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# Relationship between sexual orientation and psychotic experiences in the general population in England

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## Original Article

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## Abstract

**Background.** Non-heterosexual individuals are at high risk for a variety of factors associated with the emergence of psychotic experiences (PEs) (e.g. common mental disorders, substance use, and stress). However, there is a scarcity of data on the association between sexual orientation and PEs. Therefore, the aim of this study was to examine the sexual orientation-PE relationship, and to identify potential mediators in this relationship.

**Methods.** This study used nationally representative cross-sectional data from the 2007 Adult Psychiatric Morbidity Survey. Sexual orientation was dichotomized into heterosexual and non-heterosexual. Past 12-month PE was assessed with the Psychosis Screening Questionnaire. Regression and mediation analyses were conducted to analyze the association between sexual orientation and PEs, and to identify potential mediators involved in this relationship.

**Results.** The final sample consisted of 7275 individuals aged ⩾16 years. The prevalence of non-heterosexual orientation and any PE was 7.1% and 5.5%, respectively. After adjusting for sex, age, and ethnicity, non-heterosexual orientation was positively associated with any PE (odds ratio 1.99, 95% confidence interval 1.34–2.93). The strongest mediators involved in this relationship were borderline personality disorder (BPD) traits (mediated percentage = 33.5%), loneliness (29.1%), and stressful life events (25.4%).

**Conclusions.** These findings suggest that there is a positive relationship between sexual orientation and PEs in the general population in England, and that underlying mechanisms may involve BPD traits, loneliness, and stressful life events. Future studies with a longitudinal design are warranted to shed more light on how these factors are implicated in the association between sexual orientation and PEs.

## Introduction

Psychotic experiences (PEs) are hallucinations and delusions that do not reach the clinical threshold for a psychosis diagnosis (DeVylder *et al.*, 2017). The annual incidence and prevalence of PEs have been reported to be 2.5% and 7.2%, respectively (Linscott and van Os, 2013). PEs are associated with an increased risk for psychotic disorders (Kaymaz *et al.*, 2012), as well as several physical conditions (e.g. angina, asthma, and arthritis) (Moreno *et al.*, 2013), disability (Oh *et al.*, 2018), and all-cause mortality (Sharifi *et al.*, 2015). Therefore, identifying risk factors for PEs is a public health priority.

One potential risk factor that has been little studied to date is sexual orientation. Individuals with a non-heterosexual identity are known to be at high risk for a variety of factors that have been associated with the emergence of PEs [e.g. common mental disorders (CMDs) (Pakula and Shoveller, 2013), substance use (Hagger-Johnson *et al.*, 2013), and stress (Krueger *et al.*, 2018)]. However, to the best of our knowledge, there is only one previous study that has investigated the association between sexual orientation and PEs (Gevonden *et al.*, 2014). This Dutch study including more than 11 200 participants found that lesbian, gay, and bisexual individuals were more likely to report at least one psychotic symptom compared to heterosexuals [odds ratios (OR) 2.30–2.56], and this association was partially mediated by factors such as experiencing discrimination in the past year or living arrangement (i.e. living or not with a partner). Although the findings from this study are of interest, it has several limitations that should be acknowledged. First, the sample only included sexually active persons, and it may thus be difficult to extrapolate the results to the general population. Second, sexual



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orientation (i.e. preceding year) and PEs (i.e. lifetime) were not assessed during the concurrent period. Thus, temporality is difficult to establish. Third, although the mediation analysis included factors such as past-year discrimination and lifetime cannabis use, it failed to include important factors that might potentially play a major role in the association between sexual orientation and PEs. These factors include marital status, education, employment, income, nicotine dependence, alcohol dependence, loneliness, social support, lifetime bullying victimization, perceived stress, stressful life events, CMDs, borderline personality disorder (BPD) traits, posttraumatic stress disorder (PTSD), and sleep problems.

Investigating the role of these factors is important as, for example, non-heterosexual orientation is positively associated with tobacco smoking (Lindström *et al.*, 2014) and alcohol use (Hagger-Johnson *et al.*, 2013) possibly via minority stress and peer norms, while cigarettes (Gage *et al.*, 2014) and alcohol (Tien and Anthony, 1990) have strong psychoactive effects that can increase the risk for PEs. In addition, loneliness and a lack of social support are common in sexual minorities (Doyle and Molix, 2016), both of which may in turn lead to PEs via mental disorders (Smyth *et al.*, 2015; Jaya *et al.*, 2017). Moreover, non-heterosexual orientation is a risk factor for bullying victimization (Berlan *et al.*, 2010), perceived stress (Krueger *et al.*, 2018), and stressful life events (Austin *et al.*, 2016), and these factors may increase the risk for PEs via elevated baseline activity and responsivity of the hypothalamic-pituitary-adrenal (HPA) axis (Beards *et al.*, 2013; Catone *et al.*, 2015; DeVylder *et al.*, 2016). Sexual minorities are also known to be at a particularly high risk for CMDs (Pakula and Shoveller, 2013), BPD traits (Reuter *et al.*, 2016), and PTSD (Roberts *et al.*, 2010), and these associations may be explained by exposure to discrimination, social isolation, and limited mental health service utilization. On the other hand, these mental health conditions are well-known risk factors for subclinical psychotic symptoms (Varghese *et al.*, 2011; Alsawy *et al.*, 2015; Niemantsverdriet *et al.*, 2017). Finally, the prevalence of sleep problems is high in sexual minorities, and this may be explained by a lack of social resources, high levels of distress, and unhealthy behaviors (Chen and Shiu, 2017). Sleep problems may in turn favor the occurrence of PEs via anxiety, depression, and stress (Reeve *et al.*, 2018).

