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Stressful life events and openness to experience: relevance to depression

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Abstract

Background: Stressful life events are known as risk factors for depression, though there is considerable heterogeneity in how people respond to stress. Previous studies have found an association between experience of stressful life events and the personality trait of openness to experience, which itself has been associated with intelligence, creativity, risk-taking, and other clinically relevant behaviors. In this study we explore the association between stressful life events and openness to experience as a potential developmental pathway to depression in the Amish and Mennonites, rural populations with high degree of social and environmental homogeneity.

Methods: Participants in the Amish Connectome Project (n=531) were assessed with the NEO personality inventory, Beck Depression Inventory, Maryland Trait and State Depression scales, a Life Stressors Inventory, and cognitive tests.

Results: We found that stressful life events were significantly associated with openness to experience; that participants with a history of depression exhibited higher levels of openness; and that openness to experience was related to overall intelligence but not processing speed or working memory. We found evidence that openness to experience partially mediates the relationship between stressful life events and depression.

Limitations: This was a cross-sectional study, limiting interpretation of causal pathways. High levels of inter-relatedness among participants may have led to exaggerated effects compared to the general population.

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Author statement

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Conflicts of Interest

Dr. Hong has received or plans to receive research funding or consulting fees from Mitsubishi, Your Energy Systems LLC, Neuralstem, Taisho Pharmaceutical, Luye Pharma, Sound Pharma, Takeda, Heptares, Pfizer and Regeneron. All other authors declare no conflict of interest.

Conclusions: Together these findings indicate a complex developmental influence of major stressful life events, which paradoxically by enhancing openness may be associated with both greater intellectual engagement as well as psychopathology.

Keywords

early life stress; personality; creativity; depression

Introduction

Stressful life experiences are major risk factors for subsequent experience of major depressive disorder (Kendler, et al., 1999), though the risk may be non-specific amongst psychiatric disorders (van Nierop et al., 2015). Yet, most individuals who experience stressful events do not suffer lasting negative consequences for their mental health, and some evidence even indicates potential protective effects of early mild stress exposure (Parker, et al., 2004; Liu, 2015). This wide range of outcomes indicates that the effects of stress on human development cannot be understood simply as pathogenic but may be influenced by other behavioral traits. Of particular interest in this context are previous findings of an association between stressful life events and the personality trait of openness to experience (Allen and Lauterbach, 2007; Hengartner et al., 2015; Hovens, et al., 2016; Rahman et al., 2017). Openness to experience is one of the 'Big Five' personality traits and is broadly related to creativity, curiosity, and intelligence (Ackerman and Heggestad, 1997; Gołowska, et al., 2019). However, this trait may also be associated with increased sensation seeking, risk-taking behaviors, and vulnerability to psychopathology. For instance, cannabis users have been found to have higher levels of openness compared to non-users (Fridberg, et al., 2011; Terracciano, et al., 2008). A genome-wide association study has indicated a link between openness to experience and bipolar disorder and schizophrenia (Lo et al., 2017). On a behavioral level, openness to experience was associated with false-positive error rates in signal detection tasks, a behavior related to psychoticism (Blain, et al., 2020). Most frequently studied has been the association of openness to depression, though evidence to date has been mixed, possibly due to previous studies often relying on non-clinical samples or only measuring symptoms of depression at the time of study (Kotov, et al., 2010; Khoo and Simms, 2018). How personality factors may mediate the relationship between stressful life events and depression is not clear.

The association of early life stress with openness is intriguing as a potential clue to understanding how stress can not only predispose individuals to depression, but also potentially induce resilience to later adversities. This latter effect may be non-linear in nature, with mild and relatively controllable stressors associated with better outcomes compared to absence of early stress or severe stressors (Liu, 2015). Monkeys exposed to mild early life stress exhibited less anxiety and more exploratory behavior in a novel environment, and performed better on a task requiring inhibitory control, compared to monkeys without stress exposure (Parker et al., 2004; Parker et al., 2005). In several human studies, individuals with a moderate number of stressful life experiences exhibited more favorable outcomes (greater pain tolerance and cardiovascular reactivity to laboratory stressors; less functional impairment and global distress in surveys) compared to individuals

reporting either no major stressful experiences or high cumulative stress exposure (Seery, et al., 2010; Seery, et al., 2013).

