personality disorder. Problematic levels of emotional reactivity are often considered as psychotherapeutic goals for affective disorders treatment (Barlow et al., 2010; Linehan, 1993). Recent studies highlighted the clinical utility of distinguishing of negative and positive emotional reactivity measured by the PERS. For example, Barnhart et al., (2020) noted that people with high positive-activation and positive-intensity have a higher risk of overeating if they tend to eat when positive emotions arise, therefore supporting the clinical relevance of positive reactivity traits, which may play negative role in some affective disorder categories. Thus, there is preliminary support for emotional reactivity assessments across negative and positive emotions potentially being used to enhance cognitive behavioural therapy aimed at changing problematic levels of emotional reactivity traits.

Taken together, the previous studies evidence strong psychometric properties of the PERS and its clinical relevance. Our aim in this study is to develop a Polish version of the long-form PERS and examine its psychometric properties (factor structure, internal consistency reliability, convergent, and divergent validity). We expect that a 6-factor model comprised of the six intended subscales would be the best factor structure solution. We also anticipated, based on past work, that the PERS negative reactivity subscales would be positively correlated with depression, anxiety, and stress symptoms, whereas the positive reactivity subscales would be negatively correlated with these mental health symptoms. We also expected that the PERS would show good discriminant validity against these measures of psychopathology, as technically emotional reactivity should be a separable construct from one's current level of mental health symptoms (Becerra et al., 2019).

Method

Participants and Procedure

Our sample consisted of 491 adults (349 females and 142 males) with ages ranging from 18 to 84 ($M = 24.78$, $SD = 10.96$) from the general population in Poland. Most respondents (31.4%) lived in large cities (above 100000 inhabitants), 22.6% in towns

(from 20000 to 100000), 15.5% in small towns (up to 20000), and 30.5% in villages. Individuals with a higher education degree made up 16.5% of the respondents, with those with secondary education 72.3%, those with vocational education 4.7%, and those with primary school level education 6.5%. Among the respondents, 55.0% were single and 45.0% were in relationships.

The study was conducted from April 2022 to May 2022. The participants were recruited via social networks, i.e. Facebook and Instagram, where there was a link to an online anonymous survey by a Google Forms platform with an appended consent form. The Kazimierz Wielki University Ethics Committee approved the study (No. 1/13.06.2022). All respondents provided their written informed consent digitally before they answered the questions.

Translation of Questionnaire

The pool of 18 statements of the Polish version of the PERS–S (Larionow & Mudło-Głagolska, 2022) was used as the base for the 30-item PERS. We translated just the 12 statements of the PERS that are not included in the PERS–S. These statements were translated into Polish by three independent translators, and their common Polish translation was developed. Then, it was translated back into English, and this back translation was compared with the original version of the PERS. Minor corrections were made, resulting in the final Polish version of the PERS administered in this study (see Supplementary Materials).

Measures

1. The PERS is a 30-item self-report questionnaire designed to measure the ease of activation, intensity, and duration of positive and negative emotions (Preece et al., 2019). The PERS consists of six subscales and two composite scores. The subscales are positive-activation, positive-intensity, positive-duration, negative-activation, negative-intensity, and negative-duration. The three subscales within each valence domain can also be combined into general positive reactivity and general negative reactivity composite scores. The statements are scored on a 5-point scale ranging from 1 (*very unlike me*) to 5 (*very like me*), with higher scores indicating higher levels of emotional reactivity.
2. The Patient Health Questionnaire–4 (PHQ–4) by Kroenke et al., (2009) in its Polish version by Larionow and Mudło-Głagolska, (2023), is a 4-item questionnaire for measuring anxiety and depressive symptoms experienced in the previous 2 weeks. The PHQ–4 has two subscales: anxiety (two items, e.g. *Feeling nervous, anxious or on edge*) and depression (two items, e.g. *Feeling down, depressed, or hopeless*). The overall score of anxiety and depressive symptoms can be calculated. The PHQ–4 uses a 4-point Likert scale from 0 (*not at all*) to 3 (*nearly every day*), with higher scores indicating more severe symptoms. The Polish version of the PHQ–4 has strong psychometric properties, i.e. an intended 2-factor structure, empirically supported validity, and good test-retest and internal consistency reliabilities (Larionow & Mudło-Głagolska, 2023).

3. The Perceived Stress Scale–4 (PSS–4) developed by Cohen et al., (1983), and in its Polish version by Kleszczewska et al., (2018), was used to measure participants' level of perceived stress during the previous month. The PSS–4 has four statements (e.g. *In the last month, how often have you felt that you were unable to control the important things in your life?*), which are responded to on a 4-point Likert scale from 0 (*never*) to 4 (*very often*). Higher scores indicate higher levels of stress. The Polish version of the PSS–4 has good psychometric properties, i.e. factorial validity and internal consistency reliability (Kleszczewska et al., 2018).

Analytic Strategy

Statistical analysis was carried out using Statistica version 13.3 and the *EFAtools* and *lavaan* statistical packages in R software version 4.2.1. There were no missing data.

