Birth characteristics and schizotypy: Evidence of a potential “second hit”

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A R T I C L E   I N F O

Article history:
Received 2 June 2010
Received in revised form
16 November 2010
Accepted 9 December 2010

Keywords:
Schizotypy
Deficit
Schizoid
Schizophrenia
Birth
Winter
Psychosis
Prone

A B S T R A C T

Schizophrenia is associated with a modest increase in winter births as well as increased odds of being born in more densely populated and midrange latitude regions. It is unclear the degree to which these findings hold for individuals with schizotypy, defined in terms of the personality organization that is a potential precursor to schizophrenia-spectrum disorders. This issue is important for understanding whether birth factors contribute to general schizophrenia vulnerability or whether they reflect a secondary “hit” that increases the likelihood of psychosis onset in vulnerable individuals. The present project examined season of birth, birthplace population and birth location in a large group of young adults from the southeastern United States. Individuals with extreme schizotypy scores did not differ from those without schizotypy in season of birth, birthplace latitude or population. However, 60% of individuals within the schizotypy group who reported a diagnosis of schizophrenia or prior hospitalization were born during winter months; a dramatic difference from other individuals within the schizotypy group. We also found that individuals with negative/schizoid traits showed a birthplace population less than half that of other individuals with schizotypy. Season of birth appears to be a “second hit” that is related to expression of psychopathology onset in vulnerable individuals. This finding, and the unexpected inverse relationship between birthplace population and negative/schizoid traits, is discussed.

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1. Introduction

The observation that schizophrenia occurs, at least to some degree, as a function of season of birth and birth location is well documented (Tandon et al., 2008). The season of birth effect involves individuals with schizophrenia showing increased rates of winter, and sometimes early spring births compared to individuals without the disorder (Davies et al., 2003). A number of meta-analytic and large-scale studies suggest odds/relative risk ratios on the order of 1.10 (Davies et al., 2003; Mortensen et al., 1999; Torrey et al., 1997). Birth location is also important for several reasons. First in that midrange latitude regions, typically defined between 30 and 50/60°, are associated with increased schizophrenia rates (Saha et al., 2006). Second, it has been reasonably well established that regions with greater population give rise to increased schizophrenia rates (Mortensen et al., 1999; Sundquist et al., 2004; van Os et al., 2003; van Os et al., 2001). While there are many theories as to how these factors contribute to schizophrenia, including viral activity (Torrey et al., 1988), geothermal activity (Kay, 2004) and procreational habits (Suvisaari et al., 2001) to name a few, the causal mechanism is unclear.

What is beginning to emerge is a picture where birth factors are not necessary or sufficient for causing psychosis, but interact with other genetic or environmental factors to increase the likelihood of psychosis onset. For example, there are a handful of population-based studies to date suggesting that an alarmingly high percentage of individuals with familial liability who are born in urban settings develop psychotic disorders (van Os et al., 2003; van Os et al., 2001). This suggests that population and genetic factors interact to increase psychosis risk. Similarly, it has been found that other factors, such as obstetric complications may interact with season of birth to increase psychosis (Dassa et al., 1996; Jablensky et al., 2005). This is particularly interesting in light of a lack of familial history among patients with a winter season of birth (Dassa et al., 1996; Kinney et al., 2000). Thus, available evidence suggests that birth characteristics reflect an important potential “hit” in the manifestation of schizophrenia.

A critical issue in this line of research concerns the relationship between birth factors and schizotypy. Schizotypy is defined as the personality organization arising from genetic and environmental factors that serves as a potential precursor to schizophrenia-spectrum disorders. Taxometric study of schizotypy suggests that it has
an incidence of approximately 10% in the population (Lenzenweger and Korffne, 1992) and that a sizeable minority of these individuals will develop diagnosable schizophrenia-spectrum disorders (Gooding et al., 2005; Kwapil, 1998) presumably due to the impact of another “hit.” In support of the schizotypy construct, a relatively large literature has been established documenting schizotypia-like anomalies in individuals with schizotypy. Specifically, they tend to show dysfunctions across a range of neurocognitive (Cohen et al., 2006), neurobiological (Holahan and O'Driscoll, 2005; Mohanty et al., 2005), functional (Cohen and Davis, 2009) and genetic (Docherty and Sponheim, 2008) domains regardless of the presence or absence of clinical symptomatology. To date, very little empirical attention has been paid to the question of whether schizotypy is related to season of birth, latitude of birth or birthplace population. This is an important issue for clarifying whether birth characteristics reflect environmental factors that contribute to the general schizophrenia vulnerability state or whether they reflect a “second hit” that promotes the transition to psychosis in individuals already at-risk.

