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Positive schizotypy predicts migration intentions and desires

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ABSTRACT

Researchers have long noted higher rates of schizophrenia among immigrants, although it's not clear why this is the case. One possibility is that there is something about the process of migration itself that causes increased rates of schizophrenia. Another possibility, referred to as *selective migration*, is that people who are predisposed to schizophrenia are more likely to migrate. Multiple recent publications have denied that selective migration plays a role in explaining increase rates of schizophrenia among migrants. We challenge this claim, reviewing evidence that positive schizotypy, a longitudinal predictor of psychosis, is associated with an increased tendency towards exploration. We hypothesize that this increased exploration also results in an increased tendency to migrate. We present the results of a pre-registered study (N = 235) showing that positive schizotypy uniquely predicts migration intentions/desires when all three schizotypy factors are included in a regression.

1. Introduction

Researchers have long noted higher rates of schizophrenia amongst migrants and their recent descendants (Ødegård, 1932; Rosenthal et al., 1974). Recent meta-analyses have found that this effect is robust and is independent of the country of origin of the migrants, suggesting that it is not a byproduct of national differences in the prevalence of schizophrenia (Henssler et al., 2019; Selten, van der Ven, & Termorshuizen, 2019). This leaves two possible explanations. First, it may be that individuals predisposed to schizophrenia are more likely to migrate. We will refer to this as the *selective migration hypothesis*. On the other hand, it may be that something about the experience of immigration itself causes increased rates of schizophrenia. Although there are many versions of this latter hypothesis, we will refer to the general idea that the experience of immigration causes higher rates of psychosis as *immigration-induced psychosis*. These two hypotheses are not mutually exclusive and some combination of factors could be at play. In recent years, most researchers studying schizophrenia and immigration have been proponents of some form of immigration-induced psychosis (Abed & Abbas, 2011; Dykxhoorn & Kirkbride, 2019; Henssler et al., 2019).

Multiple recent papers have suggested that selective migration plays little to no role in causing increased rates of psychosis among migrants (Dykxhoorn & Kirkbride, 2019; Henssler et al., 2019; Selten et al., 2019). For example, Selten et al. (2019) suggest that selective migration is not important because migrants are often more somatically healthy than native populations. However, if migrants self-select based on a characteristic that is uniquely predictive of psychosis (rather than any other negative health outcomes) then the increased somatic health among migrants is irrelevant. As we will argue below, self-selection for high levels of positive schizotypy fits this description. Selten et al. (2019) also suggest that because the entire population of Ethiopian Jews migrated to Israel, selective migration cannot explain the increased rates of psychosis in this population. While this may be true, it doesn't rule out selective migration playing any role in other populations. In explaining the increased rates of psychosis among migrants, Henssler et al. (2019) don't mention the selective migration hypothesis. They suggest that discrimination and social exclusion underlie the increased rates of psychosis among immigrants, but do not consider any evidence for or against selective migration. In a recent review, Dykxhoorn and Kirkbride (2019) suggest that the selective migration hypothesis has been "strongly refuted". As this is the position that most researchers in the literature tend to take, we will consider Dykxhoorn and Kirkbride's (2019) argument in some detail. They consider three papers as evidence for the claim that selective migration has been refuted.

Using historical data provided by the local statistics bureaus, Selten, Cantor-Graae, Slaets, and Kahn (2002) conducted analyses on a hypothetical situation in which they calculated rates of psychosis among Surinam immigrants to the Netherlands *as if* the entire population of

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Surinam had immigrated. The logic behind this analysis was that if rates of psychosis were still elevated among Surinam immigrants when calculating those rates with an artificially expanded population size (i.e., a population size equivalent to the entire Surinam population, including those who hadn't actually migrated), then selective migration couldn't possibly be the only factor involved in causing the increased rates of psychosis in this population. When calculating rates with this artificially expanded population size, Selten et al. (2002) found that rates of psychosis in the immigrant population were still elevated among men, but not women. While Selten et al.' (2002) analysis does rule out selective migration as the sole explanation for the increased rates of psychosis among male Surinam immigrants, it does not rule out the possibility that selective migration accounts for *some* of the increased risk, which is what the selective migration hypothesis actually claims. As such, Selten et al.' (2002) analysis does not constitute strong evidence against the selective migration hypothesis.

