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Social environments and daily life occurrence of psychotic symptoms

An experience sampling test in a non-clinical population

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Abstract *Background* If impairment in social cognition is an important feature of psychosis, characteristics of the social environment may influence the occurrence of psychotic symptoms. The aim of this study was to explore in a non-clinical population whether specific social environments modify the expression of psychotic symptoms in daily life. *Methods* The Experience Sampling Method was used to collect information on characteristics of the social company and of the daily life psychotic experiences of a sample of 79 students. The level of psychotic symptoms was measured using the Mini International Neuropsychiatric Interview (MINI). *Results* Subjects with MINI psychosis criteria were at increased risk of experiencing unusual perceptions in the presence of non-familiar individuals, and at lower risk of experiencing strange impressions in the presence of family members or friends. Dynamic changes in the social company rather than the social company *per se* drive variation of psychotic experiences in daily life. *Conclusion* The data suggest that the earliest stages of expression of psychosis vulnerability are driven by subtle person-environment interactions in the stream of daily life.

Key words experience sampling – psychotic symptoms – social experience – students

Introduction

It has been postulated that impaired competence in social cognition, such as decreased ability of correctly interpreting the mental states of other people, may play a key role in the occurrence of psychotic symptoms [1, 2]. It has also been suggested that abnormalities of the brain structures involved in Machiavellian intelligence, i. e. in the capacity to use social cognition to collaborate or to compete with other human beings, may be implicated in the aetiology of psychosis [3]. If impairment in social cognition is an important feature of psychosis, it is attractive to hypothesise that characteristics of the social environment and changes therein influence the occurrence of psychotic symptoms. This hypothesis can only be assessed indirectly in experimental settings where social interactions are measured using proxy variables [4, 5]. The impact of the social environment on the experience of psychotic symptoms can be more efficiently explored using methods designed to measure subjective experience occurring over time in naturalistic settings [6–8]. Recent findings using such methods showed that in daily life the presence of familiar people decreased the probability of occurrence of delusions in subjects with clinical psychotic disorders [9]. We wished to further explore whether the social environment, apart from modifying the course of established psychosis, also influences the risk of developing psychosis *de novo* in vulnerable subjects recruited in non-clinical populations. The aim of the present study was to explore in a non-clinical population whether specific social environments modify the expression of psychosis proneness in daily life.

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Subjects and methods

■ Subjects

Baseline screening

The method has been outlined in detail in previous work [10]. Briefly, undergraduate university students in psychology were invited to participate in a study on daily life behaviour and experiences. All subjects gave written informed consent to participate in the investigation. Psychosis proneness was assessed using the Community Assessment of Psychic Experiences (CAPE) [10, 11], a 42-item self-report questionnaire derived from the Peters et al. Delusions Inventory (PDI-21) [12–14]. The CAPE includes 20 items assessing positive symptoms, 14 items exploring negative symptoms, and 8 cognitive symptoms exploring depressive symptoms. Each item explores the frequency of the experience on a four-point scale of “never”, “sometimes”, “often” and “nearly always”.

A standardised self-report questionnaire was used to collect information on demographic characteristics and frequency of substance use over the last month. The baseline sample included all students attending an information meeting on course organisation at the beginning of the new university year. Of the 685 subjects invited to participate in the survey, 649 fully completed the self-report screening questionnaire. The sample included 586 females and 63 males as expected by the skewed gender distribution of students in psychology. The 649 subjects had a mean age of 20 (SD 3) years; most of them ($n = 619, 95.7\%$) were single.

Selection of the ESM group

A stratification procedure was used to create a sample for the ESM phase in order to select subjects representative of the overall distribution of psychosis proneness (PP) in the baseline sample. Respondents were also selected on the basis of cannabis consumption (THC) over the past month, a variable not examined by the present study but controlled for in all analyses, as another question explored in this ESM sample was the role of cannabis use and psychosis vulnerability in relation to the occurrence of psychotic experiences in daily life [15]. The CAPE-pos scores (sum of the 20 CAPE items assessing positive symptoms, range 0–80) were categorised into tertile groups [“low PP” (0–27); “medium PP” (28–33); “high PP” (34–76)]. Cannabis use was categorised into “low THC” (no use over the past month, $n = 455, 70.1\%$) vs. “high THC” (more than once a week, $n = 76, 11.7\%$). Approximately equal numbers of subjects were randomly selected within each THC/PP group ($n = 6$). Since the baseline sample included less than 10% males, we randomly selected a higher proportion of male subjects within each THC/PP group in order to include a higher proportion (30%) of males in the ESM sample. Research psychologists blind to the selection criteria telephoned selected subjects and financial compensation (75 euros) was given to subjects agreeing to participate in the ESM phase of the study.