We are aware of two prior studies on birth characteristics in schizotypy. The first examined birth dates in a sample of 513 university students from the Northeast United States (Reid and Zbrowski, 2006). Individuals born during spring showed significantly higher schizotypy scores using the Perceptual Aberration and Magical Ideation Chapman scales (Chapman et al., 1982) compared to individuals born during winter, summer or fall seasons. While this study reflects an important first step in this line of research, it is limited in at least four ways. First, schizotypy was examined dimensionally and only a small subset of the sample would probably be considered “schizotypal” in any meaningful sense. Second, the lack of data on whether subjects had ever been diagnosed with a schizophrenia-spectrum disorder or had been hospitalized did not allow for examination on how season of birth influences the transition from schizotypy to psychosis. Third, other birth characteristics, such as population and location were not considered. Finally, schizotypy was defined in terms of only positive traits, and negative and disorganization traits were neglected. This is particularly important to consider in light of evidence that schizotypy is a heterogeneous construct.

The heterogeneity issue is well illustrated in a study examining schizoid-characteristics in 425 university students from the middle-eastern United States (Kirkpatrick et al., 2008). This study focused solely on negative/schizoid-characteristics – defined in a similar manner as the deficit syndrome of schizophrenia in that negative symptoms are not considered relevant if they manifest with concurrent unpleasant affect (Kirkpatrick et al., 2001). In this regard, a critical feature of schizoid traits is one of apathy, characterized by the lack of anxiety, depression and other forms unpleasant affective states which are commonly present in schizotypy. Individuals born in June/July showed significantly higher schizoid traits compared to other individuals. This supports a finding in the schizophrenia literature that certain individuals with schizophrenia — those with deficit schizophrenia defined in terms of idopathic and enduring negative symptoms (Kirkpatrick et al., 2001), show an increased rate of suicide as opposed to winter birth (Messias et al., 2004). Concerns about this study are similar to the Reid and Zbrowski (2006) study, that it is unclear a) how many of these individuals would actually be considered “at-risk,” b) no “outcome” data was available on prior diagnosis or hospitalization, and c) how the groups differed in birthplace population and location.

The present study examined season of birth and birthplace in a sample of 4281 young adults. Based on research and theory that schizotypy reflects a categorical construct (Lenzenweger, 2006; Meehl, 1962), we compared individuals with extreme schizotypy scores and individuals with relatively normal scores. Additionally, we compared these birth characteristics in individuals with schizotypy who reported a history of psychiatric hospitalization and/or receiving a diagnosis of schizophrenia to those with schizotypy without such a history. Next, we examined the relationship between birth characteristics and schizoid traits to extend the findings of Kirkpatrick et al. (2008). Finally, we conducted exploratory analyses to examine the relationship between birth characteristics and positive, negative and disorganized traits more generally.

2. Methods

2.1. Participants

Participants were University students enrolled at some point during Spring 2007–2009. During three separate screens, questionnaires were sent to nearly all freshman and sophomores on campus. Response rates for the first (20%; 1775 of 8993), second (17%; 1507 of 8991) and third (27%; 2145 of 7953) screens were adequate. Of these responses, a subset was unusable or invalid due to incomplete responses or an infrequency score greater than two using the Chapman Infrequency Scale (Chapman and Chapman, 1983). The valid samples were comprised of 1395, 1356 and 1691 cases from the first, second and third screening respectively (Total N = 4442). Included in the assessment were the Schizotypal Personality Questionnaire (see below), the Brief Symptom Inventory (BSI; Derogatis and Melisaratos, 1983) and descriptive and demographic information including sex, age and birth date. In two of the three screenings, subjects were asked to detail their birthplace, whether they had ever been diagnosed with a schizophrenia disorder (yes/no) and whether they had ever received inpatient psychiatric treatment (yes/no). Demographic and descriptive variables are included in Table 1. This study was approved by the LSU Human Subject Review Board and all subjects offered informed consent prior to completing the surveys.

