



## Assessing sub-clinical psychosis phenotypes in the general population – A multidimensional approach



Wulf Rössler<sup>a,b,c,\*</sup>, Vladeta Ajdacic-Gross<sup>a,c</sup>, Mario Müller<sup>a,c</sup>, Stephanie Rodgers<sup>a,c</sup>, Helene Haker<sup>d</sup>, Michael P. Hengartner<sup>c,e</sup>

<sup>a</sup> Department of Psychiatry, Psychotherapy and Psychosomatics, Psychiatric Hospital, University of Zurich, Switzerland

<sup>b</sup> Institute of Psychiatry, Laboratory of Neuroscience (LIM 27), University of Sao Paulo, Brazil

<sup>c</sup> Zurich Programme for Sustainable Development of Mental Health Services, Zurich, Switzerland

<sup>d</sup> Translational Neuromodeling Unit, Institute for Biomedical Engineering, University of Zurich & ETH, Zurich, Switzerland

<sup>e</sup> Department of Applied Psychology, Zurich University of Applied Sciences (ZHAW), Zurich, Switzerland

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### ABSTRACT

Several studies have demonstrated that expression of a psychosis phenotype can be observed below the threshold of its clinical detection. To date, however, no conceptual certainty has been reported for the validity and reliability of sub-clinical psychosis. Our main objectives were to assess the prevalence rates and severity of various psychosis symptoms in a representative community sample. Furthermore, we wanted to analyze which latent factors are depicted by several currently used psychosis questionnaires. We also examined how those latent factors for sub-clinical psychosis are linked to psychosocial factors, normal personality traits, and coping abilities related to chronic stress.

Most of the eight subscales from the Paranoia Checklist and the Structured Interview for Assessing Perceptual Anomalies had a very similar type of distribution, i.e., an inverse Gaussian (Wald) distribution. This supported the notion of a continuity of psychotic symptoms, which we would expect to find for continuously distributed symptoms within the general population. Sub-clinical psychosis can be reduced to two different factors – one representing odd beliefs about the world and odd behavior, and the other one representing anomalous perceptions (such as hallucinations). Persons with odd beliefs and behavior are under greater burden and more susceptible to psychosocial risks than are persons with anomalous perceptions. These sub-clinical psychosis syndromes are also related to stable personality traits.

In conclusion, we obtained strong support for the notion that there is no natural cut-off separating psychotic illness from good health. Sub-clinical psychosis of any kind is not trivial because it is associated with various types of social disability.

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### 1. Introduction

For a long time, psychiatric research has lost sight of the initial stages, pre-clinical processes, and sub-clinical symptoms associated with psychosis. However, several studies in the past 20 years have demonstrated that the expression of a psychosis phenotype can be observed below the threshold of its clinical detection (van Os et al., 2000; Wiles et al., 2006; Rössler et al., 2007, 2013a, 2013c). This phenotype is commonly referred to as having psychotic-(like) experiences, proneness to psychosis, at-risk mental state, schizotypy, or exceptional experiences (Fach et al., 2013). The occurrence of a psychosis phenotype in the

general population can be characterized as a continuum with differing levels of severity and persistence (Rössler et al., 2007).

van Os et al. (2009) have found in their systematic review that the median prevalence is approximately 5% for sub-clinical psychosis. This rate is at least five-fold higher than the prevalence for diagnosed schizophrenia (Rössler et al., 2005; Tandon et al., 2008), or three to four times higher than for non-affective psychosis in the general population (Kendler et al., 1996; Perala et al., 2007). However, significant variations can arise in those rates, partly because of the mode selected for assessments, i.e., whether based on self-reports, lay interviews, or professional clinical interviews. One assumes that using professional clinical interviews or professional observer ratings would reduce the frequency of false-positive answers rather than relying upon lay interviews or self-reports. Considerable variation can also be found in the instruments used in those surveys, e.g., the Paranoia Checklist (Freeman et al., 2005), the Schizotypal Personality Questionnaire (Raine and Benishay,

\* Corresponding author at: Psychiatric University Hospital, University of Zurich, Militärstrasse 8, CH-8004 Zurich, Switzerland. Tel.: +41 44 296 7401; fax: +41 44 296 7409. E-mail address: [wulf.roessler@uzh.ch](mailto:wulf.roessler@uzh.ch) (W. Rössler).

1995), the psychosis subscales from the Symptom Checklist-90 (SCL-90-R) (Rössler et al., 2007), or the Composite International Diagnostic Interview (CIDI) (Loch et al., 2011). Thus, even if scientific publications concerning sub-clinical psychosis give the impression that the concept is consistently defined, in truth the kind of sub-clinical psychosis symptoms assessed by these instruments essentially determines the substance of those concepts.

These deficiencies in sub-clinical psychosis research became apparent when a new diagnostic entity was being considered for inclusion in the new DSM-5. Labeled “Attenuated Psychosis Syndrome”, it described a condition “with recent onset of modest psychotic-like symptoms and clinically relevant distress and disability” (Tsuang et al., 2013). However, this new category did not possess any certainty of its validity or reliability. It was also unclear how one might delimit this syndrome from, for example, a schizotypal personality disorder (Tsuang et al., 2013).