Of the 88 subjects invited to participate in the ESM phase of the study, 7 declined to participate and 2 were excluded at the completion of the study due to deviations from the established procedures. There were no significant differences with regard to demographic and clinical variables between these subjects included in the final sample and the 9 selected by the stratification procedure who were not included in the ESM phase. The 79 subjects (24M/55F) included in the ESM phase had a mean age of 22.1 years (SD 5.3).

ESM procedure

Experience Sampling Method (ESM) is a structured diary technique that allows for a series of random momentary assessments in the stream of daily life, and as such may yield more valid data in the measurement of person-environment interactions [6–8, 16]. Several studies have demonstrated the validity of ESM to collect information on psychotic experiences in daily life [9, 16, 17]. Subjects participated in a training session concerning the ESM procedures in which they were instructed on how to describe their present experience by answering a brief questionnaire at each signal of a multi-alarm wristwatch. Sub-

jects were then studied in their daily living environment. Over seven consecutive days, the watch emitted an alarm signal at five randomised moments from 8 a.m. to 11 p.m.

Open-ended questions were used in the ESM form to collect information on the social company and the location of the person at the time of each signal. Psychotic experiences and level of anxiety for the period between the current and previous signals (corresponding on average to the previous 3 hours) were explored by questions formulated in order to be as acceptable as possible for repeated measurements during daily activities [9]. Subjects were asked to rate on 7-point Likert scales the following questions: 1) “How would you describe the social ambience and the persons you met?” (1 = *very friendly*/7 = *very hostile*); 2) “Did you have the impression that something strange happened to you or around you that you could not explain?” (1 = *nothing strange*/7 = *very strange*); 3) “Did you have unusual perceptual experiences?” (1 = *not at all*/7 = *very often*); 4) “Did you have the impression that your thoughts or emotions could be read or influenced?” (1 = *not at all*/7 = *very often*). Level of anxiety over the ESM assessment was examined using a 7-point Likert scale (1 = *not at all*/7 = *extremely anxious*). Substance use for the period between the current and previous signals was explored by the question “Since the last beep, did you use any substances?” (Yes/No), followed by an open question “If yes, which substance(s) did you use?”.

Assessment of “psychosis vulnerability” using clinical interviews

At the end of the ESM phase, the subjects were interviewed using the Mini International Neuropsychiatric Interview (MINI, 4.4 version), administered by research psychiatrists blind to both the risk status of subjects (psychosis proneness) as well as with regard to their ESM data. The MINI is a short diagnostic interview designed to be used in non-clinical populations [18] that includes a “psychotic” section with nine items exploring psychotic symptoms. Of these items, two are rated on the basis of clinical observations and seven are questions eliciting answers that are rated as “bizarre” or “non-bizarre” psychotic symptoms. MINI psychotic items are aimed at identifying the occurrence of psychotic experiences, but do not include any assessment of distress or disability, or symptom duration. “Psychosis vulnerability” was defined in the present study by the MINI criteria for identifying possible psychotic condition among subjects from the general population [19]: i) at least one bizarre psychotic symptom over the last month, or ii) at least two non-bizarre psychotic symptoms over the last month. Sixteen subjects fulfilled MINI criteria for psychosis (at least one bizarre psychotic symptom, or two non-bizarre psychotic symptoms). There was good agreement between risk status identified by the self-report questionnaire and by the structured diagnostic interview. None of the “low PP” subjects, 4 (13.3%) of the “middle PP” subjects, and 12 (52.2%) of the “high PP” subjects fulfilled MINI criteria for psychosis, respectively.