Our methodology allowed some individuals to potentially complete the assessment multiple times. Unfortunately, our method of ensuring confidentiality limited our ability to identify cases when this occurred. We adopted a conservative strategy for eliminating the possibility that an individual’s data was represented more than once. Any cases with identical birth date, sex, ethnicity and birthplace (when available) data were excluded (n = 522). We recomputed all analyses with these cases included and neither the significant nor the non-significant results changed.

2.2. Schizotypal traits

Schizotypal traits were assessed using one of three versions of the Schizotypal Personality Questionnaire (corresponding to the three different screening procedures detailed in section 2.1), either the full version (n = 1130; Raine, 1991), the brief version (n = 1110; Raine and Benishay, 1995) or a revised brief version (n = 1680; Cohen et al., in press). Each version has demonstrated good psychometric properties and has been used in a number of prior schizotypy studies. The sole difference between the versions of the SPQ are the number of items, with the full version having 74 statements, the brief having 22 items and the revised brief version having 34 items. SPQ items mirror the diagnostic criteria of DSM-IV schizotypal personality disorder (American Psychiatric Association, 1994) and measure a broad range of positive, negative and disorganized schizotypy traits. The original SPQ employs a forced choice “yes” or “no” response format. To address concerns that dichotomous response formats are insensitive to degrees of symptom severity (Peltier and Walsh, 1990; Wuthrich and Bates, 2005), we adopted a five-point likert scale system (Wuthrich and Bates, 2005) for each of the SPQ measures in this study. Subjects response
options ranged from “Strongly Disagree” to “Neutral” to “Strongly Agree.” The likert scale version of the SPQ has shown high convergence and improved internal reliability (α = .95) when administered in either computer or standard paper and pencil versions compared to the original version. To facilitate comparison of scores from the three different versions of the SPQ employed here (each having different means and variances), we converted scores to z-score format separately for each parent database. It is important to note known individual differences in sex and ethnicity related to SPQ scores (Mata et al., 2005). While some of these differences in scores may reflect processes related to schizotypy, the differences may also reflect extraneous noise, such as cultural interpretation, religiosity, impression management, socialization or other constructs distal to schizotypal pathology. For this reason, we adopted a conservative strategy and computed SPQ scores as control and extraneous processes related to schizotypy, and schizotypal pathology. In effect, the scores reflect the degree to which individuals have negative symptoms in the absence of negative affect (i.e., depression, anxiety). This is meant to approximate the Proxy for Deficit Syndrome scores used in prior schizophrenia studies (Kirkpatrick et al., 1993).

2.3. Birthplace data

Date of birth was collected for all subjects. This data was organized into standard winter (December 22–March 21), spring (March 22–June 21), summer (June 22–September 21) and fall (September 22–December 21) seasons. Consistent with the prior study of season of birth in schizotypy (Reid and Zborowski, 2006), we also examined month of birth and Summer-Fall versus Winter-Spring birth dichotomized. Subjects in two of the three samples provided the city and state where they were born (n = 2790). We derived two separate variables from this data. First, birthplace was coded in terms of latitude coordinates in order to quantify distance born from the equator. Second, we computed birthplace population using 1990 US census data (covering the approximate year that nearly all individuals in this study were born) for each individual.

2.4. Analyses

The analyses were conducted in five steps. First, we computed basic descriptive statistics on birth characteristics for our sample. Second, we compared the schizotypy and control groups on descriptive and demographic variables. Third, we compared these groups on birthplace data — including season of birth, birthplace population and latitude coordinates of birthplace. Fourth, we compared birthplace variables between individuals within the schizotypy group who reported having a diagnosis of schizophrenia or a history of psychiatric hospitalization versus those without either. Fifth, we examined the relationship between schizoid traits and birth characteristics two different ways. First, we duplicated the procedures in Kirkpatrick et al. (1993) where schizoid traits were compared between people born in June–July (n = 279) versus other months (n = 1076) in all individuals with SPQ cognitive-perceptual scores at or above the mean. We also computed Spearman’s correlations between schizoid scores and birthplace population and latitude in this same subset of the sample. Next we recomputed the same tests in a more refined subset of the sample comprised solely of individuals with extreme schizotypy scores (defined as SPQ-total score > 1.65). Cohen’s d values are reported when appropriate. Finally, we conducted exploratory analyses examining the relationship between positive, negative and disorganization traits and birthplace characteristics. Individuals with different seasons of birth were compared in positive negative and disorganized traits. We also computed correlations between birthplace population and latitude and positive, negative and disorganized traits. Birth population and latitude were highly skewed (skew value > 2.00). Non-parametric statistics were used for analyses examining these variables. Otherwise, all continuous
variables examined here were normally distributed. All analyses were two-tailed.

