

Latent profile analysis of psychosis liability in a community derived sample adolescents: Links with mental health difficulties, suicidal ideation, bipolar-like experiences, and psychotic-like experiences

Keywords: psychosis; schizotypal; schizotypy; adolescents; risk; latent profile

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Abstract

Aims: The main goal of the present study was to explore the latent structure of schizotypy as an indicator of psychosis liability, in a community-derived sample of adolescents. Links to mental health difficulties, prosocial behavior, suicidal ideation, bipolar-like experiences, and psychotic-like experiences (severity and distress) were compared across schizotypy latent profiles. **Methods:** The present research included 1,588 adolescents selected by a stratified random cluster sampling. The Oviedo Schizotypy Assessment Questionnaire (ESQUIZO-Q), The Paykel Suicide Scale (PSS), The Strengths and Difficulties Questionnaire (SDQ), The Prodromal Questionnaire–Brief (PQ-B), The Penn Matrix Reasoning Test (PMRT), The Family Affluence Scale-II (FAS-II), and The Oviedo Infrequency Scale (INF-OV) were used. **Results:** Using latent profile analysis four latent classes (LC) were identified: “Positive schizotypy” (14.1%, $n=224$), “Low schizotypy” (51.9%, $n=825$), “Social Disorganization schizotypy” (27.2%, $n=432$), and “High schizotypy” (6.7%, $n=107$). The “High schizotypy” class scored higher on several psychometric indicators of psychopathology (i.e., mental health difficulties, suicide ideation, attenuated bipolar experiences, and psychotic-like experiences) relative to the other three latent classes. **Discussions:** Four groups of adolescents with different patterns of schizotypal traits and different clinical-pathological meaning were found. Deficits found across schizotypy latent profiles, resembling those found in patients with psychosis and ultra-high risk samples. The identification of homogeneous subgroups of adolescents potentially at risk for psychosis may help us in the prevention of psychotic-spectrum disorders and mental health problems.

Keywords: psychosis; schizotypal; schizotypy; adolescents; risk; latent profile

Introduction

Schizotypy is defined as a latent personality organization reflecting a putative liability for schizophrenia spectrum disorders (Meehl, 1962), which can be measured by genetic, psychometric, laboratory, or/and clinical indicators (Lenzenweger, 2015). Within the psychosis continuum model, schizotypal traits and psychotic-like experiences (PLEs) are one of the possible phenotypic indicators of this liability at population level (Lenzenweger, 2010). Schizotypy is considered as a multidimensional construct encompassing positive, negative, and disorganized traits. This set of traits are usually stable over time (trait-like approach). PLEs by definition are transitory in nature and tend to disappear over time (symptom-like approach). This phenomena is characterized, in the majority of previous research, by positive experiences (e.g., hallucinatory experiences, suspiciousness, or magical ideation) (Debbané & Barrantes-Vidal, 2015; Fonseca Pedrero & Debbané, 2017; Linscott & van Os, 2013). In particular, previous research has shown that schizotypal traits are a valid putative liability marker for psychotic spectrum disorders. In addition, schizotypy may allow us to capture the behavioural manifestation of distributed multifactorial risk for psychosis at population level as well as to reliable identification of those individuals at high risk for psychosis (e.g., Barrantes-Vidal, Grant, & Kwapil, 2015; Debbané et al., 2015; Linscott & van Os, 2013; Van Os & Reininghaus, 2016).

The presence of schizotypal traits in youth is not a necessary or sufficient condition for the later development of a psychotic disorder or other mental disorder (Debbané et al., 2015; Linscott & van Os, 2013). From the proneness-persistence-impairment model in a small group of adolescents with psychosis

liability such subclinical traits and experiences may, on the one hand, interact synergistically or additively with genetic (e.g., unaffected family members of patients with psychosis), environmental (e.g., trauma, cannabis use), and/or psychological factors (e.g., affective dysregulation, avoidance coping). In addition, this set of psychosis liability experiences, genetic, environmental and psychological factors may causally impact on each other over time in network dynamic interactions, becoming abnormally persistent, help-seeking, and eventually give rise to the transition to a psychotic spectrum disorder and functional impairment (Linscott & van Os, 2013; Van Os & Linscott, 2012; Van Os & Reininghaus, 2016).

Previous factorial studies have demonstrated that schizotypy is a multidimensional construct in nature, composed basically of three factors (Cognitive-Perceptual, Interpersonal, and Disorganization), phenotypically similar to that found in patients with psychosis (e.g., positive, negative and disorganization symptoms) (Fonseca-Pedrero, Debbané, et al., 2018). Just as schizophrenia is phenotypically heterogeneous, encompassing a broad range of emotional, cognitive, perceptual, social and behavioural functions, schizotypy involves a diverse set of traits from different psychological systems (Cohen, Mohr, Ettinger, Chan, & Park, 2015). However, factorial studies are based on the idea of analyzing patterns of relations between variables and not on the identification of classes or groups of individuals. That is, finding homogenous groups of individuals potentially at risk for psychosis based on the psychotic-spectrum phenomena reported both at clinical and subclinical levels. In fact, one of the main goals in the schizotypy and clinical high risk arena is to enhance the early and reliable identification for youths at heightened risk for serious mental

disorders, prior to clinical transition (Barrantes-Vidal et al., 2015; Fusar-Poli et al., 2014).