Descriptive Statistics with Demographic Comparisons

Descriptive statistics for the PERS were reported for the sample, and the PERS scores of females and males were compared by a *t*-test. The Cohen's *d* effect size (interpretation: negligible < 0.20 < small < 0.50 < medium < 0.80 < large) was calculated using the Psychometrica calculator (Lenhard & Lenhard, 2016). Pearson correlations between the PERS scores and age were calculated. We conducted four paired *t*-tests to compare three positive-valence PERS scores and the composite scores of general positive reactivity and three negative-valence PERS scores and the composite scores of general negative reactivity, respectively, in order to examine whether emotion valence influenced the extent of people's emotional reactivity traits, respectively.

Factor Structure

A sample size of more than 500 participants is generally regarded as very good for factor analytic studies (Mundfrom et al., 2005); thus, we considered our sample size of 491 people broadly appropriate for examination of the 30-item PERS. Confirmatory factor analyses with maximum likelihood estimation with robust standard errors and a Satorra-Bentler scaled test statistic were carried out. We examined three factor models of the PERS (see Fig. 1), of increasing complexity: (1) a 1-factor model used as a comparative baseline, (2) a 2-factor correlated model comprised of two first-order valence-specific factors (negative reactivity and positive reactivity), and (3) a 6-factor correlated model comprised of the six first-order intended subscales, thus separating between negative and positive valence and between the various conceptual facets of emotional reactivity (i.e. positive-activation, positive-intensity, positive-duration, negative-activation, negative-intensity, and negative-duration). We did not test a 6-factor model with two second-order factors (composite scores of general negative reactivity and general positive reactivity), because the previous psychometric studies of the PERS have consistently found that the factor structure of the PERS was best represented by the 6-factor

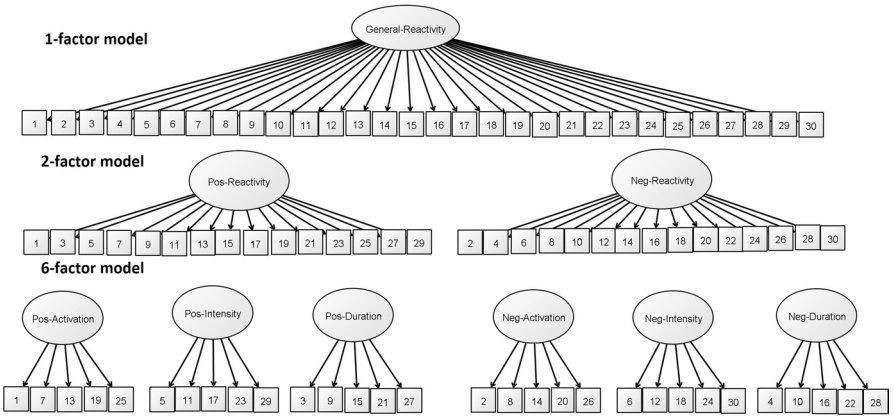

Fig. 1 Confirmatory factor analysis models of the PERS. *Note.* Ellipses are latent factors, squares are item numbers. All factors were allowed to correlate. General-Reactivity, general reactivity; Pos-Reactivity, positive reactivity; Neg-Reactivity, negative reactivity; Pos-Activation, positive-activation; Pos-Intensity, positive-intensity; Pos-Duration, positive-duration; Neg-Activation, negative-activation; Neg-Intensity, negative-intensity; Neg-Duration, negative-duration

model (corresponding to the six intended subscales); in consistency with the past work, we decided to replicate the process of these studies in terms of model testing. Model fit was judged based on three common fit index values: root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), and the comparative fit index (CFI). RMSEA and SRMR values below 0.08, and CFI values greater than 0.90 indicate acceptable levels of fit (Hu & Bentler, 1999).

Internal Consistency Reliability

Cronbach's alpha and McDonald's omega (ω) values were calculated. Reliability coefficients > 0.70 were considered acceptable, > 0.80 good, and > 0.90 excellent (Groth-Marnat, 2009).

Convergent and Divergent Validity

Pearson correlations between PERS scores and PHQ–4 and PSS–4 scores were examined to assess convergent and divergent validity.

Criterion Validity

We conducted a set of multiple regression analyses to examine whether PERS scores could predict significant variance in anxiety, depression, and stress symptoms (controlling for age and gender). Age, gender and the six PERS subscales were inputted as predictors, and anxiety, depression, and stress scores were the criterion variables across three separate multiple regression analyses.

Discriminant Validity

Discriminant validity was evaluated by conducting a second-order exploratory factor analysis (principal axis factoring with direct oblimin rotation) of the six PERS subscales, the two PHQ–4 subscales, and the PSS–4 score. We expected that the PERS subscales would not load on negative and positive emotional reactivity factors, separate from a psychopathology symptom factor (thus supporting discriminant validity). Factor loadings > 0.40 were considered meaningful loadings (Pituch & Stevens, 2016).