In this study, we explore the seemingly paradoxical relationship between experience of stress, openness to experience, and depression in members of the Old Order Amish and Mennonite (OOA/M) communities who participated in the Amish Connectome Project. Compared to the general population, the OOA/M are well-suited to studies of the complex inter-relationships of stress, depression, and personality factors. Individuals in these communities receive the same level of basic education, few use illicit substances, and all share a similar rural lifestyle, all of which may reduce potential environmental confounds as compared with a general population sample. To start we examine if the relationship between stressful life events and openness to experience can be replicated in this unique cohort. We then ask how stressful life events and openness to experience relate to clinical outcomes (tendency to experience symptoms of depression), and neuropsychology (measures of cognitive performance). Our aim is to determine if openness to experience mediates relationships between stress and cognition and depression, under the broad hypothesis that stress can simultaneously exert both positive and negative influences over development.

Methods

Participants

531 participants were recruited from Plain communities in Maryland and Pennsylvania. All participants were screened for psychiatric disorders using the Structured Clinical Interview (SCID) for DSM-IV or 5. Diagnoses indicated by SCID were reviewed and confirmed in consensus meetings involving several clinicians, including at least one psychiatrist. Exclusion criteria included history of epilepsy, cerebrovascular accident, traumatic brain injury, intellectual disability, and unstable major medical conditions at time of study. Patients and controls with substance use disorder within the past 6 months, or current substance use disorder (except nicotine) were excluded. The sample included 70 participants with history of depression that was in remission at time of study; 60 participants with depression not in remission; 25 with a history of bipolar disorder; 16 with a history of psychotic disorder; and 360 individuals without a history of serious mental illness. All participants were of European ancestry and no participant had more than a 8th grade general education, though some had additional trade school classes. Further demographic information is provided in Table 1. Participants gave written informed consent approved by the University of Maryland Baltimore IRB.

Clinical assessments

Symptoms of depression were quantified with two instruments, the Beck Depression Inventory (BDI; Beck, et al., 1988) and the Maryland Trait and State Depression scales (MTSD). The MTSD is a self-report questionnaire containing two scales assessing frequency of depression symptoms experienced over the past week (state) and over the course of adult life (trait). The MTSD was previously validated in a sample of schizophrenia patients and community comparison controls (Chiappelli, et al., 2013). Further validation

data in the OOA/M population is provided in supplementary material. To assess experience of stressful life events we adapted items from the Life Stressor Checklist–Revised (Wolfe, et al., 1997), with the inclusion of several items specific to the Plain community. Participants identify whether or not they ever experienced an event described by the item, and are asked to estimate their age at the time of the stressor. The total life events score is based on number of different types of events participants reported experiencing, ranging from 0 to 15. To examine stressful events experienced in childhood specifically, the number of items experienced prior to age 15 and number of events experienced age 15 or older were calculated; 15 was selected as a cutoff since in the OOA/M communities individuals typically attend school until completion of 8th grade (~age 14) and then are expected to transition to adult roles and responsibilities. The five factors of personality, neuroticism, extraversion, openness, agreeableness, and conscientiousness were assessed with the NEO Five-Factor Inventory-3, a 60-item self-report questionnaire (McCrae, Costa PT Jr, & Martin, 2005).

Neuropsychological assessments

The Wechsler Abbreviated Scale of Intelligence (WASI) was used to calculate full-scale intelligence quotient (IQ), and the Symbol Coding task was used to measure processing speed (Wechsler, 1997). Working memory was assessed using the Digit Sequencing task from the Brief Assessment of Cognition in Schizophrenia (Keefe et al., 2004). Working memory and processing speed are cognitive abilities closely related to fluid intelligence and are impaired in severe mental illnesses (Dickinson, et al., 2008; Semkovska et al., 2019; Rosenberg et al., 2020).

Statistical analyses

Initial analyses included 1) linear regression models examining if stressful life events (subdivided into 3 measures: total life events, events experienced <15 years old, and events experienced ≥ 15 years old) predict big five personality traits; 2) linear regression models examining if personality traits are associated with neuropsychological measures (IQ, processing speed, working memory); 3) ANOVA tests to compare openness to experience across diagnostic groups; and 4) linear regression models to see if personality measures predict measures of depression symptoms (BDI, PTSD state and trait). Participants with bipolar or psychotic disorder were excluded from analysis 2, due to potential diagnosis-specific effects on cognitive measures. All analyses include age and sex as covariates. Only results passing Bonferroni correction for number of comparisons per set of analyses are considered statistically significant. Follow-up mediation models were tested using mediation package for R (Tingley, et al., 2014).

