

Psychometric Schizotypy Predicts Psychotic-like, Paranoid, and Negative Symptoms in Daily Life

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Barrantes-Vidal, N., Chun, C., Myin-Germeys, I., & Kwapil, T.R. (2013). Psychometric schizotypy predicts the experience of psychotic-like, paranoid, and negative symptom experiences in daily life. *Journal of Abnormal Psychology*, *122*(4), 1077-87. doi: 10.1037/a0034793

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Abstract:

Positive and negative schizotypy exhibit differential patterns of impairment in social relations, affect, and functioning in daily life. However, studies have not examined the association of schizotypy with real-world expression of psychotic-like, paranoid, and negative symptoms. The present study employed experience-sampling methodology (ESM) to assess positive and negative schizotypy in daily life in a nonclinical sample of 206 Spanish young adults. Participants were prompted randomly 8 times daily for 1 week to complete assessments of their current symptoms and experiences. Positive schizotypy was associated with psychotic-like and paranoid symptoms in daily life. Negative schizotypy was associated with a subset of these symptoms and with negative symptoms in daily life. Momentary stress was associated with psychotic-like and paranoid symptoms, but only for those high in positive schizotypy. Social stress predicted momentary psychotic-like symptoms in both positive and negative schizotypy. Time-lagged analyses indicated that stress at the preceding signal predicted psychotic-like symptoms at the current assessment, but only for individuals high in positive schizotypy. The results are consistent with models linking stress sensitivity with the experience of psychotic symptoms. The findings provide cross-cultural support for the multidimensional model of schizotypy and schizophrenia. Furthermore, the findings demonstrate that ESM is an effective method for predicting the experience of psychotic-like symptoms, as well as their precursors, in daily life.

Keywords: Paranoia | Psychiatric Symptoms | Psychosis | Stress | Schizotypy | Experience sampling | Schizophrenia | Stress sensitivity

Article:

Converging evidence indicates that the underlying developmental vulnerability for schizophrenia and spectrum disorders is expressed across a dynamic continuum referred to as schizotypy, which ranges from subclinical to clinical manifestations (e.g., Claridge et al., 1996; Kwapil & Barrantes-Vidal, 2012; Lenzenweger, 2010; Meehl, 1990). Nonpsychotic schizotypes experience similar, although attenuated, forms of the cognitive, emotional, and behavioral disturbances inherent in schizophrenia, and are at heightened risk for developing schizophrenia-spectrum disorders. Thus, schizophrenia is conceptualized as the most extreme manifestation of the schizotypy continuum. Schizotypy provides a useful construct for studying the development of schizophrenia-spectrum psychopathology, including identification of risk and protective factors and intermediate phenotypes.

Schizotypy, and by extension schizophrenia, is a multidimensional construct (Raine et al., 1994; Stefanis et al., 2004; Vollema & van den Bosch, 1995) with positive and negative schizotypy the most consistently replicated factors (Kwapil, Barrantes-Vidal, & Silvia, 2008). Positive schizotypy is characterized by unusual perceptual experiences and odd beliefs, whereas negative schizotypy is characterized by affective flattening, anhedonia, social disinterest, and cognitive impairment. The conceptualization of schizotypy as a multidimensional construct is essential for resolving the marked heterogeneity in etiology, presentation, and treatment response characteristic of the schizophrenia spectrum (Kwapil & Barrantes-Vidal, 2012).

Recent confirmatory factor-analytic studies (e.g., Lewandowski et al., 2006; Brown, Silvia, Myin-Germeys, Lewandowski, & Kwapil, 2008; Kwapil et al., 2008) demonstrated that the positive and negative schizotypy dimensions can be assessed using the Wisconsin Schizotypy scales (WSS), including the Perceptual Aberration (Chapman, Chapman, & Raulin, 1978), Magical Ideation (Eckblad & Chapman, 1983), Physical Anhedonia (Chapman, Chapman, & Raulin, 1976), and Revised Social Anhedonia (Eckblad, Chapman, Chapman, & Mishlove, 1982) Scales. This two-factor structure is consistent across samples and demonstrates cross-cultural invariance (e.g., Kwapil, Ros-Morente, Silvia, & Barrantes-Vidal, 2012). The positive and negative schizotypy dimensions are associated with differential patterns of symptoms and impairment in cross-sectional questionnaire studies (e.g., Barrantes-Vidal, Gómez-de-Regil et al., 2013; Brown et al., 2008), interview studies (e.g., Barrantes-Vidal, Ros-Morente, & Kwapil, 2009), and laboratory studies (e.g., Kaczorowski, Barrantes-Vidal, & Kwapil, 2009), as well as in prospective interview studies (e.g., Kwapil, Gross, Silvia, & Barrantes-Vidal, 2013). Furthermore, these results have been supported in a cross-cultural validation study (Barrantes-Vidal, Gross et al., 2013) using Spanish-language versions of the WSS. Specifically, positive schizotypy is associated with the development of psychotic and prodromal conditions; psychotic-like, schizotypal, and paranoid symptoms; mood disorders; substance abuse; and impairment.

Negative schizotypy is associated with development of schizophrenia-spectrum disorders, schizotypal, schizoid, and negative symptoms, social dysfunction, and impaired functioning.

Experience-Sampling Methodology (ESM)

Researchers have increasingly employed ESM to examine the experience and expression of psychological constructs in daily life (e.g., Mehl & Conner, 2012; Oorschot, Kwapil, Delespaul, & Myin-Germeys, 2009). ESM is a within-day self-assessment technique that prompts participants at random intervals to complete brief questionnaires about their current experiences, including cognition, affect, social functioning, and symptoms. ESM offers several advantages to traditional assessment procedures (e.g., DeVries, Delespaul, & Dijkman-Caes, 1992; Hektner, Schmidt, & Csikszentmihalyi, 2007). Specifically, ESM (a) repeatedly assesses participants in their daily environment, thereby enhancing ecological validity, (b) assesses participants' experiences at the time of the signal, thereby minimizing retrospective bias, and (c) examines the context of participants' experiences. ESM measures exhibit good psychometric properties and provide a useful method for studying psychological phenomena outside the traditional (and artificial) laboratory and clinical settings (Csikszentmihalyi & Larson, 1992).

