

## Exploring the Psychometric Properties and the Factor Structure of the Calgary Depression Scale for Schizophrenia Across the Schizotypy Continuum

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### Abstract:

This study evaluated the psychometric properties and factor structure of the Calgary Depression Scale for Schizophrenia (CDSS) across different levels of the schizotypy continuum. A combined sample of high-schizotypy, at-risk mental states, and patients with first-episode psychosis was assessed for depression and other clinical and functional outcomes. Additionally, experience sampling methodology was used to assess depressive and psychotic-like experiences in daily life. The CDSS exhibited solid internal consistency, validity, and discrimination between depressed and nondepressed participants. Confirmatory factor analyses and the associations of the resulting factors with clinical and functional measures supported a two-factor structure that included general depression and guilt factors. Furthermore, both factors of the CDSS were differentially related to positive and negative symptoms of psychosis in daily life. The CDSS appears to have two underlying psychopathological dimensions and to be a reliable and valid measure for assessing depression across the schizotypy continuum.

**Keywords:** psychosis | depression | Calgary depression scale for schizophrenia | factor analysis | experience sampling | schizotypy

### Article:

Despite the fact that Kraepelin (1913/1919) described the comorbidity between depression and schizophrenia over 100 years ago, neurosis and psychosis have been historically conceptualized as discrete entities. More recently, empirical evidence has challenged this categorical view (Freeman & Garety, 2003; Goldberg et al., 1994; Häfner et al., 2005) and supported the relationship of depressive symptoms with psychotic symptoms and psychotic-like experiences (PLEs). Studies show clear associations in samples of individuals with different severity along the schizotypy continuum (Freeman et al., 2013; Hartley et al., 2013; Horan et al., 2008; Salokangas et al., 2016), as well as in the general population (Freeman et al., 2011; Johns et al., 2004). Schizotypy refers to the expression of the underlying vulnerability for schizophrenia-spectrum psychopathology that is expressed across a wide range of clinical, subclinical, and personality phenomenology (Kwapil & Barrantes-Vidal, 2015). Thus, schizotypy offers a useful and unifying

construct for studying the etiology and expression of schizophrenia-spectrum psychopathology from a developmental perspective (Barrantes-Vidal et al., 2015; Debbané & Barrantes-Vidal, 2015).

It has also been demonstrated that neuroticism increases the risk for PLEs and psychotic symptoms (Barrantes-Vidal et al., 2009; Krabbendam et al., 2002) and mounting evidence suggests an affective pathway to psychosis (Kramer et al., 2012; Kramer et al., 2014; Myin-Germeys & van Os, 2007). Häfner et al. (2013) described comparable prodromal stages for schizophrenia and depression until positive symptoms appear, with depressed mood the most frequent initial symptom in both illnesses. In addition, when the long-term course (12 years) of five symptoms dimensions of schizophrenia (positive, negative, disorganization, mania, depression) was explored, Häfner et al. (2013) found that the depressive dimension was the most prevalent in the prodrome of schizophrenia.

Polyfactorial models of schizophrenia and psychosis regard depression as an inherent symptom dimension of the disease (Cuesta & Peralta, 2001; Emsley et al., 2003; Kay & Sevy, 1990; Lindenmayer, 1995; Reininghaus et al., 2013; Stefanovics et al., 2014). Shevlin et al. (2017) replicated these findings in a large ( $n = 34,653$ ) general population sample, showing evidence of a structure composed of positive, negative, disorganized, depression, and mania dimensions that supports phenomenological continuity between psychotic symptoms and PLEs. Thus, the accurate assessment of depressive symptoms in schizophrenia, as well as across the whole continuum of schizotypy, becomes a critical issue.

The Calgary Depression Scale for Schizophrenia (CDSS; Addington et al., 1993) is one of the most widely used instruments for measuring depressive symptoms in schizophrenia. It was originally developed to differentiate the overlapping aspects of depressive and negative symptoms in schizophrenia (Addington et al., 1992; Addington et al., 1990). The CDSS has been translated into more than 36 languages and has been shown to have suitable psychometric properties in multiple studies (e.g., Addington et al., 1994; Bressan et al., 1998; Hani et al., 2016; Kontaxakis et al., 2000; Lançon et al., 2000; Sarró et al., 2004; Xiao et al., 2009). Furthermore, the CDSS showed a greater specificity compared with other depression rating scales for assessing depressive symptoms in schizophrenia (Addington et al., 1996; Grover et al., 2017; Schennach et al., 2012). In a recent systematic review, Lako et al. (2012) found that the CDSS has better divergent and predictive validity for assessing depressive symptoms in patients with schizophrenia than five other depression measures, and it was recommended for use in research as well as in clinical practice. However, only one study has explored the clinical utility and the factor structure of the CDSS in a healthy sample (Müller et al., 2005), and only two recent studies have investigated the psychometric properties of the CDSS in individuals at ultra-high risk (UHR) for psychosis (Addington et al., 2014; Rekhi et al., 2018). To our knowledge, no studies have addressed these issues in samples comprising different levels of clinical and subclinical expression of the schizotypy continuum.

The developers of the CDSS initially indicated that the scale was unidimensional (Addington et al., 1992). However, findings from subsequent studies have been mixed. Several studies supported a univariate solution in clinical (Bernard et al., 1998; Lançon et al., 1999) and nonclinical samples (Müller et al., 2005), whereas other studies supported a two-factor structure (e.g., Grover et al., 2017; Hani et al., 2016; Martin-Reyes et al., 2011; Rabany et al., 2013). Furthermore, other studies (Addington et al., 1996; Maggini & Raballo, 2006; Schennach et al., 2012) reported an inconsistent three-factor structure with the third-factor being based on a single item (early wakening) or a combination of this item with other items (e.g., morning depression).