■ Statistical method

Statistical analyses were conducted using STATA software [20]. Multilevel linear random regression models were used to estimate the effect of the independent variable (social company) on the dependent variables (psychotic experiences). In accordance with the categorisation used by Myin-Germeys et al. [9], social company was categorised into being “alone” (baseline condition), “with familiar individuals” (family members, friends, partner), or “with non-familiar individuals” (work colleagues, students, professors, strangers, other). Change in company between the current and previous signal was assessed for consecutive signals over the same day. Change in company was categorised as “no change” (baseline condition), “change to being alone”, “change to being with familiar individuals”, or “change to being with non-familiar individuals”. Location was categorised into “familiar location” (personal home or familiar individual’s home) (baseline condition) vs. “other location”.

ESM data can be conceptualised as two-level (or hierarchical) data, with repeated observations (ESM signal level) being nested within a given person (subject level). Multilevel or hierarchical linear modeling techniques are a variant of the more often used unilevel lin-

ear regression analyses. The advantages of these methods are that the dependency of repeated measures within the same person is taken into account, and that it can accommodate non-informative missing values [21]. Since the observations from a given subject that are temporally closer to each other may be more similar than those further apart, the variance explained by autocorrelation was taken into account by including the autoregression factor in the model (STATA XTREGAR procedure). The B is the fixed regression coefficient of the predictor in the multilevel model and can be interpreted identically to the estimate in a unilevel linear regression analysis (change in y with one unit change in x). All the models were *a priori* adjusted for gender and age. Since we have previously reported that cannabis use predicted the occurrence of psychotic experiences in daily life [15], the models were also *a priori* adjusted for cannabis use at a given ESM assessment. Interactions between independent variables were assessed by Wald test [22].

We examined: i) the effect of the social company on the ESM psychosis outcome, defined as occurrence of each psychotic experience within the same ESM assessment period; ii) the effect of “psychosis vulnerability” on the ESM psychosis outcome; and iii) the interaction between the social company and “psychosis vulnerability” on the ESM psychosis outcome. We subsequently explored whether a change in the social company between two given time periods in the same day was associated with increased occurrence of psychotic experiences in the next ESM assessment.

Results

ESM measures

The percentage of missing data for ESM variables ranged from 7 to 10%. There were neither large nor significant differences in the frequencies of missing data according to demographic characteristics or risk status of the sample (psychosis proneness). The distribution of ESM variables is presented in Table 1. Regarding substance use reports, there were 375 (14.7%) reports of cannabis use, and few reports of use of other illicit substances (ecstasy $n = 5$; cocaine $n = 1$; heroin $n = 1$).

Effects of the social company and “psychosis vulnerability” on the occurrence of psychotic experiences

In order to assess whether social company and “psychosis vulnerability” independently predicted the oc-

Table 1 Experience sampling variables distribution averaged over the assessment period

Variables (Numbers of valid ESM reports ^a)	N (%) or mean (SD)
Social company (n = 2548)	
Alone	978 (38.4%)
With familiar individuals ^b	1321 (51.8%)
With non-familiar individuals ^c	249 (9.8%)
Location (n = 2567)	
Personal or familiar individual's home	1598 (62.3%)
Other location	969 (37.8%)
Psychopathological variable reports	
Perceived hostility (n = 2510)	2.7 (1.3)
Strange impressions (n = 2548)	1.4 (1)
Unusual perceptions (n = 2541)	1.2 (0.8)
Thought influence (n = 2549)	1.5 (1.1)
Anxiety (n = 2534)	2.3 (1.6)

^a Out of 2765 ESM assessments

^b Family member, friend, partner

^c Work colleagues, students, strangers, other

currence of psychotic experiences, the two variables were entered in the same model (Table 2). There was a negative association between perceived hostility and being with familiar individuals, indicating that subjects were significantly less likely to report perceived hostility, i. e. they were more likely to find the atmosphere and the people friendly when being with familiar individuals than when being alone. In accordance with previous findings obtained in this sample [15], subjects with high “psychosis vulnerability” (MINI criteria for psychosis) were more likely to report perceived hostility, strange impressions or unusual perceptions over the ESM assessment period than subjects with low “psychosis vulnerability”. These findings indicate that in daily life, “psychosis vulnerability” is a predictor of the occurrence of psychotic experiences, independently from the characteristics of the social company.