A novel mixture model named latent class analysis (LCA) (dichotomous outcome) or the latent profile analysis (LPA) (continuous outcome) could be used to this endeavour. These psychometric techniques allow us to reduce a large number of continuous or categorical variables to a few subgroups. The idea of identifying latent classes of individuals is congruent with the schizotaxia-schizotypy Meehl's (1962) model and with the empirical evidence that discontinuous latent subpopulations may underlie the phenotypic continuum of extended psychosis phenotype (Lenzenweger, 2018; Linscott & van Os, 2010; Morton et al., 2017).

Previous studies have examined the latent structure across the psychosis phenotype such as psychotic symptoms (Kendler, Karkowski, & Walsh, 1998; Pignon et al., 2018), schizotypal personality disorder (Fossati et al., 2001), subclinical psychosis symptoms (Ryan et al., 2017; Valmaggia, Stahl, Yung, Nelson, & McGorry, 2011), PLEs (Ahmed, Buckley, & Mabe, 2012; Cella, Sisti, Rocchi, & Preti, 2011; Gale, Wells, McGee, & Oakley Browne, 2011; Shevlin, Murphy, Dorahy, & Adamson, 2007), and schizotypal traits (Cella et al., 2013; Denovan et al., 2018; Fonseca-Pedrero et al., 2016a; Fonseca-Pedrero et al., 2017c; Hori et al., 2014; Tabak and Weisman de Mamani, 2013; Wang et al., 2017). In particular, adolescence as a development stage where these kind of analyses, prior to the development of the first psychotic symptoms, may be relevant with the aim to identify the true liability subgroups and to implement early detection and intervention strategies. For instance, Cella et al. (2013) for example, uses a large sample of non-clinical adolescents, through the

dimensions of the short Oxford-Liverpool Inventory of Feelings and Experiences (sO-LIFE). Three classes were found: low schizotypy, unusual subjective experiences, and true schizotypy. The adolescents in the true schizotypy latent class reported more psychological distress and family history of psychosis relative to other classes. Fonseca-Pedrero et al., (2016a) using a LPA in a convenience sample of adolescents, identified six latent classes: no risk (asymptomatic), low mean scores with some distress, positive schizotypy, psychosis high-risk group, positive and negative schizotypy, and distress and severe clinical high-risk. These results address the question of whether it is possible to identify a homogenous subgroup of schizotypes from the adolescent general population, as well as if those potentially at high risk for psychosis are a true psychosis liability group.

The study of schizotypy during adolescence is a relatively recent field that needs to be the object of more exhaustive and systematic research. A wide variety of issues still remain to be resolved in schizotypy research from a developmental framework. For instance, the latent structure of schizotypy in the adolescent population has not been clearly delimited and analyzed. To date, very little is known about the latent structure of schizotypy in representative samples of adolescents where this liability is measured with a specific tool developed to assess the construct at this stage of development. Likewise, there has been no in-depth examination about the relationship between schizotypy latent classes and its links with other psychological and clinical psychometric indicators. It is necessary to gain a deeper understanding in the identification of psychosis liability groups at population level and its links with psychopathology. This research may allow us to improve our knowledge about tentative etiological

mechanisms as well as risk and protective factors in order to develop prevention strategies (Arango et al., 2018). Reliable identification of individuals at-high risk and timely prophylactic intervention may delay, ameliorate, or prevent the onset of frank psychotic symptoms, as well as reduce its possible impact on many levels (Barrantes-Vidal, et al., 2015; Fusar-Poli et al., 2014).

Within this research framework, the main goal of the present study was to explore the latent structure of schizotypy in a representative sample of adolescents from the general population. Moreover, associations with mental health difficulties (emotional symptoms, conduct problems, hyperactivity, and peer problems), prosocial behavior, bipolar-like experiences, suicide ideation, and psychotic like experiences (severity and distress) across latent schizotypy classes were compared in order to validate them. We hypothesized that four latent classes of psychosis liability will be found during adolescence. In addition, those theoretically at high risk for psychosis would show more deficits across all psychopathology indicators relative to non-risk groups.

Method

Participants

Stratified random cluster sampling was conducted at the classroom level, in an approximate population of 15,000 students selected from a region located in northern Spain. The students were from various public and state-subsidized secondary schools and vocational training centres, as well as from a range of socio-economic levels. The strata were created on the basis of geographical zone (East, West, and Centre) and educational stage (compulsory – to age 16 – and

post-compulsory), where likelihood of inclusion depended on the number of students in the school.

The initial sample consisted of 1,881 students, eliminating those participants who presented a high score on the Oviedo Infrequency Response Scale (more than 3 points) ($n=104$), an age older than 19 ($n=170$) or did not complete the test ($n=76$). A total of 1,588 students, 739 men (46.5%) and 849 (53.5%) women, belonging to 34 schools and 98 classrooms participated in the study. The mean age was 16.13 years ($SD=1.36$), ranging from age 14 to 19 years (14 years, $n=213$; 15 years, $n=337$; 16 years, $n=400$; 17 years, $n=382$, 18 years, $n=180$; 19 years, $n=76$).

The distribution of nationality of the participants was as follows: 89.9% Spanish, 3.7% Latin American (Bolivia, Argentina, Colombia, and Ecuador), 0.7% Portuguese, 2.4% Romanian, 1% Moroccan, 0.7% Pakistani, and 2% other nationalities.