Maggini and Raballo (2006) suggested that two specific factors of the CDSS, general depression (“depression–hopelessness”) and guilt (“guilty idea of reference–pathological guilt”), may represent distinct psychopathological dimensions of depression in schizophrenia. They reported unique associations of these two factors with positive and negative symptoms, as well as with different basic symptoms clusters, in a sample of chronically ill patients with schizophrenia. The general depression factor was associated in part with negative symptoms, while the guilt factor was associated with positive symptoms. Likewise, Rabany et al. (2013) also found these two distinct factors in a sample of patients with predominantly negative symptoms, which they linked to the existence of different underlying neural processes for depression in schizophrenia. However, in contrast to Maggini and Raballo (2006), they found that the guilt factor was not related with positive symptoms, whereas an inverse correlation between the general depression factor and negative symptoms appeared. Schennach et al. (2012) found an almost identical factor structure in a sample of 278 patients with schizophrenia, reporting that the guilt factor was associated with positive symptoms. However, unlike Maggini and Raballo (2006), but in line with Rabany et al. (2013), the general depression factor was inversely related to negative symptoms.

Finally, the only two studies that examined the factor structure of the CDSS in UHR individuals (Rekhi et al., 2018; Vargas et al., 2019) showed a comparable factor structure as the three aforementioned studies using samples with schizophrenia (Maggini & Raballo, 2006; Rabany et al., 2013; Schennach et al., 2012), providing initial evidence for the meaningful distinction between a general depression factor and a guilt factor of the CDSS also in a UHR sample. Rekhi et al. (2018) found that the guilt factor correlated with positive attenuated psychotic symptoms, even after controlling for the general depression factor, whereas the general depression factor was not associated with positive attenuated psychotic symptoms after controlling for the guilt factor. Although the general depression factor was inversely correlated with global functioning, the guilt factor was not, even after controlling for each other. No associations with negative symptoms were tested in this study. Vargas et al. (2019) reported positive correlations of the two CDSS factors with both attenuated positive and negative symptoms in UHR individuals. The association of depression and negative symptoms is complicated by the fact that they share several phenomenological similarities, including anhedonia, flattened affect, and disinterest in others and activities. However, they are distinguished by the fact that depression is characterized by increased negative affect and associated with elevated neuroticism—characteristics which are the opposite of what would be expected in negative symptoms, which are largely characterized by diminished emotional experiences, including negative affect. Furthermore, depression tends to be episodic and represent an alteration from typical functioning, whereas negative symptoms tend to be trait-like and enduring. This matter is further compounded by the fact that the phenomenological overlap oftentimes has resulted in negative symptom measures that are saturated with depression, social anxiety, and neuroticism, resulting in spurious correlations between depression and negative symptoms.

In summary, increasing evidence supports that two psychopathological dimensions underlie the CDSS in patients with schizophrenia. However, further research is needed to replicate the scant data available in UHR individuals and to examine whether these findings hold when studying different levels of expression across the schizotypy continuum. Furthermore, to our knowledge, no previous studies have explored the relationship of the CDSS factors with the expression of PLEs in daily life. Exploring the correlates of these dimensions at a micro-phenomenological, momentary level in daily life would add ecological validity to the extant literature and complement the findings obtained with retrospective self-report and interview

measures (Ben-Zeev et al., 2012; Myin-Germeys et al., 2009). The present study employed experience sampling methodology (ESM) to fill in this gap in the literature. ESM is a structured diary technique that assesses mental processes (thoughts, affect, symptoms, etc.) and contextual factors in daily life (Mehl & Conner, 2012; Palmier-Claus et al., 2011). A wide range of studies has demonstrated the relevance of ESM for assessing psychotic phenomena in daily life (e.g., Barrantes-Vidal et al., 2013; Cristóbal-Narváez et al., 2017; Kwapil et al., 2012; Kwapil et al., 2020; Palmier-Claus et al., 2012; Reininghaus et al., 2016; Thewissen et al., 2011). ESM provides several advantages to traditional assessment procedures (Hektner et al., 2007). Specifically, ESM repeatedly assesses participants' experiences in their daily environment and at the time of the signal, thereby enhancing ecological validity and minimizing retrospective bias.

The first aim of this study was to examine the underlying structure and psychometric properties of the CDSS in a combined sample comprising different levels of expression across the schizotypy continuum. Second, we examined the factor structure of the CDSS testing those competitive models (one-factor, two-factor, three-factor models) that have been most replicated in the literature. Third, we examined the relationship of the general depression and guilt factors of the CDSS with other psychopathological and functional measures were explored. Finally, we extended this study to the realm of daily life to analyze whether the CDSS factors were associated with positive and negative PLEs in daily life. Note that the present study did not examine differences between the schizotypy continuum groups, as our hypotheses focused on the psychometric properties, factor structure, and validity of the CDSS across the broad schizotypy continuum. Furthermore, previous studies have already examined these issues separately in nonclinical, at-risk mental states (ARMS), and patient groups.

## Method

### *Participants*

The current sample consisted of 164 individuals with different levels of behavioral expression of liability to psychosis. Specifically, the study included 56 nonclinically ascertained (high-schizotypy) young adults who were selected for elevated scores on measures of positive schizotypy, 70 adults with ARMS and 38 patients with a first episode of psychosis (FEP). The nonclinical participants were recruited from a sample of 206 students from the Universitat Autònoma de Barcelona who participated in interview, questionnaire, and ESM assessments described in Barrantes-Vidal et al. (2013). The 56 participants used in the present study (mean age = 21.1 years  $\pm$  2.5; 80% female) had standard scores based on sample norms of at least 1.0 on the suspiciousness subscale of the Schizotypal Personality Questionnaire (Raine, 1991). None of the participants had a psychotic disorder according to the Structured Clinical Interview for *DSM IV* Axis I Disorders (SCID-I; First et al., 1996). The university ethics committee granted ethical approval for the study and all participants provided informed consent.