Results

Relationship of stressful life events to personality traits

In linear regression models including age and sex as covariates, total number of stressful life events was positively associated with two of the five personality traits: neuroticism ($\beta=.22$, $p<.001$) and openness to experience ($\beta=.22$, $p<.001$); examining only stressful life events

experienced before the age of 15, the only significant relationship was a positive association between stressful life events and openness ($\beta=.13$, $p=.003$; see Table 2).

Relationship of personality traits to cognitive measures

The association of the 5 personality traits to 3 neurocognitive measures were assessed with linear regression models covarying for age and sex (Table 3). The only correlation that was significant after Bonferroni correction for 20 analyses was a positive association between openness and IQ ($\beta=.22$, $p<.001$). This relationship remained significant when the sample was limited to those individuals without bipolar disorder or a psychotic disorder ($n=469$, $\beta=.21$, $p<.001$) or when only individuals without a major psychiatric disorder were included ($n=345$, $\beta=.20$, $p<.001$).

Relationship of openness to experience and mood disorders

We divided the sample based on structured clinical interviews into those with a psychotic disorder ($n=16$), bipolar disorder ($n=25$), current depression ($n=60$), history of depression, currently in remission ($n=70$), and individuals with no history of mood or psychotic disorders ($n=360$), and performed a univariate ANOVA with age and sex as covariates. Results indicated a significant difference between diagnostic groups ($F(4,524)=4.18$, $p=.002$), and post-hoc tests show both depression groups and bipolar disorder, but not psychotic disorder group, had significantly higher levels of openness compared to individuals without a history of major psychiatric illness (Figure 1).

Taking a dimensional approach to examining if openness to experience is associated with depression, we examined the relationship of openness to symptoms of depression measured with the BDI and MTSD with linear regression models covarying for age and sex. In the full sample, openness was positively associated with BDI ($\beta=.13$, $p=.002$) and MTSD State ($\beta=.13$, $p=.003$), with a slightly stronger association with MTSD Trait ($\beta=.22$, $p<.001$; Table 4). If these associations are examined separately in individuals with no history of major psychiatric diagnoses and individuals with current/past depression, the only significant association is with MTSD Trait in individuals with depression ($\beta=.27$, $p=.003$).

Mediation models

These analyses showed that, of the 5 personality factors, only openness was associated with both depression and early stressful life events. Furthermore, MTSD trait depression was the depression measure most consistently and robustly associated with openness. As expected, early stressful life events are also significantly associated with MTSD trait score ($\beta=.16$, $p<.001$). Accordingly, we examined the potential mediating effect of openness on the relationship between early stressful life events and MTSD trait depression scores. The mediation effect was .023; bootstrapping indicates this effect is significant ($p=.008$) with a 95% confidence interval of .006 to .05. However, openness did not fully mediate this association, as the average direct effect in this model was still significant ($p=.016$).

As openness was associated with both stressful life events and IQ, we examined the relationship between stressful life events and IQ. Stressful life events before age 15 was significantly associated with IQ ($\beta=.11$, $p<.020$, covarying age and sex). We then examined

the mediating effect of openness on the relationship between early stressful life events and IQ. The mediation effect in this model was 0.46 ($p=.032$, 95% CI .041 to .96). The direct effect in this model was not significant ($p=.11$), indicating that openness fully mediates the relationship between stressors and IQ.

Discussion

In this study of a population with relatively high homogeneity of environmental factors, we replicated a positive association between stressful life events and openness to experience as shown in previous studies in the general population. In addition, greater openness to experience was associated both with greater symptoms of depression and higher IQ, though not with greater performance on specific cognitive tests. Importantly, openness was a significant mediator between early stressful events and depression.

The positive association between openness and a measure of general intelligence replicates previous findings in personality research (Ackerman and Heggestad, 1997). The Investment Theory posits that this association reflects the importance of motivation for learning and intellectual engagement across the lifespan in development of crystallized intelligence, though this motivation may be less important in determining fluid intelligence (von Stumm and Ackerman, 2012). Consistent with this hypothesis and with previous findings (Schretlen, et al., 2010), we find no association between openness and measures of underlying cognitive capacities such as processing speed and working memory. However, the association of greater openness with higher IQ, more childhood stress, and depression appears surprising and requires closer examination of why stress could be related to openness.