Therefore, the goal of the present nationally representative study using community-based data from the 2007 Adult Psychiatric Morbidity Survey (APMS) conducted in England was to analyze the association between sexual orientation and past 12-month PEs, and to identify the potential mediators involved in this relationship. Given that ~1.1 million people identify themselves as lesbian, gay or bisexual in Britain (Geary *et al.*, 2018), and that access to healthcare is often difficult for sexual minorities (McNamara and Ng, 2016), investigating this association using community-based data is important to obtain a better understanding of the epidemiology of PEs in this setting.

## Methods

### Study participants

This study used data from 7403 people who participated in the 2007 APMS. Full details of the survey have been published elsewhere (Jenkins *et al.*, 2009; McManus *et al.*, 2009). Briefly, this was a nationally representative survey of the English adult population (aged ⩾16 years) living in private households. The National Center for Social Research and Leicester University undertook the survey fieldwork in October 2006 to December 2007 using a multistage stratified probability sampling design where the sampling frame consisted of the small user postcode address file, while the primary sampling units were postcode sectors. Participant information was obtained through face-to-face interviews where some of the questionnaire items were self-completed (with the use of a computer). Sampling weights were constructed to account for non-response and the probability of being selected so that the sample was representative of the English adult household population. The survey response rate was 57%. Ethical permission for the study was obtained from the Royal Free Hospital and Medical School Research Ethics Committee. All participants provided informed consent before their inclusion.

### Measures

#### Sexual orientation (independent variable)

Two items, adapted from the Kinsey scale, were used to measure sexual orientation: (a) 'Which statement best describes your sexual orientation? This means sexual feelings, whether or not you have had any sexual partners.' with answer options 'entirely heterosexual,' 'mostly heterosexual,' 'bisexual,' 'mostly homosexual,' 'entirely homosexual,' and 'other'; and (b) 'Please choose the answer below that best describes how you currently think of yourself…' with answer options 'completely heterosexual,' 'mainly heterosexual,' 'bisexual,' 'mainly homosexual,' 'completely homosexual,' and 'other.' Participants were randomly allocated to item (a) and item (b) in order to analyze the impact of question wording and format on the prevalence of non-heterosexual orientation in the sample. As in a previous APMS publication, the two items were combined, and heterosexual orientation was operationalized as replying 'entirely heterosexual' to the first item or 'completely heterosexual' to the second item (Chakraborty *et al.*, 2011). All other individuals were considered to be non-heterosexual.

#### Psychotic experiences (dependent variable)

The Psychosis Screening Questionnaire (PSQ), which consists of sections on hypomania/mania, thought control, paranoia, strange experiences, and auditory hallucinations, was used to assess PEs in the past 12 months. As in a previous publication using the same dataset, the strictest criteria were used to define the presence or absence of psychotic symptoms in an attempt to capture truly anomalous experiences (Jacob *et al.*, 2018*b*). The questions used in the PSQ can be found in online Supplementary Appendix S1. Any PE referred to the endorsement of at least one of the five types of PE.

#### Mediating variables

These variables were selected based on previous literature (Tien and Anthony, 1990; Berlan *et al.*, 2010; Roberts *et al.*, 2010; Varghese *et al.*, 2011; Beards *et al.*, 2013; Hagger-Johnson *et al.*, 2013; Pakula and Shoveller, 2013; Bauermeister *et al.*, 2014; Gage *et al.*, 2014; Gevonden *et al.*, 2014; Lindström *et al.*, 2014; Alsawy *et al.*, 2015; Catone *et al.*, 2015; McGrath *et al.*, 2015; Mollborn and Everett, 2015; Smyth *et al.*, 2015; Austin *et al.*, 2016; DeVylder *et al.*, 2016; Doyle and Molix, 2016; Reuter *et al.*, 2016; Chen and Shiu, 2017; Jaya *et al.*, 2017; Lunn *et al.*, 2017; Niemantsverdriet *et al.*, 2017; Charlton *et al.*, 2018; Davies *et al.*, 2018; Krueger *et al.*, 2018; Reeve *et al.*, 2018). Specifically, factors that have been reported to be associated with sexual orientation, and can precede or cause PEs were

