Universitat Autònoma de Barcelona

Longitudinal trajectories of positive and negative schizotypy dimensions

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Longitudinal trajectories of positive and negative schizotypy dimensions

by

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1. INTRODUCTION

Schizophrenia is one the most severe mental illnesses affecting around 20 million people worldwide (GBD 2017 Disease and Injury Incidence and Prevalence Collaborators, 2018; Saha, Chant, Welham, & McGrath, 2005). Schizophrenia and related psychotic disorders are listed internationally as one of the leading causes of disability given its considerable burden for those who suffer it, their relatives and the entire society (GBD 2016 Disease and Injury Incidence and Prevalence Collaborators, 2018; Rössler, Salize, van Os, & Riecher-Rössler, 2005; Shah, Mizrahi, & McKenie, 2011). Psychotic disorders are often diagnosed in the late teen years or early adult life, and tend to emerge earlier in males than in females (McGrath, Saha, Chant, & Welham, 2008). Although their lifetime prevalence is approximately a 3% (McGrath, Saha, Chant, & Welham, 2008; Perälä et al., 2007), it is estimated that less than 14% of people who experience a first psychotic episode achieved a sustained recovery within five years after the onset of disease (Robinson, Woerner, McMeniman, Mendelowitz & Bilder, 2004). Recent reviews estimated that the international prevalence of schizophrenia and psychotic disorders in non-institutionalized populations range between 0.33% and 0.75% (Moreno-Küstner, Martín, & Pastor, 2018; Saha, Chant, Welham, & McGrath, 2005). Despite the multiple investigations that have been carried out over the past 100 years, the etiology of these disorders has not been fully clarified. Research has identified several factors (e.g., genetic, biological, psychosocial) that appear to increase the risk of transitioning from risk to a disease state, and suggests that the interaction between genes and environmental factors contribute to create a predisposition for developing these mental conditions (Shah, Tandon, & Keshavan, 2013; van Os, Krabbendam, Myin-Germeys, & Delespaul, 2005;

van Os, Kenis, & Rutten, 2010). Nevertheless, the reliable identification of vulnerable individuals has not been reached yet.

Traditionally, medical models have viewed these disorders as composed by distinct categorical entities that clearly differentiate ill from healthy populations. However, mounting evidence from different lines of research are suggesting that schizophrenia-related phenotypes are better expressed across a dynamic continuum of symptoms ranging from transient and minimal impairment to the extreme form of schizophrenia (Claridge, 1997; Debbané & Barrantes-Vidal, 2015; Kwapil & Barrantes-Vidal, 2015). In fact, recent reviews and meta-analyses have indicated that a small proportion of the general population suffers milder forms of psychotic symptoms in the absence of the disorder (van Os, Linscott, Myin-Germeys, Delespaul, & Krabbendam, 2009; Linscott & van Os, 2013).

The study of individuals with a latent vulnerability to psychosis is of crucial clinical interest to clarify etiological factors of schizophrenia and to understand pathological mechanisms involved in the transition from the nonclinical stage to frank psychosis expressions (Barrantes-Vidal, Grant, & Kwapil, 2015). This is a major goal of schizophrenia research, as it will extend our knowledge not only of causal factors but also of putative protective factors that play a crucial role in preventing the shift to clinical expressions (Kwapil & Barrantes-Vidal, 2015). Furthermore, research in nonclinical individuals, that is, without the confounding components of the disorder, are necessary for the development of effective prophylactic interventions.

The current thesis focuses on the longitudinal study of schizotypy in a nonclinical sample of young adults. Schizotypy is a unifying construct that encompasses under a single conceptual framework a broad range of conditions such as nonclinical (schizotypy traits, psychotic-like experiences), subclinical ("prodrome" or at risk mental states), and

clinical (personality and psychotic disorders) states (Debbané & Barrantes-Vidal, 2015; Kwapil & Barrantes-Vidal, 2015). Current approaches consider schizotypy as a developmental mediator between early risk factors and the transition into states of high clinical risk (Debbané & Barrantes-Vidal, 2015; Barrantes-Vidal, Grant & Kwapil, 2015). As a distal risk marker, schizotypy represents a useful construct to identify individuals with a latent vulnerability for schizophrenia-spectrum psychopathology and thus conducting longitudinal studies (Debbané & Barrantes-Vidal et al., 2015).

Schizotypy, as schizophrenia, is heterogeneous at etiological and developmental levels and it is characterized by a multidimensional structure (Kwapil & Barrantes, 2015), whit the positive and the negative dimensions being the most replicated factors (Kwapil, Barrantes-Vidal, & Silva, 2008; Kwapil, Gross, Silvia, Raulin, & Barrantes-Vidal, 2018). Positive schizotypy is characterized by odd beliefs (including full-blown delusions), unusual perceptual experiences (including illusions and hallucinations), and suspiciousness/paranoia. Negative schizotypy involves diminished functioning including anhedonia, flattened affect, social disinterest, avolition, and anergia.

Cross-sectional research has demonstrated that both schizotypy dimensions show differential patterns of associations with schizophrenia-spectrum symptoms and impairment, and these patterns have been found to be distinctively associated with positive and negative symptoms across various schizophrenia and related psychotic disorders (e.g., Barrantes-Vidal, Ros-Morente, & Kwapil, 2009; Barrantes-Vidal, Lewandowski, & Kwapil, 2010; Barrantes-Vidal et al., 2013; Blanchard, Collins, Aghevli, Leung, & Cohen, 2011; Bolinskey et al., 2015; Bolinskey & Gottesman, 2010; Ettinger et al., 2015; Horton, Barrantes-Vidal, Silva, & Kwapil, 2014; Kaczorowski, Barrantes-Vidal, & Kwapil, 2009). More recently, research using experience sampling methodology (ESM) has shown that positive and negative schizotypy dimensions are

differentially related to the real-life expression of the behavioural patterns that have been found to characterize the risk for psychosis in genetically at-risk individuals or in epidemiological cohorts (Barrantes-Vidal, Chun, Myin-Germeys, & Kwapil, 2013a; Chun, Barrantes-Vidal, Sheinbaum, & Kwapil, 2017; Kwapil, Brown, Silvia, Myin-Germeys, & Barrantes-Vidal, 2012). Thus, the multidimensional structure of schizotypy is highly relevant to identify differential developmental routes of risk and resilience to psychosis (Debbané & Barrantes-Vidal, 2015). However, knowledge of the developmental trajectories underlying the vulnerability to schizophrenia and related psychotic disorders is highly limited to a small number of studies investigating the longitudinal associations of schizotypy dimensions with subclinical psychopathological symptoms in nonclinical populations (Debbané et al., 2015).

This thesis focuses on testing that schizotypy traits are meaningful expressions of the vulnerability to schizophrenia and related psychotic disorders by examining their longitudinal associations with schizophrenia-spectrum symptoms and impairment in nonclinical individuals. The empirical work presented as part of this thesis is framed in a larger ongoing longitudinal project examining risk and resilience factors for schizophrenia-spectrum psychopathology in Catalan young adults, the Barcelona Longitudinal Investigation of Schizotypy (BLISS). It is hoped that the work carried out in the current thesis, in combination with previous research, contributes to improve the reliable identification of people vulnerable to schizophrenia-related phenotypes. This work may enhance our understanding of the multidimensional nature of schizotypy and its developmental trajectories, and may eventually has implications for the development of preventive interventions.

2. BACKGROUND

2.1. A Dimensional Conceptualization of the Psychosis Continuum

2.1.1. Schizotypy: a Framework to Study Psychosis Risk[1]

Barrantes-Vidal, N.[a,b,c], Racioppi A.[a], & Kwapil, T.R.[d]

The term schizotypy was coined by Rado (1953) and theoretically elaborated by Meehl (1962) to represent a continuous phenotype of schizophrenia-like psychopathology and impairment reflecting the inherited vulnerability to schizophrenia. Previously, both Kraepelin (1919) and Bleuler (1950) described schizophrenic-like traits and symptoms in patients before illness onset, as well as in their nonpsychotic relatives. This line of work crystallized in the construct of schizophrenia-spectrum disorders, which assumes that several phenotypes representing more transient or mild forms of schizophrenia, such as schizotypy and schizotypal personality disorder (SPD), share some common etiological factors with schizophrenia, which is the most extreme and rare manifestation of this spectrum.

This conceptualization entails that schizotypy serves as a risk marker for schizophrenia-spectrum disorders (Kwapil & Barrantes-Vidal, 2012). Schizotypy traits are heterogeneous, comprising odd beliefs and perceptual disturbances, paranoia, thought

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[1]This section is part of the book chapter:
Barrantes-Vidal, N., Racioppi, A., Kwapil, T.R. (2020). Schizotypy, Schizotypal Personality and Psychosis Risk. In A. Thompson and M. Broome (Eds.). *Risk Factors for Psychosis: Paradigms, Mechanisms, and Prevention* (pp. 83-102). Elsevier, Academic Press: Publishers.

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poverty, avolition and anhedonia, social disinterest, and disturbances in the capacity to organize and express thoughts, speech, affect and behavior. As noted by Kwapil and Barrantes-Vidal (2015), schizotypy offers a useful and unifying construct for understanding schizophrenia-spectrum psychopathology from relatively mild subclinical presentations to severe psychosis. Thus, schizophrenia, spectrum disorders, the prodrome, and subclinical manifestations can all be understood as expressions of the schizotypy continuum.

The construct of schizotypy was also developed in the context of individual differences. Kretschmer (1925) was one of the first proponents of continuity between personality and psychopathology in psychosis, suggesting a continuum of schizothymia-cyclothymia with schizophrenia and affective psychosis, respectively, at its endpoints. Drawing on this work, Claridge (1997) proposed that schizotypy reflects normal genetic and temperamental variation, thus constituting both healthy variation in cognitive-personality organization as well as vulnerability to, predominantly, psychotic disorders. He noted that this model entails a *fully*-dimensional conceptualization, as continuity extends from normal variation in personality dimensions to disorder; in contrast, the schizotypy model proposed by Meehl, that is dominant in the medical tradition, conceives schizotypy as taxonic and a *forme frustre* of psychosis, as continuity exists only within the illness domain as an analogue of severity. These theoretical issues are relevant for the study of schizotypy in the context of high-risk research (see Grant, Green, & Mason, 2018). The fully-dimensional perspective promotes a broader approach by suggesting that the assessment of schizotypy serves both as a risk indicator and as a psychological profile that can aid, for example, tailoring treatment designs in those identified at high risk. Also, it provides a framework to understand that schizotypy can be expressed as healthy and

positive psychological manifestations, such as heightened creativity (e.g., Mohr & Claridge, 2015).

Developmentally, signs of schizotypy will mostly emerge in adolescence, consistent with the timing of the initial expression of symptoms of schizophrenia and could be considered the most distal marker of psychosis risk (Debbané & Barrantes-Vidal, 2015). As noted, the expression is variable in terms of types of traits and intensity, but also in terms of developmental trajectories. Some people with schizotypic features will transition into schizophrenia spectrum disorders; however, it is expected that the majority will not – although they may continue to demonstrate mild and transient symptoms and impairment.

2.1.2. Schizotypal Personality Disorder (SPD)

The schizotypy model suggests that when schizotypy traits have a trans-situational, chronic, dysfunctional and impairing nature, they merit a clinical diagnosis of SPD. As noted by Kendler (1985), historically, the SPD definition was developed from evidences provided by studies investigating the origins of the vulnerability to schizophrenia from different perspectives. Some researchers based their studies on the familial tradition. This perspective focuses on the examination of subthreshold behavioural abnormalities in relatives of schizophrenia patients. The second perspective is the so-called clinical tradition. Researchers of this tradition focused their studies on the observation of attenuated forms of schizophrenia-like features in patients without severe psychotic deterioration. In this context, once the familial aggregation of schizophrenia has been recognized, and less severe deviations of schizophrenia features has been observed in both patients and their relatives, the terms “borderline or latent schizophrenia” were coined. Kraepelin (1919) observed that relative of schizophrenia

patients exhibited eccentric and peculiar personality features (such as suspiciousness) and behavioural traits, and found that similar deviant behavioural traits were common in people who developed the full syndrome of schizophrenia subsequently. Simultaneously, Bleuler (1911) observed that less severe variant of schizophrenia symptoms such as flat affect, ambivalence, bizarre thinking, and poor interpersonal contact often occurred in untreated relatives of schizophrenia patients. Thus, latent schizophrenia was used to define those deviant and peculiar personality features and behavioural abnormalities that were quantitatively less severe expression of schizophrenia and did not fit the diagnostic patterns of psychotic of affective disorders. In the following decades new clinical formulations of these symptoms were introduced. Rado (1953) used the term "schizotype" to identify those schizophrenia-like symptoms that were observed among relatives of patients more frequently than expected. Meehl (1962), based on the work of Rado, considered that the vulnerability to schizophrenia identified as "schizotypy" was a personality phenotype, but unlike Rado, he supposed that it was produced by genetic factors (that is, "schizotaxia").

The first empirical work analyzing schizotypal traits in relatives was the Danish Adoption Study of Schizophrenia (Kety, Rosenthal, Wender, & Schulsinger, 1968). This study found that biological relatives of schizophrenia patients reported highest rates of schizophrenia-like personality features and full-blown schizophrenia compared to controls. The subsequent re-analyses of the latent features of schizophrenia observed in the Danish Adoption Study led Spitzer and colleagues (1979) to operationalize them into eight diagnostic items that were reflected in the Diagnostic and Statistical Manual of Mental Disorders (3rd ed.; DSM-III; American Psychiatric Association, 1980) to define SPD. Changes of the SPD definition were introduced in the subsequent revised Diagnostic and Statistical Manual of Mental Disorders (3rd ed., rev.; DSM-III-R;

American Psychiatric Association, 1987) when the odd eccentric behaviour criterion was added. Therefore, SPD criteria include ideas of references and paranoid thinking, odd belief and magical thinking, unusual perceptions, odd thinking and speech, suspiciousness, constricted affect, lack of close friends, and excessive social anxiety.

In 2013, further changes of the SPD definition were introduced in the Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5; American Psychiatric Association, 2013). These changes reflect multiple evidence from emerging research and clinical knowledge indicating that SPD stands at a unique crossroads in the characterization of psychopathology, as it is conceptualized both as stable personality pathology as well as a milder manifestation of schizophrenia (Kwapil & Barrantes-Vidal, 2012). This idiosyncrasy has become fully explicit in DSM-5, in which SPD is both listed in the category of Schizophrenia Spectrum and Other Psychotic Disorders as well as in the category of Personality Disorders. SPD is defined as "a pervasive pattern of social and interpersonal deficits, including reduced capacity for close relationships; cognitive or perceptual distortions; and eccentricities of behavior, usually beginning by early adulthood but in some cases first becoming apparent in childhood and adolescence. Abnormalities of beliefs, thinking, and perception are below the threshold for the diagnosis of a psychotic disorder" (p. 89). Developmentally, the DSM-5 indicates that SPD "may be first apparent in childhood and adolescence with solitariness, poor peer relationships, social anxiety, underachievement in school, hypersensitivity, peculiar thoughts and language, and bizarre fantasies" (p. 657).

2.1.3. Prodromal Symptoms or At Risk Mental States for Psychosis

Schizophrenia, as other forms of severe mental disorder, is preceded by a relatively non-specific period of subthreshold symptoms characterized by insufficient

severity and clarity to justify a clinical diagnosis. In the 19th century, the multidimensional vision of psychosis and the multiple evidence supporting the schizotypy continuum promoted the coining of the term *prodrome* to capture the symptomatic subclinical state of psychosis (McGorry & Connell, 1990; Hafner et al., 1992). This approach prompted a new line of perspective studies investigating symptoms and experiences that occur before the onset of frank psychosis. Well-known examples are the multicentric studies such as the EPOS (The European Prediction of Psychosis Study; Klosterkotter et al., 2005) or the NAPLS (North American Prodrome Longitudinal Study; Addington et al., 2007). However, the evaluation of a prodromal state is only possible from a retrospective point of view, this means that the study of the clinical trajectory of psychotic symptoms occurs once a first psychotic episode has occurred.

First episode of psychosis has heterogeneous outcomes, from complete remission to progression in both directions along a spectrum from psychotic mood disorders to schizophrenia. Indeed, only the 60% of first episode of psychosis patients met criteria for schizophrenia or schizophreniform disorder (Henry et al., 2007). Based on these fluctuating outcomes, a new term has been coined that re-conceptualizes the prodromal period to define people at risk of developing psychosis, the *At-Risk Mental States* (ARMS; Yung, Phillips, Yuen, & McGorry, 2004). This new concept rather than consider the prodromal period as a fixed entity, highlights those evidence showing that nearly the 36% of ARMS patients transit to psychosis after three years, whereas a third experience attenuated psychotic symptoms, and a third fully remit (Cannon, 2015; Fusar-Poli et al., 2012).

Recently, as the field of early detection and intervention has developed, there has been emerging interest in the potential value of studying schizotypy and spectrum disorders in the context of clinical high risk (CHR) samples. As Debbané et al. (2015)

pointed out, schizotypy has traditionally been considered as a *trait* indicator of vulnerability for schizophrenia-spectrum disorders, whereas the field of CHR has put the emphasis on "state" indicators of an imminent transition to overt psychosis (ultra high-risk; UHR) as well as the detection of the earliest possible prodromal specific signs of pre-psychosis (basic symptoms).

Thus, UHR criteria are defined by a *state* status and entail an onset/worsening requirement (Schultze-Lutter, Schimmelmann, Ruhrmann, & Michel, 2013), which exclude schizotypal manifestations that present with a "trait" character unless meeting a diagnostic status associated with functional decline. However, it appears that state CHR and UHR indicators can best be understood as manifestations along the schizotypy continuum. Furthermore, in light of recent evidence reported by studies investigating vulnerability in CHR and UHR samples, it has been suggested that schizotypy and SPD rather than represent sorely states of different severity along the continuum in only one dimension, they are manifestations of qualitatively different dimensions, with the negative dimension being predictive of SPD and the positive of psychosis (Schultze-Lutter, Nenadic, & Grant, 2019).

2.1.4. Schizophrenia-Spectrum Disorders

Putative components of the spectrum concept are those disorders etiologically related to schizophrenia. Specifically, those that have been found to share the same genetic-risk factors. However, even if the schizophrenia-spectrum disorders share risk factors and symptoms with schizophrenia they do not completely met its diagnostic criteria (Maier, 1999). The proposed disorders included in the spectrum concept are the personality traits and disorders, and the psychotic symptoms and disorders.

Schizoid PD criteria includes anhedonia, social withdrawal, affective flattening symptoms, as well as affective indifference and social anhedonia symptoms (DSM-5). The Schizoid PD definition has been borne out by Bleuler (1911) observations of behavioural abnormalities in untreated relatives of schizophrenia patients. They reported symptoms similar to schizophrenia such as flat affect, ambivalence, bizarre thinking, poor social contact and interpersonal relationship but do not showed full-blown symptoms of the disorder. Bleuler named these less severe behavioural deviations "latent schizophrenia". Subsequently, Kretschmer (1925) describe the "schizoid" individual as unsociable, indifferent to social relationships, nervous but also eccentric. More severe and dysfunctional forms of this mental condition joined the psychiatric glossary as "schizoid personality", construct that next was included in the DSM-I and II as a personality disorder.

Paranoid PD is characterized by suspiciousness, mistrustfulness, deviations in cognition and perceptions, as well as disinclination to trust in others. In 1925 Kretschmer indicated that a further relevant trait of paranoid personality was the generalized hypersensitivity to criticism. However, suspiciousness is historically considered the main symptom of Paranoid PD since Kraepelin (1921) and giving that it is a relevant schizotypal trait in relatives of schizophrenia patients, Paranoid PD is included as a possible disease in the schizophrenia-spectrum. The DSM-5 describes the Paranoid PD as a pattern of distrust and suspiciousness, in the way that reasons of others are generally interpreted as malevolent.

These two PD together with the SPD are included in the Cluster A that capture the mental state of individuals who appear odd or eccentric. However, comorbidity is not unusual. The DSM-5 indicates that the prevalence estimates suggest that 5.7% of individuals often present co-occurring Cluster A personality disorders, and also frequent

co-occurrence of disorders from different clusters (e.g., Avoidant PD). It appears that PDs can best be understood from a dimensional perspective (Miller, Lynam, Widiger, & Leukefeld, 2001; Wilberg, Urnes, Frii, Pederson, & Karterud, 1999). Indeed, the 2001-2002 National Epidemiologic Survey on Alcohol and Related Conditions (Grant et al., 2004) suggest that PDs are not qualitative distinct diseases but represent deviant variants of general personality functioning, and highlight the need of the creation of dimensional representations to refine the categorical models.

The spectrum concept that originally included schizophrenia and related PDs (Spitzer, Endicott, & Gibbon, 1979; Kety, 1985), was later extended to schizophrenia-related Axes I disorders (Kendler, Gruenberg, & Kinney, 1994). Schizophreniform and schizoaffective disorders were considered as part of the schizophrenia-spectrum since the frequent co-occurrence that they showed with schizophrenia in genetically at risk samples and because the similarity of symptoms with chronic schizophrenia. Furthermore, the high degree of comorbidity found between Axes I disorders and PDs provide further support to the spectrum model which assume that they represent different manifestations of the same underlying disease process (McGlashan et al., 2000).

Schizophreniform disorder is described in the DSM-5 as an equivalent representation of schizophrenia from which it differs only for its duration. While schizophrenia lasts for at least 6 months, the total duration of schizophreniform disorder is at least one month but less than 6 months. Thus, this Axes I disorder is automatically part of the schizophrenia-spectrum. In fact, the DSM-5 indicates that if the individual is symptomatic beyond 6 months, the "provisional" diagnosis should be change from schizophreniform disorder to schizophrenia. Indeed, two-thirds of individuals who do not recover within the 6-month period are eventually diagnosed with schizophrenia or

schizoaffective disorder and experience similar functional consequences of these disorders.

Schizoaffective disorder require the simultaneously occurrence of schizophrenic symptoms and maniac or depressive syndromes whit the presence of mood symptoms during the majority of the total duration of the active-phase. The DSM-5 states that usually a schizoaffective disorder diagnosis is made when individuals are experiencing psychotic illness, and during this period Criterion A for schizophrenia has to be met (that is, delusions, hallucinations, disorganized speech, grossly disorganized or catatonic behavior and negative symptoms). Further, schizophrenia and schizoaffective disorder co-aggregate in families. First-degree relatives of schizophrenia patients are at increased risk for developing schizoaffective disorder.

2.2. The Multidimensional Nature of Schizotypy

Schizotypy, and by extension, schizophrenia, are heterogeneous at etiological phenotypic, and developmental levels. Both constructs share a common multidimensional structure, consisting of, at least, positive, negative and disorganization dimensions (Kwapil and Barrantes-Vidal, 2015). Evidence from factor analytic studies indicate that these dimensions underlie schizophrenia (Lenzenweger & Dworkin, 1996; Liddle, 1987), and were also identified in nonclinically schizotypy individuals (Bentall, Claridge, & Slade, 1989; Vollema & van den Bosch, 1995). Positive schizotypy is characterized by odd beliefs (including full-blown delusions), unusual perceptual experiences (including illusions and hallucinations), and suspiciousness/paranoia. Negative schizotypy involves diminished functioning including anhedonia, flattened affect, social disinterest, avolition, and anergia. The disorganization dimension involves disruptions in thought, behavior, and communication. However, the latent structure of schizotypy remained unclear and

others dimensions such as paranoia (Horton, Barrantes-Vidal, Silvia, & Kwapil, 2014) and impulsive-nonconformity (Mason, Claridge, & Jackson, 1995) have been proposed as separate factors. Overall, these dimensions have been found to be associated with differential patterns of impairment and symptoms. Therefore, this multidimensionality is critical to map differential developmental routes of risk and resilience for psychosis (Debbané & Barrantes-Vidal, 2015).

2.2.1. *The Assessment of Schizotypy Dimensions*

The psychometric high-risk strategy involves the identification of psychosis-prone or schizotypic individuals on the basis of scores on schizotypy questionnaires. Over the last decades, different self-reported schizotypy scales were developed from two complementary approaches. Some of them were oriented to test the presence of those clinical symptoms indicative of pathological features, whereas others were focused in the measurement of attenuated form of symptoms and traits. However, researchers of both approaches framed the scales within the continuum model of schizotypy.

In accordance with the first approach, Claridge and Broks (1984) developed the Schizotypal Personality Scale (STA) based on the schizotypal and borderline definition contained in the DSM-III, whereas Raine (1991) developed the Schizotypal Personality Questionnaire (SPQ) on DSM-III-R. In 2002 Stefanis and colleagues, based on the Delusions Inventory (PDI-21; Peters, Joseph, & Garety, 1999), the SANS (Andreasen, 1989) and the SENS (Selten, Gernaat, Nolen, Wiersma, & van den Bosch, 1998), developed the Community Assessment of Psychotic Experiences (CAPE), which taps the positive, negative, and depressive dimensions. The CAPE also provides the frequency of the experience and the degree of distress that they provoke.

Based on the second approach, Chapman and colleagues used individual symptoms to develop the Wisconsin Schizotypy Scales (WSS). The WSS have been one of the most extensively used schizotypy measures in the last 40 years (for complete summaries and reviews of available schizotypy measures please see Chapman, Chapman, & Kwapil, 1995; Kwapil & Chun, 2015; Mason, 2015; Mason, Claridge, & Williams, 1997). The WSS comprise four scales. Two of them tap positive features: the Perceptual Aberration Scale (PerAb; Chapman, Chapman, & Raulin, 1978) assesses psychotic-like bodily distortions and perceptual experiences, and the Magical Ideation Scale (MagId; Eckblad & Chapman, 1983) taps belief in invalid causation. The remaining two scales predominately assess negative schizotypy: the Physical Anhedonia Scale (PhysAnh; Chapman, Chapman, & Raulin, 1976) assesses deficits in sensory and esthetic pleasure, and the Revised Social Anhedonia Scale (SocAnh; Eckblad, Chapman, Chapman, & Mishlove, 1982) measures schizoid asociality. Furthermore, in 2011 the four WSS scales were used to develop a short form of the instrument to improve the efficiency of the measurement of schizotypy traits in brief assessments (Winterstain et al., 2011). The WSS scales both in its original version and in the short form were used to assess schizotypy in the work that forms part of the current thesis.

More recently, Kwapil and colleagues (Kwapil et al., 2018) developed a new multidimensional questionnaire assessing positive, negative, and disorganized schizotypy dimensions. The Multidimensional Schizotypy Scale (MSS) included items from preexisting self-reports such as the WSS scales and the SPQ, but also new items tapping experiences that occur across the schizotypy continuum.

2.2.2. Construct Validity of Schizotypy Dimensions

The continuum hypothesis establish that schizotypy represents the underlying vulnerability for schizophrenia. Thus, non-clinical individuals with high schizotypy scores are presumed to demonstrate transient or mild forms of psychopathological symptoms and functional impairment seen in schizophrenia patients, and to be at increased risk for transition into schizophrenia-spectrum disorders.

There is accumulating evidence supporting the construct validity of schizotypy. In schizophrenia, previous studies on sex differences in symptomatology reported that men are characterized by a predominance of negative symptoms (Goldstein, 1996; Hambrecht, Maurer & Häfner, 1992) and that women experience slightly more positive symptoms (Goldstein & Link, 1998; Leung & Chue, 2000), with an important presence of suspiciousness and paranoid ideation (Goldstein, 1996) and also display more affective symptoms (Leung & Chue, 2000). This pattern indicating the presence of significant differences between schizophrenic males and females, is supported by studies looking at sex differences in schizotypy with the employment of self-report measures such as the WSS and the SPQ. Published studies in nonclinical samples of young adults psychometrically identified with the WSS indicate that, compared with women, men experience more physical and social anhedonia symptoms, which relate to negative schizotypy (Chmielewski, Fernandes, Yee, & Miller, 1995; Miettunen & Jääskeläinen, 2010). In contrast, woman have been found to report higher scores of MagicId (Eckblad & Chapman, 1983) and PerAb (Chapman, Edell, & Chapman, 1980), scales assessing positive schizotypy. Further, studies analyzing sex differences of schizotypal traits in college students found that the SPQ cognitive-perceptual trait was more present in women (Raine, 1992), whereas elevated interpersonal traits were reported by men (Miller and Burns).

Additionally, several studies indicate that non-clinical individuals psychometrically identified as high schizotypy exhibit psychotic-like experiences (Gooding, Tallent, & Matts, 2005), positive and negative prodromal symptoms, suspiciousness, as well as cognitive schemas and impairment in functioning (Barrantes-Vidal et al., 2013; Racioppi et al., 2018). Findings from previous BLISS studies (Barrantes-Vidal et al., 2013; Racioppi et al., 2018) demonstrate that schizotypy dimensions show different patterns of associations with these psychopathological symptoms. Positive schizotypy was found to be uniquely associated with interview ratings of positive symptoms, as well as negative affect and negative schemas of self and others. In contrast, negative schizotypy was associated with negative symptoms, and with diminished positive schemas of self and others. Both schizotypy dimensions were associated with suspiciousness and impaired functioning.

Further support for the validity of the schizotypy construct comes from studies investigating PDs traits in nonclinical samples. Research suggest that schizotypy individuals experience high levels of schizophrenia-spectrum personality symptoms and reveal that positive and negative schizotypy dimensions are differentially related with PDs traits (Cohen, Couture, & Blanchard, 2012; Horan, Brown, & Blanchard, 2007; Barrantes-Vidal et al., 2013; Bolinskey et al., 2015, 2017). Positive schizotypy is associated with paranoid personality traits, whereas negative schizotypy is associated with schizoid personality traits, and both dimensions are associated with schizotypal personality traits. Indeed, schizotypic individuals were found to be at greater risk for the development schizophrenia spectrum or psychotic disorders with the passage of time compared to those with low schizotypy scores (Chapman, Chapman, Kwapil, Eckblad, & Zinser, 1994; Kwapil, 1998; Kwapil, Gross, Silvia, Raulin, & Barrantes-Vidal, N., 2013). Specifically, the above longitudinal studies indicate that positive schizotypy predicted the

development of psychotic disorders, whereas both positive and negative schizotypy dimensions predicted schizophrenia-spectrum disorders.

Depression and anxiety symptoms and syndromes are frequently reported by patients with schizophrenia-spectrum disorder (Braga, Petrides, & Figueira, 2004; House, Bostock, & Cooper, 1987; Sim, Mahendran, Siris, Heckers, & Chong, 2004) and by individuals with early onset of schizophrenia (Wassink, Flaum, Nopoulos, & Andreasen, 1999). Elevated affective dysregulation symptoms (that is, depression and anxiety traits) have been also found to be elevated in schizotypic individuals both cross-sectionally (Cohen & Matthews, 2010; Barrantes-Vidal et al., 2013b; Lewandowski et al., 2006) and longitudinally (Racioppi et al., 2018). Furthermore, it has been found that the positive dimension is more strongly associated with depression and anxiety symptoms than the negative dimension both in patients (Badcock, Paulik, & Maybery, 2010; Emsley, Oosthuizen, Joubert, Roberts, & Stein, 1999) and in schizotypic individuals (Lewandowsky et al., 2006; Barrantes-Vidal et al., 2013b). This pattern of results highlights the differential role of affect, such that positive schizotypy tends to be characterized by affect dysregulation and high negative affect, whereas negative schizotypy is associated with diminished positive affect. In that way, the 10-year follow-up study of Chapman et al. (1994) demonstrated that individuals high on positive schizotypy are at greater risk to develop affective disorders. Specifically they found that individuals with elevated scores on the PerAb and MagicId scales, but not those high in PhyAnh and SocAnh, reported higher rates of major depressive disorders both at baseline and ten years later.

Recently, a new line of studies employed the ESM method to validate the real-life expression of schizotypy. They showed that schizotypic individuals experience psychotic-like symptoms in daily life and also exhibit social behavioural abnormalities

(e.g., preference to be alone and poor social contact) that are similar to those seen in schizophrenia-spectrum disorders (Barrantes-Vidal et al., 2013a; Chun et al., 2017; Kwapil et al., 2012). These studies also investigated the role of daily life stressors in the expression of psychopathological symptoms. Consistent with studies indicating that patients with psychosis and their first-degree relative are more sensitive to stress in daily life (Myin-Germeys, van Os, Schwartz, Stone, & Delespaul, 2001), ESM studies demonstrated that schizotypic individuals are more reactive to high levels of stress. Indeed, it was found that in great daily life stressful situation individuals with high positive schizotypy, but not those high in negative schizotypy, experience increased momentary psychotic-like and paranoid symptoms (Barrantes-Vidal et al., 2013a; Chun et al., 2017).

2.3. Schizotypy as Predictor of Psychosis Spectrum Psychopathology[2]

Barrantes-Vidal, N.[a,b,c], Racioppi A.[a], & Kwapil, T.R.[d]

2.3.1. *Schizotypy as a Marker of Psychosis Proneness in Non-Clinical Samples*

Most research using schizotypy as a risk indicator has been performed in non-clinical samples. The majority of studies have used *cross-sectional designs*, either comparing groups of extreme scorers with control participants or analyzing the correlates of schizotypy dimensions. For example, Horan et al. (2007) compared a group of high scorers on SocAnh and MagId scales with control participants.

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[1]T his section is part of the book chapter:
Barrantes-Vidal, N., Racioppi, A., Kwapil, T.R. (2020). Schizotypy, Schizotypal Personality and Psychosis Risk. In A. Thompson and M. Broome (Eds.). *Risk Factors for Psychosis: Paradigms, Mechanisms, and Prevention* (pp. 83-102). Elsevier, Academic Press: Publishers.

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The group with high scores on SocAnh presented high levels of schizoid, schizotypal, and paranoid symptoms, as well as poor social coping style and poor social support, whereas the high MagId group specifically reported high levels of schizotypal symptoms. On the other hand, using a dimensional approach, Barrantes-Vidal et al. (2013a) examined the correlates of conceptually-driven positive and negative schizotypy dimensions derived from the WSS. Consistent with the dimensional heterogeneity reported within clinical psychosis, these dimensions showed specific as well as common patterns of associations. As hypothesized, positive schizotypy was associated with psychotic-like, paranoid, and borderline symptoms, whereas negative schizotypy was uniquely associated with both self-report and interview negative and schizoid symptoms. Both dimensions were associated with schizotypal and avoidant personality symptoms, which is consistent with the mixture of positive and negative features characterizing SPD and the social dysfunction captured in avoidant personality. Also, both dimensions were associated with ratings of suspiciousness and impaired functioning. Congruent with the robust association of positive and affective symptoms, only positive schizotypy was associated with measures of anxiety, depression, and low self-esteem. Moreover, in terms of interpersonal schemas, positive schizotypy was associated with a negative view of self and others, whereas negative schizotypy was associated with diminished positive views of self and others. This pattern highlights a differential role of affect in positive and negative dimensions that holds across nonclinical and clinical levels, such that positive schizotypy is associated with affect dysregulation and high negative affect, whereas negative schizotypy tends to be characterized by diminished positive affect. Note that other studies have reported that negative schizotypy is associated with heightened negative affect (e.g., Fonseca-Pedrero, Paino, Lemos-Giráldez, & Muñiz, 2011). However, such findings seem to reflect the use of problematic measures of negative

schizotypy that are saturated with depression and neuroticism (Barrantes-Vidal et al., 2013a; Gross, Mellin, Silvia, Barrantes-Vidal, & Kwapil, 2014; Gross, Kwapil, Raulin, Silvia, & Barrantes-Vidal, 2018; Kwapil et al., 2018). Depression and neuroticism share phenotypic similarities with negative symptoms, but are not conceptualized to be part of the construct (as negative schizotypy is presumed to involved flattened or diminished affect, not increased negative affect or affective reactivity). The above-mentioned findings offer insight into the long-term trajectories of these dimensions, such as social anxiety for positive and schizoid withdrawal for negative schizotypy.

Overall, cross-sectional research has shown that there is a consistent and meaningful pattern of associations of positive and negative schizotypy measures with schizophrenia-spectrum symptoms and impairment – patterns that have been distinctively associated with positive and negative symptom dimensions across various psychosis spectrum disorders (e.g., Barrantes-Vidal et al., 2009, 2010; Blanchard et al., 2011; Bolinskey et al., 2015; Bolinskey & Gottesman, 2010; Ettinger et al., 2015; Horton et al., 2014; Kaczorowski et al., 2009; Kwapil et al., 2008). More recently, a few studies have examined whether schizotypy measures are also valid to detect the real-life expression of behavioral patterns either characterizing psychosis or those associated with an increased risk for psychosis in genetic-risk or epidemiological cohorts. This work employs the ESM technique, a within-day self-assessment method in which individuals are repeatedly prompted at random intervals to complete brief questionnaires in the moment about their current experiences as they occur in their daily life environment. This method offers several advantages to traditional assessment procedures (Myin-Germeys et al., 2009), as it allows researchers to study the context of experiences, their prospective and dynamic association with symptoms, and potential mechanistic pathways. Barrantes-Vidal et al. (2013b) examined the real-life expression of psychometric schizotypy dimensions using

ESM for 1 week in 206 young adults with a mean age of 20 years-old. Consistent with findings from the psychometric research just described, positive schizotypy was associated with daily-life reports of psychotic-like experiences (PLEs) and paranoid symptoms, whereas negative schizotypy was associated with a subset of these symptoms and with negative symptoms such as diminished thoughts, emotions, and social contact in daily-life. Examination of the hypothesis that positive symptoms in particular are related to an abnormal pattern of stress-sensitivity revealed that ESM appraisals of stress in the moment were associated with psychotic-like and paranoid symptoms, but only in those with high *positive* schizotypy. Strikingly, time-lagged analyses showed that stress at the preceding signal predicted psychotic-like symptoms at the current assessment, but only for individuals high in positive schizotypy. In an extension of this study, Chun et al. (2017) obtained schizotypy dimensions based on dimensional *interview* ratings of Cluster A PDs and replicated the same findings: positive (as well as paranoid and disorganized) schizotypy were associated with elevated stress reactivity, whereas negative schizotypy was related with diminished reactivity. Finally, Kwapil et al. (2012) found that both positive and negative schizotypy were associated with the desire to be alone when being with others in daily-life, but that this social discomfort resulted from excessive anxiety in positive schizotypy and from reduced positive affect in negative schizotypy. This finding indicates that the same abnormality (social disinterest) results from distinct psychological mechanisms, which implies that such social discomfort may require different preventive or therapeutic strategies. People high in negative schizotypy consistently reported that they wanted to be alone when with others and that they wanted to remain alone when they were by themselves. People high in positive schizotypy wanted to be alone when with others, but desired social contact when alone (suggesting that feeling socially comfortable is difficult for people high in positive schizotypy). Overall, these studies demonstrate the

ecological validity of ESM as a method able to detect precursors of schizophrenia-spectrum psychopathology by examining the daily life experiences of schizotypic individuals.

Regarding the *prospective* association of schizotypy with clinical outcomes in non-clinical samples, Chapman et al. (1994) reported a pioneering 10-year follow-up study of college students. They selected four high-risk groups based on the following WSS: PerAb or MagId (PerMag), Impulsive Non-Nonconformity (Chapman et al., 1984) and PhysAnh, as well as a combined-risk group and a control group. Of the 534 subjects interviewed at the first assessment, 95% were reassessed ten years later. At the cross-sectional assessment, Chapman et al. noted that high-risk individuals, and especially those high on PerMag group, reported elevated rates of psychotic-like experiences and schizotypal symptoms (note that none was psychotic at baseline). At the 10-year re-interview, PerMag participants exceeded the control group in rates of psychotic disorders, psychotic-like, paranoid and schizotypal symptoms, and mood and substance use disorders. Furthermore, when Chapman et al. examined a combination of multiple predictors, the rate of psychosis increased dramatically at the 10-year follow-up: 14% of Magical Ideation subjects who also reported psychotic-like experiences (PLEs) at the initial assessment developed psychotic disorders; and participants who were deviant on MagId and scored above the mean on SocAnh had a 21% rate of psychosis at follow-up (note that the Social Anhedonia scale was not used to select a high-risk group). Finally, the study showed that PLEs were an excellent indicator of psychosis proneness, since the rate of psychosis increased to 40% in the MagId-SocAnh subjects who exhibited moderate PLEs at the initial assessment. Kwapil (1998) investigated in this sample whether SocAnh scores independently predicted the development of schizophrenia-spectrum disorders ten years later. He reported that 24% of participants identified by

elevated scores on the SocAnh suffered from schizophrenia-spectrum disorders at follow-up. Furthermore, individuals with high scores on the scale who did not develop such disorders still reported elevated schizophrenia-spectrum symptoms and impaired functioning ten years later. These findings suggest that SocAnh appears to identify a specific group of at-risk individuals with a latent vulnerability for schizophrenia-spectrum disorders. In 2013, Kwapil and colleagues used the Chapman et al. (1994) longitudinal dataset to test the predictive validity of conceptually-driven positive and negative dimensions. They assigned positive and negative schizotypy dimensional scores based on the WSS to participants in the ten-year longitudinal study. It was found that positive schizotypy predicted the development of psychotic disorders (i.e., schizophrenia and psychosis not otherwise specified), whereas both positive and negative schizotypy dimensions predicted schizophrenia-spectrum disorders (including psychotic disorders and schizophrenia-spectrum personality disorders). Moreover, positive schizotypy was associated with major depressive and manic/hypomanic episodes, substance use disorders, and mental health treatment. In contrast, negative schizotypy was associated with schizoid personality symptoms and social impairment at follow-up. These findings are especially striking given that participants were functioning well enough to enroll in a major university at the start of the study, they were only part-way into the window of greatest risk for developing psychosis at the time of the follow-up assessments, schizotypy ratings predicted schizophrenia-spectrum symptoms even after omitting participants with psychotic and spectrum disorders, and the rates of transition into schizophrenia-spectrum disorders were as high or higher than typically seen in genetic high-risk studies (Kwapil et al., 2013). Overall, these findings supported the predictive validity of the WSS and showed that schizotypy is a useful phenotype to detect developmental risk for schizophrenia and related disorders.

A similar study conducted by Gooding et al. (2005) identified two high-risk groups based on the WSS: a group of high scorers on the PerAb and/or MagId scales and high scorers on the SocAnh. At a 5-year follow-up, these groups displayed more frequent and severe psychotic-like experiences compared to a control group. However, in contrast to Chapman et al. (1994) findings, none of the baseline PLEs was an indicator of schizophrenia-spectrum psychopathology at the 5-year follow-up and no participants met diagnostic criteria for a psychotic disorder. The authors argued that this difference was probably related to the fact that Chapman's 10-year follow-up covered a greater proportion of the lifetime risk of psychosis expression compared to their 5-year follow-up. Furthermore, participants in the Gooding et al. (2005) study had a better baseline functioning (as indicated by GAF scores) than those in the Chapman study, even if all of them were college students. Consistent with Kwapil (1998), they indicated that high scorers on SocAnh were at high risk for the development of schizophrenia-spectrum disorders rather than psychopathology in general.

Bolinskey et al. (2017) reported a 2-year follow-up of a group of high schizotypy scorers on either the MagId, PerAb, or SocAnh and a matched control group. The high schizotypy group met more criteria for avoidant, paranoid, schizoid and schizotypal personality disorders than the comparison group with medium to large effect sizes, both at the baseline assessment and the 2-year follow-up, indicating a consistent temporal stability of these traits over time. As part of an ongoing longitudinal study on psychosis risk and resilience factors, Racioppi et al. (2018) reported the 3-year follow-up outcome of participants described earlier in the study by Barrantes-Vidal (2013a). As mentioned, they used conceptually-driven schizotypy dimensions rather than single-scale or mixed-scale predictors. Positive schizotypy predicted interview ratings of PLEs, depression, general psychopathology, and low self-esteem, and negative schizotypy predicted

schizoid personality traits, emotional disturbances, and mental health treatment during the past year. As expected, both schizotypy dimensions predicted schizotypal, paranoid, and avoidant personality traits, suspiciousness, and impaired functioning. Despite the fact that the studies used different outcome measures in different cultures, the longitudinal findings for the schizotypy dimensions appear strikingly consistent.

The studies described so far have been conducted in samples of college students, which entail testing hypotheses in a highly conservative manner as participants have more protective factors and less likelihood of developing schizophrenia-spectrum disorders. However, they limit the generalization of findings, so research from community samples is necessary to complement this research approach. Cohen et al. (2012) reported on the 3-year follow-up of a group with high SocAnh and a control group. The former had greater schizotypal, schizoid and paranoid ratings, as well as poorer functioning and more prevalent history of psychiatric treatment and major depressive disorder diagnosis than controls. Using the prospective Northern Finland 1966 birth cohort, Miettunen et al. (2011) examined the predictive validity of various psychological scales including the PerAb, PhysAnh and SocAnh in an 11-year longitudinal study in an unselected general population sample of 4,926 participants. The PerAb had the best concurrent validity with psychotic diagnoses at a cross-sectional assessment, and overall presented the highest predictive validity. Bogren et al. (2010) created a semi-structured interview to assesses premorbid symptoms and behaviors, such as cluster A personality traits, in an unselected general population sample (n=1,797) and examined the association of these traits with the incidence of psychosis in a 50-year follow-up. Schizotypal-paranoid traits, as well as anxiety-proneness and affective/cognitive blunting, were significantly associated with a diagnosis of psychosis (not schizophrenia) 50 years later.

2.3.2. Schizotypy in Genetically At-Risk Samples

In addition to using schizotypy measures as primary predictors of schizophrenia-spectrum psychopathology, researchers have also examined schizotypy in genetic high-risk studies. The New York High-Risk Project followed-up the offspring of persons with schizophrenia, affective disorders and controls from childhood to adulthood. PhysAnh was administered to 161 adolescents and was found to be a precursor of psychotic outcomes and social isolation in females, but not males (Erlenmeyer-Kimling et al., 1993). In the Edinburgh High Risk Study of Schizophrenia (EHRS), Miller and colleagues (Miller et al., 2002a) examined the predictive validity of schizotypy among young individuals with genetic-high risk for psychosis, with a first-episode of psychosis meeting criteria for schizophrenia, and without genetic risk. A total of 212 individuals were classified as control, high-risk individuals who did not report psychotic symptoms, high-risk individuals who displayed psychotic symptoms but did not meet criteria for psychosis, and as first-episode patients with schizophrenia 4.5 years later. A principal components analysis of SIS baseline scores revealed that four schizotypy features (social withdrawal, positive symptoms, socio-emotional dysfunction and odd behavior) accounted for the 47.8% of the variance in outcome. Patients with schizophrenia reported the highest scores on social withdrawal, whereas high-risk individuals with psychotic symptoms reported the highest scores on the odd-behavior. Both patients and high-risk individuals with psychotic symptoms reported similar high scores on positive schizotypy. Social withdrawal was the best single predictor of transition, although a combination of odd-behavior, social withdrawal, socio-emotional dysfunction and positive schizotypy features had the best predictive power. In a subsequent study of the EHRS project, Johnstone et al. (Johnstone, Ebmeier, Miller, Owens, & Lawrie, 2005) examined factors predicting transition into schizophrenia at 2.5 years in a sample of 163 young adults with

two relatives with schizophrenia as well as in control participants and individuals with risk for other psychiatric disorders. The strongest predictors of transition to psychosis were the Rust Inventory of Schizotypal Cognition (RISC; Miller, Lawrie, Byrne, Cosway, & Johnstone, 2002b), which mainly taps positive schizotypy such as bizarre and eccentric ideas, and the Structured Interview for Schizotypy (SIS; Miller et al., 2002a) at study entry, with social withdrawal and oddness factors being the most powerful predictors – providing further evidence that schizotypy is able to detect developmental vulnerability for schizophrenia. In a 10-year follow-up report of this study, Tijms and colleagues (Tijms et al., 2015) reported that there was a strong association between schizotypal cognitions and gray matter network alterations for genetic risk individuals who later developed schizophrenia before illness onset. More recently, Zarogianni et al. (Zarogianni, Storkey, Johnstone, Owens, & Lawrie, 2017) reported that introducing schizotypal cognitions in predictive models improved outcome classification, reaching a predictive accuracy of 94% when combining schizotypal cognitions, declarative memory and structural MRI data.

In a study with 96 young first- and second-degree relatives of persons with schizophrenia, Shah and colleagues (Shah et al., 2012) analyzed the predictive power of a multivariate model integrating socioenvironmental, ecological, neurodevelopmental and clinical etiological and risk factors. The three schizotypy scales administered (MagId, PerAb and SocAnh) were a direct predictor of transition to psychosis at 2.3 years, acting as mediators of the indirect effect of distal (e.g., familial, biological and socioenvironmental) and cognitive risk factors on psychosis risk.

A novel approach was recently used by the Genetic Risk and Outcome in Psychosis consortium (GROUP; van Os et al., 2017) by examining the association of a polygenic risk score (PRS) with measures of schizotypy in a sample of first-degree

relatives (siblings and parents) of patients with psychotic disorder and healthy controls in a longitudinal study. The PRS was associated with a total summary score of schizotypy as assessed with the Community Assessment of Psychic Experiences (CAPE) (Stefanis et al., 2002) and with the Structured Interview for Schizotypy-Revised (SIS-R; Kendler, Lieberman, & Walsh, 1989), as well as with the positive dimension of both measures and presence of any lifetime affective disorder, both in relatives and controls. They suggested that in individuals at elevated genetic risk, the emerging expression of phenotypic alterations may yield floor effects, which would obscure the detection of associations.

2.3.3. Schizotypy and SPD in Clinical At-Risk Samples

In the Cologne Early Recognition study (Klosterkötter, Hellmich, Steinmeyer, & Schultze-Lutter, 2001), the predictive validity of basic symptoms was tested in a sample of 160 patients that were followed-up for approximately 10 years. In addition, the value of personality disorders assessed at baseline was examined and it was found that only SPD was a predictor of transition to schizophrenia regardless of the presence of basic symptom criteria.

Mason and colleagues (Mason et al., 2004) examined the predictive power of a wide variety of factors (family history, perinatal complications, premorbid social functioning and personality, recent life events and current symptoms) for transition to psychosis in a sample of help-seeking CHR young individuals (mean age= 17.3) in New South Wales. One year after the baseline assessment, half of the sample developed a psychotic disorder. Among the premorbid factors studied, the best scale-based predictor of transition to psychosis were SPD ratings, although the score difference between those who transitioned and those who did not was small, which suggested that SPD scores would have limited clinical value in terms of improving the identification of at risk

individuals. When analyzing individual items, SPD items such as odd beliefs/magical thinking, auditory hallucinations, blunted or inappropriate affect, and anhedonia/asociality, together with impairment in role functioning, were good predictors of transition one year later. Importantly, the authors acknowledged that SPD symptoms were rated as present or absent in the last month (along with the minimum of a 5-year presence), and that this measure was used in the study. Therefore, they can actually be considered as current prodromal symptoms at study entry and hardly possible to distinguish from premorbid personality.

In the context of the Early Detection and Intervention Evaluation study with CHR individuals, Morrison and colleagues (Morrison et al., 2002) reported that high-risk youngsters receiving primary care showed elevated self-reported positive, negative and disorganized schizotypy as measured with the Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE; Mason et al., 1995) as compared to published data from sociodemographically comparable samples of healthy controls.