Because no consistent description is yet available for what constitutes sub-clinical psychosis, we examined the data collected via different questionnaires about a variety of related symptoms that might exist within a community sample. Our aims were to: 1) assess the prevalence rates and severity of symptoms as uncovered via those assorted questionnaires; 2) compare those rates with results from previous assessments; 3) analyze, which latent factors are depicted by such questionnaires; and 4) investigate any associations between latent factors of sub-clinical psychosis and psychosocial factors, normal personality traits, and coping abilities related to chronic stress.

**2. Methods**

*2.1. Study design and sampling*

This study was conducted as part of the Zurich Programme for Sustainable Development of Mental Health Services (ZInEP), a research and mental health care program involving several mental health services for the canton of Zurich, Switzerland. The Epidemiology Survey, one of the nine ZInEP subprojects, comprised four components: 1) telephone screening, 2) comprehensive semi-structured, face-to-face interviews followed by self-report questionnaires, 3) tests in the socio-physiological laboratory, and 4) a longitudinal survey (Fig. 1). Start dates were August 2010 for screening and semi-structured interviews, February 2011 for laboratory tests, and April 2011 for the survey. Screening ended in May 2012 while all other components were completed in September 2012.

As a first step, we used a computer-assisted telephone interview (CATI) to screen 9829 Swiss male and female participants who were aged 20 to 41 years at the onset of the survey and were representative of the general population of the canton of Zurich. The Symptom Checklist-27 (SCL-27) (Hardt et al., 2004) served as our screening instrument. Participants were randomly chosen through the residents’ registration offices of all municipalities within the canton. Residents without Swiss nationality were excluded. In accordance with detailed instructions from the research team, a renowned marketing and field research institute, GfK (“Growth for Knowledge”),

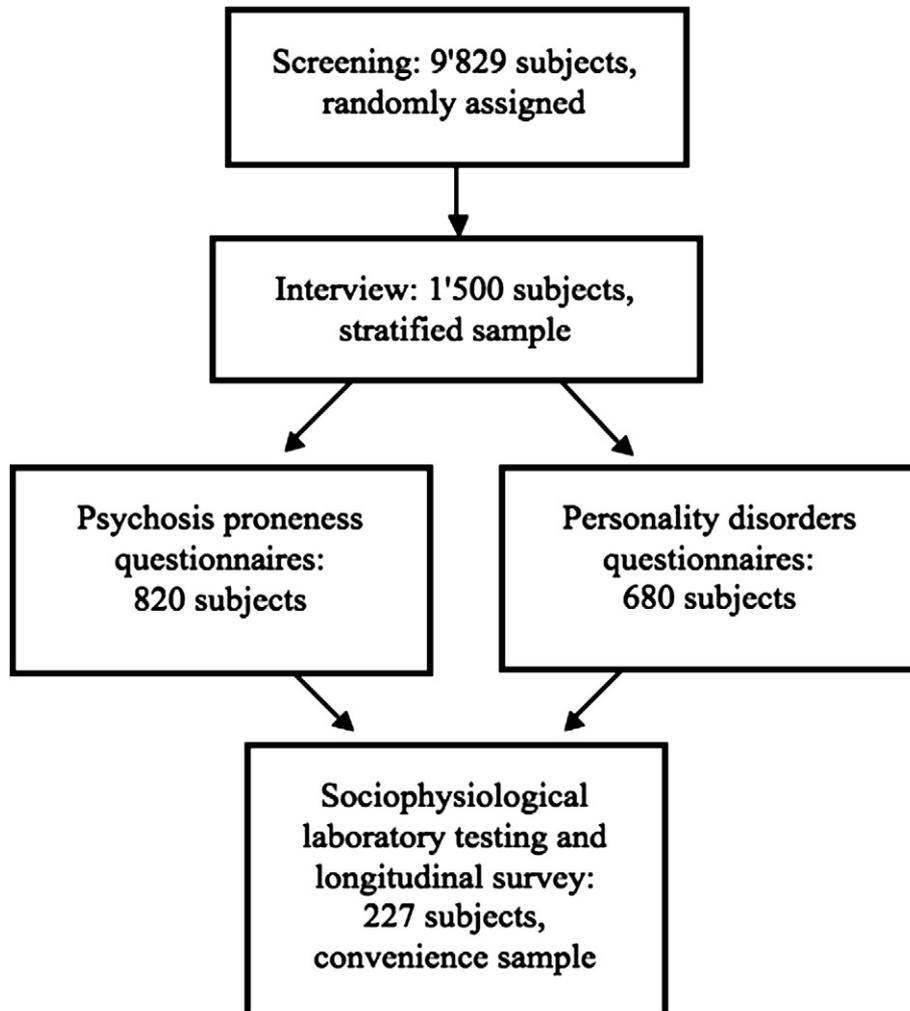


Fig. 1. Sampling procedure for ZInEP Epidemiology Survey.

conducted the CATI. The overall response rate was 53.6%. Reasons for non-response were no telephone connection, reaching only a telephone answering machine, incorrect telephone number, communication impossible, unavailability during the study period, or refusal by the target person or a third party. In cases where potential subjects were available by telephone the response rate was 73.9%.