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selected. These factors were marital status, qualification, employment, income, nicotine dependence, alcohol dependence, cannabis use, loneliness, social support, bullying victimization, perceived stress, number of stressful life events, discrimination due to sexual orientation, CMDs, BPD traits, PTSD, and sleep problems. Loneliness and lack of social support were both considered as separate mediators as they are distinct concepts which do not necessarily correlate. Specifically, loneliness refers to a subjective feeling of being alone, whereas the lack of social support refers to objective social exclusion (Tomaka *et al.*, 2006). Perceived stress and stressful life events were also included as separate mediators as perceived stress refers to a global and dynamic multidimensional subjective concept that is influenced by numerous factors (e.g. sociodemographics, personality, and lifestyle factors), whereas stressful life events refer to specific events that are known to be objectively associated with stress (Feizi *et al.*, 2012).

*Sociodemographic factors.* These included marital status (married/cohabiting or single/widowed/divorced/separated), qualification (having a qualification i.e. degree, non-degree, A-level, GCSE, and other: yes or no), employment status, and income (highest ⩾£ 29 826, middle £ 14 057–<£ 29 826 or lowest <£ 14 057; equivalized income tertiles).

*Nicotine dependence.* Nicotine dependence was assessed using the Fagerström test, a six-item questionnaire (Chabrol *et al.*, 2005). The score of the test ranges from 0 to 10, and a score of ⩾6 indicates dependence to nicotine. A dichotomized variable was created (score ⩾6 or else).

*Alcohol dependence.* Excessive alcohol consumption was screened using the Alcohol Use Disorders Identification Test (AUDIT). Alcohol dependence was assessed with the Severity of Alcohol Dependence Questionnaire in participants with an AUDIT score of 10 or above. Scores of four or above indicated alcohol dependence in the past six months (Jacob *et al.*, 2019).

*Cannabis use.* Cannabis use referred to answering affirmatively to the question 'In the last 12 months, have you taken cannabis?' Data on the frequency of lifetime cannabis use were also available and this variable was dichotomized as <10 or ⩾10 times.

*Loneliness.* Loneliness was assessed with an item from the Social Functioning Questionnaire. Respondents were asked to assess to what extent they had felt 'lonely and isolated from other people' in the past 2 weeks with response options, 'very much,' 'sometimes,' 'not often,' and 'not at all.' In the analyses that follow, these response options were dichotomized with those who responded 'sometimes' and 'very much' being categorized as lonely (Jacob *et al.*, 2019).

*Social support.* This was assessed with a 7-item measure. Using answer options 'not true' (score = 0), 'partly true' (score = 1), and 'certainly true' (score = 2), participants responded to statements which inquired if family and friends did things to make them happy, made them feel loved, could be relied on no matter what, would see that they were taken care of no matter what, accepted them just the way they are, made them feel an important part of their lives, and gave them support and encouragement. Responses were added to create a scale score that could range from 0 to 14. The internal consistency of the scale was good: Cronbach's $\alpha = 0.89$.

*Bullying victimization.* Those who claimed to have been bullied at any time in life were considered to have experienced bullying (Jacob *et al.*, 2018*a*).

*Perceived stress.* Participants were asked if their tasks at home and at work were stressful. Answers ranged from 0 'not at all' to 3 'most of the time.' Stress was then dichotomized into 'not at all' *v.* 'occasionally,' 'usually,' and 'most of the time' (Jacob *et al.*, 2019).

*Stressful life events.* Eighteen items were used to assess different stressful life events (e.g. serious illness, death of an immediate family member, major financial crises) (Jacob *et al.*, 2019). The total number of stressful life events was further calculated for each participant and ranged from 0 to 18.

*Discrimination due to sexual orientation.* Participants were asked if they had been unfairly treated in the past 12 months because of their sexual orientation.

*Common mental disorders.* These were assessed using the Clinical Interview Schedule Revised and referred to depressive episode and/or anxiety disorders (i.e. generalized anxiety disorder, panic disorder, phobia, and obsessive-compulsive disorder) in the past week (Jacob *et al.*, 2019).

*Borderline personality disorder traits.* The presence of the nine diagnostic criteria for BPD was assessed by the Structured Clinical Interview for DSM-IV Axis II disorders. The scores from each of the criteria (yes = 1 and no = 0) were added to create a scale ranging from 0–9 (Cronbach's $\alpha = 0.74$). Following the lead of a previous publication using the same dataset (Kelleher *et al.*, 2017), the cutoff to represent high-BPD traits was based on a figure that corresponds to a prevalence which is approximately 10 times higher than that of BPD (0.4% in this dataset). Specifically, a score of ⩾6 was used as the cutoff to construct the dichotomous variable subsequently used in the analyses, with a score of ⩾6 coded as 1 and a score of <6 coded as 0. Owing to the fact that there were only 16 individuals with BPD in our dataset, we were unable to conduct meaningful analyses with BPD. Thus, rather, we focused on high-BPD traits.