Clinical participants were recruited at the Sant Pere Claver–Early Psychosis Program (Domínguez-Martínez et al., 2011; Domínguez-Martínez et al., 2014) in Barcelona. The initial sample consisted of 80 individuals ARMS for psychosis and 48 individuals with FEP. However, 10 individuals from each clinical group were excluded from the analyses due to missing data or invalid ESM protocols. Thus, the final sample of clinical participants included 70 participants with ARMS (mean age = 21.4 years, *SD* = 3.9 years; 70.0% males) and 38 participants with FEP (mean age = 24.5 years, *SD* = 4.9 years; 68.4% males). ARMS criteria were determined based on the

comprehensive assessment of ARMS (Yung et al., 2005). At the time of assessment, FEP patients met *DSM-IV* (American Psychiatric Association, 2002) criteria for any psychotic disorder or affective disorder with psychotic symptoms and presented a first-episode of psychosis within the past 2 years (mean duration of illness = 12.0 months,  $SD = 7.8$ ). Patients' inclusion criteria were ages between 14 and 40 years old and  $IQ \geq 75$ . Exclusion criteria were evidence of organically based psychosis and any previous psychotic episode. All participants provided written informed consent. The project was developed in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) and was approved by the local ethical committee. The measures described below were administered along with other measures not used in the present study. Experienced psychologists who were trained in the administration of the measures conducted the interviews.

### *Measures and Procedures*

All participants were assessed with the Spanish version of the CDSS (Sarró et al., 2004), a clinician-rated scale that comprises nine items measured on a Likert-type scale of 0 to 3 (0 = absent, 1 = mild, 2 = moderate, 3 = severe). Other measures employed in this study were the Beck Depression Inventory–II (BDI-II; Beck et al., 1996) and the Social and Occupational Functioning Assessment Scale (SOFAS; Goldman et al., 1992). The Structured Clinical Interview for *DSM IV* Axis II Disorders (SCID-II; First et al., 1997) was used to assess schizophrenia-spectrum personality disorders (dimensional ratings were also obtained). Finally, the SCID-I was employed to identify any current or previous affective and psychotic disorders.

ESM data were assessed using personal digital assistants or smartphones that signaled participants randomly 8 times a day (between 11 am and 10 pm) for seven consecutive days to complete questionnaires. Participants had 15 minutes after the signal to complete each questionnaire, afterward that survey was no longer available. Studies indicate that the smartphone and PDA methods produce comparable data in terms of quantity and quality (Burgin et al., 2013; Kimhy et al., 2012). Participants who completed less than 18 ESM questionnaires were excluded from the analyses. The complete list of ESM items can be found in Barrantes-Vidal et al. (2013). All items used in this study assessed current mental or contextual experiences that were rated on a 7-point Likert-type scale ranging from *not at all* to *very much*. Within and between-person reliabilities for ESM indices were computed following Geldhof et al. (2014). To assess positive PLEs, the mean score of eight items were used: unusual senses, unusual thoughts, feeling weird, fear of losing control, difficulty controlling thoughts, familiar things seeming strange, passivity feelings, and hearing/seeing things others could not (within alpha = .65, between alpha = .88). Similarly, paranoia in daily life was measured with the mean score of two items: “Right now I feel suspicious” and “Right now I feel mistreated” (within alpha = .51, between alpha = .82). Finally, the item “Right now I have no thoughts or emotions” was employed to measure negative symptoms in daily life.

### *Statistical Analyses*

Statistical Package for Social Sciences (SPSS) Version 19.0 was used to analyze the psychometric properties of the CDSS and correlations between the CDSS and its factors with other clinical and functional measures. Confirmatory factor analyses (CFAs) using maximum likelihood estimates were performed using *Mplus* 7.11 (Muthén & Muthén, 2010) in order to test competing one-, two-

, and three-factor models. Goodness of fit indices including standardized root mean square residual (SRMR), the root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker–Lewis index (TLI) were evaluated. Following conventional criteria, SRMR and RMSEA values  $<.05$  were excellent, and CFI and TLI values  $>.95$  were excellent (Marsh et al., 2004). Akaike information criterion (AIC), Bayes information criterion (BIC), and adjusted BIC were employed to compare these models (lower scores indicate better fit). Cronbach’s  $\alpha$  was computed to analyze internal consistency. Convergent validity was explored with Pearson correlations between CDSS and BDI-II total scores. Partial correlations were performed between each CDSS factor score with schizophrenia-spectrum personality disorders ratings, BDI-II, and SOFAS controlling for the other CDSS factor. A receiver operating characteristic (ROC) curve analysis was employed to analyze the capacity of the CDSS to discriminate between those with and without a current major depressive episode as measured by the SCID-I. The area under the ROC curve was used to evaluate the overall performance of the CDSS, and the best sensitivity and specificity cutoff points were established.

ESM data have a hierarchical structure in which ESM ratings (Level 1 data) are nested within participants (Level 2 data). Multilevel linear modeling provides a more appropriate method than conventional unilevel analyses for analyzing nested data and it is standard for the analysis of ESM data (Luke, 2004; Nezlek, 2012). Level 2 predictors were grand mean centered, while parameter estimates were calculated using robust standard errors. ESM data analyses were computed with *Mplus 7.11* (Muthén & Muthén, 2010). To examine associations of the CDSS factors with daily life PLEs, direct effects of the two CDSS factors (Level 2 predictors) on positive and negative PLEs (Level 1 criteria) were independently performed. Thus, a series of multilevel linear regressions were conducted to test the impact of the CDSS factors on daily life positive and negative PLEs with both predictors simultaneously included in the model.