Cannon et al. (2008) examined the predictive power of a comprehensive set of predictors for transition to psychosis at 2.5 years in a sample of 291 CHR individuals enrolled in the North American Prodrome Longitudinal Study (NAPLS). SPD ratings did not prove to be significant predictors. Brucato et al. (2017) also did not find SPD ratings (based on a checklist following DSM-IV; APA, 1994) to predict transition to psychosis among a large set of variables in a prospective study of 200 CHR individuals followed-up for 2 years at the Center of Prevention and Evaluation (COPE). Of note, analyzing data from the NAPLS, Woods et al. (2009) reported that a group of patients with SPD who did not meet CHR criteria reported worse social functioning compared with the CHR group (which encompassed the three CHR syndromes, including participants with deterioration in functioning within the last year meeting either a diagnosis of SPD or a

family history risk criterion). In terms of transition, 40% of putatively prodromal patients transitioned into psychosis (schizophrenia-spectrum psychosis, affective psychosis, delusional disorder, brief psychotic disorder, and psychosis not otherwise specified), and 36% of the SPD group transitioned to undifferentiated schizophrenia, schizoaffective disorder, and depression with psychosis during the course of the study. The authors argued that SPD may identify a more gradual progression of illness than UHR criteria among adolescents and young adults, and suggested that SPD may capture an independent risk syndrome for psychosis. This is not entirely surprising given that UHR criteria largely focus on acute PLEs, whereas SPD involves trait-like positive, negative, interpersonal, and disorganized symptoms. A similar conclusion was made by Parnas et al. (2011) with data from the Copenhagen Prodromal Study. It was found that 25% of patients with SPD transitioned to schizophrenia over a 5-year period, although none of their various socio-demographic and psychopathological variables predicted transition to psychosis in these patients. Similar to Woods et al. (2009), Parnas and colleagues suggested that SPD seems to be a sub-psychotic condition, highly similar to schizophrenia, but with a different degree of severity.

Schultze-Lutter, Klosterkötter, Michel, Winkler, & Ruhrmann (2012) examined schizophrenia spectrum PDs and single PD features in a sample of CHR with and without transition to psychosis with a self-report questionnaire. Cluster A PDs were not frequent (14%), despite the fact that PDs were generally frequent (46%). At baseline, paranoid (9%) was the most prevalent PD among Cluster A PDs, whereas schizotypal (7%) and schizoid (3%) PDs were less frequent. Unexpectedly, they found that only schizoid, but not schizotypal PD, was a predictor of transition to psychotic disorders. Among the schizoid personality features, “lack of close friends or confidants other than first-degree

relatives" and "emotional detachment observed by others" were most prevalent in converted patients.

Only a few studies have employed self-reported measures in early-psychosis samples. In the European Prediction of Psychosis Study (EPOS), both schizotypy and SPD have been investigated a cohort of 245 CHR individuals meeting criteria for either basic symptoms (cognitive disturbances, COGDIS) or UHR criteria followed-up up to 18 months. Ruhrmann and colleagues (Ruhrmann et al., 2010) found that defined SPD (which requires its presence for only at least one year) was part of the prediction model of transition to psychosis with positive symptoms, bizarre thinking, sleep disturbances, functioning, and years of education among patients who met UHR and COGDIS (positive predictive value of 83.3%). They suggested that this algorithm might be used as a second step in the identification of at-risk individuals to improve the predictive power of UHR and COGDIS criteria. Salokangas and colleagues (Salokangas et al., 2013) reported on the predictive value of two schizotypal features assessed at baseline with the Schizotypal Personality Questionnaire (SPQ; Raine, 1991), ideas of reference and lack of close friends. Both schizotypal traits were predictive of transition to psychosis, and their co-occurrence greatly enhanced the risk of transition to psychosis, even when the effect of SPD was considered. However, other traits, such as suspiciousness, odd beliefs, magical thinking and unusual perceptual experiences, were not associated with transition to psychosis. Salokangas et al. (2013) suggested that the predictive power of the combination of ideas of reference and lack of close friends can be interpreted in the context of the differential relationship of schizotypal features with affect. Whereas ideas of reference align with high negative affectivity, lack of close friends maps on to diminished positive affectivity, and this combination is associated in schizophrenia spectrum disorders. Similarly, the former is a core component of positive schizotypy,

whereas the latter is a central feature of negative schizotypy. Of note, this pattern has also been found in nonclinical individuals. In a reanalysis of the Chapman's longitudinal study, Kwapil, Miller, Zinser, Chapman, & Chapman (1997) found that the co-occurrence of high rates of MagId and SocAnh increased the predictive power to identify individuals with psychosis proneness. Authors of both studies suggested that negative schizotypy traits such as social anhedonia and lack of close friends would strengthen positive schizotypy traits by restricting the possibility of reality testing.

Flückiger and colleagues (Flückiger et al., 2016) employed the MagId, PerAb and PhysAnh scales in a sample of 128 young adults self-seeking for help. They were classified as CHR+ or CHR- based on the UHR and/or Basic Symptoms criteria. The CHR+ group scored higher on positive schizotypy measures and the PhysAnh, but the latter was the only predictor of the CHR state. This was an unexpected finding, and authors suggested that they may been unable to tap predictive value for positive schizotypy due to the characteristics of the sample. The mean scores of the positive WSS in their sample were superior to most nonclinical and genetic high-risk samples, so they argued that they may have captured individuals positioned in the upper level of the continuum and so close to psychosis that the WSS positive schizotypy have no sufficient discriminatory power (and likely had a restricted range and distribution). Moreover, the interaction between PhysAnh and CHR status was predictive of transition to psychosis, such that those classified as CHR+ who developed psychosis had elevated PhysAnh scores, whereas low scores seemed to predict transition in the CHR- group. Data on SocAnh were missing for almost half of the sample, so it was difficult to firmly conclude on the negative dimension (although estimated statistical models seemed to confirm the role of PhysAnh and discarded a role for SocAnh). In light of their findings, Flückiger et al. (2016) proposed the need to further explore the potential of PhysAnh as a valid

screening method in clinical populations to detect a CHR status and for the prediction of psychosis among these patients.

Recently, Bang and colleagues (Bang et al., 2019) examined whether the presence and interaction of "schizophrenia-specific" basic symptoms and schizotypy predicted transition to psychosis in UHR. At baseline, UHR individuals showed higher levels of basic symptoms and schizotypy, with higher rates of SocAnh and PhysAnh compared to the controls. Transition over the course of 25.8 months was better predicted by the interaction of basic symptoms with PhysAnh than basic symptoms alone. In addition, basic symptoms severity increased the risk of transition in UHR individuals with high PhysAnh, but not in low scorers. These findings are consistent with those reported by Salokangas et al. (2013) and Flückiger et al. (2016) indicating that PhysAnh is a significant predictor of transition in CHR, and concur with the latter study in showing that PhysAnh increases the predictive power of basic symptoms and improves the discrimination of CHR individuals who will develop psychosis.

The above studies demonstrate that positive, negative and disorganized schizotypy dimensions are differentially distributed in CHR individuals and exhibited differential patterns of association with psychosis transition. The assessment of schizotypy offers a valid screening method that increased the predictive power of CHR criteria in some of the studies reviewed. Furthermore, schizotypy offers a useful phenotype that is associated with the predisposition to schizophrenia and the developmental trajectory of vulnerability for psychosis.

3. AIMS AND OUTLINE OF THIS THESIS

The research presented in this thesis is part of an ongoing longitudinal study examining risk and protective factors for schizophrenia-spectrum psychopathology, the Barcelona Longitudinal Investigation of Schizotypy (BLISS). This thesis is aimed to provide additional evidence supporting the predictive validity of the schizotypy construct by examining developmental trajectories of positive and negative schizotypy dimensions in a sample of nonclinical Spanish young adults psychometrically identified with the WSS scales. Subsumed on this overarching goal, the thesis sought to expand previous cross-sectional findings by:

1) Examine in a longitudinal framework the associations of positive and negative schizotypy dimensions with prodromal symptoms, schizophrenia-spectrum symptoms and traits, as well as affective dysregulation and impairment;

2) Investigate the temporal stability of schizophrenia-spectrum symptoms and traits in high schizotypy individuals;

3) Examine with ecological validity the prospective associations of positive and negative schizotypy dimensions with measures of momentary psychotic-like, paranoid, and negative symptoms; and by

4) Made an in-depth examination of the role of positive and negative schizotypy dimensions as potential distal mechanisms moderating the associations of stressors with psyhchotic-like, paranoid, and negative symptoms experienced in the real life environment.

These specifics aims led to the following research, wich is divided in two sections:

The **first section** is dedicated to the prospective study of schizotypy dimensions in their associations with prodromal symptoms, schizophrenia-spectrum symptoms and traits, affective dysregulation, and impairment assessed with interview and questionnaire measures. *Chapter 1* presents a longitudinal study on the predictive validity of positive and negative schizotypy dimensions at a three-year follow-up assessment. The study sought to extend previous cross-sectional findings by examining whether baseline positive and negative schizotypy ratings differentially predicted symptoms and functioning 3-years later. Specifically, it was hypothesized that both positive and negative schizotypy dimensions would be associated with schizotypal, paranoid, and avoidant personality traits, and impaired functioning, but that positive schizotypy would be specifically associated with positive (psychotic-like) symptoms, depression, and low self-esteem, whereas negative schizotypy would specifically predict negative symptoms, schizoid personality traits, and emotional blunting. An additional aim of this study was to examine the stability of symptoms and impairment over time and whether the maintenance of these symptoms was predicted by baseline ratings of positive and negative schizotypy dimensions. It was expected lower stability of symptom than trait measures and that high levels of baseline schizotypy would be predictive of the temporal stability across assessments. *Chapter 2* describes a second longitudinal study aimed to expand on previous studies of the construct and predictive validity of positive and negative schizotypy by examining the extent to which schizotypy dimensions differentially predict symptoms and impairment at a 4.4 year reassessment. This report sought to extends previous cross-sectional and longitudinal BLISS studies by including the interview-based assessment of prodromal symptoms and personality disorders. Consistent with our previous findings, it was expected that both baseline schizotypy dimensions would be associated with schizotypal, paranoid, and avoidant traits as well as suspiciousness and

impaired functioning 4.4 years later. Specifically, it was hypothesized that positive schizotypy would be specifically associated with positive symptoms, depression, anxiety and low self-esteem, whereas negative schizotypy was predicted to be specifically associated with negative symptoms and schizoid traits. Furthermore, given concerns that some interview measures of negative symptoms are saturated by depression symptoms and that specific measures for an accurate detection of non-clinical forms of negative symptoms are needed, this longitudinal study made in-depth examination of negative symptoms by using two interview measures and by analyzing the potential role of emotional dysregulation in the prediction of these symptoms.

The **second section** of the thesis is dedicated to the ecological validity of the schizotypy construct. Specifically, the study presented in *Chapter 3* aimed to replicate and extend the differential findings for schizotypy dimensions reported in previous ESM studies. This work examines the validity of the positive and negative schizotypy dimensions in predicting the experiences of psychotic-like, paranoid, and negative symptoms in daily life both in a cross-sectional and longitudinal framework. It was hypothesized 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. In contrast, negative schizotypy was predicted to be associated with diminished positive affect, reports of negative symptoms (no thoughts or emotions), solitude, and diminished social closeness. Moreover, this report sought to extend previous research by investigating how daily life stress and both social contact and stress differentially predicts the real life expression of psychotic-like, paranoid, and negative symptoms in high schizotypy individuals. Following the stress-sensitivity model, it was expected that stress and social stress would be associated with simultaneous psychotic-like and paranoid, but not negative, symptoms. In line with previous cross-

sectional ESM findings, it was expected that the association of stress and simultaneous psychotic-like symptoms would uniquely occur at high levels of positive schizotypy. Furthermore, it was also expected that stress would predict psychotic-like and paranoid symptoms at the subsequent moment, and that this would only occur at elevated levels of positive schizotypy. Therefore, the study adds to the extant literature in that it refines our understanding of how positive and negative schizotypy are differentially expressed in daily life in terms of affect, schizotypic symptoms, social contact, social functioning, and stress reactivity. Of note, the empirical works reported in *Chapter 2* and *Chapter 3* are presented in article format with their respective sections (introduction, method, results, discussion, etc.) since they are in process of being submitted at international scientific journals. That is why the format of each article may vary depending on the criteria of the journal to which it is pending to be sent.

Finally, the thesis closes with a general discussion of the key results, a consideration of the intervention implications of the present research work, and a discussion on the limitations and directions for future research.

SECTION 1

A PROSPECTIVE STUDY OF SCHIZOTYPY DIMENSIONS IN A NON-CLINICAL SAMPLE: THE BARCELONA LONGITUDINAL INVESTIGATION OF SCHIZOTYPY (BLISS)

Chapter 1

Prediction of Prodromal Symptoms and Schizophrenia-Spectrum Personality Disorder Traits by Positive and Negative Schizotypy: A 3-Year Prospective Study

Longitudinal trajectories of schizotypy dimensions in a nonclinical sample

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Abstract

Background: The present study extends previous cross-sectional findings by examining the predictive validity of positive and negative schizotypy in a young adult sample at a three-year follow-up. Schizotypy and schizophrenia share a comparable multidimensional structure with positive and negative dimensions being the most strongly supported factors. Previous cross-sectional and longitudinal studies employing the psychometric high-risk strategy indicated that schizotypy is a useful method for identifying risk and resilience factors for the development of schizophrenia-spectrum psychopathology.

Method: In the present study, 103 participants (77% of 134 candidate participants) were reassessed at a three-year follow-up.

Results: As hypothesized, positive schizotypy predicted psychotic-like symptoms, depression, low self-esteem, and general psychopathology. Negative schizotypy predicted emotional disturbances, schizoid personality traits, and mental health treatment during the past year. As expected, both schizotypy dimensions predicted schizotypal, paranoid, and avoidant personality traits, and impaired functioning.

Discussion: These longitudinal findings provide additional evidence supporting the multidimensional model of schizotypy as a valid framework for studying etiological mechanisms and trajectories of psychosis.

Keywords: schizotypy; schizophrenia; psychometric high-risk; longitudinal trajectories; Psychosis-proneness.

Introduction

Schizotypy is operationalized as a continuum of subclinical and clinical symptoms, and impairment that in the extreme is manifested as schizophrenia-spectrum disorders [1, 2]. This construct emerged from two different traditions: clinical psychopathology and individual differences [1, 3]. The former observed that there were mild forms of schizophrenia-like features in relatives of affected persons and ambulatory patients, which led to the conceptualization of schizotypy as a soft version of schizophrenia psychopathology. From this viewpoint, schizotypy is represented as personality pathology positioned at the beginning of the disease process, and dimensionality is thought to exist as a degree of clinical severity. From the personality tradition, schizotypy is conceived as both variation in healthy personality and as a risk factor for psychosis.

Schizotypy offers a unifying framework that encompasses subclinical expressions, the psychosis prodrome, schizophrenia-spectrum personality disorders, and psychotic disorders. Recent conceptualizations consider schizotypy as a distal risk marker for the identification of individuals at risk for schizophrenia, as well as a developmental mediator along the risk trajectory of schizophrenia-spectrum disorders [4]. From this perspective, schizotypy allows us to advance our understanding of etiological factors (including risk and protective factors) for schizophrenia and spectrum disorders without the confounds related to such illnesses [5, 6].

Schizotypy, like schizophrenia, is heterogeneous in terms of etiology and expression, and this heterogeneity can be captured by a multidimensional structure, with positive and negative schizotypy being the most widely replicated factors [2, 7–9]. Positive schizotypy is characterized by odd beliefs, unusual perceptual experiences, and

suspiciousness, whereas negative schizotypy involves diminished functioning such as anhedonia, affective flattening, and social disinterest. Overall, positive and negative schizotypy dimensions demonstrate solid construct, concurrent, and predictive validity in psychometric high-risk studies [10–12], cross-sectional interview and questionnaire studies (e.g., [13–17]), and in daily life studies using experience sampling methodology (ESM) [18–20]. These studies indicate that positive and negative schizotypy present certain commonalities and that are also differentially associated with psychopathology, personality, and impairment. Cross-sectional interview studies [13, 15, 17] have commonly reported that positive schizotypy is associated with positive (psychotic-like) symptoms, mood disorders, and substance abuse, whereas negative schizotypy is associated with negative and schizoid symptoms. Furthermore, both positive and negative schizotypy are associated with schizotypal and paranoid symptoms, and with impairment in general and social functioning. Additionally, studies conducted in the domain of daily-life with ESM expand and add ecological validity to the above mentioned findings. This work has demonstrated that positive schizotypy is associated with increased stress reactivity and negative affect in the moment, as well as with psychotic-like experiences and suspiciousness, whereas negative schizotypy is associated with diminished social contact in daily-life and emotional reactivity, as well as with negative symptoms and decreased positive affect in the moment [18–20]. Specifically, Kwapil et al. [18] reported that both schizotypy dimensions were associated with the desire for solitude when with others. However, in individuals high on positive schizotypy the preference for solitude was moderated by anxiety symptoms, whereas in individuals high on negative schizotypy the association was moderated by decreased positive affect. Barrantes-Vidal et al. [19] showed that stress in the moment was associated with experiencing psychotic-like and

paranoid symptoms and also predicted psychotic-like symptoms at the subsequent moment, but only for individuals with high positive, but not negative, schizotypy.

Debbané and colleagues [21] identified only six longitudinal studies investigating schizotypy in general population samples (and three of those studies drew from the same sample). These studies indicated that schizotypy dimensions are differently associated with the development of schizophrenia-spectrum symptoms and disorders, and reinforce the validity of schizotypy as a useful multidimensional construct for identifying individuals at-risk. The classic study of Chapman et al. [22] examined 534 college students identified by the Wisconsin Schizotypy Scales (WSS), including the Perceptual Aberration (PerAb) [23], Magical Ideation (MagicId) [24], and the Physical Anhedonia (PhyAnh) [25] scales. They successfully reinterviewed 508 subjects at a ten-year reassessment, reporting that participants identified by the PerAb and MagicId Scales (measures of positive schizotypy) had elevated rates of psychotic disorders and schizophrenia-spectrum symptoms at the follow-up. Using the Chapmans' longitudinal data, Kwapil [26] reported that high scores on the Revised Social Anhedonia Scale (SocAnh) [27] had elevated rates of schizophrenia-spectrum disorders and symptoms at the ten-year follow-up. In a further reanalysis of the Chapman et al. [22] data, Kwapil et al. [11] computed dimensional positive and negative schizotypy scores based on the WSS. Positive schizotypy predicted the development of psychotic disorders, whereas both positive and negative schizotypy predicted schizophrenia-spectrum disorders. Gooding et al. [28] conducted an independent psychometric high-risk study with a five-year follow-up period of participants identified by the PerAb, MagicId, and SocAnh Scales. They reported that the SocAnh group had elevated rates of schizophrenia-spectrum disorder diagnoses compared to both the PerAb/MagicId and control groups. However, in contrast to Chapman et al. [22] findings, none of the participants met diagnostic criteria for a

psychotic disorder at follow-up. Gooding and colleagues [28] argued that this discrepancy probably reflect the differences of the proportion of lifetime risk for psychosis covered by their 5-year follow-up compared to the Chapman's 10-year follow-up. However, consistent with Kwapil [26], they indicated that SocAnh identified individuals at specific high risk for the development of schizophrenia-spectrum disorders.

In 2011, Barrantes-Vidal and colleagues (e.g., [15]) began a new longitudinal study of college students assessed for positive and negative schizotypy. Consistent with previous studies, their initial interview assessment (completed 1.7 years after the schizotypy screenings) supported the construct validity of both schizotypy dimensions. Positive and negative schizotypy dimensions were associated with schizotypal and avoidant personality traits, suspiciousness, and impaired functioning. Negative schizotypy was associated with negative symptoms and schizoid personality. Positive schizotypy was associated with psychotic-like experiences, negative affect, and borderline and paranoid personality traits. In addition, both dimensions demonstrated differential associations with cognitive schemas. Positive schizotypy was associated with elevated negative interpersonal schemas, whereas negative schizotypy was associated with diminished positive views of self and others.

The extant cross-sectional and longitudinal findings are striking in that nonclinically ascertained participants demonstrate comparable patterns of symptoms and impairment (albeit at a milder level) as patients with schizophrenia-spectrum disorders. Furthermore, nonclinically ascertained young adults who endorse schizotypic traits are at elevated risk for the development of schizophrenia-spectrum symptoms and disorders. However, such longitudinal studies are rare, and only one [11] examined the predictive validity of psychometrically identified positive and negative schizotypy dimensions. The present work employs a prospective framework to study the expression of positive and

negative schizotypy in a young, general population sample and assesses the construct validity of multidimensional schizotypy as an indicator of schizophrenia-spectrum psychopathology.

Goals and hypotheses

The present study further examined the validity of psychometrically assessed positive and negative schizotypy in a nonclinically ascertained sample of young adults at a three-year follow-up assessment (Time 3; T3) of the sample initially reported by Barrantes-Vidal et al. [15]. The first goal of this study was to extend our previous findings by examining, in a longitudinal framework, whether baseline (Time 1; T1) positive and negative schizotypy ratings differentially predicted symptoms and functioning at the three-year reassessment. It was hypothesized that both positive and negative schizotypy dimensions would be associated with schizotypal, paranoid, and avoidant personality traits, and impaired functioning, but that positive schizotypy would be specifically associated with positive (psychotic-like) symptoms, depression, and low self-esteem, whereas negative schizotypy would specifically predict negative symptoms, schizoid personality traits, and emotional blunting. Secondly, we examined whether reports at the Time 2 (T2) interview assessment (1.7 years after T1 and 1.4 years before the current T3 assessment) of symptoms and impairment predicted the same constructs assessed at T3. It was expected that in general T2 measurements would be predictive of the T3 scores, with symptom measures showing lower stability than trait measures. Finally, we examined whether positive and negative schizotypy assessed at T1 predicted the associations of these constructs (i.e., temporal stability or maintenance of symptoms from T2 to T3). We expected that high levels of baseline schizotypy would predict maintenance of symptoms from T2 to T3, whereas low levels of baseline schizotypy would predict low stability.

Method

The method employed to select participants is available as supporting information; see Protocol of the Psychometric High-Risk Strategy Project for Examining Risk and Resilience Trajectories across the Psychosis Continuum dx.doi.org/10.17504/protocols.io.ubieske

Participants and procedure

The present assessment is part of an ongoing longitudinal study examining risk for schizophrenia-spectrum psychopathology. Participants were initially screened and recruited from psychology courses at Universitat Autònoma de Barcelona. As described in Barrantes-Vidal et al. [15], a total of 589 unselected students completed self-report questionnaires at T1, with usable screening data obtained from 547 participants (mean age = 20.6; SD = 4.1; 86% female). In order to have continuous distributions of scores on the schizotypy dimensions with an adequate representation of high scorers, we invited all 189 participants who had standard scores based upon sample norms of at least 1.0 on the positive or negative schizotypy factors from the WSS, the suspiciousness subscale of the Schizotypal Personality Questionnaire (SPQ) [29], or the positive symptom subscale of the Community Assessment of Psychic Experiences (CAPE) [30], and 150 randomly selected participants who had standard scores < 1.0 on each of these measures to participate at T2. Participants were assigned positive and negative schizotypy factor scores based upon norms from 6137 American young adults [17]. Note that Kwapil et al. [31] demonstrated that the positive and negative schizotypy factor structure underlying the scales was invariant in Spanish and American samples. The Spanish adaptation of the WSS used [32] has shown good reliability in college samples as well as external validity (e.g., [33]). Furthermore, the norm-based factor scores correlated .99 with factor scores

generated from a principal components analysis with the Spanish sample of 547 participants.

At T2, 214 participants (mean age = 21.4 years; SD = 2.4; 78% female), completed the assessment (described in Barrantes-Vidal et al. [15]). The sample included 123 participants with at least one schizotypy screening score above 1.0 and 91 with standard scores below 1.0. The mean interval between T1 and T2 assessments was 1.7 years (SD = 0.2 years, range 1.4 to 2.2 years).

Due to funding limitations, we selected a sub-sample of the T2 participants that retained a similar distribution of schizotypy scores for assessment at T3. We recruited 134 participants (93 with high schizotypy and 41 with standard scores below 1.0). Of these, 103 (77%) participants (mean age = 23.06; SD = 2.6; 37.9% male) were reassessed, 75 of 93 (82%) participants with elevated schizotypy scores and 28 of 43 (65%) with standard scores below 1.0. There were no significant differences on positive or negative schizotypy scores between the participants assessed at T3 and the non-followed participants. The mean interval between T2 and T3 assessments was 1.4 years (SD = 0.3 years, range 0.9 to 2.1 years) and between T1 and T3 assessments was 3.1 years (SD = 0.3 years, range 2.6 to 3.6 years). At each assessment, participants provided informed consent and ethical approval was granted by the Ethics Committee of the Universitat Autònoma de Barcelona (Comissió d'Ètica en l'Experimentació Animal i Humana (CEEAH); number 701H-JS; http://www.recerca.uab.es/ceeah/).

Materials

Time 1 self-report measures.

All 547 participants at T1 were administered the WSS intermixed with an infrequency scale [34] and the CAPE and SPQ-suspiciousness scale. The Wisconsin

Schizotypy Scales were used to assess positive and negative schizotypy traits. The Perceptual Aberration Scale [23] assesses psychotic-like bodily distortions and perceptual experiences; the Magical Ideation Scale [24] taps belief in invalid causation; the Revised Social Anhedonia Scale [27] measures schizoid asociality; and the Physical Anhedonia Scale [25] assesses deficits in sensory and esthetic pleasure. The CAPE [30] assesses positive, negative, and depressive dimensions of the psychosis spectrum. The positive dimension scale contains 20 items and was used in this study to assess psychotic-like experiences. The SPQ [29] is a measure of schizotypal personality traits as defined in the Diagnostic and Statistical Manual of Mental Disorders [35]. The 8-item Suspiciousness subscale was used to assess suspiciousness/paranoid ideation.

Time 2 and Time 3 self-report and interview measures and procedures.

Participants at the T2 and T3 assessments were administered questionnaires and diagnostic interviews (along with measures not reported in this study). The interviews were conducted by psychologists and advanced graduate students in clinical psychology. All interviewers were extensively trained and were unaware of participants' scores on the T1 and T2 measures.

Participants completed the Rosenberg Self-Esteem Scale [36]. The Comprehensive Assessment of At-Risk Mental States (CAARMS) [37] is a structured interview that assesses the psychosis prodrome and is used to assess psychotic-like symptoms in nonpatients. Severity scores for seven CAARMS subscales were used. Interview information collected in the CAARMS was used to rate the Structured Interview for Prodromal Symptoms (SIPS) and the Scale of Prodromal Symptoms (SOPS) [38] positive, negative, disorganized, general and total symptom dimensions. The Structured Clinical Interview for DSM-IV Axis II Disorders [39] was used to assess schizophrenia-spectrum personality disorders and obtain dimensional ratings for

paranoid, schizoid, schizotypal and avoidant personality disorders. Functioning was rated using the Social and Occupational Functioning Assessment Scale [40] and the Global Assessment of Functioning [41]. Depressive symptoms were assessed with the Calgary Depression Scale [42] and the Beck Depression Inventory-II [43].

Results

Descriptive statistics

The mean for positive schizotypy assessed at T1 was −.05 (SD = 1.07, range = −1.45 to 3.23), and for negative schizotypy was .20 (SD = 1.17, range = −1.57 to 4.27). Both dimensions were unimodal and positively skewed. The schizotypy dimensions were not correlated (r = .03). In addition, the mean for CAPE positive symptoms dimension assessed at T1 was 9.46 (SD = 5.31, range = 0 to 23), and for SPQ suspiciousness subscale was 3.48 (SD = 2.29, range = 0 to 8). Table 1 provides descriptive data for the measures used in the study.

Validity of the schizotypy dimensions

Hierarchical linear regressions were computed to examine the variance accounted for by T1 assessments of positive and negative schizotypy in measures of T3 psychopathology, personality, and functioning (Table 2). Positive and negative schizotypy dimension scores were entered simultaneously in the regression models at the first step. In the second step, the T2 measure of the current T3 criterion was entered as a predictor to examine the stability of these measures across measurements. Finally, at the third step, the interaction of both schizotypy dimension with the step 2 measure was entered in order to examine whether positive and negative schizotypy were associated with trait stability or maintenance of symptoms across the assessments. The standardized regression coefficient (β), change in R2, and effect size f 2 were reported for each

predictor in the regressions. Following Cohen [44], f 2 values above .15 are medium and above .35 are large effect sizes. Given that many of the dependent variables were skewed (especially measures of psychopathology), maximum likelihood estimation and bootstrap procedures (with 2 000 samples) were used.

As hypothesized, the T1 positive schizotypy dimensional score predicted positive (psychotic-like) symptoms, depression, low self-esteem, and general psychopathology at T3. In contrast, T1 negative schizotypy predicted emotional disturbances and schizoid personality ratings at T3. As expected, both positive and negative schizotypy predicted schizotypal, paranoid, and avoidant personality ratings, and global functioning ratings as well as motor/physical symptoms.

At the second step, T2 measures of symptoms and functioning generally predicted their analogous constructs at T3 over-and-above positive and negative schizotypy. Furthermore, psychosis-spectrum symptom measures generally exhibited lower stability across time in the prediction of T3 analogous constructs than schizophrenia-spectrum personality measures. The interaction of T1 positive and negative schizotypy dimensions with T2 symptom ratings were generally unassociated with measures at T3. However, the interaction of positive schizotypy and T2 paranoid personality ratings predicted T3 paranoid personality traits, whereas negative schizotypy and T2 social and occupational functioning interaction predicted T3 functioning. Simple slope analyses were computed to decompose these interactions. The relationship between T2 and T3 paranoid personality symptoms was significant at all levels of positive schizotypy (Fig 1). However, the relationship strengthened as positive schizotypy increased from low ($\beta = 0.30$, $p < 0.04$), to moderate ($\beta = 0.44$, $p < 0.001$), to high levels ($\beta = 0.58$, $p < 0.001$). T2 social and occupational functioning ratings and the same construct assessed 1.4 years later

were significantly related at moderate ($\beta = 0.39$, $p < 0.001$) and high ($\beta = 0.65$, $p < 0.001$) levels of negative schizotypy, but not low levels ($\beta = 0.12$, $p = 0.5$) (Fig 2).

We also examined whether the positive x negative schizotypy interaction terms predicted symptoms and impairment over-and-above the main effects of positive and negative schizotypy. The schizotypy interaction only predicted CAARMS motor/physical symptoms ($\beta = .331$, $\Delta R2 = .106$, $f 2 = .14$, $p < .01$) at T3. Simple slope analysis indicated that positive schizotypy and CAARMS motor/physical symptoms were significantly related at moderate ($\beta = 0.49$; $p < 0.05$) and high ($\beta = 1.11$; $p < 0.01$) levels of negative schizotypy (T1), but not at low levels ($\beta = -0.14$; $p = 0.5$) (Fig 3). The lack of significant positive x negative schizotypy interactions is consistent with Kwapil et al. [17] and Barrantes-Vidal et al. [15] who reported additive, but not interactive, effects for positive and negative schizotypy.

We examined the extent to which the schizotypy dimensions predicted prodromal symptom dimensions using SIPS/SOPS ratings at T3 (Table 3). As expected, positive and general prodromal symptoms were predicted by positive schizotypy, whereas negative schizotypy predicted negative prodromal symptoms. Both dimensions predicted total prodromal symptoms.

Binary logistic regressions were computed to assess the prediction of diagnostic criteria by the schizotypy dimensions. Seven participants assessed at T3 qualified for personality disorder diagnoses at T2: three with Avoidant, two with Schizotypal, and four with Paranoid Personality Disorders (three had more than one disorder). At T3, three of these participants retained schizophrenia-spectrum personality disorders: two with Paranoid and two with Avoidant Personality Disorders (one with two disorders). There were no new cases of personality disorders at T3. Positive schizotypy (OR = 1.97, 95%CI = 0.71–5.51), negative schizotypy (OR = 1.23, 95%CI = 0.39–3.84), and the interaction

term (OR = 1.14, 95%CI = 0.40–3.28) failed to predict schizophrenia-spectrum personality disorders at T3. Of the four participants who did not retain their personality disorder diagnosis, three met multiple criteria for personality disorders, but fell short of diagnostic thresholds.

Given that most participants reported sub-diagnostic threshold traits for Cluster A personality disorders, we created an overall Cluster A dimensional score for participants at T2 and T3. This was computed by standardizing and summing the dimensional ratings for schizoid, schizotypal, and paranoid personality disorder at each assessment. We then computed regression analyses predicting the Cluster A rating at T3. Both positive (β = .270, $p < .01$) and negative schizotypy (β = .431, $p < .001$) predicted the ratings, although their interaction term did not (β = .142, ns). The Cluster A rating at T2 predicted the rating at T3 (β = .535, $p < .001$); however, neither the interaction of the T2 rating with positive schizotypy (β = .070, ns) nor with negative schizotypy (β = .056, ns) were significant.

Seven participants who met the CAARMS attenuated psychosis criteria at T2 were reassessed at T3. Of these, three participants continued to meet the attenuated psychosis criteria at T3. There were no new cases meeting CAARMS high-risk criteria at T3. Positive schizotypy (OR = 1.29, 95%CI = 0.44–3.73), negative schizotypy (OR = 1.28, 95%CI = 0.48–3.38), and the schizotypy interaction (OR = 1.23, 95%CI = 0.42–3.62) did not predict CAARMS attenuated psychosis criteria.

Binary logistic regressions were computed in order to examine the prediction of any mental health treatment during the past year at the T3 assessment by schizotypy dimensions assessed at T1. Ten participants reported receiving treatment within the past year. Negative schizotypy (OR = 1.62, $p < .05$), but not positive schizotypy (OR = .91) or the interaction term (OR = 1.10), uniquely predicted mental health treatment at T3.

Discussion

Multidimensional models of schizotypy provide a useful conceptualization for understanding the underlying developmental vulnerability for schizophrenia-spectrum psychopathology [1, 2]. The psychometric assessment of schizotypy allows us to examine the etiology of schizophrenia-spectrum disorders by identifying individuals with a putative vulnerability for developing such disorders, which should enhance our understanding of etiological factors, inform us about developmental trajectories and risk and protective factors, and potentially provide insights for developing prophylactic interventions. The present study extended our previous findings [15] examining the schizotypy dimensions in a 3-year follow-up of nonclinically ascertained young adults and supported the validity of the two factor structure as distinct dimensions of schizotypy.

Consistent with previous research examining the associations of positive and negative schizotypy with symptoms and impairment [15, 17], both schizotypy dimensions predicted differential associations with psychopathology, personality, and functioning in the present study. Note that the dimensions did not identify additional individuals who had transitioned into schizophrenia-spectrum disorders since the T2 assessment. However, less than 1-1/2 years had passed since that assessment. Furthermore, this is a relatively high functioning sample that has only recently entered into the time of greatest risk for developing schizophrenia-spectrum disorders. Note that the mean age of the sample is only 23 years old, which is younger than Gooding et al.'s [28] and Chapman et al.'s [22] samples at their follow-up.

Negative schizotypy predicted impaired functioning, schizoid and schizotypal personality symptoms and emotional disturbances. The finding that the negative schizotypy dimension did not predict subclinical negative symptoms assessed by the

CAARMS is consistent with our previous cross-sectional study [15] and likely reflects the fact that the CAARMS negative symptom rating appears heavily saturated with depression. For example, it correlated moderately with depression (r = .45), but only minimally with schizoid symptoms (r = .22) and presented a high correlation with CAARMS positive symptoms ratings (r = .54). In order to assess negative symptoms in a young adult sample, Kwapil et al. [17] used the Negative Symptom Manual (NSM) [45] to quantify negative symptoms. Findings showed that negative, but not positive, schizotypy had a strong and unique association with NSM ratings. Furthermore, NSM scores were strongly associated with schizoid personality traits, but minimally associated with depression and positive symptoms.

As hypothesized, positive schizotypy predicted psychotic-like symptoms, depression, and low self-esteem, and was related with all schizophrenia-spectrum measures except for schizoid personality. The present study also investigated the association of schizotypy dimensions with depressive symptoms and self-esteem. Our finding that positive, but not negative, schizotypy predicted depression and low self-esteem 3-years later is consistent with our prior cross-sectional study [15] with the present sample. The stronger association of affective symptoms with positive rather than negative schizotypy has been previously reported by cross-sectional (e.g., [46]) and longitudinal studies of non-clinical samples. In the longitudinal study of Chapman et al. [22], participants with elevated scores on the PerAb and MagicId scales reported higher rates of major depressive disorders both at baseline and at 10-year follow-up. In contrast, PhyAnh and SocAnh were not associated with mood disorders at follow-up [22, 26]. These findings suggest that individuals high on positive schizotypy are at greater risk to develop both affective disorders and non-affective psychotic disorders, whereas individuals high on negative schizotypy appear to be at risk especially for schizophrenia-

spectrum disorders. Furthermore, evidence indicating that affective experiences are differentially related to positive and negative schizotypy comes from research using ESM. Kwapil et al. [18] reported that negative schizotypy was associated with decreased positive affect in the moment, whereas positive schizotypy was associated with increased negative affect in the moment. Consistent with the latter finding, psychotic-like experiences were related with affective dysregulation in a 10-year longitudinal study in a community sample [47]. It was found that psychotic-like experiences were more likely to have clinical relevance and persist over time with increasing levels of affective dysregulation. Authors suggested that affective dysregulation may causally contribute to the persistence and increasing clinical severity of these experiences through the facilitation of attributions of aberrant salience to abnormal perceptual and cognitive experiences.

The present findings showed that both schizotypy dimensions predicted avoidant personality disorder symptoms, which is consistent with our previous cross-sectional findings [15] as well as with other research conducted with genetic and psychometric high-risk participants showing a link between avoidant personality and liability for schizophrenia. In terms of genetic risk, the UCLA family study [48] demonstrated that avoidant personality disorder occurred more often in individuals with genetic risk for schizophrenia than in control participants, even after controlling for paranoid and schizotypal personality disorders. These authors concluded that such compelling findings suggest that avoidant personality enhances the detection of individuals with vulnerability for schizophrenia and supports the inclusion of avoidant personality as a schizophrenia-spectrum disorder. In fact, Fogelson and colleagues [49] had already indicated that avoidant personality should be included as an additional dimension of schizotypy along with the more traditionally regarded dimensions. In a factor analysis including all

schizotypal, schizoid, paranoid, avoidant, and borderline personality disorder traits, avoidant symptoms emerged as a dimension along with positive, negative, disorganized, paranoid, and borderline dimensions. In light of these findings, Gooding et al. [50] reanalyzed data from their 5-year longitudinal study [28] and found that individuals from both SocAnh and PerAb/MagicId groups (especially the former), but not control participants, met criteria for avoidant and Cluster A personality disorders. At the same time, some high-risk participants meeting criteria for avoidant personality disorder did not meet criteria for Cluster A personality disorders. Similarly, Bolinskey et al. [51] found that individuals with elevated schizotypy traits met more criteria for avoidant and Cluster A personality symptoms as compared to control participants, and suggested that avoidant personality disorder may reflect a less severe form of vulnerability for schizophrenia than schizoid personality in which social withdrawal is also associated with conflicting interpersonal feelings. Finally, avoidant symptoms have also been found in schizophrenia patients [52, 53] and in ultra high-risk individuals [54, 55]. Fresán and colleagues [55] reported that avoidant behavior symptoms were more prevalent in ultra high-risk and schizophrenia groups than in control participants and suggested that avoidant personality features may lead to the dysfunctional social interaction observed in both ultra high-risk individuals and schizophrenia patients. Additionally the present results seems to suggest that, on the one hand, avoidant personality is driven by an anxiety component and its association with positive schizotypy and, on the other hand, by the social withdrawal and social disinterest characteristic of negative schizotypy. Social anhedonia (withdrawal/disinterest) and social anxiety have been found to show different patterns of association with affective symptoms, real-life social environment, and schizotypy. Brown et al. [56] reported that social anhedonia was associated with negative schizotypy, whereas social anxiety was associated with positive schizotypy. In a study examining

these associations in daily-life by means of ESM, Brown et al. [57] indicated that social anhedonia was associated with decreased positive affect in the moment, reduced desire for social contact, and with preference of solitude. In contrast, social anxiety was found to be associated with increased negative affect in the moment and with the preference to be alone especially when being with people with whom one feels less close to—a situation in which individuals with social anxiety have been found to report the highest level of negative affect. These findings suggested that individuals with high social anxiety desire social contact but feel anxious with non-close others, whereas individuals with social anhedonia are actually not so influenced by the context and present a deficit in affect and disinterest for social interactions.

The present study examined whether baseline measures of schizotypic symptoms and functioning assessed at T2 were associated with the same measures 1.4 years later. As hypothesized, measures generally predicted their analogous ratings at T3, with generally stronger effect sizes for trait than symptoms measures. Unexpectedly, emotional disturbances and schizoid personality ratings at T2 did not significantly predict their equivalent measures at T3. In general, ratings of schizoid personality traits were low and none of the participants qualified for schizoid personality disorders. Nevertheless, negative schizotypy was robustly associated with schizoid traits at T3 (as it had been at T2). The finding that schizoid personality ratings at T2 demonstrated lower stability over time is contrary to our hypothesis and in contrast with the stability of the schizoid psychopathology reported by Lenzenweger [58] in a 4-year longitudinal study. However, consistent with Roberts and Del Vecchio's [59] meta-analysis, longitudinal research on personality disorders suggested changes in individual personality pathology across time and a degree of flexibility and plasticity rather than fixed stability [60–63].

The findings that schizophrenia-spectrum symptoms predicted their equivalent measure across time with large effect sizes provides further evidence for the stability and the persistence of schizophrenia-spectrum characteristics for those participants who reported high levels of symptoms 1.4 years before the T3 assessment. Hanssen et al. [64] reported that subclinical psychotic experiences in the general population are 100 times greater than the incidence of psychotic diagnoses. In the same line, the epidemiological study of Werbeloff et al. [65] showed that 20–22% of the population reported negative symptoms and of these only a few reported psychiatric clinical diagnoses. This is consistent with previous studies in the general population that reported the presence of subclinical psychotic symptoms is greater than the incidence of psychotic diagnosis [64, 65]. Moreover, De Loore et al. [66] reported that 5% of 1912 adolescents reported auditory hallucinations and these symptoms were persistent in one-third of them. Thus, psychometric study of schizotypy provides a valid method to identify and study developmental trajectories of schizophrenia-spectrum psychopathology in a longitudinal framework.

In general, the association of symptom, trait, and impairment ratings from T2 to T3 did not vary as a function of baseline levels of positive or negative schizotypy at T1. Based upon the main effects for positive and negative schizotypy, this suggests that people high in positive and negative schizotypy tended to report higher levels of symptom, traits, and impairment at T2, which were maintained at T3, whereas people lower in schizotypy tended to have lower scores on interview measures that maintained across the two assessments. Nevertheless, there were two significant interactions. High levels of positive schizotypy at baseline predicted a stronger association of paranoid personality ratings across assessments. Similarly, high levels of negative schizotypy at baseline predicted a stronger association of social impairment.

The present findings provide further evidence of the predictive validity of positive and negative schizotypy dimensions and are consistent with our previous cross-sectional findings [15]. The present study is not without limitations. The fact that at T3 we did not attempt to reassess the entire sample of T2 is a limitation; however, we achieved a high reassessment rate (77%) of the identified pool of participants. Note that the lack of an interview assessment at T1 (when psychometric positive and negative schizotypy were assessed) means that we cannot rule out that some participants were already experiencing symptoms and impairment at baseline. This limits our ability to make specific inferences about the developmental timecourse of the symptoms and impairment from T1 to T3, but does not limit our ability to evaluate differential patterns of associations of T1 positive and negative schizotypy with T3 symptoms and impairment. Furthermore, the interpretations of the associations of T2 and T3 symptoms and impairment were not impacted by the presence or absence of symptoms and impairment at T1, nor were the interactions of positive and negative schizotypy with the T2 –T3 relationships. An advantage of the present longitudinal study is that it recruited participants from a nonclinically ascertained sample, which allows us to examine etiological factors without the confounders associated with the disease and to examine the course of participants who do and do not transition into schizophrenia-spectrum disorders [6]. Although at the three-year follow-up none of the participants transitioned into psychotic disorders, this approach should allow us to identify participants who do so at subsequent assessments. This method may ultimately allow us to identify individuals at risk and to develop intervention strategies aimed at decreasing possible risk factors and increasing protective factors (i.e., quality of life, improve affect, social support, etc.) for the development of schizophrenia-spectrum disorders.

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Competing interests

The authors have declared that no competing interests exist.

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Tables and Figures

Table 1.

Descriptive statistics for quantitative dependent measures of symptoms, impairment, and personality.

	Time 2				Time 3			
Measure	**Mean**	**SD**	**Range**	**Alpha [a]**	**Mean**	**SD**	**Range**	**Alpha [a]**
CAARMS positive symptoms	1.55	2.77	0-16	-	1.21	2.16	0-12	-
CAARMS negative symptoms	1.90	2.72	0-11	-	1.63	2.34	0-9	-
CAARMS cognitive symptoms	1.11	1.80	0-8	-	1.02	1.51	0-7	-
CAARMS emotional disturbance	1.23	2.11	0-8	-	0.91	1.46	0-6	-
CAARMS behavioral symptoms	1.64	2.19	0-8	-	1.71	2.24	0-9	-
CAARMS motor/physical symptoms	1.18	2.15	0-14	-	1.14	1.87	0-10	-
CAARMS general psychopathology	3.85	4.15	0-21	-	4.63	4.33	0-22	-
Schizotypal personality ratings	1.46	2.35	0-13	-	1.33	1.98	0-10	-
Schizoid personality ratings	1.15	1.76	0-8	-	1.01	1.80	0-8	-
Paranoid personality ratings	2.06	2.58	0-12	-	1.65	2.11	0-10	-
Avoidant personality ratings	2.56	3.10	0-12	-	1.83	2.47	0-11	-
Social and occupational functioning	86.0	8.7	55-100	-	85.1	8.26	60-100	-
Global assessment of functioning	84.8	11.0	51-100	-	81.1	11.3	50-100	-
Rosenberg total	22.2	5.21	3-30	.90	22.9	5.28	7-30	.90
Beck depression inventory	5.94	5.46	0-25	.85	6.17	6.80	0-28	.90
Calgary depression scale	1.24	1.87	0-11	-	1.55	2.41	0-11	-

[a] Coefficient alpha reported for questionnaire measures only.

Table 2.

Linear regressions of measures of psychosis spectrum, affective dysregulation, self-esteem and functioning.

	Step 1 (df =1,100)						**Step 2** (df =1,99)			**Step 3** (df =1,97)					
	T1 Positive schizotypy			T1 Negative schizotypy			Criterion T2			Interaction Pos SZ x Criterion T2			Interaction Neg SZ x Criterion T2		
Criterion T3	**β**	**ΔR²**	***f*²**	**β**	**ΔR²**	***f*²**	**β**	**ΔR²**	***f*²**	**β**	**ΔR²**	***f*²**	**β**	**ΔR²**	***f*²**
Psychosis Spectrum															
CAARMS Positive symptoms	.234*	.055	.06	.149	.022	.02	.498*	.227	**.33**	-.024	.000	.00	.096	.007	.01
CAARMS Negative symptoms	.140	.020	.02	.119	.014	.01	.377***	.121	.14	-.066	.004	.00	.101	.009	.01
CAARMS Cognitive symptoms	.072	.005	.01	.137	.019	.02	.488***	.232	**.31**	.016	.000	.00	.025	.001	.00
CAARMS Emotional disturbance	.104	.011	.01	.302**	.091	.10	.210	.038	.04	-.142	.019	.02	.068	.004	.00
CAARMS Behavioral symptoms	.200	.040	.04	.034	.001	.00	.218*	.043	.05	-.139	.017	.02	-.067	.004	.00
CAARMS Motor/physical symptoms	.277*	.076	.09	.249*	.062	.07	.313*	.094	.12	.149	.019	.03	.237	.026	.04
CAARMS General psychopathology	.285**	.081	.09	.067	.004	.00	.538***	.242	**.36**	-.120	.013	.02	.050	.002	.00
Schizotypal personality	.240*	.058	.07	.273**	.074	.09	.624***	.331	**.62**	.057	.002	.00	.092	.008	.02
Schizoid personality	.086	.007	.01	.553***	.306	**.45**	.299	.067	.11	-.129	.014	.02	.083	.005	.01
Paranoid personality	.330**	.109	.13	.219**	.048	.06	.594***	.295	**.54**	.211*	.033	.06	-.109	.010	.02
Avoidant personality	.294*	.086	.10	.212*	.045	.05	.720***	.418	**.94**	.060	.003	.01	.006	.000	.00
Affective dysregulation and self-esteem															
Rosenberg total	-.446***	.198	**.26**	-.144	.021	.03	.707***	.360	**.86**	-.058	.002	.00	.031	.001	.00
Calgary depression scale	.360**	.129	**.15**	-.034	.001	.00	.440***	.180	**.26**	.198	.022	.03	.079	.004	.01
Beck depression inventory	.238*	.057	.06	.141	.020	.02	.491***	.192	**.26**	-.046	.002	.00	.103	.009	.01
Functioning															
Social and occupational functioning	-.136	.018	.02	-.373**	.139	**.17**	.542***	.249	**.43**	-.099	.009	.02	.290**	.059	.12
Global assessment of functioning	-.331**	.110	.14	-.287**	.082	.10	.554***	.249	**.45**	-.027	.001	-.02	.133	.015	.03

*p<0.05, **p<0.01, ***p<0.001.

Note 1: A series of linear regressions were computed to examine the variance accounted for by positive and negative schizotypy (T1) in predicting psychopathology, personality and functioning at T3; maximum likelihood estimation and bootstrap procedures (with 2 000 samples) were employed.

Note 2: According to Cohen [44], f 2 values above .15 are medium and above .35 are large effect sizes.

Table 3.

Linear regressions of measures of prodromal psychotic SIPS/SOPS symptoms.