In a second step, we randomly selected 1500 subjects from the initial screening sample for face-to-face interviews (response rate: 65.2%). Our stratified-sampling procedure included 60% higher-scorers (i.e. scoring above the 75th percentile of the global severity index (GSI) of the SCL-27) and 40% lower-scorers (i.e. below the 75th percentile of the GSI). This design was chosen to enrich the sample pool with subjects at higher risk for mental disorders. Such a two-phase procedure – initial screening and comprehensive interviews with a stratified subsample – is fairly common in epidemiological research (Dunn et al., 1999). In order to get estimates representative of the general population, results need to be weighted according to the probability of the lower- and higher-scorer stratum. The study design is explained in further details in Ajdacic-Gross et al. (2014).

Experienced and trained clinical psychologists carried out the face-to-face interviews, which took place at either the participants' homes or the Psychiatric University Hospital in Zurich. All subjects who completed the semi-structured interviews were subsequently asked to complete various self-report questionnaires. For this purpose the sample of 1500 was divided into two subsamples: one focusing on self-report questionnaires related to psychosis proneness (N = 820) and the other subsample focusing on self-report questionnaires related to personality disorders (N = 680) (Table 1). Here we exclusively analyzed the data of the self-report questionnaires. Data from laboratory examinations of subjects, who participated in this final assessment step of our study, were not used in this analysis.

The ethics committee of the canton of Zurich (KEK) approved the ZInEP Epidemiology Survey as fulfilling all requirements for legal and privacy data protection. It was designed to be in strict accordance with the declaration of Helsinki of the World Medical Association as revised in 2008. All participants gave their written informed consent.

## 2.2. Instruments and measures

We conducted a literature search for self-report questionnaires as used in studies referring to sub-clinical psychosis, psychotic-(like) experiences, proneness to psychosis, at-risk mental state, schizotypy, or exceptional experiences. The mostly applied instruments were then chosen for our study. These instruments are detailed below.

**Table 1**  
Descriptive statistics and weighted data.

	N	Possible range	Current study	Reference
			Mean (SD)	Mean (SD)
SPQ-cog	1164	0–8	1.36 (1.40)	3.0 (2.1) <sup>a</sup>
SPQ-int	1160	0–8	2.27 (1.86)	3.0 (2.3) <sup>a</sup>
SPQ-dis	1158	0–6	1.08 (1.50)	1.6 (1.7) <sup>a</sup>
PARA-fre	630	0–72	4.56 (5.38)	11.9 (10.5) <sup>b</sup>
PARA-con	634	0–72	17.49 (21.65)	16.7 (12.1) <sup>b</sup>
PARA-dis	637	0–72	9.75 (12.27)	14.6 (12.2) <sup>b</sup>
SIAPA-aud	643	0–4	0.46 (0.60)	–
SIAPA-vis	643	0–4	0.51 (0.63)	–
SIAPA-tac	645	0–4	0.33 (0.56)	–
SIAPA-olf	644	0–4	0.20 (0.43)	–
SIAPA-gus	642	0–4	0.21 (0.43)	–

SPQ: Schizotypal Personality Questionnaire; cog: cognitive-perceptual; dis: disorganized; int: interpersonal.

PARA: Paranoia Checklist; fre: frequency; con: conviction; dis: distress.

SIAPA: Structured Interview for Assessing Perceptual Anomalies; aud: auditory; vis: visual; tac: tactile; olf: olfactory; gus: gustatory.

<sup>a</sup> Compton et al. (2009); undergraduate students, southeastern state in the USA, mean age: 20.1 ± 1.7.

<sup>b</sup> Freeman et al. (2005); students, Norwich and London, England, mean age: 23.0 ± 6.1.

The brief form of the Schizotypal Personality Questionnaire (SPQ-B) (Raine and Benishay, 1995) contains 22 items and measures three factors of schizotypy, namely “cognitive-perceptual” (SPQ-cog: paranoid ideation, illusionary perception), “interpersonal” (SPQ-int: lack of close friends, social withdrawal, anhedonia), and “disorganized” (SPQ-dis: eccentric behavior, odd mannerisms). Each dichotomous item answered by a “yes” scores one point on the corresponding factor. Internal consistency and test-retest reliability of the subscales are high (Raine and Benishay, 1995), and the three-factor structure has been replicated (Reynolds et al., 2000). Here, we used the German-language version of SPQ-B translated by Klein et al. (1997). Because items in that questionnaire were designed to measure stable personality traits, they were not restricted to a specific time frame.

The Paranoia Checklist (PARA) (Freeman et al., 2005) is a self-report instrument with 18 items, each rated on a five-point Likert scale. The PARA measures the most recent one-week prevalence of paranoid ideation. Each item assessing a feature of paranoid and suspicious thoughts is rated separately for frequency (PARA-fre), degree of conviction (PARA-con), and distress (PARA-dis). We used the German translation by Lincoln et al. (2009). Internal consistency of the PARA is very good and convergent validity has also been provided (Freeman et al., 2005; Lincoln et al., 2009).