Several models based on developmental theory have predicted that early life stressors could steer developmental plasticity, potentially favoring risk-taking behavior (Hostinar and Gunnar, 2013; Ellis and Del Giudice, 2019). Experiments in rodents and monkeys provide reason to believe that early life stress can increase subsequent exploratory behavior and novelty-seeking (Parker et al., 2007; Toledo-Rodriguez and Sandi, 2011). The relationship between stressful life events and openness may also be consistent with studies on the effects of trauma on belief systems. The “shattered assumptions” theory proposes that major stressful events, especially when random and/or perceived as unjust, can force people to reassess core beliefs that they have about the world, as part of the process of seeking meaning in the face of adversity (Janoff-Bulman, 2004). In support of this theory, several studies have shown greater change in beliefs in people who have experienced trauma (Schuler and Boals, 2016; Poulin and Silver, 2019). Based on these previous theories we speculate that stressful life events can increase motivation for introspective rumination and exploration of new ideas, potentially kindling an interest and comfort level in mental activities that fall under the rubric of openness to experience. In the context of evolutionary-developmental theories, increased receptiveness to new beliefs and practices could be adaptive when the early life environment is more uncertain and unstable. The hypotheses above presume that stressful life experiences have causal effects on personality; an opposite causal pathway must also be considered. The association between stress and openness should be considered in the particular context of the OOA/M population, as an interest in new ideas and experiences may be in conflict with the conservative nature of Plain community culture, leading to

greater stress. However, one previous study did not find a relationship between trauma and openness measured when participants were children, but did find an association between childhood trauma and openness measured in adulthood, a finding which favors a causal and developmental role of stress (Hampson et al., 2016).

We found a positive association between openness to experience and symptoms of depression, replicating some of the results from previous studies (Kotov et al., 2010). The current study included a measure of ‘trait depression’ and a relatively homogenous community sample, which may explain why the association was stronger in this study compared to previous work. Previous work has also found greater openness to be associated with better response to various modalities of treatment for depression, including psychotherapy, ketamine and medications (Bagby et al., 2008; Takahashi et al 2014; Amare et al., 2018; Dale et al., 2020). Psilocybin treatment, an emerging potential treatment for depression, appears to increase openness in depressed and healthy participants (Maclean, et al., 2011; Erritzoe et al., 2018). As the construct of openness to experience encompasses facets including fantasy, imagination, and willingness to explore new ideas, it is possible that openness could be related to depression through greater rumination on negative experiences and attentiveness to negative feelings, but also could be related to better treatment outcomes through greater willingness to engage in treatment and re-evaluation of negative thoughts (Khoo and Simms, 2018). Consistent with this hypothesis, we found openness partially mediates the association between stressful life events and depression. In this study we did not have data on suicidal behavior, but our findings may have implications for future studies of suicidal ideation and behavior. Stressful life experiences, both recent and experienced in childhood and adolescence, are associated with risk of suicide attempt and repeated suicide attempts (Pompili, et al., 2011). Higher openness to experience has been associated with greater self-report of suicidal ideation; however, lower openness to experience may be associated with completed suicide in older adults (Heisel, et al, 2006). Stress-induced openness could be associated with greater suicidal ideation via increased willingness to ‘think the unthinkable’, but could also be associated with greater willingness to report these thoughts to providers (Heisel, et al, 2006). Further study of the interplay between stress, openness, and depression may help improve risk assessments for suicide, especially among older adults.

As this study is cross-sectional in design, we cannot make strong conclusions regarding causal pathways underlying the relationship between stressful life events, openness to experience, and intelligence. Furthermore, the unique nature of the population studied here may limit generalizability of our findings. This study did not include individuals raised in the Plain communities but who later left; these individuals potentially could have been unusually high in openness to experience. Given our recruitment strategies and the high level of consanguinity among the OOA/M, many of the participants in this study were related to each other, so familial and genetic influences on personality and depression could have led to exaggerated associations in comparison to studies of the general population.

