Published in final edited form as:

Psychiatry Res. 2018 October ; 268: 229–237. doi:10.1016/j.psychres.2018.07.010.

Personality variables modify the relationship between childhood maltreatment history and poor functional outcomes

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Abstract

Childhood maltreatment history is a prevalent risk factor for substance use disorder and has lifelong adverse consequences on psychiatric wellbeing. The role of personality variations in determining childhood maltreatment-associated outcomes is poorly understood. This study sought to test neuroticism and agreeableness as mediator and moderator, respectively, of functional outcomes associated with having a history of childhood maltreatment and presence/absence of cocaine dependence. Ninety-four participants completed the Structured Clinical Interview for DSM-IV (SCID-IV), Childhood Trauma Questionnaire (CTQ), NEO-Five Factor Inventory (NEO-FFI), and the Addiction Severity Index (ASI). The distribution-of-the-product strategy tested if neuroticism mediated the relationship between CTQ and ASI scores. Agreeableness was tested as a moderator using bootstrapped multiple regression analyses with agreeableness*CTQ interaction terms as predictors of ASI scores. Analyses covaried for cocaine dependence to determine its influence. Neuroticism mediated the relationship between severity of childhood maltreatment history and family (ASI-Family) and psychiatric (ASI-Psychiatric) dysfunction in adulthood, independent of cocaine dependence. Agreeableness negatively moderated the effect of childhood maltreatment severity on family dysfunction. Exposure to emotional neglect and abuse selectively drove the mediation and moderation effects. Personality-directed interventions that reduce neuroticism or increase agreeableness may be promising approaches to uncouple childhood maltreatment history from lifelong social and psychiatric dysfunction.

Keywords

Neuroticism; Agreeableness; Child abuse; Addiction severity index; Five-factor model of personality; Emotional abuse

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2018.07.010.

1. Introduction

Childhood maltreatment is a highly prevalent global public health problem associated with life-long consequences. One quarter of adults report that they experienced childhood physical abuse, and 1 in 5 women report that they experienced childhood sexual abuse (World Health Organization Media Centre, 2017). Large sample studies assessing the long-term effects of childhood maltreatment, such as the Adverse Childhood Experiences (ACE) study, indicate that having a history of childhood maltreatment adversely affects social, medical, and psychiatric well-being throughout one's life. Socially, the number of ACE categories endorsed by adults dose-dependently increases their odds of reporting serious problems with family, employment, and finances (Hillis et al., 2004). For low-income women, adverse childhood experiences are highly correlated to adverse adult experiences, including physical or emotional abuse from a current or former partner, alcohol misuse, drug use, crime victimization, and incarceration (Mersky et al., 2018). Medically, childhood maltreatment history is positively associated with chronic systemic inflammation (Rasmussen et al., 2018; Baumeister et al., 2016), and increases one's risk and severity of suffering from myriad debilitating medical conditions, including autoimmune diseases (Dube et al., 2009), obesity, ischemic heart disease, and cancer (Felitti et al., 1998). Psychiatrically, adults with histories of adverse childhood experiences are 7–10 times more likely to report having illicit drug use problems or addictions compared to those with no history of maltreatment (Dube et al., 2003). Furthermore, adults who endorse four or more categories of ACE are 4.6 times more likely to report past-year depression relative to adults who endorse no categories of ACE (Felitti et al., 1998), and the odds of attempting suicide are 1.7- to 17-fold greater in adults endorsing 1 or 7 ACE categories, respectively, relative to adults with no ACE (Dube et al., 2001). Increased severity of bipolar disorder, including earlier age at onset, suicide attempts, rapid cycling, and number of depressive episodes, is associated with childhood maltreatment history (Etain et al., 2013). Altogether, these clinical outcomes lead to poor quality of life and increase the risk of early death from all causes by more than 50% (Kelly-Irving et al., 2013), and individuals who endorse 6 or more ACE categories die, on average, almost 20 years earlier than those with no ACE (Brown et al., 2009). This growing literature profoundly characterizes early life adversity as a major risk for life-long morbidity and mortality.

The mechanisms that determine susceptibility to poor outcomes associated with childhood maltreatment histories are multi-faceted and not well understood, though personality variables are widely implicated. Personality can be defined as a set of enduring, largely predictable traits, behaviors, and thought processes. The five-factor model of personality is an empirically-derived personality construct of five traits identified using factor analysis (Cattell, 1943; Tupes and Christal, 1992; Norman, 1963). These traits include neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness (Costa and McCrae, 1992; Saucier, 1998). The Five-Factor Model is a well-validated, widely accepted trait model that has been used to characterize the effects of early life environment on personality (Hengartner et al., 2015; Rogosch and Cicchetti, 2004) and the relationship of personality with well-being in adulthood (Lahey, 2009; Schneider-Matyka et al., 2016). This

study focused on two major personality traits associated with the influence of environment on one's well-being—neuroticism and agreeableness.