*Posttraumatic stress disorder.* The Trauma Screening Questionnaire was used to examine PTSD symptoms. 'Reliving' of the traumatic event was assessed with five items, while experiencing 'arousal' subsequent to the trauma was assessed with five other items. Each item with an affirmative answer was given one point, and a total score of ⩾6 points out of the possible 10 indicated a positive screen for PTSD, or probable PTSD (Alsawy *et al.*, 2015).

*Sleep problems.* Two questions were used to assess sleep problems: 'In the past month, have you been having problems with trying to get to sleep or with getting back to sleep if you woke up or were woken up?' (sleeping less than usual) and 'Has sleeping more than you usually been a problem for you in the past month?' (sleeping more than usual). Participants were considered as having sleep problems if they reported sleeping less or more than usual.

### Control variables

The present study controlled for sex, age, and ethnicity (British White: yes or no).

## Statistical analyses

Individuals with definitive or probable psychosis were omitted from the analysis as the focus of the study was on PEs not reaching the clinical threshold for a psychosis diagnosis (definition provided in online Supplementary Appendix S2). Differences in the sample characteristics by sexual orientation (heterosexual *v.* non-heterosexual) were tested with $\chi^2$ tests for categorical variables and Student's *t* tests for continuous variables.

We conducted multivariable logistic regression analyses to assess the association between sexual orientation (independent variable) and the individual types of PE and any PE (dependent variables). Sensitivity analysis by the two groups that were

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administered different questions on sexual orientation was subsequently performed. We further conducted mediation analysis to quantify the degree to which the association between sexual orientation and PEs may be explained by factors which can theoretically be mediators in this association. The khb (Karlson–Holm–Breen) command in Stata was used for this analysis (Breen *et al.*, 2013). This method can be applied in logistic regression models and decomposes the total effect (i.e. unadjusted for the mediator) of a variable into direct (i.e. the effect of sexual orientation on any PE adjusted for the mediator) and indirect effects (i.e. the mediational effect). Using this method, the percentage of the main association explained by the mediator can also be calculated (mediated percentage). Each of the 17 mediating factors was included individually in the model.

The regression analyses including the mediation analysis were adjusted for sex, age, and ethnicity. Furthermore, since previous research has found that the association between sexual orientation and mental health disorders differs by sex (Bolton and Sareen, 2011), an interaction analysis was conducted by including the product term of sexual orientation × sex in the models. All variables used in the analyses were categorical variables with the exception of age, social support, and the number of stressful life events. The sample weighting and the complex study design (i.e. strata and primary sampling units) were taken into account in all analyses with the use of the *svy* command in Stata, which relies on the Taylor linearization method. Under 2.0% of the values were missing for all the variables used in our study with the exception of income (20.0%). Complete case analysis was done. The level of statistical significance was set at $p < 0.05$. All analyses were performed with Stata version 13.1 (Stata Corp LP, College Station, Texas, USA).

## Results

There were 7403 people aged ⩾16 years who participated in the 2007 APMS. We excluded 40 people who had probable psychosis from the study. Of the remaining 7363 individuals, a further 88 were excluded due to the lack of information on definitive/probable psychosis and/or sexual orientation. The prevalence of non-heterosexual orientation and any PE was 7.1% and 5.5%, respectively. The sample characteristics are displayed in Table 1. Ethnicity other than British White, single/widowed/divorced/separated, alcohol dependence, cannabis use, loneliness, bullying victimization, perceived stress, discrimination due to sexual orientation, CMDs, BPD traits, PTSD, and sleep problems were more common, and age and social support lower, while the number of stressful life events higher in non-heterosexual than in heterosexual individuals. The prevalence of any PE was 10.6% and 5.1% in non-heterosexual and heterosexual participants, respectively. After adjusting for sociodemographic factors (i.e. sex, age, ethnicity), non-heterosexual orientation was positively associated with any PE [OR 1.99, 95% confidence interval (CI) 1.34–2.93], hypomania/mania (OR 3.66, 95% CI 1.47–9.13), paranoia (OR 2.06, 95% CI 1.17–3.63), and strange experiences (OR 2.19, 95% CI 1.38–3.46; Fig. 1). Interaction analysis further revealed that sex was not a significant effect modifier in the sexual orientation-PE relationship (data not shown). The results of the sensitivity analysis by the two groups that were administered different questions on sexual orientation were similar, and this suggests that the phrasing of the question had little impact on the results. Finally, the results of the mediation analyses are shown in Table 2. The association between sexual orientation and any PE was significantly mediated by BPD traits (mediated percentage = 33.5%), loneliness (29.1%), stressful life events (25.4%), sleep problems (19.1%), CMDs (18.1%), bullying victimization (15.9%), marital status (13.0%), social support (10.5%), perceived stress (8.9%), cannabis use (8.4%), PTSD (8.3%), and alcohol dependence (6.4%). The mediated percentage for cannabis use was 5.9% when frequency (i.e. ⩾ or <10 times in life) was taken into account (data shown only in text). The level of pair-wise correlation between the mediators is shown in online Supplementary Appendix S3. A high level of correlation was not observed for any of the pairs.