Table 2 Effect of social company and “psychosis vulnerability” on ESM psychosis outcome

	Perceived hostility B ^A (95% CI)	Strange impressions B ^A (95% CI)	Unusual perceptions B ^A (95% CI)	Thought influence B ^A (95% CI)
Social company ^B				
Alone	*	*	*	*
With familiar individuals ^C	-0.52 (-0.62; -0.43) p = 0.0001	-0.06 (-0.14; 0.01) p = 0.10	0.02 (-0.05; 0.08) p = 0.65	0.06 (-0.02; 0.15) p = 0.14
With other individuals ^D	-0.2 (-0.18; 0.13) p = 0.76	0.07 (-0.05; 0.19) p = 0.29	0.06 (-0.05; 0.17) p = 0.29	0.04 (-0.10; 0.18) p = 0.58
“Psychosis vulnerability” ^{B, E}	0.42 (0.02; 0.82) p = 0.04	0.44 (0.13; 0.74) p = 0.005	0.26 (0.10; 0.43) p = 0.002	0.26 (-0.10; 0.62) p = 0.16

* Baseline category

^A Regression coefficient adjusted for age, sex and cannabis use; ^B Social environment and “psychosis vulnerability” in the same model; ^C Family member, friend, partner;

^D Work colleagues, students, strangers, other; ^E MINI psychosis criteria;

■ Interaction between the social company and “psychosis vulnerability” on psychosis outcome

Significant interactions were found between the social company and “psychosis vulnerability” in the association with the daily life experiences of strange impressions ($\chi^2 = 6.3$, $ddl = 2$, $p = 0.04$) and unusual perceptions ($\chi^2 = 11.02$, $ddl = 2$, $p = 0.004$). No interaction was found between social company and psychosis vulnerability in the association with perceived hostility ($\chi^2 = 1.73$, $ddl = 2$, $p = 0.42$) and thought influence ($\chi^2 = 0.8$, $ddl = 2$, $p = 0.67$). Stratified analyses (Table 3) showed that subjects with high “psychosis vulnerability” were more likely to experience unusual perceptions in the presence of non-familiar individuals than when alone, and were less likely to experience strange impressions in the presence of familiar individuals than when alone. No association was found between the social company and daily life occurrence of psychotic experiences in subjects with low “psychosis vulnerability”.

■ Impact of potential confounders in the association between the social company and psychotic experiences in vulnerable subjects

We first explored the influence of type of location (“familiar location” vs. “other location”) as a possible confounder of the associations between psychotic experiences and the social company in subjects with high “psychosis vulnerability”. Adjustment for ESM location did not change the strength of the association between unusual perceptions and “being with non-familiar people” ($B = 0.44$, 95% CI 0.06, 0.84; $p = 0.03$), or between strange impressions and “being with familiar people” ($B = -0.22$, 95% CI -0.45 , 0.02; $p = 0.05$). These findings suggest that the influence of the social company on the occurrence of psychotic experiences in vulnerable subjects is independent of being in a familiar location.

We also explored whether the associations between psychotic experiences and social company in subjects with high “psychosis vulnerability” could in fact be explained by the level of self-reported anxiety. There was no association between ESM anxiety and unusual percep-

tion ($B = 0.06$, 95% CI -0.02 , 0.13; $p = 0.17$) and the association between unusual perceptions and “being with non-familiar people” was not changed after further adjustment for ESM reported anxiety ($B = 0.39$, 95% CI 0.03, 0.75; $p = 0.04$). These findings suggest that the increased occurrence of abnormal perceptions in vulnerable subjects when with unfamiliar individuals as compared to when alone is not explained by the level of anxiety. There was a significant association between ESM anxiety and “strange impressions” ($B = 0.16$, 95% CI 0.08, 0.25; $p = 0.001$), and the strength of the negative association between “strange impressions” and “being with familiar people” was reduced after adjustment for ESM reported anxiety ($B = -0.16$, 95% CI -0.38 , 0.06; $p = 0.15$). This finding suggests that the level of anxiety explains in part the fact that subjects with high “psychosis vulnerability” are less likely to experience strange impressions in the presence of familiar individuals than when alone.

Lastly, we explored whether the associations between psychotic experiences and the social company in subjects with high “psychosis vulnerability” could be explained by the level of perceived hostility. Adjustment for perceived hostility did not modify the strength of the associations between unusual perceptions and “being with non-familiar people” ($B = 0.38$, 95% CI 0, 0.74; $p = 0.05$), or between strange impressions and “being with familiar people” ($B = -0.21$, 95% CI -0.43 , 0.02; $p = 0.08$).