Instruments

The Oviedo Schizotypy Assessment Questionnaire-Revisited (ESQUIZO-Qr) (Fonseca-Pedrero, Muñiz, Lemos-Giráldez, Paino, & Villazón-García, 2010). The ESQUIZO-Qr is a self-report measure developed for the assessment of schizotypal traits in adolescents. This revised version comprises a total of 62 items with Likert type response format in five categories (from 1 “totally disagree” to 5 “totally agree”). Its 10 subscales are derived empirically by means of factor analysis, which in turn are grouped into three general dimensions: Reality Distortion (e.g., Ideas of Reference, Magical Thinking, Unusual Perceptual Experiences, and Paranoid Ideation), Anhedonia (Physical Anhedonia and Social

Anhedonia), and Social Disorganization (Odd Thinking and Speech, Odd Behaviour, Lack of Close Friends, and Excessive Social Anxiety). Internal consistency levels for the subscales ranged from 0.62 to 0.90. In addition, several sources of validity evidence with other psychopathology measures were gathered (e.g., depression, schizotypal traits, personality disorders, emotional problems) (Fonseca-Pedrero et al., 2010; 2011; 2016).

The Paykel Suicide Scale (PSS) (Paykel, Myers, Lindenthal, & Tanner, 1974). The PSS is a self-report tool designed for the evaluation of suicidal ideation. It consists of a total of 5 items with a dichotomous response system Yes / No (score, 1 and 0, respectively). The scores range from 0 to 5. The time frame to which the questions refer is the last year. Higher scores are related with high severity on suicidal ideation. The Spanish adaptation of the PSS has demonstrated adequate psychometric properties (Bousoño et al., 2017; Fonseca-Pedrero, Inchausti, et al., 2018).

The Mood Disorder Questionnaire (MDQ) (Hirschfeld et al., 2000). The MDQ consists of 13 yes/no items based on the DSM-IV criteria for bipolar disorder. A result is considered positive if the participant replies affirmatively to 7 or more items of the 13 proposed and if, in addition, the symptoms described occurred during the same time period (Criterion 2) and represented moderate or severe problems (Criterion 3). In this study, we used the Spanish version validated in adolescents and young adults (Fonseca-Pedrero, Ortuno-Sierra, Paino, & Muniz, 2016).

The Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997). The SDQ is a self-report questionnaire that is widely used for the assessment of different emotional and behavioural difficulties related to mental health in

adolescents. The SDQ is made up of a total of 25 statements distributed across five subscales: Emotional symptoms, Conduct problems, Hyperactivity, Peer problems, and Prosocial behaviour. The first four subscales yield a Total difficulties score. In this study we used a Likert-type response format with three options (0 = “Not true”, 1 = “Somewhat true”, 2 = “Certainly true”). The validated Spanish version of the SDQ was used in the present study (Ortuño-Sierra, Chocarro, Fonseca-Pedrero, Riba, & Muñiz, 2015).

The Prodromal Questionnaire–Brief (PQ-B) (Loewy, Pearson, Vinogradov, Bearden, & Cannon, 2011). The PQ-B is a psychosis-risk screening measure containing 21-items that are answered in a dichotomous response format (true/false). The PQ-B asks additional questions regarding frequency/severity of impairment and distress, rated on a Likert-type (1 “strongly disagree” to 5 “strongly agree”) scales ranging from *no* to *always*. The Spanish adaptation of the PQ-B has demonstrated adequate psychometric properties (Fonseca-Pedrero et al., 2016).

The Penn Matrix Reasoning Test (PMRT) (Gur et al., 2012; Moore, Reise, Gur, Hakonarson, & Gur, 2015). This is a task of the Penn Computerized Neurocognitive Battery-Child version developed to measure non-verbal reasoning (using matrix reasoning problems as used in the Raven’s Progressive Matrices Test), within complex cognition domain. This task composed by 20 items may be considered as estimated IQ. The battery includes different neurobehavioural indicators with different tasks adapted to guarantee psychometric properties and its linkage to brain systems for children (Gur et al., 2012; Moore et al., 2015).

The Family Affluence Scale-II (FAS-II) (Boyce, Torsheim, Currie, & Zambon, 2006). Socioeconomic status was measured using a 4-item child-

appropriate measure of family wealth with scores ranging from 0 to 9. Previous international studies have demonstrated its adequate psychometric properties (Boyce et al., 2006).

The Oviedo Infrequency Scale (INF-OV) (Fonseca-Pedrero, Lemos-Giráldez, Paino, Villazón-García, & Muñiz, 2009). INF-OV was administered to the participants to detect those who responded in a random, pseudorandom or dishonest manner. The INF-OV instrument is a self-report composed of 12 items in a 5-point Likert- scale format (1 = completely disagree; 5 = completely agree). Students with more than three incorrect responses on the INF-OV scale were eliminated from the sample.

Procedure

The research was approved by the Educational Government of La Rioja and the Ethical Committee of Clinical Research of La Rioja (CEICLAR). The tests and neurocognitive battery were administered collectively, through personal computers, in groups of 10 to 30 students, during normal school hours and in a classroom specially prepared for this purpose. Administration took place under the supervision of the researchers trained in a standard protocol. No incentive was provided for their participation. For participants under 18, parents were asked to provide a written informed consent in order for their child to participate in the study. Participants were informed of the confidentiality of their responses and of the voluntary nature of the study.