## Discussion

### Main findings

To the best of our knowledge, this is one of the first studies to examine the association between sexual orientation and PEs, while it is the first to investigate the potential mediating role played by a wide range of factors in this association. In this nationally representative study of English adults, the prevalence of any PE was around 11% in the non-heterosexual group and 5% in the heterosexual group. The regression analysis adjusted for sociodemographic factors (i.e. sex, age, and ethnicity) further revealed that non-heterosexual orientation was associated with a 2.0-fold increase in the risk for any PE compared to heterosexual orientation. We also found that the association of sexual orientation with hypomania/mania, paranoia, and strange experiences was particularly strong and this suggests that sexual orientation may not impact all types of PEs similarly. Finally, BPD traits, loneliness, and stressful life events explained around 25% to 34% of the sexual orientation-any PE relationship. Substance use had very little influence in the association.

### Interpretation of the findings

The fact that non-heterosexual individuals were at higher risk for PE in our study is in line with the earlier Dutch study which found that non-heterosexual orientation was associated with 2.30–2.56 times higher odds for PE (Gevonden *et al.*, 2014). The results also accord with those of previous studies that have investigated the association between sexual orientation and more severe forms of psychosis. For example, a nationally representative study using data from around 34 700 US participants showed that sexual minorities (e.g. gay and bisexual) were at an increased risk for psychosis, with ORs ranging from 1.99 to 2.70 (Bolton and Sareen, 2011). Another UK study found in more than 7400 adults that there was more than a three-fold increase in the risk for probable psychosis in non-heterosexual individuals compared to heterosexual individuals (Chakraborty *et al.*, 2011).

In terms of the mediators, we found that BPD traits, loneliness, and stressful life events explained more than 25% of the association between sexual orientation and PE, while other factors such as sleep disorders, CMDs, bullying victimization, marital status, and social support explained 10–20% of the association. In contrast, the most important mediator identified in the Dutch study was past-year discrimination due to sexual orientation (34%) (Gevonden *et al.*, 2014). Although we used a similar variable, discrimination due to sexual orientation was not a significant mediator in our study. This discrepancy in the findings highlights the fact that psychosocial factors involved in the sexual

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**Table 1.** Sample characteristics (overall and by sexual orientation)

| Characteristics | Category | Overall | Sexual orientation | | |
|---|---|---|---|---|---|
| | | | Heterosexual | Non-heterosexual | *p* value[a] |
| Sex | Male | 48.7 | 48.8 | 47.4 | 0.582 |
| | Female | 51.3 | 51.2 | 52.6 | |
| Age (years) | Mean (s.d.) | 46.3 (18.5) | 46.7 (18.5) | 40.7 (17.7) | <0.001 |
| British White | No | 14.7 | 14.2 | 21.6 | <0.001 |
| | Yes | 85.3 | 85.8 | 78.4 | |
| Marital status | Single/widowed/divorced/separated | 36.9 | 35.7 | 53.8 | <0.001 |
| | Married/cohabiting | 63.1 | 64.3 | 46.2 | |
| Qualification | No | 23.7 | 23.8 | 22.4 | 0.504 |
| | Yes | 76.3 | 76.2 | 77.6 | |
| Employment | No | 38.9 | 39.0 | 38.1 | 0.713 |
| | Yes | 61.1 | 61.0 | 61.9 | |
| Income | Highest | 36.0 | 36.1 | 35.4 | 0.329 |
| | Middle | 32.6 | 32.8 | 29.8 | |
| | Lowest | 31.4 | 31.1 | 34.9 | |
| Nicotine dependence[b] | No | 97.0 | 97.1 | 95.7 | 0.102 |
| | Yes | 3.0 | 2.9 | 4.3 | |
| Alcohol dependence[c] | No | 92.3 | 92.8 | 85.1 | <0.001 |
| | Yes | 7.7 | 7.2 | 14.9 | |
| Cannabis use | No | 92.5 | 93.2 | 83.9 | <0.001 |
| | Yes | 7.5 | 6.8 | 16.1 | |
| Loneliness | No | 79.8 | 80.8 | 67.5 | <0.001 |
| | Yes | 20.2 | 19.2 | 32.5 | |
| Social support[d] | Mean (s.d.) | 13.2 (1.9) | 13.2 (1.8) | 12.7 (2.4) | <0.001 |
| Bullying victimization | No | 79.7 | 80.7 | 66.1 | <0.001 |
| | Yes | 20.3 | 19.3 | 33.9 | |
| Perceived stress | No | 39.4 | 40.2 | 28.5 | <0.001 |
| | Yes | 60.6 | 59.8 | 71.5 | |
| Number of stressful life events | Mean (s.d.) | 3.5 (2.4) | 3.4 (2.4) | 3.9 (2.9) | 0.001 |
| Discrimination due to sexual orientation | No | 99.5 | 99.9 | 94.3 | <0.001 |
| | Yes | 0.5 | 0.1 | 5.7 | |
| CMDs | No | 92.4 | 92.9 | 88.1 | <0.001 |
| | Yes | 7.6 | 7.1 | 14.0 | |
| BPD traits | No | 96.3 | 97.0 | 88.1 | <0.001 |
| | Yes | 3.7 | 3.0 | 11.9 | |
| PTSD | No | 97.1 | 97.3 | 94.4 | <0.001 |
| | Yes | 2.9 | 2.7 | 5.6 | |
| Sleep problems | No | 57.9 | 58.6 | 48.3 | <0.001 |
| | Yes | 42.1 | 41.4 | 51.7 | |