The Structured Interview for Assessing Perceptual Anomalies (SIAPA) (Bunney et al., 1999) captures the most recent (i.e., “past few days”) deficits in sensory gating. There, perceptual and attentional anomalies such as hyper-alertness and poor selective attention to external stimuli are evaluated. The SIAPA focuses on auditory, visual, tactile, olfactory, and gustatory modalities. Combined, they provide a total mean score (SIAPA-total). Using a five-point Likert scale, each modality includes three items – hypersensitivity, inundation or flooding, and selective attention. For the ZInEP Epidemiology Survey the SIAPA was adapted as a self-report questionnaire by the authors of the current manuscript. Reliability and validity of the original interview form are good. Here, the internal consistency of the various modalities for the adapted questionnaire form ranged from Cronbach's  $\alpha = 0.64$  to  $\alpha = 0.82$  and the coefficient for the total score was  $\alpha = 0.89$  (Bunney et al., 1999).

We addressed different coping styles with the brief Coping Orientation to Problems Experienced (Brief COPE) (Carver, 1997). This self-report questionnaire comprises 28 items that are each rated on a four-point Likert scale ranging from “I haven't been doing this at all” to “I've been doing this a lot”. The Brief COPE allows one to measure features of coping that are emotion-focused (e.g., searching for social support and accepting reality), problem-focused (e.g., conceiving strategies for problem-solving), or dysfunctional (e.g., distracting oneself with alcohol use, denial) (Cooper et al., 2008). According to the present definition of problem-focused and emotion-focused coping, both styles depict adaptive strategies that have also been organized into the higher-order category of engagement coping. The strategies assessed by dysfunctional coping have also been categorized as disengagement or avoidant coping. Internal consistency and test-retest reliability of these three coping strategies are high and convergent, and concurrent validity has been provided (Carver, 1997; Cooper et al., 2008).

The Trier Inventory for the Assessment of Chronic Stress (TICS) (Schulz and Schlotz, 1999) was developed to cover chronic stress in various domains of daily life, such as work overload, worries, lack of social recognition, or work discontent. From this questionnaire a short form, Screening Scale for Chronic Stress (SSCS) (Schulz et al., 2004), was derived. Providing a global measure of chronic stress, the SSCS rates 12 items on a five-point Likert scale. Both TICS and SSCS have shown good reliability and satisfactory validity (Schulz and Schlotz, 1999; Schulz et al., 2004).

The Connor-Davidson Resilience Scale (CD-RISC) (Connor and Davidson, 2003) captures a global measure of resilience, a construct defined as the ability to cope with stress and resistance against adverse experiences (Richardson, 2002). The CD-RISC contains 25 items rated on a five-point Likert scale ranging from “rarely true” to “true nearly

all of the time". Its total score provides good reliability and validity (Connor and Davidson, 2003).

The Big Five Inventory short form (BFI-S) (Schupp and Gerlitz, 2008) is a German adaptation of the popular Big Five Inventory by John et al. (1991). Its 15 items are divided into five broad domains – neuroticism, extraversion, openness, agreeableness, and conscientiousness. Those items are rated on a seven-point Likert scale ranging from "don't agree at all" to "completely agree". The domain concentration on particular traits, with neuroticism assessing being frequently worried, tense, and fearful; extraversion, being talkative, outgoing, and sociable; openness, being inventive, imaginative, and experience-seeking; agreeableness, being gentle, forgiving, and cordial; and conscientiousness, being thorough, diligent, and efficient. The BFI-S has shown good reliability and validity (Schupp and Gerlitz, 2008).

### 2.3. Statistical analysis

Descriptive statistics and prevalence rates were weighted according to the above-described stratum to provide estimates representative of the general population of the canton of Zurich, Switzerland. Missing data were excluded from our analyses.

We included all 11 subscales from the three selected questionnaires in a Principal Component Analysis (PCA) on an 11 × 11-item correlation matrix. In detail we included from the Schizotypal Personality Questionnaire the cognitive-perceptual (cog), disorganized (dis) and interpersonal (int) subscales, from the Paranoia Checklist (PARA) the frequency (fre), conviction (con) and distress (dis) subscales and finally from the Structured Interview for Assessing Perceptual Anomalies (SIAPA) the auditory (aud), visual (vis), tactile (tac), olfactory (olf) and gustatory (gus) subscales.

The best-fitting factor solution was determined by inspecting the scree test (Cattell, 1966) and Horn's parallel analysis (PA) (Horn, 1965). The latter was carried out with a syntax program provided by O'Connor (2000). The component structure was inspected according to guidelines described by Costello and Osborne (2005). Ideally, a clean component structure would fulfill the following: each component at least loaded on three items higher than 0.50, each item exhibited a loading of at least 0.32, and only one component could load higher than 0.32 on the same item (the occurrence of two or more components loading higher than 0.32 on the same item was referred to as "cross-loadings"). Factor scores were derived according to the Bartlett method. Associations with various categorical socio-demographic variables were analyzed with a series of one-way ANOVAs that included the component scores as the dependent variable. Associations with continuous psychosocial measures were examined with robust generalized linear regression models. The psychosocial measures were z-transformed and entered as independent variables. All statistical tests were performed with SPSS 20 for Macintosh.