The second paper cited by Dykxhoorn and Kirkbride (2019) assessed the prevalence of pre-morbid risk factors for schizophrenia among Swedish individuals who later emigrated (van der Ven et al., 2015). The risk factors included low IQ, poor social adjustment, disturbed behavior, non-psychotic psychiatric disorder, cannabis use, urban upbringing, childhood trauma, and a parental history of non-affective psychosis or bipolar disorder. The researchers found that, when analyzing all of these risk factors together, they do not significantly predict migration decisions. However, most of these risk factors are relatively peripheral and non-specific to the development of schizophrenia (e.g., low IQ, poor social adjustment, childhood trauma). In other words, most of these variables are associated with *general dysfunction* rather than psychosis per se (former diagnosis and parental history of diagnosis being exceptions), and thus including them in the analysis may obscure a real relationship between psychosis risk and migration decisions if that relationship is confounded by general dysfunction. In other words, if factors specific to psychosis-risk *increase* the propensity to migrate but factors associated with general dysfunction *decrease* the propensity to migrate, then the analysis will be confounded by factors associated with general dysfunction. We will argue below that the construct of *positive schizotypy* constitutes a set of traits which predisposes to psychosis (in a relatively specific way) and which is not associated with general dysfunction.

The third paper cited by Dykxhoorn and Kirkbride (2019) tested whether delusional ideation (a construct related to positive schizotypy) or manic symptoms were correlated with aspirations and/or plans to migrate (Lundberg, Cantor-Graae, Kahima, & Östergren, 2007). We will consider this study in some detail since our own study is very similar to it. Lundberg, Cantor-Graae, Kahima, and Östergren (2007) found that delusional ideation was significantly related to aspirations, but not plans, to migrate, while manic symptoms were related to neither. The primary limitation of this study is that it was massively underpowered to detect an effect. The sample size was 129, which might have been enough had the authors of the study not decided to dichotomize their predictor variables by using a median split. That is, instead of using the continuous raw data for the measures of delusional ideation and manic symptoms, they conducted a median split and analyzed the data in terms of "high" and "low" levels of these traits. Although dichotomizing a continuous variable may serve to simplify the analysis, it comes at the cost of severely reducing statistical power (Altman & Royston, 2006). As a result of the relatively small sample size and their choice to dichotomize the predictor variables, the margins of error for this study were extremely wide. For example, the adjusted odds ratio (95% confidence interval) for one measure of delusional ideation predicting plans to migrate was 0.6–5.8. The other odds ratios were similarly wide. Therefore, the null results in this study cannot distinguish the lack of a true effect from a type II (i.e., false negative) error. Although Dykxhoorn and Kirkbride (2019) cite this study as a refutation of the selective migration hypothesis, it should not be taken as evidence either for or against it.

1.1. Positive schizotypy and exploration

Schizotypy represents a cluster of traits which predispose to psychosis. Schizotypy is usually thought to have three factors: positive, negative, and disorganized schizotypy (Fossati, Raine, Carretta, Leonardi, & Maffei, 2003; Reynolds, Raine, Mellingen, Venables, & Mednick, 2000). Positive schizotypy consists of having unusual experiences (e.g., paranormal), magical thinking (e.g., believing in extra-sensory-perception), and ideas of reference (e.g., believing that the television or radio is transmitting special messages to you). Negative schizotypy consists of social anhedonia and constricted affect. Disorganized schizotypy consists of odd behavior, appearance, and speech (e.g., having an odd appearance or rambling in one's speech). A ten-year longitudinal study found that positive and negative schizotypy uniquely predicted the onset of schizophrenia-spectrum disorders, although the authors didn't test this for disorganized schizotypy (Kwapil, Gross, Silvia, & Barrantes-Vidal, 2013). Of these three, only negative and disorganized schizotypy are unambiguously associated with social and psychological dysfunction (Mohr & Claridge, 2015). On the other hand, positive schizotypy is often associated with creative and imaginative talent, especially in relation to artistic endeavors (Holt, 2015, 2019; Nettle, 2006). Besides its association with creativity, positive schizotypy has been correlated with subjective well-being and there is evidence that people who are high in positive schizotypy but low in the other two factors represent a healthy subtype that can derive benefits from their unusual experiences (Mohr & Claridge, 2015). As Nettle and Clegg (2006) argue, when the cognitive style characteristic of positive schizotypy is coupled with stable neurodevelopment (e.g., low levels of deleterious mutations in the genome, benign environmental conditions) the result may be a healthy manifestation of positive schizotypy that predisposes to creativity. On the other hand, when people high in positive schizotypy have unstable genetic or environmental conditions, this can lead to unhealthy (i.e., negative and disorganized) schizotypy and to schizophrenia. This means that positive schizotypy on its own is neither positive nor negative from a health perspective, but can manifest in healthy or unhealthy ways depending on the genetic and environmental context.