ESM has been used to assess daily life experiences of schizophrenia-spectrum (e.g., Ben-Zeev, Morris, Swendsen, & Granholm, 2012; Kimhy et al., 2010; Myin-Germeys, Nicolson, & Delespaul, 2001) and prodromal (Palmier-Claus, Dunn, & Lewis, 2012) patients. However, few studies have examined the real-world expression of nondisordered schizotypy. Vérdoux, Husky, Tournier, Sorbara, and Swendsen (2003) investigated daily life experiences of individuals with subclinical psychotic symptoms and reported positive associations between unusual perceptions and contact with unfamiliar people. Collip et al. (2011) found that individuals with paranoid traits experienced momentary paranoia and social threats in daily life, regardless of familiarity of social contacts. Husky, Grondin, and Swendsen (2004) reported that psychosis proneness predicted the interaction of mood with social context and environmental situation. In addition, socially anhedonic individuals exhibit schizoid-like social functioning in daily life (Kwapil et al., 2009).

Kwapil, Brown, Silvia, Myin-Germeys, and Barrantes-Vidal (2012) used ESM to examine the expression of positive and negative schizotypy dimensions derived from the WSS in 412 young adults. Positive schizotypy was associated with increased negative affect, thought impairment, suspiciousness, negative beliefs about current activities, and perceived rejection. Negative schizotypy, on the other hand, was associated with diminished positive affect and pleasure in daily life, and decreases in social contact and interest. However, their study did not assess schizotypic symptoms (e.g., psychotic-like, paranoid, and negative symptoms) in daily life.

Stress, Psychosis, and Daily Life

Daily life stressors may play an important role in the expression of psychotic-like and paranoid symptoms (e.g., van Winkel et al., 2008). Although prolonged or excessive stress can be

deleterious to anyone, schizotypic individuals may be especially sensitive to the momentary effects of stress. ESM studies indicate that both patients with psychosis and their first-degree relatives react more intensely to stress in daily life (Myin-Germeys, van Os, Schwartz, Stone, & Delespaul, 2001). This is independent of cognitive impairment, which suggests two distinct vulnerability mechanisms: a psychosis-prone/stress-sensitivity pathway (consistent with positive schizotypy) and a negative-symptom/neurocognitive-impairment pathway (Myin-Germeys, Krabbendam, Jolles, Delespaul, & van Os, 2002). The finding that positive schizotypy in nonpatients is associated with psychotic-like experiences in daily life and that this relationship is exacerbated by momentary stress would lend further support for the stress-sensitivity model and further validation for the multidimensional model of schizotypy.

Goals and Hypotheses

The goal of the present study was to examine the validity of positive and negative schizotypy dimensions in a nonclinically ascertained sample of Spanish young adults. Specifically the study sought to (a) replicate the differential findings for positive and negative schizotypy reported by Kwapil, Brown et al. (2012); (b) extend these findings by examining the association of the schizotypy dimensions with ESM measures of psychotic-like, paranoid, and negative symptoms in daily life; (c) examine whether stress predicts psychotic-like and paranoid symptoms in high-positive schizotypy participants; and (d) demonstrate the cross-cultural validity of the schizotypy dimensions in a Spanish sample. Based upon our theoretical conceptualization and recent interview and ESM studies of schizotypy, we hypothesized that positive and negative schizotypy would be associated with differential patterns of experiences in daily life. Specifically, we expected that positive schizotypy would be associated with increased negative affect, elevated ratings of stressful situations, paranoid and psychotic-like symptoms, feeling unwanted, and feeling unable to cope. Negative schizotypy was predicted to be associated with diminished positive affect, reports of negative symptoms (no thoughts or emotions), solitude, and diminished social closeness.

Consistent with Myin-Germeys et al.'s (2002) stress-sensitivity model, we expected that stress would be associated in the moment with psychotic-like and paranoid, but not negative, symptoms. We specifically predicted that reports of the current situation being stressful, as well as reports of social stress, would predict psychotic-like and paranoid symptoms. Furthermore, we predicted that positive schizotypy would moderate these associations—that is, the association of stress and psychotic-like symptoms in the moment would only occur at high levels of positive schizotypy. Note that a concurrent association of stress and psychotic-like symptoms does not disentangle whether stress gives rise to these symptoms. Therefore, we predicted that stress at the preceding ESM signal would predict psychotic-like and paranoid symptoms at the current assessment, and that this would only occur at elevated levels of positive schizotypy. We did not expect that negative schizotypy would be associated with stress reactivity, given its trait-like nature and association with diminished affect. Note that the present study employed a nonclinical sample of young adults. Therefore, we expected that the overall levels of psychotic-like,

paranoid, and negative symptoms in daily life would be relatively low, but would demonstrate predicted associations with psychometrically assessed positive and negative schizotypy.

Method

Participants

The data were collected as part of an ongoing longitudinal project examining psychosis risk and expression. The participants were drawn from a screening sample of 589 undergraduates at the Universitat Autònoma de Barcelona, Spain. Usable screening data were obtained from 547 participants (42 were excluded due to invalid protocols). A subset of 339 participants was invited to take part in the ESM assessment with the goal of assessing 200 individuals. We invited all 189 who had standard scores based upon sample norms of at least 1.0 on the positive or negative schizotypy dimension, the suspiciousness subscale of the Schizotypal Personality Questionnaire (SPQ; Raine, 1991), or the positive-symptom subscale of the Community Assessment of Psychic Experiences (CAPE; Stefanis et al., 2002), and 150 randomly selected participants who had standard scores <1.0 on each of these measures. The goal of the enrichment procedure was to ensure adequate representation of schizotypy in the sample. Usable ESM data were collected from 206 participants (163 female) with a mean age of 19.8 ($SD = 2.4$). An additional eight participants enrolled in the ESM study, but were omitted due to equipment malfunctions or insufficient ESM data. The final ESM sample included 48 participants (23.3%) with standard scores of at least 1.0 and 23 participants (11.2%) with standard scores of at least 2.0 on the positive schizotypy dimension. It included 52 participants (25.2%) with standard scores of at least 1.0 and 23 participants (11.2%) with standard scores of at least 2.0 on the negative schizotypy dimension. Ethical approval for the study was granted by the university ethics committee and participants provided informed consent.