Results

Descriptive Statistics with Demographic Comparisons

Table 1 presents descriptive statistics for all the study variables. All PERS items and subscales/composite scores were reasonably normally distributed; skewness values ranged from −0.81 to 0.39, whereas kurtosis ones ranged from −1.36 to −0.25.

In terms of subscale level PERS scores, negative-activation ($t(489) = 3.61$, $p < 0.001$, $d = -0.358$), negative-intensity ($t(489) = 2.78$, $p = 0.006$, $d = -0.278$), and negative-duration ($t(489) = 3.88$, $p < 0.001$, $d = -0.386$) were higher in females than in males. At the composite level, general negative reactivity was higher in females ($t(489) = 3.60$, $p < 0.001$, $d = -0.358$). In general, effect size of these differences was small. There were no statistically significant gender differences in positive-activation ($t(489) = 1.64$, $p = 0.102$, $d = -0.163$), positive-intensity ($t(489) = 1.96$, $p = 0.050$, $d = -0.194$), positive-duration ($t(489) = 1.42$, $p = 0.157$, $d = -0.140$) subscale scores, or in the general positive reactivity composite score ($t(489) = 1.88$, $p = 0.061$, $d = -0.187$).

Pearson correlations between age and PERS scores were calculated in the groups of females and males separately. In the group of females ($N = 349$), age was significantly negatively associated negative-activation ($r = -0.24$, $p < 0.001$), negative-intensity ($r = -0.19$, $p < 0.001$), negative-duration ($r = -0.16$, $p = 0.002$), and general negative reactivity ($r = -0.21$, $p < 0.001$), but age was not correlated with any positive reactivity scores (r from 0.02 to 0.09, all $ps > 0.05$). In the group of males ($N = 142$), age was not significantly associated with any PERS scores (r from −0.14 to -0.02, all $ps > 0.05$).

The participants reported significantly more negative-activation ($t(490) = 5.67$, $p < 0.001$, $d = 0.256$), negative-intensity ($t(490) = 11.54$, $p < 0.001$, $d = 0.521$), negative-duration ($t(490) = 4.96$, $p < 0.001$, $d = 0.224$), and general negative reactivity ($t(490) = 7.89$, $p < 0.001$, $d = 0.356$) levels compared to their positive reactivity levels, respectively, indicating utility of distinguishing emotional valence when assessing the components of the emotional reactivity construct. The effect size of these differences was small, except the differences between negative-intensity and positive-intensity traits with a medium effect size.

Table 1 Descriptive statistics and Cronbach's alpha (α) and McDonald's omega (ω) values for the study variables

Scale/subscale	Total sample					Females			Males		
	N	α	ω	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
PERS subscales											
Positive-activation	491	0.80	0.80	15.94	4.50	349	16.15	4.43	142	15.42	4.63
Positive-intensity	491	0.88	0.88	14.65	5.05	349	14.93	5.08	142	13.95	4.94
Positive-duration	491	0.84	0.84	15.09	4.78	349	15.28	4.86	142	14.61	4.58
Negative-activation	491	0.87	0.87	17.55	5.46	349	18.11	5.47	142	16.18	5.21
Negative-intensity	491	0.90	0.90	18.23	5.62	349	18.68	5.51	142	17.13	5.74
Negative-duration	491	0.87	0.87	16.79	5.41	349	17.38	5.21	142	15.32	5.63
PERS composite scores											
General positive reactivity	491	0.93	0.93	45.68	12.82	349	46.37	12.81	142	43.98	12.75
General negative reactivity	491	0.95	0.96	52.57	15.66	349	54.17	15.37	142	48.63	15.70
PHQ–4											
Anxiety symptoms	491	0.78	0.78	3.34	1.91	349	3.56	1.83	142	2.82	1.98
Depressive symptoms	491	0.82	0.82	3.20	2.00	349	3.25	1.99	142	3.08	2.03
Total PHQ–4 score	491	0.87	0.87	6.55	3.61	349	6.81	3.54	142	5.90	3.72
PSS–4											
Stress	190	0.74	0.74	8.89	3.34	169	8.99	3.37	21	8.14	2.99

PERS Perth Emotional Reactivity Scale, *PHQ–4* Patient Health Questionnaire–4; *PSS–4* Perceived Stress Scale–4

Factor Structure

In our confirmatory factor analyses, the 1-factor model did not converged successfully, suggesting model problems, and the 2-factor models was a poor fit to the data (χ^2/df = 1825.21/404; CFI = 0.833; RMSEA = 0.093 [90% CI: 0.088; 0.097]; SRMR = 0.111). In the 6-factor model analysis, the covariance matrix of latent variables was not positive definite, indicating a common situation in confirmatory factor analysis called a Heywood case (Kolenikov & Bollen, 2012). We analysed the modification indices and added four correlated error terms into the 6-factor model (between PERS items 12 & 14, 19 & 21, 5 & 29, and 10 & 16)[1]. We felt adding these error terms was theoretically justifiable, because of conceptual and wording similarities between those items (refer to Table 2) and their addition improved fit index values (χ^2/df = 1198.92/386; CFI = 0.904; RMSEA = 0.072 [90% CI: 0.067; 0.076]; SRMR = 0.097). The results indicated that the 6-factor model was a satisfactory fit. All items loaded well on their intended subscale factor (factor loadings > 0.523, all *ps* < 0.001; see

[1] Adding these four correlated errors to the 1-factor and 2-factor models did not resolve the issues in those models, in terms of unsuccessful convergence in the 1-factor model and unacceptable fit index values in the 2-factor model.