Data analyses

First, we calculated descriptive statistics for the measures. Second, Pearson correlation coefficients between ESQUIZO-Qr, PSS, SDQ, MDQ, and PQ-B were conducted.

Third, in order to test for the existence of discrete groups (classes) with similar psychometric profiles, we conducted a latent profile analysis (LPA) using ESQUIZO-Qr subscales, transformed in z scores. In the present study we have decided to use the ESQUIZO-Qr, instead of the PQ-B, for the following reasons: a) schizotypy is considered as a multidimensional structure to encompass positive, negative and disorganized traits, however, PQ-B only taps into positive psychotic-like experiences). Considering this limitation, we benefit further from a tool which is able to capture the behavioural manifestation of distributed multifactorial risks for psychosis at population level; and b) ESQUIZO-Qr was developed specifically to measure these set of traits in adolescents from the general population, and PQ-B was developed originally to measure PLEs in adult population. Thus, ESQUIZO-Qr, is seen to be an adequate measure to test our main goal in the present study.

In LPA, models are compared to determine the optimal number of classes (i.e., class enumeration), beginning with evaluating the fit of a 1-class model and incrementally adding latent classes until the best class solution has been satisfied. Model selection is based upon consideration of several fit indices including information criteria and likelihood ratios. In terms of the information criteria such as the Akaike Information Criterion (AIC) (Akaike, 1987), the Bayesian Information Criterion (BIC) (Schwarz, 1978), and the sample-size adjusted BIC (ssaBIC) (Sciove, 1987) information criterion statistics, lower

values indicate a better fit. We considered the Lo-Mendell-Rubin's adjusted likelihood ratio test (LRT) (Lo, Mendell, & Rubin, 2001). The likelihood ratios of the $k-1$ and k class models test the null hypothesis that there is no statistically significant difference. Thus, a $p < 0.05$ suggests that the k class model is a better fitting model than the $k-1$ class model while a $p > 0.05$ suggests that $k-1$ class solution is preferred in terms of accurately reflecting the data. We can further assess whether we have chosen the right number of classes using the bootstrapped parametric likelihood ratio test. Standardized measure of entropy was also computed. The entropy measure (values ranging from 0 to 1) assess relative accuracy in participants' classification, with higher values indicating better separation of the identified groups (Ramaswamy, DeSarbo, Reibstein, & Robinson, 1993).

Fourth, after determining the best latent class solution, the effect of latent classes membership on the the SDQ, PSS, MDQ, and PQ-B (frequency and distress) scores were analyzed using multivariate analysis of covariance (MANCOVA), where gender, estimated IQ, and socio-economic status were used as covariates, based on previous results showing that gender is significantly associated with schizotypal traits as well as psychopathology indicators. Partial eta squared (η^2) was used as index of effect size.

SPSS 22.0 (IBM Corp Released, 2013) and Mplus 7.4 (Muthén and Muthén, 1998-2015) were used for these analyses.

Results

Descriptive statistics and Pearson correlation between measures

Table 1 shows the descriptive statistics of the measures. As shown in Table 2, most of the correlations between ESQUIZO-Qr subscales and SDQ subscales, MDQ, PQ-B, and PSS total scores were statistically significant ($p < 0.05$). Positive schizotypal traits were associated with psychotic-like experiences (frequency and distress). Social anhedonia traits were associated with peer problems. Social Disorganization traits were strongly associated with psychotic-like experiences, peer problems, and emotional symptoms. Prosocial behavior of SDQ was negatively associated with schizotypal traits.

-----Insert Tables 1 and 2 about here -----

Latent profile analyses of schizotypy: Identification

We computed five latent profile solutions. Table 3 provides the goodness-of-fit indices for the competing latent profile models of schizotypy performed. In all solutions the entropy value was < 0.90 . First, the LMR-A p value for the 2-class model indicated significant improvement over the 1-class model. A comparison of 2-class and 3-class solutions revealed that the 3-class solution was superior, due to lower AIC, BIC, ssaBIC statistics and a significant LMR-A-LRT p -value. Next, the 4-class model showed nonsignificant LMR-A p value and also it demonstrated a lower AIC, BIC and ssaBIC than the 2-class and 3 class-competing models. However, 4-class model showed the low entropy value relative to the 2- and 3-class models. The 5-class model showed nonsignificant LMR-A p value and the lowest entropy value. Thus, hence, there was no further consideration of other latent profile solutions. We opted to rely more heavily upon the Bayesian information criterion than the LMR-A-LRT p value.

As a result, we chose the 4-class model as the better-fitting one. In the 4-class solution, class 1 (LC1) described 14.1% ($n=224$), class 2 (LC2) 51.9% ($n=825$), class 3 (LC3) 27.2% ($n=432$), and class 4 (LC4) 6.7% ($n=107$) of the adolescents. The average class membership for class 1, class 2, class 3, and class 4, was 0.88, 0.94, 0.85, and 0.94, respectively, indicating good overall discrimination.