Materials and Procedures

Participants completed Spanish versions of the WSS (Ros-Morente, Rodríguez-Hansen, Vilagrà-Ruiz, Kwapil, & Barrantes-Vidal, 2010). The scales reliably produce two factors, positive and negative schizotypy, that account for 80% of their variance. Participants were assigned positive and negative schizotypy factor scores based upon norms from 6,137 young adults (Kwapil et al., 2008). The mean score for the positive schizotypy dimension was $-.31$ ($SD = .89$), with a range of -1.56 to 3.23 . The mean for the negative schizotypy dimension was $.02$ ($SD = 1.05$), with a range of -1.57 to 4.27 . Both distributions were unimodal and positively skewed. Note that Kwapil, Ros-Morente et al. (2012) demonstrated that the positive and negative schizotypy factor structure underlying the WSS was invariant in Spanish and American samples (consistent with Fonseca-Pedrero, Paino, Lemos-Giráldez, Sierra-Baigrie, & Muñiz, 2010). Furthermore, these norm-based factor scores correlated $.99$ with factor scores generated from principal components analyses with the original Spanish screening sample of 547.

ESM data were collected on personal digital assistants (PDAs). The ESM questionnaire inquired about a variety of daily life events. Table 1 contains the English translation of the ESM items and indices. In contrast to previous studies of schizotypy in daily life, the present study included 8 items assessing psychotic-like symptoms, 2 items assessing paranoid symptoms, and 8 items assessing characteristics of negative schizotypic symptoms. Note that we created separate psychotic-like and paranoid symptom indices given that previous findings have suggested that these are separate dimensions of schizotypy (e.g., Stefanis et al., 2004). We did not create a negative symptom index because the items were not asked at every signal; however, these items are indicated in Table 1. The PDA signaled the participants to complete the questionnaire eight times daily between 10 a.m. and 10 p.m. for seven days.

Table 1 *Experience-Sampling Methodology Questionnaire and Summary Indices*

Note: all questions answered from 1 (not at all) to 7 (very much), unless otherwise noted
1) Right now I feel happy
2) Right now I feel sad
3) Right now I feel anxious (nervous)
4) Right now I fear losing control
5) Right now I feel relaxed
6) Right now I feel angry
7) Right now I feel weird
8) Right now I feel good about myself
9) Right now I feel guilty or ashamed
10) Right now I can concentrate well
11) Right now I have difficulty controlling my thoughts
12) Right now I have no thoughts or emotions
13) Right now my thoughts are strange or unusual
14) Right now I feel tired
15) Right now I feel that others care about me
16) Right now I feel suspicious
17) Right now familiar things have a special meaning or importance to me
18) Right now I do not feel well
19) Right now I feel mistreated
20) I like what I'm doing right now
21) Right now I can do my current activity
22) Right now my sight or hearing seem strange or unusual
23) Since the last beep, I have heard or seen things others could not
24) Right now I feel that someone or something is controlling my thoughts or actions
25) Right now familiar things seem strange and unusual
26) Right now I can cope
27) My current situation is positive
28) My current situation is stressful
29) Since the last beep, I consumed: Food Caffeine Medication Snuff Alcohol Cannabis or other drugs

30) Right now I am alone Yes 1, No 2
If answer is yes to item 30:
31) I am alone because people do not want to be with me
32) Right now I would prefer to be with people
If answer is no to item 30:
33) I feel close to this person (these people)
34) Right now I would prefer to be alone

Note. Negative affect index is the mean of Items 2, 3, 6, and 9 (coefficient $\alpha = .83$). Paranoia index is the mean of Items 16 and 19 (coefficient $\alpha = .70$). Psychotic-like experiences index is the mean of Items 4, 7, 11, 13, 22, 23, 24, and 25 (coefficient $\alpha = .74$). Negative symptom items include: 1 (reversed), 8 (reversed), 12, 20 (reversed), 27 (reversed), 32 (reversed), 33 (reversed) and 34.

ESM data have a hierarchical structure in which ESM ratings repeatedly made in daily life (level 1 data) are nested within participants (level 2 data). Hierarchical linear modeling provides a more appropriate method than conventional unilevel analyses for analyzing nested data and is standard for the analysis of ESM data (Luke, 2004; Nezlek, 2001). The multilevel analyses examined three types of relationships between the schizotypy factor scores and daily life experiences. The first type of analyses examined whether positive and negative schizotypy uniquely predicted experiences such as psychotic-like symptoms and negative affect in daily life. Specifically, these direct effects examined whether the schizotypy dimensions (level 2 predictors) predicted the intercept of the ESM ratings (level 1 dependent measures). The second type of analyses examined whether the associations of experiences in daily life (e.g., stress and psychotic-like symptoms) were moderated by the positive and negative schizotypy dimensions. These cross-level interactions (or slopes-as-outcomes) tested whether the relationship of ESM ratings (level 1 variables) within an individual is predicted by the schizotypy dimension scores (level 2 variables). Cross-level interactions examined the association of level 1 predictors (e.g., stress) and level 1 criteria (e.g., psychotic-like symptoms) that were assessed at the same ESM questionnaire. Because the level 1 predictors and criteria are measured at the same ESM questionnaire, cross-level interactions did not allow us to disentangle temporal relationships between the level 1 predictors and criteria. The third type of analysis allowed us to examine the temporal sequence of experiences in daily life. Time-lagged analyses examined whether level 1 predictors at the preceding ESM assessment predicted criteria at the current assessment, and whether this relationship varied across (was moderated by) positive and negative schizotypy. The level 2 predictors, positive and negative schizotypy, were entered simultaneously in all analyses. The analyses were computed with Mplus6 (Muthén & Muthén, 2010). Level 1 predictors were group mean centered and level 2 predictors were grand mean centered. The data departed from normality in some cases, so parameter estimates were calculated using robust standard errors. Furthermore, level 1 criteria exhibiting substantial skew were treated as categorical.