## 3. Results

The descriptive statistics, based on weighted raw scores of all measures, are presented in Table 1. Those estimates are representative of the general population aged 20 to 41 years within the canton of Zurich, Switzerland. Reference values from other community samples chosen by virtue of the highest possible comparability are listed if applicable. Our SPQ-B scores were considerably lower than the reference values provided by Compton et al. (2009). However, the latter set was assessed in a sample of much younger undergraduate students that were not representative of the general population in a community (mean age = 20.1 versus 29.2 in our study). This discrepancy may have specifically biased the results. The same logic applied when explaining the variation in scores derived from PARA-fre and -dis. Again, higher values in the reference sample were obtained from younger students (mean age = 23.0), as tabulated by Freeman et al. (2005). Interestingly, and in contrast to that, the mean scores for PARA-con were nearly identical between

our study and that of Freeman. Finally, because we had adapted the SIAPA to be a self-report questionnaire that had not previously been applied elsewhere we were unable to provide reference scores for those scales. The prevalence/severity of various symptoms of sub-clinical psychosis is indicated in Table 2. The most frequent category for the PARA subscales was "seldom"/"slightly"; the most prevalent category for the SIAPA subscales was "never"/"not at all".

The eigenvalues of the first five components were 4.05, 1.57, 0.98, 0.77, and 0.74. The scree plot (Fig. 2) demonstrated that the first two components explained most (36.8% and 14.2%) of the total variance whereas the third and subsequent components explained only 8.9% or less. Thus, according to the scree test, we could extract two components. This finding was confirmed by Horn's PA, which also identified a two-component solution that explained 51.0% of the total variance. The matrix is presented in Table 3. Our results showed that the first component loaded highly on all SIAPA subscales (all loadings > 0.600), whereas the second component loaded strongly on the SPQ and PARA subscales (all loadings > 0.400). The communalities indicated that the two components explained a substantial portion of the variance in each item (>41.0%), except for PARA-con (16.6%). This two-component structure was clean, stable, and easily interpretable. We then used the scores derived from this two-component model to compute an anomalous-perception (Component 1) and odd-belief/behavior (Component 2) score for each participant. Because those scores were standardized they were approximately normally distributed with a mean of 0.0 and a standard deviation of 1.0.

The two component scores were distributed across various socio-demographic variables (Table 4). With respect to the anomalous-perception component, considerable mean differences that corresponded at least to a small effect size (Cohen's  $d > 0.2$ ) occurred for a family history of psychosis, having children, education level, and unemployment. The strongest effect was found for family history (Cohen's  $d = 0.37$ ), indicating that persons with a parent or sibling with psychosis reported slightly more psychosis symptoms. As for odd beliefs/behavior, weak associations (Cohen's  $d > 0.2$ ) were found for housing, having children, marital status, and unemployment. Moderate associations (Cohen's  $d > 0.5$ ) were found for family history and having a partner. The strongest effect indicated moderately elevated odd beliefs/behavior in persons with a family history of psychosis (Cohen's  $d = 0.58$ ).

Psychosocial covariates of the component scores are shown in Table 5. Anomalous perception yielded weak associations ( $\beta > 0.1$ ) with dysfunctional coping, resilience (negative), neuroticism, openness, and conscientiousness (negative) as well as a moderate association ( $\beta > 0.3$ ) with chronic stress. Odd beliefs/behavior demonstrated weak associations ( $\beta > 0.1$ ) with extraversion (negative), openness, conscientiousness, and agreeableness (both negative); moderate associations ( $\beta > 0.3$ ) with resilience (negative), neuroticism, and dysfunctional coping; and a strong association ( $\beta > 0.5$ ) with chronic stress.

## 4. Discussion

We analyzed our data in a carefully selected representative population sample. 3/4 of the subjects available on the telephone participated in the screening phase and 2/3 of those subjects who were selected for in-depth interviews. This is a good response rate.

Our main objectives were to assess how well the prevalence rates and severity of psychosis symptoms in the general population are acquired through several questionnaires used in studies dealing with sub-clinical psychosis. We also wanted to analyze which latent factors are depicted by these questionnaires. In addition, we examined the associations that latent sub-clinical psychosis factors have with psychosocial factors, normal personality traits, and coping abilities related to chronic stress.

**Table 2**  
Prevalence/severity of symptoms along sub-clinical psychosis scales and weighted data (not applicable to SPQ).