Figure 1 illustrates the profile of schizotypy facets for this latent profile solution. Class 1 members showed high scores on positive schizotypy (Magical Thinking, Ideas of Reference, and Unusual perceptual experiences) and was named “positive schizotypy group”. Participants in Class 2 displayed low scores across all schizotypy facets and were denominated “low schizotypy group”. Participants in Class 3 displayed higher scores on Social Anhedonia, No close Friends, Odd Behavior and Speech, and Excessive Social Anxiety features; we identified this class as the “Social Disorganization schizotypy group”. Class 4 members showed high scores on all schizotypy domains. We identified as “High schizotypy group”. No statistical significant differences were found by age ($F_{(3, 1587)} = 2.070$; $p=0.102$) nor by gender ($\chi^2_{(3)} = 0.441$; $p=0.934$) across latent classes.

-----Insert Table 3 and Figure 1 about here -----

Validation of the schizotypy latent classes

In order to validate the four schizotypy latent profiles a MANCOVA was carried out. Gender, age, estimated IQ, and socio-economic status were used as covariates. The MANCOVA revealed a significant overall main effect for latent

class group [Wilk's $\lambda = 0.405$, $F_{(27, 4591.7)} = 61,679$; $p < 0.001$]. Table 4 depicts the mean and standard deviation as well p -values and effect sizes for 4-latent profile solution. Small, moderate, and large effect sizes were found. The four latent profiles showed different patterns of associations with psychotic-like experiences, mental health difficulties, suicide ideation, and bipolar-like experiences. Particularly, "high schizotypy group" showed higher mean scores, relative to other 3 latent classes, across all domains measured, particularly in the severity and distress of the psychotic-like experiences (e.g., large effect sizes).

-----Insert Table 4 about here -----

Discussion and Conclusions

In this study we have aimed to identify homogenous groups of adolescents with different patterns of schizotypal traits and analyzed their associations with mental health difficulties, prosocial behavior, suicidal ideation, bipolar-like experiences, and psychotic-like experiences. Similar to those studies conducted with psychotic symptoms (Gale et al., 2011), mixture modelling like latent profile analysis (LPA) can help characterize patterns of multidimensional psychosis proneness by identifying similar subgroups from heterogeneous populations that probabilistically share a common set of specific schizotypal traits.

The best fit was obtained with a four-class solution, including the following: "Positive schizotypy" (14.1%), "Low schizotypy" (51.9%), "Social Disorganization schizotypy" (27.2%), and "High schizotypy" (6.7%). The psychosis liability at population level may actually correspond to four subgroups characterized by different patterns of schizotypal traits. It is relevant to note that schizotypy, as a

multidimensional and complex construct, allow us to identify these subgroups and to take into account the multiple expression of the psychosis phenotype (positive, negative, and disorganization) rather than only the positive dimension of this phenotype) (Pignon et al., 2018). Previous studies have examined the latent structure across all psychotic spectrum such as psychotic symptoms (Kendler et al., 1998; Pignon et al., 2018), schizotypal personality disorder (Fossati et al., 2001), subclinical psychosis symptoms (Ryan et al., 2017; Valmaggia et al., 2011), PLEs (Ahmed et al., 2012; Cella et al., 2011; Gale et al., 2011; Shevlin et al., 2007), and schizotypal traits (Cella et al., 2013; Denovan et al., 2018; Fonseca-Pedrero et al., 2016a; Fonseca-Pedrero et al., 2017c; Hori et al., 2014; Tabak and Weisman de Mamani, 2013; Wang et al., 2017). Although there is heterogeneity in the measures used and the nature of the samples, previous studies conducted in adolescent population are clearly convergent with the results found in this study. For instance, Cella et al. (2013), through the sO-LIFE and a sample of adolescents, reported three-classes (low schizotypy, an unusual subjective experiences, and true schizotypy) similar to those found in the present research. In another study, Barrantes-Vidal et al. (2002) using a cluster analyses in a Spanish adolescents sample found 4 subgroups named “Negative schizotypy”, “High or mixed schizotypy”, “Positive schizotypy”, and “Normal scorers”. Similar results were found when latent class of schizotypy was analyzed in young adults. For instance, Fonseca-Pedrero et al. (2017), using the SPQ brief revised in a sample of adolescents and young adults, identified four latent classes: low schizotypy, average schizotypy, interpersonal schizotypy, and high schizotypy.

Another important issue involves the clinical implications of these homogeneous groups of psychosis liability. First, the literature on schizotypy suggest that anhedonia is the most consistently found predictor of conversion to psychosis (Debbané, et al., 2015; Flückiger, et al., 2016; Radua et al., 2018); thus it could be hypothesized that, in a longitudinal study, the “Social Disorganization schizotypy” group would entail higher conversion rates than the other groups. Second, the “High schizotypy” group may have a higher risk for other forms of psychopathology, within *P* factor model (Caspi et al., 2014; Wright et al., 2016). In fact, this group may just be a reflection of a subgroup that is high in psychopathology in general and not as a “true schizotypy” group. These findings allow us to reconcile a general psychopathology and schizotypy approach. Third, based on previous research (e.g., Debbané et al., 2015; Fusar-Poli et al., 2012; 2014), the group named “positive schizotypy” scored higher on positive psychotic-like experiences could be viewed as potential indicators of a susceptibility to psychotic disorders.