	Step 1 (df =1,100)						**Step 2** (df =1,99)		
	T1 Positive schizotypy			T1 Negative schizotypy			T1 Pos X Neg Schizotypy		
Criterion T3	**β**	**ΔR ^{2}**	***f*** ^{2}	**β**	**ΔR ^{2}**	***f*** ^{2}	**β**	**ΔR ^{2}**	***f*** ^{2}
SIPS/SOPS									
Positive	.251*	.063	.07	.173	.030	.03	.233	.052	.06
Negative	.195	.038	.04	.287**	.082	.09	.076	.006	.01
Disorganized	.167	.028	.03	.128	.016	.02	.133	.017	.02
General	.262*	.068	.07	.105	.011	.01	.171	.028	.03
Total	.273*	.074	.09	.232**	.054	.06	.186	.033	.04

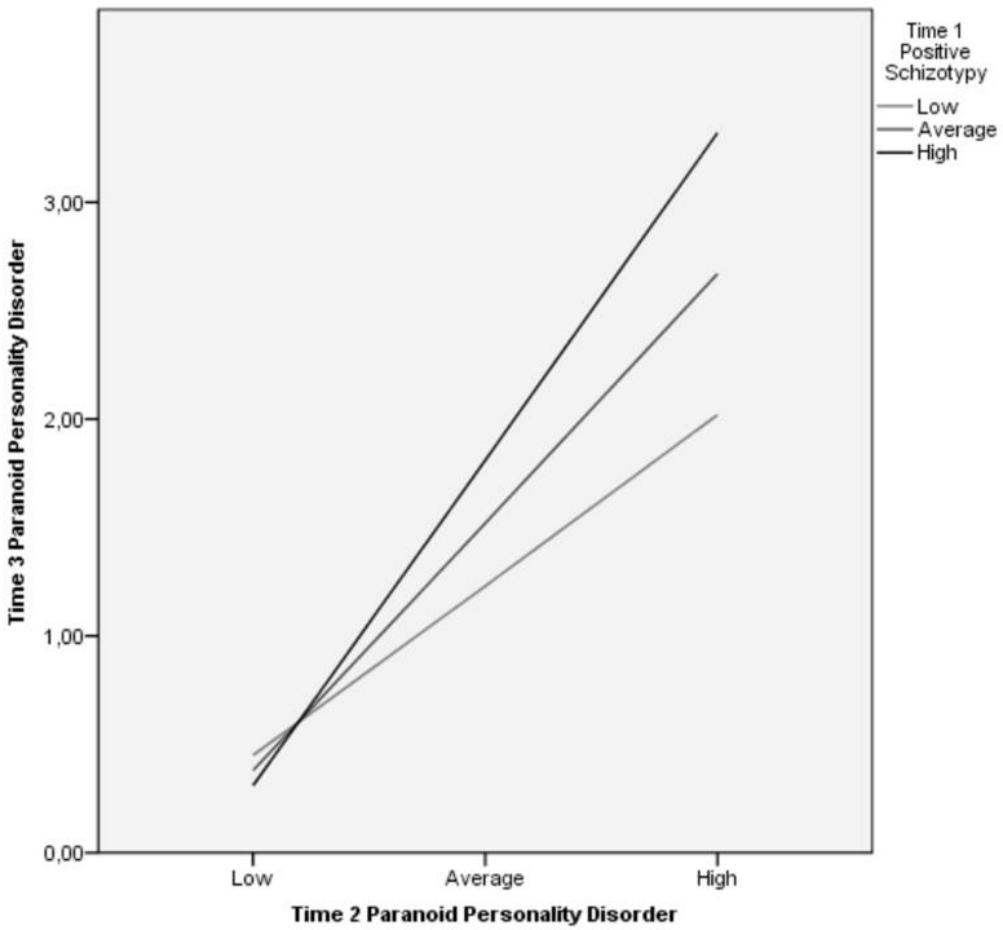
*p<0.05, **p<0.01, ***p<0.001.

Note 1: A series of linear regressions were computed to examine the variance accounted for by positive and negative schizotypy (T1) in predicting SIPS/SOPS prodromal symptoms and states at T3; maximum likelihood estimation and bootstrap procedures (with 2 000 samples) were employed.

Note 2: According to Cohen [44], f 2 values above .15 are medium and above .35 are large effect sizes.

Fig 1.

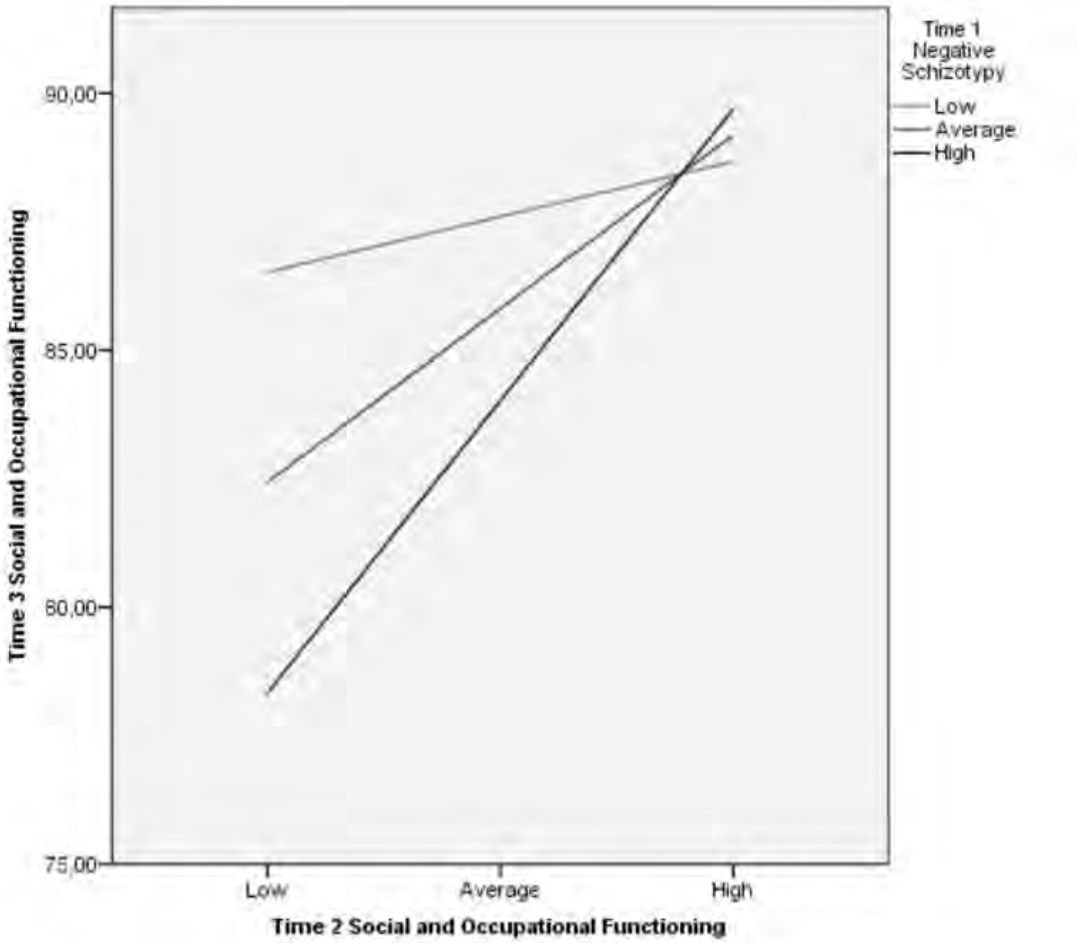
Relationship between T2 and T3 paranoid personality symptoms across levels of T1 positive schizotypy.



Relationship between levels of T2 paranoid personality symptoms and T3 paranoid personality symptoms at three levels of T1 positive schizotypy (low, medium, high) as indicated by simple slope analysis.

Fig 2.

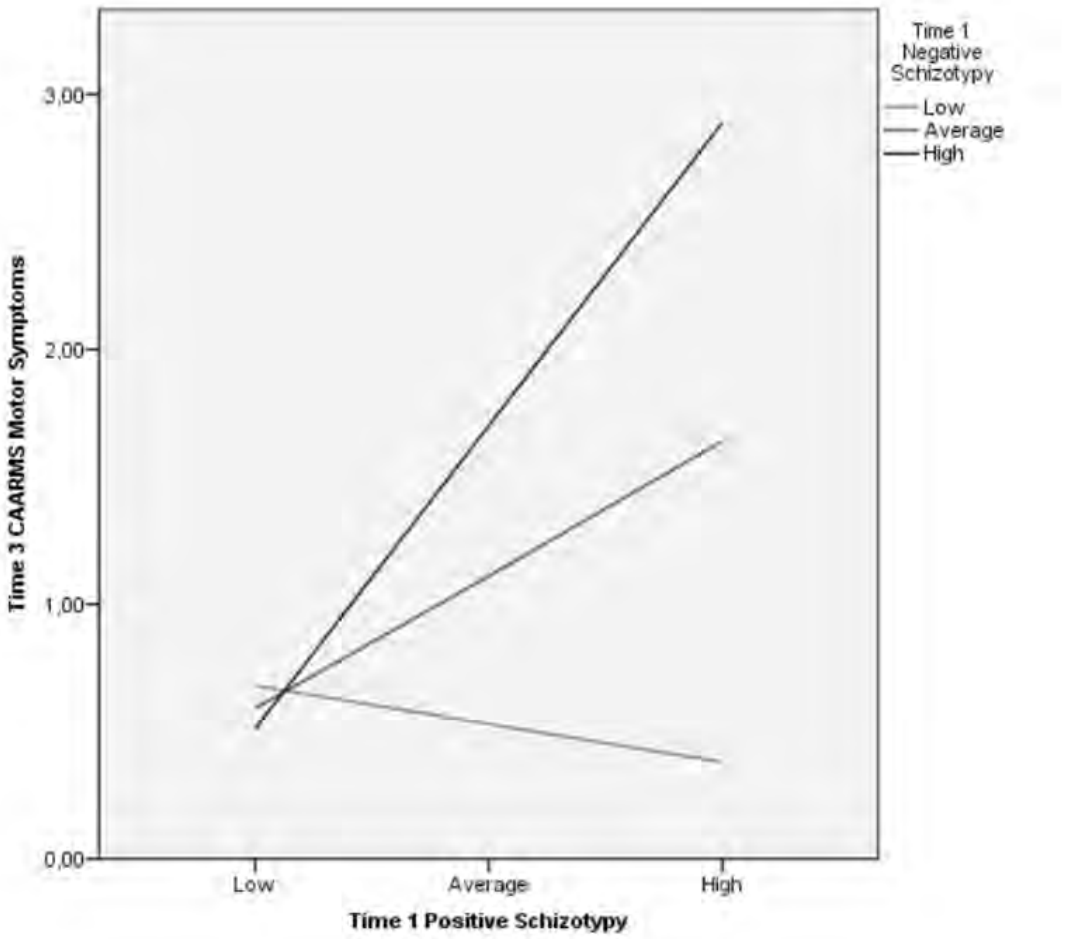
Relationship between T2 and T3 social and occupational functioning across levels of T1 negative schizotypy.



Relationship between levels of T2 social and occupational functioning and T3 social occupational functioning at three levels of T1 negative schizotypy (low, medium, high) as indicated by simple slope analysis.

Fig 3.

Relationship between T1 positive schizotypy and T3 CAARMS motor/physical symptoms across T1 negative schizotypy levels.



Relationship between levels of T1 positive schizotypy and T3 CAARMS motor/physical symptoms at three levels of T1 negative schizotypy (low, medium, high) as indicated by simple slope analysis.

References

1. Claridge G. Theoretical background and issues. In: Claridge G, editor. Schizotypy: Implications for Illness and Health. Oxford University Press; 1997. pp. 3–18.
2. Kwapil TR, Barrantes-Vidal N. Schizotypy: looking back and moving forward. Schizophr Bull. 2015; 41 Suppl 2: S366–S373.
3. Claridge G, Beech T. Fully and quasi-dimensional constructions of schizotypy. In: Raine A., Lencz T, Mednick SA, eds. Schizotypal Personality Disorder. Cambridge University Press; 1995 pp. 192–216.
4. Debbané M, Barrantes-Vidal N. Schizotypy from a developmental perspective. Schizophr Bull. 2015; 41 Suppl 2: S386–S395.
5. Barrantes-Vidal N, Grant P, Kwapil TR. The role of schizotypy in the study of the etiology of schizophrenia spectrum disorders. Schizophr Bull. 2015; 41 Suppl 2: S408–S416.
6. Lenzenweger MF. Thinking clearly about schizotypy: hewing to the schizophrenia liability core, considering interesting tangents, and avoiding conceptual quicksand. Schizophr Bull. 2015; 41 Suppl 2: S483–S491.
7. Vollema MG, van den Bosch RJ. The multidimensionality of schizotypy. Schizophr Bull. 1995; 21: 19–31.
8. Fonseca-Pedrero E, Debbané M, Ortuño-Sierra J, Chan RCK, Cicero DC, Zhang LC, et al. The structure of schizotypal personality traits: a cross-national study. Psychol Med. 2017; 17: 1–12.
9. Kwapil TR, Gross GM, Silvia PJ, Raulin ML, Barrantes-Vidal N. Development and psychometric properties of the Multidimensional Schizotypy Scale: a new

measure for assessing positive, negative, and disorganized schizotypy. Schizophr Res. 2018; 193: 209–217.

10. Blanchard JJ, Collins LM, Aghevli M, Leung WW, Cohen AS. Social anhedonia and schizotypy in a community sample: the Maryland longitudinal study of schizotypy. Schizophr Bull. 2011; 37: 587–602.
11. Kwapil TR, Gross GM, Silvia PJ, Raulin ML, Barrantes-Vidal N. Prediction of psychopathology and functional impairment by positive and negative schizotypy in the Chapmans' ten-year longitudinal study. J Abnorm Psychol. 2013; 122: 807–815.
12. Miettunen J, Veijola J, Isohanni M, Paunio T, Freimer N, Jääskeläinen E, et al. Identifying schizophrenia and other psychoses with psychological scales in the general population. J Nerv Ment Dis. 2011; 199: 230–238.
13. Barrantes-Vidal N, Lewandowski KE, Kwapil TR. Psychopathology, social adjustment and personality correlates of schizotypy clusters in a large nonclinical sample. Schizophr Res. 2010; 122: 219–225.
14. Barrantes-Vidal N, Rosa A, Kwapil TR. An examination of neuroticism as a moderating factor in the association of positive and negative schizotypy with psychopathology in a nonclinical sample. Schizophr Res. 2009; 115: 303–309.
15. Barrantes-Vidal N, Gross GM, Sheinbaum T, Mitjavila M, Ballespí S, Kwapil TR. Positive and negative schizotypy are associated with prodromal and schizophrenia-spectrum symptoms. Schizophr Res. 2013; 145: 50–55.
16. Horton LE, Barrantes-Vidal N, Silvia PJ, Kwapil TR. Worries about being judged versus being harmed: disentangling the association of social anxiety and paranoia with schizotypy. PLoS One 2014; 9 (6). doi: 10.1371/journal.pone.0096269.

17. Kwapil TR, Barrantes-Vidal N, Silvia PJ. The dimensional structure of the Wisconsin Schizotypy Scales: factor identification and construct validity. Schizophr Bull. 2008; 34: 444–457.
18. Kwapil TR, Brown LH, Silvia PJ, Myin-Germeys I, Barrantes-Vidal N. The expression of positive and negative schizotypy in daily life: an experience sampling study. Psychol Med. 2012; 42: 2555–2566
19. Barrantes-Vidal N, Chun CA, Myin-Germeys I, Kwapil TR. Psychometric schizotypy predicts psychotic-like, paranoid, and negative symptoms in daily life. J Abnorm Psychol. 2013; 122: 1077–1087.
20. Chun CA, Barrantes-Vidal N, Sheinbaum T, Kwapil TR. Expression of schizophrenia-spectrum personality traits in daily life. Personal Disord. 2017; 8: 64–74.
21. Debbané M, Eliez S, Badoud D, Conus P, Flückiger R, Schultze-Lutter F. Developing psychosis and its risk states through the lens of schizotypy. Schizophr Bull. 2015; 41 Suppl 2: S396–S407.
22. Chapman LJ, Chapman JP, Kwapil TR, Eckblad M, Zinser M. Putatively psychosis-prone subjects 10 years later. J Abnorm Psychol. 1994; 103: 171–183.
23. Chapman LJ, Chapman JP, Raulin ML. Body-image aberration in schizophrenia. J Abnorm Psychol. 1978; 87: 399–407.
24. Eckblad M, Chapman LJ. Magical ideation as an indicator of schizotypy. J. Consult. Clin. Psychol. 1983; 51: 215–225.
25. Chapman LJ, Chapman JP, Raulin M. Scales for physical and social anhedonia. J Abnorm Psychol. 1976; 85: 374–382.
26. Kwapil TR. Social anhedonia as a predictor of the development of schizophrenia-spectrum disorders. J Abnorm Psychol. 1998; 107: 558–565.

27. Eckblad ML, Chapman LJ, Chapman JP, Mishlove M. The Revised Social Anhedonia Scale; 1982. Unpublished test copies available from T.R. Kwapil, UIUC Department of Psychology, Champaign, NC, 61820.
28. Gooding DC, Tallent KA, Matts CW. Clinical status of at-risk individuals 5 years later: further validation of the psychometric high-risk strategy. J Abnorm Psychol. 2005; 114: 170–175.
29. Raine A. The SPQ: a scale for the assessment of schizotypal personality based on DSM-III-R criteria. Schizophr Bull. 1991; 170: 555–564.
30. Stefanis NC, Hanssen M, Smirnis NK, Avramopoulos DA, Evdokimidis IK, Stefanis CN, et al. Evidence that three dimensions of psychosis have a distribution in the general population. Psychol Med. 2002; 32: 347–358.
31. Kwapil TR, Ros-Morente A, Silvia PJ, Barrantes-Vidal N. Factor invariance of psychometric schizotypy in Spanish and American samples. J. Psychopathol. Behav. Assess. 2012; 34: 145–152.
32. Ros-Morente A, Rodríguez-Hansen G, Vilagrà-Ruiz R, Kwapil TR, Barrantes-Vidal N. Proceso de adaptación al castellano de las Escalas de Vulnerabilidad a las Psicosis de Wisconsin (Adaptation of the Wisconsin scales of psychosis proneness to Spanish). Actas Esp. Psiquiatr. 2010; 38: 33–41.
33. Barrantes-Vidal N, Fañanás L, Rosa A, Caparrós B, Riba MD, Obiols JE. Neurocognitive, behavioural, and neurodevelopmental correlates of schizotypy clusters in adolescents from the general population. Schizophr. Res. 2003; 61: 293–302.
34. Chapman LJ, Chapman JP. Infrequency scale for personality measures; 1983. Unpublished scale available from T.R. Kwapil, UIUC Department of Psychology, Champaign, NC, 61820.

35. American Psychological Association, 1987. Diagnostic and Statistical Manual of Mental Disorders, third edition. (Text Revision). Washington Author, American Psychological Association.
36. Rosenberg M. Society and the Adolescent Self-Image. Princeton: Princeton University Press; 1965.
37. Yung AR, Yuen H, McGorry PD, Phillips LJ, Kelly D, Dell'Olio M, et al. Mapping the onset of psychosis: the comprehensive assessment of at-risk mental states. Aust N Z J Psychiatry. 2005; 39: 964–971.
38. Miller TJ, McGlashan TH, Rosen JL, Cadenhead K, Cannon T, Ventura J, et al. Prodromal assessment with the structured interview for prodromal syndromes and the scale of prodromal symptoms: predictive validity, interrater reliability, and training to reliability. Schizophr Bull. 2003; 29: 703–715.
39. First MB, Gibbon M, Spitzer RL, Williams JBW, Benjamin LS. Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II). Washington: American Psychiatric Press; 1997.
40. Goldman HH, Skodol AE, Lave TR. Revising Axis V for DSM-IV: a review of measures of social functioning. Am. J. Psychiatry 1992; 149: 1148–1156.
41. American Psychiatric Association, 2000. Diagnostic and Statistical Manual of Mental Disorders, fourth edition. (Text Revision). Washington Author, American Psychiatric Association.
42. Addington D, Addington J, Maticka-Tyndale E, Joyce J. Reliability and validity of a depression rating scale for schizophrenics. Schizophr Res. 1992; 6: 201–208.
43. Beck AT, Steer RA, Brown GK. Manual for the Beck Depression Inventory-II. San Antonio: Psychological Corporation; 1996.
44. Cohen J. A power primer. Psychol Bull. 1992; 112: 155–159.

45. Kwapil TR, Dickerson LA. Unpublished results. Negative symptom manual. Unpublished interview manual.
46. Lewandowski KE, Barrantes-Vidal N, Nelson-Gray RO, Clancy C, Kepley HO, Kwapil TR. Anxiety and depression symptoms in psychometrically identified schizotypy. Schizophr Res2006; 83: 225–235.
47. van Rossum I, Dominguez MD, Lieb R, Wittchen HU, van Os J. Affective dysregulation and reality distortion: a 10-year prospective study of their association and clinical relevance. Schizophr Bull. 2011; 37: 561–71.
48. Fogelson DL, Nuechterlein KH, Asarnow RA, Payne DL, Subotnik KL, Jacobson KC, Neale MC, Kendler KS. Avoidant personality disorder is a separable schizophrenia-spectrum personality disorder even when con- trolling for the presence of paranoid and schizotypal personality disorders: the UCLA family study. Schizophr Res 2007; 91: 192–199.
49. Fogelson DL, Nuechterlein KH, Asarnow RF, Payne DL, Subotnik KL, Giannini CA. The factor structure of schizophrenia spectrum personality disorders: signs and symptoms in relatives of psychotic patients from the UCLA family members study. Psychiatry Res. 1999; 87: 137–46.
50. Gooding DC, Tallent KA, Matts CW. Rates of avoidant, schizotypal, schizoid and paranoid personality disorders in psychometric high-risk groups at 5-year follow-up. Schizophr Res 2007; 94: 373–374.
51. Bolinskey PK, James AV, Cooper-Bolinskey D, Novi JH, Hunter HK, Hudak DV, Schuder KM, Myers KR, Iati CA, Lenzenweger MF. Revisiting the blurry boundaries of schizophrenia: spectrum disorders in psychometrically identified schizotypes. Psychiatry Res 2015; 225: 335–340.

52. Keshavan MS, Duggal HS, Veeragandham G, McLaughlin NM, Montrose DM, Haas GL, Schooler NR. Personality dimensions in first-episode psychoses. Am J Psychiatry. 2005; 162: 102–109.
53. Solano J, De Chávez M. Premorbid personality disorders in schizophrenia. Schizophr Res 2000; 44: 137–144.
54. Lee S, Kim K, Park J, Park J, Kim B, Kang J, Lee E, An SK, Kwon JS. Coping strategies and their relationship to psychopathologies in people at ultra high-risk for psychosis and with schizophrenia. J Nerv Ment Dis 2011; 199: 106–110.
55. Fresán A, León-Ortiz P, Robles-García R, Azcárraga M, Guizar D, Reyes-Madrigal F, Tovilla-Zárate C, de la Fuente-Sandoval,C. Personality features in ultra-high risk for psychosis: A comparative study with schizophrenia and control subjects using the Temperament and Character Inventory-Revised (TCI-R). J. Psychiatr. Res 2015; 61: 168–173.
56. Brown LH, Silvia PJ, Myin-Germeys I, Lewandowski KE, Kwapil TR. The Relationship of Social Anxiety and Social Anhedonia to Psychometrically Identified Schizotypy. J Soc Clin Psychol. 2008; 27: 127-149.
57. Brown LH, Silvia PJ, Myin-Germeys I, Kwapil TR. When the need to belong goes wrong: The expression of social anhedonia and social anxiety in daily life. Psychol. Sci. 2007; 18: 778-782.
58. Lenzenweger MF. A source, a cascade, a schizoid: a heuristic proposal from the Longitudinal Study of Personality Disorders. Dev. Psychopathol. 2010; 22: 867–881.
59. Roberts BW, DelVecchio WF. The rank-order consistency of personality traits from childhood to old age: a quantitative review of longitudinal studies. Psychol Bull. 2000; 126: 3–25.

60. Grilo CM, Sanislow CA, Gunderson JG, Pagano ME, Yen S, Zanarini MC, et al. Two-year stability and change of schizotypal, borderline, avoidant, and obsessive-compulsive personality disorders. J Consult Clin Psychol. 2004; 72: 767–75.
61. Johnson JG, Cohen P, Kasen S, Skodol AE, Hamagami F, Brook JS. Age-related change in personality disorder trait levels between early adolescence and adulthood: a community-based longitudinal investigation. Acta Psychiatr Scand. 2000; 102: 265–275.
62. Lenzenweger MF, Willett JB. Does change in temperament predict change in schizoid personality disorder? A methodological framework and illustration from the Longitudinal Study of Personality Disorders. Dev. Psychopathol. 2009; 21: 1211–1231.
63. Shea M, Stout R, Gunderson J, Morey L, Grilo C, McGlashan T, et al. Short-term diagnostic stability of schizotypal, borderline, avoidant, and obsessive–compulsive personality disorders. Am J Psychiatry. 2002; 159: 2036–2041.
64. Hanssen M, Bak M, Bijl R, Vollebergh WAM, van Os J. The incidence and outcome of subclinical psychotic experiences in the general population. Br J Clin Psychol. 2005; 44: 181–191.
65. Werbeloff N, Dohrenwend BP, Yoffe R, van Os J, Davidson M, Weiser M. The association between negative symptoms, psychotic experiences and later schizophrenia: a population-based longitudinal study. PLoS One 2015; 10 (3). doi: 10.1371/journal.pone.011985.
66. De Loore E, Gunther N, Drukker M, Feron F, Sabbe B, Deboutte D, et al. Persistence and outcome of auditory hallucinations in adolescence: a longitudinal general population study of 1800 individuals. Schizophr Res. 2011; 127: 252–256.

Chapter 2

Schizotypy Dimensions Predict At-Risk Mental States, Schizophrenia-Spectrum Symptoms, and Impairment: A 4.4 Year Prospective Study

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Abstract

Schizotypy represents a useful construct for understanding the underlying vulnerability for schizophrenia and related disorders. However, there are only three previous longitudinal studies examining the predictive validity of schizotypy in nonclinical samples. The present study offers a unique, longitudinal assessment of the association of psychometric positive and negative schizotypy at baseline with interview-based ratings of symptoms and impairment 4.4 years later in a sample of nonclinical young adults. A total of 89 individuals (86% of 103 candidate participants) completed the fourth longitudinal assessment. Positive schizotypy predicted positive symptoms, whereas negative schizotypy uniquely predicted negative and schizoid personality symptoms (PDs). Both schizotypy dimensions predicted schizotypal and paranoid PDs symptoms, as well as suspiciousness, low self-esteem, and depression symptoms. Only negative schizotypy predicted impairment in social and global functioning four years later. The analyses of the moderating role of schizotypy in the stability of symptoms across the third and fourth wave of the study (1.3 years) showed that participants with high baseline levels of positive schizotypy presented a wide range of scores on positive symptoms and that these scores were highly consistent across the two assessments. These longitudinal results provide further support for the predictive validity of psychometrically assessed positive and negative dimensions. Schizotypy traits seem to underlie the symptom and impairment expression characterizing at-risk mental states and may be useful as preclinical risk indicators. Given the current interest in focusing on pre-clinical stages, these results are highly relevant to identify at risk individuals and to develop effective preventing treatments for psychosis.

Keywords: schizotypy, schizophrenia, psychosis-proneness, psychometric high-risk, liability, longitudinal.

1. Introduction

Schizotypy is conceptualized as the phenotypic expression of the developmental vulnerability for schizophrenia that is expressed across a dynamic continuum of traits and symptoms ranging from subclinical impairment to full-blown schizophrenia (Debbané et al., 2015; Kwapil and Barrantes-Vidal, 2012; 2015; Nelson et al., 2013). Although there is not a universal consensus about its multidimensional latent structure, current conceptualizations (Kwapil and Barrantes-Vidal, 2015), confirmatory factor analysis (e.g., Gross et al., 2014; Kwapil et al., 2008), psychometric network models (Christensen, et al., 2018; Fonseca-Pedrero et al., 2018), new instruments assessing schizotypy (Gross, et al., 2018; Kwapil et al., 2018), and multicultural research examining the structure of schizotypy (Chan et al., 2015; Fonseca-Pedrero et al., 2017), indicate that the most supported dimensions are positive, negative, and disorganized schizotypy. The positive (psychotic-like) dimension includes odd beliefs, perceptual anomalies, ideas of reference, and paranoia, while the negative (deficit) dimension involves anhedonia, avolition, flattened affect, alogia, and anergia. The disorganized dimension is characterized by disruptions in the form of thought, communication, and behavior.

The study of schizotypy in non-clinical samples aims to detect individuals with an increased risk for psychosis, and as such, facilitates the identification of risk and protective factors, as well as etiological mechanisms before the onset of clinical manifestations. This avoids the severe confounds associated with these disorders (Lenzenweger, 2015; Barrantes-Vidal et al., 2015; Debbané and Barrantes-Vidal, 2015). This research also informs preventative treatment strategies, complementing the findings obtained in clinical high risk (CHR) samples. For example, findings of recent studies examining schizotypy in CHR individuals demonstrate that schizotypy is a valid screening method that improves the predictive power of CHR criteria (Bang et al., 2019; Flückiger et al., 2016; Salokangas et al., 2013). Overall, these findings indicate that schizotypy offers a useful phenotype that is associated with the predisposition to schizophrenia and the developmental trajectory of vulnerability for psychosis.

The psychometric high-risk method is a cost-effective strategy that is widely in studying the underlining developmental vulnerability for schizophrenia and spectrum-disorders in non-clinical samples. The utility and validity of this method have been demonstrated in cross-sectional studies with non-clinical young adults, which indicated that positive and negative schizotypy are associated with distinct and overlapping symptoms and impairment (e.g., Barrantes-Vidal et al., 2010; Barrantes-Vidal et al., 2013a,b; Badcock et al., 2016; Bolinskey et al., 2015; Lenzenweger, 2018; ; Cicero et al., 2015; Ettinger et al., 2015; Gross et al., 2012; Kwapil et al., 2012; Nelson et al., 2013; Wang et al., 2012). However, there is a paucity of longitudinal studies regarding their predictive validity.

The pioneering longitudinal study by Chapman et al. (1994) employed the psychometric-high strategy in a sample of non-clinical college students identified by scores on the Wisconsin Schizotypy Scales (WSS), including the Perceptual Aberration (PerAb; Chapman et al., 1978), Magical Ideation (MagicId; Eckblad and Chapman, 1983), and Physical Anhedonia (PhyAnh; Chapman et al., 1976) Scales. They reassessed 95% of their 534 participants at a ten-year follow-up. In the re-analysis of their findings, Kwapil et al. (2013) examined the predictive validity of the psychometrically identified positive and negative schizotypy as assessed by the WSS (including the addition of the Revised Social Anhedonia Scale (SocAnh); Eckblad et al., 1982). They reported that positive schizotypy predicted the development of psychotic disorders, whereas both positive and negative schizotypy dimensions predicted schizophrenia-spectrum disorders. Furthermore, positive schizotypy predicted psychotic-like symptoms, paranoid and schizotypal personality disorder traits, as well as major depressive and manic/hypomanic episodes, substance use disorders, and mental health treatment at the ten-year follow-up. Negative schizotypy predicted schizoid, schizotypal, and paranoid personality traits, as well as social impairment, 10-years later. These findings are striking given that participants were functioning well enough to enroll in a major university at the start of the study, they were only part-way into the window of greatest risk for developing psychosis at the time of the follow-up assessments, and schizotypy ratings predicted schizophrenia-spectrum symptoms even after omitting participants with

schizophrenia-spectrum disorders. The rates of transition into schizophrenia-spectrum disorders were as high as those typically seen in genetic high-risk studies (Kwapil et al., 2013). Overall, these findings supported the predictive validity of the WSS and showed that schizotypy is a useful phenotype for detecting developmental risk for schizophrenia and related disorders. However, Chapman et al.'s (1994) study only reported on findings from an initial and ten-year follow-up assessments, and thus they could not provide specific information about when, how, and why symptoms and impairment developed across the ten-year period.

In 2005 Gooding and colleagues reported findings of a five-year longitudinal study. They identified two high-risk groups based on the WSS: a group of high scorers on the PerAb /MagicId Scales and high scorers on the SocAnh Scale. At the reassessment, both groups displayed more frequent and severe positive symptoms compared to a control group. In contrast to the 1994 findings by Chapman et al., baseline ratings did not predict schizophrenia-spectrum disorders at the follow-up and no participants met criteria for a psychotic disorder. The authors argued that this difference was related to the fact that Chapman's 10-year follow-up covered a greater period of risk. Furthermore, participants in the Gooding et al. (2005) study had better baseline functioning than those in the Chapman study (1994), even when considering that they were college students. More recently, Bolinskey and colleagues (2017) conducted a two-year longitudinal study of high schizotypy scorers on either the PerAb, MagicId, or SocAnh Scales, and a matched control group. They reported that the high schizotypy group met more avoidant, paranoid, schizoid, and schizotypal personality traits and were more likely to meet criteria for these PDs than the comparison group at both the baseline and two-year reassessment.

In line with these studies, we previously reported cross-sectional and longitudinal findings as part of an ongoing longitudinal project examining risk and protective factors for psychosis in a college student sample psychometrically identified with the WSS scales, the Barcelona Longitudinal Investigation of Schizotypy (BLISS). In a cross-sectional study, Barrantes-Vidal et al. (2013b) found that positive schizotypy was uniquely associated with interview ratings of positive symptoms, paranoid, and borderline personality traits, as well as

negative affect and negative schemas of self and others. In contrast, negative schizotypy was associated with negative and schizoid symptoms, and with diminished positive schemas of self and others. Moreover, both schizotypy dimensions were associated with schizotypal and avoidant PDs traits, suspiciousness, and impaired functioning. In a 3-year follow-up study (Racioppi et al., 2018), positive schizotypy predicted interview ratings of positive symptoms and general psychopathology, as well as self-reported depression and low self-esteem, whereas negative schizotypy predicted interview ratings of schizoid traits, emotional disturbance, and mental health treatment during the past year. Additionally, both schizotypy dimensions predicted schizotypal, paranoid, and avoidant traits, suspiciousness, and impaired functioning three years later.

1.1. Goals and hypotheses

The primary goal of the present study was to expand on previous studies of the construct and predictive validity of psychometrically assessed positive and negative schizotypy by conducting a 4.4 year longitudinal reassessment of non-clinically ascertained young adults in the BLISS project. This report extends previous cross-sectional (Barrantes-Vidal et al., 2013b) and longitudinal (Racioppi et al., 2018) findings by examining the extent to which psychometrically identified positive and negative schizotypy differentially predict symptoms and impairment. The present study expands on the limited prospective research in this area by: a) including the interview-based assessment of prodromal symptoms and personality disorders, b) employing dimensional measures of positive and negative schizotypy as predictors, and c) assessing negative symptoms with multiple interviews, which is important when considering concerns that some interview measures of negative symptoms are saturated with depression and neuroticism—characteristics that are not part of current conceptualizations of negative symptoms (Barrantes-Vidal et al., 2013b; Racioppi et al., 2018). Given concerns about the feasibility of capturing negative-like symptoms in non-clinical populations, the predictive validity of negative schizotypy of these symptoms was examined controlling for emotional dysregulation.

Consistent with our previous findings, it was hypothesized that positive and negative schizotypy dimensions would be associated with overlapping and differential patterns of

symptoms and impairment. Specifically, it was expected that both schizotypy dimensions assessed at Time 1 (T1) would be associated with schizotypal, paranoid, and avoidant PDs traits as well as suspiciousness and impaired functioning 4.4 years later (Time 4; T4). It was predicted that positive schizotypy would be specifically associated with positive symptoms, depression, anxiety and low self-esteem, whereas negative schizotypy was expected to be specifically associated with negative symptoms and schizoid traits. We also investigated whether the temporal stability of schizophrenia-spectrum personality traits, positive and negative symptoms, as well as impairment, anxiety, depression, self-esteem and functioning across T3 and T4 (1.3-year interval) was predicted by baseline levels of schizotypy assessed 4.4 years before (T1). It was expected that high levels of baseline schizotypy would predict a higher stability of symptoms and functional impairment. Furthermore, we analyzed whether the interaction of positive and negative schizotypy assessed at T1 was predictive of the outcome measures at T4.

2. Method

2.1. Participants and Procedure

This study is part of BLISS, an ongoing longitudinal project examining schizotypy and risk for schizophrenia-spectrum psychopathology within a young college sample. Figure 1 of the supplementary material provides a flow diagram describing the selection of study participants. At T1, 589 young adults from psychology courses at Universitat Autònoma de Barcelona completed the WSS, the suspiciousness subscale of the Schizotypal Personality Questionnaire (SPQ; Raine, 1991), and the positive symptom subscale of the Community Assessment of Psychic Experiences (CAPE; Stefanis et al., 2002). Of these, 42 participants were excluded from the final study due to invalid protocols, leaving 547 participants with usable data (mean age = 20.6; SD = 4.1; 86% female). We invited all 189 participants who had standard scores based upon sample norms of at least 1.0 on the positive or negative schizotypy factors derived from the three measures, and 150 randomly selected participants who had standard scores < 1.0 to participate at T2. Participants were assigned positive and negative schizotypy factor scores based upon norms from 6137 American young adults (Kwapil et al., 2008). A more detailed description of the participants and

selection procedures is described in previous BLISS studies (Barrantes-Vidal et al., 2013a, b; Racioppi et al., 2018), and it is also reported in the flow diagram (Fig.1) of the current study supplementary material.

Three interview and questionnaire reassessments were conducted (T2, T3, and T4). The T2 reassessment took place an average of 1.7 years (SD=0.2 years, range 1.4 to 2.2 years) after the T1 screening. At T2, we assessed a selected sub-sample of 214 participants (mean age = 21.4 years; SD = 2.4; 78% female). T3 took place an average of 1.4 years after T2 (SD= 0.3 years, range 0.9 to 2.1 years) and 3.1 years after T1 (SD= 0.3 years, range 2.6 to 3.6 years). A total of 103 (77%) participants (mean age= 23.06; SD=2.6; 37.9% male) completed T3 reassessment. The sample included 75 of 93 (82%) participants with elevated schizotypy scores and 28 of 43 (65%) with standard scores below 1.0.

The current assessment (T4) took place on average of 1.3 years after T3 assessment (SD= 0.2 years, range 1.0 to 2.1 years). A total of 89 (86%) participants (mean age = 24.8 years; SD=2.7; 38.2% male) completed the reassessment. The sample included 66 of 75 (88%) participants with elevated schizotypy scores (standardized scores of at least 1.0 on any of the T1 schizotypy measures) and 23 of 28 (82%) with standard scores below 1.0. The mean interval between T1 and T4 assessments was 4.4 years (SD= 0.3 years, range 4.0 to 5.2 years) and 2.7 years (SD= 0.2, range 2.3 to 3.4 years) between T2 and T4.

2.2. Materials

2.2.1. Time 1 questionnaires

At T1, participants completed the WSS and CAPE scales, and the SPQ-Suspiciousness subscale. The WSS is one of the most extensively used instruments for assessing schizotypy. Two factors (positive and negative schizotypy) have been consistently found to underlie the four scales and account for approximately 80% of their variance in American and Spanish samples (e.g., Kwapil et al., 2008; Kwapil et al., 2012). These factor scores were used as predictors of symptoms and impairment at the follow-up assessments. The WSS scales were administered intermixed with an infrequency scale (Chapman and Chapman, 1983) to identify invalid responders.

2.2.2. Time 3 and Time 4 questionnaire and interview measures

2.2.2.1. Questionnaire measures

Suspiciousness was assessed with the SPQ-Suspiciousness subscale. Self-esteem was measured with the Rosenberg Self-Esteem Scale (Rosenberg, 1965). Anxiety symptoms were assessed with the Beck Anxiety Inventory (BAI; Beck et al., 1988), and depressive symptoms with the Beck Depression Inventory-II (BDI-II; Beck et al., 1996).

2.2.2.2. Interview measures

Prodromal symptoms were measured with the Comprehensive Assessment of At-Risk Mental States (CAARMS; Yung et al., 2005). The CAARMS is a structured interview that can be used to assess positive symptoms in non-clinical populations (e.g., Simons et al., 2007). The CAARMS subscales assessing the severity of positive and negative symptoms were administered. Given concerns that the CAARMS negative symptom rating is strongly associated with depressive symptoms and emotional dysregulation, the Negative Symptom Manual (NSM; Kwapil and Dickerson, 2001) was employed to assess clinical and subclinical negative symptoms at T4. The NSM is a structured clinical interview that assesses five classes of symptoms: Anhedonia, Social Withdrawal, Avolition/Anergia, Affective Flattening, and Alogia. Dimensional ratings of schizophrenia-spectrum PDs were obtained with the Structured Clinical Interview for DSM-IV Axis II Disorders (First et al., 1997). Participants were interviewed for Paranoid, Schizoid, Schizotypal and Avoidant Disorder. Functioning was assessed with the Social and Occupational Functioning Assessment Scale (Goldman et al., 1992) and the Global assessment of Functioning (American Psychiatric Association, 2000).

2.3. Data analysis

A series of hierarchical linear regressions were computed to examine whether T1 positive and negative schizotypy dimensions predicted symptoms and functioning at T4. In the first model, T1 positive and negative schizotypy dimensions were entered simultaneously at the first step to examine their unique effects as predictors of the outcome measures at T4. In a second step, T3 measures of prodromal symptoms, schizophrenia-spectrum PDs traits, mood, self-esteem and

functioning were entered in order to evaluate the association with their analogous measures assessed at T4 (1.3 years later). At the third step, the interaction term of T1 schizotypy dimensions with each criterion measure, as assessed at T3, was entered in order to examine its effect over-and-above the temporal stability of the equivalent constructs reassessed 4.4 years later. A second regression model was computed with the positive x negative schizotypy interaction term entered at the second step in order to analyze the contribution of the interaction between the schizotypy dimensions over-and-above the main effect of each one to account for T4 measures. For each predictor in the regression models the standardized regression coefficient (β), semi-partial r^2, and effect size f^2 are reported. According to Cohen (1992), f^2 values above .15 are medium effects and above .35 are large effect sizes (however, note that designs that employ oversampling can lead to inflated estimates of effect sizes). Given that many of the continuous dependent variables were skewed (especially measures of psychopathology), maximum likelihood estimation and bootstrap procedures (with 2000 samples) were employed.

3. Results

The means for the 89 participants reassessed at T4 were 0.63 for positive schizotypy (SD=1.35, range=−1.16 to 3.84) and 0.36 for negative schizotypy (SD=1.32, range=−1.63 to 5.18). Both dimensions were unimodal and positively skewed. They were not significantly correlated (r =.05). Table 1 provides descriptive data for the interview and questionnaire measures assessed at T4.

Results of linear regressions analyzing the prediction of schizophrenia-spectrum measures, prodromal symptoms, functioning, self and mood are reported in Tables 2 and 3. As hypothesized, both schizotypy dimensions assessed at T1 predicted schizotypal and paranoid PD traits, as well as suspiciousness at T4. In addition, both schizotypy dimensions predicted T4 positive symptoms, although the magnitude for positive schizotypy was greater than that of negative schizotypy. Depression ratings and low self-esteem were also predicted by both dimensions. Anxiety ratings were not predicted by either schizotypy dimension. As expected, negative schizotypy uniquely predicted schizoid traits (with a large effect size) and negative

symptoms, as assessed by both the CAARMS and NSM, as well as dysfunctional impairment, at T4.

Given concerns that the CAARMS negative symptom ratings tapped emotion dysregulation, we computed additional linear regression analyses to examine the predictive validity of negative symptoms as measured by both the CAARMS and NSM partialling out the variance of emotional dysregulation (i.e. avoidant PD, anxiety, and depression symptoms) (Table 4). Results showed that the prediction of T4 CAARMS negative symptoms by T1 negative schizotypy was no longer significant, whereas the prediction of T4 NSM negative symptoms by T1 negative schizotypy remained significant.

The second step of the hierarchical linear regressions (Table 2) showed, as hypothesized, that ratings on interview measures of symptoms at T3 were associated with ratings at T4, generally on the order of medium to large effect sizes. As expected, schizophrenia-spectrum personality disorder traits presented overall higher stability than psychosis-spectrum symptoms measures. The only exceptions were for measures of positive symptoms and functioning. It is important to note that negative symptoms were not assessed with the NSM at T3, and thus, it is not possible to examine their stability with this measure.

Concerning the third step (Table 2), results showed that the interaction terms of T1 schizotypy dimensions and T3 measures were generally unassociated with measures at T4, indicating that the association of T3 and T4 measures did not differ depending on the level of T1 positive or negative schizotypy. Only positive symptoms (T4) were predicted by the interaction of T1 positive schizotypy and with T3 positive symptoms. Simple slope analysis revealed that the relation between T3 and T4 positive symptoms was significant at low (β= -0.33, $p < 0.01$) and high (β= 0.39, $p < 0.001$) levels of T1 positive schizotypy, but not at moderate levels (β= 0.03, $p = 0.7$) (Fig. 2).

The interaction term of the two schizotypy dimensions (Table 3) was generally unassociated with psychosis-spectrum, functioning, and affective dysregulation at T4. However, the interaction between T1 positive and negative schizotypy predicted T4 paranoid and avoidant

PDs ratings. Simple slopes indicated that the relationship between T4 paranoid traits and T1 negative schizotypy was significant at moderate (β= 0.51, $p < 0.01$) and high (β= 0.91, $p < 0.01$) levels of T1 positive schizotypy, but not at low levels (β= 0.12, $p = 0.6$) (Fig. 3). Likewise, simple slope analysis revealed that T4 avoidant traits and T1 negative schizotypy were significantly related at moderate (β= 0.46, $p < 0.05$) and high (β= 1.03, $p < 0.05$) levels of T1 positive schizotypy, but not at low levels (β= -0.11, $p = 0.7$) (Fig. 4).

Results of the linear regression model examining the prediction of negative symptoms as assessed by the NSM and CAARMS negative subscales are reported in Table 5. T1 negative schizotypy uniquely predicted NSM subscales of anhedonia, avolition/anergia, alogia symptoms, social withdrawal, and affective flattening. In contrast, T1 negative schizotypy only predicted CAARMS negative symptom subscale of anhedonia, and both schizotypy dimensions predicted avolition/anergia symptom subscale. Additionally, the positive x negative schizotypy interaction did not predict NSM and CAARMS negative symptom subscales. In order to examine the relationship between negative symptoms as assessed by both CAARMS and NSM with emotional dysregulation and schizoid PD symptoms we ran additional analysis. CAARMS negative symptoms correlated moderately with avoidant (r=.35) and anxiety symptoms (r=.34), but showed a large correlation with depression symptoms (r=.50) and presented a moderate correlation with CAARMS positive symptoms ratings (r=.39). In contrast, NSM was moderately correlated with avoidant (r=.32) and depression (r=.35) symptoms, and not with anxiety symptoms (r=.09), but presented a large correlation with CAARMS positive ratings (r=.53). Notably, the NSM presented a large correlation with schizoid symptoms (r=.69), whereas CAARMS negative symptoms was not associated with schizoid symptoms (r=.16).

Binary logistic regressions were conducted to examine dichotomous outcome measures, such as diagnostic status. At T3, 3 (2.9%) participants met criteria for schizophrenia-spectrum PDs: 2 for Paranoid and 2 for Avoidant personality disorder (1 qualified for more than one disorder). All of them were reassessed at T4. Only one of the two participants who met criteria for Paranoid personality disorder retained the same diagnosis. At T4, 4 (4.5%) participants (three

new cases) had schizophrenia-spectrum personality disorders: 2 Paranoid, 1 Avoidant, and 1 Schizoid PDs. Neither positive (OR= 1.82, 95%CI=0.53-6.34) nor negative schizotypy (OR=1.75, 95%CI=0.75-4.09) or the interaction term (OR= 1.12, 95%CI= 0.44-2.82) predicted the schizophrenia-spectrum disorders at T4. Note that three of the new cases meeting criteria for PDs at T4, two met multiple diagnostic criteria for the same personality disorder at T3 although not reaching a diagnostic status.

At T3, the CAARMS attenuated psychosis syndrome criteria were met by 3 (2.9%) of the participants, but none of them continued to meet criteria at T4. There were 2 new cases (2.2%) at T4. Binary logistic regression results showed that neither positive (OR=3.90, 95%CI=0.70-21.65) nor negative schizotypy (OR=0.99, 95%CI=0.12-8.21), nor the interaction term (OR=0.76, 95%CI=0.18-3.33) predicted CAARMS attenuated psychosis syndrome at T4.

Binary logistic regressions were computed to determine whether T1 positive and negative schizotypy predicted self-reports of mental health treatment (i.e., psychopharmacological, psychiatric, or psychological treatment) during the past year or at the time of T4 assessments. Twelve participants (13.5%) reported receiving treatment within the past year at T4. T1 negative schizotypy (OR=1.68, 95%CI = 1.01–2.80, p<.05) predicted mental health treatment during the past year, while positive schizotypy (OR=1.67, 95%CI = .85–3.29) and the interaction term (OR=0.86, 95%CI = .49–1.52) did not. Moreover, six participants (6.7%) reported that they were receiving treatment at the time of T4 assessments. T1 negative schizotypy (OR=2.20, 95%CI = 1.04–4.67, p<.05) predicted mental health treatment at the time of T4 assessments, but positive schizotypy (OR=0.67, 95%CI = .20–2.26) and the interaction term (OR=1.45, 95%CI = .54–3.85) did not.

4. Discussion

The present study sought to extend our previous findings with the BLISS sample by further examining the longitudinal trajectories of positive and negative schizotypy in a non-clinical sample over a period of 4.4 years. Notably, to our knowledge this is the first study to report the predictive validity of schizotypy dimensions for positive and negative symptoms

assessed with CAARMS in non-clinical population (and, with the current report, to do so over three time points). Consistent with our hypotheses and previous cross-sectional (Barrantes-Vidal et al., 2013b) and longitudinal (Racioppi et al., 2018) findings, the schizotypy dimensions showed theoretically meaningful differential and overlapping patterns of predictions for schizophrenia-spectrum symptoms and PDs, as well as with other forms of psychopathology and impairment, thus confirming their predictive validity. In terms of our primary predictions, baseline positive schizotypy predicted interview-rated positive symptoms 4.4 years later with a large effect size, whereas negative schizotypy uniquely predicted interview-rated negative symptoms and schizoid personality traits with large effect sizes, as well as impairment in social and global functioning. Notably, the prediction of negative symptoms remained significant with a large effect size when variance of mood symptoms and avoidant personality were partialled out of the analyses of NSM-rated negative symptoms, but not CAARMS negative symptoms. Additionally, only negative schizotypy predicted concurrent and past-year history of mental health treatment. On the other hand, both schizotypy dimensions predicted suspiciousness, schizotypal, and paranoid personality symptoms, as well as symptoms of low self-esteem and depression at T4. In addition, T3 measures of schizophrenia-spectrum psychopathology generally predicted their equivalent constructs at T4. The interaction term of T3 positive symptoms and T1 positive schizotypy was associated with T4 positive symptoms. In addition, T1 positive and negative schizotypy interaction term was associated with T4 paranoid and avoidant personality symptoms. Finally, only T1 negative schizotypy was associated with T4 NSM negative symptoms both the global score and the five different classes.