CMDs, Common Mental Disorders; BPD, Borderline Personality Disorder; PTSD, Posttraumatic Stress Disorder; s.d. Standard Deviation.
Participants were asked about their sexual orientation, and sexual orientation was dichotomized into heterosexual and non-heterosexual (i.e. mostly/mainly heterosexual, bisexual, mostly/mainly homosexual, entirely/completely homosexual, other)
[a]*p* values were based on $\chi^2$ tests except for age, social support, and the number of stressful life events (*t*-tests).
[b]Individuals who do not smoke were included in the category 'no nicotine dependence'.
[c]Individuals who do not consume alcohol were included in the category 'no alcohol dependence'.
[d]The variable on social support ranged from 0 to 14, with higher scores representing higher levels of social support.

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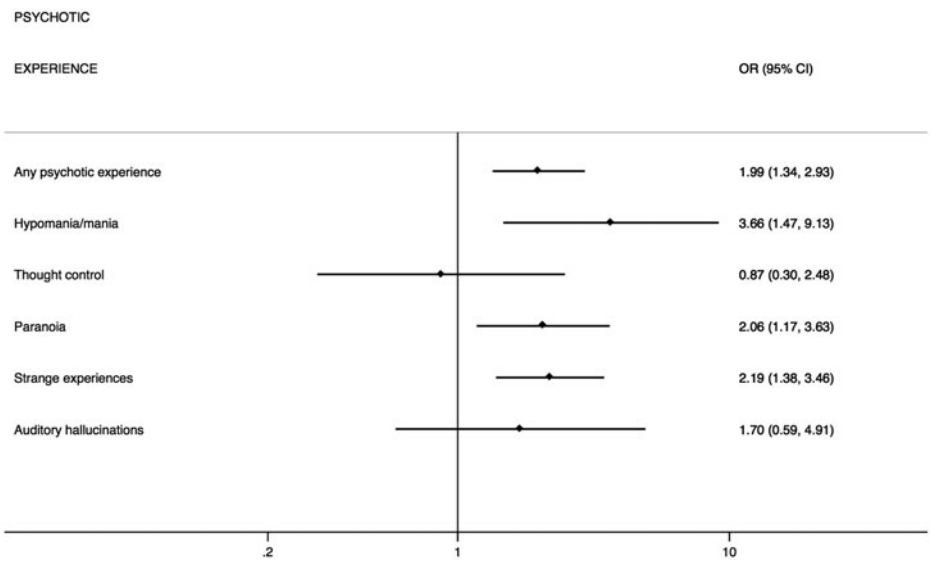


**Fig. 1.** Association between non-heterosexual orientation (exposure) and different types of PEs or any PEs (outcomes) estimated by multivariable logistic regression. OR, odds ratio; CI, confidence interval. Participants were asked about their sexual orientation, and sexual orientation was dichotomized into heterosexual and non-heterosexual (i.e. mostly/mainly heterosexual, bisexual, mostly/mainly homosexual, entirely/completely homosexual, other). Models were adjusted for sex, age, and ethnicity.

orientation-PE relationship may be population or context specific. Regarding substance use, the results of the two studies concur and show that it only plays a minor mediating role.

In our study, stressful life events explained around 25% of the sexual orientation-PE relationship. A longitudinal study conducted in the US and including young adults followed for several years showed that stressful life events (e.g. a life-threatening event, death of a loved one, divorce) were more frequent in bisexual or lesbian and in mostly heterosexual women than in their completely heterosexual counterparts (Austin *et al.*, 2016). On the other hand, a meta-analysis of 16 studies further reported that stressful life events increased the risk for psychotic disorder or subclinical psychosis (OR 3.19) (Beards *et al.*, 2013). The association between stressful life events and PEs likely involves several mechanisms such as negative distortions of perception of the external world and dysregulations of the HPA axis (Beards *et al.*, 2013). Bullying victimization may also be implicated in the sexual orientation-PE association in a similar way. Although some stressful life events and bullying victimization could have occurred for a variety of reasons during childhood and adolescent developmental stages, youths who will later identify as being non-heterosexual may display certain levels of gender non-conformity, and this could make them more susceptible to parental maltreatment at home or peer bullying at school during this formative period (Gevonden *et al.*, 2014).