All organisms are perpetually faced with the problem of deciding whether they should exploit their current opportunities or search for better ones (Del Giudice & Crespi, 2018; Mehlhorn et al., 2015). Should I continue hunting in this area or move on to more fertile hunting grounds? Should I buy the car being advertised to me or continue my search? Should I marry the person I'm currently dating or keep looking? These exploration-exploitation tradeoffs are ubiquitous in human life and in nature more generally (Mehlhorn et al., 2015). In this section we present evidence that positive schizotypy is related to a general exploratory tendency. This connection between exploration and positive schizotypy constitutes the basis for our prediction that positive schizotypy will be related to migration intentions and desires. It stands to reason that somebody with an increased propensity for exploration will be more willing to leave their birthplace and move somewhere new.

In a study that tested predictions based on the diametric model of autism and psychosis, Del Giudice, Klimczuk, Traficonte, and Maestripieri (2014) found evidence for increased exploratory behavior in people with high positive schizotypy. The diametric model of autism and psychosis posits that autism spectrum disorders and psychosis spectrum disorders are cognitive and genetic opposites (Crespi & Badcock, 2008). The diametric model also suggests that non-social autistic traits and positive schizotypy represent opposite ends of a single continuum. It predicts that autistic-like traits and positive schizotypy should have opposite correlations (i.e., one should be positive, the other negative) with many psychological constructs (Crespi & Badcock, 2008; Del Giudice et al., 2014; Dinsdale, Hurd, Wakabayashi, Elliot, & Crespi, 2013). For example, autistic-like traits and positive schizotypy have been found to be oppositely related to measures of imagination, mentalizing, attention styles, spirituality, susceptibility to visual illusions, and

impulsivity (Abu-Akel, Apperly, Spaniol, Geng, & Mevorach, 2018; Abu-Akel, Wood, Hansen, & Apperly, 2015; Crespi & Dinsdale, 2019; Crespi, Dinsdale, Read, & Hurd, 2019; Crespi, Leach, Dinsdale, Mokkonen, & Hurd, 2016; Del Giudice et al., 2014). Since the diametric model suggests that autistic-like traits and positive schizotypy should form a bipolar continuum, Del Giudice et al. (2014) used principal components analysis (PCA) to extract a bipolar autism-schizotypy variable (the second unrotated component) from data that included measures of both autistic-like traits and schizotypy. Higher scores on the autism-schizotypy variable represent higher positive schizotypy, while lower scores represent higher levels of non-social autistic-like traits. Del Giudice et al. (2014) found that the autism-schizotypy variable was positively correlated with the Big Five traits of Openness and Extraversion. Openness and Extraversion are reliably correlated with each other and their shared variance forms a higher-order factor of the Big Five called Plasticity (DeYoung, Peterson, & Higgins, 2002; Digman, 1997), which has been characterized as a general tendency towards exploration (DeYoung, 2015). That positive schizotypy was associated with increased Openness and Extraversion therefore provides some evidence for an increased exploratory tendency. Del Giudice et al. (2014) also found that the autism-schizotypy variable was correlated with a measure of sensation-seeking, which has also been characterized as representing increased exploration (DeYoung, 2013).