Note that ESM studies involve complex designs in which constructs are measured at multiple levels (in the lab and in daily life). We used the terms positive and negative schizotypy

dimensions to refer to the level 2 variables based upon WSS factor scores. We assessed a variety of schizotypic symptoms in daily life including psychotic-like, paranoid, and negative symptoms. We used the term “symptoms” rather than “experiences”; however, we realize that these are assessed in a nonclinical sample and involve both clinical and subclinical manifestations. Obviously, the ESM questions are not diagnostic and we know from other studies of this sample (e.g., Barrantes-Vidal, Gross et al., 2013) that the majority of participants do not meet criteria for schizophrenia-spectrum disorders at the present time. However, consistent with our conceptual model of schizotypy, we expect that the positive and negative schizotypy dimensions will be associated with schizotypic or schizophrenic-like symptoms and experiences in daily life.

Results

Participants completed an average of 40.8 usable questionnaires ($SD = 9.1$). Neither the positive nor the negative schizotypy factor was associated with the number of usable records ($r = .00$ and $.03$, respectively). The positive and negative schizotypy dimension scores were not significantly correlated ($r = .11$).

Associations of Positive and Negative Schizotypy With Experiences in Daily Life

Positive and negative schizotypy were differentiated by participants’ experiences of affect and functioning in daily life (see Table 2). Positive schizotypy was associated with diminished positive and increased negative affect (as well as with each individual negative affect rating). Likewise, it was associated with decreased reports of the current situation as positive and increased reports that the situation was stressful. Positive schizotypy was associated with impaired ability to concentrate and diminished feelings of being able to cope in the moment. As expected, negative schizotypy was associated with the four negative-symptom items assessing diminished positive affect and situations, and decreased enjoyment of current activities, but was unassociated with ratings of negative affect and stress. Neither positive nor negative schizotypy was associated with reports of drug use in daily life.

Table 2 Relationship of Positive and Negative Schizotypy with Affect and Functioning in Daily Life

Level 1 criterion	Level 2 predictors	
	Positive schizotypy γ_{01} ($df = 203$)	Negative schizotypy γ_{02} ($df = 203$)
Happy	-0.265 (0.070)***	-0.178 (0.049)***
Good about self	-0.294 (0.064)***	-0.214 (0.053)***
Negative affect	0.229 (0.050)***	0.048 (0.038)
Situation positive	-0.321 (0.070)***	-0.237 (0.055)***
Situation stressful	0.297 (0.078)***	0.081 (0.068)
Enjoy current activity	-0.108 (0.060)	-0.186 (0.047)***
Able to cope	-0.285 (0.058)***	-0.156 (0.052)**

Able to concentrate	-0.252 (0.071)***	-0.042 (0.064)
Drug use	-0.276 (0.641)	-0.443 (0.544)

Note. Raw multilevel regression coefficients indicating the relationship of the level 2 predictors with the level 1 (daily life experience) criteria. * $p < .05$. ** $p < .01$. *** $p < .001$.

The schizotypy dimensions were associated with psychotic-like and suspicious symptoms, and with the negative symptom of diminished thoughts and emotions in daily life (see Table 3). Positive schizotypy was associated with all of the items tapping psychotic-like symptoms, such as difficulty controlling one’s thoughts and hearing/seeing things that others could not sense, as well as with feeling suspicious and mistreated in the moment. As expected, negative, but not positive, schizotypy predicted having no thoughts or emotions. However, negative schizotypy also predicted the psychotic-like and paranoia indices, as well as several of the individual symptoms comprising those composites.

Table 3 Relationship of Positive and Negative Schizotypy with Psychotic-Like, Paranoid, and Negative Schizotypic Experiences in Daily Life

Level 1 criterion	Level 2 predictors	
	Positive schizotypy γ_{01} ($df = 203$)	Negative schizotypy γ_{02} ($df = 203$)
Fear losing control	0.510 (0.128)***	0.175 (0.132)
Feel weird	0.891 (0.135)***	0.244 (0.112)*
Difficulty controlling thoughts	0.702 (0.124)***	0.225 (0.113)*
Strange or unusual thoughts	0.664 (0.142)***	0.343 (0.117)**
Special meaning	0.988 (0.219)***	-0.335 (0.186)
Senses are Unusual	0.368 (0.146)**	0.308 (0.094)***
Hearing/seeing things	0.385 (0.158)*	0.077 (0.144)
Feel controlled	0.415 (0.151)**	0.196 (0.117)
Familiar things strange	0.765 (0.146)***	0.369 (0.109)**
Psychotic-like experience index	0.066 (0.014)***	0.025 (0.009)**
Feel suspicious	0.760 (0.140)***	0.308 (0.115)**
Feel mistreated	0.579 (0.153)***	0.191 (0.124)
Paranoia index	0.126 (0.031)***	0.054 (0.023)*
No thoughts or emotions	-0.015 (0.035)	0.244 (0.059)***

Note. Raw multilevel regression coefficients indicating the relationship of the Level-2 predictors with the Level-1 (daily life experience) criteria. * $p < .05$. ** $p < .01$. *** $p < .001$.

A possible concern with interpreting these results is that the ESM psychotic-like symptom items may generally be capturing emotional distress rather than specifically tapping psychotic-like symptoms, and that the association of positive schizotypy with the psychotic-like symptoms in daily life may reflect the association of positive schizotypy with increased general distress. It is possible that the subtle or psychotic-like wording of the items (e.g., “right now I fear losing control”) may be more likely to capture variance associated with general distress than items

assessing frank psychosis. Furthermore, items assessing psychotic-like or psychotic experiences likely capture variance associated with distress related to the experience. However, we believe that two lines of evidence suggest that our psychotic-like ESM items are not primarily capturing variance associated with emotional distress, and that their association with positive schizotypy is not simply driven by emotional distress. First of all, the endorsement rates for the ESM stress and negative affect items are generally higher than for the psychotic-like symptom items, suggesting that the latter were not simply tapping general distress. Furthermore, we recomputed the analyses predicting ESM psychotic-like and paranoid symptom ratings after partialing out *Symptom Checklist-90-Revised* (*SCL-90-R*; Derogatis, 1994) anxiety-subscale scores (our closest proxy measure for general distress). In both cases, positive schizotypy predicted psychotic-like symptoms in daily life, over and above the effects of general distress.

Both schizotypy dimensions were associated with decreased social contact and diminished reports that others cared about them (see Table 4). Consistent with Kwapil, Brown et al. (2012), negative schizotypy was associated with negative-symptom items of diminished closeness, increased preference to be alone when with others, and decreased desire to be with others when alone. Positive schizotypy was associated with increased desire to be alone when with others.