Loneliness also explained an important proportion of the association between sexual orientation and PEs. A previous study showed that sexual minorities (i.e. mostly heterosexual, bisexual, mostly gay/lesbian, and gay/lesbian) are more likely to be lonely possibly due to marginalization (Doyle and Molix, 2016). In turn, loneliness may lead to PE via depression and other mental disorders (Jaya *et al.*, 2017). Interestingly, despite this finding on loneliness, social support explained the sexual orientation-PE association to a much lesser extent in our study. This may mean that the self-perception of social relationships is more important than actual social ties.

Next, a variety of psychopathology including BPD traits, CMDs, and PTSD has been reported to be more common in non-heterosexual individuals, and this may be due to factors such as chronic environmental invalidation (e.g. negation of emotions, dismissal of cognitive experiences) and disruptions in identity formation (Reuter *et al.*, 2016). On the other hand, PEs are known to be highly prevalent among those with BPD and other psychiatric conditions (Niemantsverdriet *et al.*, 2017). Moreover, an important proportion of non-heterosexual individuals is affected by sleep disorders (Chen and Shiu, 2017), and sleep problems have been reported to induce PEs (Koyanagi and Stickley, 2015). Furthermore, perceived stress is highly frequent in sexual minorities (Krueger *et al.*, 2018), and the association between perceived stress and PEs may involve chronic hyperactivity of the HPA axis (DeVylder *et al.*, 2016). However, it is also important to note that the mediators identified in our study may be operating at multiple levels of the causal pathway. For example, non-heterosexual orientation may lead to increased levels of perceived stress (Krueger *et al.*, 2018), while this in turn, may increase risk for sleep problems (Charles *et al.*, 2011) and a variety of mental disorders (Bergdahl and Bergdahl, 2002), which could lead to the emergence of PEs (Varghese *et al.*, 2011; Reeve *et al.*, 2018). Finally, it is possible that other factors which were not measured in our study may be implicated in the sexual orientation-PE relationship, and these may include factors such as cortisol levels (Collip *et al.*, 2011) and sexually transmitted diseases (Alciati *et al.*, 2001; Fenton *et al.*, 2005).

### Clinical implications and directions for future research

The results of our study showed that PEs in non-heterosexual individuals are likely to be explained, at least in part, by psychosocial factors (e.g. loneliness, stressful life events, bullying victimization) and mental health conditions (e.g. BPD traits, CMDs, PTSD). Clinicians should be aware that these conditions are more common among non-heterosexuals and that these may be underlying factors for PEs. Taken together, our findings highlight the importance of the social context in the sexual orientation-PE relationship. These findings also underline the need for new programs aiming at the improvement of the health, safety, and well-being of sexual minorities. In addition, the lack of acceptance of non-heterosexual individuals may have considerable effects on their health and well-being, and this should be the focus of collective efforts in the future. Finally, further studies that investigate

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**Table 2.** Mediating factors in the association between non-heterosexual orientation (independent variable) and any psychotic experience (dependent variable)