Across schizotypy latent profiles, different deficits were found, resembling those found in patients with psychosis and high risk samples (e.g. Fusar-Poli et al., 2014). The schizotypy classes found have demonstrated different clinical-pathological meanings. Adolescents of the “high schizotypy” latent class scored higher on all psychometric indicators of psychopathology, such as mental health difficulties (e.g., emotional symptoms), suicide behaviour (tentative and ideation), bipolar-like experiences, and psychotic-like experiences (frequency and distress), relative to other three latent classes. Similar results were found in previous studies in both adolescent and young adults when the latent structure of schizotypy was analyzed. For instance, Cella et al. (2013), demonstrated that

those adolescents in the “True schizotypy” latent class reported more psychological distress and a family history of psychosis relative to other classes. In another study, Barrantes-Vidal et al. (2002) found that “High schizotypes” performed poorly on neurocognition and obtained the highest teacher ratings of behavioural problems. In young adults, Fonseca-Pedrero et al. (2017) found that the “High schizotypy” class scored higher on mental distress, hypomanic experiences, and anticipatory and consummatory pleasure relative to non-risk latent classes. It is relevant to note that those subgroups of participants potentially at high risk for psychosis, plus suicide ideation, affective symptoms, and/or distressing PLEs may require attention; for instance, could benefit from further comprehensive assessments (e.g., clinical interview) in order to analyze their mental health status and developmental trajectories as well as to implement prophylactic preventive interventions (Arango, et al., 2018; McGorry, Hartmann, Spooner, & Nelson, 2018). It would be particularly relevant to detect those adolescents at risk of suicide behavior, due to the personal, clinical and societal implications involved. Previous studies have demonstrated that adolescents with psychopathology who report psychotic symptoms are at clinical high risk for suicide attempts (Kelleher et al., 2013).

It is worth noting that these findings are congruent with the notion that transdiagnostic psychosis spectrum encompass both non-affective and affective psychotic experiences at both clinical and subclinical levels (Van Os & Reininghaus, 2016). Here, those individuals at risk for psychosis have also shown deficits at affective level. In addition, it is necessary to understand these results within the proneness-persistence-impairment model of psychotic disorder. From this model the transitory developmental expression of psychosis may become

abnormally persistent, distressing, and subsequently clinically relevant, depending on the interaction with other genetic (e.g., polymorphisms), environmental (e.g., cannabis use, trauma, urbanicity), and psychological factors (e.g. avoided coping, affective dysregulation) (Linscott & van Os, 2013; Van Os & Reininghaus, 2016).

Elucidating schizotypal traits prior to clinical outcome is important if we are to understand the various manifestations of psychosis spectrum liability and to reliably identify individuals at high-risk for psychosis. Schizotypy allows us to study these patterns without the effects commonly associated with patients with schizophrenia (e.g., medication, iatrogenic effects) and from a developmental perspective. Membership in the schizotypy class during adolescence or young adulthood could be a sensitive and specific predictor of the emergence of psychosis-spectrum disorders in adulthood (Tyrka et al., 1995). The reliable identification of true schizotypy individuals and their psychopathological meaning, may provide a window to the prevention of those at heightened risk for psychosis spectrum disorders as well as other forms of psychopathology (Arango et al., 2018). In addition, the results indicated that identification of specific subgroup of psychosis liability in combination with other psychopathology indicators could be used in samples of the general population in a two-stage process model or in a close-in strategy. Thus, combining psychosis liability subgroups and multiple psychopathology variables and risk indicators may improve our predictive power and prognosis.

Some limitations of this study should be acknowledged. First, adolescence is a developmental period in which the brain, cognition, and personality are still consolidating. Second, participants (adolescents) above 16 years old are not

obliged to continue with the compulsory educational system; this group may therefore not be representative of the general adolescent population. Although we carried out a stratified random sampling, this fact could affect the representativeness of the adolescent sample. Third, relevant factors in the prediction of psychosis, such as trauma, cannabis, or bullying were not included in the present study. Fourth, we only investigated the psychosis risk through self-report screening measures. These measures have been associated with stigmatization and negative labelling. There is an inherent problem in the use of self-reports as indirect indicators of this phenomena (e.g., acquiescence) (Suárez, Pedrosa, Lozano, García-Cueto, Cuesta, & Muñiz, 2018). Finally, it should be borne in mind that this study was of a cross-sectional nature, so that we cannot make cause-effect inferences.

In summary, the current research provides support for four latent psychosis liability classes (Positive schizotypy, Low schizotypy, Social Disorganization schizotypy, and High schizotypy) derived from a large sample of adolescents from the general population. Those considered tentative as high schizotypy class scored higher on internalization and externalization problems, suicide ideation, bipolar-like experiences, and psychotic-like experiences relative to other latent classes.

Future studies should improve the strategies of early identification of homogeneous subgroups of individuals potentially at risk for psychosis. This would help us in the prevention of psychotic-spectrum disorders and mental health problems. For instance, it would be interesting to conduct follow up studies to determine the predictive validity or to conduct new studies using multiple indicators from multiple level of analyses (e.g., genetic, neuroimagen,

neurocognitive, etc.), new methodologies like ambulatory assessment and conceptual approaches like network or dynamic system theory.