## Results

### *Participants’ Characteristics*

The sample comprises 164 participants with a mean age of 22.0 years ( $SD = 4.0$ , range 14-32), 47.3% were female, the majority were Spanish (84.2%), and lived with their parents (82.3%). Forty participants (24.4%) met criteria for a current major depressive episode and four (2.4%) for current dysthymia. The mean CDSS total score was 4.03 ( $SD = 4.03$ , range 0-17), the median was 3, the mode was 0, and 54 participants (32.9%) had a CDSS total score  $>5$  (the most suitable cutoff to discriminate between depressed and nondepressed participants in our sample). Of the total sample, 159 participants had valid data for the BDI-II, 44 of which (28.9%) had a BDI-II total score  $>19$ , the lowest cutoff to discriminate between depressed and nondepressed participants in psychiatric samples (Wang & Gorenstein, 2013). The mean BDI-II total score was 15.0 ( $SD = 11.7$ , range 0-58), the median was 13, and the mode was 4. There were no sex differences for the CDSS total score ( $t = 1.22, p = .23$ ) or the BDI-II total score ( $t = 1.03, p = .31$ ).

### *Reliability of the CDSS*

Cronbach’s alpha value for the total CDSS in our sample was .83, demonstrating a good internal consistency. Item analysis of the CDSS is shown in Table 1. Removal of item “early wakening” slightly increased internal consistency—its correlation with the total score of the scale was .297.

While the item “depression” was the most relevant for increasing the total scale score mean, the item “suicide” was the most relevant for reducing the total scale score mean.

**Table 1.** Calgary Depression Scale for Schizophrenia (CDSS) Item Analysis.

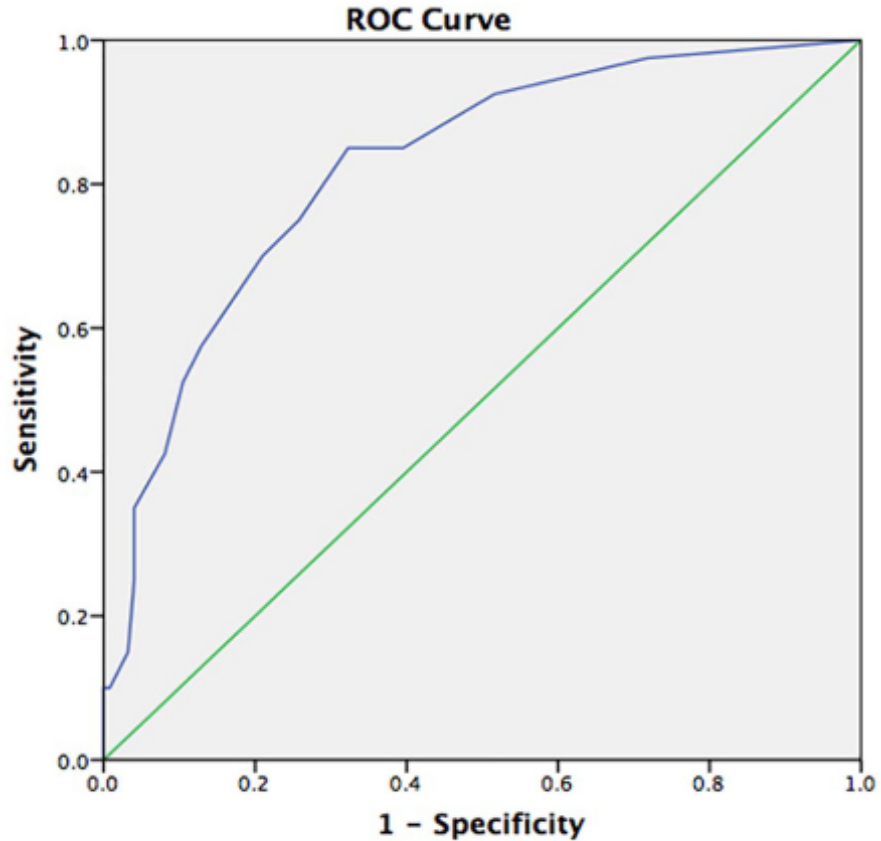
CDSS items	M	SD	Total CDSS score mean if item deleted	Item-total correlation (corrected)	Cronbach’s alpha if item deleted
1. Depression	0.75	0.83	3.28	.733	.783
2. Hopelessness	0.59	0.80	3.45	.635	.797
3. Self-depreciation	0.68	0.86	3.35	.592	.804
4. Guilty ideas of reference	0.26	0.56	3.77	.377	.826
5. Pathological guilt	0.55	0.71	3.48	.443	.820
6. Morning depression	0.35	0.68	3.68	.552	.811
7. Early wakening	0.25	0.63	3.78	.297	.834
8. Suicide	0.21	0.43	3.82	.518	.816
9. Observed depression	0.40	0.61	3.63	.727	.790

### *Validity Measures*

The high positive correlation between the CDSS and BDI-II ( $r = .77, p < .001$ ) indicated good convergent validity for the CDSS. In addition, the CDSS showed a significant correlation with the presence of major depressive episode ( $r = .52, p < .001$ ) as measured by the SCID-I, which provides evidence for the concurrent validity of the scale. The area under the ROC curve of the scale against SCID-I criteria for major depressive episode was 0.823 (95% confidence interval [0.751, 0.896],  $p < .001$ ), which is considered a good range of accuracy (Figure 1). Thus, the scale has the capacity to discriminate between the depressed and not depressed participants of this study. The most suitable cut-off to discriminate between depressed and nondepressed participants was 5, with a sensitivity of 75.0% and specificity of 74.2%.

### *CDSS Confirmatory Factor Analyses*

CFA were used to evaluate and compare the fit of the one-factor, two-factor, and three-factor models. Following the literature reviewed above, the two-factor model comprises Factor 1 “general depression” (Items 1 to 3 and 6 to 9) and Factor 2 comprises “guilty” (Items 4 and 5). The three-factor model comprises Factor 1 “general depression” (Items 1 to 3, 8, and 9), Factor 2 comprises “guilty” (Items 4 and 5), and Factor 3 comprises “morning symptoms” (Items 6 and 7). SRMR, RMSEA, CFI, and TLI were employed to assess absolute models fit, whereas AIC, BIC, and adjusted BIC were employed to compare these models. Results revealed better-fit statistics for the two-factor structure (AIC = 2589.17; BIC = 2675.96; adjusted BIC = 2587.32; SRMR = .037; RMSEA = .036; CFI = .987; TLI = .983), then for the one-factor structure (AIC = 2592.60; BIC = 2676.30; adjusted BIC = 2590.82; SRMR = .042; RMSEA = .047; CFI = .977; TLI = .970), and then for the three-factor structure (AIC = 2592.83; BIC = 2685.82; adjusted BIC = 2590.85; SRMR = .037; RMSEA = .043; CFI = .984; TLI = .975). The standardized loadings of the CDSS items scores from the two-factor model are shown in Table 2. The correlation between the two factors was .48.