	Never/not at all	Seldom/slightly	Sometimes/moderately	Often/severely	Always/extremely
PARA-fre	25.2%	71.7%	3.0%	0.1%	0.0%
PARA-con	13.4%	58.0%	11.2%	3.9%	13.5%
PARA-dis	21.9%	59.0%	14.0%	3.8%	1.4%
SIAPA-aud	44.6%	35.3%	15.5%	4.4%	0.3%
SIAPA-vis	44.8%	29.6%	21.2%	3.8%	0.6%
SIAPA-tac	63.8%	18.0%	15.9%	2.1%	0.2%
SIAPA-olf	74.3%	17.0%	7.3%	1.4%	0.0%
SIAPA-gus	73.4%	17.6%	8.0%	1.0%	0.1%

SPQ: Schizotypal Personality Questionnaire; cog: cognitive-perceptual; dis: disorganized; int: interpersonal.

PARA: Paranoia Checklist; fre: frequency; con: conviction; dis: distress.

SIAPA: Structured Interview for Assessing Perceptual Anomalies; aud: auditory; vis: visual; tac: tactile; olf: olfactory; gus: gustatory.

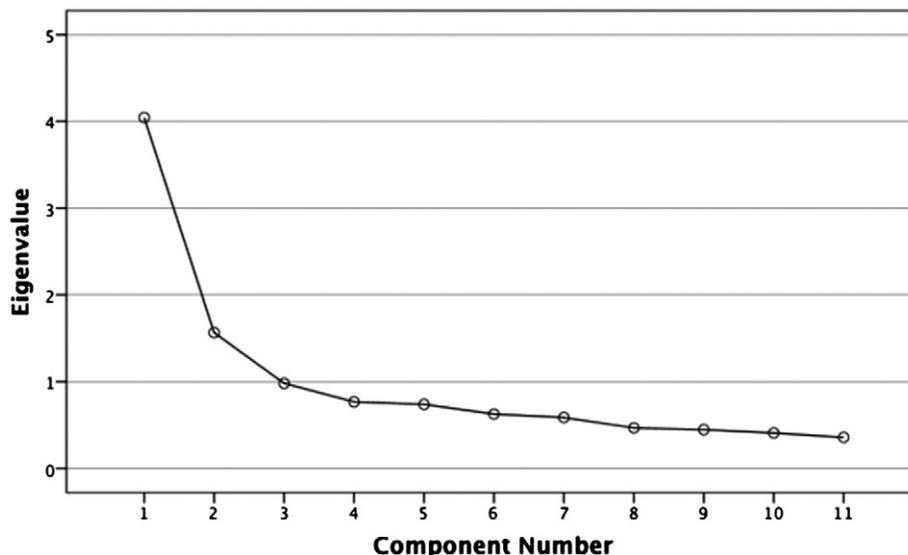
#### 4.1. Prevalence rates and severity of psychosis symptoms in the general population

When the mean scores of the various questionnaires and their subscales were compared, we quite regularly found lower mean scores as had been specified in earlier reports. The most likely explanation for this was that we conducted our study among a representative, i.e., non-selected, population sample, whereas the other studies were performed with selected convenience samples that were presumably biased for participants who had a special interest in the research topic. Alternatively we also might consider that Switzerland in general and the canton of Zurich in particular are characterized by social stability of the indigenous population and efficient health care systems resulting in lower rates of mental problems.

The subscales of the Paranoia Checklist (concerning frequency, conviction and distress) and of the Structured Interview for Assessing Perceptual Anomalies (referring to the auditory, visual, tactile, olfactory and gustatory subscales) showed a very similar type of distribution, i.e., an inverse Gaussian (Wald) distribution, with declining values from rare/slight symptoms over occasional/moderate symptoms to rare and more severe/impairing symptoms. Schizotypy was not included in this analysis of distribution patterns because the answers derived from the SPQ were only dichotomized. We found no “zone of rarity”, which is characterized by very low values for occasional/moderate symptoms between rare/slight symptoms and more severe/impairing symptoms, and which would clearly constitute two distinct groups.

Therefore, this supports the notion of a continuity of psychotic symptoms, which we would expect to find for such even distributions within the general population (van Os et al., 2009). Independent of distribution type, we noted the more frequent occurrence of odd beliefs (as expressed in the Paranoia Checklist) within the general population when compared with anomalous perceptions (as indicated in the SIAPA).

When we examined the screening pool from which our current sample was drawn, we identified the same distribution types in two other sub-clinical psychosis syndromes. During that screening phase, we had applied the SCL-27 plus two additional psychosis scales from the SCL-90-R (Rössler et al., 2013a). Comparable to odd beliefs/behavior, the “schizotypal signs” syndrome was much more frequent in the screening sample than was the “schizophrenia nuclear symptoms” syndrome (comparable to anomalous perception). Previously we had found such an inverse Gaussian distribution type in another community study when the same self-report measures were used for psychotic symptoms (Rössler et al., 2007). We identified the same distribution type after we conducted semi-structured interviews to assess psychosis syndromes in the last named sample (Rössler et al., 2013c). This therefore demonstrated strong support (from various community samples) that no natural cut-off separates psychotic illness from good health, even if different questionnaires are applied to one or several population samples. Thus, such a dimensional approach seems to reflect psychosis phenotypes within the general population much better than might be gained by taking a categorical/classificatory approach (Rössler, 2013).



**Fig. 2.** Scree plot from Principal Component Analysis with 11 items.

**Table 3**  
Factor-loadings and communalities of a two-component Principal Component Analysis. Loadings greater than 0.320 are indicated in bold.