Although we cannot make firm conclusions on causality, in context of previous literature our findings hint at a developmental process that may be crucial for understanding depression and other psychopathology. Openness to experience may be an intermediate phenotype

between stress and both vulnerability to psychopathology and increased intellectual engagement. As such, further study of the phenomenological and neurobiological aspects of openness may inform mental health and personality research.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

- Ackerman PL, Heggestad ED, 1997. Intelligence, personality, and interests: evidence for overlapping traits. *Psychological bulletin*, 121(2), 219–245. [PubMed: 9100487]
- Allen B, Lauterbach D, 2007. Personality characteristics of adult survivors of childhood trauma. *Journal of traumatic stress*, 20(4), 587–595. [PubMed: 17721954]
- Amare AT, Schubert KO, Tekola-Ayele F, Hsu YH, Sangkuhl K, Jenkins G, ... Baune BT, 2018. Association of the Polygenic Scores for Personality Traits and Response to Selective Serotonin Reuptake Inhibitors in Patients with Major Depressive Disorder. *Frontiers in psychiatry*, 9, 65. [PubMed: 2955929]
- Bagby RM, Quilty LC, Segal ZV, McBride CC, Kennedy SH, Costa PT, 2008. Personality and differential treatment response in major depression: a randomized controlled trial comparing cognitive-behavioural therapy and pharmacotherapy. *Canadian journal of psychiatry. Revue canadienne de psychiatrie*, 53(6), 361–370. [PubMed: 18616856]
- Beck AT, Steer RA, Carbin MG, 1988. Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. *Clinical psychology review*, 8(1), 77–100.
- Blain SD, Longenecker JM, Grazioplene RG, Klimes-Dougan B, DeYoung CG, 2020. Apophenia as the disposition to false positives: A unifying framework for openness and psychoticism. *Journal of abnormal psychology*, 129(3), 279–292. [PubMed: 32212749]
- Chiappelli J, Nugent KL, Thangavelu K, Searcy K, Hong LE, 2014. Assessment of trait and state aspects of depression in schizophrenia. *Schizophrenia bulletin*, 40(1), 132–142. [PubMed: 23686021]
- Dale RM, Bryant KA, Finnegan N, Cromer K, Thompson NR, Altinay M, & Anand A, 2020. The NEO-FFI domain of openness to experience moderates ketamine response in treatment resistant depression. *Journal of affective disorders*, 260, 323–328. [PubMed: 31521869]
- Dickinson D, Ragland JD, Gold JM, Gur RC, 2008. General and specific cognitive deficits in schizophrenia: Goliath defeats David? *Biological psychiatry*, 64(9), 823–827. [PubMed: 18472089]
- Ellis BJ, & Del Giudice M, 2019. Developmental Adaptation to Stress: An Evolutionary Perspective. *Annual review of psychology*, 70, 111–139.
- Erritzoe D, Roseman L, Nour MM, MacLean K, Kaelen M, Nutt DJ, & Carhart-Harris RL, 2018. Effects of psilocybin therapy on personality structure. *Acta psychiatrica Scandinavica*, 138(5), 368–378. [PubMed: 29923178]
- Fridberg DJ, Vollmer JM, O'Donnell BF, Skosnik PD, 2011. Cannabis users differ from non-users on measures of personality and schizotypy. *Psychiatry research*, 186(1), 46–52. [PubMed: 20813412]
- Gocłowska MA, Ritter SM, Elliot AJ, Baas M, 2019. Novelty seeking is linked to openness and extraversion, and can lead to greater creative performance. *Journal of personality*, 87(2), 252–266. [PubMed: 29604214]
- Hampson SE, Edmonds GW, Goldberg LR, Barckley M, Klest B, Dubanoski JP, Hillier TA, 2016. Lifetime trauma, personality traits, and health: A pathway to midlife health status. *Psychological trauma : theory, research, practice and policy*, 8(4), 447–454.