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Table 1

Descriptive statistics of the measures

	Mean	SD	Skewness	Kurtosis
ESQUIZO-Qr				
Ideas of Reference	6.74	2.90	1.16	1.13
Magical Thinking	8.29	3.32	1.26	1.80
Unusual Perceptual Experiences	11.00	4.97	1.69	2.89
Odd Thinking and Speech	15.25	5.08	0.25	-0.42
Paranoid ideation	8.38	3.56	1.28	1.68
Physical Anhedonia	16.36	4.06	0.23	-0.33
Social Anhedonia	17.30	4.59	0.92	1.09
Odd Behaviour	7.64	3.03	1.11	1.24
Lack of Close Friends	10.07	3.90	0.30	-0.58
Excessive Social Anxiety	17.23	5.74	0.44	-0.07
PQ-B Frequency	6.03	4.39	0.62	-0.28
PQ-B Distress	11.10	11.47	1.64	3.48
MDQ	5.03	2.83	0.14	-0.61
PSS	0.90	1.33	1.42	1.01
SDQ Emotional problems	3.54	2.45	0.50	-0.53
SDQ Behavioural problems	2.00	1.68	0.96	1.00
SDQ Peer problems	1.54	1.57	1.33	1.97
SDQ Hiperactivity	4.33	2.18	0.10	-0.49
SDQ Prosocial behaviour	8.56	1.49	-1.31	2.01
PMRT	5.37	4.51	0.35	-0.96
FAS-III	6.14	1.69	-0.27	-0.38

Note. ESQUIZO-Qr= The Oviedo Schizotypy Assessment Questionnaire-Revised; PQ-B=Prodromal Questionnaire-Brief; PSS= The Paykel Suicide Scale; SDQ= The Strengths and Difficulties Questionnaire; MDQ= The Mood Disorder Questionnaire; PMRT= The Penn Matrix Reasoning Test; FAS-II= The Family Affluence Scale-II.

Table 2

Pearson's correlations between measures

ESQUIZO-Qr	PQ-B Frequency	PQ-B Distress	MDQ	PSS	SDQ Emotional	SDQ Behavioral	SDQ Peer problems	SDQ Hiperactivity	SDQ Prosocial
Ideas of Reference	.497**	.472**	.309**	.233**	.235**	.254**	.244**	.163**	-0.035
Magical Thinking	.475**	.478**	.232**	.277**	.269**	.260**	.187**	.209**	-.078**
Unusual Perceptual Experiences	.638**	.634**	.304**	.405**	.343**	.328**	.329**	.254**	-.142**
Odd Thinking and Speech	.487**	.465**	.348**	.361**	.455**	.320**	.275**	.552**	-.155**
Paranoid ideation	.461**	.472**	.290**	.365**	.344**	.411**	.465**	.237**	-.204**
Physical Anhedonia	-.125**	-.074**	-.065**	-0.011	-.070**	.095**	-0.01	0.03	-.212**
Social Anhedonia	.278**	.290**	.079**	.323**	.273**	.207**	.498**	.096**	-.402**
Odd Behaviour	.467**	.432**	.238**	.348**	.333**	.259**	.508**	.195**	-.179**
Lack of Close Friends	.352**	.353**	.259**	.401**	.404**	.232**	.413**	.175**	-.161**
Excessive Social Anxiety	.323**	.307**	.124**	.243**	.518**	.083**	.331**	.159**	-.099**

** $p < .01$

Note. ESQUIZO-Qr= The Oviedo Schizotypy Assessment Questionnaire-Revised; PQ-B= The Prodromal Questionnaire-Brief; PSS= The Paykel Suicide Scale; SDQ= The Strengths and Difficulties Questionnaire; MDQ=The Mood Disorder Questionnaire; PMRT= The Penn Matrix Reasoning Test; FAS-II= The Family Affluence Scale-II

Table 3

Goodness-of-fit statistics for the latent profile solutions

Model	Log-likelihood	AIC	BIC	ssaBIC	Entropy	LMR-A	LMR-A p
1	-22527.74	45095.49	45202.89	45139.35	-	-	-
2	-20936.28	41934.57	42101.05	42002.57	0.873	3144.13	0.001
3	-20410.41	40904.82	41130.37	40996.95	0.841	1038.92	0.003
4	-20153.40	40412.81	40697.43	40529.06	0.833	507.76	0.004
5	-19982.55	40093.11	40436.81	40233.50	0.830	337.52	0.094

Note. AIC= Akaike information criterion; BIC= Bayesian information criterion; ssaBIC= sample-size adjusted BIC; LMR-A= Lo-Mendell-Rubin-adjusted likelihood ratio test.

Table 4

Mean comparisons across schizotypy latent classes

	LC1 (n=224)		LC2 (n=825)		LC3 (n=432)		LC4 (n=107)		<i>F</i>	<i>p</i>	<i>Partial η²</i>	<i>Post hoc comparisons</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
PQ-B Frequency	9.49	3.95	3.79	3.09	6.78	3.59	12.93	3.86	349.545	<0.001	0.399	Between all groups
PQ-B Distress	18.61	11.10	5.78	6.70	12.23	9.65	31.83	14.35	345.39	<0.001	0.396	Between all groups
MDQ	6.32	2.48	4.28	2.69	5.29	2.78	7.02	2.61	59.861	<0.001	0.102	1>2,1<4; 2<1,3,4; 3<1,4, 3>2; 4>1,2,3
PSS	1.24	1.42	0.40	0.84	1.22	1.43	2.69	1.64	143.885	<0.001	0.215	1>2,1<4; 2<1,3,4; 3<1,4, 3>2; 4>1,2,3
SDQ Emotional problems	4.28	2.28	2.52	2.03	4.49	2.36	5.93	2.45	147.116	<0.001	0.218	1>2,1<4; 2<1,3,4; 3<4, 3>2; 4>1,2,3
SDQ Behavioural problems	2.43	1.58	1.49	1.39	2.31	1.70	3.78	2.01	91.436	<0.001	0.148	1>2,1<4; 2<1,3,4; 3<4, 3>2; 4>1,2,3
SDQ Peer problems	1.58	1.32	0.88	1.00	2.24	1.68	3.68	1.94	187.306	<0.001	0.262	All groups
SDQ Hiperactivity	5.04	1.97	3.75	2.05	4.75	2.19	5.67	2.11	53.056	<0.001	0.092	Between all groups, except 1-3
SDQ Prosocial behaviour	8.67	1.41	8.87	1.31	8.15	1.51	7.66	2.08	38.924	<0.001	0.069	Between all groups, except 1-2