■ Impact of change in social company between two consecutive ESM assessments on the occurrence of psychotic experiences

Regardless of vulnerability status, subjects were more likely to find the atmosphere friendly when they changed to being with familiar individuals ($B = -0.31$, 95% CI -0.42 , -0.20 ; $p = 0.0001$) compared to not changing, and less likely to experience such feelings when they changed to being alone compared to not changing ($B = 0.20$, 95% CI 0.07, 0.33; $p = 0.002$). No other association was found between change in social environment and occurrence of psychotic experiences in the whole sample of subjects.

Table 3 Effects of social company on ESM psychosis outcome by level of “psychosis vulnerability”

Effect of social company by level of “psychosis vulnerability”	Strange impressions B ^a (95% CI)	Unusual perceptions B ^a (95% CI)
Subjects with high “psychosis vulnerability” ^b		
Alone	*	*
With familiar individuals ^c	-0.21 (-0.43; 0.01) $p = 0.07$	-0.04 (-0.25; 0.18) $p = 0.73$
With non-familiar individuals ^d	0.14 (-0.25; 0.52) $p = 0.49$	0.38 (-0.25; 0.17) $p = 0.04$
Subjects with low “psychosis vulnerability” ^b		
Alone	*	*
With familiar individuals ^c	-0.02 (-0.09; 0.05) $p = 0.58$	0.03 (-0.03; 0.10) $p = 0.32$
With non-familiar individuals ^d	0.05 (-0.07; 0.17) $p = 0.46$	-0.02 (-0.13; 0.08) $p = 0.66$

* Baseline category

^a Regression coefficient adjusted for age, sex and cannabis use; ^b MINI psychosis criteria; ^c Family member, friend, partner; ^d Work colleagues, students, strangers, other

There were significant interactions between change in social company and “psychosis vulnerability” in the associations with ESM strange impressions ($\chi^2 = 16.1$, $ddl = 3$, $p = 0.001$) and unusual perceptions ($\chi^2 = 23.01$, $ddl = 3$, $p = 0.0001$). No interaction was found regarding ESM perceived hostility ($\chi^2 = 3.80$, $ddl = 3$, $p = 0.28$) and thought influence ($\chi^2 = 4.3$, $ddl = 3$, $p = 0.23$). Stratified analyses (Table 4) showed that subjects with high psychosis vulnerability were less likely to experience strange impressions when they changed to be with familiar individuals than when there was no change in their social company, and more likely to experience unusual perceptions when they changed to being with non-familiar individuals compared to no change in the social company.

In order to assess if “current social company” and “change in social company” independently predicted the occurrence of strange impressions and unusual perceptions in subjects with “psychosis vulnerability”, the two variables were entered in the same model adjusted for age, gender and cannabis use. Compared to no change in social company, change to being with non-familiar individuals remained the only independent predictor of occurrence of unusual perceptions ($B = 0.93$, 95% CI 0.09, 1.8; $p = 0.03$), while being currently with non-familiar individuals did not independently predict the occurrence of unusual perceptions ($B = 0.13$, 95% CI -0.24 , 0.50; $p = 0.50$). Compared to no change in social company, the likelihood of presenting with strange impressions was decreased by changing to familiar individuals ($B = -0.34$, 95% CI -0.64 , -0.04 ; $p = 0.03$), and was increased, albeit statistically imprecise by conventional alpha, by changing to non-familiar individuals ($B = 0.79$, 95% CI -0.06 , 1.63; $p = 0.07$). The current social company did not independently predict the occurrence of strange impressions after adjustment for change in social company.