Table 2). In this model, as expected based on past results, the estimated correlations between subscales of positive-activation, positive-intensity and positive-duration were positive and high (from 0.724 to 0.894, all $ps < 0.001$), and correlations between negative-activation, negative-intensity, and negative-duration factors ranged from 0.953 to 0.975 (all $ps < 0.001$; Table 3). The superiority of the 6-factor model over the 2-factor model though supported the statistical value of separating between the three facets within each valence domain.

Internal Consistency Reliability

The reliability of all PERS subscales and composite scores was good (α and $\omega \geq 0.80$; see Table 1).

Convergent and Divergent Validity

Pearson correlations between the PERS scores and other study variables were calculated (see Table 4). In general, most PERS positive reactivity scores were slightly negatively correlated with mental health symptoms. In contrast, most PERS negative reactivity scores (especially, negative-duration) were moderately positively associated with these symptoms, supporting good convergent validity.

Criterion Validity

Our multiple regression analyses (forced entry method) reinforced that PERS scores were significant predictors of anxiety, depressive, and stress symptoms (controlling for age and gender; see Table 5).

All regression models were statistically significant ($p < 0.001$) and explained 25 to 30% of the variance in the assessed psychopathology symptoms. In particular, negative-duration and positive-duration were significant unique predictors of anxiety, depression, and stress symptoms. As such, there was good support in these data for the clinical relevance of emotional reactivity scores across both negative and positive emotions.

Discriminant Validity

Our second-order exploratory factor analysis of the six PERS subscales, anxiety and depressive symptoms (the two PHQ–4 subscales), and stress (the PSS–4 score), extracted three factors (i.e. factor 1 "negative reactivity", factor 2 "positive reactivity" and factor 3 "mental health symptoms"; see Table 6). As expected, all negative reactivity PERS subscales and positive reactivity ones loaded cleanly on the "negative reactivity" and "positive reactivity" factors, respectively, and did not load on the "mental health symptoms" factor, thus supporting the discriminant validity of the PERS.

Table 2 Completely standardized item factor loadings from confirmatory factor analyses of the 6-factor PERS model with four correlated error terms ($N = 491$)

Subscales	Item number	Statements	Completely standardized factor loadings
Negative-activation	2	I tend to get upset very easily	0.755
	8	I tend to get disappointed very easily	0.704
	14	I tend to get frustrated very easily	0.736
	20	My emotions go from neutral to negative very quickly	0.792
	26	I tend to get pessimistic about negative things very quickly	0.799
Negative-intensity	6	If I'm upset, I feel it more intensely than everyone else	0.740
	12	I experience the feeling of frustration very deeply	0.761
	18	Normally, when I'm unhappy I feel it very strongly	0.835
	24	When I'm angry I feel it very powerfully	0.796
	30	My negative feelings feel very intense	0.900
Negative-duration	4	When I'm upset, it takes me quite awhile to snap out of it	0.773
	10	It takes me longer than other people to get over an anger episode	0.636
	16	It's hard for me to recover from frustration	0.728
	22	Once in a negative mood, it's hard to snap out of it	0.864
	28	When annoyed about something, it ruins my entire day	0.739
Positive-activation	1	I tend to get happy very easily	0.714
	7	My emotions go automatically from neutral to positive	0.557
	13	I tend to get enthusiastic about things very quickly	0.620
	19	I feel good about positive things in an instant	0.643
	25	I react to good news very quickly	0.761

Table 2 (continued)

Subscales	Item number	Statements	Completely standardized factor loadings
Positive-intensity	5	I think I experience happiness more intensely than my friends	0.619
	11	When I am joyful, I tend to feel it very deeply	0.765
	17	I experience positive mood very strongly	0.837
	23	When I'm enthusiastic about something, I feel it very powerfully	0.792
	29	I experience positive feelings more deeply than my relatives and friends	0.771
Positive-duration	3	When I'm happy, the feeling stays with me for quite a while	0.786
	9	When I'm feeling positive, I can stay like that for a good part of the day	0.796
	15	I can remain enthusiastic for quite a while	0.804
	21	I stay happy for a while if I receive pleasant news	0.659
	27	If someone pays me a compliment, it improves my mood for a long time	0.523

Table 3 Estimated correlations between the subscales of the 6-factor PERS model with four correlated error terms ($N = 491$)