3. Results

3.1. Descriptive statistics for birth characteristics

Subjects overall showed a slight increase in summer births ($n = 1031, 26\%$) over winter ($n = 935, 24\%$), spring ($n = 964, 25\%$) and fall ($n = 975, 25\%$) births. Most of the subjects were born between 20 and 30 ($n = 883, 33\%$) and between 31 and 40 ($n = 1622, 60\%$) degrees latitude. Few subjects were born above $40^\circ$ ($n = 155, 6\%$) or below $20^\circ$ ($n = 40, 1\%$). There was variability across birthplace population, with approximately $42\%$ ($n = 1032$) of individuals being born in a metropolitan area of more than 1 million people (according to 1990 US census), $41\%$ ($n = 1000$) being born in a smaller metropolitan area ($250,000$ people or less), and the remainder being born in smaller or rural areas ($n = 426; 17\%$).

3.2. Schizotypy versus controls: descriptive and demographic variables

Table 1 contains the descriptive and demographic variables for the schizotypy and control groups. The groups did not differ in age or parental education. We did not compare the groups on sex or ethnicity given that these variables were controlled for when deriving SPQ scores for group categorization. The schizotypy group had significantly poorer school performance, higher SPQ scores, and a dramatically higher proportion of individuals reporting a prior diagnosis of schizophrenia or psychiatric hospitalization.

3.3. Schizotypy versus controls: birth characteristics

Fig. 1 contains the percentage of individuals from the schizotypy and control groups born from each season. Statistically significant differences were not observed ($X^2 [3] = 2.37, p = .50$). As a post-hoc analysis, we compared the groups on birth month ($X^2 [11] = 3.14, p = .99$) and birth half-year ($X^2 [2] = .17, p = .68$) and still found no significant effects. These three analyses mimic the methods of the previous schizotypy and season of birth investigation (Reid and Zborowski, 2006).

Table 2 contains the information regarding group comparisons on other birth characteristics. The schizotypy and control groups did not significantly differ in birth latitudes or birthplace raw population.

3.4. Within schizotypy: comparing those with diagnosis/hospitalization to those without on birth characteristics

Approximately $15\%$ of the schizotypy sample reported a history of schizophrenia diagnosis and/or being psychiatric hospitalized ($n = 18$). Interestingly, these individuals showed a dramatic increase in winter births compared to individuals from the schizotypy group without a history of diagnosis or hospitalization ($n = 101$) ($X^2 [3] = 12.55, p = .01$). As seen in Fig. 2, nearly $60\%$ of hospitalized/diagnosed individuals versus $20\%$ of the other schizotypy individuals were born in winter months. Examination of the hospitalization ($X^2 [3] = 10.10, p = .01$) and diagnosis ($X^2 [3] = 11.41, p = .01$) variables separately from the smaller sample that provided birth location data revealed they were each associated with an increase in winter births. No significant differences were seen between these two groups in birth latitude ($t [64] = .84, p = .40$) or birthplace population ($t [67] = .107, p = .29$).