Table 4 Interaction between change in social environment and “psychosis vulnerability” on ESM psychosis outcome

Effect of social company by level of “psychosis vulnerability”	Strange impressions B ^a (95% CI)	Unusual perceptions B ^a (95% CI)
Subjects with high “psychosis vulnerability” ^b		
<u>No change</u>	*	*
Change to being alone	0.22 (−0.09; 0.52) $p = 0.16$	0.02 (−0.33; 0.29) $p = 0.89$
Change to being with familiar individuals ^c	−0.25 (−0.5; 0) $p = 0.05$	−0.09 (−0.35; 0.17) $p = 0.50$
Change to being with non-familiar individuals ^d	0.47 (−0.07; 1.01) $p = 0.09$	0.85 (0.29; 1.4) $p = 0.003$
Subjects with low “psychosis vulnerability” ^b		
<u>No change</u>	*	*
Change to being alone	0.03 (−0.07; 0.13) $p = 0.53$	−0.02 (−0.11; 0.06) $p = 0.60$
Change to being with familiar individuals ^c	0.01 (−0.08; 0.10) $p = 0.86$	0.05 (−0.02; 0.13) $p = 0.18$
Change to being with non-familiar individuals ^d	0.04 (−0.11; 0.20) $p = 0.59$	−0.03 (−0.17; 0.10) $p = 0.65$

* Baseline category

^a Regression coefficient adjusted for age, sex and cannabis use; ^b MINI psychosis criteria; ^c Family member, friend, partner; ^d Work colleagues, students, strangers, other

Discussion

The effects of social company on the occurrence of psychotic experiences in daily life are modified by the subject’s level of vulnerability for psychosis. Subjects with high psychosis vulnerability were at increased risk of experiencing unusual perceptions in the presence of non-familiar individuals as compared to when alone, and at lower risk of experiencing strange impressions in the presence of family members or friends than when alone. Change in the social company between two assessments was a stronger predictor of occurrence of psychotic experiences than the current social company. Compared to no change in social company, change to being with non-familiar individuals was associated to increased occurrence of unusual perceptions and strange impressions, and the likelihood of presenting with strange impressions was decreased by changing to familiar individuals. No impact of the social company on the occurrence of psychotic experiences was found in subjects with low vulnerability for psychosis.

Methodological limitations

The generalisability of our findings may be questioned, as the characteristics of students’ social contacts may differ from those of subjects from the general population, such as, for example, regarding the frequency of contacts with family members. However, we have little motive to suspect that these differences might have modified the direction and the strength of the associations between the social company and psychotic experiences. Nevertheless, since the study was restricted to young adults, it might be of interest to explore the links between the social company and psychotic experiences

in other age groups, in order to examine the potential impact of aging on these associations.

Although the students included in the ESM phase were not currently identified as clinical cases of psychosis, these subjects presented with a relatively high prevalence of psychotic symptoms assessed using a structured diagnostic interview. This finding is an expected consequence of our sampling procedure. The MINI psychotic section has been designed to rule out probable psychotic disorders, and for identification of possible psychotic condition in subjects from the general population [19]. Thus, MINI psychotic items are aimed at identifying occurrence of psychotic experiences, but do not include any assessment of distress or disability, or symptom duration. Due to the fact that some MINI items are over-inclusive [19], we cannot rule out that different findings would have been obtained using a different measure of “psychosis vulnerability” as, for example, familial morbid risk for psychosis.

Another consequence of the sampling procedure is that these students included in the ESM phase presented with a high prevalence of cannabis abuse. However, the potential confounding effect of cannabis use was controlled by the fact that all the associations were *a priori* adjusted for ESM reports of cannabis use. In other words, the findings reported in the present study are the associations found between social company and occurrence of psychotic experiences, independently from the impact of cannabis use on occurrence of such experiences.

It has been suggested that misinterpretation may hamper the validity of self-reported psychotic experiences in subjects from the general population, and that psychotic experiences identified using such methods may not be clinically relevant [23]. However, a growing body of evidence demonstrates that self-reported psychotic experiences lie on a continuum with psychotic symptoms identified as clinically relevant [24–26]. Further evidence supporting the continuum hypothesis is drawn from studies showing that self-reported delusional or hallucinatory experiences are strong predictors of subsequent psychotic illness [27] and that the risk factors associated with such experiences are similar to those associated with clinical cases of psychotic disorders [28, 29].