Further evidence for a link between positive schizotypy and exploration comes from research on latent inhibition. Latent inhibition represents the tendency to screen from conscious awareness information which has previously been deemed irrelevant (Carson, 2010; Kumari & Ettinger, 2010). Evidence suggests that positive schizotypy and the positive symptoms of psychosis are associated with *reduced latent inhibition* (Carson, 2018; Gray, Fernandez, Williams, Ruddle, & Snowden, 2002; Kumari & Ettinger, 2010). People with reduced latent inhibition are less able to focus on the task at hand because they are constantly directing their attention towards information that is irrelevant to the current task. However, this diffuse, distractible style of attention has also been associated with increased creativity because screening information that *seems* irrelevant from conscious awareness may prohibit making the kind of distant connections that facilitate creative thinking (Carson, 2018). There is evidence that reduced latent inhibition predicts the future onset of psychosis when accompanied by low cognitive ability but leads to increased creative achievement when accompanied by high cognitive ability (Carson, Peterson, & Higgins, 2003).

The distractible attention style associated with low latent inhibition is plausibly related to increased exploratory behavior. Those with low latent inhibition will tend to be drawn away from their current pursuits because their perceptual system is constantly presenting them with attractive but distracting alternatives. Indeed, two studies have found that low latent inhibition is associated with increased Plasticity, indicating an increased tendency towards exploration for those with reduced latent inhibition (Peterson & Carson, 2000; Peterson, Smith, & Carson, 2002).

Positive schizotypy (Mohr & Ettinger, 2014), Plasticity (DeYoung, 2013), and low latent inhibition (Young, Moran, & Joseph, 2005) have all been associated with hyper-dopaminergic functioning. DeYoung (2013) reviewed theoretical and empirical evidence which suggest that dopamine can rightly be characterized as "the neuromodulator of exploration." Thus, the increased exploratory behavior associated with positive schizotypy may be mediated by hyper-dopaminergic functioning (DeYoung, 2013).

The decision to migrate has been associated with higher levels of Plasticity (Canache, Hayes, Mondak, & Wals, 2013; Ciani & Capiluppi, 2011; Fouarge, Özer, & Seegers, 2019; Jokela, 2009), suggesting that a hyper-exploratory tendency predisposes to migration. In light of these considerations, we predicted that positive schizotypy would be associated with increased desires and intentions to migrate. This prediction was pre-registered on the Open Science Framework (See Appendix 1).

The diametric model of autism and psychosis suggests that autistic-like traits should be associated with a *reduced* propensity to migrate. In consideration of the diametric model, we also included a measure of autistic-like traits in our study. Our plan was to replicate previous studies in which a bipolar autism-schizotypy variable is extracted using PCA from data in which both schizotypy and autistic-like traits have been measured (Del Giudice et al., 2014; Dinsdale et al., 2013). However, the reliability of our measure of autistic-like traits (the Autism Quotient; AQ) was so low that this data was unusable. At least one other study has found sub-par reliability for the AQ (Hurst, Mitchell, Kimbrel, Kwapil, & Nelson-Gray, 2007). Therefore, we will report the Cronbach's alphas for the AQ but our data analysis will focus on testing whether positive schizotypy predicts migration intentions and desires. We also gave participants a measure of the Big Five personality traits, but those results will not be included in this report because they are not relevant to the hypothesis being tested.

2. Methods

2.1. Participants

235 participants (133 women) were recruited. To be eligible to participate in our study, participants had to be under the age of 25 (M age = 21.7), born and raised in the United States, not second-generation immigrants, and currently living in the state they were born in. All participant recruitment and data collection was handled by Qualtrics panels, which recruits participants and ensures data quality (by disqualifying "speeders" who finish the survey too quickly and "straight-liners" who give the same answer for most of the items) for a fee of $5.50 per participant.

We used the software program G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) to conduct an a priori power analysis. The average effect size reported by a previous study with a similar design (Lundberg, Cantor-Graae, Kahima, & Östergren, 2007) was $f^2 = 0.085$. To account for bias (e.g., publication bias), this effect size was deflated to 0.06 for the purpose of calculating the necessary sample size. Our goal was to obtain 0.95 power to detect an effect of this size at the standard 0.05 alpha error probability. This power analysis revealed that we would need 219 participants. In order to account for any potential data loss, we recruited 235 participants.