Note. LC= Latent class; M=Mean; SD= Standard deviation; ESQUIZO-Qr= The Oviedo Schizotypy Assessment Questionnaire-Revised; PQ-B= The Prodromal Questionnaire-Brief; PSS= The Paykel Suicide Scale; SDQ= The Strengths and Difficulties Questionnaire; MDQ=The Mood Disorder Questionnaire; PMRT= The Penn Matrix Reasoning Test; FAS-II= The Family Affluence Scale-II

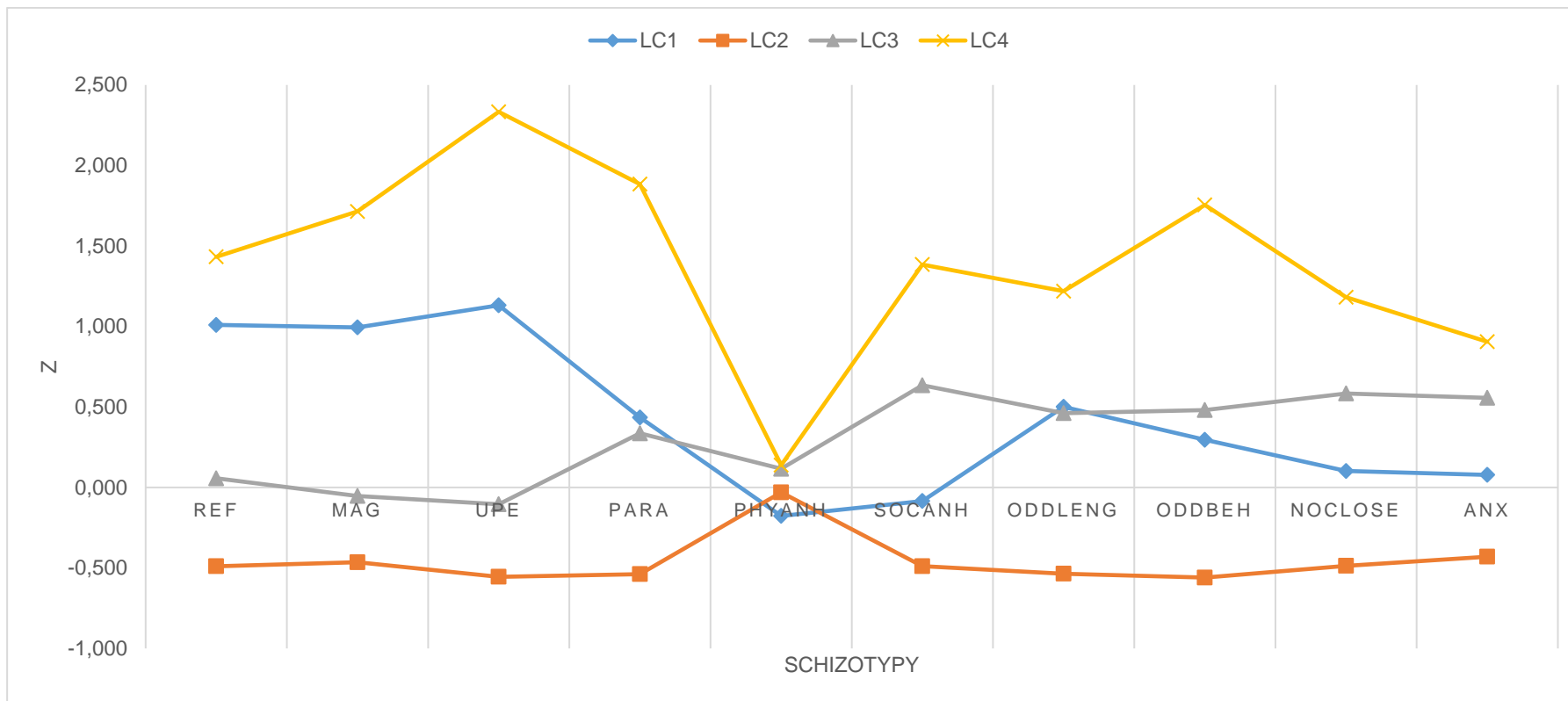


Figure 1. Latent Profile Analysis of schizotypy: four latent classes.

Note. REF=Ideas of Reference; MAG= Magical Thinking; UPE= Unusual Perceptual Experiences; PARA= Paranoid Ideation or Suspiciousness; PHYANH= Physical Anhedonia; SOCANH= Social Anhedonia; NOCLOSE= No Close Friends; ODDBEH= Odd Behavior; ODDLENG=Odd Speech and Thinking. ANX= Excessive Social Anxiety.