**Figure 1.** ROC curve for the CDSS with the SCID-I criteria for major depressive episode as outcome measure.

*Note.* CDSS = Calgary Depression Scale for Schizophrenia; SCID-I = Structured Clinical Interview for *DSM-IV* Disorders.

**Table 2.** Standardized Factor Loadings of Calgary Depression Scale for Schizophrenia (CDSS) Items.

CDSS items	Factor 1: General depression	Factor 2: Guilt
1. Depression	0.826	
2. Hopelessness	0.715	
3. Self-depreciation	0.671	
4. Guilty ideas of reference		0.528
5. Pathological guilt		0.610
6. Morning depression	0.578	
7. Early wakening	0.333	
8. Suicide	0.531	
9. Observed depression	0.816	



Finally, following the recommendations of a reviewer, as some studies found that self-depreciation loaded along with the second factor (e.g., Rekhi et al., 2018; Vargas et al., 2019), we tested an alternate two-factor model with Items 3, 4, and 5 (guilty ideas of reference, pathological guilt, and self-depreciation) loading on the second factor. Results reveal an adequate fit for this model (AIC = 2594.49; BIC = 2681.29; adjusted BIC = 2592.64; SRMR = .042; RMSEA = .050; CFI = .975; TLI = .966). However, the previous two-factor model with the self-depreciation item included in the first factor showed a better fit.

### *Correlations of the CDSS Total Score and the CDSS Factors With Symptoms, Impairment, and PLEs in Daily Life*

Pearson's correlations of the CDSS total score, the CDSS subscale scores, and partial correlations of the CDSS subscale scores with schizophrenia-spectrum personality disorders ratings, BDI-II, and SOFAS are shown in Table 3.<sup>2</sup> For the entire sample, the CDSS total score and subscale scores were positively associated with schizophrenia-spectrum personality disorders ratings and BDI-II total score, and negatively associated with SOFAS score. Likewise, the CDSS Factor 1 general depression was significantly associated with schizophrenia-spectrum personality disorders ratings, BDI-II, and SOFAS after controlling for Factor 2. In contrast, the CDSS Factor 2 guilt was only correlated with schizotypal personality ratings and BDI-II when Factor 1 was controlled for. For the FEP group, the CDSS Factor 1 general depression was significantly associated with schizophrenia-spectrum personality disorders ratings and BDI-II, but not with SOFAS, after controlling for Factor 2. In contrast, the CDSS Factor 2 guilt was not correlated with any measure when Factor 1 was controlled for. For the ARMS group, the CDSS Factor 1 general depression was significantly correlated with paranoid personality ratings, BDI-II, and SOFAS after controlling for Factor 2. Factor 2 guilt was associated with schizotypal personality ratings, BDI-II, and SOFAS when Factor 1 was controlled for. Finally, for the high-schizotypy group, Factor 1 was only positively associated with BDI-II, and negatively associated with SOFAS after controlling for Factor 2. On the other hand, Factor 2 was correlated with schizotypal personality ratings and negatively associated with SOFAS after controlling for Factor 1.

The CDSS total score was associated with the positive PLEs and paranoia indices in daily life, but not with negative PLEs. Similarly, the CDSS factor scores were associated with the positive PLEs and paranoia indices in daily life, but not with negative PLEs (Table 4 upper part). Factor 1 (general depression) was associated with positive and negative PLEs and paranoia after controlling for Factor 2. In contrast, Factor 2 (guilt) was negatively associated with negative PLEs, but unassociated with paranoia and positive PLEs after controlling for Factor 1 (Table 4 bottom part).