	Component		Communality
	1	2	
SPQ-cog	0.152	<b>0.587</b>	0.445
SPQ-int	−0.184	<b>0.747</b>	0.473
SPQ-dis	−0.040	<b>0.777</b>	0.579
PARA-fre	0.114	<b>0.714</b>	0.593
PARA-con	−0.013	<b>0.412</b>	0.166
PARA-dis	0.048	<b>0.625</b>	0.419
SIAPA-aud	<b>0.608</b>	0.161	0.480
SIAPA-vis	<b>0.790</b>	−0.029	0.605
SIAPA-tac	<b>0.789</b>	−0.052	0.590
SIAPA-olf	<b>0.834</b>	−0.058	0.658
SIAPA-gus	<b>0.776</b>	0.003	0.605

SPQ: Schizotypal Personality Questionnaire; cog: cognitive–perceptual; dis: disorganized; int: interpersonal.

PARA: Paranoia Checklist; fre: frequency; con: conviction; dis: distress.

SIAPA: Structured Interview for Assessing Perceptual Anomalies; aud: auditory; vis: visual; tac: tactile; olf: olfactory; gus: gustatory.

In epidemiological terms, the distribution type can give us some hints about the underlying causes of a presumed continuum. If one assumes that psychosis is a multifactorial disorder comparable to other chronic disorders like diabetes, then the distribution of characteristics to be investigated depends upon the degree to which these causes interact, their prevalence, and the extent to which their effect sizes differ (Johns and van Os, 2001). If the effects of those causes are moderate and contribute additively, we should expect to see a Gaussian distribution. If those causes, instead, contribute both independently and interactively, then we would expect an inverse Gaussian distribution. In the current study, the latter type was found.

**4.2. Latent factor structure of psychosis symptoms depicted by self-report questionnaires**

Our PCA results revealed two major components that explained more than 50% of the total variance, i.e., the 11 subscales of the Paranoia Checklist, of the Structured Interview for Assessing Perceptual Anomalies and of the Schizotypal Personality Questionnaire loaded either on an anomalous-perception component or on an odd-belief/behavior component. Except for the subscale “conviction” of the Paranoia Checklist,

those component-loadings were quite high. This might have been attributed to a fluctuating course by which people were convinced of their odd beliefs.

Our observation here that odd beliefs/behavior is more frequently reported in the general population than are perceptual abnormalities (and, comparably, “schizotypal signs” vs. “schizophrenia nuclear symptoms”; Rössler et al., 2013a) might be explained by the human striving to make sense of the world. Individuals who experience persistently anomalous perceptions tend to explain them away by integrating them into their model of the world, resulting in odd beliefs about the world and people living in it.

Based on the findings described here, it seems that the Babylonian speech confusion concerning sub-clinical psychosis can be reduced to distinct factors that resemble the two main aspects of positive symptoms in schizophrenia: hallucinations and delusions. That is, anomalous perceptions can turn into hallucinations and odd beliefs can develop into delusions. Both transitions can be seen as an increase in conviction, a concept that is the internal representation of either the perception or the belief.

Because ours was a cross-sectional study we cannot make any conclusions about the chronology of the identified latent factors/syndromes. However, in the clinical case of schizophrenia, prodromal stages are often characterized by a subtle perceptual change. This is followed by a delusional mood – the world feeling strange and a yet-undefined sense of an underlying cause – that precedes full-blown psychosis with hallucinations and the breaking through of concretely formulated delusions.

**4.3. Associations with psychosocial risk factors**

Mental disorders in general and psychosis in particular are commonly associated with psychosocial risk factors (Rössler et al., 2005; Tandon et al., 2008). This is what we also found concerning sub-clinical psychosis, albeit with differences between odd beliefs/behavior and anomalous perceptions. Here, persons with odd beliefs/behavior showed more psychosocial risks and burdens than did those with anomalous perceptions. Although neither of these groups showed an age effect, both indicated a family history of mental illness. We do not know if this is a clue for a genetic predisposition, a sign of adverse rearing conditions, or a combination of both (Rössler et al., 2014). A low level of education and unemployment were risk factors for both groups. A significantly higher proportion from both groups was not married and had no children. Although women were at slightly higher risk for anomalous perceptions,