2.2. Measures

2.2.1. Schizotypy

Schizotypal Personality Questionnaire (SPQ; Raine, 1991). The SPQ is a 74-item self-report measure with a yes/no response format designed to assess schizotypal traits in non-clinical populations. The SPQ (α = 0.96) has three positive schizotypy subscales (total α = 0.90): *magical thinking* (α = 0.77), *unusual perceptual experiences* (α = 0.80), and *ideas of reference* (α = 0.78), three negative schizotypy subscales (total α = 0.89): *social anxiety* (α = 0.84), *constricted affect* (α = 0.72), and *no close friends* (α = 0.75), and three disorganized schizotypy subscales (total α = 0.90): *odd/eccentric behavior* (α = 0.79), *odd speech* (α = 0.79), and *suspiciousness* (α = 0.80).

2.2.2. Autistic-like traits

Autism-Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). The AQ is a 50-item self-report measure in which participants rate their agreement with descriptors of their self (e.g., "I enjoy doing things spontaneously") on a 4-point Likert scale. The AQ (α = 0.60) has five subscales: *social skills* (α = 0.52), *attention switching* (α = 0.33), *attention to detail* (α = 0.48), *communication* (α = 0.36), and *imagination* (α = 0.32). Because all of the AQ subscales had poor reliability, we did not analyze any data related to the AQ.

2.2.3. Migration intentions and desires

Because it's possible to *desire* to migrate without having explicit *plans*

to migrate, we included measures for both of these possibilities. If, for example, positive schizotypy was only associated with desires (but not plans) to migrate and at the same time desires had less of an effect on actual migration behavior, then we would need to adjust our conclusions based on that. As it turned out, desires and plans loaded onto the same latent factor so this was not an issue. We used six items to measure migration intentions and desires. There were three items to measure desires:

1) How appealing to you is the idea of living in a different city in your native state?
2) How appealing to you is the idea of living in a different state?
3) How appealing to you is the idea of living in a different country?

Similarly, there were three items to measure migration intentions:

1) Do you have plans to move to a different city in your native state?
2) Do you have plans to move to a different state?
3) Do you have plans to move to a different country?

3. Results

3.1. Data reduction

All analyses were performed in SPSS Statistics 27 (IBM Corp., 2020). In accordance with our pre-registered plan, we sought to reduce the six migration items to a smaller number of summary variables in order to improve the robustness of the results. We performed a PCA on the six migration items. This resulted in a single component with an eigenvalue greater than one (eigenvalue = 2.72), which accounted for 45.3% of the variance. We saved this component as a variable (referred to hereafter as the Migration Factor) to be used in subsequent analyses.

3.2. Positive schizotypy and migration

Descriptive statistics and correlations between total schizotypy, the three main schizotypy subscales, and the Migration Factor are reported in Table 1. Descriptive statistics and correlations between the nine smaller schizotypy subscales and the Migration Factor are reported in Table 2. All schizotypy subscales except "social anxiety" were positively correlated with the Migration Factor.

Because of the low alpha values for the AQ, we had to deviate from our pre-registered plan to perform a PCA on the correlation matrix of the SPQ and AQ subscales and use the second component (autism-schizotypy; Del Giudice et al., 2014) as our main predictor variable. Because the AQ data were not viable, our emphasis shifted to testing whether positive schizotypy robustly predicts migration intentions and desires (i.e., the Migration Factor). Because positive schizotypy is the only factor of schizotypy that predicts exploratory behaviors and is diametric to autistic-like traits (Del Giudice et al., 2014; Dinsdale et al., 2013), we predicted that only positive schizotypy would be robustly related to the Migration Factor.

To test this prediction, we used a linear regression with the three main schizotypy factors (the sum of the subscales for positive, negative, and disorganized schizotypy) as our predictors, age and sex as covariates, and the Migration Factor as the dependent variable. These five predictors explained 13.4% of the variance (Adjusted $R^2 = 0.134$, $F(5, 228) = 8.20$, $p < .001$). As expected, positive schizotypy was the only significant predictor of the Migration Factor ($\beta = 0.259$, $p < .01$). The other predictors were non-significant (all p values $> .05$; see Table 3). The variance inflation factor (VIF) for each predictor was less than 10, indicating that multicollinearity was not an issue (Keith, 2019).

Table 1
Descriptive statistics and correlations between the migration factor, total schizotypy, and the three major schizotypy subscales ($N = 235$).