Subscales	Positive-activation	Positive-intensity	Positive-duration	Negative-activation	Negative-intensity
Positive-intensity	0.894***	—	—	—	—
Positive-duration	0.860***	0.724***	—	—	—
Negative-activation	0.209**	0.156*	−0.154**	—	—
Negative-intensity	0.220**	0.217***	−0.105	0.970***	—
Negative-duration	0.081	0.093	−0.186**	0.953***	0.975***

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table 4 Pearson correlations between scores on the PERS and psychopathology symptoms

Variables	PHQ-4 Anxiety symptoms (N = 491)	PHQ-4 Depressive symptoms (N = 491)	Total PHQ–4 score (N = 491)	PSS-4 Stress (N = 190)
PERS General positive reactivity	−0.15***	−0.24***	−0.21***	−0.33***
PERS Positive-activation	−0.09	−0.16***	−0.13**	−0.24***
PERS Positive-intensity	−0.07	−0.14**	−0.11*	−0.22**
PERS Positive-duration	−0.26***	−0.35***	−0.33***	−0.43***
PERS General negative reactivity	0.48***	0.44***	0.50***	0.27***
PERS Negative-activation	0.45***	0.41***	0.47***	0.22**
PERS Negative-intensity	0.44***	0.41***	0.46***	0.24***
PERS Negative-duration	0.48***	0.45***	0.50***	0.32***

PERS, Perth Emotional Reactivity Scale; PHQ–4, Patient Health Questionnaire–4; PSS–4, Perceived Stress Scale–4. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. The number of the participants (N) who completed each questionnaire was shown in the parentheses near the measures

Table 5 Regression models for predicting psychopathology symptoms

Predictors	PHQ–4 Anxiety symptoms (N = 491)	PHQ–4 Depressive symptoms (N = 491)	PSS–4 Stress (N = 190)
	Beta	Beta	Beta
Age	−0.05	**−0.08***	−0.09
Gender (females = 1, males = 2)	**−0.11****	0.02	0.00
PERS Negative-activation	0.16	0.08	−0.02
PERS Negative-intensity	0.05	0.06	−0.04
PERS Negative-duration	**0.25****	**0.29*****	**0.33***
PERS Positive-activation	−0.04	−0.01	0.07
PERS Positive-intensity	0.06	0.04	−0.03
PERS Positive-duration	**−0.24*****	**−0.33*****	**−0.44*****
Model parameters	$F(8, 482) = 26.05$, $p < 0.001$	$F(8, 482) = 27.08$, $p < 0.001$	$F(8, 181) = 8.92$, $p < 0.001$
Proportion of variance explained (adjusted R^2, %)	29.02	29.86	25.10

PERS, Perth Emotional Reactivity Scale; PHQ–4, Patient Health Questionnaire–4; PSS–4, Perceived Stress Scale–4. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. Significant predictors are in bold

Discussion

The aim of the study was to introduce and validate the Polish version of the PERS. Overall, the Polish PERS appeared to perform similarly to the original English version, demonstrating good validity and reliability. Our analysis showed that the

Table 6 Factor loadings from a second-order exploratory factor analysis (principal axis factoring with direct oblimin rotation) of the PERS subscales, anxiety, and depressive symptoms as well as stress (N = 190).

Variables	Factor 1 ("negative reactivity")	Factor 2 ("positive reactivity")	Factor 3 ("mental health symptoms")
PERS Negative-activation	**0.917**	0.060	−0.005
PERS Negative-intensity	**0.987**	0.028	−0.046
PERS Negative-duration	**0.899**	−0.072	0.052
PERS Positive-activation	0.083	**0.952**	0.039
PERS Positive-intensity	−0.008	**0.811**	0.080
PERS Positive-duration	−0.048	**0.730**	−0.204
PHQ–4 Anxiety symptoms	0.067	0.024	**0.767**
PHQ–4 Depressive symptoms	−0.053	0.064	**0.965**
PSS–4 Stress	0.015	-0.112	**0.694**
Proportion of total variance (%)	37.6	30.3	8.6

PERS, Perth Emotional Reactivity Scale; PHQ–4, Patient Health Questionnaire–4; PSS–4, Perceived Stress Scale–4. Factor loadings > 0.30 are shown in bold

Polish version of the PERS was characterized by an intended 6-factor structure, corresponding to the six subscales. The 6-factor model had the best fit to the data compared to a 1-factor and 2-factor models. This is in line with previous studies on the PERS and its short form (an 18-item PERS–S) conducted in other cultures (Balaban & Bilge, 2021; Becerra et al., 2019; Larionov et al., 2021; Larionow & Mudło-Głagolska, 2022; Mousavi Asl et al., 2020; Preece et al., 2019) and thus supports the capacity of the PERS to assess all components of emotional reactivity across both negative and positive emotions. Use of the valence-specific composite scores is further supported by the high observed correlations between the ease of activation, intensity, and duration factors within each valence domain. The reliability of the six subscales and two composite scores was high (α and $\omega \geq 0.80$), thus supporting that robust scores can be derived at subscale and composite levels.