The present results showed that negative schizotypy uniquely predicted schizoid personality traits, negative symptoms, and impairment in social and global functioning over a 4.4-year period. However, negative schizotypy did not predict avoidant personality ratings, suggesting that the predictive association with schizoid personality is not merely driven by the behavioural component that these two PDs share. The finding that T1 negative schizotypy uniquely predicted T4 schizoid personality symptoms is consistent with our previous cross-

sectional (Barrantes-Vidal et al., 2013b) and longitudinal (Racioppi et al., 2018) reports showing the same association at T2 and T3, respectively. Consistent with the specific and stable association between negative schizotypy and schizoid personality traits across three data waves spanning 4.4 years, and mirroring our previous finding at T3, negative schizotypy uniquely predicted diminished social functioning at T4. Of note, the finding that negative schizotypy robustly predicts social functioning problems in college students is especially striking given that these individuals are functioning well enough as to enroll in and attend college courses. These findings are in line with previous longitudinal studies conducted with individuals at high psychometric (Kwapil et al., 2013) and clinical risk (Corcoran et al., 2011), as well as with patients with a first episode of psychosis (Ho et al., 1998; Milev et al., 2005), showing that negative symptoms were specifically associated with social impairment. The finding that negative schizotypy predicted social impairment 4.4 years later offers additional evidence to the usefulness of schizotypy assessment in non-clinical samples as a psychometric screening method able to detect mechanisms that may be important in terms of the developmental course of schizophrenia. Participants of this sample with high social deterioration might be at greater risk for a psychotic transition. Note that the longitudinal study of Cannon et al. (2008) showed that social deterioration strongly increased the transition to psychosis in CHR individuals 2.5 years later.

The present study made an in-depth examination of negative symptoms in non-clinical participants by using two interview measures at T4 and by analyzing the potential role of emotional dysregulation in the prediction of these symptoms. Negative schizotypy uniquely predicted negative symptoms as assessed with NSM 4.4 years later with a large effect size. This is consistent with findings from Kwapil et al. (2008) and Kemp et al., (2019). In contrast, and consistent with our previous cross-sectional (Barrantes-Vidal et al., 2013b) and longitudinal (Racioppi et al., 2018) reports, CAARMS negative symptoms appeared to be saturated by affective dysregulation symptoms, as their prediction was no longer significant once variance for avoidant personality, depression and anxiety traits was considered in the model. Furthermore, results indicated that CAARMS negative symptoms presented a large correlation with depression

symptoms. As noted, some questionnaire and interview measures of negative schizotypy and symptoms appear to suffer from contamination by constructs such as neuroticism, depression, and social anxiety. On the surface, these constructs may appear overlapping with negative schizotypy (as they share features such as flattened affect, social disinterest, and anhedonia). In negative schizotypy, however, diminished positive affect, motivation, and cognition tend to be trait-like, and not linked to elevated negative affect; whereas these characteristics are episodic and associated with negative affect in depression. Furthermore, neuroticism, which is characterized by erratic/unstable affect and behavior, stands in contrast to the diminution of affect, motivation, and social interest characterizing negative schizotypy. Cohen and Matthews (2010) hypothesized that negative schizotypy tends to be characterized by two different mechanisms, a primary one, more stable, that includes social anhedonia and is directly associated with risk for schizophrenia, and a second, less stable mechanism, characterized by depression or anxiety, which tends to be associated with risk for paranoid, schizoaffective or other non-deficit psychotic disorders (Cohen and Matthews, 2010). However, Campellone et al. (2016) suggested that inconsistencies across studies are generally related to the instrument employed to assess negative symptoms.

The current study showed that negative schizotypy was associated with the five different features of negative symptoms as assessed with the NSM interview 4.4 years later. Specifically, negative schizotypy, but not positive schizotypy, was strongly associated with social withdrawal and affective flattening, moderately with anhedonia, and minimally with alogia and avolition. Notably, negative symptoms assessed with NSM were found to be cross-sectionally associated with negative schizotypy in larger non-clinical samples of American students (Barrantes-Vidal et al., 2009; Barrantes-Vidal et al., 2010; Kwapil et al., 2008; Kemp et al., 2019). The present findings extend these cross-sectional studies by demonstrating that negative schizotypy prospectively predicts negative symptoms as assessed with the NSM. This suggests that negative schizotypy is strongly related to social withdrawal and affective flattening. As shown in Table 5, in accordance with NSM results, negative schizotypy predicted anhedonia symptoms with a medium effect size. In contrast, both schizotypy dimensions predicted avolition symptoms with a

minimum effect size and neither negative nor positive schizotypy predicted alogia symptoms as assed by CAARMS 4-years later. As reported in the supplementary material, the features of negative symptoms assessed in both CAARMS negative and NSM interviews are not specular. The CAARMS negative symptoms index consist of alogia, avolition, and anhedonia symptoms, while social anhedonia is included in the Behavioural Change index and affective flattening in the Emotional Disturbance index. In contrast, the NSM assess features captured by the CAARMS negative index but also includes affective flattening and social withdrawal symptoms. The negative symptoms identified by the NSM are closely related to the criteria of Schizoid PD. Results indicate that schizoid symptoms correlated highly with NSM and surprisingly they did not correlate with CAARMS negative. It seems that the discrepancy between results is related to the features of negative symptoms captured by both interview measures and the criteria for schizoid PD diagnosis. As in CAARMS negative symptoms and NSM, the schizoid PD criteria includes anhedonia symptoms but also social withdrawal and affective flattening symptoms that are assessed by the NSM interview but not included in the CAARMS negative symptoms. Another difference may be that the NSM interview emphasizes carefully screening out other factors that could account for negative features, such as depression, anxiety, illness, and environmental factors.

Negative schizotypy predicted CAARMS positive symptoms at T4 (although positive schizotypy showed a large effect size, whereas negative schizotypy only a small effect size), However, negative schizotypy was not associated with positive symptoms at our T2 and T3 assessment (Barrantes-Vidal et al., 2013b; Racioppi et al., 2018). Nevertheless, the present findings are consistent with previous interview studies. Kemp et al. (2019) reported that both positive schizotypy (large effect) and negative schizotypy (small effect) predicted interview ratings of positive symptoms. Likewise, Kwapil et al. (2013) reported comparable findings at the ten-year follow-up assessment. These findings are consistent with suggestions dating back to Bleuler (1911/1950) that negative symptoms are the fundamental dysfunctions in schizophrenia-

spectrum psychopathology, whereas positive symptoms are transient and cut across multiple forms of psychopathology.

Both schizotypy dimensions predicted schizotypal traits and suspiciousness 4.4 years later, consistent with findings at the previous follow-up reports (Barrantes-Vidal et al., 2013b; Racioppi et al., 2018) and with numerous other interview studies (e.g., Kwapil et al., 2008; Kemp et al., 2019). Moreover, T1 positive and negative schizotypy predicted low self-esteem and depression symptoms at T4 as was found at T2 by Barrantes-Vidal et al. (2013b). Additionally, in line with T3 results (Racioppi et al., 2018), both schizotypy dimensions predicted paranoid personality ratings at T4. The present findings, taken together with those reported in our previous cross-sectional (Barrantes-Vidal et al., 2013b) and longitudinal (Racioppi et al., 2018) reports, indicate a robust high temporal stability of measures across assessments. Subjects identified as high on negative and positive schizotypy at baseline generally demonstrate maintenance of psychopathological symptoms, schizophrenia-spectrum disorders traits, and impairment of functioning 1.7 (Barrantes-Vidal et al., 2013b), 3.1 (Racioppi et al., 2018), and 4.4 years later.

The current study investigated whether T3 measures of schizophrenia-spectrum symptoms and impairment predicted the same construct at T4. Results indicate that schizophrenia-spectrum PDs, negative symptoms, suspiciousness, as well as anxiety and depression symptoms, and self-esteem assessed at T3 predicted their analogous ratings 1.3 years later revealing an overall stability across time. The present findings suggest that non-clinical individuals who experiences high levels of schizophrenia-spectrum symptoms demonstrate a strong stability of the same symptoms over a long-term period, from T2 to T3 (Racioppi et al., 2018) and from T3 to T4 (1.3 years later). Consistent with our previous 3-year longitudinal study examining the stability of these constructs assessed at T2 and T3 in the same sample, we found that individuals with high levels of T3 negative, schizotypal, avoidant, and paranoid personality symptoms, as well as low self-esteem and depression symptoms, predicted their equivalent construct over a period of 1.3 years (T4) with a large effect size. Contrary to our hypothesis, previous levels of positive symptoms (T3) did not predicts the same construct at T4.

This likely is due to the fact that people low in positive schizotypy tend not to report any positive symptoms at any of the assessments, whereas positive symptoms may be transient and variable for high positive schizotypy participants.

The present results indicate that high levels of T1 positive schizotypy predicted a strong association of positive symptoms across T3 and T4. The level of CAARMS positive symptoms and their stability across T3 and T4 (1.3 years) were conditional to participants' scores on positive schizotypy at T1. Those with low positive schizotypy at T1 did not present positive-like experiences, whereas participants with medium levels of positive schizotypy generally did not present these experiences. When they did, there was no association between them across the two assessments. In contrast, participants with high schizotypy presented with a wider range of scores on CAARMS positive and these scores were highly consistent across the two assessments. These findings indicate that only individuals with baseline high positive schizotypy who reports high levels of positive symptoms at T3, tend to experience persistent positive symptoms 1.3 years later (T4). Importantly, only individuals with high levels of positive schizotypy at T1 presented a range of scores in interview ratings of CAARMS positive symptoms both at T3 and T4, and the ratings across these two waves (3.1 and 4.4 years later, respectively) were highly consistent. This finding is particularly relevant, as it shows that positive schizotypy traits are not only predictive of positive-like symptoms, but also that the symptom-like expression of these underlying traits has consistency over time (even in developmental period when these experiences as supposed to be particularly instable). This strongly supports the predictive validity of schizotypy as well as developmental and dimensional models of psychosis risk (Kwapil and Barrantes-Vidal, 2015; Debbané and Barrantes-Vidal, 2015). Also, this highlights the relevance of assessing schizotypy traits in protocols of psychosis risk. In their systematic review and meta-analysis, van Os et al. (2009) indicated that the majority of psychotic experiences disappears with the passage of time especially in young individuals. Nevertheless, the exposure to additional environmental risk factors could induce such subclinical transitory experiences to become persistent clinical outcomes. Further, the persistence appears to be related to baseline presence of psychotic

experiences and suggests a continuity with the stability across time of psychotic disorders and schizophrenia (Linscott and van Os, 2013). The continuity between phenotypic subclinical and clinical expression of psychosis was recently tested in a cross-sectional study (Thomas et al. 2018). It was found that patients with schizophrenia or schizoaffective disorder reported higher levels of positive schizotypy compared to healthy controls which reported moderate or low levels of positive schizotypy. Furthermore, positive symptoms were rated only in the patient group, and results showed that positive symptoms were uniquely related to positive schizotypy. The current findings extend these results by demonstrating that uniquely positive schizotypy longitudinally predicts the persistence of positive symptoms, including in young nonclinical individuals, and at the same time provide additional evidence to positive and negative schizotypy as distinct dimensions of symptoms.

The present findings show that the interaction of positive and negative schizotypy dimensions generally did not account for additional variance and suggest that positive and negative dimensions tend to have an additive effect. This is consistent with T2 cross-sectional study (Barrantes-Vidal et al., 2013b) and with Kwapil et al. (2008; 2013) in which the interaction term did not predict schizophrenia-spectrum symptoms and impairment.

The interaction of positive and negative schizotypy predicted avoidant and paranoid personality traits. The finding for paranoid traits is consistent with both the cross-sectional and longitudinal findings from Kwapil et al. (2013). Both positive and negative schizotypy are associated with paranoid personality traits, and their significant interaction may reflect the intersection of multiple contributions to paranoia. Positive schizotypy appears to be prominently associated with the ideational component of paranoid beliefs that the world is a threatening place and others are hostile and malevolent. This is consistent with current conceptual models (e.g., Kwapil and Barrantes-Vidal, 2015) that paranoia and suspiciousness are part of positive schizotypy. Negative schizotypy may tap paranoid personality disorder traits more because of behavior secondary to disinterest in contact and closeness with the world, as opposed to overt

paranoid ideation (Kemp et al., 2019). These distinct pathways appear to interact in a synergistic fashion.

Similarly, positive and negative schizotypy may provide distinct, interacting pathways to avoidant personality traits. Positive schizotypy is associated with social anxiety (Brown et al., 2008), as well as with the aforementioned suspiciousness that may be activated by avoidant fear of humiliation. Negative schizotypy appears less connected to social anxiety and fear of embarrassment, but may be more behaviorally related to the social isolation that is experienced by people with avoidant traits.

Note that this is in line with studies examining psychometric schizotypy in real-life environment using the experience sampling methodology. In the daily-life study of Barrantes-Vidal et al. (2013a), it was found that both positive and negative schizotypy dimensions were associated with positive symptoms, suspiciousness and paranoia experiences, decreased social contact in daily life, and diminished reports that others care about them. Moreover, in both American (Kwapil et al., 2012) and Spanish (Barrantes-Vidal et al., 2013a) non-clinical college samples, schizotypy dimensions were found to be associated with an increase in the desire to be alone when with others. Kwapil et al. (2012) reported that this desire was moderated by high levels of anxiety in positive schizotypy, whereas it was associated with decreased positive affect in negative schizotypy. Interestingly, Barrantes-Vidal et al. (2013a) also found that positive schizotypy moderated the association of stress with psychotic-like and paranoid experiences. In contrast, negative schizotypy moderated the association of social closeness and feeling unwanted with psychotic-like experiences. In an extension of this study, Chun et al. (2017) found that positive schizotypy moderated the associations of paranoia with stressful situations in daily-life. In contrast, negative schizotypy predicted the associations of desire to be alone, stress, and social stress with negative affect and psychotic-like experiences. In line with their findings, our results seem to suggest that positive schizotypy amplifies the effect of negative schizotypy. Specifically, it appears that positive schizotypy has a multiplicative effect on the social withdrawal feature of negative schizotypy due to its anxious component. The present findings provide evidence that the

interaction of schizotypy dimensions exacerbate the social withdrawal and social disinterest component of both avoidant and paranoid personality disorders.

The current study is not without limitations. While we were able to reassess the majority (86%) of the individuals who completed T3 assessment, the T4 sample size was still relatively small and this may reduce the robustness of our results. However, it is important to highlight that the present longitudinal findings are consistent with those reported in largest non-clinical samples (Chapman et al., 1994; Gooding et al., 2005; Kwapil et al., 2013; Racioppi et al., 2018). This provides additional support for the validity and usefulness of the psychometric high-risk approach as a method able to detect individuals with an increased risk for a future development of schizophrenia-spectrum disorders. This method demonstrates its ability to improve our knowledge of etiological factors without the confounds related to the disorders. It also helps us better understand developmental trajectories along the schizophrenia continuum, which will be useful for elaborating specific early intervention strategies.

Tables

Table 1. Descriptive statistics for quantitative dependent measures of schizophrenia-spectrum personality and symptoms, mood, self-.esteem and impairment.

Measure	Mean	SD	Range	Alpha[a]
SPQ suspiciousness	1.25	1.53	0-7	.69
CAARMS positive symptoms	1.17	1.96	0-9	-
CAARMS negative symptoms	1.63	2.46	0-12	-
NSM negative symptoms	1.92	2.90	0-13	-
Schizotypal personality ratings	1.08	1.77	0-8	-
Schizoid personality ratings	1.02	1.94	0-11	-
Paranoid personality ratings	1.65	2.30	0-12	-
Avoidant personality ratings	2.01	2.48	0-10	-
Social and occupational functioning	85.8	9.86	50-99	-
Global assessment of functioning	82.2	12.89	50-100	-
Rosenberg total	22.9	5.16	9-30	.88
Beck depression inventory	5.64	6.58	0-33	.89
Beck anxiety inventory	5.54	5.78	0-39	.88

[a] Coefficient alpha reported for questionnaire measures only.

Table 2. Linear regressions of schizophrenia-spectrum measures, prodromal symptoms, functioning, self-esteem, and mood.

	Step 1						Step 2			Step 3					
	T1 Positive schizotypy			T1 Negative schizotypy			Criterion T3			Interaction Pos SZ x Criterion T3			Interaction Neg SZ x Criterion T3		
Criterion T4	β	ΔR^2	f^2	β	ΔR^2	f^2	β	ΔR^2	f^2	β	ΔR^2	f^2	β	ΔR^2	f^2
Psychosis Spectrum															
CAARMS positive symptoms	.431**	.185	**.25**	.230*	.053	.07	.266	.063	.09	.426**	.114	**.21**	.050	.002	.00
CAARMS negative symptoms	.230	.053	.06	.308**	.095	.11	.408**	.159	**.23**	.210	.040	.07	.166	.024	.04
Negative Symptom Manual	.148	.022	.03	.553***	.305	***.46***	na			na			na		
Schizotypal personality rating	.291*	.084	.10	.325**	.105	.13	.421**	.145	**.22**	.226	.039	.06	.098	.008	.01
Schizoid personality rating	.040	.002	.00	.544**	.296	***.42***	.499**	.167	**.31**	.064	.004	.01	-.129	.008	.02
Paranoid personality rating	.231*	.053	.06	.234*	.055	.06	.763***	.431	***.95***	.183	.021	.05	-.021	.000	.00
Avoidant personality rating	.220	.048	.05	.184	.034	.04	.699***	.406	***.80***	.023	.000	.00	.095	.007	.01
SPQ suspiciousness	.279**	.077	.09	.288**	.083	.10	.686***	.399	***.93***	-.042	.001	.00	.045	.002	.00
Functioning															
Social and occupational functioning	-.143	.020	.02	-.291*	.085	.09	.213	.035	.04	.141	.020	.02	-.025	.000	.00
Global assessment of functioning	-.125	.016	.02	-.341**	.116	.13	.237	.044	.05	.023	.001	.00	.159	.022	.03
Mood and Self-esteem															
Rosenberg total	-.309**	.095	.11	-.207*	.043	.05	.662***	.345	***.67***	.059	.003	.01	-.042	.002	.00
Beck depression inventory	.268*	.072	.09	.277*	.077	.09	.591***	.308	***.57***	-.155	.021	.04	.030	.001	.00
Beck anxiety inventory	.085	.007	.01	.153	.023	.02	.494**	.222	**.30**	-.048	.002	.00	-.102	.007	.01

*p<0.05, **p<0.01, ***p<0.001.

[a] A series of linear regressions were computed to examine the variance accounted for by positive and negative schizotypy (T1) in predicting psychopathology, personality and functioning at T4; maximum likelihood estimation and bootstrap procedures (with 2 000 samples) were employed.

[b] According to Cohen (1992), Medium effect sizes in bold ($f^2 > .15$), Large effect sizes in bold and italics ($f^2 > .35$).

Table 3. Linear regressions of schizophrenia-spectrum symptoms and personality, functioning, self-esteem, and mood.

	Step 1						Step 2		
	T1 Positive schizotypy			T1 Negative schizotypy			T1 Interaction		
Criterion T4	**β**	**ΔR^2**	**f^2**	**β**	**ΔR^2**	**f^2**	**β**	**ΔR^2**	**f^2**
Psychosis Spectrum									
CAARMS positive symptoms	.431**	.185	***.25***	.230*	.053	.07	.180	.032	.04
CAARMS negative symptoms	.230	.053	.06	.308**	.095	.11	.171	.029	.04
Negative Symptom Manual	.148	.022	.03	.553***	.305	***.46***	.143	.020	.03
Schizotypal personality rating	.291*	.084	.10	.325**	.105	.13	.151	.022	.03
Schizoid personality rating	.040	.002	.00	.544**	.296	***.42***	.120	.014	.02
Paranoid personality rating	.231*	.053	.06	.234*	.055	.06	.198*	.039	.04
Avoidant personality rating	.220	.048	.05	.184	.034	.04	.263*	.068	.08
SPQ suspiciousness	.279**	.077	.09	.288**	.083	.10	.028	.001	.00
Functioning									
Social and occupational functioning	-.143	.020	.02	-.291*	.085	.09	-.202	.040	.05
Global assessment of functioning	-.125	.016	.02	-.341**	.116	.13	-.102	.010	.01
Mood and Self-esteem									
Rosenberg total	-.309**	.095	.11	-.207*	.043	.05	-.101	.010	.01
Beck depression inventory	.268*	.072	.09	.277*	.077	.09	.153	.023	.03
Beck anxiety inventory	.085	.007	.01	.153	.023	.02	-.164	.026	.03

*p<0.05, **p<0.01, ***p<0.001.

[a] A series of linear regressions were computed to examine the variance accounted for by positive and negative schizotypy interaction term (T1) in predicting psychopathology, personality and functioning at T4; maximum likelihood estimation and bootstrap procedures (with 2 000 samples) were employed.

[b] According to Cohen (1992), Medium effect sizes in bold ($f^2 > .15$), Large effect sizes in bold and italics ($f^2 > .35$).

Table 4. Linear regressions of CAARMS negative and NSM controlling for emotional dysregulation.

	Criterion T4					
Predictors	CAARMS negative			NSM		
T1 Measures	**β**	**ΔR²**	***f*²**	**β**	**ΔR²**	***f*²**
Schizotypy Dimensions						
Positive schizotypy	.102	.009	.01	.071	.004	.01
Negative schizotypy	.174	.027	.04	.486***	.213	***.35***
T4 Measures						
Emotional Dysregulation						
Avoidant personality ratings	.186	.030	.05	.159	.021	.03
Beck depression inventory	.276*	.046	.07	.186	.021	.03
Beck anxiety inventory	.154	.017	.03	-.095	.007	.01

*p<0.05, **p<0.01, ***p<0.001.

[a] A series of linear regressions were computed to examine the variance accounted for by positive and negative schizotypy (T1) and emotional dysregulation symptoms (T4) in predicting CAARMS negative and NSM measures at T4; maximum likelihood estimation and bootstrap procedures (with 2 000 samples) were employed.

[b] According to Cohen (1992), Medium effect sizes in bold ($f^2 > .15$), Large effect sizes in bold and italics ($f^2 > .35$).

Table 5. Linear regressions of NSM and CAARMS negative symptom subscales.

	Step 1						Step 2		
	T1 Positive schizotypy			T1 Negative schizotypy			T1 Interaction		
Criterion T4	**β**	**ΔR²**	**f^2**	**β**	**ΔR²**	**f^2**	**β**	**ΔR²**	**f^2**
NSM									
Anhedonia	.208	.043	.05	.397**	.157	**.20**	.190	.036	.05
Avolition/Anergia	.107	.012	.01	.283*	.080	.09	.073	.005	.01
Alogia	.065	.004	.00	.208*	.043	.05	-.059	.003	.00
Social Withdrawal	.012	.000	.00	.566***	.320	***.47***	.158	.025	.04
Affective Flattening	.159	.025	.04	.521**	.271	***.39***	.092	.008	.01
CAARM negative									
Anhedonia	.064	.004	.00	.384**	.147	**.17**	.122	.015	.02
Avolition/Anergia	.262*	.068	.08	.236*	.055	.06	.198	.038	.05
Alogia	.232	.054	.06	.147	.022	.02	.088	.008	.01

*p<0.05, **p<0.01, ***p<0.001.

[a] A series of linear regressions were computed to examine the variance accounted for by positive and negative schizotypy (T1) in predicting anhedonia, social withdrawal, avolition/anergia, affective flattening, and alogia as assessed with the NSM at T4; maximum likelihood estimation and bootstrap procedures (with 2 000 samples) were employed.

[b] According to Cohen (1992), Medium effect sizes in bold ($f^2 > .15$), Large effect sizes in bold and italics ($f^2 > .35$).

Supplementary material

Figure 1. Flow diagram describing the selection of study participants. Highlighted boxes represent T1, T3, and T4 sub-samples of participants, those that are directly relevant to the present analyses.

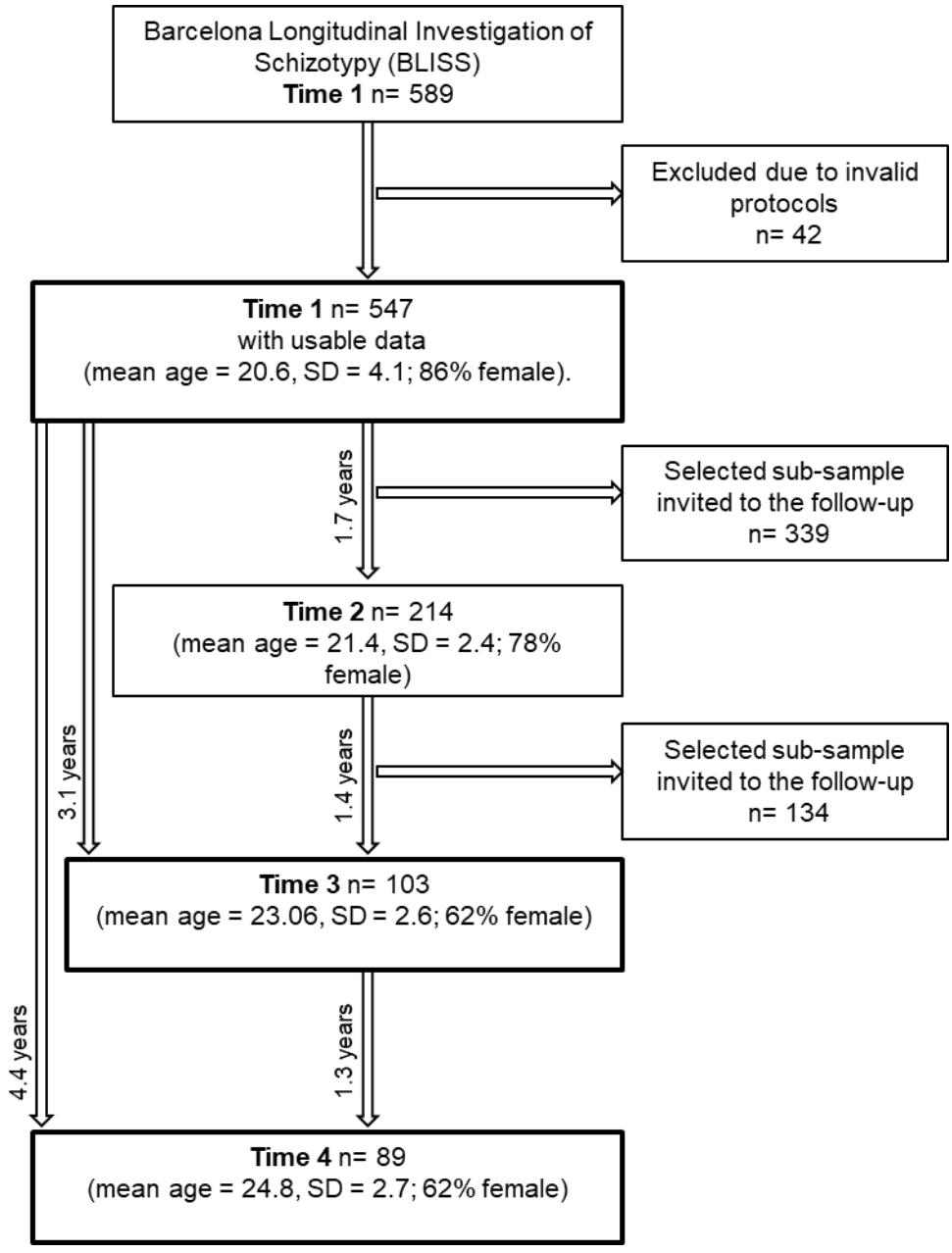

Figure Caption

Fig. 2. Relationship between levels of T3 and T4 CAARMS positive symptoms across levels of T1 positive schizotypy.

Relationship between levels of T3 and T4 CAARMS positive symptoms at three levels of T1 positive schizotypy (low, medium, high) as indicated by simple slope analysis. The relationship was significant at low (β= 0.10; $p < 0.001$) and high (β= 0.39; $p < 0.001$) levels of positive schizotypy (T1), but not at moderate levels (β= 0.07; $p = 0.7$).

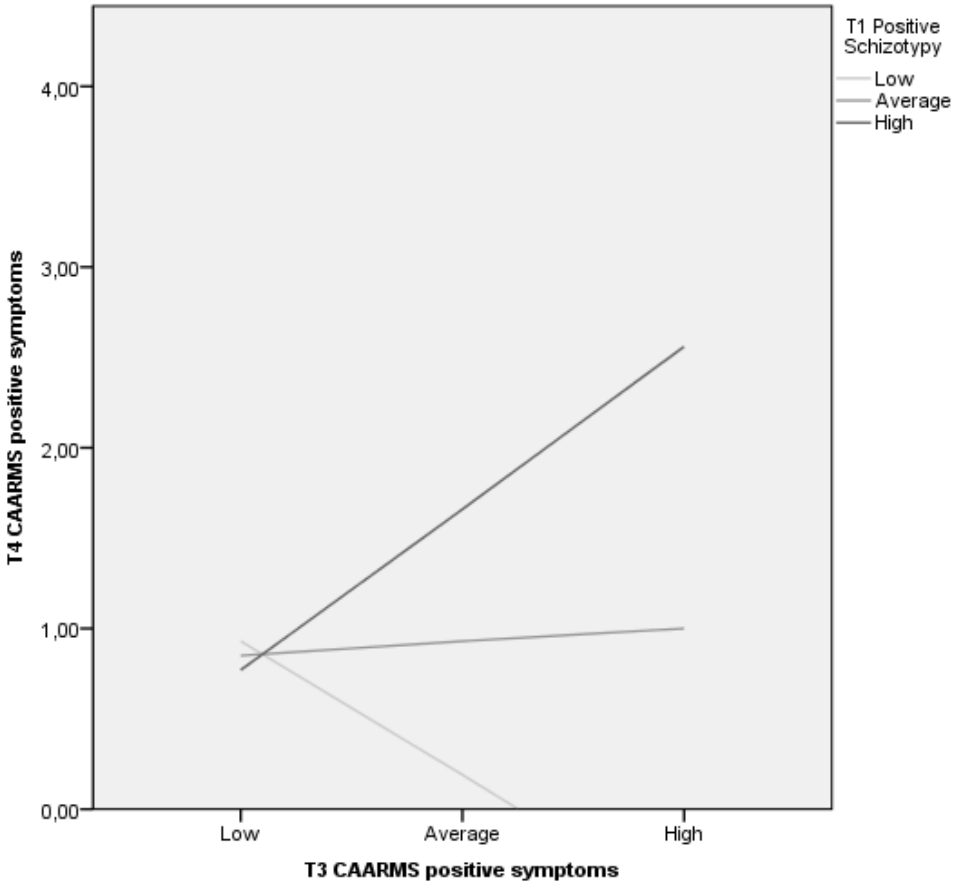

Figure Caption

Fig. 3. Relationship between levels of T1 negative schizotypy and T4 paranoid personality symptoms across levels of T1 positive schizotypy.

Relationship between levels of T1 negative schizotypy and T4 paranoid personality symptoms at three levels of T1 positive schizotypy (low, medium, high) as indicated by simple slope analysis. The relationship was significant at moderate (β= 0.51; $p < 0.01$) and high (β= 0.91; $p < 0.01$) levels of positive schizotypy (T1), but not at low levels (β= 0.12; $p = 0.6$).

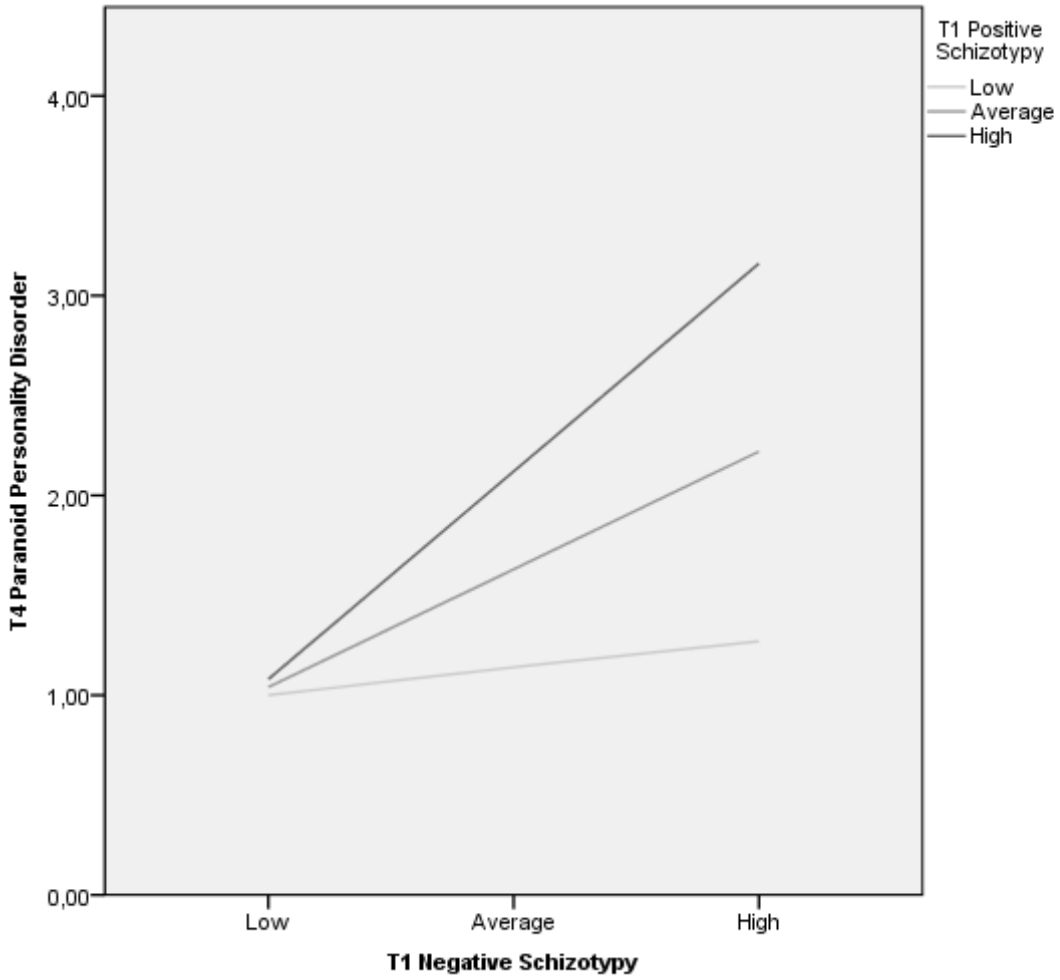

Figure Caption

Fig. 4. Relationship between levels of T1 negative schizotypy and T4 avoidant personality symptoms across levels of T1 positive schizotypy.

Relationship between levels of T1 negative schizotypy and T4 avoidant personality symptoms at three levels of T1 positive schizotypy (low, medium, high) as indicated by simple slope analysis. The relationship was significant at moderate (β= 0.46; $p < 0.05$) and high (β= 1.31; $p < 0.05$) levels of positive schizotypy (T1), but not at low levels (β= 0.11; $p = 0.7$).

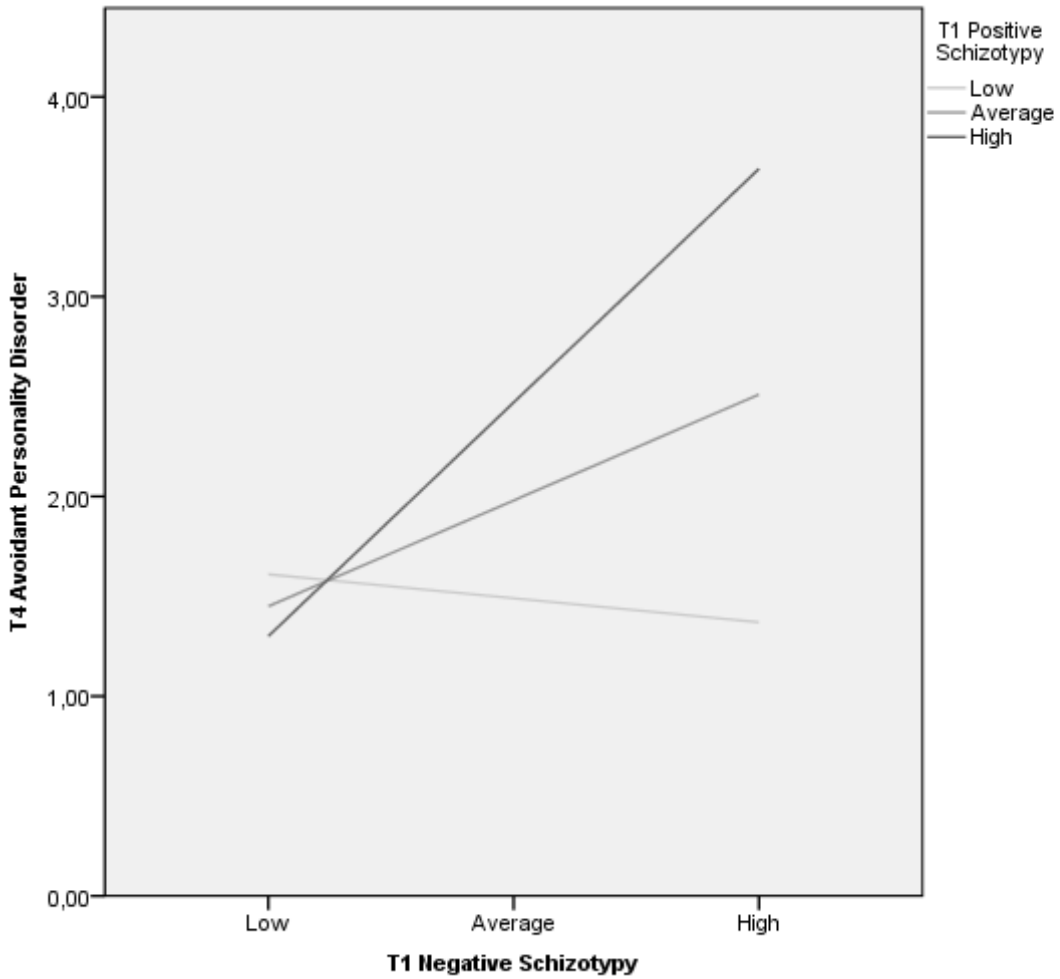

Table 1. Bivariate correlations of CAARMS Negative and NSM with Schizoid PD and emotional dysregulation.

	T4	
	CAARMS Negative	**NSM**
T4 Measures	***r***	***r***
Schizoid PD	.16	***.68******
Emotional Dysregulation		
Anxiety	.34**	.09
Depression	***.50****	.35**
Avoidant PD	.35**	.32**

*p<0.05, **p<0.01, ***p<0.001.

[a] Large effect size in bold and italics.

[b] Note: PD refers to Personality Disorder; Anxiety refers to the Beck Anxiety Inventory (BAI; Beck et al., 1991); Depression refers to the Beck Depression Inventory-II (BDI-II; Beck et al., 1996); CAARMS Negative refers to the Comprehensive Assessment of At-Risk Mental States (CAARMS; Yung et al., 2005) negative symptoms dimension; NSM refers to the Negative Symptom Manual (NSM; Kwapil and Dickerson, 2001).

Table 2.
Comparison of negative symptoms features and their assessment with the NSM and the CAARMS interview measures with symptoms of Schizoid PD according to the DSM-V.

	NSM	CAARMS negative	Schizoid PD
Negative symptoms			
Alogia	Poverty of content of speech - quality of speech (abstract vs. concrete) - impoverished thought processes (nonproductive vs. productive – rich responses vs. vague responses with little content) - thought blocking (difficulty in completion of responses – loses the thought) - spontaneity (difficulty in producing responses to questions that should not require a great deal of thought or in initiating conversation) - lengthy pauses in answering questions that do not appear to be because of productive thought processes - repetitive or perseverative speech Poverty of form of speech - restricted quantity - muteness	Problems trying to form conversations (i.e., hard to find words, thought blocking); responses to questions vague, or convey little information; long time to respond to questions, but when prompted, displays an awareness of the question.	

	- incoherence or muttered, garbled, mumbled speech - inarticulateness		
Avolition/Anergia	Assess lack of will, purpose, and volition in the following areas: (1) Goals/planning (lack of goals or difficulty in meeting goals) (2) Impersistence (difficulty in persisting in short- and long-term tasks) (3) motivation (apathy, reduced sense of will or purpose) (4) energy level/psychomotor activity (amount of time spent in aimless activity, reduced or slow physical movements) (5) grooming/hygiene	Assess lack of (1) energy (mental and physical) (2) motivation (3) will power (4) physical strength And if this interfere with activities (e.g., school/work and other everyday tasks).	
Anhedonia	Assesses the degree to which the participant anticipates, experiences, and pursues pleasurable experiences from the domains of physical experiences, sensory experiences, hobbies, recreational interests, occupational and/or school interests	Assess the degree to which the participant was able to enjoy social activities/work/study as much as usual; if had noticed a decrease in the level of interest in things the participant usually enjoy; if this interfered with the ability to perform activities (e.g., going to school/work/participating in events).	- Reduce or absent interest for sexual relationships and pleasure activities.
Affective Flattening	Assesses the degree to which the	- *Subjective emotional disturbance*	- Constricted affect

	participant reports and demonstrates a lack of affective tone and responsivity. Observations cover appearance, tone of voice, interactions with interviewer, facial expressions, and overall affect.	- *Observed blunter affect* - *Observed inappropriate affect* Symptoms included in the CAARMS Emotional Disturbance index.	- Flattened affectivity.
Social withdrawal	Assesses the degree to which participants experience disinterest in and withdrawal from interpersonal relationships, including relations with family, intimates, friends, and acquaintances. The scale assesses asociality, *not* antisocial tendencies or social anxiety.	- *Social isolation* Symptom included in the CAARMS Behavioural Change index.	- Preference for solitary activities - Lack of close friends or confidants.

NSM = according to the Negative Symptoms Manual (Kwapil and Dickerson, 2001).
CAARMS negative = according to the Comprehensive Assessment of At Risk Mental State (Yung et al., 2005) negative symptom dimension.
Schizoid PD = symptoms of Schizoid Personality Disorder according to the DSM-V criteria.
[a] Note: the following Schizoid Personality Disorder symptoms were not included in the table: *Indifference to criticism* identifying Affective Indifference, and *Lack of desire for intimacy* identifying Social Anhedonia.

References

American Psychiatric Association, 2000. Diagnostic and Statistical Manual of Mental Disorders, fourth ed. Author, Washington, DC (Text Revision).

Badcock, J.C., Barkus, E., Cohen, A.S., Bucks, R., Badcock, D.R., (2016). Loneliness and Schizotypy Are Distinct Constructs, Separate from General Psychopathology. Front. Psychol. 7:1018. doi: 10.3389/fpsyg.2016.01018.

Bang, M., Park, J.Y., Kim, K.R., Lee, S.Y., Song, Y.Y., Kang, J.I., Lee, E., An, S.K., 2019. Psychotic conversion of individuals at ultra-high risk for psychosis: The potential roles of schizotypy and basic symptoms. Early Interv Psychiatry. 13(3), 546–554.

Bleuler, E. P. (1950). Dementia praecox or the group of schizophrenias (J. Zinkin, Trans.). New York, NY: International Universities Press. German original, Dementia praecox oder Gruppe der Schizophrenien, published in 1911.

Barrantes-Vidal, N., Chun, C.A., Myin-Germeys, I., Kwapil, T.R., 2013a. Psychometric schizotypy predicts psychotic-like, paranoid, and negative symptoms in daily life. J. Abnorm. Psychol. 122, 1077–1087.

Barrantes-Vidal, N., Grant, P., Kwapil, T.R., 2015. The role of schizotypy in the study of the etiology of schizophrenia spectrum disorders. Schizophr. Bull. 41 (2), S408–S416.

Barrantes-Vidal, N., Gross, G.M., Sheinbaum, T., Mitjavila, M., Ballespí, S., Kwapil, T.R., 2013b. Positive and negative schizotypy are associated with prodromal and schizophrenia-spectrum symptoms. Schizophr. Res. 145, 50–55.

Barrantes-Vidal, N., Lewandowski, K.E., Kwapil, T.R., 2010. Psychopathology, social adjustment and personality correlates of schizotypy clusters in a large nonclinical sample. Schizophr. Res. 122, 219–225.

Barrantes-Vidal, N., Ros-Morente, A., Kwapil, T.R., 2009. An examination of neuroticism as a moderating factor in the association of positive and negative schizotypy with psychopathology in a nonclinical sample. Schizophrenia Research 115, 303–309.

Beck, A.T., Brown, G., Epstein, N., Steer, R.A., 1988. An inventory for measuring clinical anxiety: psychometric properties. J. Consult. Clin. Psychol. 56, 893–897.

Beck, A.T., Steer, R.A., Brown, G.K., 1996. Manual for the Beck Depression Inventory-II. Psychological Corporation, San Antonio.

Bolinskey, P.K., James, A.V., Cooper-Bolinskey, D., Novi, J.H., Hunter, H.K., Hudak, D.V., Schuder, K.M., Myers, K.R., Iati, C.A., Lenzenweger, M.F., 2015. Revisiting the blurry boundaries of schizophrenia: spectrum disorders in psychometrically identified schizotypes. Psychiatry Research 225, 335–340.

Bolinskey, P.K., Smith, E.A., Schuder, K.M., Cooper-Bolinskey, D., Myers, K.R., Hudak, D.V., James, A.V., Hunter, H.K., Novi, J.H., Guidi, J.P., Gonzalez, Y., McTiernan, E.F., Arnold, K.M., Iati, C.A., Gottesman, I.I., 2017. Schizophrenia spectrum personality disorders in psychometrically identified schizotypes at two-year follow-up. Psychiatry Res. 252, 289–295.

Brown, L.H., Silvia, P.J., Myin-Germeys, I., Lewandowski, K.E., Kwapil, T.R., 2008. The Relationship of Social Anxiety and Social Anhedonia to Psychometrically Identified Schizotypy. J Soc Clin Psychol. 27, 127–149.

Campellone, T.R., Elis, O., Mote, J., S., A.H., Kring, A.M., 2016. Negative symptoms in psychometrically defined schizotypy: The role of depressive symptoms. Psychiatry Res. 240, 181–186.

Cannon, T.D., Cadenhead, K., Cornblatt, B., Woods, S.W., Addington, J., Walker, E., Seidman, L.J., Perkins, D., Tsuang, M., McGlashan, T., Heinssen, R., 2008. Prediction of psychosis in youth at high clinical risk: a multisite longitudinal study in North America. Arch Gen Psychiatry 65, 28–37.

Chan, R.C.K., Shi, H., Geng, F., Liu, W., Yan, C., Wang, Y., Gooding, D.C., 2015. The Chapman psychosis-proneness scales: Consistency across culture and time. Psychiatry Res. 228, 143–149.

Chapman, L.J., Chapman, J.P., 1983. Infrequency scale for personality measures. Unpublished scale available from T.R. Kwapil, UIUC Department of Psychology, Champaign, NC 61820.

Chapman, L. J., Chapman, J. P., Kwapil, T. R., Eckblad, M., Zinser, M., 1994. Putatively psychosis-prone subjects 10 years later. J. Abnorm. Psychol. 103, 171–183.

Chapman, L.J., Chapman, J.P., Raulin, M.L., 1976a. Scales for physical and social anhedonia. J. Abnorm. Psychol. 85, 374–382.

Chapman, L.J., Chapman, J.P., Raulin, M.L., 1978b. Body-image aberration in schizophrenia. J. Abnorm. Psychol. 87, 399–407.

Christensen, A.P., Kenett, Y.N., Aste, T., Silvia, P.J., Kwapil, T.R., 2018. Network structure of the Wisconsin Schizotypy Scales–Short Forms: Examining psychometric network filtering approaches. Behav Res Methods 50(6), 2531–2550.

Chun, C.A., Barrantes-Vidal, N., Sheinbaum, T., Kwapil, T.R., 2017. Expression of schizophrenia-spectrum personality traits in daily life. Personality Disorders: Theory, Research, and Treatment 8, 64–74.

Cicero, D.C., Krieg, A., Becker, T.M., Kerns, J.G., 2016. Evidence for the Discriminant Validity of the Revised Social Anhedonia Scale From Social Anxiety. Assessment. 23 (5), 544–556.

Cohen, J., 1992. A power primer. Psychol. Bull. 112 (1), 155–159.

Cohen, A.S., Matthews, R.A., 2010. Primary and secondary negative schizotypal traits in a large non-clinical sample. Pers Individ Dif 49 (5), 419–424.

Corcoran, C.M., Kimhy, D., Parrilla-Escobar, M.A., Cressman, V.L., Stanford, A.D., Thompson, J., Ben David, S., Crumbley, A., Schobel, S., Moore, H., Malaspina, D., 2011. The relationship of social function to depressive and negative symptoms in individuals at clinical high risk for psychosis. Psychol Med 41, 251–261.

Debbané, M., Barrantes-Vidal, N., 2015. Schizotypy from a developmental perspective. Schizophr. Bull. 41 (2), S386–S395.

Debbané, M., Eliez, S., Badoud, D., Conus, P., Flückiger, R., Schultze-Lutter, F., 2015. Developing psychosis and its risk states through the lens of schizotypy. Schizophr. Bull. 41 (2), S396–S407.

Eckblad, M., Chapman, L. J., 1983. Magical ideation as an indicator of schizotypy. J. Consult. Clin. Psychol. 51, 215–225.

Eckblad, M. L., Chapman, L. J., Chapman, J. P., Mishlove, M., 1982. The Revised Social Anhedonia Scale. Unpublished test copies available from T.R. Kwapil, UIUC Department of Psychology, Champaign, NC 61820.

Ettinger, U., Mohr, C., Gooding, D.C., Cohen, A.S., Rapp, A., Haenschel, C., Park, S., 2015. Cognition and brain function in schizotypy: a selective review. Schizophr. Bull. 41 (Suppl. 2), S417–S426.

First, M.B., Gibbon, M., Spitzer, R.L., Williams, J.B.W., Benjamin, L.S., 1997. Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II). American Psychiatric Press, Inc., Washington.

Flückiger, R., Ruhrmann, S., Debbané, M., Michel, C., Hubl, D., Schimmelmann, B.G., Klosterkötter, J., Schultze-Lutter, F., 2016. Psychosis-predictive value of self-reported schizotypy in a clinical high-risk sample. J. Abnorm. Psychol. 125 (7), 923–932.

Fonseca-Pedrero, E., Debbané, M., Ortuño-Sierra, J., Chan, R.C.K., Cicero, D.C., Zhang, L.C., Brenner, C., Barkus, E., Linscott, R.J., Kwapil, T., Barrantes-Vidal, N., Cohen, A., Raine, A., Compton, M.T., Tone, E.B., Suhr, J., Muñiz, J., Fumero, A., Giakoumaki, S., Tsaousis, I., Preti, A., Chmielewski, M., Laloyaux, J., Mechri, A., Lahmar, M.A., Wuthrich, V., Larøi, F., Badcock, J.C., Jablensky, A., 2017. The structure of schizotypal personality traits: a cross-national study. Psychol. Med. 17, 1–12.

Fonseca-Pedrero E, Ortuño-Sierra J, Debbané M, Chan, R.C.K., Cicero, D., Zhang, L.C., Brenner, C., Barkus, E., Linscott, R.J., Kwapil, T., Barrantes-Vidal, N., Cohen, A., Raine, A., Compton, M.T., Tone, E.B., Suhr. J., Inchausti, F., Bobes, J., Fumero, A., Giakoumaki, S., Tsaousis, I., Preti, A., Chmielewski, M., Laloyaux, J., Mechri, A., Aymen Lahmar,

M., Wuthrich, V., Larøi, F., Badcock, J.C., Jablensky, A., Isvoranu, A.M., Epskamp, S., Fried, E.I., 2018. The network structure of schizotypal personality traits. Schizophr Bull. 44 (2), S468–S479.