Variables	1	2	3	4	5
1. Migration factor	–				
2. Positive schizotypy	0.37	–			
3. Negative schizotypy	0.26	0.60	–		
4. Disorganized schizotypy	0.34	0.78	0.77	–	
5. Total schizotypy	0.36	0.88	0.88	0.95	–
Mean		1.4	1.5	1.5	4.4
Standard deviation		0.26	0.26	0.27	0.71

Note. All correlations are significant at $p < .001$.

4. Discussion

Based on evidence indicating that positive schizotypy should be related to an increased tendency towards exploration, we predicted that positive schizotypy would be correlated with intentions/desires to migrate. Our results support this prediction, showing that all subscales of schizotypy except social anxiety are correlated with the Migration Factor (a latent variable representing intentions and desires to migrate), but that only positive schizotypy is significantly related to the Migration Factor when included in a regression with the other two schizotypy factors (negative and disorganized schizotypy).

As discussed in the introduction, there is very little direct evidence with which to judge whether selective migration contributes to high rates of schizophrenia among migrants. To our knowledge, ours is the first adequately powered study to test whether well-validated measures of schizotypy predict migration intentions and desires. The only previous study with a similar design was massively underpowered and used a questionable measure of schizotypy (Lundberg, Cantor-Graae, Kahima, & Östergren, 2007). Our study showed that there were zero-order correlations between all of the schizotypy subscales except social anxiety and the Migration Factor. More specifically, and in line with our predictions, we showed that it is *positive schizotypy* which primarily drives the relationship between schizotypy and intentions/desires to migrate. These findings call into question the idea that selective migration has been "strongly refuted" as an explanation for high rates of schizophrenia among migrants (Dykxhoorn & Kirkbride, 2019).

Our study has some limitations. First, most of the studies related to high rates of schizophrenia among migrants have been conducted among European, African, or Middle Eastern immigrants (Henssler et al., 2019; Selten et al., 2019), while our sample was American. It is possible that there is something unique about our sample which would lead to a relationship between positive schizotypy and migration intentions/desires that would not replicate in other populations. Our findings should be subjected to replication tests in other parts of the world.

Another limitation is the potential disconnect between intentions/desires to migrate and actual migration behavior. Studies show that migration intentions are an important factor in predicting who will eventually migrate, but the correlations are far from perfect (De Jong, Root, Gardner, Fawcett, & Abad, 1985; van Dalen & Henkens, 2008). For example, one study found that 24% of people who reported intentions to migrate did so within two years (van Dalen & Henkens, 2008). Given this possible disconnect between migration intentions and migration behavior, future research could test for levels of positive schizotypy among recent migrants or use a longitudinal design to investigate whether positive schizotypy predicts actual migration behavior.

5. Conclusion

It is well-established that rates of schizophrenia tend to be higher among immigrants than native populations and that this finding cannot be attributed to higher rates of schizophrenia in the immigrants' country of origin (Henssler et al., 2019; Selten et al., 2019). However, the underlying causes driving these findings are still unclear. While some researchers have suggested that people who are predisposed to psychosis may be more likely to migrate (Ødegård, 1932), most researchers today take the position that the experience of immigration itself causes

Table 2
Descriptive statistics and correlations between the Migration Factor and the nine schizotypy subscales (N = 235).

Variables	1	2	3	4	5	6	7	8	9	10
1. Migration Factor	–									
2. Odd beliefs	**0.37**	–								
3. Unusual experiences	**0.27**	**0.70**	–							
4. Ideas of reference	**0.33**	**0.51**	**0.67**	–						
5. No close friends	*0.21*	**0.34**	**0.45**	**0.51**	–					
6. Constricted affect	**0.36**	**0.49**	**0.63**	**0.61**	**0.69**	–				
7. Social anxiety	0.12	**0.26**	**0.41**	**0.46**	**0.66**	**0.59**	–			
8. Odd behavior	**0.28**	**0.56**	**0.67**	**0.59**	**0.48**	**0.64**	**0.51**	–		
9. Odd speech	**0.28**	**0.47**	**0.60**	**0.63**	**0.57**	**0.67**	**0.59**	**0.67**	–	
10. Suspiciousness	**0.32**	**0.44**	**0.58**	**0.67**	**0.63**	**0.64**	**0.52**	**0.53**	**0.59**	–
Mean		1.4	1.4	1.5	1.5	1.4	1.6	1.5	1.5	1.5
1Standard deviation		0.31	0.30	0.30	0.28	0.28	0.33	0.33	0.29	0.32

Note. $p < .01$ is italicized, $p < .001$ is bold.