Our second-order exploratory factor analysis showed that the negative reactivity and positive reactivity traits, as measured by the PERS, were statistically separable from one's current level of mental health symptoms. These results therefore supported the discriminant validity of the PERS and are also consistent with results from the Turkish version of the PERS by Balaban and Bilge, (2021) who also noted good discriminant validity for the PERS against anxiety, depression, somatization, and obsessive-compulsive symptoms. Thus, the PERS appears to assess an emotional reactivity trait that is meaningfully separable from one's current level of psychopathology symptoms. Overall, our study further supports the generalizability of the PERS's psychometric performance, demonstrating now across various cultures (Balaban & Bilge, 2021; Becerra et al., 2019; Larionov et al., 2021; Mousavi Asl et al., 2020; Preece et al., 2019).

Comparisons between the PERS and measures of psychopathology were also in line with our expectations. In general, negative reactivity (especially,

negative-duration) was moderately positively related to anxiety, depression, and stress symptoms, whereas positive reactivity was slightly negatively related to these mental health symptoms. Our results in this respect are in line with previous studies on the PERS and PERS–S (Balaban & Bilge, 2021; Becerra et al., 2019; Larionov et al., 2021; Larionow & Mudło-Głagolska, 2022; Mousavi Asl et al., 2020; Preece et al., 2019).

Clinical Relevance of Assessing Positive and Negative Reactivity Traits The valence of the emotion when assessing emotional reactivity appeared to play an important role in our dataset. Participants reported significantly higher levels of negative reactivity compared to positive reactivity. Furthermore, we examined the predictive power of the PERS scores, finding them to account for 25 to 30% of the variance in depression, anxiety, and stress. The duration dimensions appeared to be the best unique predictors across depression, anxiety, and stress (with negative-duration predicting higher symptoms, and positive-duration predicting lower symptoms). While participants reported significantly higher negative reactivity compared to positive reactivity, positive-duration was the stronger predictor of depressive and stress symptoms as compared to negative-duration, along with a practically the same size of *beta* coefficients in predicting anxiety symptoms. Thus, low positive reactivity appears to have particular relevance in predicting these psychopathology symptoms. These results are consistent with the broaden-and-build theory of positive emotions by Fredrickson, (2001), who noted that positive emotions can neutralize the effect of negative emotions and contribute to faster recovery from negative emotional states, forming psychological resiliency, through which preventing the development of chronic stress is possible. Our results are also consistent with models that position trait negative reactivity as a key vulnerability factor for depressive and anxiety symptoms (e.g. Sauer-Zavala & Barlow, 2021). Following Brosschot et al.'s ideas on stress theory, we believe that low positive-duration levels and high negative-duration levels may prolong stress-related affective and physiological activation that may lead for the development of pathogenic states and diseases (Brosschot et al., 2005; Brosschot et al., 2006). However, these ideas do not exclude that acute stress (very intense, but short-term emotions) may lead to the development of psychopathology.

Sociodemographic Differences As for gender differences, our results suggested that females have higher levels of negative reactivity compared to males, which is in line with previous reports (Becerra et al., 2019; Larionov et al., 2021; Larionow & Mudło-Głagolska, 2022). Age was slightly negatively correlated with negative reactivity only in females, whereas no correlations between age and emotional reactivity traits were noted in males. It can thus be concluded that, in our sample, positive emotional reactivity traits were relatively stable across age in females and in males, whereas negative reactivity decreased with age only in females. This may be due to the fact that, with age, people learn and gain more practice with various strategies to regulate their negative emotions, which is in line with literature reviews on processing, remembering, and acting on emotions (Charles & Carstensen, 2009).

Practical Implications of Assessing Emotional Reactivity for Psychotherapeutic Approaches The clinical relevance of positive reactivity traits will be important for future and more in-depth investigation as our data suggest that positive-duration might, in some instances, be a more significant, but protective factor for psychopathology development, as compared to negative-duration appears to be a risk factor. Previous work has often considered lowering problematic levels of negative emotional reactivity as psychotherapeutic goals for treatment of affective disorders or borderline personality disorder (Barlow et al., 2010; Linehan, 1993). Recent papers have stressed the role of emotion valence in problematic activation, intensity, and duration of emotional responses as characteristics of various forms of psychopathology (Becerra & Campitelli, 2013; Gross & Jazaieri, 2014). Considering the clinical relevance of positive-valence emotional reactivity characteristics in predicting low levels of psychopathology, in order to provide sufficient psychological support or treatment, such data suggest that it may not be enough just to reduce the levels of negative reactivity, but it is necessary also to try to increase the levels of positive reactivity, especially positive-duration. In future, the PERS could be used for establishing the typical reactivity profiles of various diagnostic categories, for assessment emotion generation processes, and conducting primary prevention of mental disorders, especially at the earliest stages of their development, and when identifying risk groups of psychopathology development (Becerra et al., 2019; Larionow & Mudło-Głagolska, 2022; Preece et al., 2019).