3.5. Within schizotypy: comparing those with negative/schizoid traits to those without on birth characteristics

Our first comparison of individuals born in June/July versus those born in other months yielded no significant differences in schizoid scores ($t[1301] = .77, p = .44$). Severity of schizoid traits corresponded to having a birthplace with a lower population (Spearman’s $r [1171] = -.06, p < .05$) but was unrelated to birth latitude ($r [1270] = .01, p = .67$). We next recomputed these analyses on a subset of the sample comprised of individuals with extreme schizoid scores. There were no significant differences in schizoid scores whether compared across season of birth ($F [3, 127] = 1.76, p = .16$) or being born in June–July versus other months ($t [129] = .21, p = .83$). Within the schizotypy group, schizoid scores corresponded to lower birthplace population (Spearman’s $r [118] = -.20, p < .05$) but were unrelated to birth latitude ($r [129] = .11, p = .23$). Birthplace population in individuals with extreme schizoid scores ($z$-score $> 1.65, n = 19, p = 0.05$) was less than half that of other schizotypic individuals (population $M \pm SD = 164,481 \pm 158,513$) was less than half that of other schizotypic individuals (population $M \pm SD = 349,903 \pm 731,893$). In short, schizoid traits were associated with birthplace in dramatically less populated areas, but were not associated with an identifiable season of birth or latitude effect.

3.6. Exploratory analyses examining the relationship between positive, negative and disorganized schizotypy traits and birth characteristics

A series of ANOVAs were computed comparing subjects born in summer, fall, winter and spring seasons in level of positive, negative and disorganized traits. None of these analyses approached statistical significance (all $F$s $< .64, p$s $> .59$). Correlations were then computed between positive, negative and disorganization trait scores and the population and latitude variables. Only one value was statistically significant: negative traits were associated with decreased birth population ($r[2468] = -.05, p < .05$). No other correlations were statistically significant ($r$s $< .04, p$s $> .05$). Thus, outside of the relationship between negative traits and reduced birthplace population, there were no notable findings from this set of analyses.

4. Discussion

The present study examined season of birth, location of birth and birthplace population in a large group of young adults living in the southeastern United States who were assessed across positive, negative and disorganized schizotypy traits. We found that schizotypy was not associated with any birth characteristic: there was no increase in winter births, no increased population of birth location and no birthplace population effect. This would suggest that prenatal or perinatal factors, at least those related to the variable examined here, do not contribute much to a generalized.
959

schizophrenia vulnerability as evidenced by schizotypal character-
istics. Given recent findings that genetic anomalies are associ-
ated with schizophrenia (Docherty and Sponheim, 2008), genetic
factors, as opposed to birthplace ones seem a likely culprit con-
tributing to schizophrenia.

The most striking finding from this project was that winter birth
was dramatically high in individuals who reported both schizotypy
and a history of psychiatric hospitalization and/or schizophrenia
diagnosis. Nearly sixty percent of these individuals were born in
winter months. This finding is consistent with the manifest litera-
ture documenting a season of birth effect in individuals with full-
blown schizophrenia (Davies et al., 2003; Mortensen et al., 1999;
Torrey et al., 1997). Taken with the null relationships between
birth characteristics and schizotypy more generally, these results
suggest that season of birth influences illness trajectory - but only
as a “second hit”. That is, other genetic or environmental factors
give rise to the vulnerability state but being born during winter
months constitutes a factor that promotes development of
psychopathology. Our data provide evidence that latitude and
population size are not associated with transition to psychosis and
that season of birth may have relative specificity as a birthplace
characteristic associated with expression of psychopathology.

Similar to what we observed in schizotypy, we did not find
a season of birth effect with schizoid traits. Interestingly, we did find
that schizoid individuals tended to be born in regions that were
dramatically less densely populated. Our group comparison sug-
gested that the birthplace populations were half that for schizoid
versus other schizotypic individuals. While the reasons for this are
not immediately clear, there are a number of interesting possibili-
ties. For example, it could be that schizoid traits reflect genetic
factors conferred from biological parent to probands. Parents of the
schizoid individuals presumably chose to live in less densely
populated regions, a decision that could reflect genetically related
schizoid-like attitudes in the parents. In support of this, approach
motivations and extraversion, two constructs related to social drive
have shown modest heritability (Buckholtz et al., 2008; Jang et al.,
1996). Schizoid traits could also reflect non-genetic familiar
factors, where schizoid attitudes are conferred via social learning
from family members or from a relative lack of opportunity for social
engagement. Behavioral genetics studies have also demonstrated
a modest contribution of environmental genetic factors for extra-
version, so this interpretation does not seem out of the realm of
plausibility (Jang et al., 2002, 1996). Further research clarifying the
relationship between population and schizoid traits is called for.