Goldman, H.H., Skodol, A.E., Lave, T.R., 1992. Revising Axis V for DSM-IV: a review of measures of social functioning. Am. J. Psychiatry 149 (9), 1148–1156.

Gooding, D. C., Tallent, K. A., Matts, C. W., 2005. Clinical status of at-risk individuals 5 years later: further validation of the psychometric high-risk strategy. J. Abnorm. Psychol. 114, 170–175.

Gross, G.M., Kwapil, T.R., Raulin, M.L., Silvia, P.J., Barrantes-Vidal, N., 2018. The multidimensional schizotypy scale-brief: Scale development and psychometric properties. Psychiatry Res. 261, 7–13.

Gross, G.M., Mellin, J., Silvia, P.J., Barrantes-Vidal, N., Kwapil, T.R., 2014. Comparing the factor structure of the Wisconsin Schizotypy Scales and the Schizotypal Personality Questionnaire. Pers. Dis. Theory Res. Treat. 5, 397–405.

Gross, G.M., Silvia, P.J., Barrantes-Vidal, N., Kwapil, T.R., 2012. Psychometric properties and validity of short forms of the Wisconsin Schizotypy Scales in two large samples. Schizophr. Res. 134, 267–272.

Ho, B.C., Nopoulos, P., Flaum, M., Arndt, S., Andreasen, N.C., 1998. Two-year outcome in first-episode schizophrenia: predictive value of symptoms for quality of life. Am J Psychiatry 155, 1196–1201.

Kemp, K.C., Gross, G.M., Kwapil, T.R., 2019. Psychometric properties of the Multidimensional Schizotypy Scale and Multidimensional Schizotypy Scale-Brief: Item and scale test-retest reliability and concordance of original and brief forms. J Pers Assess. 23, 1–8.

Kwapil, T.R., Dickerson, L.A., 2001. Unpublished results. Negative symptom manual. Unpublished interview manual.

Kwapil, T.R., Barrantes-Vidal, N., 2012. Schizotypal personality disorder: an integrative review. In: Widiger, T.A. (Ed.), The Oxford Handbook of Personality Disorders. Oxford University Press, New York, NY, pp. 437–477.

Kwapil, T.R., Barrantes-Vidal, N., 2015. Schizotypy: looking back and moving forward. Schizophr. Bull. 41 (2), S366–S373.

Kwapil, T.R., Barrantes-Vidal, N., Silvia, P.J., 2008. The dimensional structure of the Wisconsin Schizotypy Scales: factor identification and construct validity. Schizophr. Bull. 34, 444–457.

Kwapil, T.R., Brown, L.H., Silvia, P.J., Myin-Germeys, I., Barrantes-Vidal, N., 2012. The expression of positive and negative schizotypy in daily life: an experience sampling study. Psychol. Med. 42, 2555–2566.

Kwapil, T.R., Gross, G.M., Silvia, P.J., Raulin, M.L., Barrantes-Vidal, N., 2013. Prediction of psychopathology and functional impairment by positive and negative schizotypy in the Chapmans' ten-year longitudinal study. J. Abnorm. Psychol. 122, 807–815.

Kwapil, T.R., Gross, G.M., Silvia, P.J., Raulin, M.L., Barrantes-Vidal, N., 2018. Development and psychometric properties of the Multidimensional Schizotypy Scale: a new measure for assessing positive, negative, and disorganized schizotypy. Schizophr. Res. 193, 209–217.

Kwapil, T.R., Ros-Morente, A., Silvia, P.J., Barrantes-Vidal, N., 2012. Factor Invariance of Psychometric Schizotypy in Spanish and American Samples. J Psychopathol Behav Assess 34, 145–152.

Lenzenweger, M.F., 2015. Thinking clearly about schizotypy: hewing to the schizophrenia liability core, considering interesting tangents, and avoiding conceptual quicksand. Schizophr. Bull. 41 (2), S483–S491.

Lenzenweger, M.F., 2018. Schizotypy, Schizotypic Psychopathology, and Schizophrenia: Hearing Echoes, Leveraging Prior Advances, and Probing New Angles. Schizophr. Bull. 44 (2), S564–S569.

Linscott, R.J., van Os, J., 2013. An updated and conservative systematic review and meta-analysis of epidemiological evidence on psychotic experiences in children and adults: on the pathway from proneness to persistence to dimensional expression across mental disorders. Psychol. Med. 43, 1133–1149.

Milev, P., Ho, B.C., Arndt, S., Andreasen, N.C., 2005. Predictive values of neurocognition and negative symptoms on functional outcome in schizophrenia: a longitudinal first-episode study with 7-year follow-up. Am J Psychiatry. 162, 495–506.

Nelson, M.T., Seal, M.L., Pantelis, C., Phillips, L.J., 2013. Evidence of a dimensional relationship between schizotypy and schizophrenia: a systematic review. Neurosci. Biobehav. Rev. 37, 317–327.

Racioppi, A., Sheinbaum, T., Gross, G.M., Ballespí, S., Kwapil, T.R., Barrantes-Vidal, N., 2018. Prediction of prodromal symptoms and schizophrenia-spectrum personality disorder traits by positive and negative schizotypy: A 3-year prospective study. PLoS ONE 13(11): e0207150. https://doi.org/10.1371/journal.pone.0207150

Raine, A., 1991. The SPQ: a scale for the assessment of schizotypal personality based on DSM-III-R criteria. Schizophr. Bull. 170 (4), 555–564.

Rosenberg, M., 1965. Society and the Adolescent Self-Image. Princeton University Press, Princeton.

Salokangas, R.K., Dingemans, P., Heinimaa, M., Svirskis, T., Luutonen, S., Hietala, J., Ruhrmann, S., Juckel, G., Graf von Reventlow, H., Linszen, D., Birchwood, M., Patterson, P., Schultze-Lutter, F., Klosterkotter, J., 2013. Prediction of psychosis in clinical high-risk patients by the Schizotypal Personality Questionnaire. Results of the EPOS project. European Psychiatry 28, 469–475.

Simons, C.J., Jacobs, N., Jolles, J., van Os, J., Krabbendam, L., 2007. Subclinical psychotic experiences and cognitive functioning as a bivariate phenotype for genetic studies in the general population. Schizophr Res. 92 (1-3), 24–31.

Stefanis, N.C., Hanssen, M., Smirnis, N.K., Avramopoulos, D.A., Evdokimidis, I.K., Stefanis, C.N., van Os, J., 2002. Evidence that three dimensions of psychosis have a distribution in the general population. Psychol. Med. 32, 347–358.

Thomas, E.H.X., Rossell, S.L., Tan, E.J., Neill, E., Van Rheenen, T.E., Carruthers, S.P., Sumner, P.J., Louise, S., Bozaoglu, K., Gurvich, C., 2018. Do schizotypy dimensions reflect the symptoms of schizophrenia? Aust. N. Z. J. Psychiatry, 1–12.

van Os, J., Linscott, R.J., Myin-Germeys, I., Delespaul, P., Krabbendam, L., 2009. A systematic review and meta-analysis of the psychosis continuum: evidence for a psychosis proneness-persistence-impairment model of psychotic disorder. Psychol Med 39, 179–195.

Wang, Y., Neumann, D., Shum, D.H., Chan, R.C., 2012. A cross-validation study of clustering of schizotypy using a non-clinical Chinese sample. Psychiatry Res. 200 (1), 55–58.

Yung, A.R., Yuen, H., McGorry, P.D., Phillips, L.J., Kelly, D., Dell'Olio, M., Buckby, J., 2005. Mapping the onset of psychosis: the comprehensive assessment of at-risk mental states. Aust. N. Z. J. Psychiatry 39 (11-12), 964–971.

SECTION 2

THE PREDICTIVE VALIDITY OF SCHIZOTYPY DIMENSIONS AS MEASURED IN DAILY-LIFE: THE BARCELONA LONGITUDINAL INVESTIGATION OF SCHIZOTYPY (BLISS)

Chapter 3

Schizotypy Predicts Psychotic-Like, Paranoid, and Negative Symptoms in Daily Life 3 Years Later: an Experience Sampling Methodology Longitudinal Study

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Abstract

The present study aimed to enhance and replicate previous cross-sectional findings by examining the ecological validity of positive and negative schizotypy assessed at baseline and at the current three-year follow-up in a young adult sample of college students. Previous BLISS cross-sectional study employing the experience-sampling methodology (ESM) indicated that positive and negative schizotypy dimensions differentially moderated the association of stress and social stress with psychotic-like, paranoid, and negative symptoms in daily life. This study examined (i) the prospective association of baseline positive and negative schizotypy and (ii) their cross-sectional association with schizotypic symptoms and experiences in the daily life environment of 89 nonclinical individuals. Consistent with previous cross-sectional BLISS results, positive schizotypy predicted psychotic-like and paranoid symptoms, while negative schizotypy predicted a subset of these symptoms and showed a trend toward significance in the prediction of negative symptoms in daily-life. Momentary stress was associated with paranoid symptoms but only for those high in positive schizotypy. Furthermore, social stress was associated with momentary psychotic-like and paranoid symptoms also in those high in positive schizotypy. Social contact was associated with negative symptoms in those high in positive schizotypy, and with momentary psychotic-like and paranoid symptoms in those high in negative schizotypy. Time-lagged analyses showed that stress at the previous signal predicted increased psychotic-like symptoms at the subsequent signal in high positive schizotypy individuals. Negative affect at the previous signal predicted psychotic-like symptoms at the current assessment for those high in positive schizotypy. These findings provide additional evidence of positive and negative schizotypy as distinct constructs and support the validity of schizotypy dimensions in predicting schizotypic symptoms in daily life environment.

Keywords: schizotypy, schizophrenia, Experience Sampling Methodology, longitudinal study

1. Introduction

Current approaches conceptualized schizotypy as an underline developmental vulnerability for schizophrenia that is expressed along a dynamic continuum running from subclinical symptoms and impairment to clinical manifestation of schizophrenia-spectrum disorders (Claridge, 1997; Kwapil and Barrantes-Vidal, 2012; 2015). Schizotypy as a distal risk marker is considered a useful construct for the identification of individuals with an underlying vulnerability for schizophrenia (Debbané and Barrantes-Vidal, 2015). From this perspective, the reliable assessment of schizotypy should be essential to enhance our understanding of etiological factors (including risk and protective factors), to clarify developmental trajectories, and to develop early preventive interventions.

Schizotypy, like schizophrenia, is heterogeneous in terms of etiology and expression, and this heterogeneity can be captured at least in part by a multidimensional structure. During the last decades, researchers have proposed several factors to disentangle the latent structure of schizotypy (Bilder et al., 1985; Liddle, 1987; Peralta et al., 1992; Venables and Rector, 2000; Nuechterlein et al., 2002; Fonseca-Pedrero et al., 2015), but the most consistently replicated ones are the positive and the negative factors (Vollema and van den Bosch, 1995; Kwapil and Barrantes-Vidal, 2015; Kwapil et al., 2008, 2012, 2018; Fonseca-Pedrero et al., 2017). Positive schizotypy has been characterized by odd beliefs, unusual perceptual experiences and suspiciousness; whereas negative schizotypy involves diminished functioning such as anhedonia, affective flattening and social disinterest.

Previously mentioned theoretical conceptualizations mentioned before have been operationalized in several instrument to measure schizotypy in nonclinical individuals. The Wisconsin Schizotypy Scales (WSS) have been designed to detect high schizotypy individuals who are at great risk for the development of schizophrenia-spectrum psychopathology. The WSS are universally employed to assess schizotypy dimensions through four scales: the Perceptual Aberration (PerAb; Chapman et al., 1978) and the Magical Ideation Scale (MagicId; Eckblad and Chapman, 1983) to measure positive schizotypy, while the Physical Anhedonia Scale (PhyAnh;

Chapman et al., 1976) and the Revised Social Anhedonia Scale (SocAnh; Eckblad et al., 1982) to measure negative schizotypy. In the pioneering longitudinal study of Chapman and colleagues (1994), the PerAb, MagicId, and SocAnh Scales were used to assess schizotypy in a nonclinical sample of college students. At the 10-year follow-up, they found that among the 508 re-interviewed participants those with higher scores on the PerAb and MagicId scales reported elevated rates of psychotic disorders and schizophrenia-spectrum symptoms. In the subsequent re-analysis of the dimensional WWS scores (including those of the SocAnh Scale), Kwapil et al. (2013) found that uniquely positive schizotypy predicted the development of psychotic disorders, whereas both positive and negative schizotypy predicted schizophrenia-spectrum disorders. In 2005, Gooding and colleagues conducted an independent study during a 5-year follow-up period. They employed the PerAb, MagicId, and SocAnh Scales to assess psychometric risk in a sample of nonclinical college students. Compared to previous studies, Gooding et al. (2005) also found that both PerAb/MagicId and SocAnh risk group reported frequent and severe positive symptoms (with SocAnh group reporting highest rates), but they did not found that baseline schizotypy ratings predicted schizophrenia-spectrum disorders at the follow-up. Authors argued that the discrepancy of results with the Chapman et al. (1994) study concerns the different proportion of time analyzed by both works. In fact, while the Chapman's study covered 10 years of the period of highest risk for the development of psychosis, Gooding et al. (2005) examined only a 5-year period. Overall, these findings demonstrated that schizotypy dimensions are significant predictors of schizophrenia-spectrum disorders and supported the employment of the WSS as a valid instrument to identify individuals at greater developmental risk.

In line with the previous longitudinal studies, we employed the WSS to psychometrically identify positive and negative schizotypy in nonclinical college students participating in the Barcelona Longitudinal Investigation of Schizotypy (BLISS) project. We previously reported findings from cross-sectional and longitudinal BLISS studies analyzing the validity of positive and negative schizotypy dimensions in the prediction of interview and self-report measures assessing schizophrenia-spectrum symptoms and traits. In the cross-sectional study examining

reports of 214 psychometrically identified individuals, Barrantes-Vidal and colleagues (2013b) found that positive schizotypy was uniquely associated with interview ratings of positive and paranoid symptoms, and borderline personality traits. In contrast, negative schizotypy was associated with negative and schizoid symptoms. Furthermore, we successfully re-interviewed 103 participants at the 3-year follow-up assessment (Racioppi et al., 2018). Specifically, we found that positive schizotypy predicted interview ratings of positive symptoms and general psychopathology, whereas negative schizotypy predicted interview ratings of schizoid traits, emotional disturbance, and mental health treatment during the past year. Additionally, both schizotypy dimensions predicted schizotypal, paranoid, and avoidant traits, suspiciousness, and impaired functioning three years later. In a subsequent study we reported findings from the 4-year follow-up assessment in which 89 participants of the original sample were reevaluated (Racioppi et al., *in preparation*). We found that positive schizotypy predicted positive symptoms, whereas negative schizotypy uniquely predicted negative and schizoid personality symptoms. Both schizotypy dimensions predicted schizotypal and paranoid symptoms, as well as suspiciousness. Exclusively negative schizotypy predicted impairment in social and global functioning four years later.

Furthermore, previous cross-sectional BLISS studies examined the validity of schizotypy dimensions in detecting the real-life expression of behavioral patterns either characterizing schizophrenia-spectrum disorders or those recognized as indicators of increased risk for developing psychosis. We employed the experience sampling methodology (ESM), a within-day self-assessment technique that repeatedly prompts participants to complete brief questionnaires about their current experiences at random intervals. Compared to the traditional assessment techniques, the ESM method allows researcher to study the real-life environment in which the experiences occur, minimize retrospective bias, and improve the ecological validity.

In 2013, Barrantes-Vidal and colleagues examined the daily-life expression of psychometric schizotypy dimensions using ESM for 1 week in 206 participants. They found that positive schizotypy was associated with daily-life reports of psychotic-like and paranoid

symptoms, whereas negative schizotypy was associated with a subset of these symptoms and with negative symptoms such as diminished thoughts, emotions, and social contact in daily-life. In addition, stress in the moment was associated with psychotic-like and paranoid symptoms, but only in those with high positive schizotypy. Social closeness and feeling unwanted were associated with paranoid symptoms, but only in those with high positive schizotypy. In contrast, social closeness and feeling unwanted were associated with psychotic-like symptoms in those with high negative schizotypy and in those with high positive schizotypy. Time-lagged analyses indicated that stress at the preceding signal predicted psychotic-like symptoms at the subsequent moment but only for individuals high in positive schizotypy.

Goals and Hypotheses

The main goal of the present study was to further examine the validity of psychometrically assessed positive and negative schizotypy in a nonclinically ascertained sample of Spanish young adults at a three-year follow-up assessment (Time 3; T3) of the sample initially reported by Barrantes-Vidal et al. (2013a). Specifically this study sought to (a) replicate, both cross-sectionally and longitudinally, the differential findings for positive and negative schizotypy reported by Barrantes-Vidal et al. (2013a) at the Time 2 (T2) assessment; (b) extend these findings by examining the association of Time 1 (T1) and Time 3 (T3) schizotypy dimensions with ESM measures of psychotic-like, paranoid, and negative symptoms at the three-year reassessment; (c) examine whether stress differentially predicts psychotic-like, paranoid and negative symptoms in high-positive and high-negative schizotypy participants; and (d) examine whether the interaction of both positive and negative schizotypy assessed at both T1 and T3 predicted these constructs in daily life. According to previous interview and ESM BLISS reports, it was hypothesized that both positive and negative schizotypy dimensions 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. In contrast, negative schizotypy was predicted to be associated with diminished positive affect, reports of negative symptoms (no

thoughts or emotions), solitude, and diminished social closeness. Following previous cross-sectional ESM findings, we expected that stress would be associated with simultaneous psychotic-like and paranoid, but not negative, symptoms at T3. Furthermore, it is hypothesized that the association of stress and momentary psychotic-like symptoms would be moderated by positive schizotypy. Finally, we expected that previous momentary stress would predict psychotic-like and paranoid symptoms at the subsequent moment. Given that negative schizotypy was repeatedly found related to diminished reactivity to stress compared to positive schizotypy, we did not expect that negative schizotypy would moderate the association of stress with psychotic-like symptoms.

2. Method

2.1. Participants and Procedure

This study is part of the BLISS ongoing longitudinal project examining schizotypy and risk for schizophrenia-spectrum psychopathology in a sample of college students. At T1, 589 young adults from psychology courses at Universitat Autònoma de Barcelona completed the WSS, the suspiciousness subscale of the Schizotypal Personality Questionnaire (SPQ; Raine, 1991), and the positive symptom subscale of the Community Assessment of Psychic Experiences (CAPE; Stefanis et al., 2002). Of these, 42 participants were excluded from the final study due to invalid protocols, leaving 547 participants with usable data (mean age = 20.6; SD = 4.1; 86% female). In order to have continuous distributions of scores on the schizotypy dimensions with an adequate representation of high scorers, we invited all 189 participants who had standard scores based upon sample norms of at least 1.0 on the positive or negative schizotypy factors derived from the three measures, and 150 randomly selected participants who had standard scores < 1.0 to participate at T2. Participants were assigned positive and negative schizotypy factor scores based upon norms from 6137 American young adults (Kwapil et al., 2008). A more detailed description of the participants and selection procedures is reported in previous BLISS studies (Barrantes-Vidal et al., 2013a, b; Racioppi et al., 2018).

Two interview, questionnaire and ESM reassessments were conducted (T2 and T3). The T2 reassessment took place an average of 1.7 years (SD=0.2 years, range 1.4 to 2.2 years) after

the T1 screening. At T2, we assessed a selected sub-sample of 214 participants (mean age = 21.4 years; SD = 2.4; 78% female). Usable ESM data were collected from 206 participants (163 female) with a mean age of 19.8 (SD = 2.4).

The current assessment (T3) took place an average of 1.4 years (SD= 0.3 years, range 0.9 to 2.1 years) after T2, and an average of 3.1 years (SD= 0.3 years, range 2.6 to 3.6 years) after T1. Due to funding limitations, we selected a sub-sample of the T2 participants that retained a similar distribution of schizotypy scores for assessment at T3. We recruited 134 participants (93 with high schizotypy and 41 with standard scores below 1.0). Of these, a total of 103 (77%) participants (mean age= 23.06; SD=2.6; 37.9% male) completed T3 reassessment. Usable ESM data were collected from 89 (86%) participants (60 female) with a mean age of 22.9 (SD = 2.5). The ESM sample included 60 of 75 (80%) participants with elevated schizotypy scores and 28 of 28 (100%) with standard scores below 1.0.

2.2. Materials

2.2.1. Time 1 questionnaires

At T1, participants completed the WSS and CAPE scales, and the SPQ-Suspiciousness subscale. The WSS is one of the most extensively used instruments for assessing schizotypy. Two factors (positive and negative schizotypy) have been consistently found to underlie the four scales and account for approximately 80% of their variance in American and Spanish samples (e.g., Kwapil et al., 2008; Kwapil et al., 2012). The PerAb Scale assesses psychotic-like bodily distortions and perceptual experiences; the MagicId Scale taps belief in invalid causation; the SocAnh Scale measures schizoid asociality; and the PhyAnh Scale assesses deficits in sensory and esthetic pleasure. The WSS scales were administered intermixed with an infrequency scale (Chapman and Chapman, 1983) to identify invalid responders. At T1, the mean score for the positive schizotypy dimension was -.05 (SD = 1.06), with a range of -1.45 to 3.23. The mean for the negative schizotypy dimension was .15 (SD = 1.18), with a range of - 1.57 to 4.27. Both distributions were unimodal and positively skewed.

The CAPE assesses positive, negative, and depressive dimensions of the psychosis spectrum. The positive dimension scale contains 20 items and was used in this study to assess psychotic-like experiences. The SPQ measures schizotypal personality traits as defined in the Diagnostic and Statistical Manual of Mental Disorders, and the 8-item Suspiciousness subscale assess suspiciousness/paranoid ideation.

2.2.2. Time 3 questionnaires and ESM

At T3, questionnaires and diagnostic interviews (along with measures not reported in this study) were administered. The WSS short-form (Winterstein et al., 2011) was employed to assess positive and negative schizotypy traits. Previous studies reported that the short scales demonstrated good reliability, correlated highly with the original scales, and exhibited hypothesized associations with measures of psychopathology, personality, and impairment (Gross et al., 2012). Consistent with the original WSS, previous study examining the dimensional structure of the WSS short-form indicate that the positive and negative schizotypy factor structure provide the best model (Gross et al., 2015). At the current assessment, the mean score for the positive schizotypy dimension was -.69 (SD = .66), with a range of -1.27 to 3.79. The mean for the negative schizotypy dimension was -.12 (SD = 1.08), with a range of - 1.03 to 4.21. Both distributions were unimodal and positively skewed. These factor scores were used as predictors of T3 psychotic-like, paranoid, and negative symptoms in daily-life.

At T3, ESM data were collected on personal digital assistants (PDAs). The ESM questionnaire inquired about a variety of daily life events. The full list of ESM items can be found in Barrantes-Vidal et al. (2013a). Consistent with the previous BLISS cross-sectional report (Barrantes-Vidal et al., 20013a), the present study included 8 items assessing psychotic-like symptoms, 2 items assessing paranoid symptoms, and 8 items assessing characteristics of negative schizotypic symptoms. 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.

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 T3 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 T3 experiences in daily life (e.g., stress and psychotic-like symptoms) were moderated by the positive and negative schizotypy dimensions (T3). 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 at T3. 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 T3 level 1 predictors at the preceding ESM assessment predicted criteria at the current assessment of T3, 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 Mplus7.11 (Muthén and Muthén, 2013). 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.

3. Results

Participants completed an average of 39.3 usable questionnaires (SD=9.7). At T1, neither the positive nor the negative schizotypy factor was associated with the number of usable records (r= -.13 and -.06, respectively). The positive and negative schizotypy dimension scores were not significantly correlated (r =.06). Similarly, at T3, neither the positive nor the negative schizotypy factor was associated with the number of usable records (r= -.13 and -.03, respectively). The positive and negative schizotypy dimension scores were not significantly correlated (r =.14).

3.1. Longitudinal and Cross-sectional Relations of Positive and Negative Schizotypy With Experiences in Daily Life

As seen in Table 1, T1 positive schizotypy predicted T3 diminished positive affect and increased negative affect, as well as each individual symptom comprising this latter composite. In addition, it predicted increased T3 reports that the current situation was stressful, with impaired ability to concentrate, and diminished feelings of being able to cope in the moment. In contrast, T1 negative schizotypy predicted the three negative-symptom items assessing diminished positive affect and situations, and decreased enjoyment of current activities. Furthermore, the T1 interaction term generally did not account for a significant prediction of T3 ESM constructs. However, both T1 positive and negative schizotypy and the interaction term predicted T3 diminished positive affect item of feeling happy in daily life. Neither positive nor negative schizotypy, nor the interaction term predicted reports of drug use in daily life.

T3 positive schizotypy was associated with diminished positive affect and increased negative affect, as well as with each symptom of this latter construct. Furthermore, it was associated with decreased ratings of the current situation as positive and increased ratings that the situation was stressful. T3 positive schizotypy was also associated with impaired ability to concentrate in the moment and diminished ability to cope in the moment. In addition, T3 positive schizotypy was associated with diminished enjoyment of current activities. In contrast, T3 negative schizotypy was only associated with diminished feeling of good about self. Neither T3 positive nor negative schizotypy were associated with reports of drug use in daily life. Finally,

the interaction term of T3 positive and negative schizotypy was associated with positive situation in the moment and decreased drug use in daily life.

As can be seen in Table 2, T1 schizotypy dimensions predicted T3 psychotic-like and suspiciousness symptoms. Specifically, T1 positive schizotypy predicted some of the items tapping psychotic-like symptoms such as difficulty controlling thoughts and unusual senses, and it also predicted feeling suspicious and mistreated in the moment. In addition, T1 positive schizotypy predicted T3 paranoid symptoms in daily life. In contrast, T1 negative schizotypy predicted T3 suspicious symptoms and the psychotic-like index. Finally, the T1 interaction term was generally unassociated with T3 constructs.

On the other hand, T3 positive schizotypy and the interaction term were associated with psychotic-like, suspicious, and paranoid symptoms in daily life (Table 2). Positive schizotypy and the interaction term were 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. In addition, T3 positive schizotypy was also associated with feeling suspicious and mistreated in the moment. However, neither T3 positive nor negative schizotypy were associated with the negative symptom of diminished thoughts or emotions in daily life.

As can be seen in Table 3, T1 positive schizotypy predicted increased desire to be alone when with others, whereas T1 negative schizotypy predicted negative-symptoms items of diminished closeness, increased preference to be alone when with others, and decreased desire to be with others when alone. Only T1 negative schizotypy predicted decreased social contact and diminished reports that others care about them. The T1 interaction term did not account for a significant relation with social stress symptoms in daily life.

Cross-sectionally**,** both T3 schizotypy dimensions were differentially associated with social contact and functioning in daily life (table 4). T3 positive schizotypy was associated with increased social contact but with increased preference to be alone when with others. T3 negative, but not positive, schizotypy was associated with diminished reports that others cared for them and decreased social contact. In addition, negative schizotypy was associated with negative-symptom

item of diminished closeness when with others, as well as with preference to be with others when alone. Furthermore, the T3 interaction term was associated with increased reports that others cared about them and with decreased preference to be alone.

3.2. Longitudinal and Cross-sectional Relations of Stress and Schizotypic Symptoms

We examined whether T3 stress was associated with T3 psychotic-like and paranoid symptoms, and with the T3 negative symptom of diminished thoughts and emotions in the moment, and whether these relationships varied across levels of positive and negative schizotypy assessed at T1 and T3 (see Table 4 and 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. Cross-level analyses examining the predictive validity of the schizotypy dimensions interaction terms revealed that individuals of the current sample were assigned to four different groups that varied across levels of positive and negative schizotypy as assessed at T1 or at T3. The identified four groups for the T1 positive and negative schizotypy interaction term are: individuals high in both positive (mean=2.165) and negative (mean=2.112) schizotypy dimensions, those high in positive and low in negative (mean=-1.449) schizotypy, those high in negative and low in positive (mean=-1.496) schizotypy, and finally those low in both positive and negative schizotypy. Whereas, the identified four groups for the T3 positive and negative schizotypy interaction term are: individuals high in both positive (mean=1.223) and negative (mean=1.502) schizotypy dimensions, those high in positive and low in negative (mean=-0.738) schizotypy, those high in negative and low in positive (mean=-0.501) schizotypy, and finally those low in both positive and negative schizotypy.

As expected, T3 stressful situations and social stress (but not social contact) were associated with T3 psychotic-like and paranoid symptoms in the moment. Furthermore, T3 stressful situation was also associated with the T3 negative symptom of diminished thoughts or emotions. The relationship between the T3 social stress item of feeling unwanted and T3

psychotic-like symptoms was moderated by T1 positive schizotypy. As seen in Figure 1, feeling unwanted was associated with psychotic-like symptoms, but only in participants high in positive schizotypy at T1. Unexpectedly, the relationship between T3 social contact and the negative symptom of diminished thoughts or emotion was moderated by T1 positive schizotypy. Figure 2 shows that for high positive schizotypy at T1 being alone was associated with having less no thoughts or emotions, whereas being with others was associated with having more no thoughts or emotions. Furthermore, the relationship between T3 social contact and paranoid symptoms was moderated by T1 negative schizotypy. As shown in Figure 3, in high T1 negative schizotypy being alone was associated with having less paranoid symptoms in the moment, whereas when with others it was associated with having more paranoid symptoms in the moment.

According to what expected, T3 stressful situation and social stress (that is, "Alone because not wanted"), but not social contact, were associated with paranoid symptoms in the moment and these relations were moderated by T3 positive schizotypy and the interaction term. As seen in Figure 4, stress was associated with paranoid symptoms, but only in individuals high in T3 positive schizotypy and in those high in both T3 positive and negative schizotypy. Similarly, Figure 5 displays that social stress was associated with paranoid symptoms, but only in high T3 positive schizotypy participants, and in those with high T3 positive schizotypy in interaction with high or low T3 negative schizotypy. Furthermore, T3 negative schizotypy and the interaction term moderated the association of social contact with psychotic-like and paranoid symptoms in the moment. As seen in Figure 6, social contact condition of being alone was associated with psychotic-like symptoms in high T3 negative schizotypy and in those with high negative schizotypy in interaction with high T3 positive schizotypy. As shown in figure 7, the social contact condition of being alone was associated with paranoid symptoms in high T3 negative schizotypy, and in those with high T3 negative schizotypy in interaction with high or low T3 positive schizotypy. In addition, T3 negative schizotypy moderated the association of social stress with the negative symptom item of diminished thoughts or emotions. As can be seen in Figure 8, the social stress item of feeling close to the other was associated with the negative symptoms of

diminished thoughts or emotions, but only in high T3 negative schizotypy. Finally, the T3 interaction term also moderated the association of social stress with psychotic-like and paranoid symptoms in the moment (Figure 9), as well as the association of social contact with the negative symptom of diminished thoughts and emotions (Figure 10).

We next conducted time-lagged analyses examining whether T3 stress at the preceding ESM signal predicted T3 psychotic-like and paranoid symptoms at the current ESM signal, and whether these relationships were moderated by schizotypy dimensions assessed both at T1 and T3. We also reversed the association examining whether symptoms at the preceding signal predicted stress at the current signal. As seen in Table 6, T1 positive schizotypy did not moderate any of the time-lagged associations between the T3 stress and schizotypic symptoms. However, giving that stress at the preceding ESM signal predicted psychotic-like symptoms, we run additional analyses controlling for the effect of psychotic-like symptoms at the previous signal. Unexpectedly, the time-lagged association of stress with psychotic-like experiences was not retained. Moreover, stress at the preceding ESM signal predicted paranoid symptoms and this association was moderated by T1 negative schizotypy. Further analyses indicated that this effect was not retained after partialing out the effect of paranoid symptoms at the previous signal. Similarly, negative affect at the previous ESM signal predicted stress in the moment and this association was moderated by T1 negative schizotypy, but this effect was not retained after partialing out the effect of stress at the previous signal. Furthermore, after controlling for the effect of psychotic-like symptoms at the previous signal, we found that T3 negative affect at the preceding ESM signal predicted psychotic-like symptoms and this association was moderated by T1 negative schizotypy (γ_{12}= -0.012, SE = 0.005, p <.05) —that is, the significant association of prior negative affect symptoms with current psychotic-like symptoms at high levels of T1 negative schizotypy was not simply the result of psychotic-like symptoms at the prior signal. Additionally, stress at the preceding ESM signal predicted negative affect symptoms and this association was almost significantly moderated by T1 negative schizotypy, but this effect was not retained after partialing out the effect of negative affect at the previous signal.

As can be seen in Table 7, stress at the preceding ESM signal predicted psychotic-like and this relation was moderated by T3 positive schizotypy. In addition, this effect was 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 (γ_{11}= 0.006, SE = 0.002, $p < .01$). Moreover, negative affect at the preceding ESM signal predicted psychotic-like symptoms and this association was moderated by both T3 schizotypy dimensions. Furthermore, this effect was held even after partialing out the effects of psychotic-like symptoms at the previous signal—that is, the significant association of prior negative affect with current psychotic-like associations at high levels of positive schizotypy (γ_{11}= 0.007, SE = 0.002, $p < .01$) and negative schizotypy (γ_{12}= -0.012, SE = 0.006, $p < .05$) was not simply the result of psychotic-like symptoms at the prior signal. Note that at T3, stress also predicted negative affect and psychotic-like symptoms were further associated with negative affect at the subsequent signal, but none of these relations was moderated by T1 or T3 positive and negative schizotypy.

4. Discussion

The present study extends our previous findings (Barrantes-Vidal et al., 2013a) by examining the real-world expression of schizotypy dimensions in a 3-year follow-up in a young non-clinical sample of Spanish students. Our findings lend additional support to positive and negative schizotypy as two distinct constructs hat exhibit differential patterns of associations with schizotypic symptoms in daily life.

The present results demonstrate that the associations of positive schizotypy assessed at T1 and at T3 was associated with the same affect and functioning ESM symptoms that were reported to be related to positive schizotypy, 1.4 years before the present assessment (Barrantes-Vidal et al., 2013a). Consistent with findings of Barrantes-Vidal and colleagues (2013a), T1 and T3 positive schizotypy were related to diminished positive affect and increased negative affect (as well as each individual negative affect symptom). Furthermore, both were associated with increased reports that the situation was stressful and decreased reports that the situation was

positive. In line with T2 results (Barrantes-Vidal et al., 2013a), T1 and T3 positive schizotypy were related to impaired ability to concentrate and diminished feelings of being able to cope in the moment. On the contrary, negative schizotypy assessed at T1 and at T3 were differentially related with affect and functioning symptoms in daily life. T1 negative schizotypy, but not T3, predicted the equivalent ESM constructs that were previously reported to be associated with negative schizotypy at T2 (Barrantes-Vidal et al., 2013a). In fact, as in the previous cross-sectional study (Barrantes-Vidal et al., 2013a), 3.1 years later T1 negative schizotypy predicted the three negative-symptom items assessing diminished positive affect and situation, as well as diminished enjoyment of current activities and feelings of able to cope in daily life. In contrast, T3 negative schizotypy was only associated with diminished positive symptoms of feeling good about self, although presented trend toward significance in the association with decreased reports that the situation was positive and with diminished enjoyment of the current activity. Concerning the interaction term of schizotypy dimensions, we found that T1 interaction term longitudinally predicted decreased positive symptoms of feeling happy in the moment, whereas T3 interaction term was cross-sectionally associated with increased report that the situation was positive as well as decreased drug use in daily life. T3 interaction term also presented almost significant association with increased report of feeling good about self and increased feelings of being able to cope in the moment.

Moreover, positive and negative schizotypy were differentially related to psychotic-like, paranoid, and negative symptoms experienced in daily life. At T3, we found that the association with momentary paranoid symptoms was strongest for T1 positive schizotypy then for T1 negative schizotypy. This is consistent with Barrantes-Vidal et al. (2013a) study showing that 1.4 years before the present assessment T1 schizotypy dimensions predicted momentary paranoid symptoms at T2, but the association was stronger for positive than for negative schizotypy. In this regard, it is interesting to note that the present study by indicating that uniquely T3 positive, but not negative, schizotypy predicted increased reports of paranoid symptoms at T3 is showing that

the prediction of paranoid symptoms by schizotypy dimensions is following a consistent trend of associations across T2 and T3 assessments.

Furthermore, we found that T1 positive and negative schizotypy as well as T3 positive schizotypy predicted suspiciousness symptoms at T3, whereas only T1 and T3 positive schizotypy predicted feeling mistreated in daily life. The finding that baseline positive and negative schizotypy predicted momentary suspiciousness symptoms 3.1 years later is consistent with T2 results (Barrantes-Vidal et al., 2013a), and also in line with our previous longitudinal studies showing that both baseline schizotypy dimensions predicted questionnaire ratings of suspiciousness symptoms 3.1 years later at T3 (Racioppi et al., 2018) and 4.4 years later at T4 (Racioppi et al., *in preparation*). By demonstrating that both schizotypy predict suspiciousness while uniquely positive schizotypy predicts feeling mistreated, these findings support the idea that suspiciousness, when is not extreme or pervasive, represents a moderate mistrust of the situations or of the others, whereas feeling mistreated implies a more active situation in which the individual has felt subjected to an act of physical or psychological maltreatment.

Consistent with T2 study (Barrantes-Vidal et al., 2013a), T1 and T3 positive schizotypy were associated with the psychotic-like symptoms index score. As in the previous T2 cross-sectional study (Barrantes-Vidal et al., 2013a), in the present study we found that T3 positive schizotypy was associated with each of the individual psychotic-like symptoms at T3 and that T1 positive schizotypy predicted a subset of them, such as difficulty controlling thoughts and unusual sense. Thus, by showing that individuals with baseline high positive schizotypy tends to experience high levels of psychotic-like symptoms in the real-life environment 3.1 years later, these findings seems to indicate that the predictive validity of positive schizotypy for psychotic-like symptoms in daily life is particularly consistent with the passage of time. The persistence of psychotic-like symptoms in nonclinical samples was previously found by longitudinal studies employing clinical questionnaire measures to assess positive symptoms. For example, we found that positive schizotypy predicted positive symptoms in this same sample at T3 (Racioppi et al., 2018) and at T4 (Racioppi et al., in preparation), respectively 3.1 years and 4.4 years after the

baseline assessment. The current findings provide additional support to the predictive validity of positive schizotypy in young nonclinical adults even in the real-life environment and highlight the relevance of the employment of psychometric measures to detect individuals with a latent vulnerability for psychosis.

T1 negative schizotypy predicted the psychotic-like index score and also presented a trend toward significance in the longitudinal association with feeling weird in the moment, while T3 negative schizotypy was unrelated to the overall composite of psychotic-like symptoms or to individual symptoms. The finding that after 3.1 years negative symptoms predicted the overall psychotic-like symptoms composite is consistent with previous cross-sectional findings (Barrantes-Vidal et al., 2013a) showing that baseline negative schizotypy predicted momentary psychotic-like symptoms at T2. Other studies reported comparable association of negative schizotypy with interview ratings of positive symptoms both cross-sectionally (Kemp et al., 2019) and longitudinally (Kwapil et al., 2013). For example, in our previous longitudinal study (Racioppi et al., *in preparation*) we found that, even if it was not the case at T2 (Barrantes-Vidal et al., 2013b) or at T3 (Racioppi et al., 2018) assessments, baseline negative schizotypy predicted T4 positive symptoms assessed with the Comprehensive Assessment of At Risk Mental State (Yung et al., 2005) that among the four classes of positive symptoms includes the unusual thought content (that is, delusional mood and perplexity, ideas of reference, and bizarre ideas). However, in contrast with T2 results (Barrantes-Vidal et al., 2013a), baseline negative schizotypy also revealed an almost significant prediction of feeling losing control, which implies a strong affective response. This latter result indicating that high negative schizotypy individuals show an affective activation seems to go against the present finding showing that uniquely T1 and T3 negative schizotypy presented an almost significant association with increased no thoughts and emotions, a negative symptom tapping alogia and affective flattening. Nevertheless, in the previous longitudinal study (Racioppi et al., 2018) we found that T1 negative schizotypy predicted T3 negative symptoms of CAARMS, which was included in the negative index symptoms as avolition, anhedonia and alogia. Thus, the present study enhances previous results by

demonstrating that negative schizotypy predicts negative and positive symptoms also in the real-life environment and supports the validity of schizotypy as a useful construct to identify developmental trajectories of schizophrenia-spectrum psychopathology.

The findings that uniquely T1 and T3 negative schizotypy predicted increased reports of being alone and that the prediction of feeling not cared by others was strongest for both T1 and T3 negative schizotypy dimensions compared to positive schizotypy, is in contrast with our previous cross-sectional study (Barrantes-Vidal et al., 2013a). At T2, both baseline schizotypy dimensions were related to decreased reports of social contact and feeling close to the others in daily life. Nevertheless, in line with previous T2 results (Barrantes-Vidal et al., 2013a) we found that when with others individuals high on both schizotypy dimensions desire to be alone. The present study appears to indicate that while high negative schizotypy individuals spend more time alone and do not wish to be with others, those high in positive schizotypy tend to spend more time being with others but at the same time they experience an increase desire to be alone. This is in line with previous studies showing that schizotypy dimensions are differentially related to social withdrawal and social anxiety symptoms assessed with interview and questionnaire measures. In a previous cross-sectional study, Brown et al. (2008) found that negative schizotypy was associated with social anhedonia (withdrawal/disinterest) while positive schizotypy was associated with social anxiety. Our previous longitudinal study (Racioppi et al., *in preparation*) enhanced these findings by showing that T1 negative schizotypy predicts several negative symptoms facets and presents strong effect size especially in the prediction of social withdrawal and affective flattening symptoms 4.4 years later. In contrast, T1 positive schizotypy was found to be associated only with T4 avolition symptoms. Social withdrawal and social anxiety also revealed to be differentially associated with social stressors in the real-life environment. The previous ESM study analyzing means of daily-life experiences in an American sample (Brown et al., 2007) found that social anhedonia was associated with diminished desire of social contact and preference to be alone. On the contrary, social anxiety was found to be related with the desire to be alone especially when with others to whom individuals are not feeling close to. Furthermore,

it is important to note that, both cross-sectionally (Bolinskey et al., 2015; Barrantes-Vidal et al., 2010, 2013b; Kwapil et al., 2008) and longitudinally (Bolinskey et al., 2017; Gooding et al; 2007; Kwapil et al. 2013; Racioppi et al., 2018, in preparation.), the WSS negative schizotypy scales as well as the dimensional negative schizotypy composite were repeatedly found to be uniquely associated with Schizoid Personality Disorder, which criteria includes anhedonia, social withdrawal, and affective flattening symptoms. Taken together, these findings may suggest that individuals with high positive schizotypy tends to desire more social contact but because of the great social anxiety that they experience, when with others they desire to be alone. In contrast, individuals with high negative schizotypy who are not concern about social relationships (high levels of social withdrawal) prefer to spend more time alone.

In order to extend our previous T2 ESM cross-sectional findings (Barrantes-Vidal et al., 2013a), we also examined whether schizotypic symptoms assessed at T3 were related to specific stressors and if these associations were exacerbated in individuals who reported high schizotypy scores at T1 or at T3. In addition to T2 cross-sectional work (Barrantes-Vidal et al., 2013a), in the present study we also analyzed the predictive validity of the T1 and T3 positive and negative schizotypy interaction terms in the association of social and situational stressors with schizotypic symptoms.

As expected, and in line with T2 findings (Barrantes-Vidal et al., 2013a), the present results indicated that stressful situations were cross-sectionally associated, but not longitudinally, with momentary paranoid symptoms for those high in positive schizotypy, but not those low in positive schizotypy. That is, in low-stress situation both low and high positive schizotypy rarely experience paranoid symptoms, but in high-stress situation high positive schizotypy individuals experience greater paranoid symptoms. Unexpectedly and in contrast with the previous cross-sectional study (Barrantes-Vidal et al., 2013a), even if the present results showed that positive schizotypy predicted both longitudinally and cross-sectionally elevated daily life experiences of stressful situations and psychotic-like symptoms, we found that neither T1 nor T3 positive

schizotypy moderated the associations of stressful situations with simultaneous psychotic-like symptoms at T3.

We found that social stress is associated with psychotic-like, and paranoid and negative symptoms in daily life and these associations were differentially moderated by T1 and T3 schizotypy dimensions. In contrast to Barrantes-Vidal and colleagues (2013a), we generally did not find that T1 or T3 schizotypy dimensions predicted the association of the social stress situation of feeling close to the others with psychotic-like and paranoid symptoms in daily life. In accordance with T2 results (Barrantes-Vidal et al., 2013a), at T3 we found that the social stress item of feeling unwanted when alone was associated with simultaneous psychotic-like symptoms in daily life. Nevertheless, it was inversely moderated by T1 levels of positive schizotypy compared to previous T2 findings (Barrantes-Vidal et al., 2013a). Specifically, feeling unwanted when alone was associated with decreased momentary psychotic-like symptoms for those high in positive schizotypy, and with increased psychotic-like symptoms for those low in positive schizotypy. In line with Barrantes-Vidal et al. (2013a) T2 results, feeling unwanted when alone was associated with momentary paranoid symptoms for high positive schizotypy at T3, but not for those low in positive schizotypy. Unlike previous T2 cross-sectional results, we found an almost significant prediction of the association of feeling unwanted with the negative symptoms of no thoughts and emotions by the T3 negative schizotypy. Feeling unwanted when alone was associated with negative symptoms for individuals low in negative schizotypy, but not for those high in negative schizotypy. Thus, the present findings appear to indicate that in high social stress situations in which people are alone because unwanted, nonschizotypic individuals experience a simultaneous increase of psychotic-like and negative symptoms in daily life, whereas high positive schizotypy individuals tend to experience increased simultaneous paranoid symptoms.

The present findings revealed that the interaction term of positive and negative schizotypy assessed at T3 follow-up predicted the associations of social stress and stressful situations with momentary psychotic-like and paranoid symptoms experienced at T3. Thus, paranoid symptoms remained low in low-stress situations across all levels of both schizotypy dimensions but in high-

stress situations, these four groups and especially individuals high in both schizotypy dimensions will experience increased psychotic-like symptoms in daily life. Findings demonstrate that in low social stress situation of not being alone because unwanted paranoid and psychotic-like symptoms remained low across the four groups of schizotypy scores but when people are alone because not wanted (thus, at high social stress), those with high positive and low negative schizotypy as well as those high in both dimensions experience greater paranoia in daily life, whereas those with high negative and low positive schizotypy as well as those high in both schizotypy dimensions experience increased momentary psychotic like symptoms. Furthermore, the present study shows that in the low social stress situation in which people are with others to whom they are feeling close to, those with low levels in both schizotypy dimensions experience fewer psychotic-like symptoms while the other three groups and especially those high in both schizotypy dimensions experience increased simultaneous psychotic-like symptoms. In addition, when they are feeling close to the others those with high negative and low positive schizotypy and those with low levels on both schizotypy dimensions experience fewer momentary paranoid symptoms while those with high positive and low negative schizotypy as well as those high on both dimensions experience increased paranoid symptoms in daily life.

In contrast with previous cross-sectional results of T2 assessment reported by Barrantes-Vidal et al. (2013a), at T3 we found that social contact was associated with schizotypic symptoms in daily life and these associations were differentially moderated by schizotypy dimensions assessed at T1 and at T3. It was found that T1 positive and negative schizotypy longitudinally moderated the association of social contact with the negative symptoms of no thought or emotions and that uniquely T1 and T3 negative schizotypy moderated the association of social contact with paranoid symptoms. Specifically, being alone was related to increased negative symptom of no thoughts or emotions in individuals low in positive schizotypy as in those high in negative schizotypy, and with momentary paranoid symptoms for individuals low in negative schizotypy. Conversely, being with others was associated with increased reports of negative symptom in individuals high in positive schizotypy as in those low in negative schizotypy, and with paranoid

symptoms in individuals high in negative schizotypy. The cross-sectional examination of T3 ESM reports reveals that uniquely negative schizotypy assessed at T3 moderated the relation of social contact with psychotic-like symptoms in the moment. Specifically, being alone was associated with momentary psychotic-like symptoms for low negative schizotypy individuals. Reversely, being with others was associated with momentary psychotic-like symptoms in individuals with high negative schizotypy.

The T3 (but not T1) interaction term of positive and negative schizotypy moderated the associations of social contact with paranoid and psychotic-like symptoms as well as with the negative symptom of no thoughts or emotions in daily life. Being alone was associated with increased momentary psychotic-like and paranoid symptoms for individuals low in both positive and negative schizotypy compared to those high in positive and low in negative schizotypy as well as those individuals high in negative and low in positive schizotypy who on the contrary reported increased negative symptom of no thoughts and emotions when alone. Conversely, being with others was associated with increased momentary psychotic-like and paranoid symptoms especially for individuals high in both schizotypy dimensions, but also for those high in positive and low in negative schizotypy and those high in negative and low in positive schizotypy, with the first group reporting a larger increase of psychotic-like symptoms than the second group of individuals who inversely reported larger increase of momentary paranoid symptoms. Furthermore, being with others was associated with increased negative symptoms in each group, but not for those high in negative and low in positive schizotypy.

In the previous cross-sectional ESM study of the T2 follow-up, Barrantes-Vidal and colleagues (2013a) analyzed the temporal sequence of schizotypic symptoms and stress in daily life. In the current study we replicated these analyses by examining the time-lagged associations of stress, paranoid, and psychotic-like symptoms and whether they were predicted by high levels of positive and negative schizotypy assessed at T1 and at T3.

In addition to the previous study, we also examined the temporal sequence of momentary negative affect symptoms with stress and psychotic-like symptoms at T3. Results indicated that

experience of momentary negative affect preceded the onset of psychotic-like symptoms for individuals with high positive schizotypy scores at T3, whereas it was unrelated to subsequent increased experiences of psychotic-like symptoms in daily life for those high in negative schizotypy at T1 and at T3. Moreover, we found that psychotic-like symptoms preceded the onset of negative affect symptoms, but it was not unique to positive schizotypy scores at T1 or at T3. Results suggests that negative affect symptoms only produce the deviant psychotic-like experiences in positive schizotypic individuals, whereas psychotic-like experiences can produce negative affect symptoms in nonschizotypic individuals. Note that the time-lagged effect of negative affect 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 in positive schizotypy individuals. In addition, stress preceded the onset of negative affect symptoms, but it was not unique to positive or negative schizotypy scores at T1 or at T3. Similarly, negative affect symptoms preceded the experience of stress, but it was not unique to positive or negative schizotypy scores at T1 or at T3. We were not surprised to find that the experience of stress at the preceding signal did not produce negative affect at the subsequent signal in high negative schizotypy individuals. Previous studies repeatedly found negative schizotypy to be unrelated to increased momentary negative affect symptoms (Barrantes- Vidal et al. 2013a; Brown et al., 2007). In line with those studies, we found that uniquely positive schizotypy predicted stressful situations and negative affect symptoms in daily life both cross-sectionally and longitudinally. This suggests that stress can produce negative affect symptoms and conversely negative affect symptoms can induce stress in nonschizotypic individuals (albeit to a greater extent in positive schizotypy).