Limitations of the Study Our study took place in a general community sample of adults with a wide range of ages. However, there was a higher proportion of females in the sample. Moreover, we did not test the PERS in clinical or adolescent samples. Our concurrent validity measures were all self-report; thus, future studies are recommended to examine the PERS's validity with behavioural markers or in laboratory settings with psychophysiological markers. Additionally, the test–retest reliability of the PERS was not assessed.

Conclusions

The Polish version of the PERS appears to be a valid and comprehensive tool for assessing the multidimensional emotional reactivity construct across both negative and positive emotions. It is characterized by a theoretically congruent factor structure, has high internal consistency reliability, and shows good convergent validity, criterion validity, and discriminant validity. Our results provide a strong foundation for use of the PERS in Polish contexts and for conducting future studies in different settings (i.e. on clinical and adolescent samples).

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Author Contribution Paweł Larionow: conceptualization, formal analysis, data curation, investigation, methodology, writing, reviewing and editing, and project administration
David A. Preece: writing, reviewing, and editing
Karolina Mudło-Głagolska: data curation, and investigation
All authors approved the final article and agreed to the authorship order.

Data Availability The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Declarations

Ethics Approval The study was conducted in accordance with the Declaration of Helsinki Ethical Principles. The Kazimierz Wielki University Ethics Committee approved the study (No. 1/13.06.2022).

Conflict of Interest The authors have no conflicts of interest to declare that are relevant to the content of this article.

References

Bachorowski, J.-A., & Braaten, E. B. (1994). Emotional intensity: measurement and theoretical implications. *Personality and Individual Differences, 17*(2), 191–199. https://doi.org/10.1016/0191-8869(94)90025-6

Balaban, G., & Bilge, Y. (2021). Psychometric properties of Perth emotional reactivity scale-short form in Turkish community sample. *Current Approaches in Psychiatry, 13*(Suppl. 1), 281–297. https://doi.org/10.18863/pgy.982578

Barlow, D. H., Ellard, K. K., Fairholme, C. P., Farchione, T. J., Boisseau, C. L., Allen, L. B., & Ehrenreich-May, J. T. (2010). *Unified protocol for transdiagnostic treatment of emotional disorders: workbook*. Oxford University Press. https://doi.org/10.1093/med:psych/9780199772674.001.0001

Barnhart, W. R., Braden, A. L., & Jordan, A. K. (2020). Negative and positive emotional eating uniquely interact with ease of activation, intensity, and duration of emotional reactivity to predict increased binge eating. *Appetite, 151*, 104688. https://doi.org/10.1016/j.appet.2020.104688

Becerra, R., & Campitelli, G. (2013). Emotional reactivity: critical analysis and proposal of a new scale. *International Journal of Applied Psychology, 3*(6), 161–168. https://doi.org/10.5923/j.ijap.20130306.03

Becerra, R., Preece, D., Campitelli, G., & Scott-Pillow, G. (2019). The assessment of emotional reactivity across negative and positive emotions: Development and validation of the Perth emotional reactivity scale (PERS). *Assessment, 26*(5), 867–879. https://doi.org/10.1177/1073191117694455

Boyes, M. E., Carmody, T. M., Clarke, P. J. F., & Hasking, P. A. (2017). Emotional reactivity and perseveration: Independent dimensions of trait positive and negative affectivity and differential associations with psychological distress. *Personality and Individual Differences, 105*, 70–77. https://doi.org/10.1016/j.paid.2016.09.025

Brosschot, J. F., Pieper, S., & Thayer, J. F. (2005). Expanding stress theory: Prolonged activation and perseverative cognition. *Psychoneuroendocrinology, 30*(10), 1043–1049. https://doi.org/10.1016/j.psyneuen.2005.04.008

Brosschot, J. F., Gerin, W., & Thayer, J. F. (2006). The perseverative cognition hypothesis: A review of worry, prolonged stress-related physiological activation, and health. *Journal of Psychosomatic Research, 60*(2), 113–124. https://doi.org/10.1016/j.jpsychores.2005.06.074

Charles, S. T., & Carstensen, L. L. (2009). Social and emotional aging. *Annual Review of Psychology, 61*(1), 383–409. https://doi.org/10.1146/annurev.psych.093008.100448

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*(4), 385–396. https://doi.org/10.2307/2136404

Cyniak-Cieciura, M., Zawadzki, B., & Strelau, J. (2018). The development of the revised version of the formal characteristic of behaviour – temperament inventory FCB–TI(R). *Personality and Individual Differences, 127*, 117–126. https://doi.org/10.1016/j.paid.2018.01.036

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology. The broaden-and-build theory of positive emotions. *The American Psychologist, 56*(3), 218–226. https://doi.org/10.1037//0003-066x.56.3.218

Gross, J. J., & Jazaieri, H. (2014). Emotion, emotion regulation, and psychopathology: An affective science perspective. *Clinical Psychological Science, 2*(4), 387–401. https://doi.org/10.1177/2167702614536164

Groth-Marnat, G. (2009). *Handbook of Psychological Assessment (5th Edition)*. Wiley.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55. https://doi.org/10.1080/10705519909540118

Kleszczewska, D., Mazur, J., Dzielska, A., Michalska, A., Gaspar de Matos, M., Santos, T., Gaspar, T., Branquinho, C., Inês Antão, M., & Guedes, F. (2018). *Improve the youth. Zdrowie psychiczne młodzieży. Raport z badań*. Instytut Matki i Dziecka.