Our data did not replicate the season of birth effects reported in
prior schizotypy studies (Kirkpatrick et al., 2008; Reid and
Zborowski, 2006), and the reasons for this are not entirely clear.
Both prior studies conducted dimensional examination, and it
seems that only a minority of subjects in these studies were
schizotypic or schizoid in any meaningful sense. What may have
been examined in these studies is an individual difference
regarding eccentricity or social drive – an individual difference
with unclear relevance to psychosis-proneness more generally. It
is also possible that the season of birth effect is only pronounced
in higher latitude regions than were examined here. The majority of
subjects examined in both prior studies were from regions with
a latitude of forty degrees or higher whereas most individuals in the
present study were from a latitude of approximately thirty degrees.
This becomes an issue as individuals in this study were largely born
in a subtropical region with relatively mild winters. Subtropical
regions may be protective in some fashion. Increased winter season
of birth effects have been reported for schizophrenia in subtropical
and tropical regions in some (Munoz-Delgado et al., 2003), but
not all studies (CarriAn-Baralt et al., 2006; de Messias et al., 2001),
and it is unclear whether birthplace region affected the season of birth
effect. This is an interesting issue for future research.

Consistent with prior research (Gooding et al., 2005; KwapiI,
1998), schizotypy was associated with increased risk for psychi-
atric complications and diagnosis of schizophrenia. In the present
study, individuals from the schizotypy group reported a near ten-
fold increase in psychiatric hospitalization or in being diagnosed
with a schizophrenia disorder. This is particularly startling in that
individuals in this study were by and large just entering the
window of risk. Thus, this figure is likely an underestimate for the
number of individuals who will eventually develop a full-blown
schizophrenia-spectrum disorder or require psychiatric treatment.
It is important to keep in mind that our figures are based on self-
report which may be limited by autobiographical memory, insight
and willingness to acknowledge psychopathology. Interestingly,
some studies have reported that self-report is superior to inter-
view-based assessment in that individuals may be reluctant to
describe their illness accurately when facing an interviewer (Kessler et al., 1995;
Mond et al., 2007). Our use of self-report data here offers a unique perspective
that should be cross-validated with other types of data in future studies.

Limitations of the present project warrant mention. First, three
different versions of the SPOQ were used to measure schizotypy
traits. While each measure has empirical support for this purpose,
their aggregate use may have introduced unintended noise into our
analyses and reduced our overall power. Second, the sample

| Table 2
<p>| Birthplace Population and location data compared for Schizotypy and Control groups. |</p>
<table>
<thead>
<tr>
<th>Schizotypy (n = 121)</th>
<th>Controls (n = 2067)</th>
<th>Test statistic</th>
<th>Cohen’s d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birthplace location</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Latitude</td>
<td>31.56</td>
<td>4.54</td>
<td>30.61</td>
</tr>
<tr>
<td>Raw population</td>
<td>34,115.00</td>
<td>723,648.00</td>
<td>30,584.00</td>
</tr>
</tbody>
</table>

* Mann-Whitney U test, not statistically significant.
comprised undergraduate students who may not be representative of all individuals with schizotypy. Third, the sample was over-represented by females, and this may limit generalizability. Fourth, sample sizes differed across the various analyses, which may complicate interpretation in that our analyses had different levels of power. Finally, as noted above, our measures were based on self-report, which is but one mode of assessment.

The present data holds potentially important insights regarding the epidemiology of psychosis-proneness and the manifestation of schizophrenia. Replication of the lack of relations between birth characteristics and schizotypy and schizoidia are needed, particularly from alternate regions of the world. Future research should also help to explain how winter and psychotic symptoms are related and why individuals with schizoid traits tended to be born in regions of low population.

Role of funding source

Funding for this study was provided by an internal University grant to the first author and by the Louisiana Board of Regents; the funding agency had no further role in study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

Contributor

Alex S. Cohen designed the study and wrote the protocol. Alex S. Cohen managed the analyses, and wrote the first draft of the manuscript. Both authors contributed to and have approved the final manuscript.

Conflict of interest

None declared.

Acknowledgements

The authors wish to acknowledge the efforts of Kyle Minor, Laura Brown, Bianca Iglesias and the research participants who made this study possible.

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