Table 4 Relationship of Positive and Negative Schizotypy with Social Contact and Functioning in Daily Life

Level 1 criterion	Level 2 predictors	
	Positive schizotypy γ_{01} ($df = 203$)	Negative schizotypy γ_{02} ($df = 203$)
Others care about me	-0.233 (0.077)**	-0.381 (0.083)***
Alone at signal ^a	-0.171 (0.053)**	-0.138 (0.044)**
When with others		
Close to other	-0.105 (0.066)	-0.253 (0.063)***
Prefer to be alone	0.221 (0.052)***	0.220 (0.047)***
When alone		
Alone b/c not wanted	0.354 (0.210)	0.211 (0.209)
Prefer to be with others	-0.033 (0.095)	-0.208 (0.084)***

Note. Raw multilevel regression coefficients indicating the relationship of the level 2 predictors with the level 1 (daily life experience) criteria. ^a Item is scored *alone* = 1 and *with others* = 2. * $p < .05$. ** $p < .01$. *** $p < .001$.

Association of Stress and Schizotypic Symptoms

We next examined whether stress was associated with psychotic-like and paranoid symptoms, and with the negative symptom of diminished thoughts and emotions in the moment, and whether these relationships varied across levels of positive and negative schizotypy (see Table 5). Specifically, we examined whether schizotypic symptoms were associated with reports that the current situation was stressful and with two indicators of social stress, “Being with people

with whom you are not close” and “Feeling unwanted.” We also used the dichotomous item “Alone/with others” as a Level-1 predictor to differentiate the effects of social contact from social stress. As hypothesized, stressful situations and social stress (but not social contact) were associated with psychotic-like and paranoid symptoms in the moment, but were not associated with the negative symptom of diminished thoughts or emotion. Stress was associated with psychotic-like and paranoid symptoms—and in every case, this relationship was moderated by positive schizotypy. As seen in Figure 1, stress was associated with psychotic-like and paranoid symptoms, but only in participants high in positive schizotypy. Similarly, Figure 2 displays that social stress was associated with psychotic-like symptoms, but only in high positive schizotypy participants. In contrast to our hypotheses, negative schizotypy moderated the association of social closeness and feeling unwanted with psychotic-like symptoms in the moment.

Table 5 *Cross-Level Interactions of Stress and Schizotypic Symptoms Across Levels of Positive and Negative Schizotypy*

Level 1 criterion	Level 1 predictor		Level 2 predictors [@]	
	γ_{10} ($df = 203$)		Positive schizotypy γ_{11} ($df = 203$)	Negative schizotypy γ_{12} ($df = 203$)
Psychotic-like index	Situation stressful	0.034 (0.004)***	0.018 (0.006)**	0.007 (0.004)
Psychotic-like index	Alone	0.000 (0.006)	-0.013 (0.008)	-0.001 (0.005)
Psychotic-like index	Close to other	-0.008 (0.003)**	-0.009 (0.003)**	-0.005 (0.002)*
Psychotic-like index	Alone b/c not wanted	0.069 (0.014)***	0.053 (0.018)**	0.051 (0.018)**
Paranoia index	Situation stressful	0.077 (0.009)***	0.027 (0.012)*	0.004 (0.009)
Paranoia index	Alone	-0.007 (0.014)	-0.016 (0.017)	0.017 (0.013)
Paranoia index	Close to other	-0.028 (0.007)***	-0.028 (0.009)**	-0.014 (0.007)
Paranoia index	Alone b/c not wanted	0.136 (0.046)**	0.092 (0.045)*	0.068 (0.062)
No thoughts or emotions	Situation stressful	-0.004 (0.007)	0.005 (0.007)	-0.007 (0.007)
No thoughts or emotions	Alone	-0.021 (0.019)	-0.011 (0.018)	-0.023 (0.020)
No thoughts or emotions	Close to other	-0.023 (0.009)**	-0.007 (0.007)	-0.016 (0.010)
No thoughts or emotions	Alone b/c not wanted	0.022 (0.043)	-0.010 (0.021)	0.027 (0.039)

[@] Cross-level interaction of the association of the Level-2 variable with the slope of the Level-1 predictor and criterion. * $p < .05$. ** $p < .01$. *** $p < .001$.

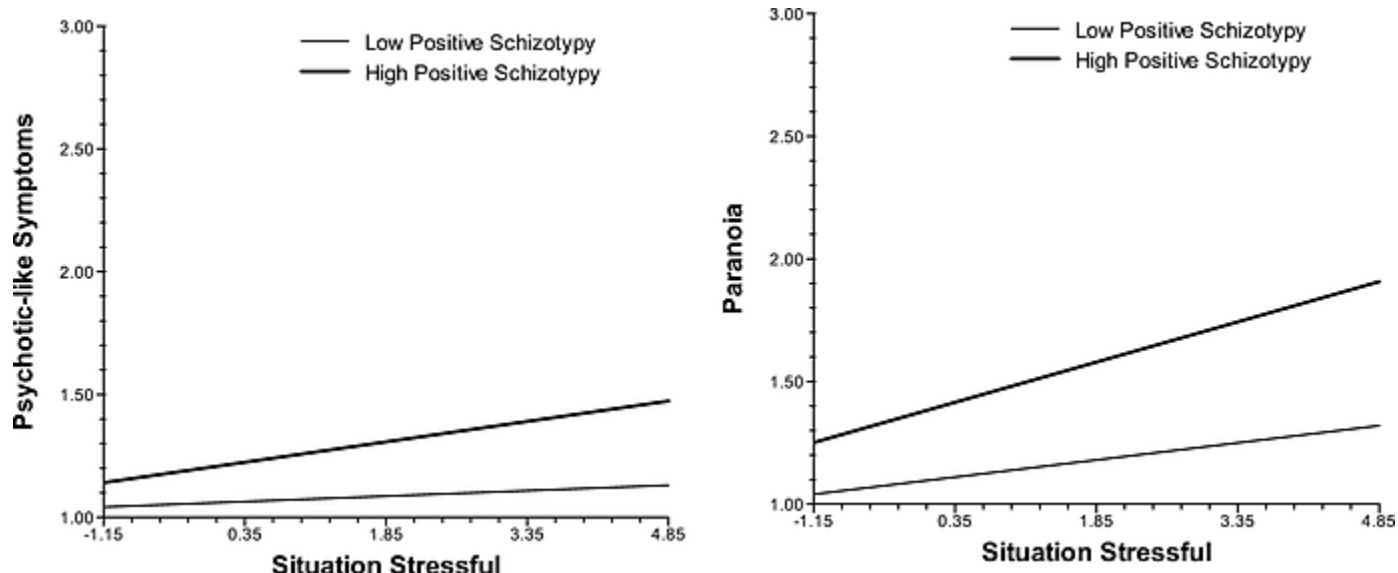


Figure 1. Cross-level interactions of stress with psychotic-like and paranoid experiences across levels of positive schizotypy.