Kolenikov, S., & Bollen, K. A. (2012). Testing negative error variances. *Sociological Methods & Research, 41*(1), 124–167. https://doi.org/10.1177/0049124112442138

Kroenke, K., Spitzer, R. L., Williams, J. B., & Löwe, B. (2009). An ultra-brief screening scale for anxiety and depression: The PHQ-4. *Psychosomatics, 50*, 613–621. https://doi.org/10.1176/appi.psy.50.6.613

Kuo, J. R., Fitzpatrick, S., Metcalfe, R. K., & McMain, S. (2016). A multi-method laboratory investigation of emotional reactivity and emotion regulation abilities in borderline personality disorder. *Journal of Behavior Therapy and Experimental Psychiatry, 50*, 52–60. https://doi.org/10.1016/j.jbtep.2015.05.002

Larionow, P., & Mudło-Głagolska, K. (2022). Assessment of activation, intensity and duration of positive and negative emotions: Psychometric properties of the Polish version of the Perth emotional reactivity scale – short form. *Current Issues in Personality Psychology.* https://doi.org/10.5114/cipp/156146

Larionow, P., & Mudło-Głagolska, K. (2023). The patient health questionnaire-4: Factor structure, measurement invariance, latent profile analysis of anxiety and depressive symptoms and screening results in Polish adults. *Advances in Cognitive Psychology, 19*(2), 123–137. https://doi.org/10.5709/acp-0384-9

Larionov, P. M., Ageenkova, E. K., & Belashina, T. V. (2021). Psychometric properties of the Russian version of the Perth emotional reactivity scale-short form. *Neurology, Neuropsychiatry, Psychosomatics, 13*(2), 26–33. https://doi.org/10.14412/2074-2711-2021-2-26-33

Larsen, R. J., & Diener, E. (1987). Affect intensity as an individual difference characteristic: A review. *Journal of Research in Personality, 21*(1), 1–39. https://doi.org/10.1016/0092-6566(87)90023-7

Lenhard, W. & Lenhard, A. (2016). Computation of effect sizes. https://www.psychometrica.de/effect_size.html. Accessed 9 Mar 2023.

Linehan, M. M. (1993). *Cognitive-behavioral treatment of borderline personality disorder*. Guilford Press.

Mousavi Asl, E., Mohammadian, Y., Gharraee, B., Khanjani, S., & Pazouki, A. (2020). Assessment of the emotional reactivity through the positive and negative emotions: The psychometric properties of the Persian version of the Perth emotional reactivity scale. *Iranian Journal of Psychiatry and Behavioral Sciences, 14*(2), e98057. https://doi.org/10.5812/ijpbs.98057

Mundfrom, D. J., Shaw, D. G., & Ke, T. L. (2005). Minimum sample size recommendations for conducting factor analyses. *International Journal of Testing, 5*(2), 159–168. https://doi.org/10.1207/s15327574ijt0502_4

Nock, M. K., Wedig, M. M., Holmberg, E. B., & Hooley, J. M. (2008). The emotion reactivity scale: development, evaluation, and relation to self-injurious thoughts and behaviors. *Behavior Therapy, 39*(2), 107–116. https://doi.org/10.1016/j.beth.2007.05.005

Pituch, K. A., & Stevens, P. (2016). *Applied multivariate statistics for the social sciences, 6th edition*. Routledge.

Preece, D., Becerra, R., & Campitelli, G. (2019). Assessing emotional reactivity: Psychometric properties of the Perth emotional reactivity scale and the development of a short form. *Journal of Personality Assessment, 101*(6), 589–597. https://doi.org/10.1080/00223891.2018.1465430

Ripper, C. A., Boyes, M. E., Clarke, P. J. F., & Hasking, P. A. (2018). Emotional reactivity, intensity, and perseveration: Independent dimensions of trait affect and associations with depression, anxiety, and stress symptoms. *Personality and Individual Differences, 121*, 93–99. https://doi.org/10.1016/j.paid.2017.09.032

Sauer-Zavala, S., & Barlow, D. H. (2021). *Neuroticism: A new framework for emotional disorders and their treatment*. Guilford Publications.

Vorst, H. C. M., & Bermond, B. (2001). Validity and reliability of the Bermond–Vorst alexithymia questionnaire. *Personality and Individual Differences, 30*(3), 413–434. https://doi.org/10.1016/S0191-8869(00)00033-7

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