- Heisel MJ, Duberstein PR, Conner KR, Franus N, Beckman A, & Conwell Y, 2006. Personality and reports of suicide ideation among depressed adults 50 years of age or older. *Journal of affective disorders*, 90(2-3), 175–180. [PubMed: 16380165]
- Hengartner MP, Cohen LJ, Rodgers S, Müller M, Rössler W, & Ajdacic-Gross V, 2015. Association between childhood maltreatment and normal adult personality traits: exploration of an understudied field. *Journal of personality disorders*, 29(1), 1–14. [PubMed: 24932873]
- Hostinar CE, Gunnar MR, 2013. The Developmental Effects of Early Life Stress: An Overview of Current Theoretical Frameworks. *Current directions in psychological science*, 22(5), 400–406. [PubMed: 25419054]
- Hovens JG, Giltay EJ, van Hemert AM, Penninx BW, 2016. Childhood maltreatment and the course of depressive and anxiety disorders: the contribution of personality characteristics. *Depression and anxiety*, 33(1), 27–34. [PubMed: 26418232]
- Janoff-Bulman R, 2004. Posttraumatic growth: Three explanatory models. *Psychological inquiry*, 15(1), 30–34.
- Keefe RS, Goldberg TE, Harvey PD, Gold JM, Poe MP, Coughenour L, 2004. The Brief Assessment of Cognition in Schizophrenia: reliability, sensitivity, and comparison with a standard neurocognitive battery. *Schizophrenia research*, 68(2-3), 283–297. [PubMed: 15099610]
- Kendler KS, Karkowski LM, Prescott CA, 1999. Causal relationship between stressful life events and the onset of major depression. *The American journal of psychiatry*, 156(6), 837–841. [PubMed: 10360120]
- Khoo S, Simms LJ, 2018. Links between depression and openness and its facets. *Personality and mental health*, 12(3), 203–215. [PubMed: 29611346]
- Kotov R, Gamez W, Schmidt F, Watson D, 2010. Linking "big" personality traits to anxiety, depressive, and substance use disorders: a meta-analysis. *Psychological bulletin*, 136(5), 768–821. [PubMed: 20804236]
- Liu RT, 2015. A developmentally informed perspective on the relation between stress and psychopathology: when the problem with stress is that there is not enough. *Journal of abnormal psychology*, 124(1), 80–92. [PubMed: 25688435]
- Lo MT, Hinds DA, Tung JY, Franz C, Fan CC, Wang Y, ... Chen CH, 2017. Genome-wide analyses for personality traits identify six genomic loci and show correlations with psychiatric disorders. *Nature genetics*, 49(1), 152–156. [PubMed: 27918536]
- MacLean KA, Johnson MW, Griffiths RR, 2011. Mystical experiences occasioned by the hallucinogen psilocybin lead to increases in the personality domain of openness. *Journal of psychopharmacology (Oxford, England)*, 25(11), 1453–1461.
- McCrae RR, Costa PT Jr, Martin TA, 2005. The NEO-PI-3: a more readable revised NEO Personality Inventory. *Journal of personality assessment*, 84(3), 261–270. [PubMed: 15907162]
- Parker KJ, Buckmaster CL, Schatzberg AF, Lyons DM, 2004. Prospective investigation of stress inoculation in young monkeys. *Archives of general psychiatry*, 61(9), 933–941. [PubMed: 15351772]
- Parker KJ, Rainwater KL, Buckmaster CL, Schatzberg AF, Lindley SE, Lyons DM, 2007. Early life stress and novelty seeking behavior in adolescent monkeys. *Psychoneuroendocrinology*, 32(7), 785–792. [PubMed: 17604913]
- Pompili M, Innamorati M, Szanto K, Di Vittorio C, Conwell Y, Lester D, Tatarelli R, Girardi P, & Amore M, 2011. Life events as precipitants of suicide attempts among first-time suicide attempters, repeaters, and non-attempters. *Psychiatry research*, 186(2-3), 300–305. [PubMed: 20889216]
- Poulin MJ, Silver RC, 2019. When are assumptions shaken? A prospective, longitudinal investigation of negative life events and worldviews in a national sample. *Journal of research in personality*, 83, 103866.
- Rahman MS, Guban P, Wang M, Melas PA, Forsell Y, Lavebratt C, 2017. The serotonin transporter promoter variant (5-HTTLPR) and childhood adversity are associated with the personality trait openness to experience. *Psychiatry research*, 257, 322–326. [PubMed: 28800511]
- Rosenberg MD, Martinez SA, Rapuano KM, Conley MI, Cohen AO, Cornejo MD, ... Casey BJ, 2020. Behavioral and Neural Signatures of Working Memory in Childhood. *The Journal of*