In contrast with previous T2 findings (Barrantes-Vidal et al., 2013a), we did not find that the experience of stress preceded the onset of psychotic-like symptoms for individuals high in positive schizotypy scores at T1. However, the cross-sectional examination of the time-lagged association of stress with psychotic-like experiences was uniquely significant for individuals high

in positive schizotypy at T3. This seems to suggest that for positive schizotypy individuals' stressful situations must have been lived recently in daily life to provoke increased experiences of psychotic-like symptoms in the real-life environment. Indeed, as in T2 (Barrantes-Vidal et al., 2013a), we found that daily life stress was associated with the simultaneous experience of psychotic-like symptoms, but it was not unique for those high in positive schizotypy at T1 or at T3. Furthermore, we found that the time-lagged association of stress with psychotic-like experiences was not unique to those individuals high in positive schizotypy 3.1 years before the present follow-up. Nevertheless, the present T3 cross-sectional findings and those reported by Barrantes-Vidal et al. (2013a) at T2 indicated that previous stress induces psychotic-like symptoms at the subsequent moment uniquely in individuals identified as high in positive schizotypy at the same follow-up in which the ESM questionnaires have been assessed (that is, at T2 and at T3). Additionally, results indicate that the temporal association of stress with subsequent psychotic-like symptoms was over-and-above the effect of previous psychotic-like symptoms at both cross-sectional assessments. That is, in both T2 and T3 assessment the time-lagged association was not simply the result of psychotic-like symptoms provoking an increase of symptoms over time.

Contrary to what reported by Barrantes-Vidal et al. (2013a), we did not find that stress can produce suspiciousness and feelings of mistreatment in nonschizotypic or in schizotypic individuals. However, results of the present study showed that stressful situations and the social stress item of feeling unwanted when alone were associated with simultaneous paranoid symptoms only for individuals high in positive schizotypy at T3. The present findings appear to indicate that in positive schizotypic individuals, stressors (including social stress) are uniquely associated with simultaneous experience of paranoid symptoms in daily life.

Overall, the present time-lagged findings by indicating that high positive schizotypy individuals are more reactive to daily stressful situations and social stress compared to those high in negative schizotypy are consistent with those reported in the further examination of the T2 follow-up by Chun and colleagues (2017). They obtained schizotypy dimensions based on

dimensional interview ratings of Cluster A Personality Disorders and found that positive (as well as paranoid and disorganized) schizotypy predicted associations of daily life stress, social stress, and desire to be alone with momentary negative affect, and psychotic-like and paranoid symptoms. Furthermore, they found that the association of daily life stress with increased momentary negative affect and paranoid symptoms was uniquely moderated by positive schizotypy. The present study lends new evidence to support the greater reactivity of positive schizotypy in high-stress situations, while remarks the diminished reactivity of negative schizotypy. Furthermore, the current findings demonstrate the predictive validity of positive and negative schizotypy dimensions in daily life by showing their consistency in the prediction of schizotypic symptoms with the passage of time. The present study enhances our understanding of how stress and social stressors are associated with schizotypic symptoms and the way in which they vary across levels of positive and negative schizotypy dimensions. The findings may have implications in the real-life environment for the development of intervention strategies aimed to reduce the impact of those factors that can exacerbate the risk of future schizophrenia-spectrum disorders, and to potentiate the effect of those protective factors (e.g., spending time with close friends and family) that can minimize the risk in nonclinical individuals.

Tables and Figures

Table 1

Longitudinal and Cross-sectional Relationship of Positive and Negative Schizotypy and the Interaction Term With Affect and Functioning in Daily Life

	T1 Level 2 predictors[a]			T3 Level 2 predictors[b]		
Level 1 criterion	Positive schizotypy γ_{01} (*df* = 89)	Negative schizotypy γ_{02} (*df* = 89)	Interaction term γ_{03} (*df* = 89)	Positive schizotypy γ_{01} (*df* = 89)	Negative schizotypy γ_{02} (*df* = 89)	Interaction term γ_{03} (*df* = 89)
Happy	-0.182 (0.051)***	-0.125 (0.57)*	-0.165 (0.061)**	-0.221 (0.046)***	-0.108 (0.068)	0.011 (0.024)
Good about self	-0.222 (0.051)***	-0.132 (0.054)*	-0.086 (0.062)	-0.273 (0.043)***	-0.144 (0.069)*	0.038 (0.021)#p=.078
Negative affect	0.128 (0.042)**	0.058 (0.036)	0.070 (0.075)	0.248 (0.036)***	0.007 (0.041)	-0.013 (0.013)
Situation positive	-0.154 (0.050)**	-0.122 (0.055)*	-0.087 (0.065)	-0.231 (0.042)***	-0.112 (0.065)#p=.087	0.040 (0.018)*
Situation stressful	0.174 (0.087)*	0.054 (0.102)	0.168 (0.167)	0.330 (0.067)***	0.046 (0.130)	-0.013 (0.038)
Enjoy current activity	-0.127 (0.054)*	-0.101 (0.056)#p=.072	-0.040 (0.100)	-0.224 (0.051)***	-0.123 (0.074)#p=.096	-0.033 (0.020)
Able to cope	-0.161 (0.046)***	-0.134 (0.052)*	-0.060 (0.056)	-0.218 (0.042)***	-0.101 (0.066)	0.040 (0.021)#p=.054
Able to concentrate	-0.180 (0.059)**	0.023 (0.074)	-0.074 (0.090)	-0.218 (0.038)***	0.035 (0.096)	0.001 (0.027)
Drug use	0.142 (0.165)	-0.015 (0.253)	-0.394 (0.247)	0.202 (0.270)	-0.082 (0.371)	-0.204 (0.099)*

Note. Raw multilevel regression coefficients indicating the relationship of the Level-2 predictors with the Level-1 (daily life experience) criteria.

[a] Longitudinal: T1 schizotypy dimensions predicting T3 criteria.

[b] Cross-sectional: associations of T3 schizotypy dimensions with T3 criteria.

#p < .10. *p < .05. **p < .01. ***p < .001.

Table 2

Longitudinal and Cross-sectional Relationship of Positive and Negative Schizotypy and the interaction term With Psychotic-Like, Paranoid, and Negative Schizotypic Experiences in Daily Life

	T1 Level 2 predictors[a]			T3 Level 2 predictors[b]		
Level 1 criterion	Positive schizotypy γ_{01} (*df* = 89)	Negative schizotypy γ_{02} (*df* = 89)	Interaction term γ_{03} (*df* = 89)	Positive schizotypy γ_{01} (*df* = 89)	Negative schizotypy γ_{02} (*df* = 89)	Interaction term γ_{03} (*df* = 89)
Fear losing control	0.040 (0.016)*	0.022 (0.012)[#] p=.069	0.020 (0.020)	0.124 (0.028)***	-0.004 (0.021)	-0.024 (0.005)***
Feel weird	0.079 (0.029)**	0.035 (0.019)[#] p=.065	0.082 (0.048)[#] p=.088	0.128 (0.016)***	0.021 (0.024)	0.006 (0.007)
Difficulty controlling thoughts	0.063 (0.029)*	0.044 (0.027)	0.029 (0.048)	0.109 (0.047)*	0.021 (0.040)	-0.042 (0.010)***
Strange or unusual thoughts	0.021 (0.013)	0.009 (0.006)	0.012 (0.014)	0.082 (0.026)**	-0.010 (0.015)	-0.018 (0.005)***
Special meaning	0.025 (0.055)	-0.031 (0.049)	0.017 (0.065)	0.161 (0.069)*	-0.064 (0.061)	-0.057 (0.015)***
Senses are Unusual	0.018 (0.007)*	-0.002 (0.003)	0.001 (0.006)	0.050 (0.017)**	-0.014 (0.009)	-0.013 (0.003)***
Hearing/seeing things	0.012 (0.009)	0.005 (0.003)	0.006 (0.007)	0.053 (0.015)**	-0.014 (0.009)	-0.010 (0.003)**
Feel controlled	0.010 (0.007)	0.010 (0.008)	-0.006 (0.009)	0.043 (0.020)*	-0.009 (0.011)	-0.016 (0.003)***
Familiar things strange	0.017 (0.013)	0.003 (0.007)	-0.002 (0.013)	0.099 (0.049)*	-0.012 (0.028)	-0.037 (0.008)***
Psychotic-like experiences index	0.032 (0.012)**	0.016 (0.007)*	0.018 (0.016)	0.086 (0.025)**	-0.003 (0.016)	-0.019 (0.004)***
Feel suspicious	0.083 (0.030)**	0.063 (0.028)*	.052 (0.062)	0.266 (0.025)***	0.044 (0.029)	0.017 (0.009)[#] p=.052
Feel mistreated	0.040 (0.020)*	0.015 (0.017)	0.025 (0.035)	0.181 (0.025)***	0.008 (0.017)	-0.005 (0.007)
Paranoia index	0.061 (0.024)*	0.039 (0.022)[#] p=.068	0.038 (0.047)	0.223 (0.022)***	0.026 (0.020)	0.006 (0.007)
No thoughts or emotions	-0.034 (0.028)	0.130 (0.079)[#] p=.099	-0.109 (0.062)[#] p=.078	-0.052 (0.049)	0.212 (0.113)[#] p=.061	-0.051 (0.027)[#] p=.060

Note. Raw multilevel regression coefficients indicating the relationship of the Level-2 predictors with the Level-1 (daily life experience) criteria.

[a] Longitudinal: T1 schizotypy dimensions predicting T3 criteria.

[b] Cross-sectional: associations of T3 schizotypy dimensions with T3 criteria.

[#]p < .10. *p < .05. **p < .01. ***p < .001.

Table 3

Longitudinal and Cross-sectional Relationship of Positive and Negative Schizotypy and interaction term With Social Contact and Functioning in Daily Life

	T1 Level 2 predictors[a]			T3 Level 2 predictors[b]		
Level 1 criterion	Positive schizotypy γ_{01} (*df* = 89)	Negative schizotypy γ_{02} (*df* = 89)	Interaction term γ_{03} (*df* = 89)	Positive schizotypy γ_{01} (*df* = 89)	Negative schizotypy γ_{02} (*df* = 89)	Interaction term γ_{03} (*df* = 89)
Others care about me	-0.143 (0.084)[#] p=.088	-0.308 (0.104)**	0.162 (0.130)	-0.022 (0.087)	-0.352 (0.149)*	0.096 (0.043)*
Alone at the signal[c]	0.010 (0.013)	-0.039 (0.015)*	0.013 (0.019)	0.040 (0.011)***	-0.039 (0.016)*	0.003 (0.005)
When with others						
Close to others	-0.003 (0.061)	-0.149 (0.064)*	0.153 (0.089)[#] p=.088	0.033 (0.068)	-0.205 (0.104)*	0.053 (0.031)[#] p=.085
Prefer to be alone	0.142 (0.061)*	0.151 (0.058)**	0.008 (0.092)	0.183 (0.083)*	0.220 (0.122)[#] p=.072	-0.079 (0.029)**
When alone						
Alone b/c not wanted	0.012 (0.023)	0.024 (0.018)	-0.021 (0.020)	0.025 (0.016)	-0.033 (0.018)[#] p=.066	0.005 (0.005)
Prefer to be with others	-0.080 (0.079)	-0.248 (0.101)*	0.001 (0.127)	-0.019 (0.100)	-0.261 (0.125)*	0.083 (0.046)[#] p=.069

Note. Raw multilevel regression coefficients indicating the relationship of the Level-2 predictors with the Level-1 (daily life experience) criteria.

[a] Longitudinal: T1 schizotypy dimensions predicting T3 criteria.

[b] Cross-sectional: associations of T3 schizotypy dimensions with T3 criteria.

[c] Item is scored *alone* = 1 and *with others* = 2.

[#]p < .10. *p < .05. **p < .01. ***p < .001.

Table 4

Cross-Level Interactions of Stress and Schizotypic Symptoms Across Levels of T1 Positive and Negative Schizotypy

	Level 1 predictor		Level 2 predictors[@]		
Level 1 criterion			Positive Schizotypy γ_{11} (*df* = 89)	Negative Schizotypy γ_{12} (*df* = 89)	Interaction term γ_{13} (*df* = 89)
Psychotic-like index	Situation stressful	0.015(0.004)***	-0.001 (0.002)	0.004 (0.003)	0.002 (0.004)
Psychotic-like index	Alone	0.005 (0.010)	0.004 (0.006)	0.006 (0.006)	0.010 (0.008)
Psychotic-like index	Close to other	0.001 (0.003)	0.002 (0.002)	0.000 (0.002)	0.003 (0.004)
Psychotic-like index	Alone b/c not wanted	0.061 (0.021)**	-0.030 (0.014)*	-0.009 (0.014)	0.016 (0.022)
Paranoia index	Situation stressful	0.048 (0.012)***	0.007 (0.009)	0.005 (0.009)	0.024 (0.016)
Paranoia index	Alone	0.005 (0.017)	-0.004 (0.011)	0.040 (0.014)**	0.030 (0.028)
Paranoia index	Close to other	-0.016 (0.012)	-0.007 (0.009)	-0.006 (0.009)	0.002 (0.014)
Paranoia index	Alone b/c not wanted	0.185 (0.087)*	0.016 (0.066)	0.062 (0.064)	0.128 (0.078)[#]p=.099
No thoughts or emotions	Situation stressful	-0.024 (0.008)**	0.001 (0.004)	-0.006 (0.008)	0.011 (0.008)
No thoughts or emotions	Alone	0.019 (0.019)	0.030 (0.010)**	-0.044 (0.023)[#]p=.061	0.015 (0.022)
No thoughts or emotions	Close to other	0.006 (0.008)	-0.001 (0.006)	-0.022 (0.012)[#]p=.076	-0.008 (0.011)
No thoughts or emotions	Alone b/c not wanted	-0.029 (0.049)	-0.006 (0.027)	0.048 (0.040)	-0.036 (0.031)

[@] Cross-level interaction of the association of the Level-2 variable with the slope of the Level-1 predictor and criterion.

[#]p < .10. *p < .05. **p < .01. ***p < .001.

Table 5

Cross-Level Interactions of Stress and Schizotypic Symptoms Across Levels of T3 Positive and Negative Schizotypy

	Level 1 predictor		Level 2 predictors[@]		
			Positive schizotypy	Negative schizotypy	Interaction term
Level 1 criterion	γ_{10} (*df* = 89)		γ_{11} (*df* = 89)	γ_{12} (*df* = 89)	γ_{13} (*df* = 89)
Psychotic-like index	Situation stressful	0.015(0.004)***	-0.002 (0.004)	0.004 (0.004)	0.001 (0.001)
Psychotic-like index	Alone	0.005 (0.010)	0.002 (0.014)	0.016 (0.008)*	0.013 (0.002)***
Psychotic-like index	Close to other	0.001 (0.003)	0.003 (0.004)	0.005 (0.004)	0.004 (0.001)***
Psychotic-like index	Alone b/c not wanted	0.054 (0.020)**	-0.003 (0.018)	0.013 (0.024)	-0.021 (0.006)***
Paranoia index	Situation stressful	0.044 (0.011)***	0.036 (0.005)***	0.014 (0.009)	0.007 (0.003)**
Paranoia index	Alone	0.005 (0.016)	0.029 (0.034)	0.063 (0.021)**	0.035 (0.004)***
Paranoia index	Close to other	-0.018 (0.012)	0.000 (0.013)	0.003 (0.012)	0.016 (0.002)***
Paranoia index	Alone b/c not wanted	0.137 (0.066)*	0.236 (0.054)***	0.001 (0.083)	-0.056 (0.026)*
No thoughts or emotions	Situation stressful	-0.024 (0.008)**	0.004 (0.004)	-0.011 (0.012)	0.004 (0.003)
No thoughts or emotions	Alone	0.021 (0.020)	0.035 (0.023)	-0.044 (0.035)	0.021 (0.008)*
No thoughts or emotions	Close to other	0.006 (0.010)	-0.004 (0.005)	-0.033 (0.015)*	-0.006 (0.009)
No thoughts or emotions	Alone b/c not wanted	-0.042 (0.050)	0.041 (0.038)	-0.090 (0.050)[#]p=.071	0.036 (0.020)[#]p=.072

[@] Cross-level interaction of the association of the Level-2 variable with the slope of the Level-1 predictor and criterion.

[#]p < .10. *p < .05. **p < .01. ***p < .001.

Table 6

Time-Lagged Analyses of Stress and Schizotypic Symptoms Across Levels of T1 Positive and Negative Schizotypy

	Level 1 predictor		Level 2 predictors[@]	
Level 1 criterion			Positive schizotypy γ_{11} (*df* = 89)	Negative Schizotypy γ_{12} (*df* = 89)
Psychotic-like index	Situation stressful	0.013 (0.005)*	0.001 (0.002)	0.002 (0.003)
Situation stressful	Psychotic-like index	0.219 (0.282)	0.109 (0.145)	0.103 (0.187)
Paranoia index	Situation stressful	0.006 (0.017)	-0.009 (0.012)	-0.027 (0.013)*
Situation stressful	Paranoia index	0.137 (0.140)	-0.015 (0.075)	-0.077 (0.080)
Negative affect	Situation stressful	0.082 (0.015)***	-0.008 (0.010)	-0.015 (0.008)[#]p=.068
Situation Stressful	Negative affect	0.429 (0.065)***	-0.002 (0.040)	-0.145 (0.054)**
Psychotic-like index	Negative affect	0.031 (0.008)***	0.003 (0.005)	-0.008 (0.006)
Negative affect	Psychotic-like index	0.594 (0.164)***	-0.023 (0.100)	-0.082 (0.094)

[@] Time-lagged interaction of the association of the Level 2 variable with the slope of the Level 1 predictor and criterion.

[#]p<.10. *p <.05. **p <.01. ***p <.001.

Table 7

Time-Lagged Analyses of Stress and Schizotypic Symptoms Across Levels of T3 Positive and Negative Schizotypy

	Level 1 predictor		Level 2 predictors[@]	
			Positive schizotypy	Negative schizotypy
Level 1 criterion	γ_{10} (*df* = 89)		γ_{11} (*df* = 89)	γ_{12} (*df* = 89)
Psychotic-like index	Situation stressful	0.012 (0.005)*	0.006 (0.003)*	-0.002 (0.004)
Situation stressful	Psychotic-like index	0.320 (0.244)	-0.074 (0.104)	-0.051 (0.151)
Paranoia index	Situation stressful	0.001 (0.016)	0.002 (0.038)	-0.059 (0.034)
Situation stressful	Paranoia index	0.082 (0.138)	0.035 (0.021)	-0.016 (0.052)
Negative affect	Situation stressful	0.082 (0.015)***	0.021 (0.021)	-0.034 (0.023)
Situation Stressful	Negative affect	0.409 (0.068)***	0.038 (0.040)	-0.068 (0.051)
Psychotic-like index	Negative affect	0.030 (0.008)***	0.008 (0.003)**	-0.014 (0.006)*
Negative affect	Psychotic-like index	0.554 (0.140)***	0.049 (0.075)	-0.080 (0.078)

[@] Time-lagged interaction of the association of the Level 2 variable with the slope of the Level 1 predictor and criterion.
[#]p < .10. *p < .05. **p < .01. ***p < .001.

Figure 1. Cross-level interactions of the T3 social stress item of feeling unwanted with psychotic-like symptoms across levels of T1 positive schizotypy.

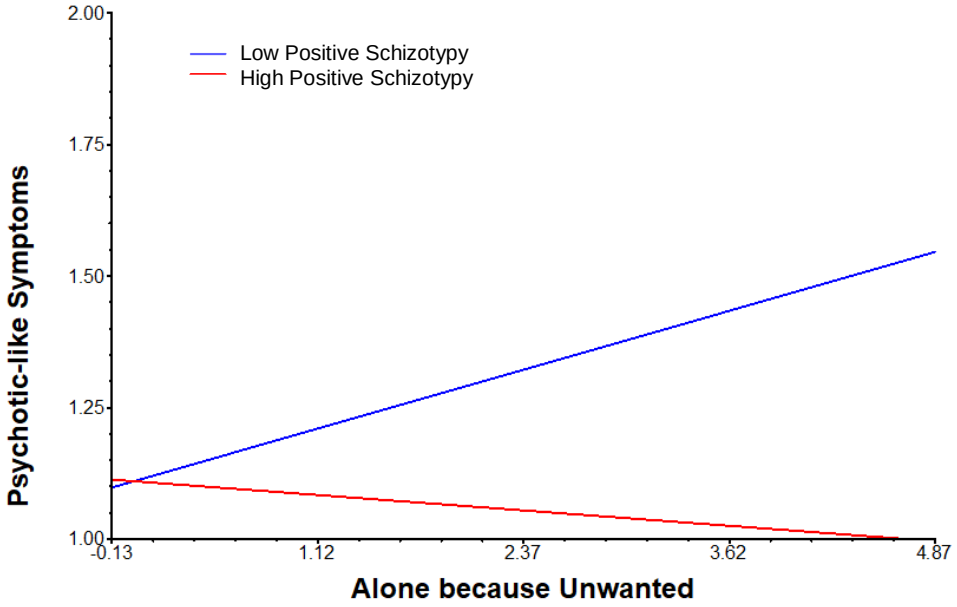
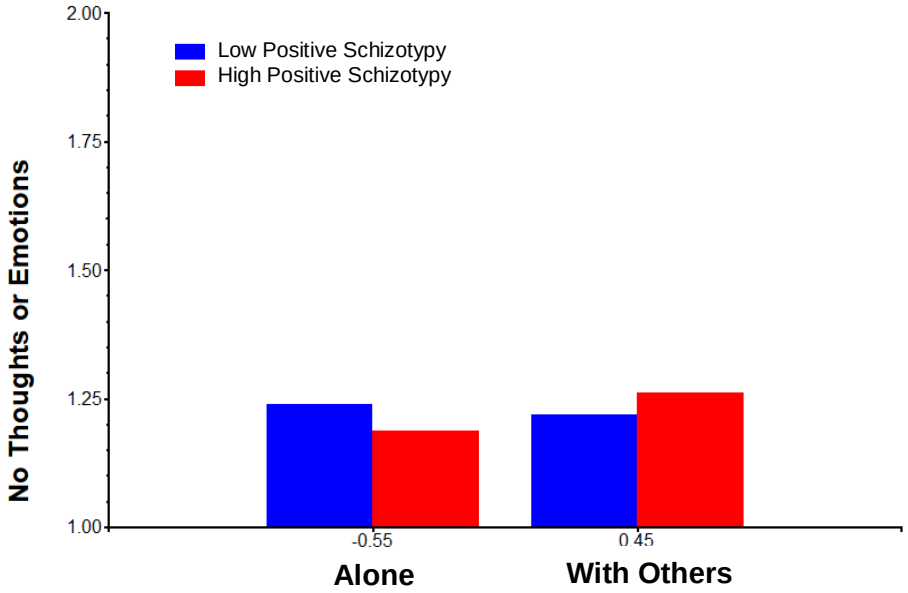


Figure 2. Cross-level interactions of T3 social contact with the negative symptom item of diminished thoughts or emotions across levels of T1 positive and negative schizotypy.



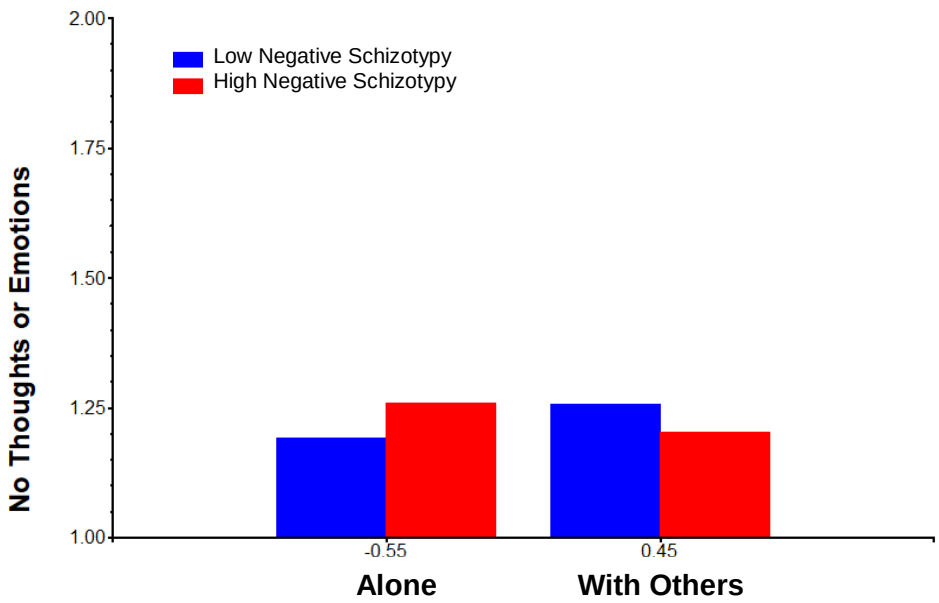


Figure 3. Cross-level interactions of T3 social contact with paranoid symptoms across levels of T1 negative schizotypy.

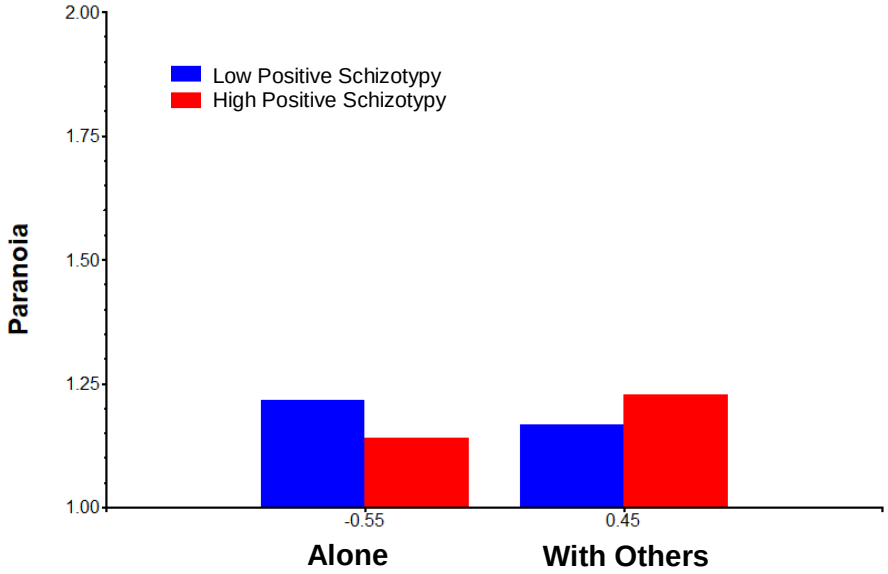
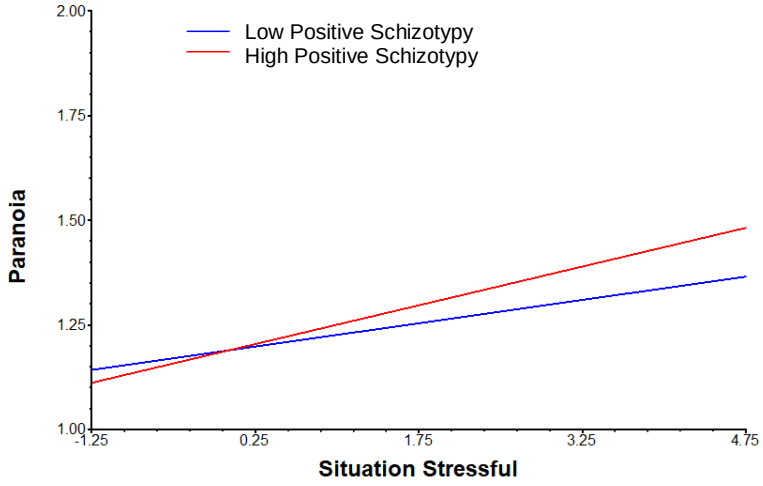


Figure 4. Cross-level interactions of the T3 stress with paranoid symptoms across levels of T3 positive schizotypy and the interaction of T3 positive and negative schizotypy.



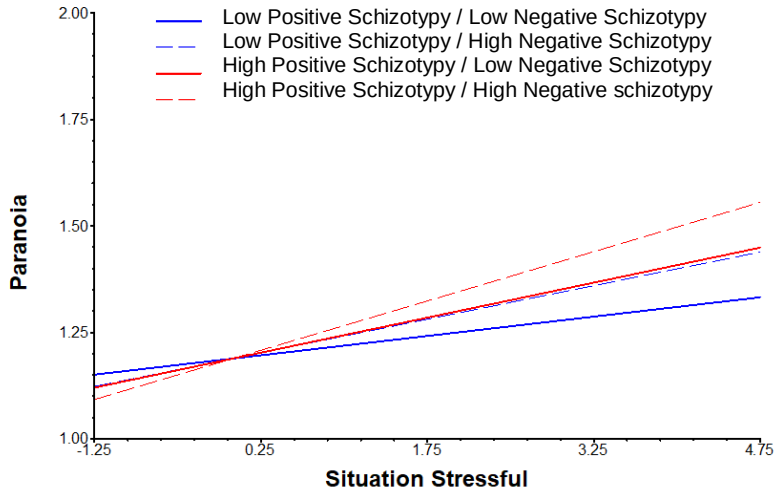


Figure 5. Cross-level interactions of the T3 social stress condition of feeling unwanted with paranoid symptoms across levels of T3 positive schizotypy and the interaction of T3 positive and negative schizotypy.

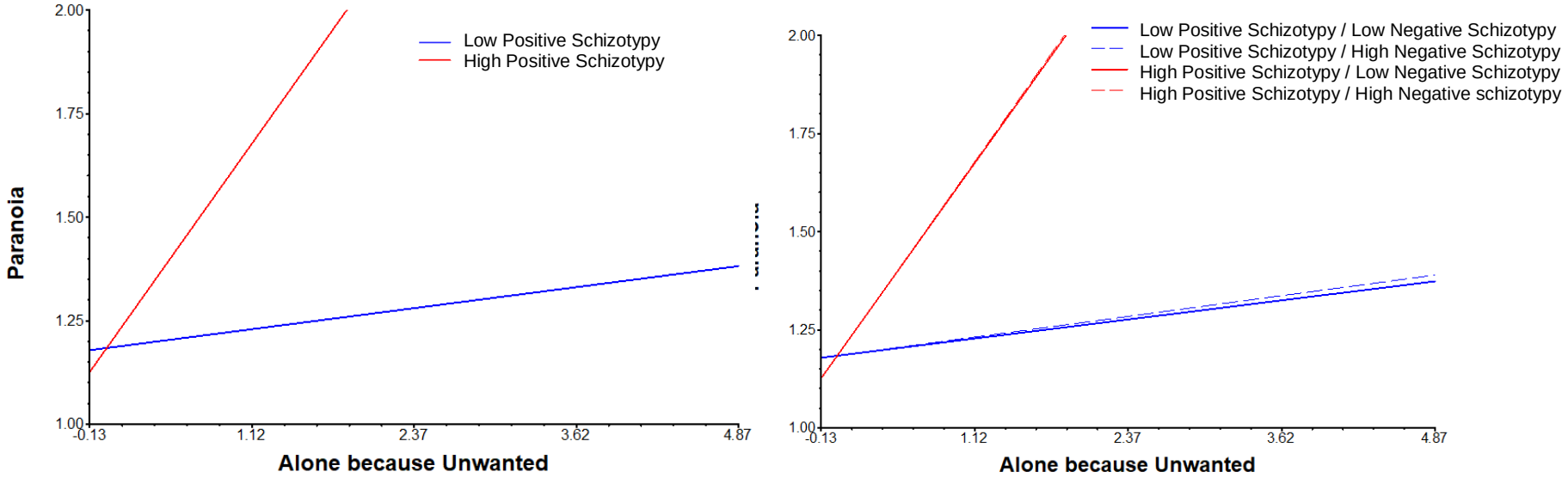


Figure 6. Cross-level interactions of the T3 social contact condition of being alone with psychotic-like symptoms across levels of T3 negative schizotypy and the interaction of T3 positive and negative schizotypy.

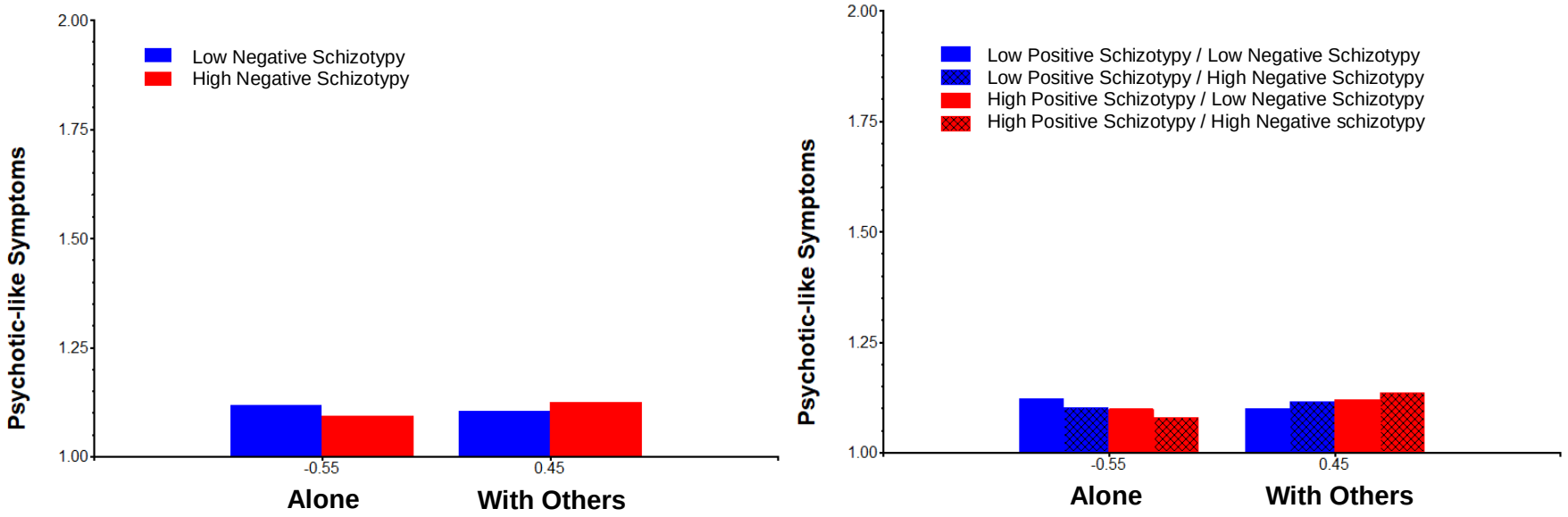


Figure 7. Cross-level interactions of the T3 social contact condition of being alone with paranoid symptoms across levels of T3 negative schizotypy and the interaction of T3 positive and negative schizotypy.

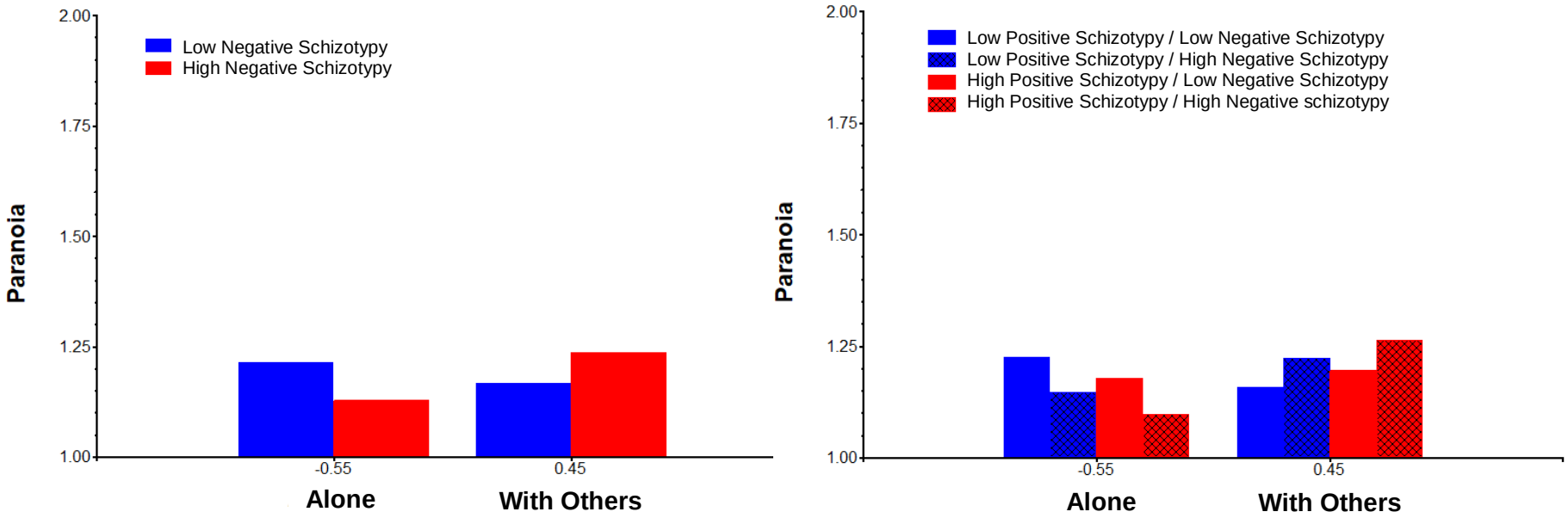


Figure 8. Cross-level interactions of the T3 social stress item of feeling close to the other with the negative symptom item of having to no thoughts or emotions across levels of T3 negative schizotypy.

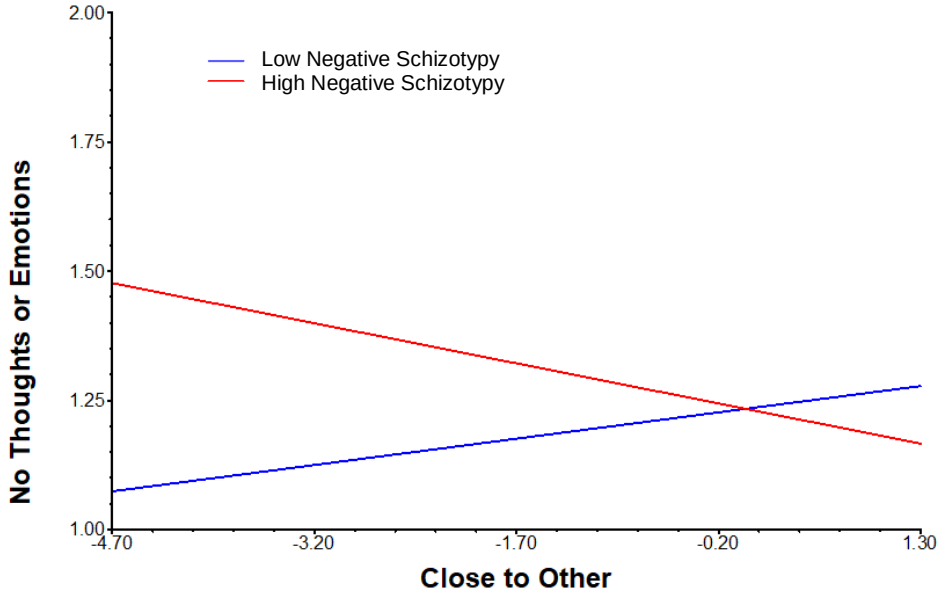


Figure 9. Cross-level interactions of the T3 social stress condition of feeling close to the others with psychotic-like and paranoid symptoms across levels of the interaction of T3 positive and negative schizotypy.

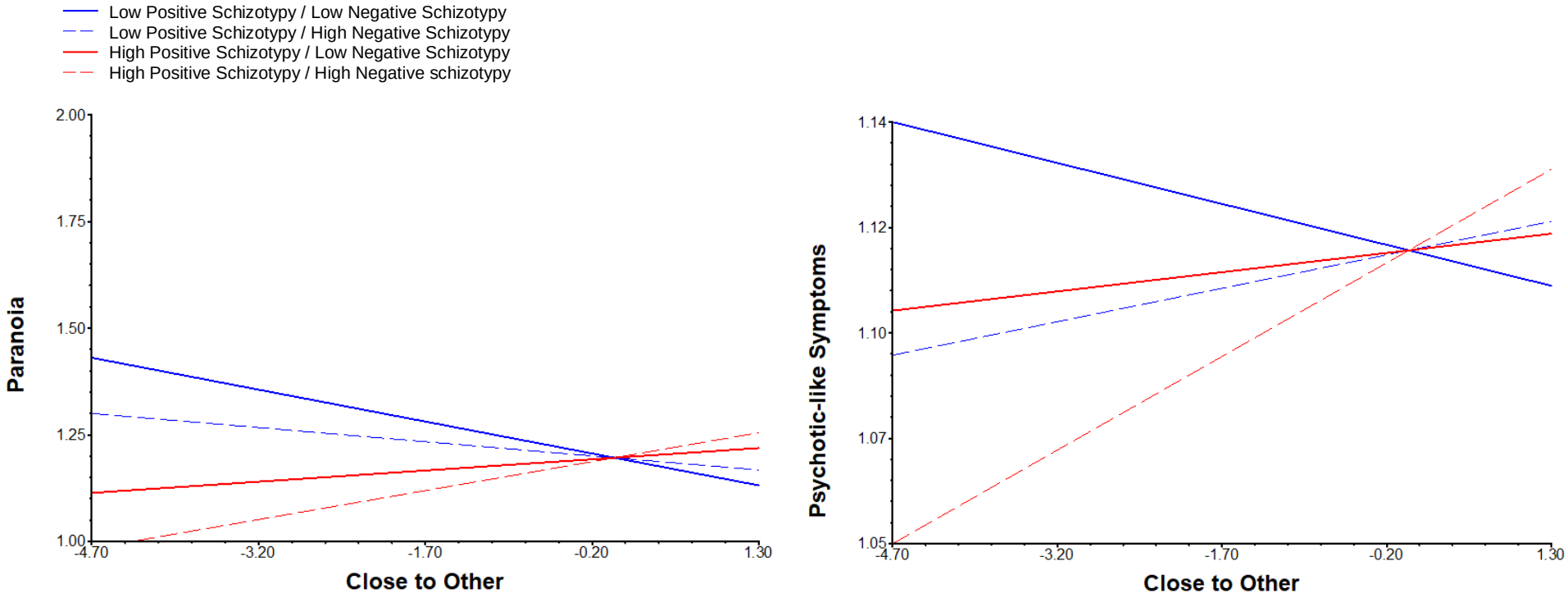
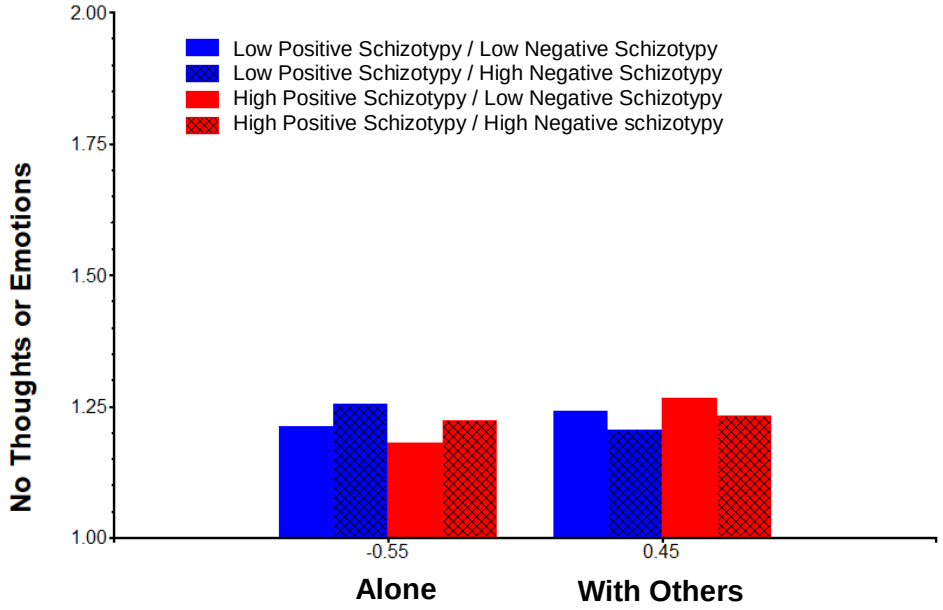


Figure 10. Cross-level interactions of the T3 social contact condition of being alone with the negative symptom item of having to no thoughts or emotions across levels of T3 positive and negative schizotypy interaction.



References

Barrantes-Vidal, N., Grant, P., Kwapil, T.R., 2015. The role of schizotypy in the study of the etiology of schizophrenia spectrum disorders. Schizophr. Bull. 41 (2), S408–S416.

Barrantes-Vidal, N., Gross, G.M., Sheinbaum, T., Mitjavila, M., Ballespí, S., Kwapil, T.R., 2013b. Positive and negative schizotypy are associated with prodromal and schizophrenia-spectrum symptoms. Schizophr. Res. 145, 50–55.

Barrantes-Vidal, N., Lewandowski, K.E., Kwapil, T.R., 2010. Psychopathology, social adjustment and personality correlates of schizotypy clusters in a large nonclinical sample. Schizophr. Res. 122, 219–225.

Bilder, R. M., Mukherjee, S., Rieder, R. O., Pandurangi, A. K., 1985. Symptomatic and neuropsychological components of defect states. Schizophr. Bull. 11, 409–419.

Bolinskey, P.K., James, A.V., Cooper-Bolinskey, D., Novi, J.H., Hunter, H.K., Hudak, D.V., Schuder, K.M., Myers, K.R., Iati, C.A., Lenzenweger, M.F., 2015. Revisiting the blurry boundaries of schizophrenia: spectrum disorders in psychometrically identified schizotypes. Psychiatry Research 225, 335–340.

Bolinskey, P.K., Smith, E.A., Schuder, K.M., Cooper-Bolinskey, D., Myers, K.R., Hudak, D.V., James, A.V., Hunter, H.K., Novi, J.H., Guidi, J.P., Gonzalez, Y., McTiernan, E.F., Arnold, K.M., Iati, C.A., Gottesman, I.I., 2017. Schizophrenia spectrum personality disorders in psychometrically identified schizotypes at two-year follow-up. Psychiatry Res. 252, 289–295.

Brown, L.H., Silvia, P.J., Myin-Germeys, I., Kwapil, T.R., 2007. When the need to belong goes wrong: The expression of social anhedonia and social anxiety in daily life. Psychol. Sci. 18, 778–782.

Brown, L.H., Silvia, P.J., Myin-Germeys, I., Lewandowski, K.E., Kwapil, T.R., 2008. The Relationship of Social Anxiety and Social Anhedonia to Psychometrically Identified Schizotypy. J Soc Clin Psychol. 27, 127–149.

Chapman, L.J., Chapman, J.P., 1983. Infrequency scale for personality measures. Unpublished scale available from T.R. Kwapil, UIUC Department of Psychology, Champaign, NC 61820.

Chapman, L. J., Chapman, J. P., Kwapil, T. R., Eckblad, M., Zinser, M., 1994. Putatively psychosis-prone subjects 10 years later. J. Abnorm. Psychol. 103, 171–183.

Chapman, L.J., Chapman, J.P., Raulin, M.L., 1976a. Scales for physical and social anhedonia. J. Abnorm. Psychol. 85, 374–382.

Chapman, L.J., Chapman, J.P., Raulin, M.L., 1978b. Body-image aberration in schizophrenia. J. Abnorm. Psychol. 87, 399–407.

Chun, C.A., Barrantes-Vidal, N., Sheinbaum, T., Kwapil, T.R., 2017. Expression of schizophrenia-spectrum personality traits in daily life. Personality Disorders: Theory, Research, and Treatment 8, 64–74.

Claridge, G., 1997. Theoretical background and issues, in: Claridge, G. (Eds.), Schizotypy: Implications for Illness and Health. Oxford University Press, UK, pp. 3–18.

Debbané, M., Barrantes-Vidal, N., 2015. Schizotypy from a developmental perspective. Schizophr. Bull. 41 (2), S386–S395.

Eckblad, M., Chapman, L. J., 1983. Magical ideation as an indicator of schizotypy. J. Consult. Clin. Psychol. 51, 215–225.

Eckblad, M. L., Chapman, L. J., Chapman, J. P., Mishlove, M., 1982. The Revised Social Anhedonia Scale. Unpublished test copies available from T.R. Kwapil, UIUC Department of Psychology, Champaign, NC 61820.

Fonseca-Pedrero, E., Debbané, M., Ortuño-Sierra, J., Chan, R.C.K., Cicero, D.C., Zhang, L.C., Brenner, C., Barkus, E., Linscott, R.J., Kwapil, T., Barrantes-Vidal, N., Cohen, A., Raine, A., Compton, M.T., Tone, E.B., Suhr, J., Muñiz, J., Fumero, A., Giakoumaki, S., Tsaousis, I., Preti, A., Chmielewski, M., Laloyaux, J., Mechri, A., Lahmar, M.A., Wuthrich, V., Larøi, F., Badcock, J.C., Jablensky, A., 2017. The structure of schizotypal personality traits: a cross-national study. Psychol. Med. 17, 1–12.

Fonseca-Pedrero, E., Ortuño-Sierra, J., Sierro, G., Daniel, C., Cella, M., Preti, A., Mohr, C., Mason, O.J., 2015. The measurement invariance of schizotypy in Europe. Eur. Psychiatry 30, 837–844.

Gooding, D.C., Tallent, K.A., Matts, C.W., 2005. Clinical status of at-risk individuals 5 years later: further validation of the psychometric high-risk strategy. J. Abnorm. Psychol. 114, 170–175.

Gooding, D.C., Tallent, K.A., Matts, C.W., 2007. Rates of avoidant, schizotypal, schizoid and paranoid personality disorders in psychometric high-risk groups at 5-year follow-up. Schizophr. Res. 94, 373–374.

Gross, G.M., Silvia, P.J., Barrantes-Vidal, N., Kwapil, T.R., 2012. Psychometric properties and validity of short forms of the Wisconsin Schizotypy Scales in two large samples. Schizophr. Res. 134, 267–272.

Gross, G.M., Silvia, P.J., Barrantes-Vidal, N., Kwapil, T.R., 2015. The dimensional structure of short forms of the Wisconsin Schizotypy Scales. Schizophr. Res. 166, 80–85.

Kemp, K.C., Gross, G.M., Kwapil, T.R., 2019. Psychometric properties of the Multidimensional Schizotypy Scale and Multidimensional Schizotypy Scale-Brief: Item and scale test-retest reliability and concordance of original and brief forms. J Pers Assess. 23, 1–8.

Kwapil, T.R., Barrantes-Vidal, N., 2012. Schizotypal personality disorder: an integrative review. In: Widiger, T.A. (Ed.), The Oxford Handbook of Personality Disorders. Oxford University Press, New York, NY, pp. 437–477.