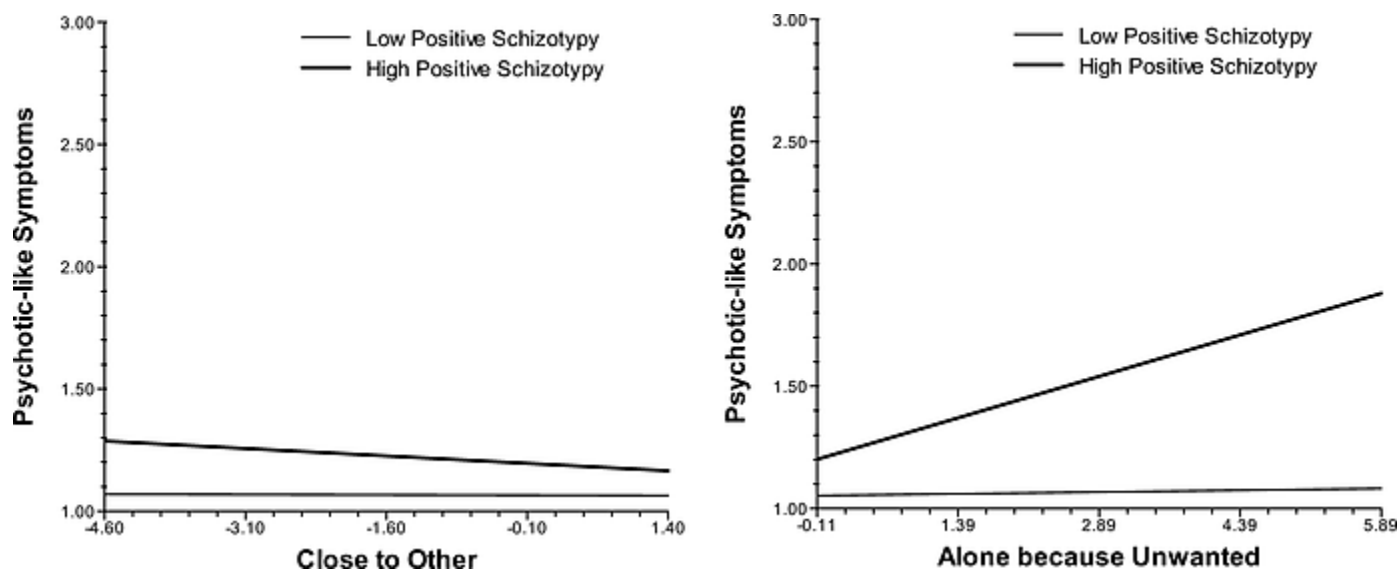


Figure 2. Cross-level interactions of social stress with psychotic-like experiences across levels of positive schizotypy.

In order to disentangle the temporal sequence of stress with psychotic-like and paranoid symptoms, we conducted time-lagged analyses examining whether stress at the preceding ESM signal predicted psychotic-like and paranoid symptoms at the current ESM signal, and whether schizotypy moderated these relationships. We also reversed the association examining whether symptoms at the preceding signal predicted stress at the current signal. Note that we did not conduct these analyses for the social predictors, because the ESM social closeness item was only

answered when participants were with others and the ESM unwanted item was only answered when participants were alone—raising concerns that there were not sufficient numbers of contiguous questions completed for these items to allow for time-lagged analyses. As can be seen in Table 6, stress at the preceding ESM signal predicted psychotic-like symptoms and this association was moderated by positive schizotypy. Furthermore, this effect held even after partialing out the effects of psychotic-like symptoms at the previous signal—that is, the significant association of prior stress with current psychotic-like associations at high levels of positive schizotypy was not simply the result of psychotic-like symptoms at the prior signal ($\gamma_{11} = 0.007$, $SE = 0.004$, $p < .05$). Note that stress also predicted the development of paranoid symptoms, and both psychotic-like and paranoid symptoms were associated with stress at the subsequent signal, but none of these relations was moderated by positive schizotypy.

Table 6 Time-Lagged Analyses of Stress and Schizotypic Symptoms Across Levels of Positive and Negative Schizotypy

Level 1 criterion	Level 1 predictor (preceding signal)		Level 2 predictors [@]	
			Positive schizotypy γ_{11} ($df = 203$)	Negative schizotypy γ_{12} ($df = 203$)
	γ_{10} ($df = 203$)			
Psychotic-like index	Situation stressful	0.014 (0.003)***	0.013 (0.004)**	-0.001 (0.003)
Situation stressful	Psychotic-like index	0.362 (0.122)**	0.050 (0.090)	-0.061 (0.092)
Paranoia index	Situation stressful	0.040 (0.010)***	0.011 (0.012)	0.003 (0.008)
Situation stressful	Paranoia index	0.211 (0.058)***	-0.015 (0.046)	-0.034 (0.042)

[@] Time-lagged interaction of the association of the Level 2 variable with the slope of the Level 1 predictor and criterion. * $p < .05$. ** $p < .01$. *** $p < .001$.

Note that five of the 206 participants met criteria for schizophrenia-spectrum Cluster A personality disorders of the *Diagnostic and Statistical Manual of Mental Disorders*, 4th ed., text rev. (*DSM-IV-TR*; APA, 2000). These included three participants with paranoid personality disorder, one with schizotypal personality disorder, and one with both schizotypal and paranoid personality disorders. Following the recommendations of a reviewer, we reran all of the direct-effect and cross-level analyses with these participants omitted. The statistical significance was unchanged for all of the analyses, other than for two direct effects and one cross-level interaction. Specifically, positive schizotypy's association was no longer significant for the ESM items "Senses are unusual" and "Hearing/seeing things." Furthermore, positive schizotypy no longer predicted the cross-level interaction of situation stressful and the paranoia index. Note that following the recommendation of a reviewer, we also examined the association of reports of drug use in daily life with psychotic-like and paranoid symptoms. Neither of these relationships were

significant, nor were the cross-level interactions of these relationships with positive and negative schizotypy.