Table 3
Summary of regression analysis for variables predicting the migration factor (N = 234).

Variable	*B*	*SE B*	*β*
Positive schizotypy	0.986	0.375	0.259**
Negative schizotypy	−0.100	0.378	−0.026
Disorganized schizotypy	0.643	0.459	0.173
Age	0.041	0.032	0.081
Sex	0.119	0.129	0.081
Adjusted R^2	0.134		
F for change in R^2	8.20**		

* $p < .05$.
** $p < .01$.

increased rates of psychosis, eschewing the idea that immigrants may have an increased predisposition to psychosis (Abed & Abbas, 2011; Dykxhoorn & Kirkbride, 2019; Henssler et al., 2019). The current study presents a challenge to this dominant position.

After reviewing theory and evidence suggesting that positive schizotypy is related to a general exploratory tendency, we predicted that positive schizotypy should also be related to increased intentions/desires to migrate. In the first adequately powered study of its kind, we showed that all schizotypy subscales except social anxiety are related to increased intentions/desires to migrate. We also showed that the overall relationship between schizotypy and migration intentions/desires is primarily driven by positive schizotypy, as predicted. In light of this data, we suggest that the selective migration hypothesis is still a viable candidate to help explain the puzzle of increased rates of schizophrenia among immigrants, though we want to be clear that selective migration and immigration-induced psychosis are not mutually exclusive, and some combination of factors may be at work. The current state of the evidence regarding selective migration is inconclusive, and strong conclusions – such as the notion that selective migration has been "strongly refuted" (Dykxhoorn & Kirkbride, 2019) – are not warranted. Future research can move closer to resolving this issue by testing (with an adequately powered design) for a relationship between positive schizotypy and actual migration behaviors rather than intentions/desires. This sort of test would require more funding (since it would require a longitudinal design) but would provide stronger evidence for or against selective migration as a contributor to high rates of schizophrenia among immigrants.

CRediT authorship contribution statement

Brett Andersen: Conceptualization, Writing – Original draft preparation, Investigation.
Laith Al-Shawaf.: Writing- Review and editing.
Rachel Bearden: Writing- Review and editing, funding, resources.

Appendix 1

Pre-registration

Study information

1. Title: Autism, schizotypy, and migration.
2. Authors: *Omitted*
3. Description: Does personality variation related to autism and/or positive schizotypy correlate with the intention or desire to migrate?
4. Hypotheses:
   - 4.1. We will seek to replicate the findings from the principal components analyses (PCA) used in previous studies (Del Giudice et al., 2014; Dinsdale et al., 2013)
     - 4.1.1. This means that when performing a PCA on the schizotypal personality questionnaire (SPQ) and the autism quotient (AQ), without any rotations, the first component will represent individual differences in social difficulty.
     - 4.1.2. The second component will represent an axis of individual differences with positive schizotypy on one end and autistic-like traits on the other.
   - 4.2. The second component described above (called autism-schizotypy) will correlate with the factor(s) derived from the PCA on the six migration items (described in Section 13). To be clear, this means that we are predicting that people higher in schizotypy will be more likely to have desires and intentions to migrate.
   - 4.3. The hypothesized correlation(s) described in 4.2 will be mediated by metatrait Plasticity (i.e., the shared variance between the Big Five traits of Openness/Intellect and Extraversion).

Design plan

In this section, you will be asked to describe the overall design of your study. Remember that this research plan is designed to register a single study, so if you have multiple experimental designs, please complete a separate preregistration.

5. Study type: Correlational Study
6. Blinding: No blinding is involved in this study.
7. Study design: Cross sectional

Sampling plan

8. As of the date of submission of this research plan for preregistration, the data have not yet been collected, created, or realized.
9. Data collection procedures (required)
   - 9.1. The Qualtrics company will be handling data collection. Participants will be American, under the age of 25, and

without a prior history of between-country migration. Qualtrics uses an algorithm to disqualify "speeders" and "straight-liners" (participants who answer too quickly or put the same response for every question). We will pay Qualtrics $5.50 per quality response.