- neuroscience : the official journal of the Society for Neuroscience, 40(26), 5090–5104. [PubMed: 32451322]
- Schretlen DJ, van der Hulst EJ, Pearlson GD, Gordon B, 2010. A neuropsychological study of personality: trait openness in relation to intelligence, fluency, and executive functioning. *Journal of clinical and experimental neuropsychology*, 32(10), 1068–1073. [PubMed: 20408002]
- Schuler ER, Boals A, 2016. Shattering world assumptions: A prospective view of the impact of adverse events on world assumptions. *Psychological trauma: theory, research, practice, and policy*, 8(3), 259.
- Seery MD, Holman EA, Silver RC, 2010. Whatever does not kill us: cumulative lifetime adversity, vulnerability, and resilience. *Journal of personality and social psychology*, 99(6), 1025–1041. [PubMed: 20939649]
- Seery MD, Leo RJ, Lupien SP, Kondrak CL, Almonte JL, 2013. An upside to adversity?: moderate cumulative lifetime adversity is associated with resilient responses in the face of controlled stressors. *Psychological science*, 24(7), 1181–1189. [PubMed: 23673992]
- Semkowska M, Quinlivan L, O'Grady T, Johnson R, Collins A, O'Connor J, ... Gload T, 2019. Cognitive function following a major depressive episode: a systematic review and meta-analysis. *The Lancet. Psychiatry*, 6(10), 851–861. [PubMed: 31422920]
- Takahashi M, Suzuki M, Muneoka K, Tsuruoka Y, Sato K, Shirayama Y, 2014. Personality traits as predictors for the outcome of lithium augmentation in treatment-resistant depression. *Psychiatry research*, 220(3), 1144–1146. [PubMed: 25453642]
- Terracciano A, Löckenhoff CE, Crum RM, Bienvenu OJ, Costa PT Jr, 2008. Five-Factor Model personality profiles of drug users. *BMC psychiatry*, 8, 22. [PubMed: 18405382]
- Tingley D, Yamamoto T, Hirose K, Keele L, Imai K, 2014. Mediation: R package for causal mediation analysis.
- Toledo-Rodriguez M, Sandi C, 2011. Stress during Adolescence Increases Novelty Seeking and Risk-Taking Behavior in Male and Female Rats. *Frontiers in behavioral neuroscience*, 5, 17. [PubMed: 21519389]
- van Nierop M, Viechtbauer W, Gunther N, van Zelst C, de Graaf R, Ten Have M, ... van Winkel R, 2015. Childhood trauma is associated with a specific admixture of affective, anxiety, and psychosis symptoms cutting across traditional diagnostic boundaries. *Psychological medicine*, 45(6), 1277–1288. [PubMed: 25273550]
- von Stumm S, Ackerman PL, 2013. Investment and intellect: a review and meta-analysis. *Psychological bulletin*, 139(4), 841–869. [PubMed: 23231531]
- Wechsler D, 1997. Wechsler Adult Intelligence Scale – Third Edition (WAIS-III). San Antonio, TX: Harcourt Assessment.
- Wolfe J, Kimberling R, Brown P, Chrestman K, Levin K, 1997. Life Stressor Checklist-Revised (LSC-R). Retrieved from <https://www.ptsd.va.gov/professional/assessment/te-measures/lsc-r.asp>

Highlights

- Childhood stress was associated with openness to experience
- Openness partially mediated association of stress and depression
- Higher openness was associated with higher IQ
- Openness mediated association of stress and IQ