**Table 4**  
Associations of the component scores with socio-demographic variables.

		Anomalous perception		Sig.	Schizotypy/false belief		Sig.
		Mean	SD		Mean	SD	
Family history	No (N = 565)	−0.015	0.993	0.058	−0.021	0.981	P = 0.003
	Yes (N = 27)	0.360	1.168		0.561	1.219	
Sex	Female (N = 319)	0.094	1.068	0.014	−0.032	0.961	P = 0.406
	Male (N = 285)	−0.105	0.908		0.036	1.042	
Age	20–23 (N = 187)	0.101	1.011	0.254	0.087	0.993	P = 0.278
	27–30 (N = 222)	−0.045	0.995		−0.072	1.002	
	34–41 (N = 195)	−0.046	0.993		−0.001	1.003	
Housing	Alone (N = 81)	−0.004	0.840	0.953	0.237	0.990	P = 0.021
	With others (N = 513)	−0.011	1.009		−0.040	1.002	
Children	No (N = 448)	0.056	1.040	0.020	0.073	1.034	P = 0.002
	Yes (N = 156)	−0.160	0.858		−0.210	0.864	
Partner	No (N = 184)	0.082	1.064	0.188	0.352	1.111	P < 0.001
	Yes (N = 419)	−0.035	0.971		−0.152	0.907	
Marital status	Unmarried (N = 427)	0.045	1.019	0.032	0.091	1.029	P < 0.001
	Married (N = 168)	−0.148	0.899		−0.237	0.877	
Education level	Low (N = 360)	0.133	1.089	0.000	0.077	1.037	P = 0.018
	High (N = 242)	−0.204	0.814		−0.119	0.932	
Unemployment	No (N = 538)	−0.032	0.981	0.026	−0.045	0.992	P = 0.001
	Yes (N = 66)	0.258	1.117		0.370	0.993	

**Table 5**  
Associations of the component scores with coping, resilience, and personality traits.

		Anomalous perception			Schizotypy/false belief		
		$\beta$	SE	Sig	$\beta$	SE	Sig
Coping	Problem-focused	−0.012	0.038	0.754	−0.003	0.040	P = 0.936
	Emotion-focused	0.082	0.043	0.057	0.068	0.048	P = 0.158
	Dysfunctional	0.262	0.044	0.000	0.408	0.039	P < 0.001
	Chronic stress	0.344	0.040	0.000	0.506	0.035	P < 0.001
	Resilience	−0.131	0.044	0.003	−0.327	0.047	P < 0.001
Personality	Neuroticism	0.181	0.042	0.000	0.373	0.040	P < 0.001
	Extraversion	0.042	0.040	0.294	−0.287	0.039	P < 0.001
	Openness	0.167	0.041	0.000	0.120	0.045	P = 0.007
	Conscientiousness	−0.119	0.044	0.007	−0.211	0.045	P < 0.001
	Agreeableness	−0.025	0.044	0.567	−0.114	0.042	P = 0.007

this did not affect persons who had a partner or who lived alone. In contrast, participants describing odd beliefs lived more often alone and without a partner. It seems to be more difficult to share an aberrant model of the world with someone close than to make changes in one's own perceptions.

Because this was a cross-sectional epidemiological study, we cannot say if psychosocial risk factors preceded or were a consequence of sub-clinical psychosis symptoms. However, we posit that sub-clinical psychosis of any kind is not trivial because it obviously leads to some type of social disability, even though most of the associations reported herein were rather weak, what was to be expected in multi-factorial syndromes. Thus, it is not surprising that both syndromes, but especially odd beliefs, were moderately related to chronic stress, reduced resilience, and dysfunctional coping. These associations, taken together, somewhat suggested that the odd-belief/behavior factor represents a more severe form of pathology than do perceptual anomalies. The question still remains whether the assessed psychopathology is a more stable trait or a momentary state. As mentioned above, we cannot answer this based on our cross-sectional data. However, our previous analysis concerning the structure of sub-clinical psychosis indicated that, although most of those related symptoms are transient and episodic in nature, the variability in their expression is predominantly caused by stable traits (Rössler et al., 2013b).

#### 4.4. Associations with personality traits

In the present examination, we searched for associations between sub-clinical psychosis symptoms and personality traits. Both syndromes were positively linked with neuroticism and openness and negatively with conscientiousness. In addition, odd beliefs were slightly negatively related to extraversion and agreeableness. Thus, we might conclude that sub-clinical psychosis symptoms are related to stable personality traits, as has also been confirmed by research on personality, personality disorder traits, and general personality dysfunction (Thomas et al., 2013; Hengartner et al., 2014).

#### 4.5. Strengths and limitations

One of the strengths of this study was that we conducted our analyses using a carefully selected and representative population sample. This provided more weight to our assessed rates of prevalence. We also employed several assessment instruments for indicating sub-clinical psychosis so we could depict its latent structure. Furthermore, we were able to search for associations of sub-clinical psychosis not only with some common psychosocial risk factors, including chronic stress, but also with concepts that ultimately demonstrate “health”, such as personality traits and various coping strategies. Nevertheless, despite these strengths, the decisive weakness of our study was its cross-sectional character. Because such an assessment, in particular, does not allow one to make causal inferences, some of our conclusions must remain speculative for the time being.

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#### Contributors

Wulf Rössler took responsibility for the study design and also drafted and revised the manuscript. Vladeta Ajdacic-Gross took responsibility for the study design, supervised the epidemiological assessments and substantially contributed to drafting and critical revision of the manuscript. Mario Müller and Stephanie Rodgers took responsibility for the assessments and substantially contributed to drafting and critical revision of the manuscript. Helene Haker substantially contributed to drafting and critical revision of the manuscript. Michael P. Hengartner conducted all statistical analyses and substantially contributed to drafting and critical revision of the manuscript.

#### Conflict of interest

None.

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