**Table 3.** Correlations of the CDSS Total Score and the CDSS Factors With Clinical and Functional Variables.

	CDSS Total	CDSS Factor 1: General depression	CDSS Factor 2: Guilt	CDSS Factor 1 <sup>a</sup> : General depression	CDSS Factor 2 <sup>b</sup> : Guilt
	Zero-order correlations			Partial correlations	
<i>Entire sample</i>					
Schizotypal personality rating ( <i>n</i> = 164)	<b>.55**</b>	<b>.50**</b>	<b>.46**</b>	<b>.36**</b>	<b>.29**</b>
Schizoid personality rating ( <i>n</i> = 163)	<b>.32**</b>	<b>.32**</b>	<b>.20*</b>	<b>.25**</b>	.06
Paranoid personality rating ( <i>n</i> = 163)	<b>.42**</b>	<b>.40**</b>	<b>.31**</b>	<b>.33**</b>	.09
BDI-II Total score ( <i>n</i> = 159)	<b>.77**</b>	<b>.75**</b>	<b>.54**</b>	<b>.65**</b>	<b>.28**</b>
SOFAS score ( <i>n</i> = 164)	<b>-.50**</b>	<b>-.52**</b>	<b>-.21*</b>	<b>-.49**</b>	.07
<i>FEP participants</i>					
Schizotypal personality rating ( <i>n</i> = 38)	<b>.55**</b>	<b>.52**</b>	<b>.40*</b>	<b>.46**</b>	.08
Schizoid personality rating ( <i>n</i> = 38)	<b>.39*</b>	<b>.40*</b>	.18	<b>.37*</b>	-.04
Paranoid personality rating ( <i>n</i> = 38)	<b>.39*</b>	<b>.39*</b>	.21	<b>.50**</b>	-.27
BDI-II Total score ( <i>n</i> = 35)	<b>.69**</b>	<b>.68**</b>	<b>.49**</b>	<b>.55**</b>	.16
SOFAS score ( <i>n</i> = 38)	-.30 <sup>+</sup>	<b>-.33*</b>	<b>-.08</b>	-.22	-.03
<i>ARMS participants</i>					
Schizotypal personality rating ( <i>n</i> = 70)	.32**	<b>.32**</b>	<b>.45**</b>	.12	<b>.38**</b>
Schizoid personality rating ( <i>n</i> = 69)	.12	.12	.09	.09	.03
Paranoid personality rating ( <i>n</i> = 69)	.38**	<b>.38**</b>	<b>.36**</b>	<b>.27*</b>	.21
BDI-II Total score ( <i>n</i> = 68)	<b>.75**</b>	<b>.75**</b>	<b>.57**</b>	<b>.66**</b>	<b>.36**</b>
SOFAS score ( <i>n</i> = 70)	-.26*	<b>-.26*</b>	.08	<b>-.38**</b>	<b>.28*</b>
<i>High-schizotypy participants</i>					
Schizotypal personality rating ( <i>n</i> = 56)	.31*	<b>.31*</b>	<b>.36**</b>	.22	<b>.30*</b>
Schizoid personality rating ( <i>n</i> = 56)	.24	.24	<b>.23</b>	.18	.17
Paranoid personality rating ( <i>n</i> = 56)	.26	.26	.21	.21	.15
BDI-II Total score ( <i>n</i> = 56)	<b>.45**</b>	<b>.45**</b>	<b>.31*</b>	<b>.40**</b>	.20
SOFAS score ( <i>n</i> = 56)	<b>-.50**</b>	<b>-.50**</b>	<b>-.41**</b>	<b>-.43**</b>	-.31*

	Schizotypal personality rating	Schizoid personality rating	Paranoid personality rating	BDI-II Total score	SOFAS score
<i>Entire sample</i>					
Zero-order cancellation					
Schizotypal personality rating ( <i>n</i> = 164)	—				
Schizoid personality rating ( <i>n</i> = 163)	<b>.53**</b>	—			
Paranoid personality rating ( <i>n</i> = 163)	<b>.42**</b>	<b>.26**</b>	—		
BDI-II Total score ( <i>n</i> = 159)	<b>.52**</b>	<b>.33**</b>	<b>.42**</b>	—	
SOFAS score ( <i>n</i> = 164)	<b>-.53**</b>	<b>-.45**</b>	<b>-.25**</b>	<b>-.50**</b>	—

*Note.* Significant correlations are presented in bold. ARMS = at-risk mental state; FEP = first-episode psychosis; CDSS = Calgary Depression Scale for Schizophrenia; BDI-II = Beck Depression Inventory–II; SOFAS = Social and Occupational Functioning Assessment Scale.

<sup>a</sup>Controlling for Factor 2. <sup>b</sup>Controlling for Factor 1.

\**p* < .05. \*\**p* < .01.

**Table 4.** Associations of the CDSS Total Score and the CDSS Factors with PLEs in Daily Life.

Level 2 predictors	Criteria: PLEs in daily life		
	ESM PLEs index	ESM Paranoia	ESM negative symptom
		$\gamma_{01}$ (df = 163)	
CDSS Total	<b>0.066 (0.018)***</b>	<b>0.095 (0.025)***</b>	0.025 (0.022)
CDSS Factor 1	<b>0.075 (0.022)**</b>	<b>0.112 (0.029)***</b>	0.038 (0.026)
CDSS Factor 2	<b>0.168 (0.058)**</b>	<b>0.210 (0.090)*</b>	-0.042 (0.062)
		$\gamma_{01}$ (df = 163)	
CDSS Factor 1 <sup>a</sup>	<b>0.066 (0.025)**</b>	<b>0.106 (0.032)**</b>	<b>0.057 (0.027)*</b>
CDSS Factor 2 <sup>b</sup>	0.063 (0.067)	0.043 (0.091)	<b>-0.132 (0.056)*</b>

*Note.* Significant associations are presented in bold. PLEs = psychotic-like experiences; ESM = experience sampling methodology; CDSS = Calgary Depression Scale for Schizophrenia; df = degrees of freedom.

<sup>a</sup>Controlling for Factor 2. <sup>b</sup>Controlling for Factor 1.

\* $p < .05$ . \*\* $p < .01$ . \*\*\* $p < .001$ .

## Discussion

To our knowledge, the present study was the first to explore the psychometric properties and the factor structure of the CDSS across the schizotypy continuum. In contrast to previous studies focusing on relatively homogeneous samples (e.g., Addington et al., 2014; Grover et al., 2017; Müller et al., 2005; Rekhi et al., 2018), we employed a more heterogeneous sample including individuals with various levels, both clinical and subclinical, of psychosis risk and symptom expression (i.e., high-schizotypy, UHR, and FEP individuals). Our findings lend further support to the validity and reliability of the CDSS, a scale originally developed for use in diagnosed schizophrenia-spectrum disorders, as a measure to assess depression across the schizotypy continuum. Besides, we explored whether the distinction between the two underlying dimensions of the CDSS previously reported in the literature was present in this sample. Differential associations between a general depression factor and a guilt factor of the CDSS with clinical and functional measures suggested that two underlying psychopathological dimensions of the CDSS should be considered, not only in schizophrenia patients but also across the schizotypy continuum. Importantly, we expanded on previous studies by showing that these two dimensions of the CDSS were differentially associated with the expression of positive and negative PLEs in daily life.