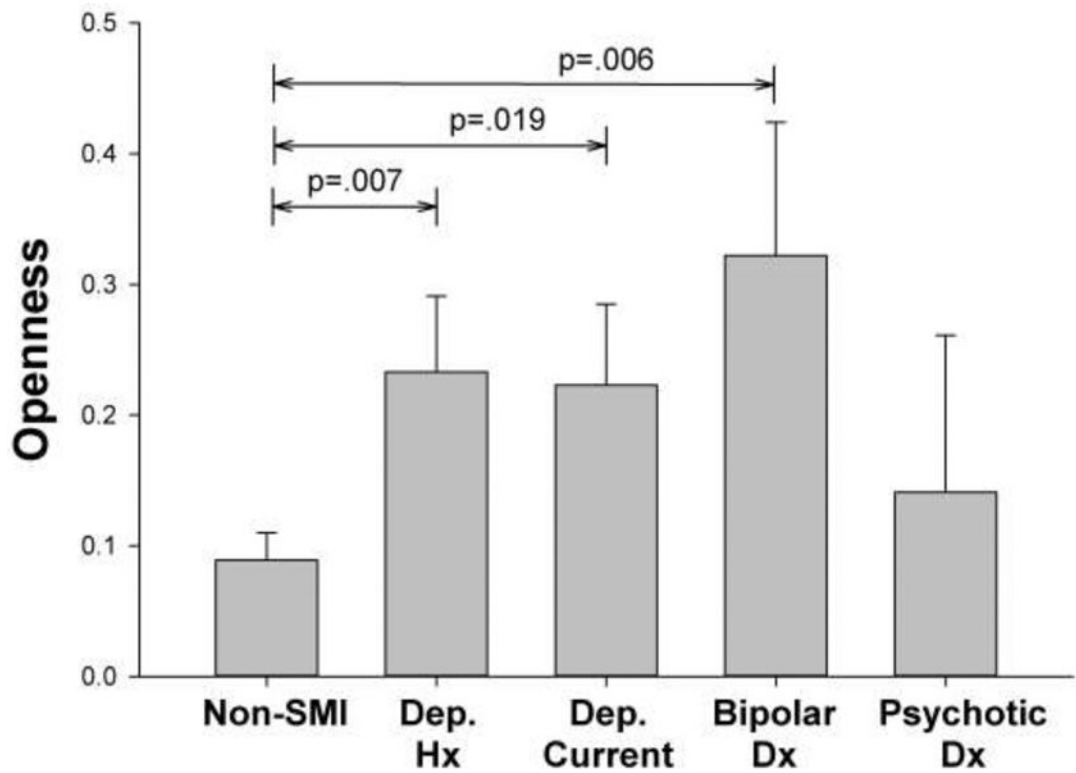


Figure 1:

Average openness to experience scores by diagnostic group. Non-SMI refers to individuals without past or current diagnosis of depression (Dep. Hx and Dep Current), bipolar disorder, or psychotic disorder. Note that openness scores reflect average of 12 items with responses coded -2 (strongly disagree) to 2 (strongly agree). Error bars represent standard error.

Table 1:

Summary of demographic characteristics. Variance reported as \pm standard deviation.

	No history of SMI (n=360)	Depression in remission (n=70)	Current depression (n=60)	Bipolar disorder (n=25)	Psychotic disorder (n=16)
Age \pm s.d. (years)	40.0 \pm 18.8	41.7 \pm 14.8	41.5 \pm 13.2	42.7 \pm 15.9	37.6 \pm 17.5
Sex (M/F)	162/198	20/50	18/42	15/10	9/7
n, antidepressant use	16 (4.4%)	34 (48.6%)	22 (37.9%)	13 (52.0%)	8 (50%)
n, mood stabilizer use	1 (0.3%)	4 (5.7%)	3 (5.0%)	15 (60%)	4 (25%)
n, antipsychotic use	2 (0.6%)	3 (4.3%)	2 (3.3%)	18 (72%)	10 (62.5%)

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Table 2:

Regression coefficients from linear regression models examining relationship of stressful life events and personality traits, covarying for age and sex. Results passing correction for multiple comparisons in bold.

	Life Events <age 15		Life Events total		Life Events age 15	
	Beta	p-value	Beta	p-value	beta	p-value
Agreeableness	-.04	.39	-.03	.56	.06	.21
Conscientiousness	.11	.015	.03	.54	.01	.80
Extraversion	.03	.52	-.01	.80	-.03	.59
Neuroticism	.06	.14	.22	<.001	.18	<.001
Openness	.13	.003	.22	<.001	.20	<.001

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Table 3:

Relationship of personality factors to cognitive measures, controlling for age and sex, in sample excluding individuals with bipolar disorder or psychotic disorder (n=469, includes individuals with depression). Results passing Bonferroni correction for 15 comparisons ($p < .0033$) in bold.

	WASI full IQ		Symbol Coding		Digit Sequencing	
	Beta	p-value	Beta	p-value	Beta	p-value
Agreeableness	-.06	.22	.06	.20	.00	.97
Conscientiousness	.00	.99	.13	.004	.02	.66
Extraversion	.05	.30	.01	.74	.03	.54
Neuroticism	.00	.97	-.03	.58	.05	.33
Openness	.21	<.001	.04	.31	.06	.17

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Table 4:

Relationship of personality traits to measures of depressive symptoms in full sample, covarying for age and sex.

	BDI		MTSD-State		MTSD-Trait	
	Beta	p-value	Beta	p-value	beta	p-value
Agreeableness	-.21	<.001	-.11	.013	-.12	.006
Conscientiousness	-.23	<.001	-.17	<.001	-.14	.001
Extraversion	-.19	<.001	-.22	<.001	-.26	<.001
Neuroticism	.63	<.001	.46	<.001	.49	<.001
Openness	.13	.0021	.13	.003	.22	<.001

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