Discussion

The present study examined the real-world expression of positive and negative schizotypy in a nonclinically ascertained Spanish sample of young adults. Our findings lend further support to a growing body of research supporting the multidimensional structure of schizotypy (e.g., Kwapil et al., 2008; Kwapil, Brown et al., 2012). Positive and negative schizotypy are promising dimensions in that they can be readily identified in nonclinical samples and exhibit differential patterns of associations, both in the laboratory and in daily life. The present study revealed that positive and negative schizotypy were differentially expressed in daily life in terms of affect, schizotypic symptoms, social contact, social functioning, and stress reactivity. The heterogeneity of schizotypy and schizophrenia-spectrum disorders (e.g., Liddle, 1987; Vollema & van den Bosch, 1995) highlights the need for these dimensions to be differentiated when conducting research. The present findings also supported the cross-cultural validity of schizotypy. In addition, the study supported the utility of psychometric screening for identifying at-risk individuals in nonclinical samples. Although psychotic-like symptoms were endorsed at a relatively low rate, they reflected the same pattern of expression found in schizophrenia. Moreover, these psychotic-like, paranoid, and negative symptoms were associated, as hypothesized, with positive and negative schizotypy dimensions. The present findings are consistent with community studies (e.g., Van Os, Hanssen, Bijl, & Ravelli, 2000), family studies (e.g., Kendler, McGuire, Gruenberg, & Walsh, 1995), studies of the prodrome (e.g., Woods et al., 2009), and high-risk designs (e.g., Gooding, Tallent, & Matts, 2005), which indicate that brief, transient, and subclinical psychotic symptoms are not uncommon in the general population and may precede the development of schizophrenia-spectrum disorders.

The present study presented an extensive examination of the momentary experience of psychotic-like, paranoid, and negative symptoms. Based upon a review of the ESM literature, we believe that a strength of this study is that we assessed a larger number and a broader range of psychotic-like experiences in daily life than have previous studies. Our previous study of the expression of positive and negative schizotypy in daily life (Kwapil et al., 2012) primarily examined the experience of affect and social functioning, and did not include ESM items assessing psychotic-like experiences. The present study focused on examining schizotypic symptoms in daily life. Given that there is a practical limitation on the number of ESM questions that can be assessed at each signal, we were not able to include as many items examining affect, social functioning, and activities in this study as in our previous study. Note that we are currently conducting studies to expand our assessment of the association of the schizotypy dimensions with cognitive impairment in daily life.

Note that unlike the overall index that we computed for the psychotic-like symptoms in daily life, we did not compute an overall index for negative symptoms. Negative symptoms do not

have a universally accepted definition, but usually include flattened affect, anhedonia, social disinterest, avolition, anergia, and alogia. We believe that at least eight items tapped this construct, including: “Right now I have no thoughts or emotions,” “Right now I feel happy (reversed),” “Right now I feel good about myself (reversed),” “My current situation is positive (reversed),” “Right now I would prefer to be with people (asked when alone and reversed),” “Right now I would prefer to be alone (asked when with others),” “I feel close to this person/these people” (asked when with others and reversed), and “I like what I’m doing right now (reversed).” It is worth noting that negative schizotypy was significantly associated with each of these items in the expected direction.

The present findings indicated that positive schizotypy was uniquely associated with the paranoid symptom of feeling mistreated, whereas individuals with both positive and negative schizotypy reported increased levels of suspiciousness. We suggest that suspiciousness conveys a more moderate questioning of the trustworthiness of situations and others, whereas feeling mistreated reflects a more active experience. As hypothesized, positive schizotypy was associated with the psychotic-like symptoms index score and each of the individual symptoms. These included psychotic-like disruptions in cognition, passivity experiences, and unusual perceptual experiences. Negative schizotypy was related to overall psychotic-like symptoms and several of the individual symptoms. Specifically, negative schizotypy was associated with psychotic-like symptoms involving cognitive disruptions (e.g., difficulty controlling thoughts), but not symptoms involving strong affective responses (e.g., fear of losing control). This is consistent with findings that negative schizotypy is associated with diminution of thought and affect, analogous to alogia and affective flattening observed in negative symptoms in schizophrenia.

The finding that negative schizotypy was associated with some psychotic-like and paranoid symptoms is consistent with historical notions dating back to Bleuler (1911/1950), that negative symptoms represent the fundamental symptoms of schizophrenia and embody the core genetic construct of schizophrenia (Torgersen et al., 2002). Furthermore, negative schizotypy in nonclinical samples is associated with the development of schizophrenia-spectrum disorders (Kwapil et al., 2013) and social anhedonia and withdrawal were associated with positive symptoms in schizophrenia patients and in unaffected siblings (Velthorst et al., 2012). Dominguez et al. (2010) proposed a model in which negative symptoms reflect deviances in brain development related to genetic risk that influence a final common pathway of neurotransmitter dysregulation that, in interaction with environmental exposures, results in the emergence of positive symptoms. Findings from their longitudinal study supported two separate liabilities, reality distortion and developmental impairment, that map onto positive and negative symptoms, respectively. Of note, persistent negative features preceded positive features.

The fundamental differences in positive and negative symptoms raise potential concerns that our assessments of these symptoms in daily life were not comparable. Positive symptoms represent deviant expressions of affect, cognition, and perception (e.g., odd beliefs or perceptual

experiences), whereas negative symptoms often involve diminution of normal aspects of functioning (e.g., affect, cognition, and social functioning). Oorschot et al. (2009) reviewed studies of negative symptoms in daily life and stated that negative symptoms should be assessed in terms of [diminished] mood and interest in daily life. Our psychotic-like symptom items generally assessed odd and unusual experiences. In contrast, only one of the negative-symptom items (no thoughts or emotions) assessed a markedly unusual experience. The remainder of the negative-symptom items assessed appraisals of affect, cognition, and social functioning. Note that this is consistent with previous studies of negative symptoms in daily life (e.g., Oorschot et al., 2013). Obviously, experiences other than negative schizotypy (e.g., depression) could predict these experiences. However, our previous findings (e.g., Kwapil et al., 2008; Barrantes-Vidal et al., 2013) indicated that negative schizotypy is not associated with depression and the current results indicated that negative schizotypy was not associated with negative affect. An additional measurement concern was that all of our psychotic-like and paranoid items were administered at every questionnaire, whereas only seven of the eight negative-symptom items were administered at every questionnaire (one item was only administered when the participant was with others and one was only administered when he or she was alone). Thus, we were unable to compute an overall negative-symptom index. Therefore, additional refinements are needed for the assessment of negative symptoms in daily life.