| | Total effect | | Direct effect | | Indirect effect | | |
|---|---|---|---|---|---|---|---|
| Mediator | OR (95% CI) | *p* value | OR (95% CI) | *p* value | OR (95% CI) | *p* value | %Mediated |
| Marital status | 2.01 (1.38–2.93) | <0.001 | 1.83 (1.25–2.69) | 0.002 | 1.09 (1.05–1.15) | <0.001 | 13.0 |
| Qualification | 1.99 (1.37–2.90) | <0.001 | 1.97 (1.35–2.86) | <0.001 | 1.01 (1.00–1.03) | 0.158 | NA[a] |
| Employment | 1.99 (1.36–2.90) | <0.001 | 1.95 (1.33–2.84) | 0.001 | 1.02 (1.00–1.05) | 0.093 | NA[a] |
| Income | 1.88 (1.21–2.92) | 0.005 | 1.83 (1.18–2.84) | 0.007 | 1.03 (0.99–1.07) | 0.163 | NA[a] |
| Nicotine dependence | 1.96 (1.32–2.90) | 0.001 | 1.94 (1.31–2.86) | 0.001 | 1.01 (0.99–1.03) | 0.281 | NA[a] |
| Alcohol dependence | 1.96 (1.34–2.86) | <0.001 | 1.88 (1.28–2.74) | 0.001 | 1.04 (1.01–1.08) | 0.013 | 6.4 |
| Cannabis use | 1.96 (1.34–2.88) | 0.001 | 1.85 (1.26–2.73) | 0.002 | 1.06 (1.02–1.10) | 0.006 | 8.4 |
| Loneliness | 1.90 (1.29–2.81) | 0.001 | 1.58 (1.07–2.33) | 0.022 | 1.21 (1.12–1.30) | <0.001 | 29.1 |
| Social support | 1.96 (1.34–2.87) | 0.001 | 1.83 (1.24–2.68) | 0.002 | 1.07 (1.03–1.12) | <0.001 | 10.5 |
| Bullying victimization | 1.96 (1.35–2.86) | <0.001 | 1.76 (1.21–2.57) | 0.003 | 1.11 (1.06–1.17) | <0.001 | 15.9 |
| Perceived stress | 2.00 (1.38–2.92) | <0.001 | 1.88 (1.29–2.74) | 0.001 | 1.06 (1.02–1.11) | 0.005 | 8.9 |
| Stressful life events | 1.86 (1.27–2.73) | 0.001 | 1.59 (1.08–2.33) | 0.018 | 1.17 (1.08–1.26) | <0.001 | 25.4 |
| Discrimination due to sexual orientation | 1.86 (1.26–2.73) | 0.002 | 1.76 (1.18–2.61) | 0.005 | 1.06 (1.00–1.12) | 0.069 | NA[a] |
| CMDs | 1.89 (1.27–2.82) | 0.002 | 1.68 (1.13–2.52) | 0.011 | 1.12 (1.05–1.19) | <0.001 | 18.1 |
| BPD traits | 1.60 (1.03–2.49) | 0.035 | 1.37 (0.88–2.14) | 0.167 | 1.17 (1.08–1.27) | <0.001 | 33.5 |
| PTSD | 1.92 (1.30–2.86) | 0.001 | 1.82 (1.23–2.71) | 0.003 | 1.06 (1.01–1.11) | 0.025 | 8.3 |
| Sleep problems | 2.03 (1.38–2.97) | <0.001 | 1.77 (1.20–2.61) | 0.004 | 1.14 (1.07–1.23) | <0.001 | 19.1 |

OR, odds ratio; CI, confidence interval; CMDs, Common Mental Disorders; BPD, Borderline Personality Disorder; PTSD, Posttraumatic Stress Disorder.
Participants were asked about their sexual orientation, and sexual orientation was dichotomized into heterosexual and non-heterosexual (i.e. mostly/mainly heterosexual, bisexual, mostly/mainly homosexual, entirely/completely homosexual, other).
Any PE referred to the presence of at least one of: hypomania/mania, thought control, paranoia, strange experiences, and auditory hallucinations.
Models are adjusted for sex, age, and ethnicity.
[a]Mediated percentage was only calculated when the indirect effect was significant ($p$ value < 0.05)

the underlying mechanisms that lead to stronger associations between sexual orientation and certain types of PE are warranted.

### *Limitations*

First, in order to achieve a sample of individuals without clinical psychosis, we used a conservative approach of excluding not only individuals with a definitive psychosis diagnosis but also people with probable psychosis. However, it is possible that some individuals with probable psychosis did not have clinical psychosis, and thus, some individuals without clinical psychosis could have been excluded. Second, the design of this study was cross-sectional, and it was thus not possible to determine causality or temporality in the sexual orientation-PE relationship. Relatedly, mediation and confounding have been found to be statistically identical and distinguished only on conceptual grounds in the context of ordinary least squares regression (MacKinnon *et al.*, 2000). While many of the mediating variables assessed in this study can be conceptualized as mediators, it is not possible to determine whether the attenuation in the ORs after the inclusion of the mediating variable is due to mediation or confounding in our cross-sectional study. Nonetheless, given that the influential factors in the association between sexual orientation and PE are largely unknown, we believe that our study provides an important platform for future longitudinal studies to provide more concrete evidence for the establishment of causality.

## Conclusion

Our findings suggest that there is a positive relationship between non-heterosexual orientation and PEs in the general population in England, and that underlying mechanisms may involve other mental health conditions as well as psychosocial factors. Further studies with a longitudinal design are warranted to understand in more detail, how these factors are implicated in the association between sexual orientation and PEs.

**Supplementary material.** The supplementary material for this article can be found at https://doi.org/10.1017/S003329171900309X.

**Data.** The dataset on which the present study was based is publicly available to all interested researchers but they must make a formal request to the UK data service data repository (https://www.ukdataservice.ac.uk/) where the dataset is stored.

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**Author contributions.** Louis Jacob and Ai Koyanagi designed the study, managed the literature search, undertook the statistical analysis, and wrote the first draft of the manuscript. Lee Smith, Daragh McDermott, Josep Maria Haro, and Andrew Stickley contributed to the design of the study and the intellectual content. All authors contributed to and have approved the final manuscript.

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