Overall, the study supported the reliability and validity of the CDSS. The CDSS was highly correlated with the BDI-II, one of the most widely used and best-known depression tests (McDowell, 2006), indicating good validity. The area under the ROC curve displayed a good range of accuracy, and the data supported the validity of the CDSS to discriminate between individuals with and without a major depressive episode. In our sample, the best cut-off point to optimize both sensitivity and specificity was 5. This is in line with the version employed in the present study, the Spanish cross-cultural adaptation and validation of the CDSS (Sarró et al., 2004), and with the Arabic (Hani et al., 2016), Chinese (Xiao et al., 2009), and Greek (Kontaxakis et al., 2000) validation studies of the scale. However, other studies have found different cut-off scores to discriminate between participants with and without depression (see review by Lako et al., 2012). Thus, the developers of the scale found that the most suitable cut-off score was 6 in a sample of chronic schizophrenic patients (Addington et al., 1993), as well as in a sample of UHR participants (Addington et al., 2014), while Rekhi et al. (2018) suggested a most suitable cut-off score of 7 also

in a sample of UHR individuals. The different composition and clinical characteristics of the samples could explain these differences. For instance, Kim et al. (2006) reported an optimal cut-off point of 8/9 with a sensitivity of 94% and a specificity of 89%, though they employed a long-term schizophrenic inpatient sample which was untreated for depressive symptoms. Furthermore, the employment of different criteria to establish the diagnosis of depression, differences in the expression and course of depressive symptoms across countries (Kessler & Bromet, 2013), and even subtle cross-cultural differences among the raters of the various studies, could be sources accounting for differences in the optimal cutoff values across studies. Finally, it has to be noted that the purpose of the CDSS is not to determine diagnosis of depression. It is a continuous measure of symptom severity that can be used to indicate depression symptoms and the need for further assessment.

The internal consistency of the CDSS in our sample was good ( $\alpha = .83$ ) and in accordance with the Spanish validation study ( $\alpha = .83$ ; Sarró et al., 2004). Although we employed a heterogeneous sample, our results are in agreement with a wide range of studies that employed more homogeneous samples (e.g., in and out-patients with schizophrenia [ $\alpha = .79$ ; Addington et al., 1992], schizophrenic patients with predominant negative symptoms [ $\alpha = .83$ ; Rabany et al., 2013], UHR individuals [ $\alpha = .86$ ; Rekhi et al., 2018], healthy participants [ $\alpha = .76$ ; Müller et al., 2005]), and samples from different cultures, Arabic validation ( $\alpha = .82$ ; Hani et al., 2016), Chinese validation ( $\alpha = .80$ ; Xiao et al., 2009), French validation ( $\alpha = .79$ ; Bernard et al., 1998), and Japanese validation ( $\alpha = .82$ ; Kaneda et al., 2000)]. Item analysis revealed that all items, except for Item 7 (early wakening), appeared indispensable for the construction of the scale, which replicates previous findings (Rabany et al., 2013; Rekhi et al., 2018; Suttajit et al., 2013). In our sample, Item 7 had an item-total corrected correlation of .30 and its removal did not impact the internal consistency of the scale. Other studies also found that Item 7, in addition to other items, was not necessary for the construction of the scale (Bernard et al., 1998; Lançon et al., 1999; Sarró et al., 2004; Xiao et al., 2009). All of this seems to indicate that removal of Item 7 fails to meaningfully impact the reliability of the CDSS; nevertheless, other studies have found Item 7 as an essential component of the scale (Addington et al., 1992; Hani et al., 2016; Kontaxakis et al., 2000; Müller et al., 2005). Several factors, such as variation in symptom expression across cultures or clinical features of selected samples, could interact to explain these differences. Moreover, side effects of neuroleptic medication (Lally & MacCabe, 2015) or secondary negative symptoms induced by medication (Kirschner et al., 2017), specifically sedation and drowsiness, could attenuate this symptom (early wakening) in populations of schizophrenic patients, primarily medicated with this type of drugs. Finally, the authors of the scale retained this item, apart from methodological reasons, mainly for its clinical significance since early wakening is a symptom of melancholia, which is a specifier for a major depressive episode (Addington et al., 1996). Therefore, as methodological evidence seems contradictory regarding the role of Item 7, clinical considerations should prevail.

The developers of the scale initially defended the unidimensionality of the scale (Addington et al., 1992), but most recent research in different cross-cultural samples (e.g., Addington et al., 1996; Grover et al., 2017; Hani et al., 2016; Martin-Reyes et al., 2011; Schennach et al., 2012) supports a two- or three-factor structure. Thus, subsequent CFAs in our sample showed a solution in which a general depression component was clearly distinguished from a guilt component. This is in agreement with Rabany et al. (2013), who found an identical structure in a sample of schizophrenia patients with predominant negative symptoms, and with Rekhi et al. (2018), who reported a very similar result in a sample of UHR individuals. Furthermore, although

other studies with schizophrenia-spectrum disorders patients (Maggini & Raballo, 2006; Schennach et al., 2012) reported a three-factor structure, they also found and highlighted the meaningful distinction between a general depression factor and a guilt factor for the CDSS. They found different correlations for these two factors, but not for the third one, with other psychopathological measures. Thereby, in light of these findings on different cross-cultural and clinical samples, it seems that at least two components of the CDSS should be considered: one component that would combine mostly general symptoms (depression, hopelessness, suicide, etc.) and the other one composed primarily by the domain of guilt (pathological guilt and guilty ideas of reference). However, it has to be noted that other studies found a substantially different factor composition (Addington et al., 1996; Grover et al., 2017; Hani et al., 2016; Martin-Reyes et al., 2011). The use of different methodological approaches in factorial analysis (type of rotation, exploratory vs. confirmatory, etc.) and sample characteristics (different stages or expression of the illness, cultural or sociodemographic differences) could be responsible for the mixed findings in the structure of the CDSS. Notably, mixed findings in the structure of other depression measures have been also found (Addington et al., 1996; Grover et al., 2017; Huang & Chen, 2015; Schennach et al., 2012; Shafer, 2006; Wang & Gorenstein, 2013).