Kwapil, T.R., Barrantes-Vidal, N., 2015. Schizotypy: looking back and moving forward. Schizophr. Bull. 41 (2), S366–S373.

Kwapil, T.R., Barrantes-Vidal, N., Silvia, P.J., 2008. The dimensional structure of the Wisconsin Schizotypy Scales: factor identification and construct validity. Schizophr. Bull. 34, 444–457.

Kwapil, T.R., Gross, G.M., Silvia, P.J., Raulin, M.L., Barrantes-Vidal, N., 2013. Prediction of psychopathology and functional impairment by positive and negative schizotypy in the Chapmans' ten-year longitudinal study. J. Abnorm. Psychol. 122, 807–815.

Kwapil, T.R., Gross, G.M., Silvia, P.J., Raulin, M.L., Barrantes-Vidal, N., 2018. Development and psychometric properties of the Multidimensional Schizotypy Scale: a new measure for assessing positive, negative, and disorganized schizotypy. Schizophr. Res. 193, 209–217.

Kwapil, T.R., Ros-Morente, A., Silvia, P.J., Barrantes-Vidal, N., 2012. Factor Invariance of Psychometric Schizotypy in Spanish and American Samples. J Psychopathol Behav Assess 34, 145–152.

Liddle, P.F. 1987. The symptoms of chronic schizophrenia: a re-examination of the positive negative dichotomy. Br. J. Psychiatry, 151, 145–151.

Luke, D. A. 2004. Multilevel modeling. Thousand Oaks, CA: Sage.

Muthén, L.K., Muthén, B.O. 1998 –2013. Mplus user's guide (7.11th ed.). Los Angeles, CA: Muthén & Muthén.

Nezlek, J. B. 2001. Multilevel random coefficient analyses of event- and interval-contingent data in social and personality psychology research. Pers Soc Psychol Bull 27, 771–785.

Nuechterlein, K.H., Asarnow, R.F., Subotnik, K.L., Fogelson, D.L., Payne, D.L., Kendler, K.S., Neale, M.C., Jacobson, K.C., Mintz, J., 2002. The structure of schizotypy: relationships between neurocognitive and personality disorder features in relatives of schizophrenic patients in the UCLA Family Study. Schizophr. Res. 54, 121–130.

Peralta, V., Cuesta, M.J., de Leon, J., 1992. Positive versus negative schizophrenia and basic symptoms. Compr. Psychiatry 33, 202 – 206.

Racioppi, A., Sheinbaum, T., Gross, G.M., Ballespí, S., Kwapil, T.R., Barrantes-Vidal, N., 2018. Prediction of prodromal symptoms and schizophrenia-spectrum personality disorder traits by positive and negative schizotypy: A 3-year prospective study. PLoS ONE 13(11): e0207150. https://doi.org/10.1371/journal.pone.0207150

Racioppi, A., Sheinbaum, T., Gross, G.M., Ballespí, S., Kwapil, T.R., Barrantes-Vidal, N. Schizotypy dimensions predict at-risk mental states, schizophrenia-spectrum symptoms, and impairment: A 4.4 year prospective study. In preparation.

Raine, A., 1991. The SPQ: a scale for the assessment of schizotypal personality based on DSM-III-R criteria. Schizophr. Bull. 170 (4), 555–564.

Stefanis, N.C., Hanssen, M., Smirnis, N.K., Avramopoulos, D.A., Evdokimidis, I.K., Stefanis, C.N., van Os, J., 2002. Evidence that three dimensions of psychosis have a distribution in the general population. Psychol. Med. 32, 347–358.

Venables, P. H., Rector, N. A. 2000. The content and structure of schizotypy: A study using confirmatory factor analysis. Schizophr. Bull. 26, 587-602.

Vollema, M.G., van den Bosch, R.J., 1995. The multidimensionality of schizotypy. Schizophr. Bull. 21, 19–31.

Winterstein, B P., Ackerman, T.A., Silvia, P.J., Kwapil, T.R., 2011. Psychometric properties of the Wisconsin Schizotypy Scales: Classical test theory, item response theory, and differential item functioning. J. Psychopath. Beh. Assessment. 33: 480. https://doi.org/10.1007/s10862-011-9242-9.

Yung, A.R., Yuen, H., McGorry, P.D., Phillips, L.J., Kelly, D., Dell'Olio, M., Buckby, J., 2005. Mapping the onset of psychosis: the comprehensive assessment of at-risk mental states. Aust. N. Z. J. Psychiatry 39 (11-12), 964–971.

5. GENERAL DISCUSSION

The main aim of this thesis was to examine the developmental trajectories of positive and negative schizotypy dimensions and their relation to schizophrenia-spectrum phenotypes in nonclinical young adults. In the process of working toward this aim, the thesis first sought to extend previous BLISS cross-sectional reports by investigating, in a longitudinal framework, the prospective associations of positive and negative schizotypy dimensions with interview measures of prodromal symptoms, schizophrenia-spectrum PD traits, and functioning at both three- and four-year follow-up assessments. Furthermore, the thesis focused on the temporal stability of schizophrenia-spectrum phenotypes across assessments and examined whether baseline positive and negative schizotypy predicted the associations of these constructs with psychopathology and impairment across time. Also, this thesis focused on the relationship between negative schizotypy traits and symptoms with depressive symptoms. Finally, the thesis encloses an examination of the ecological validity of the schizotypy dimensions. Thus, the prospective associations of positive and negative schizotypy dimensions with the real-world expression of psychotic-like, paranoid, and negative symptoms were investigated. Moreover, the role of schizotypy dimensions as mediators of the associations between daily life stressors and a spectrum of subclinical psychotic experiences was also analyzed. The key results of the work described in each section of the present thesis are summarized below, followed by a consideration of their implications for preventive interventions. Finally, the strengths and limitations of this thesis and directions for future research are also discussed.

5.1. Integration of Findings

This thesis is an investigation of the multidimensionality, assessment and developmental trajectories of schizotypy in a nonclinical sample of young adults. The longitudinal findings of this thesis provide additional evidence supporting the multidimensional model of schizotypy as a useful method for identifying etiological mechanisms and trajectories underlying the development of schizophrenia-spectrum psychopathology (Barrantes-Vidal et al., 2015; Kwapil & Barrantes-Vidal, 2015). The reports included in this thesis are part of the BLISS project, an ongoing longitudinal project examining schizotypy and risk for schizophrenia-spectrum psychopathology within a young college sample. The work presented in *Chapter 1* extends our previous cross-sectional findings (Barrantes-Vidal et al., 2013b) by examining the predictive validity of positive and negative schizotypy at a three-year follow-up initially reported by Barrantes-Vidal et al. (2013b). This longitudinal study, framed within the psychometric high-risk strategy, demonstrates that positive and negative schizotypy dimensions display differential associations with psychopathology, PDs, and functioning 3.1 years later. The predictions of this study, based on theoretical formulations and the findings reported by Barrantes-Vidal et al. (2013b), were largely confirmed. More specifically, positive schizotypy predicted psychotic-like symptoms, low self-esteem, and general psychopathology, whereas negative schizotypy predicted emotional disturbances, schizoid PD traits, and receiving mental health treatment during the past year. Both schizotypy dimensions predicted schizotypal, paranoid, and avoidant PDs traits, as well as impairment in functioning. Furthermore, the study showed that positive, but not negative, schizotypy predicted depression symptoms at the three-year follow-up, which supports the claim of a stronger association of affective symptoms with positive rather than negative schizotypy. Together with previous seminal longitudinal studies using the

psychometric high-risk method (Chapman et al., 1994; Kwapil, 1998), this study also suggests that individuals with high positive schizotypy are at a greater risk for the later development of both affective disorders and non-affective psychotic symptoms and disorders, whereas individuals with high negative schizotypy seem to be at risk especially for schizophrenia-spectrum psychopathology. Moreover, results indicated that measures of schizophrenia-spectrum symptoms and functioning predicted their analogous ratings 1.4 years later, with generally stronger effect sizes for trait rather than symptom measures. In addition, the stability of paranoid PD symptoms across assessments varied as a function of baseline levels of positive schizotypy, such that individuals with high levels of baseline positive schizotypy reported higher levels of paranoid PD symptoms, across a 1.4-year period. In contrast, high levels of negative schizotypy at baseline predicted a stronger stability of social impairment as expected. These findings are in line with those reported by previous studies indicating that the presence of subclinical psychotic symptoms among the general population individuals is greater than the incidence of psychotic diagnoses (Hanssen, Bak, Bijl, Vollebergh & van Os, 2005; Werbeloff et al., 2015). Overall, this empirical work lends further evidence supporting the psychometric study of schizotypy as a valid method to identify and study developmental trajectories of schizophrenia-spectrum psychopathology in a longitudinal framework (Debbané and Barrantes-Vidal, 2015).

Other findings that converge with the above to confirm the predictive validity of positive and negative schizotypy dimensions are those reported by the study described in *Chapter 2*. This longitudinal study offers a unique, longitudinal assessment of the association of psychometric positive and negative schizotypy at baseline with interview-based ratings of symptoms and impairment in a 4-year follow-up assessment of the same nonclinically ascertained sample examined in the previous BLISS reports (Barrantes-

Vidal et al., 2013a; Racioppi et al., 2018).The study expands on previous findings with the BLISS sample by examining the predictive validity of schizotypy dimensions for positive and negative symptoms as measured with the CAARMS in a nonclinical population over three reassessments. In line with our previous cross-sectional (Barrantes-Vidal et al., 2013b) and longitudinal findings (Racioppi et al., 2018), this report indicates that positive and negative schizotypy dimensions longitudinally predict theoretically meaningful differential and overlapping patterns of symptoms, PDs, and functioning. Indeed, positive schizotypy predicted positive symptoms, whereas negative schizotypy uniquely predicted negative and schizoid PD symptoms. Both schizotypy dimensions predicted schizotypal and paranoid PDs symptoms, as well as suspiciousness, low self-esteem, and depression symptoms over a 4.4-year period. Notably, it was found that only negative schizotypy predicted impairment in social and global functioning 4 years later, but also concurrent and past-year history of mental health treatment. This finding is in line with previous longitudinal studies reporting that negative symptoms were specifically associated with social impairment in individuals at high psychometric (Kwapil et al., 2013) and clinical (Corcoran et al., 2011) risk, as well as in those with a first episode of psychosis (Ho et al., 1998; Milev et al., 2005), and suggest that individuals of this sample showing signs of social deterioration might be at greater risk for a future transition to psychosis. Additionally, measures of schizophrenia-spectrum symptoms and impairment showed temporal stability across time by predicting the same construct across a 1.3-year period. Furthermore, the analyses of the moderating role of schizotypy in the stability of symptoms across the third and fourth follow-up reassessments shows that uniquely positive schizotypy predicts the persistence of positive symptoms across time in nonclinical individuals. In sum, the longitudinal findings of this thesis, taken together with those reported by the previous cross-sectional BLISS report (Barrantes-Vidal et al.,

2013), indicate that individuals with high negative and positive schizotypy at baseline show a pattern of persistence of psychopathological symptoms, schizophrenia-spectrum disorders traits and impairment of functioning across time, specifically 1.7 (Barrantes-Vidal et al., 2013b), 3.1 (Racioppi et al., 2018), and 4.4 years later. Furthermore, they appear to suggest that even at the subclinical level individuals with elevated ratings of schizophrenia-spectrum symptoms experience a strong stability of symptoms over 1.3 and 1.4 years (Racioppi et al., 2018) years.

The longitudinal study reported in Chapter 2 extends previous prospective research in this area by making an in-depth examination of the predictive validity of negative schizotypy of negative symptoms controlling for emotional dysregulation. Given the critical importance of disentangling the relationship between negative schizotypy traits and symptoms with depressive symptoms, and that specific measures for an accurate detection of non-clinical forms of negative symptoms are needed, two interview measures were employed to assess negative symptoms. It was found that negative schizotypy uniquely predicted negative symptoms as assessed by both the CAARMS and NSM interviews. However, after controlling for avoidant PD, anxiety, and depression symptoms, CAARMS negative symptoms was no longer predicted by negative schizotypy, which suggests that this measure of negative symptoms is highly saturated with emotional dysregulation variance. Consistent with previous BLISS reports (Barrantes-Vidal et al., 2013a; Racioppi et al., 2018), this study reveals that depression was associated with negative symptoms as assessed by the CAARMS, whereas the NSM was not saturated by depression symptoms (the latter was not examined in previous reports, so we have only cross-sectional evidence for this finding). Furthermore, given the poor clarity regarding the latent structure of negative symptoms, the study examined the prediction of negative symptoms as assessed by the NSM and the CAARMS negative

subscale. It was found that self-reported negative schizotypy was associated with the five different features of negative symptoms as assessed with the NSM (that is, social withdrawal, affective flattening, anhedonia, alogia and avolition), whereas it was only associated with the CAARMS subscale of anhedonia. The findings from the current thesis extend previous studies in larger non-clinical samples of American students (Barrantes-Vidal et al., 2009; Barrantes-Vidal et al., 2010; Kwapil et al., 2008; Kemp, Gross, & Kwapil, 2019) by demonstrating that negative schizotypy prospectively predicts negative symptoms as assessed with the NSM, and demonstrate that the NSM is a valid instrument to assess negative symptoms in nonclinical populations. Furthermore, results suggest that negative schizotypy is strongly related, especially, to social withdrawal and affective flattening, and support that negative symptoms are a distinct dimension from positive symptoms and emotional dysregulation (that is, avoidant PD, depression, and anxiety) even at a nonclinical level.

The current thesis also expanded previous cross-sectional BLISS findings (Barrantes-Vidal et al., 2013a) by examining the ecological validity of positive and negative schizotypy as assessed at baseline and at the 3-year follow-up. Consistent with Barrantes-Vidal et al. (2013a) previous BLISS results, this study indicates that positive and negative schizotypy dimensions differentially predicted psychotic-like, paranoid, and negative symptoms as assessed in daily life with the ESM method. Specifically, positive schizotypy predicted psychotic-like and paranoid symptoms, while negative schizotypy predicted a subset of these symptoms and showed a trend toward significance in the prediction of negative symptoms in daily-life. The study reveals that positive and negative schizotypy are differentially expressed in daily life in terms of affect. These findings are consistent with those reported 1.4 years before (Barrantes-Vidal et al., 2013a) by showing that positive schizotypy assessed at baseline and at the third reassessment was associated

with diminished positive affect and increased negative affect, whereas baseline negative schizotypy predicted diminished positive but not increased negative affect 3.1 years later. Furthermore, both schizotypy dimensions predicted suspiciousness, whereas positive schizotypy uniquely predicted feeling mistreated. These findings are in line with previous ESM (Barrantes-Vidal et al., 2013a) and interview-based (Racioppi et al., 2018) studies and support the idea that suspiciousness is characterized by a moderate mistrust of situations or others, whereas feeling mistreated implies a more active context. Furthermore, this study indicates that schizotypy dimensions are differentially related to social contact and social stress in daily life. Both longitudinally and cross-sectionally negative schizotypy uniquely predicted increased reports of being alone, whereas both schizotypy dimensions were associated with feeling not cared by others, with negative schizotypy presenting the strongest prediction compared to positive schizotypy. Also, both schizotypy dimensions were associated with the desire to be alone when being with others, consistent with the social discomfort that characterizes psychosis-spectrum personalities. These findings are in line with previous cross-sectional (Brown et al., 2008; 2007) and longitudinal (*Chapter 2*) studies showing that negative schizotypy is associated with social withdrawal whereas positive schizotypy is predominantly associated with social anxiety symptoms.

The findings of the current thesis also add to the current literature by highlighting that individuals high in positive schizotypy are especially sensitive to the effect of daily life stressors. Consistent with the stress-sensitivity model of psychosis (Myin-Germeys, Krabbendam, Jolles, Delespaul, & van Os, 2002), it was found that stress in the moment was associated with psychotic-like symptoms only in individuals psychometrically identified as high on positive schizotypy 3.1 years before. Furthermore, stress in the moment was associated with paranoid symptoms only in individuals psychometrically

identified as high on positive schizotypy in the same follow-up during which they completed the ESM week. Finally, time-lagged analyses showed that stress at the previous signal predicted increased psychotic-like symptoms at the subsequent signal only in high positive schizotypy individuals. These findings are in line and expand in a longitudinal framework those reported by the previous ESM study of Chun and colleagues (2017) showing that positive schizotypy is characterized by a greater reactivity to high-stress situations, whereas negative schizotypy is defined by a diminished reactivity to stress. These findings lend additional support to the stress-sensitivity model and further validation to the multidimensional model of schizotypy. Findings of the current thesis also expand the previous ESM cross-sectional BLISS study (Barrantes-Vidal et al., 2013a) by showing that social contact was associated with schizotypic symptoms in daily life and that these associations were differentially moderated by schizotypy dimensions. More specifically, it was found that the proportion of time spent alone was related to higher levels of negative symptoms in participants with low positive schizotypy and those with high negative schizotypy. On the contrary, being with others was associated with increased reports of negative symptoms in individuals with high positive schizotypy as in those with low negative schizotypy. In addition, being with others was associated with paranoid symptoms in individuals high in negative schizotypy. Negative schizotypy uniquely moderated the relation of social contact with psychotic-like symptoms in daily life. Specifically, being alone was associated with momentary psychotic-like symptoms for low negative schizotypy individuals. Reversely, being with others was associated with momentary psychotic-like symptoms in individuals with high negative schizotypy. These ESM findings are in line with those reported in previous interview-based longitudinal studies indicating that negative schizotypy is predictive of social impairment over a 10-year (Kwapil et al., 2013) and 4.4-year (*Chapter 2*) period,

and expand them by showing that individuals high on negative schizotypy are especially sensitive to the momentary effects of the social context. Overall, these findings demonstrate the ecological validity of ESM as a valid method to identify precursors of schizophrenia-spectrum psychopathology by examining the experiences of schizotypic individuals in the real-world environment. Taken together, the longitudinal studies in this thesis provide further support for the predictive validity of schizotypy and lend additional evidence of positive and negative schizotypy as distinct constructs. Furthermore, the findings support that schizotypy provides a useful model for understanding risk and resilience factors for the development of schizophrenia-spectrum psychopathology. Schizotypy traits seem to underlie the symptoms and impairment expression characterizing at-risk mental states and they may be useful as distal risk indicators in nonclinical individuals.

5.2. Implications for Clinical Interventions

Schizophrenia is considered one of the most disabling conditions with a potentially chronic nature, and is frequently associated with relevant economic burden for the society (van Os & Kapur, 2009). In addition, antipsychotic medications have variable effectiveness (Meltzer, 1992) and present risk of severe adverse effects (Ray et al. 2001; Zipursky, Reilly, & Murray, 2013). Since the conceptualization of the UHR state for psychosis two decades ago (Yung et al., 1996), clinical services have moved the focus of interventions from chronic to early stages of psychosis. Individuals meeting UHR criteria are at greater risk for developing schizophrenia-spectrum disorders in a relatively short period of time (Fusar-Poli et al., 2013). Current evidence of preventive interventions indicate that most of CHR patients improve in response to treatment in their symptoms and functioning over time and transition rates are reduced (Nelson, Amminger, & McGorry, 2018). However, studies indicate that there is a sub-group of UHR patients

who manifest persistent symptoms and functional impairment that do not respond to current treatments and it has not yet been identified a specific intervention demonstrating more effectiveness than others. Furthermore, given the comorbidity of clinical diseases in early stages of psychosis, it has been suggested that it would be of great value develop and test preventive intervention strategies not only in specific sub-groups within the UHR population, but also in young people at transdiagnostic risk (Nelson, Amminger, & McGorry, 2018).

In this context, research on the schizotypy continuum is highly relevant given that allows to study the vulnerability to schizophrenia and thus detecting at-risk individuals among nonclinical population and, in do so, it might facilitates without major confounders unravelling causal mechanisms from sub-clinical to clinical stages. From this point of view, the definition of developmental trajectories of positive and negative schizotypy dimensions reported in this thesis (through interview, questionnaires, and ESM methodology) has implications in relation to clinical work. In agreement with previous cross-sectional and longitudinal studies, the present results by showing that high schizotypy individuals are at greater risk for the experience of schizophrenia-spectrum symptoms and traits, support the validity of the psychometric high-risk strategy and underscore the usefulness of implementing this method to identify individuals who will or will not transit to psychotic disorders in the next future (Barrantes-Vidal et al., 2015; Barrantes-Vidal & Kwapil, 2015). These findings might contribute to correctly detect people at high risk and to create specific treatments in early life stages.

Recent approaches are re-conceptualizing the current classification of mental disorders and making evident that the way in which the mental health care system is operationalizing therapeutic interventions has to change (Evans et al., 2013; McGorry & van Os, 2013). Schizophrenia-spectrum disorders are complex phenomena both in terms

of etiology and developmental course, and the phenotypic expressions crystallize in a different way in each person given his/her uniqueness. Thus, effective preventing treatments for psychosis focusing on pre-clinical stages should be customized on individual's specific needs rather than on group characteristics (Evans et al., 2013; McGorry & van Os, 2013). The present longitudinal results indicate that individuals with a predominance of elevations in either positive or negative schizotypy present different symptoms and impairment across time. This evidence should contribute to detect specific risk pathways and mechanisms that are highly important for the redefinition and innovation of current preventive treatments in a person-targeted way.

In this regard, the ESM is a valid method to examine individuals in their daily-life interactions with the environment and can clarify the context in which dynamic changes occur, which is difficult to assess in laboratory settings with questionnaires and interviews (Myin-Germeys et al., 2009; Oorschot, Kwapil, Delespaul, & Myin-Germeys, 2009). In this sense the use of ESM allows to personalize interventions since it represents a useful method to interact with the individual's real-world and to provide needs in the specific moment (Myin-Germeys, Klippel, Steinhart, & Reininghaus, 2016). The ecologically-based findings of this thesis indicated that the interaction of person characteristics and environment factors is involved in the increased risk for schizophrenia-spectrum symptoms. The current results show that in individuals high on positive schizotypy momentary situational and social stress trigger psychotic-like and paranoid symptoms in daily life. It would seem that reduction of stressors experienced in the real-world environment by individuals with a heightened risk may prevent the appearance of clinical outcomes. This evidence seem to be especially relevant in the field of preventive treatments. Indeed, innovative therapeutic approaches are currently employing ESM to develop ecological momentary interventions (EMIs) aimed at reducing vulnerability by

diminishing the impact of symptoms and reinforcing beneficial behaviors in daily life (Hartmann et al., 2015; Kramer et al., 2014). Results of this thesis are relevant for a new line of studies framed in the Positive Psychology field that tested Positive-Psychological Interventions (PIs) in nonclinical individuals at psychometric high-risk for psychosis with the use of the ESM method. Grant, Munk, & Hennig (2018) showed that the implementation of positive tasks in daily life largely reduces reported schizotypic symptoms. Therefore, the present findings support the employment of ESM in mental health practice, as it allows to collect specific ecologically valid information of how symptoms are associated with each other over time at the individual level. ESM represents a helpful method for clinicians to personalize interventions that interact with the real-world environment of persons. For example, ESM can be used to map personalized networks of interactions between momentary psychopathological symptoms suffered by patients and their relation with outcome and pharmacological and psychological treatment (Bak, Drukker, Hasmi, & van Os, 2016). This thesis provide prospective evidence for the development of EMIs in at-risk individuals and highlight the importance of preventive intervention strategies aimed at decreasing risk factors and increasing protective factors (i.e., quality of life, improve affect, social support, etc.) that are experienced in the real-world.

5.3. Strengths and Limitations

The studies presented in this thesis have notable strengths, but are not without limitations. As previously mentioned, due to funding limitations a sub-sample of the T2 participants that retained a similar distribution of schizotypy scores was selected to be reassessed at T3. Thus, at T3 the 77% of participants who completed T2 were reassessed, but not the entire sample. Furthermore, the sample size of T4 was relatively small even if the majority (86%) of the individuals who completed T3 assessment were achieved.

These are to be considered as limitations and may reduce the robustness of the current results. However, please note that each sub-sample retained a comparable and continuous distributions of scores on the schizotypy dimensions with an adequate representation of high scorers. An additional limitation is that individuals were psychometrically assessed at T1 for positive and negative schizotypy but were interviewed at the subsequent T2 assessment. This lack of interview assessment at T1 means that it cannot be ruled out if some participants were already experiencing symptoms and impairment at baseline. This limits the ability to make specific inferences about the developmental trajectories of the symptoms and impairment from T1 to T3 as from T1 to T4, but does not limit our ability to evaluate differential patterns of associations of T1 positive and negative schizotypy with T3 and T4 schizophrenia-spectrum symptoms and impairment. Similarly, the interpretations of the associations of symptoms and impairment across T2 and T3 and those across T3 and T4 were not impacted by the presence or absence of symptoms and impairment at baseline, nor were the interactions of positive and negative schizotypy with the relationships of constructs from T2 to T3, and from T3 to T4.

Furthermore, the number of ESM questions that can be assessed at each signal is a limitation. Indeed, items examining different features of negative symptoms, as well as social functioning, and activities were not included in the T3 ESM questionnaire. Therefore, the overall index for negative symptoms was not computed. However, to the best of our knowledge, studies with a longitudinal design employing the ESM method are scare in the literature. The use of ecologically valid data obtained prospectively and repeatedly 8 times daily for 1 week to assess symptoms and experiences greatly increases the validity of schizotypy and its multidimensionality. In addition, the employment of time-lagged analyses improve our ability to understand the complex temporal associations of these symptoms and the possibility to identify causal pathways. This is a

very important issue, given that most research has been only able to report cross-sectional associations.

The fact that the studies presented in this thesis were conducted with a sample of Spanish university students is a limitation given that results may not generalize to other samples. Young adults of the BLISS sample were functioning well enough to enroll in a major university and were only part-way into the window of greatest risk for developing schizophrenia-spectrum disorders. However, this sample contained a large distribution of scores and traits and symptoms measures, which indicate that these is sufficient and valid variance in the constructs of interest.

Finally, a significant limitation of the present thesis is that the measurement of schizotypy was restricted to positive and negative dimensions. This does not mean that the multidimensional structure of schizotypy is composed uniquely by these dimensions, it only reflects the nature of the instrument employed to assess the construct. Indeed, there is good support for positive, negative, and disorganized (e.g., American Psychiatric Association, 2013; Kwapil & Barrantes-Vidal, 2015; Tandon, Nasrallah, & Keshavan, 2009; Vollema & van den Bosch, 1995) as distinct dimensions underling the heterogeneity of schizotypy. However, the WSS does not include a measure of disorganized schizotypy. This measure was chosen at the beginning of this project since the two only previous longitudinal studies available used these pioneering and widely-validated scales. Recently a new instrument tapping positive, negative, and disorganized dimensions of schizotypy, the Multidimensional Schizotypy Scale (Kwapil et al., 2018) has been designed, and it would be relevant examine the prospective associations of this three-factor model with schizophrenia-spectrum symptoms and traits in nonclinical individuals.

Importantly, the longitudinal findings of this thesis are consistent with those reported in larger non-clinical samples (Chapman et al., 1994; Gooding et al., 2005; Kwapil et al., 2013) conducted with American young adults, thus supporting the cross-cultural consistency of findings. This enhance the compatibility of findings across studies and provides additional support for the validity of the psychometric high-risk approach and its usefulness to detect individuals with an increased risk for the development of schizophrenia-spectrum disorders.

5.4. Future Directions

Schizotypy represents a promising framework to conceptualize the continuum of schizophrenic symptoms and impairment, and a vital construct for research focusing on the vulnerability to schizophrenia. Schizotypy unifies multiple related constructs such as psychosis proneness, the prodrome, personality disorders, and psychotic disorders. Given that these conditions share a comparable etiology and that they differ on the degree of severity, but not on qualitative characteristics, schizotypy provides a useful method for identifying individuals at risk for developing schizophrenia-spectrum disorders. Research into schizotypy offers a unique opportunity to explore etiology and to expand our knowledge of the dynamic mechanisms underlying the vulnerability to schizophrenia-spectrum disorders, but to date the complete picture of risk and protective factors, as well as trajectories of schizotypic symptoms and impairment is still incomplete. Future research should be aimed at achieving a better understanding of schizotypy by developing a clear and consistent operationalization and measurement of the construct, and by continuing to explore its phenomenology and developmental trajectories.

Schizotypy, as schizophrenia, is characterized by considerable heterogeneity in terms of etiology, development and expression. This heterogeneity seems to be best captured by a multidimensional structure. Although the exact number and nature of these

dimensions is not settled, the strongest support appears to be for positive (psychotic-like), negative (deficit), and disorganized schizotypy dimensions. Cross-sectional and longitudinal studies have demonstrated the validity of these dimensions in that they have unique patterns of associations with clinical symptoms, personality traits, daily life experiences, neurocognitive deficits, biobehavioral markers, genetic indicators, and neural assessments. Furthermore, the combination of high scores on schizotypy dimensions appears to predict elevated symptoms and impairment. Indeed, the presence of positive and negative features predicted increased risk for psychosis both in nonclinical (Kwapil et al., 1998) and CHR (Salokangas et al., 2013) samples. Also, it appears that schizotypy dimensions have both an additive and interactive effect. For example, in the cluster analyses study reported by Barrantes-Vidal and colleagues (2010) it was found that high positive and negative schizotypy cluster exhibited the most severe impairment and symptoms relative to the high positive schizotypy cluster, high negative schizotypy cluster, and the low schizotypy cluster. Kwapil et al. (2013) found that the interaction of positive and negative schizotypy significantly predicted paranoid symptoms. Thus, to avoid the risk of losing relevant information it is extremely important for future studies to adequately assess schizotypy by reflecting its multidimensional nature rather than treating it as a homogenous construct.

Although the positive, negative, and disorganized factors have been found to underlie schizotypy, the measures that have been developed often differ in terms of their factor structure and their basic conceptualization of the construct. As mentioned before, numerous questionnaire measures have been developed to assess schizotypy and have improved our understanding of the construct. However, these instruments were not developed based upon rich conceptual descriptions of the schizotypy dimensions and as a result it appears that schizotypy is defined more by the measure employed to assess the

construct than by an a priori model. The most widely used of these measures are the WSS and the SPQ, and although they are relatively inexpensive, brief, and non-invasive to administer, suffer from some limitations. For example, the WSS positive and negative schizotypy dimensions were design to taps characteristics described in Meehl's (1964) schizotypy checklist and does not assess disorganized schizotypy. Furthermore, items assessing paranoia are not included in the positive schizotypy dimension and the negative schizotypy dimension is restricted to social and physical anhedonia. The SPQ was developed as a measure of schizotypal personality disorder, but it is currently employed to assess schizotypy. In addition, there is not a general agreement of the factor structure of this instrument. Previous studies have suggested that the SPQ has a two to four-factor models or a three factor structure with cognitive-perceptual, interpersonal, and disorganized dimensions. Further, the SPQ interpersonal factor is used to assess negative schizotypy, despite the fact that it loads highly on neuroticism and social anxiety which are not typically considered to forms part of the negative schizotypy dimension. The SPQ disorganization factor appears to be especially related to oddness and eccentricity characteristic of positive schizotypy, than cognitive and behavioral disorganization. Considering the several limitations that characterized current available measures such as the lack of a clear conceptual framework, outdated wording, or unclear factor structure, it is highly necessary for future research to achieve a reliable identification of schizotypy dimensions to correctly examine the heterogeneity of the construct and to understand its origins, development, and expression. In this regard, the MSS appears to provide a promising measure for assessing schizotypy. The MSS (Kwapil et al., 2018; Gross et al., 2018) was specifically developed to assess positive, negative, and disorganized schizotypy overcoming many of the limitations of previous measures. Future studies using new generation measures as the one just mentioned should enhance the predictive

validity of schizotypy and refine its capacity to map developmental routes to psychosis spectrum conditions.

5.5. Conclusions

The studies presented in this thesis provide new insights on the predictive validity of schizotypy and its multidimensional nature. They expand our current knowledge about how positive and negative schizotypy longitudinally predict clinical risk symptoms, schizophrenia-spectrum traits, and impairment in nonclinical young adults, both in the laboratory and in daily life. This thesis also provides additional evidence of the relationship between stress and schizotypic experiences, and how this association differs for positive and negative schizotypy in the real-world environment. Overall, this thesis adds further support to the claim that the study of risk and resilience trajectories in nonclinical individuals is highly relevant to clarify etiological mechanisms driving the onset of psychosis and, therefore, to inform the development of early effective interventions in universal preventative interventions. Collectively, the findings of the present thesis indicate that:

1) Consistent with previous cross-sectional BLISS findings (Barrantes-Vidal et al., 2013), T1 schizotypy dimensions presented theoretically meaningful differential and overlapping patterns of predictions for subclinical psychopathology, personality disorder traits and functioning at 3.1 and 4.4 years later, thus adding further support to their predictive validity. Specifically, T1 positive schizotypy predicted CAARMS positive symptoms with a large effect size, whereas T1 negative schizotypy uniquely predicted negative symptoms and schizoid PD traits at T3 and at T4, thus showing a stable pattern of predictive validity. Furthermore, T1 negative schizotypy predicted poor functioning and both concurrent and past-year history of mental health treatment.

2) Individuals with high scores on negative and positive schizotypy at baseline showed stability of symptoms, schizophrenia-spectrum personality traits, and poor functioning at the 3.1- (Racioppi et al., 2018; Chapter 1) and 4.4-year (Chapter 2) follow-up reassessments. Positive-like symptoms, which are transient and dynamic, were only stable for those with high trait positive schizotypy, strongly supporting the predictive validity of schizotypy as well as developmental and dimensional models of psychosis risk.

3) Negative Schizotypy uniquely predicted negative symptoms 4.4 years later in nonclinical individuals over and above the effects of positive schizotypy, thus supporting that this is a distinct dimension from positive and emotional dysregulation symptoms (avoidant personality disorder traits, depression, and anxiety) even at a nonclinical level.

4) The Negative Symptom Manual (NSM) is a valid instrument to assess negative symptoms in non-clinical populations as shown by a) its ability to identify sub-clinical manifestations of negative-like symptomatology across various domains, b) the fact that it is less confounded by emotional dysregulation (as compared to the CAARMS), and c) its large and persistent association with schizoid personality traits.

5) Positive and negative schizotypy are differentially expressed in daily life in terms of affect, schizotypic experiences, social contact, social functioning, and stress reactivity. Furthermore, these differential patterns of associations were stable over time, thus providing additional support to the predictive validity and the multidimensional model of schizotypy as well as to the validity of ESM as an effective method for predicting the experience of schizotypic experiences in daily life.

6) Consistent with etiological models on the role of stress sensitivity in the experience of *positive* psychotic symptoms, positive schizotypy was associated with elevated levels of stress reactivity, whereas negative schizotypy was associated with diminished reactivity

in daily life. Specifically, momentary situational and social stress were associated with psychotic-like and paranoid symptoms only for those individuals high on positive schizotypy. In addition, time-lagged analyses showed that stress at the previous signal predicted an increase of psychotic-like symptoms at the subsequent signal only in individuals with high positive schizotypy.

References

Andreasen, N.C. (1989). The Scale for the Assessment of Negative Symptoms (SANS): Conceptual and Theoretical Foundations. British Journal of Psychiatry, 155 (7), S49–S52. doi: 10.1192/S0007125000291496

American Psychiatric Association. (1980). *Diagnostic and Statistical Manual of Mental Disorders.* (3th ed.). Washington, DC: Author.

American Psychiatric Association. (1987). *Diagnostic and Statistical Manual of Mental Disorders.* (3th ed., text rec.). Washington, DC: Author.

American Psychiatric Association. (1994). *Diagnostic and Statistical Manual of Mental Disorders*. (4th ed.). Washington, DC: Author.

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders*. (5th ed.). Washington, DC: Author. doi: 10.1176/appi.books.9780890425596

Badcock, J.C., Paulik, G., & Maybery, M. (2011). The role of emotion regulation in auditory hallucinations. Psychiatry Research, 185(3), 303–308. doi: 10.1016/j.psychres.2010.07.011

Bak, M., Drukker, M., Hasmi, L., & van Os, J. (2016). An n=1 Clinical Network Analysis of Symptoms and Treatment in Psychosis. *PLoS ONE, 11(9)*: e0162811. doi: 10.1371/journal.pone.0162811

Bang, M., Park, J.Y., Kim, K.R., Lee, S.Y., Song, Y.Y., Kang, J.I., Lee, E., An, S.K., 2019. Psychotic conversion of individuals at ultra-high risk for psychosis: The potential roles of schizotypy and basic symptoms. *Early Intervention in Psychiatry, 13(3)*, 546–554. doi: 10.1111/eip.12518

Barrantes-Vidal, N., Grant, P., & Kwapil, T.R. (2015). The role of schizotypy in the study of the etiology of schizophrenia spectrum disorders. *Schizophrenia Bulletin, 41(2)*, S408–S416. doi: 10.1093/schbul/sbu191

Barrantes-Vidal, N., Chun, C.A., Myin-Germeys, I., & Kwapil, T.R. (2013a). Psychometric schizotypy predicts psychotic-like, paranoid, and negative symptoms in daily life. *Journal of Abnormal Psychology, 122*, 1077–1087. doi: 10.1037/a0034793

Barrantes-Vidal, N., Gross, G.M., Sheinbaum, T., Mitjavila, M., Ballespí, S., & Kwapil, T.R. (2013b). Positive and negative schizotypy are associated with prodromal and schizophrenia-spectrum symptoms. *Schizophrenia Research, 145*, 50–55. doi: 10.1016/j.schres.2013.01.007

Barrantes-Vidal, N., Lewandowski, K.E., & Kwapil, T.R. (2010). Psychopathology, social adjustment and personality correlates of schizotypy clusters in a large nonclinical sample. *Schizophrenia Research, 122*, 219–225. doi: 10.1016/j.schres.2010.01.006

Barrantes-Vidal, N., Ros-Morente, A., & Kwapil, T.R. (2009). An examination of neuroticism as a moderating factor in the association of positive and negative schizotypy with psychopathology in a nonclinical sample. *Schizophrenia Research, 115*, 303–309. doi: 10.1016/j.schres.2009.09.021

Bentall, R.P., Claridge, G.S., & Slade, P.D. (1989). The multidimensional nature of schizotypal traits: a factor analytic study with normal subjects. *British Journal of Clinical Psychology, 28(4)*, 363–375. doi: 10.1111/j.2044-8260.1989.tb00840.x

Blanchard, J.J., Collins, L.M., Aghevli, M., Leung, W.W., & Cohen, A.S. (2011). Social anhedonia and schizotypy in a community sample: the Maryland Longitudinal

Study of Schizotypy. *Schizophrenia Bulletin, 37*, 587–602. doi: 10.1093/schbul/sbp107

Bleuler, E.P. (1950). Dementia praecox or the group of schizophrenias. J., Zinkin, Trans. New York: International Universities Press. Original work published in 1911.

Bogren, M., Mattisson, C., Tambs, K., Horstmann, V., Munk-Jørgensen, P., & Nettelbladt, P. (2010). Predictors of psychosis: a 50-year follow-up of the Lundby population. *European Archives of Psychiatry and Clinical Neuroscience, 260*, 113–125. doi: 10.1007/s00406-009-0022-4

Bolinskey, P.K., & Gottesman, I.I. (2010). Premorbid personality indicators of schizophrenia-related psychosis in a hypothetically psychosis-prone college sample. *Scandinavian Journal of Psychology, 51*, 68–74. doi: 10.1111/j.1467-9450.2009.00730.x

Bolinskey, P.K., James, A.V., Cooper-Bolinskey, D., Novi, J.H., Hunter, H.K., Hudak, D.V., … Lenzenweger, M.F. (2015). Revisiting the blurry boundaries of schizophrenia: spectrum disorders in psychometrically identified schizotypes. *Psychiatry Research, 225*, 335–340. doi: 10.1016/j.psychres.2014.12.015

Bolinskey, P.K., Smith, E.A., Schuder, K.M., Cooper-Bolinskey, D., Myers, K.R., Hudak, D.V., … Gottesman, I.I. (2017). Schizophrenia spectrum personality disorders in psychometrically identified schizotypes at two-year follow-up. *Psychiatry Research, 252*, 289–295. doi: 10.1016/j.psychres.2017.03.014

Braga, R.J., Petrides, G., & Figueira, I. (2004). Anxiety disorders in schizophrenia. *Comprehensive Psychiatry, 45(6)*, 460–468. doi; 10.1016/j.comppsych.2004.07.009

Brucato, G., Masucci, M.D., Arndt, L.Y., Ben-David, S., Colibazzi, T., … Girgis, R.R. (2017). Baseline demographics, clinical features and predictors of conversion

among 200 individuals in a longitudinal prospective psychosis-risk cohort. *Psychological Medicine, 47*, 1923–1935. doi: 10.1017/S0033291717000319

Cannon, T.D. (2015). How schizophrenia develops: cognitive and brain mechanisms underlying onset of psychosis. *Trends in Cognitive Sciences, 19*, 744–56. doi: 10.1016/j.tics.2015.09.009

Cannon, T.D., Cadenhead, K., Cornblatt, B., Woods, S.W., Addington, … Heinssen, R. (2008). Prediction of psychosis in youth at high clinical risk: a multisite longitudinal study in North America. *Archives of General Psychiatry, 65*, 28–37. doi:10.1001/archgenpsychiatry.2007.3

Chapman, L.J., Chapman, J.P., Kwapil, T.R., Eckblad, M., & Zinser, M. (1994). Putatively psychosis-prone subjects 10 years later. *Journal of Abnormal Psychology, 103*, 171–183.

Chapman, J.P., Chapman, L.J., & Kwapil, T.R. (1995). Scales for the measurement of schizotypy. In: Raine, A., Lencz, T., Mednick, S. (Eds.) Schizotypal Personality Disorder. Cambridge: Cambridge University Press, 79-106.

Chapman, L. J., Chapman, J. P., Numbers, J. S., Edell, W. S., Carpenter, B. N., & Beckfield, D. (1984). Impulsive nonconformity as a trait contributing to the prediction of psychotic-like and schizotypal symptoms. *Journal of Nervous and Mental Disease, 172*, 681–691. doi: 10.1097/00005053-198411000-00007

Chapman, L.J., Chapman, J.P., & Raulin, M.L. (1976). Scales for physical and social anhedonia. *Journal of Abnormal Psychology, 85*, 374–382. doi: 10.1037/0021-843X.85.4.374

Chapman, L.J., Chapman, J.P., & Raulin, M.L. (1978). Body image aberration in schizophrenia. *Journal of Abnormal Psychology, 87*, 399– 407. doi: 10.1037/0021-843X.87.4.399

Chapman, L.J., Edell, W.S., & Chapman, J.P. (1980). Physical anhedonia, perceptual aberration and psychosis-proneness. *Schizophrenia Bulletin, 6*, 639–653. doi: 10.1093/schbul/6.4.639

Chmielewski, P.M., Fernandes, L.O.L., Yee, C.M., & Miller, G.A. (1995). Ethnicity and gender in scales of psychosis proneness and mood disorders. *Journal of Abnormal Psychology, 104(3)*, 464–470. doi: 10.1037/0021-843X.104.3.464

Chun, C.A., Barrantes-Vidal, N., Sheinbaum, T., & Kwapil, T.R. (2017). Expression of schizophrenia-spectrum personality traits in daily life. *Personality Disorders: Theory, Research, and Treatment, 8*, 64–74. doi:10.1037/per0000141

Cohen, A.S., Couture, S.M., & Blanchard, J.J. (2012). Neuropsychological functioning and social anhedonia: Three year follow-up data from a longitudinal community high risk study. *Journal of Psychiatric Research, 46 (7)*, 898–904. doi: 10.1016/j.jpsychires.2012.03.020

Cohen, A.S. & Matthews, R.A. (2010). Primary and secondary negative schizotypal traits in a large non-clinical sample. *Personality and Individual Differences, 49 (5)*, 419–424. doi: 10.1016/j.paid.2010.04.010

Claridge, G. (1997). Theoretical background issues. In: Claridge, G. (Ed.), Schizotypy: Implications for Illness and Health. Oxford: Oxford University Press, pp. 3–18.

Claridge, G. & Broks, P. (1984). Schizotypy and hemisphere function I: Theoretical considerations and the measurement of schizotypy. *Personality and Individual Differences, 5(6)*, 633–648. doi:10.1016/0191-8869(84)90111-9

Debbané, M., & Barrantes-Vidal, N. (2015). Schizotypy from a developmental perspective. *Schizophr Bulletin, 41(2)*, S386–S395. doi: 10.1093/schbul/sbu175

Debbané, M., Eliez, S., Badoud, D., Conus, P., Flückiger, R., & Schultze-Lutter, F. (2015). Developing psychosis and its risk states through the lens of schizotypy. *Schizophrenia Bulletin, 41(2)*, S396–S407. doi: 10.1093/schbul/sbu176

Eckblad, M. & Chapman, L.J. (1983). Magical ideation as an indicator of schizotypy. *Journal of Consulting and Clinical Psychology, 51*, 215–225. doi: 10.1037/0022-006X.51.2.215

Eckblad, M.L., Chapman, L.J., Chapman, J.P., & Mishlove, M. (1982). The Revised Social Anhedonia Scale (unpublished test copies). Greensboro, NC: University of North Carolina, Department of Psychology, Greensboro, NC 27402.

Emsley, R.A., Oosthuizen, P.P., Joubert, A.F., Roberts, M.C., & Stein, D.J. (1999). Depressive and anxiety symptoms in patients with schizophrenia and schizophreniform disorder. *The Journal of Clinical Psychiatry, 60(11)*, 747–751. doi: 10.4088/JCP.v60n1105

Erlenmeyer-Kimling, L., Cornblatt, B.A., Rock, D., Roberts, S., Bell, M., & West, A. (1993). The New York High-Risk Project: anhedonia, attentional deviance, and psychopathology. *Schizophrenia Bulletin, 19*, 141–153. doi: 10.1093/schbul/19.1.141

Ettinger, U., Mohr, C., Gooding, D.C., Cohen, A.S., Rapp, A., Haenschel, C., & Park, S. (2015). Cognition and brain function in schizotypy: a selective review. *Schizophrenia Bulletin, 41(2)*, S417–S426. doi: 10.1093/schbul/sbu190

Evans, S.C., Reed, G.M., Roberts, M.C., Esparza, P., Watts, A.D., … Saxena, S. (2013). Psychologists' perspectives on the diagnostic classification of mental disorders: results from the WHO-IUPsyS Global Survey. *International Journal of Psychology, 48*, 177–193. doi: 10.1080/00207594.2013.804189

Flückiger, R., Ruhrmann, S., Debbané, M., Michel, C., Hubl, D., … Schultze-Lutter, F. (2016). Psychosis-predictive value of self-reported schizotypy in a clinical high-risk sample. *Journal of Abnormal Psychology, 125(7)*, 923–932. doi: 10.1037/abn0000192

Fonseca-Pedrero, E., Paino, M., Lemos-Giráldez, S., Muñiz, J. (2011). Schizotypal traits and depressive symptoms in nonclinical adolescents. *Comprehensive Psychiatry, 52*, 293–300. doi: 10.1016/j.comppsych.2010.07.001

Fusar-Poli, P., Bechdolf, A., Taylor, M.J., Bonoldi, I., Carpenter, W.T., … McGuire, P. (2013). At risk for schizophrenic or affective psychoses? A meta-analysis of DSM/ICD diagnostic outcomes in individuals at high clinical risk. *Schizophrenia Bulletin, 39(4)*, 923–932. doi: 10.1093/schbul/sbs060

Fusar-Poli, P., Bonoldi, I., Yung, A.R., Borgwardt, S., Kempton, M.J., Valmaggia, L., … McGuire, P. (2012). Predicting psychosis: meta-analysis of transition outcomes in individuals at high clinical risk. *Archives of General Psychiatry, 69(3)*, 220–229.

GBD 2016 Disease and Injury Incidence and Prevalence Collaborators (2017). Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet, 390*, 1211–1259. doi: 10.1016/S0140-6736(17)32154-2

GBD 2017 Disease and Injury Incidence and Prevalence Collaborators (2018). Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet, 392*, 1789–1858. doi: 10.1016/S0140-6736(18)32279-7

Goldstein, J.M. (1996). Sex and brain abnormalities in schizophrenia: Fact or fiction? *Harvard Review of Psychiatry, 4*, 110–115. doi: 10.3109/10673229609030533

Goldstein, J.M. & Link, B.G. (1998). Gender and the expression of schizophrenia. *Journal of Psychiatric Research, 22(2)*, 141–155. doi: 10.1016/0022-3956(88)90078-7

Gooding, D.C., Tallent, K.A., & Matts, C.W. (2005). Clinical status of at-risk individuals 5 years later: Further validation of the psychometric high-risk strategy. *Journal of Abnormal Psychology, 114*, 170–175. doi: 10.1037/0021-843X.114.1.170

Grant, P., Green, M.J., & Mason, O.J. (2018). Models of schizotypy: The importance of conceptual clarity. *Schizophrenia Bulletin, 44(2)*, S556–S563. doi: 10.1093/schbul/sby012.

Grant, P., Munk, A.J.L., & Hennig, J. (2018). A positive-psychological intervention reduces acute psychosis-proneness. *Schizophrenia Research, 199*, 414-419. doi: 10.1016/j.schres.2018.04.007

Grant, B.F., Stinson, F.S., Dawson, D.A., Chou, S.P., Ruan, W.J., & Pickering, R.P. (2004). Co-occurrence of 12-month alcohol and drug use disorders and personality disorders in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Archives of General Psychiatry, 61(4)*, 361–368.