■ Interpretation of findings

There is a striking similarity between the findings obtained by Myin-Germeys et al. [9] in a clinical sample of subjects with psychosis, and those found in the present study in a non-clinical population, as being with familiar people has a protective effect on the occurrence of psychotic experiences in subjects with clinical psychosis as well as in subjects with a high vulnerability for psychosis. A further convergent finding obtained in the present study is that being with unfamiliar people is a risk factor for the occurrence of abnormal perceptions

in subjects with high vulnerability for psychosis. As in the study by Myin-Germeys et al. [9], the impact of the social company on the occurrence of psychotic experiences was not modified after adjustment for the type of familiar vs. unfamiliar location. This finding suggests that the influence of familiarity on psychotic experiences is restricted to the social component of environment. A slight difference between the findings reported by Myin-Germeys et al. [9] and those obtained in the present study is that we found that change in social company over two ESM assessments was a stronger predictor of psychotic experiences than current social company. This difference may be due to methodological differences such as the number of ESM assessments over a day, or the fact that the subjects were asked to report psychotic experiences occurring over the last ESM period in the present study vs. psychotic experiences occurring at the time of signal in the other study [9].

Which mechanisms may underlie the impact of social factors on the daily life occurrence of psychotic experiences? The association between the social company characteristics and psychotic experiences may be mediated by an increased reactivity of subjects with high vulnerability for psychosis to the stress generated by change in the social company. It has been hypothesised that hyperarousal due to minimal stress may trigger hallucinations in vulnerable subjects [30]. Moving from a safe social company to an environment with unfamiliar people may generate an emotional reaction favouring the onset of unusual perceptions in subjects with a high vulnerability for psychosis. We used self-reported anxiety as a proxy measure of stress level to estimate the impact of this factor on the association between the social company and psychotic experiences. We found that a decrease in the level of ESM self-reported anxiety explained in part the fact that subjects with high psychosis vulnerability are less likely to experience strange impressions in the presence of familiar individuals than when alone. However, change in anxiety level did not explain the increased occurrence of unusual perceptions in vulnerable subjects when with unfamiliar individuals. Thus, other mechanisms than variations in the level of anxiety may be implicated in the influence of the social company on unusual perceptions.

It can be hypothesised that vulnerable subjects might be overwhelmed by the amount of social signals generated by exposure to new social company. In such conditions, they might have difficulties in distinguishing relevant social signals from “noise”, and to identify the source of the social signals. For example, difficulties in correctly labelling social interactions might induce strangeness feelings, and verbal interactions between strangers might be misinterpreted as self-directed hallucinatory voices. A notable finding is that the associations between occurrence of psychotic experiences and social environment were not modified after adjustment for threat-perception levels. We can speculate that labelling these unusual experiences as hostile may be a secondary cognitive construct, aimed at providing a

causal explanation to the occurrence of such experiences when in the presence of non-familiar people.

We can also speculate that these findings obtained at the micro environmental level, i. e. at the level of social interactions in daily life, may be relevant for shedding light on the mechanisms underlying the influence of macro environmental characteristics on the risk of psychosis. A large body of evidence suggests that urban life is associated with an increased risk of psychosis [31–33]. It is likely that the effects of urbanicity on the risk of psychosis already operate early in life [31]. However, since city birth, city upbringing and city residence are strongly associated [34], these early effects may also subsist at later developmental stages, and may have a cumulative impact on the risk of psychosis. Urbanicity is a proxy measure for intermediate risk factors mediating the effect on this macro environmental variable on the expression of psychosis vulnerability. Amongst the long list of putative risk factors differentiating urban from rural environments, potential candidates are differences in social factors. It has been shown that macro environmental social characteristics at the neighbourhood level have an influence on the risk of psychosis, independently of individual-level characteristics, and that perceived level of social isolation may increase the risk of psychosis in vulnerable subjects [35, 36]. These ecological findings obtained at the macro environmental level might be underlaid by similar mechanisms to those found at the micro environmental social level in the present study. In other words, we can speculate that the acute increased risk of psychotic experiences in vulnerable subjects exposed to unfamiliar people might lie on a continuum with the increased risk of psychosis in vulnerable subjects chronically exposed to social isolation. Cumulative exposure to these micro environmental social risk factors might lead to onset of psychosis in subjects with high vulnerability for psychosis. As social isolation/being surrounded by strangers are experiences more common in cities than in rural environments, it may be hypothesised that these social factors might at least in part mediate the increased frequency of psychosis in cities, by favouring the expression of vulnerability for psychosis. This speculative hypothesis has to be confirmed by further studies.

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