Further analyses revealed alternative associations of the general depression and the guilt factors of the CDSS with schizophrenia-spectrum personality disorders ratings and functional level, which appear to further support the two-factor structure of the CDSS. Although both factors were related to schizotypal personality ratings, only the general depression factor was driving the association of depression with schizoid and paranoid personality ratings. In addition, the general depression, but not the guilt factor, was negatively associated with functioning, consistent with findings in UHR individuals (Rekhi et al., 2018) and confirming that the general depression factor is mostly responsible for the association of depression and functioning. As expected, when these correlations were broken down by group some differences across FEP, ARMS, and high-schizotypy groups were found. The association of the general depression factor with schizotypal and schizoid personality ratings only remained significant for the FEP group, whereas the association of this factor with paranoid personality ratings was high for the FEP group, low for the ARMS group, and no statistically significant for the high-schizotypy group. In contrast, the guilt factor was significantly correlated with schizotypal personality ratings in the ARMS and high-schizotypy groups, but not in the FEP group. In summary, alternate associations of the two factors of the CDSS with other clinical and functional measures were found in the FEP, ARMS, and high-schizotypy groups, which seems to reinforce the two-factor structure of the CDSS.

The CDSS total score was not related with momentary negative PLEs in daily life, which seems to suggest that the CDSS, as intended by its developers, overcomes the problematic differentiation between depressive and negative symptoms. In contrast, clear associations between CDSS total score and positive PLEs were found, which is in agreement with other studies describing the relationship between depressive and positive symptoms in clinical (Häfner et al., 2013; Hartley et al., 2013; Peralta & Cuesta, 2009; Salokangas et al., 2016; Zisook et al., 1999) and nonclinical populations (Cella et al., 2008; Debbané et al., 2009; Lewandowski et al., 2006; Moritz et al., 2017), and in ESM studies (Ben-Zeev et al., 2011; Kramer et al., 2014; Thewissen et al., 2011; van der Steen et al., 2017). Similarly, we found a clear association of the general depression factor of the CDSS with positive PLEs, which is also consistent with various studies (Addington et al., 2014; Lançon et al., 1999; Suttajit et al., 2013). Conversely, we found that the guilt factor was not related to momentary positive PLEs, which is in line with other studies that did not find an association of this factor with the positive subscale of the Positive and Negative

Syndrome Scale (PANSS; Rabany et al., 2013; Schennach et al., 2012). This seems to reinforce the distinction between these two underlying dimensions of the CDSS. Regarding the relationship between the CDSS factors and negative symptoms, a positive association of the general depression factor with negative PLEs was found in our sample. This is in line with Maggini and Raballo (2006), who reported an association of the general depression factor of the CDSS with the negative symptom domains “affective flattening,” “avolition-apathy,” and “anhedonia asociality” of the Subjective Experience of Negative Symptoms. Although Rabany et al. (2013) and Schennach et al. (2012) reported a weak inverse correlation between the general depression factor and the negative subscale score of PANSS, this could be due to the fact that the negative subscale of the PANSS covers a wider array of negative symptoms beyond diminished expression or flattened affect, and some of them (e.g., stereotyped thinking, difficulty in abstract thinking) are not included in current conceptualizations of negative symptoms (Lincoln et al., 2017). However, it is argued that there is a relative independence of the negative and depressive symptom domains of schizophrenia (Zisook et al., 1999), and that the co-occurrence of prominent negative and depressive symptoms is relatively uncommon (Kirkpatrick et al., 1994; Pogue-Geile & Harrow, 1984). Thus, these findings may simply represent improper measurement of negative symptoms due to the fact that the phenomenological overlap oftentimes has resulted in negative symptom measures that are saturated with depression. In contrast, the guilt factor was not related to momentary negative PLEs in our sample, similar to other studies (Maggini & Raballo, 2006; Rabany et al., 2013, Schennach et al., 2012), which adds further evidence to the distinction of the general depression and guilt factors of the CDSS.

Several limitations of the present study should be considered. No test–retest and interrater validity measures on the CDSS were assessed in this study. However, other studies have demonstrated these properties for the CDSS (see review by Lako et al., 2012). Although the total CDSS mean score in our sample was similar to other studies, the relatively low scores on the CDSS items (see Table 2) could limit the interpretation of the results. Of note, the high-schizotypy participants included in our sample were selected because of high scores on trait-paranoia. Therefore, further work should examine the psychometric properties of the CDSS in a more heterogeneous sample of high positive schizotypy participants (i.e., with unusual cognitive-perceptual experiences). The sample size employed in this study is relatively small to perform structural analyses; further studies should replicate these findings in larger samples. Although Vargas et al. (2019) found that the two-factor structure of the CDSS had metric and scalar invariance across clinical high risk for psychosis and schizophrenia, concerns remained regarding possible systematic differences in item endorsement between groups. However, our sample was not large enough to test measurement invariance analyses across high-schizotypy, ARMS, and FEP groups.

Finally, the measure we employed to explore negative PLEs in daily life was based on a single item and, therefore, does not cover all the components of the negative symptom dimension. Still as ESM is based on self-reported repeated measures that assess inner mental experience in the context in which they occur, it is possible that ESM provides a qualitatively different measure and a more fine-grained insight of subjective emotional experience than traditional self-reported or observational assessment scales (Oorschot et al., 2013).

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## Notes

1. As Item 7 (early wakening) appeared not indispensable for the construction of the scale, the fit of the one-factor and two-factor models excluding Item 7 from the analyses were also compared. Results revealed that that the two-factor structure (AIC = 2286.96; BIC = 2364.50; adjusted BIC = 2285.32; SRMR = .038; RMSEA = .052; CFI = .980; TLI = .971) was still better than the one-factor structure (AIC = 2290.43; BIC = 2364.80; adjusted BIC = 2288.82; SRMR = .044; RMSEA = .062; CFI = .970; TLI = .958).
2. Correlational analyses were also performed using derived factor scores from CFA instead of the raw item sum. The results remained substantively unchanged. The correlation between the summed and derived Factor 1 was .98. The correlation between the summed and derived Factor 2 was .88.

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