Gross, G.M., Mellin, J., Silvia, P.J., Barrantes-Vidal, N., & Kwapil, T.R. (2014). Comparing the factor structure of the Wisconsin schizotypy scales and the Schizotypal Personality Questionnaire. *Personality Disorders: Theory, Research, and Treatment, 5*, 397–405. doi: 10.1037/per0000090

Gross, G.M., Kwapil, T.R., Raulin, M.L., Silvia, P.J., & Barrantes-Vidal, N. (2018). The Multidimensional Schizotypy Scale-Brief: Scale development and psychometric properties. *Psychiatry Research, 261*, 7–13. doi: 10.1016/j.psychres.2017.12.033

Häfner, H., Riecher-Rössler, A., Hambrecht, M., Maurer, K., Meissner, S., Schmidtke, A., …. van der Heiden W. (1992). IRAOS: an instrument for the assessment of onset and early course of schizophrenia. Schizophrenia Research, 6(3), 209–223. doi: 10.1016/0920-9964(92)90004-o

Hambrecht, M., Maurer, K., & Häfner, H. (1992). Gender differences in schizophrenia in three cultures: results of the WHO collaborative study on psychiatric disability. *Social Psychiatry and Psychiatric Epidemiology, 27*, 117–121. doi: 10.1007/BF00788756

Hanssen, M., Bak, M., Bijl, R., Vollebergh, W.A.M., & van Os, J. (2005). The incidence and outcome of subclinical psychotic experiences in the general population. *British Journal of Clinical Psychology, 44*, 181–191. doi: 10.1348/014466505X29611

Hartmann, J.A., Wichers, M., Menne-Lothmann, C., Kramer, I., Viechtbauer, W., … Delespaul, P. (2015). Experience sampling-based personalized feedback and positive affect: a randomized controlled trial in depressed patients. *PLoS ONE 10(6)*, e0128095. doi:10.1371/journal.pone.0128095

Henry, L.P., Harris, M.G., Amminger, G.P., Yuen, H.P., Harrigan, S.M., Lambert, M., … McGorry, P.D. (2007). Early Psychosis Prevention and Intervention Centre long-term follow-up study of first-episode psychosis: methodology and baseline characteristics. Early Intervention in Psychiatry, 1(1), 49–60. doi: 10.1111/j.1751-7893.2007.00008.x

Horan, W.P., Brown, S.A., & Blanchard, J.J. (2007). Social anhedonia and schizotypy: the contribution of individual differences in affective traits, stress, and coping. *Psychiatry Research, 149*, 147–156. doi: 10.1016/j.psychres.2006.06.002

Horton, L.E., Barrantes-Vidal, N., Silvia, P.J., & Kwapil, T.R. (2014). Worries about being judged versus being harmed: disentangling the association of social anxiety and paranoia with schizotypy. *PLoS ONE, 9(6)*: e96269. doi: 10.1371/journal.pone.0096269

House, A., Bostock, J., & Cooper J. (1987). Depressive syndromes in the year following onset of a first schizophrenic illness. British Journal of Psychiatry, 151, 773-779. doi: 10.1192/bjp.151.6.773

Johnstone, E.C., Ebmeier, K.P., Miller, P., Owens, D.G., & Lawrie, S.M. (2005). Predicting schizophrenia: findings from the Edinburgh High-Risk Study. *British Journal of Psychiatry, 186*, 18–25. doi: https://doi.org/10.1192/bjp.186.1.18

Kaczorowski, J.A., Barrantes-Vidal, N., & Kwapil, T.R. (2009). Neurological soft signs in psychometrically identified schizotypy. *Schizophrenia Research, 115*, 293–302. doi: 10.1016/j.schres.2009.06.018

Kemp, K.C., Gross, G.M., & Kwapil, T.R. (2019). Psychometric properties of the Multidimensional Schizotypy Scale and Multidimensional Schizotypy Scale-Brief: Item and scale test-retest reliability and concordance of original and brief forms. *Journal of Personality Assessment, 23*, 1–8. doi: 10.1080/00223891.2019.1591425

Kendler, K.S. (1985). Diagnostic approaches to schizotypal personality disorder: a historical perspective. *Schizophrenia Bulletin, 11(4)*, 538–53. doi: 10.1093/schbul/11.4.538

Kendler, K.S., Gruenberg, A.M., & Kinney, D.K. (1994). Independent diagnoses of adoptee and relatives as defined by DSM-III in the provincial and national samples of the Danish Adoption Study of Schizophrenia. *Archives of General Psychiatry 51*, 456–468. doi: 10.1001/archpsyc.1994.03950060020002

Kendler, K.S., Lieberman, J.A., & Walsh, D. (1989). The structured interview for Schizotypy (SIS): a preliminary report. Schizophrenia Bulletin 15, 559–571.

Kety, S.S., Rosenthal, D., Wender, P.H., & Schulsinger, F. (1968). The types and prevalence of mental illness in the biological and adoptive families of adopted schizophrenics. *Journal of Psychiatric Research, 6*, 345–362. doi: 10.1016/0022-3956(68)90026-5

Kety, S.S. (1985). Schizotypal personality disorder: an operational definition of Bleuler's latent schizophrenia? *Schizophrenia Bulletin, 11(4)*, 590–594. doi: 10.1093/schbul/11.4.590

Klosterkötter, J., Hellmich, M., Steinmeyer, E.M., & Schultze-Lutter, F. (2001). Diagnosing Schizophrenia in the Initial Prodromal Phase. *Archives of General Psychiatry, 58(2)*, 158–164. doi:10.1001/archpsyc.58.2.158

Kraepelin, E. (1919). *Dementia praecox and paraphrenia*. Edinburgh: Livingstone. Original work published in 1913.

Kraepelin, E. (1921). Manic-depressive Insanity and Paranoia. Translated by R. Mary Barclay edited by George M. Robertson, M.D., F.R.C.P.Edin. Edinburgh: E. & S. Livingstone, 1921. New York: Arno Press.

Kramer I, Simons CJ, Hartmann JA, Menne-Lothmann C, Viechtbauer W, … Wichers, M. (2014). A therapeutic application of the experience sampling method in the treatment of depression: a randomized controlled trial. *World Psychiatry, 13(1)*, 68–77. doi: 10.1002/wps.20090

Kretschmer, E. (1925). *Physique and Character*. W.J.H., Sprott, Trans. London: Kegan, Trench and Trubner.

Kwapil, T.R. (1998). Social anhedonia as a predictor of the development of schizophrenia-spectrum disorders. *Journal of Abnormal Psychology, 107*, 558–565. doi: 10.1037/0021-843X.107.4.558

Kwapil, T.R., & Barrantes-Vidal, N. (2012). Schizotypal personality disorder: an integrative review. In: Widiger, T.A. (Ed.), The Oxford Handbook of Personality Disorders. New York: Oxford University Press, pp. 437–477.

Kwapil, T.R., & Barrantes-Vidal, N. (2015). Schizotypy: looking back and moving forward. *Schizophrenia Bulletin, 41(2)*, S366–S373. doi: 10.1093/schbul/sbu186

Kwapil, T.R., Barrantes-Vidal, N., & Silvia, P.J. (2008). The dimensional structure of the Wisconsin Schizotypy Scales: factor identification and construct validity. *Schizophrenia Bulletin, 34*, 444–457. doi: 10.1093/schbul/sbm098

Kwapil, T.R., Brown, L.H., Silvia, P.J., Myin-Germeys, I., & Barrantes-Vidal, N. (2012). The expression of positive and negative schizotypy in daily life: an experience sampling study. *Psychological Medicine, 42*, 2555–2566. doi: 10.1017/S0033291712000827

Kwapil, T.R. & Chun, C.A. (2015). The psychometric assessment of schizotypy. In: Mason, O., Claridge, G. (Eds.), Schizotypy. New York: Oxford University Press, pp. 7-32.

Kwapil, T.R., Gross, G.M., Silvia, P.J., Raulin, M.L., & Barrantes-Vidal, N. (2013). Prediction of psychopathology and functional impairment by positive and negative schizotypy in the Chapmans' ten-year longitudinal study. Journal of Abnormal Psychology, 122, 807–815. doi: 10.1037/a0033759

Kwapil, T.R., Gross, G.M., Silvia, P.J., Raulin, M.L., & Barrantes-Vidal, N. (2018). Development and psychometric properties of the Multidimensional Schizotypy Scale: a new measure for assessing positive, negative, and disorganized schizotypy. *Schizophrenia Research, 193*, 209–217. doi: 10.1016/j.schres.2017.07.001

Kwapil, T.R., Miller, M.B., Zinser, M.C., Chapman, J., & Chapman, L.J. (1997). Magical ideation and social anhedonia as predictors of psychosis proneness: a partial replication. *Journal of Abnormal Psychology, 106(3)*, 491–495. doi: 10.1037//0021-843x.106.3.491

Lenzenweger, M.F. (2015). Thinking clearly about schizotypy: hewing to the schizophrenia liability core, considering interesting tangents, and avoiding conceptual quicksand. *Schizophrenia Bulletin, 41(2)*, S483–S491. doi: 10.1093/schbul/sbu184

Lenzenweger, M.F. & Dworkin, R.H. (1996). The dimensions of schizophrenia phenomenology. Not one or two, at least three, perhaps four. *British Journal of Psychiatry, 168*, 432–440. doi: 10.1192/bjp.168.4.432

Leung, A. & Chue, P. (2000). Sex differences in schizophrenia, a review of the literature. *Acta Psychiatrica Scandinavica, 101(401)*, 3–38. doi: 10.1111/j.0065-1591.2000.0ap25.x

Lewandowski, K.E., Barrantes-Vidal, N., Nelson-Gray, R.O., Clancy, C., Kepley, H.O., & Kwapil, T.R. (2006). Anxiety and depression symptoms in psychometrically identified schizotypy. *Schizophrenia Research, 83*, 225–235. doi: 10.1016/j.schres.2005.11.024

Liddle, P.F. (1987). The symptoms of chronic schizophrenia. A reexamination of the positive-negative dichotomy. *British Journal of Psychiatry, 151*, 145–151. doi: 10.1192/bjp.151.2.145

Linscott, R. J., & van Os, J. (2013). An updated and conservative systematic review and meta-analysis of epidemiological evidence on psychotic experiences in children and adults: On the pathway from proneness to persistence to dimensional expression across mental disorders. *Psychological Medicine, 43*, 1133–1149. doi: 10.1017/S0033291712001626

Maier, W. (1999). Diagnostic classification of psychiatric disorders and familial-genetic research. *Dialogues in Clinical Neuroscience, 1(3)*, 191–196.

Mason, O. (2015). The assessment of schizotypy and its clinical relevance. *Schizophrenia Bulletin, 41(2)*, S374–S385. doi: 10.1093/schbul/sbu194

Mason, O., Claridge, G., & Jackson, M. (1995). New scales for the assessment of schizotypy. *Personality and Individual Differences, 18*, 7–13. doi: 10.1016/0191-8869(94)00132-C

Mason, O., Claridge, G., & Williams, L. (1997). Questionnaire measurement. In: Claridge, G. (Ed.), Schizotypy: Implications for Illness and Health. Oxford University Press, New York, pp. 19–37.

Mason, O., Startup, M., Halpin, S., Schall, U., Conrad, A., & Carr, V. (2004). Risk factors for transition to first episode psychosis among individuals with "at-risk mental states". *Schizophrenia Research, 71*, 227–237. doi: 10.1016/j.schres.2004.04.006

McGlashan, T.H., Grilo, C.M., Skodol, A.E., Gunderson, J.G., Shea, M.T., Morey, L.C., … Stout, R.L. (2000). The Collaborative Longitudinal Personality Disorders Study: baseline Axis I/II and II/II diagnostic co-occurrence. *Acta Psychiatrica Scandinavica, 102(4)*, 256–64. doi: 10.1034/j.1600-0447.2000.102004256.x

McGorry, P. & Connell, S. (1990). The nosology and prognosis of puerperal psychosis: a review. *Comprehensive Psychiatry, 31(6)*, 519–534. doi: 10.1016/0010-440x(90)90066-2

McGorry, P. & van Os, J. (2013). Redeeming diagnosis in psychiatry: timing versus specificity. *Lancet, 381*, 343–345. doi: 10.1016/S0140-6736(12)61268-9

McGrath, J., Saha, S., Chant, D., & Welham, J. (2008). Schizophrenia: a concise overview of incidence, prevalence, and mortality. *Epidemiologic Reviews, 30*, 67–76. doi: 10.1093/epirev/mxn001

Meehl, P.E., 1962. Schizotaxia, schizotypy, schizophrenia. *American Psychologist, 17*, 827–838. doi: 10.1037/h0041029

Meehl, P.E., 1964. Manual for use with checklist of schizotypic signs. Unpublished manuscript.

Meltzer, H.Y. (1992). Treatment of the neuroleptic-nonresponsive schizophrenic patient. *Schizophrenia Bulletin, 18*, 515–542. doi: 10.1002/wps.20090

Miettunen, J. & Jääskeläinen, E. (2010). Sex Differences in Wisconsin Schizotypy Scales-A Meta-analysis. *Schizophrenia Bulletin, 36(2)*, 347–358. doi: 10.1093/schbul/sbn075

Miller, P., Byrne, M., Hodges, A., Lawrie, S.M., Owens, D.G., & Johnstone, E.C. (2002a). Schizotypal components in people at high risk of developing schizophrenia: early findings from the Edinburgh High-Risk Study. *British Journal of Psychiatry, 180*, 179–184. doi: 10.1192/bjp.180.2.179

Miller, P.M., Lawrie, S.M., Byrne, M., Cosway, R., & Johnstone, E.C. (2002b). Self-rated schizotypal cognitions, psychotic symptoms and the onset of schizophrenia in young people at high risk of schizophrenia. *Acta Psychiatrica Scandinavica, 105*, 341–345. doi: 10.1034/j.1600-0447.2002.1o175.x

Miller, J.D., Lynam, D.R., Widiger, T.A., & Leukefeld, C. (2001). Personality disorders as extreme variants of common personality dimensions: can the five factor model adequately represent psychopathy? *Journal of Personality, 69*, 253–276. doi: 10.1111/1467-6494.00144

Mohr, C. & Claridge, G. (2015). Schizotypy--do not worry, it is not all worrisome. *Schizophrenia Bulletin, 41(2)*, S436–S443. doi: 10.1093/schbul/sbu185

Moreno-Küstner, B., Martín, C., Pastor, L. (2018). Prevalence of psychotic disorders and its association with methodological issues. A systematic review and meta-analyses. *PLoS ONE, 13(4)*: e0195687. doi: 10.1371/journal.pone.0195687

Morrison, A.P., Bentall, R.P., French, P., Walford, L., Kilcommons, … Lewis, S.W. (2002). Randomised controlled trial of early detection and cognitive therapy for preventing transition to psychosis in high-risk individuals. Study design and interim analysis of transition rate and psychological risk factors. *British Journal of Psychiatry, 181(43)*, S78–S84. doi: 10.1192/bjp.181.43.s78

Myin-Germeys, I., Klippel, A., Steinhart, H., & Reininghaus, U. (2016). Ecological momentary interventions in psychiatry. *Current Opinion in Psychiatry, 29(4)*, 258–263. doi: 10.1097/YCO.0000000000000255

Myin-Germeys, I., Krabbendam, L., Jolles, J., Delespaul, P.A., & van Os, J. (2002). Are cognitive impairments associated with sensitivity to stress in schizophrenia? An experience sampling study. *The American Journal of Psychiatry, 159*, 443–449. doi: 10.1176/appi.ajp.159.3.443

Myin-Germeys, I., Ooschort, M., Collip, D., Lataster, J., Delespaul, P., & van Os, J. (2009). Experience sampling research in psychopathology: opening the black box of daily life. *Psychological Medicine, 39*, 1533–1547. doi: 10.1017/S0033291708004947

Myin-Germeys, I., van Os, J.J., Schwartz, J.F., Stone, A.A., & Delespaul, P.A. (2001). Emotional reactivity to daily life stress in psychosis. *Archives of General Psychiatry, 58*, 1137–1144. doi: 10.1001/archpsyc.58.12.1137

Nelson, B., Amminger, G.P., & McGorry, P.D. (2018). Recent Meta-Analyses in the Clinical High Risk for Psychosis Population: Clinical Interpretation of Findings and Suggestions for Future Research. *Frontiers in Psychiatry, 9*, 502. doi: 10.3389/fpsyt.2018.00502

Oorschot, M., Kwapil, T., Delespaul, P., & Myin-Germeys, I. (2009). Momentary assessment research in psychosis. *Psychological Assessment, 21(4)*, 498–505. doi: 10.1037/a0017077

Parnas, J., Raballo, A., Handest, P., Jansson, L., Vollmer-Larsen, A., & Saebye, D. (2011). Self-experience in the early phases of schizophrenia: 5-year follow-up of the Copenhagen prodromal study. *World Psychiatry, 10*, 200–204. doi: 10.1002/j.2051-5545.2011.tb00057.x

Perälä, J., Suvisaari, J., Saarni, S. I., Kuoppasalmi, K., Isometsä, E., Pirkola, S., ... Lönngvist, J. (2007). Lifetime prevalence of psychotic and bipolar I disorders in a general population. *Archives of General Psychiatry, 64(1)*, 19–28. doi: 10.1001/archpsyc.64.1.19

Peters, E.R., Joseph, S.A., & Garety, P.A. (1999). Measurement of delusional ideation in the normal population: introducing the PDI (Peters et al. Delusions Inventory). Schizophrenia Bulletin, 25(3), 553–576. doi: 10.1093/oxfordjournals.schbul.a033401

Racioppi, A., Sheinbaum, T., Gross, G.M., Ballespí, S., Kwapil, T.R., & Barrantes-Vidal, N. (2018). Prediction of prodromal symptoms and schizophrenia-spectrum personality disorder traits by positive and negative schizotypy: A 3-year

prospective study. *PLoS ONE, 13(11)*: e0207150. doi: 10.1371/journal.pone.0207150

Raine, A. (1991). The SPQ: a scale for the assessment of schizotypal personality based on DSM III–R Criteria. *Schizophrenia Bulletin, 17(4)*, 555–564. doi: 10.1093/schbul/17.4.555

Rado, S., 1953. Dynamics and classification of disordered behavior. *American Journal of Psychiatry, 110*, 406–416. doi: 10.1176/ajp.110.6.406

Ray, W.A., Meredith, S., Thapa, P.B., Meador, K.G., Hall, K., & Murray, K.T. (2001). Antipsychotics and the risk of sudden cardiac death. *Archives of General Psychiatry, 58*, 1161–1167. doi: 10.1001/archpsyc.58.12.1161

Robinson, D. G., Woerner, M. G., McMeniman, M., Mendelowitz, A. & Bilder, R. M. (2004). Symptomatic and functional recovery from a first episode of schizophrenia or schizoaffective disorder. *American Journal of Psychiatry, 161(3)*, 473–479. doi: 10.1176/appi.ajp.161.3.473

Rössler, W., Salize, H.J., van Os, J., & Riecher-Rössler, A. (2005). Size of burden of schizophrenia and psychotic disorders. *European Neuropsychopharmacology, 15(4)*, 399–409.

Ruhrmann, S., Schultze-Lutter, F., Salokangas, R.K., Heinimaa, M., Linszen, D., … Klosterkötter, J. (2010). Prediction of psychosis in adolescents and young adults at high risk: results from the prospective European prediction of psychosis study. *Archives of General Psychiatry, 67*, 241–251. doi: 10.1001/archgenpsychiatry.2009.206

Saha, S., Chant, D., Welham, J., & McGrath, J. (2005). A systematic review of the prevalence of schizophrenia. *PLoS Medicine, 2(5)*: e141. doi: 10.1371/journal.pmed.0020141

Salokangas, R.K., Dingemans, P., Heinimaa, M., Svirskis, T., Luutonen, … Klosterkotter, J. (2013). Prediction of psychosis in clinical high-risk patients by the Schizotypal Personality Questionnaire. Results of the EPOS project. *European Psychiatry, 28*, 469–475. doi: 10.1016/j.eurpsy.2013.01.001

Schultze-Lutter, F., Klosterkötter, J., Michel, C., Winkler, K., & Ruhrmann, S. (2012). Personality disorders and accentuations in at-risk persons with and without conversion to first-episode psychosis. *Early Intervention in Psychiatry, 6*, 389–398. doi: 10.1111/j.1751-7893.2011.00324.x

Schultze-Lutter, F., Nenadic, I., & Grant, P. (2019). Psychosis and Schizophrenia-Spectrum Personality Disorders Require Early Detection on Different Symptom Dimensions. *Frontiers in Psychiatry, 10,* 476. doi: 10.3389/fpsyt.2019.00476

Schultze-Lutter, F., Schimmelmann, B.G., Ruhrmann, S., Michel, C. (2013). 'A rose is a rose is a rose', but at-risk criteria differ. *Psychopathology, 46*, 75–87.

Selten, J.P., Gernaat, H.B., Nolen, W.A., Wiersma, D., & van den Bosch, R.J. (1998). Experience of negative symptoms: comparison of schizophrenic patients to patients with a depressive disorder and to normal subjects. *American Journal of Psychiatry, 155(3)*, 350–354. doi: 10.1176/ajp.155.3.350

Shah, J., Eack, S.M., Montrose, D.M., Tandon, N., Miewald, J.M., … Keshavan, M.S. (2012). Multivariate prediction of emerging psychosis in adolescents at high risk for schizophrenia. *Schizophrenia Research, 14*, 189–96. doi: 10.1016/j.schres.2012.08.012

Shah, J., Mizrahi, R., & McKenzie, K. (2011). The four dimensions: A model for the social aetiology of psychosis. *British Journal of Psychiatry, 199(1)*, 11–14. doi: 10.1192/bjp.bp.110.090449

Shah, J. L., Tandon, N., & Keshavan, M. S. (2013). Psychosis prediction and clinical utility in familial high-risk studies: Selective review, synthesis, and implications for early detection and intervention. *Early Intervention in Psychiatry, 7*, 345–370. doi: 10.1111/eip.12054

Sim, K., Mahendran, R., Siris, S.G., Heckers, S., & Chong, S.A. (2004). Subjective quality of life in first episode schizophrenia spectrum disorders with comorbid depression. *Psychiatry Research, 129(2)*, 141-147. doi: 10.1016/j.psychres.2004.07.007

Spitzer, R.L., Endicott, J., & Gibbon, M. (1979). Crossing the border into borderline personality and borderline schizophrenia. *Archives of General Psychiatry, 36*, 17–24. doi: 10.1001/archpsyc.1979.01780010023001

Stefanis, N.C., Hanssen, M., Smirnis, N.K., Avramopoulos, D.A., Evdokimidis, I.K., Stefanis, C.N., … van Os, J. (2002). Evidence that three dimensions of psychosis have a distribution in the general population. *Psychological Medicine, 32(2)*, 347–358. doi: 10.1017/s0033291701005141

Tandon, R., Nasrallah, H.A., & Keshavan, M.S. (2009). Schizophrenia, "Just the Facts" 4. Clinical features and conceptualization. *Schizophrenia Research, 110*, 1–23. doi: 10.1016/j.schres.2009.03.005

Tijms, B.M., Sprooten, E., Job, D., Johnstone, E.C., Owens, D.G., … Lawrie, S.M. (2015). Grey matter networks in people at increased familial risk for schizophrenia. *Schizophrenia Research, 168*, 1–8. doi: 10.1016/j.schres.2015.08.025

van Os, J., Kenis, G., & Rutten, B. (2010). The environment and schizophrenia. *Nature, 468*, 203–2012. doi: 10.1038/nature09563

van Os, J., Krabbendam, L., Myin-Germeys, I., & Delespaul, P. (2005). The schizophrenia envirome. *Current Opinion in Psychiatry, 18*, 141–145.

van Os, J., Linscott, R. J., Myin-Germeys, I., Delespaul, P., & Krabbendam, L. (2009). A systematic review and meta-analysis of the psychosis continuum: Evidence for a psychosis proneness-persistence-impairment model of psychotic disorder. *Psychological Medicine, 39*, 179–195. doi: 10.1017/S0033291708003814

van Os, J., van der Steen, Y., Islam, M.A., Gülöksüz, S., Rutten, B.P., … G.R.O.U.P. Investigators (2017). Evidence that polygenic risk for psychotic disorder is expressed in the domain of neurodevelopment, emotion regulation and attribution of salience. *Psychological Medicine, 47(14)*, 2421–2437. doi: 10.1017/S0033291717000915

Vollema, M.G. & van den Bosch, R.J. (1995). The multidimensionality of schizotypy. *Schizophrenia Bulletin, 21(1)*, 19–31. doi: 10.1093/schbul/21.1.19

Wassink, T.H., Flaum, M., Nopoulos, P., & Andreasen, N.C. (1999). Prevalence of depressive symptoms early in the course of schizophrenia. *American Journal of Psychiatry, 156*, 315–316.

Werbeloff, N., Dohrenwend, B.P., Yoffe, R., van Os, J., Davidson, M., & Weiser, M. (2015). The association between negative symptoms, psychotic experiences and later schizophrenia: a population-based longitudinal study. *PLoS ONE, 10(3)*: e0119852. doi: 10.1371/journal.pone.011985

Wilberg, T., Urnes, O., Frii, S., Pederson, G., & Karterud, S. (1999). Borderline and avoidant personality disorders and the five-factor model of personality: a comparison between DSM-IV diagnoses and NEO-PI-R. *Journal of Personality Disorders, 13*, 226–240. doi: 10.1521/pedi.1999.13.3.226

Winterstein, B. P., Silvia, P. J., Kwapil, T. R., Kaufman, J. C., Reiter-Palmon, R., & Wigert, B. (2011). Brief assessment of schizotypy: Developing short forms of the Wisconsin Schizotypy Scales. *Personality and Individual Differences, 51(8)*, 920–924. doi: 10.1016/j.paid.2011.07.027

Woods, S.W., Addington, J., Cadenhead, K.S., Cannon, T.D., Cornblatt, B.A., … McGlashan, T.H. (2009). Validity of the prodromal risk syndrome for first psychosis: findings from the North American Prodrome Longitudinal Study. *Schizophrenia Bulletin, 35*, 894–908. doi: 10.1093/schbul/sbp027

Yung, A.R., McGorry, P.D., McFarlane, C.A., Jackson, H.J., Patton, G.C., & Rakkar, A. (1996). Monitoring and care of young people at incipient risk of psychosis. *Schizophrenia Bulletin, 22*, 283–303. doi: 10.1093/schbul/22.2.283

Yung, A.R., Phillips, L.J., Yuen, H.P., & McGorry, P.D. (2004). Risk factors for psychosis in an ultra high-risk group: psychopathology and clinical features. *Schizophrenia Research, 67*, 131–142. doi: 10.1016/S0920-9964(03)00192-0

Zarogianni, E., Storkey, A.J., Johnstone, E.C., Owens, D.G., & Lawrie, S.M. (2017). Improved individualized prediction of schizophrenia in subjects at familial high risk, based on neuroanatomical data, schizotypal and neurocognitive features. *Schizophrenia Research, 181*, 6–12. doi: 10.1016/j.schres.2016.08.027

Zipursky, R.B., Reilly, T.J., & Murray, R.M. (2013). The myth of schizophrenia as a progressive brain disease. *Schizophrenia Bulletin, 39(6)*, 1363–1372. doi: 10.1093/schbul/sbs135

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Department of Clinical and Health Psychology, Universitat Autònoma de Barcelona (UAB), Barcelona, Spain:
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6. Member of Funded Research Projects

Consolidated Research Group: Person-Environment Interaction in Risk and Resilience for Mental Health, Research Group Support-Consolidated Modality (SGR 2017)
Principal Investigator: Neus Barrantes-Vidal.
Funding Agency: Agència de Gestió d'Ajuts Universitaris i de Recerca (AGAUR)-Generalitat de Catalunya
Research team: Ballespí, S. (UAB), Chanes, L., (UAB), Cristòbal, P. (UAB), Hinojosa, L. (UAB), Monsonet, M. (UAB), **Racioppi, A.** (UAB).

Developmental trajectories of risk and resilience to psychosis: Integrative study of Gene-Person-Environment Interactions across the Extended Psychosis Phenotype / Trayectorias de riesgo y resiliencia a la psicosis: Estudio integrador de las interacciones Gen-Persona-Ambiente en el fenotipo extenso de la psicosis.
Principal Investigator: Neus Barrantes-Vidal.
Project Reference: PSI2017-87512-C2-00.
Funding Agency: Spanish Ministry of Economy and Competitiveness (MINECO), Plan Nacional de I+D+I (National Plan of R+D).
Duration: January 2018 to December 2020.

Subproject 1: **Developmental trajectories of risk and resilience to psychosis: Longitudinal examination of the psychological and biological stress sensitization hypothesis / Trayectorias de desarrollo de riesgo y resiliencia a la psicosis: Estudio longitudinal de la hipótesis de sensibilización psicológica y biológica al estrés**
Principal investigator: Neus Barrantes-Vidal
Project Reference: PSI2017-87512-C2-1-R
Investigators: Ballespí, S. (UAB).

Teamwork: Cristóbal, P. (UAB)., Domínguez, T. (Instituto de Psiquiatría de Méjico), Herrera, S. (Fundació Sanitària Sant Pere Claver), Hinojosa, L. (UAB), Kwapil, T.R. (University of Illinois at Urbana-Champaign, USA), Monsonet, M. (UAB), Montoro, M. (Fundació Sanitària Sant Pere Claver), Myin-Germeys, I. (KU Leuven, Belgium), **Racioppi, A.** (UAB), Sheinbaum, T. (University of Southern California, USA), Torices, I. (Fundació Sanitària Sant Pere Claver).

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Teamwork: Cristóbal, P. (UAB), Guasch, V., Montoro, M., Herrero, S., **Racioppi, A.** (UAB), Hinojosa, L. (UAB), Monsonet, M. (UAB).

Consolidated Research Group: Person-Environment Interaction in Psychopathology, Suport als Grups de Recerca – Modaliat Consolidada (SGR 2014)
Principal Investigator: Neus Barrantes-Vidal
Project Reference: 2014SGR1070
Funding Agency: Agencia de Gestió d'Ajuts Universitaris i de Recerca (AGAUR) - Generalitat de Cataluña
Amount Requested: 24.520€ (maximum possible in this call according to the number of PhD members belonging to our institution in the group with a permanent position: 16.000€)
Amount Funded: 15.000€
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Acciones de Dinamización "Redes de Excelencia": Investigación en Procesos, Mecanismos y Tratamientos Psicológicos para la Promoción de la Salud Mental (PROMOSAM)
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Funding Agency: Spanish Ministry of Economy and Competitiveness (MINECO), (Programa de Fomento de la Investigación Científica y Técnica de Excelencia)
Amount Requested: 109.775€

Amount Funded: 40.000€
Duration: 2015-2016

7. Publications

a) *In preparation*

Racioppi, A., Gross, G. M., Kwapil, T. R., Barrantes-Vidal, N. Schizotypy dimensions predict at-risk mental states, schizophrenia-spectrum symptoms, and impairment: A 4.4-year prospective study.

Racioppi, A., Kwapil, T. R., Barrantes-Vidal, N. Schizotypy Predicts Psychotic-Like, Paranoid, and Negative Symptoms in Daily Life 3 years later: an Experience Sampling Methodology Longitudinal Study.

Sheinbaum, T., **Racioppi, A.**, Kwapil, T.R., Barrantes-Vidal, N. Attachment as a mechanism between childhood maltreatment and subclinical psychotic phenomena: Results from an eight-year follow-up study. Schizophrenia Research.

b) Submitted for publication

Mongan, D., Föcking, M., Healy, C., Susai, S. R., Heurich, M., Wynne, K., Nelson, B., McGorry, P., Amminger, P., Nordentoft, M., Krebs, M-O., Riecher-Rössler, A., Bressan, R., Barrantes-Vidal, N., Borgwardt, S., Ruhrmann, S., Sachs, G., Pantelis, C., van der Gaag, M., de Haan, L., PhD; Valmaggia, L., Kempton, M., Rutten, B., Cannon, M., Zammit, S., Cagney, G., Cotter, D. R., McGuire, P., and the EU-GEI High Risk Study Group (McGuire, P., Valmaggia, L.R., Pollak, T., Iyegbe, C., Tognin, S., Modinos, G., de Haan, L., van der Gaag, M., Velthorst, E., Kraan, T.C., van Dam, D.S., Burger, N., Nelson, B., McGorry, P., Amminger, G.P., Pantelis, C., Politis, A., Goodall, J., Riecher-Rössler, A., Borgward, S., Rapp, C., Ittig, S., Studerus, E., Smieskova, R., Bressan, R., Gadelha, A., Brietzke, E., Asevedo, G., Asevedo, E., Zugman, A., Barrantes-Vidal, N., Domínguez-Martínez, T., Racioppi, A., Kwapil, T.R., Monsonet, M., Rosa, A., Kebir, O., Daban, C., Bourgin, J., Chaumette, B., Mam-Lam-Fook, C., Krebs, M., Nordholm, D., Randers, L., Krakauer, K., Glenthøj, L.B., Glenthøj, B., Nordentoft, M., Ruhrmann, S., Gebhard, D., Arnhold, J., Klosterkötter, J., Sachs, G., Lasser, I., Winklbaur, B. Delespaul, P.A., Rutten, B. P., van Os, J., 2020. Development of proteomic prediction models for transition to psychotic disorder in the clinical high-risk state and psychotic experiences in adolescence.

c) *Publications in International Journals*

2019

Cohen, J.R., Thomsen, K.N., **Racioppi, A.**, Ballespi, S., Sheinbaum, T., Kwapil, T.R., Barrantes-Vidal, N. (2019). Emerging adulthood and prospective depression: A simultaneous test of cumulative risk theories. *Journal of Youth & Adolescence*. doi: 10.1007/s10964-019-01017-y. IF JCRSCI2018: 3,259. Quartile 1. Category: Psychology, Developmental (ranking: 17/74).

Menghini-Müller, S., Studerus, E., Ittig, S., Heitz, U., Egloff, L., Andreou, C., Valmaggia, L.R., Kempton, M.J., van der Gaag, M., de Haan, L., Nelson, B., Barrantes-Vidal, N., Nordentoft, M., Ruhrmann, S., Sachs, G., Rutten, B.P., Os, J.V., Riecher-Rössler, A.; EU-GEI High Risk Study Group, McGuire, P., Valmaggia, L.R., Kempton, M.J., Calem, M., Tognin, S., Modinos, G., de Haan, L., van der Gaag, M., Velthorst, E., Kraan, T.C., van Dam, D.S., Burger, N., Nelson, B., McGorry, P., Amminger, G.P., Pantelis, C., Politis, A., Goodall, J., Riecher-Rössler, A., Borgwardt, S., Rapp, C., Ittig, S., Studerus, E., Smieskova, R., Bressan, R., Gadelha, A., Brietzke, E., Asevedo, G., Asevedo, E., Zugman, A., Barrantes-Vidal, N., Domínguez-Martínez, T., **Racioppi, A.**, Cristóbal-Narváez, P., Kwapil, TR., Monsonet, M., Kazes, M., Daban, C., Bourgin, J., Gay, O., Mam-Lam-Fook, C., Krebs, M.O., Nordholm, D., Randers, L., Krakauer, K., Glenthøj, L., Glenthøj, B., Nordentoft, M., Ruhrmann, S., Gebhard, D., Arnhold, J., Klosterkötter, J., Sachs, G., Lasser, I., Winklbaur, B., Delespaul, P.A., Rutten, B.P., van Os, J. (2019). Gender differences of patients at-risk for psychosis regarding symptomatology, drug use, comorbidity and functioning- Results from the EU-GEI study. European Psychiatry. doi: 10.1016/j.eurpsy.2019.04.007. Epub 2019 May 7. 59, 52-59. IF JCRSCI2018: 3,941. Quartile 1. Category: Psychiatry (ranking: 24/142).

2018

Racioppi, A., Sheinbaum, T., Gross, G.M., Ballespí, S., Kwapil, T.R., Barrantes-Vidal, N. (2018). Prediction of prodromal symptoms and schizophrenia-spectrum personality disorder traits by positive and negative schizotypy: A 3-year prospective study. PLoS ONE 13(11): e0207150. https://doi.org/10.1371/journal.pone.0207150. IF JCRSCI2017: 2,766. Quartile 1. Category: Multidisciplinary Sciences (ranking: 15/64).

2017

de Castro-Català, M., Mora-Solano, A., Kwapil, T.R., Cristóbal-Narváez, P., Sheinbaum, T., **Racioppi, A.**, Barrantes-Vidal, N., Rosa, A. (2017). The genome-wide associated candidate gene ZNF804A and psychosis-proneness: Evidence of sex-modulated association. PLoS One, Sep 20;12(9):e0185072. doi: 10.1371/journal.pone.0185072. IF JCRSCI2016: 3.057. Quartile 1. Category: Multidisciplinary Sciences (ranking: 11/61).

Cristóbal-Narváez, P., Sheinbaum, T., Myin-Germeys, I., Kwapil, T.R., de Castro-Català, M., Domínguez-Martínez, T., **Racioppi, A.**, Monsonet, M., Hinojosa, L., van Winkel, R., Rosa, A., Barrantes-Vidal, N. (2017). The role of stress-regulation genes in moderating the association of stress and daily-life psychotic experiences. Acta Psychiatrica Scandinavica, 134(4), 389-399. IF JCRSCI2016: 6.79. Quartile 1. Category: Psychiatry (ranking: 10/142).

d) Book Chapters

Barrantes-Vidal, N., **Racioppi, A.**, Kwapil, T.R. (2020). Schizotypy, Schizotypal Personality and Psychosis Risk. In: A. Thompson & M. Broome (Eds.), Risk Factors for Psychosis: Paradigms, Mechanisms, and Prevention (pp. 83-102). Elsevier. Academic Press. (ISBN: 9780128132012).

e) *Published Abstracts*

2019

Mertens, Y.L., **Racioppi, A.**, Sheinbaum, T., Barrantes-Vidal, N. Dissociation and insecure attachment mediate the effect of emotional abuse on paranoia in the non-clinical psychotic-like phenotype. The 16th Europena Society of Trumatic Stress Studies Conference (ESTSS19). Rotterdam, Netherlands. June 14th- 16th, 2019. Abstract published in: *European Journal of Psychotraumatology*, 10 (Suppl.1), S013.

2016

Barrantes-Vidal, N., Cristóbal-Narváez, P., Sheinbaum, T., de Castro-Català, M., Monsonet, M., Hinojosa, L., **Racioppi**, A., Domínguez-Martínez, T., Peña, E., Ballespí, S., Rosa, A., Kwapil, T.R. (2016). Impact of Childhood Adversity, Genetic Variation, and their Interaction on Psychotic-like Symptoms and Stress Reactivity in Psychometric and Clinical High Risk Samples. *Early Intervention in Psychiatry*, 10 (1), 53. DOI: 10.1111/eip.12395. IF: 2.4. Q2. Category: Psychiatry.

Racioppi, A., Sheinbaum, T., Ballespí, S., Mitjavila, M., Gross, G. M., Kwapil, T. R., Barrantes-Vidal, N. (2016). Positive and negative schizotypy prediction of prodromal symptoms and schizophrenia-spectrum personality disorder traits: A 3-year prospective study. The 5th Biennial Schizophrenia International Research Society Conference (SIRS). Florence, Italy. April 2nd-6th. Abstract published in: *npj Schizohprenia-Nature*, 2, 45.

Racioppi, A., Sheinbaum, T., Ballespí, S., Mitjavila, M., Gross, G. M., Kwapil, T. R., Barrantes-Vidal, N. (2016). Psychometric schizotypy predicts prodromal and schizophrenia-spectrum symptoms, psychological measures, and functional adaptation: A 4-year longitudinal study. The 5th Biennial Schizophrenia International Research Society Conference (SIRS). Florence, Italy. April 2nd-6th. Abstract published in: *npj Schizohprenia-Nature*, 2, 46.

2015

Racioppi, A., Sheinbaum, T., Ballespí, S., Mitjavila, M., Gross, G., Kwapil, T.R., Barrantes-Vidal, N. (2015). Positive and negative schizotypy prediction of prodromal symptoms and schizophrenia-spectrum personality disorder traits: A 3-year prospective study. The 5th European Conference on Schizophrenia Research (ECSR). Berlin, Germany. September 24th-26th. Abstract published in: *European Archives of Psychiatry and Clinical Neuroscience*, 265 (Suppl.1), S116.

8. Presentations at Conferences

Talks and oral communications

2019

Barrantes-Vidal, N., Monsonet, M., **Racioppi, A**., Kwapil, T.R. (2019). The association between social stress with schizotypy traits and psychotic-like experiences in the flow of daily life. Presented as an oral communication at the 7th European Conference on Schizophrenia Research (ECSR) 2019 meeting in Berlin, Germany. September 26th-28th, 2019.

Barrantes-Vidal, N., **Racioppi, A.**, Sheinbaum, T., Ballespí, S., Gross, G. M., Kwapil, T. R. (2019). Psychometric schizotypy predicts prodromal and schizophrenia-spectrum symptoms, psychological measures, and functional adaptation: A 4.4-year longitudinal study. Presented as an oral communication at the International

Consortium for Schizotypy Research (ICSR) 2019 meeting in New Orleans (LA, USA). June 10th-12th, 2019.

Racioppi, A., Sheinbaum, T., Ballespí, S., Gross, G. M., Kwapil, T. R., Barrantes-Vidal, N. (2019). Barcelona Longitudinal Investigation of Schizotypy (BLISS): Predictive Validity of Negative Schizotypy in a Nonclinical Population. Presented as an oral communication at the International Consortium for Schizotypy Research (ICSR) 2019 meeting in New Orleans (LA, USA). June 10th-12th, 2019.

2017

Cristóbal-Narváez, P., Sheinbaum T., Rosa, A., Dominguez-Martinez, T., de Castro-Catala, M., Monsonet, M., Hinojosa, L., **Racioppi, A.**, Peña, E., Kwapil, T. R., Barrantes-Vidal, N. (2017). Impact of Gene-Environment Interaction on the Real-World Expression of Psychosis Risk: Linking Genetic Variation, Early-life and Momentary Experiences. Accepted for presentation as part of a Symposium at the Society for Ambulatory Assessment (SAA 2017) in Luxembourg, 15-17 June 2017.

2016

Barrantes-Vidal, N., Cristóbal-Narváez, P., Sheinbaum T., de Castro-Catala, M., Monsonet, M., Hinojosa, L., **Racioppi, A.**, Dominguez-Martinez, M., Peña, E., Ballespi, S., Rosa, A., T. Kwapil, T.R. (2016). Impact of Childhood Adversity, Genetic Variation, and their Interaction on Psychotic-like Symptoms and Stress Reactivity in Psychometric and Clinical High Risk Samples. Accepted for presentation as part of a symposium at the 10th IEPA Conference Early Intervention in Mental Health. Milan, Italy, October 19th-22th.

2015

Barrantes-Vidal, N., Cristóbal-Narváez, P., Sheinbaum, T., Monsonet, M., **Racioppi, A.**, Chun, C. A., Ballespí, S., Kwapil, T. R. (2015). Ecological phenotypes in schizotypy and clinical high risk. Accepted for presentation as part of a Symposium at the 5th European Conference on Schizophrenia Research. Berlin, Germany, September 24-26.

Posters

2019

Sheinbaum, T., **Racioppi, A.,** Kwapil, T. R., & Barrantes-Vidal, N. (2019). Adult attachment disorganization as a mechanism linking childhood maltreatment with subclinical psychotic phenomena. Poster presentation at the 9th International Attachment Conference. Vancouver, Canada. July 18th-20th, 2019.

Mertens, Y.L., **Racioppi, A.**, Sheinbaum, T., Barrantes-Vidal, N. Dissociation and insecure attachment mediate the effect of emotional abuse on paranoia in the non-clinical psychotic-like phenotype. The 16th Europena Society of Trumatic Stress Studies Conference (ESTSS19). Rotterdam, Netherlands. June 14th- 16th, 2019.

Monsonet, M., Ballespí, S., **Racioppi, A.**, Sheinbaum, T., Valiente, C., Espinosa, R., Kwapil, T.R., Barrantes-Vidal, N. (2019).Implicit and explicit self-esteem discrepancies, and self-schemas in subclinical paranoia: The critical role of depressive symptomatology. International Consortium for Schizotypy Research (ICSR) 2019 meeting in New Orleans (LA, USA). June 10th-12th, 2019.

Racioppi, A., Sheinbaum, T., Ballespí, S., Gross, G. M., Kwapil, T. R., Barrantes-Vidal, N. Predictive validity of positive and negative schizotypy in a non-clinical sample of young adults: A 3-year longitudinal study. International Consortium for

Schizotypy Research (ICSR) 2019 meeting in New Orleans (LA, USA). June 10th-12th, 2019.

2017

Racioppi, A., Sheinbaum, Cristóbal-Narváez, P., T., Ballespí, S., Mitjavila, M., Gross, G., Kwapil, T.R., & Barrantes-Vidal, N. (2017). Positive Schizotypy Predicts Negative Affect, Paranoid and Psychotic-Like Experiences in Daily Life: A Longitudinal ESM Study. Presented at the 5th biennial conference of the 4rd Core Seminar in Mental Health (CORE 2017) in Barcelona, 9 November 2017.

Racioppi, A., Sheinbaum, Cristóbal-Narváez, P., T., Ballespí, S., Mitjavila, M., Gross, G., Kwapil, T.R., & Barrantes-Vidal, N. (2017). Positive Schizotypy Predicts Negative Affect, Paranoid and Psychotic-Like Experiences in Daily Life: A Longitudinal ESM Study. Presented at the 5th biennial conference of the Society for Ambulatory Assessment (SAA 2017) in Luxembourg, 15-17 June 2017.

2016

Gross, G., **Racioppi, A.**, Sheinbaum, T., Ballespí, S., Mitjavila, M., Kwapil, T.R., & Barrantes-Vidal, N. (2016). A Three-year Longitudinal Study of the Predictive Validity of Positive and Negative Schizotypy. Presented at the 2016 meeting of the Society for Research in Psychopathology, Baltimore, MD.

Racioppi, A., Sheinbaum, T., Ballespí, S., Mitjavila, M., Gross, G. M., Kwapil, T. R., Barrantes-Vidal, N. (2016). Positive and negative schizotypy prediction of prodromal symptoms and schizophrenia-spectrum personality disorder traits: A 3-year prospective study. Presented at the 5th Biennial Schizophrenia International Research Society Conference (SIRS). Florence, Italy. April 2nd-6th.

Racioppi, A., Sheinbaum, T., Ballespí, S., Mitjavila, M., Gross, G. M., Kwapil, T. R., Barrantes-Vidal, N. (2016). Psychometric schizotypy predicts prodromal and schizophrenia-spectrum symptoms, psychological measures, and functional adaptation: A 4-year longitudinal study. Presented at the 5th Biennial Schizophrenia International Research Society Conference (SIRS). Florence, Italy. April 2nd-6th.

2015

Racioppi, A., Sheinbaum, T., Ballespí, S., Mitjavila, M., Gross, G., Kwapil, T.R., Barrantes-Vidal, N. (2015). Positive and negative schizotypy prediction of prodromal symptoms and schizophrenia-spectrum personality disorder traits: A 3-year prospective study. Presented at the 5th European Conference on Schizophrenia Research (ECSR). Berlin, Germany. September 24-26th.

9. Attendance to Conferences

III Jornadas Científicas del grupo de excelencia Promoción de la Salud Mental (PROMOSAM) in Madrid, Spain. May 16-17th, 2017.

B-DEBATE, International Center for Scientific Debate Barcelona. "*Early life experiences: vulnerability or resilience*?" in Barcelona, Spain. October 25-26th, 2016.

XII Intensive Course of Introduction to neurosciences: The early origin of adult mental health. Brain development and early stressful conditions in mental health: the mediating role of epigenetic mechanisms and the neuroimaging correlates (CIBERSAM) in Barcelona, Spain. June 2nd, 2016.

II Jornadas Científicas del grupo de excelencia Promoción de la Salud Mental (PROMOSAM) in Zaragoza, Spain. May 17-18th, 2016.

The 5th Biennial Schizophrenia International Research Society Conference (SIRS). Florence, Italy. April 2-6th, 2016.

The 5th European Conference on Schizophrenia Research (ECSR). Berlin, Germany. September 24-26th, 2015.

VII Jornada de Atención al Trastorno Psicótico Incipiente (PAE-TPI). "Salud Mental: Nuevas Tecnologías y Medios de Comunicación". Organized by Fundación Sanitaria Sant Pere Claver y la Comisión Gestora del Programa de Atención Específica en Psicosis Incipiente de Cataluña. Barcelona, Spain. June 12th, 2015.

I Jornadas Científicas del grupo de excelencia Promoción de la Salud Mental (PROMOSAM), Valencia, Spain. May 21-23th, 2015.

I Jornada Científica de la Comunitat de Recerca Estratègica (CORE) en Salut Mental de la UAB, Barcelona, Spain. October 29th, 2014.

XV Simpòsium de La Marató de TV3 sobre "Malaties Mentals", Barcelona, Spain. June 26th, 2014.

Lemanic International Exploratory Workshop on Schizotypy. Universtiy of Geneva (Switzerland). Geneva, Suiza, December 5-7th, 2013.

10. Attendance to Research-related Workshops

Workshop: "La Psicoteràpia Psicoanalítica Focal i Breu des d'una perspectiva clínica". Organized by the Fundació Sant Pere Claver, Barcelona, Spain. January 25th, 2019.

Workshop: "Publicar en accés obert". Organized by the Biblioteca de Ciencies Socials, Universitat Autònoma de Barcelona, Bellaterra, Spain. October 23th, 2018.

Whorkshop: "Les polítiques d'Open Acces / Open Data: Implicacions a la recerca". Organized by the Unitat de Projectes Estratègics Programa de desenvolupament Professional d'Investigadors Àrea de Recerca, Universitat Autònoma de Barcelona, Bellaterra, Spain. September 20th, 2018.

Workshop: "Research on Early Psychosis and Trauma". Organized by Fundació Sanitària Sant Pere Claver and Universitat Autònoma de Barcelona (UAB). Barcelona, Spain. July 25th, 2014.

11. Attendance to Research Seminars

2019

"CBT Therapies and digital Health", Dr. Lucia Valmaggia (King's College-London), Workshop at Universitat Autònoma de Barcelona (UAB). March 25th-26th, Bellaterra, Spain, 2019.

"Using Multilevel Modeling to Analyze Ambulatory Assessment Data" by Dr. Thomas R. Kwapil (University of Illinois at Urbana-Champaign). Organized by the Department of Clinical Psychology at the Universitat Autònoma de Barcelona (UAB). March 18th-19th, Bellaterra, Spain, 2019.

2018

"Borderline Personality disorder and mentalization" by Dr. Carla Sharp (University of Houston, USA). Organized by the Department of Clinical Psychology at the Universitat Autònoma de Barcelona (UAB). December 10th-11th, Bellaterra, Spain, 2018.

"Classification issues in personality pathology with a focus on borderline personality disorder (BPD)" by Dr. Carla Sharp (University of Houston, USA). Organized by the Department of Clinical Psychology at the Universitat Autònoma de Barcelona (UAB). December 10th, Bellaterra, Spain, 2018.

"Psicología Positiva" by Dr. Carmelo Vázquez (Universidad Complutense de Madrid). Organized by the Department of Clinical Psychology at the Universitat Autònoma de Barcelona (UAB). November 26th, Bellaterra, Spain, 2018.

2016

"Body and Self in the Brain: Psychological and Neurological Perspectives" by Dra. Sohee Park (Vanderbilt University-USA). Organized by the Department of Clinical Psychology at the Universitat Autònoma de Barcelona (UAB). April 26-27th, Bellaterra, Spain, 2016.

2015

"Schizophrenia: symptom, course, etiology, pathophysiology, treatment" by Dr. Lieuwe de Haan (University of Amsterdam, UVA). Organized by the Department of Clinical Psychology at the Universitat Autònoma de Barcelona (UAB). November 3-4th, Bellaterra, Spain, 2015.

"Cultural equivalence in psychological assessment & the assessment of emotional competence" by Dr. Johnny Fontaine (Ghent University). Organized by the Department of Clinical Psychology at the Universitat Autònoma de Barcelona (UAB). February 2-3rd, Bellaterra, Spain, 2015.

"Oxytocin and Love" by Dr. Josep Toro Trallero (Hospital Clinic of Barcelona). Organized by the Department of Clinical Psychology at the Universitat Autònoma de Barcelona (UAB). January 21th, Bellaterra, Spain, 2015.