In addition to the direct associations of positive and negative schizotypy in daily life, we also examined whether the relation of schizotypic symptoms to specific stressors was exacerbated in individuals with high schizotypy scores, indicating a particular vulnerability to stress. Indeed, we found that stressful situations and social stress are associated with momentary psychotic-like and paranoid symptoms for those high in positive schizotypy, but not those low in positive schizotypy. Stress may precipitate impairment, distress, and even some psychological symptoms in people low in positive schizotypy, but we would argue that it would be relatively unlikely to produce psychotic-like symptoms in such individuals. In contrast, social contact was unrelated to the experience of psychotic-like and paranoid symptoms, highlighting the critical importance of subjective appraisals of social experiences.

Unexpectedly, negative schizotypy predicted the association of social stress with momentary psychotic-like symptoms. However, it did not moderate the association of psychotic-like symptoms with nonsocial, situational stress. This is consistent with the finding that negative schizotypy is associated with feeling uncared for, a sense of social distance, and the preference to be alone when with others, but not with negative affect or perceiving situations as stressful. In other words, negative schizotypy moderates psychotic reactivity to socially defeating appraisals, but not to general stress. Given the lack of comparable studies, these findings require replication, but highlight the utility of ESM for teasing apart dynamic relationships of affect, cognition, and symptoms. These findings support the need to deepen our understanding of the psychological architecture of negative symptoms, which has received limited attention relative to positive symptoms (e.g., Rector, Beck, & Stolar, 2005). Furthermore, even though negative schizotypy

acted as a moderator, these stressors were related to the experience of transient psychotic-like symptoms only, and not to trait-like negative symptoms of having no thoughts or emotions. This reveals an exclusive pattern of stress sensitivity for individuals with positive symptoms.

We also examined the temporal sequence of psychotic-like experiences in daily life for this study. Specifically, we found that daily life stressors (including social stress) were associated with the simultaneous experience of psychotic-like and paranoid symptoms for individuals high in positive schizotypy (and in some cases negative schizotypy). Furthermore, the experience of stress preceded the onset of psychotic-like symptoms for those with high positive schizotypy scores. Several features of these findings are worth noting. First of all, the time-lagged association of stress with psychotic-like experiences was unique to high positive schizotypy, whereas the association of paranoid symptoms was not unique to positive schizotypy (although the main effect was elevated in high positive schizotypy). This suggests that stress only produces the deviant psychotic-like experiences in positive schizotypic individuals, whereas stress can produce suspiciousness and feelings of mistreatment in nonschizotypic individuals (albeit to a greater extent in positive schizotypy). Second, the time-lagged effect of stress at the previous signal producing psychotic-like symptoms was over and above the effects of psychotic-like symptoms at the previous signal—so it was not simply the case of psychotic-like symptoms predicting more symptoms across time. We were not surprised to find that the experience of psychotic-like symptoms at the preceding signal produced stress at the subsequent signal, nor that this was not unique to positive schizotypy, but the association of preceding stress with psychotic-like symptoms was unique to high positive schizotypy. In other words, anyone who experienced psychotic-like symptoms would subsequently tend to report increased stress, but stress only predicted the development of psychotic-like symptoms in high positive schizotypy individuals. As seen by these examples, ESM provides a unique method for examining these complex temporal associations. Understanding the temporal sequence of the experience of such symptoms should help to identify causal pathways and may provide useful translational implications. Obviously, the present study was limited by the fact that we were examining a nonclinically ascertained sample; however, we are currently extending our findings by examining the temporal sequence of psychotic-like symptoms in prodromal and first-episode psychotic patients.

The finding that stress predicted the onset of psychotic-like symptoms in individuals with high levels of positive schizotypy is especially problematic, given that these individuals reported more stress than their nonschizotypic peers. According to Nuechterlein and Dawson's (1984) vulnerability–stress model, both stressful life events and momentary hassles may serve as precipitating factors for psychotic episodes in at-risk individuals. Furthermore, psychotic-like symptoms in nonpsychotic schizotypes predict the development of psychotic disorders. For example, a longitudinal study showed that 14% of schizotypic individuals with psychotic-like experiences in early adulthood developed a psychotic disorder 10 years later (Chapman et al.,

1994; Kwapil, Chapman, & Chapman, 1999). Therefore, the measurement of psychotic-like symptoms in the moment may identify individuals at risk for developing psychosis.

The present findings provide clues regarding possible risk and protective factors for the experience of psychotic-like experiences in the moment. As depicted in Figure 2, participants who were with people they felt close to experienced fewer psychotic-like symptoms in the moment. This relationship holds true even for individuals with high levels of schizotypy. So spending time with close friends and family appears to protect at-risk individuals from experiencing momentary symptoms and may act as a long-term buffer against the development of schizophrenia-spectrum disorders. As continued ESM research points to additional protective factors, interventions with better ecological validity can be developed. An in-the-moment clinical assessment tool, the PsyMate (Myin-Germeys, Birchwood, & Kwapil, 2011), has recently been used to help patients assess the frequency, intensity, and duration of their psychotic symptoms. Researchers found that both internal (e.g., stress, diminished self-esteem) and external factors (e.g., urban exposure, social context, cannabis) precede paranoia and positive symptoms in these patients. This method offers a promising intervention strategy that could involve providing daily cognitive-behavioral therapy feedback (Myin-Germeys et al., 2011). These techniques could be employed with nondisordered schizotypes to minimize daily stress and the onset of psychotic-like symptoms, as well as to increase their quality of life by ameliorating affective, social, and functioning problems they experience in day-to-day life.

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