10. Sample size: 227 participants will be recruited. However, Qualtrics tends to overshoot the requirement so data may be collected for up to 250 participants.
11. Sample size rationale
    11.1. We used the software program G*Power to conduct a power analysis. The average effect size reported by a previous study with a similar design (Lundberg et al., 2007) was $f^2 = 0.085$. To account for bias (e.g., publication bias), this effect size was deflated to 0.06 for the purpose of calculating the necessary sample size. Our goal was to obtain 0.95 power to detect an effect of this size at the standard 0.05 alpha error probability. This power analysis revealed that we would need 219 participants. We received a grant that would allow us to afford 227 participants (with a guarantee of data quality).

Variables

12. Measured variables
    12.1. Schizotypy
        12.1.1. The schizotypal personality questionnaire is a self-report measure meant to assess schizotypal traits in the general population. It has 74 yes/no items. There are nine subscales:
            12.1.1.1. Three positive schizotypy subscales: Magical thinking, unusual perceptual experiences, and ideas of reference.
            12.1.1.2. Three negative schizotypy subscales: Social anxiety, constricted affect, and no close friends.
            12.1.1.3. Three disorganization subscales: Odd/eccentric behavior, odd speech, and suspiciousness.
    12.2. Autistic-like traits
        12.2.1. The autism quotient is a self-report measure meant to assess autistic-like traits in the general population. It has 50 self-report items on a four-point scale (from 1: Definitely Agree to 4: Definitely Disagree). There are five subscales:
            12.2.1.1. Communication
            12.2.1.2. Social skills
            12.2.1.3. Attention switching
            12.2.1.4. Imagination
            12.2.1.5. Attention to detail
    12.3. Intentions and desires to migrate
        12.3.1. For desires, there will be three items measured on a 5-point scale from "not at all" to "extremely". The items will read:
            12.3.1.1. How appealing to you is the idea of living in a different town within your native state?
            12.3.1.2. How appealing to you is the idea of living in a different state?
            12.3.1.3. How appealing to you is the idea of living in a different country?
        12.3.2. For intentions, there will be three items with a dichotomous yes/no response. The items will read:
            12.3.2.1. Do you have plans to move to a different town within your native state in the future?
            12.3.2.2. Do you have plans to move to a different state in the future?
            12.3.2.3. Do you have plans to move to a different country in the future?
    12.4. Five aspects scale
        12.4.1. 100 items, measures the normal Big Five traits and breaks them down into two aspects each. Answered on a 5-point scale.

Analysis plan

13. Statistical models
    13.1. A principal components analysis with no rotations will be performed on the 14 subscales of the AQ and the SPQ.
    13.2. If the structure found in previous studies is replicated, we will use the 2nd component to test our main hypotheses (discussed below).
    13.3. If the structure is not replicated, we will composite autism and schizotypy scores (i.e., the total scores on the AQ and SPQ), entering them both into the regression.
    13.4. The six migration items will be subjected to dimension reduction via PCA with an exploratory approach. We will interpret and use whatever factors are produced from this PCA as the outcome variables.
    13.5. In order to test the main hypotheses we will use multiple regression with the 2nd component from the first PCA (called autism-schizotypy) as the predictor variable, the outcome measure after dimension reduction (whatever results from the second PCA) as the outcome variable, with age and sex as covariates.
    13.6. To test for robustness, we will also re-run the regression(s) while taking into consideration the false discovery rate.
14. Data exclusion – We should not have to exclude any data because Qualtrics will exclude all participants who do not meet the requirements. The requirements are:
    14.1. 18–25 years old
    14.2. Born and raised in the United States (i.e., not an immigrant).
    14.3. Currently residing in the state they were born in.
    14.4. Outliers will be considered, and if found, we will perform robustness tests to see how much influence they have (e.g., by doing the regression with and without outliers, reporting both sets of results).
15. Exploratory analysis
    15.1. If the PCA structure from previous studies isn't replicated (see Section 13.3) we will also perform exploratory analysis using the individual subscales of the AQ and SPQ, since the total scores may be confounded with 'social difficulty' (see Del Giudice et al., 2014).

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