The definition of neuroticism has varied throughout its history, but the current general consensus is that neuroticism is the propensity to experience negative emotions (Ormel et al., 2013). Assessments that measure Five-Factor Model neuroticism are based on an empirical lexical model; an assumption of such a model is that verbal language represents concepts of importance, interest, and meaning to individuals (Ormel et al., 2013). While some factors of the model have been called into question due to poor item loading (i.e., extraversion and openness), neuroticism exhibits robust psychometric validity (McCrae and Costa, 2004) and has high clinical relevance. For example, increased neuroticism is associated with childhood maltreatment history (Hillmann et al., 2016; McFarlane et al., 2005), and elevated expression of neuroticism in adulthood is associated with many adverse outcomes related to childhood maltreatment history. These outcomes include drug abuse and addiction (Prisciandaro et al., 2011; Grekin et al., 2006; Valero et al., 2014), depression, anxiety, suicidal ideation (Bienvenu et al., 2004; DeShong et al., 2015), and non-psychiatric medical conditions (Lahey, 2009). Neuroticism also mediates the relationship between childhood maltreatment history and poor sleep quality in adulthood (Ramsawh et al., 2011). Furthermore, individuals with childhood maltreatment histories and elevated expression of the personality trait of neuroticism are significantly more likely to develop psychiatric disorders in adulthood than individuals with childhood maltreatment histories and lower neuroticism trait scores (Collishaw et al., 2007).

In contrast, trait agreeableness, which is the tendency to be cooperative, altruistic, and straightforward, is positively associated with adaptive personality profiles that protect against psychological distress (Spinhoven et al., 2016). Agreeableness also is protective against the development of drug abuse in at-risk adults (Wallace et al., 2016) and the escalation of drug misuse in adolescents (Whelan et al., 2014). The collective findings indicate that neuroticism likely promotes, and agreeableness likely protects against, negative outcomes in adults with histories of childhood maltreatment.

We previously reported that being cocaine dependent and having a history of childhood maltreatment independently predicted neuroticism and agreeableness (Brents et al., 2015). In the present study, we extend our previous findings by determining whether neuroticism and agreeableness promote risk for and protection against, respectively, poor daily functioning (i.e., social, medical, and psychiatric functioning) associated with childhood maltreatment. Our analyses focused on neuroticism and agreeableness because these traits appear to oppose each other in determining susceptibility for mental disorders and poor outcomes. Using a sample that was enriched in maltreated and cocaine-dependent individuals, we tested the hypotheses that neuroticism mediates and agreeableness negatively moderates the relationship between childhood maltreatment history and poor daily functioning, independent of cocaine dependence. We tested this hypotheses by answering the following questions: does childhood maltreatment history predict poor daily functioning? Does neuroticism mediate the relationship between childhood maltreatment history and poor daily functioning? Does agreeableness negatively moderate the relationship between childhood maltreatment history and poor daily functioning? Does controlling for cocaine dependence

affect the mediation and moderation by neuroticism and agreeableness, respectively? Does the subtype of childhood maltreatment history (e.g., physical, emotional, or sexual abuse; physical or emotional neglect) play an important role in personality-mediated or—moderated effects on poor daily functioning?

Substance use disorders represent both a consequence of childhood maltreatment history and a contributor to the poor social, medical, and psychiatric outcomes of childhood maltreatment. We examined the role of cocaine dependence in our analyses because substance use disorders can complicate the understanding of childhood maltreatment-related personality outcomes. Identifying interventions that potentially un-couple childhood maltreatment history from poor daily functioning, and understanding how substance use disorder contributes to their coupling, will inform the development of treatments for individuals with substance use disorders and those at-risk by exposure to childhood maltreatment.

2. Methods

2.1. Recruitment

The current study represents an analysis of behavioral data and personality assessment data obtained from a functional magnetic resonance imaging (fMRI) study on the influence of childhood maltreatment history on the neural correlates of cocaine craving and inhibitory control (Elton et al., 2015; Elton et al., 2014). In this regard, we exploited an efficient model of personality research (Mar et al., 2013) in which we capitalized on neuroimaging data collected for separate purposes and combined it with new behavioral data (i.e., NEO-FFI personality trait measures) to test novel hypotheses. Advertisements for adult study participants with cocaine dependence and/or childhood maltreatment histories (and healthy comparison subjects with no childhood maltreatment histories) were posted in Central Arkansas Transit (CAT) buses, in Little Rock-area newspapers, and throughout the community. During a brief phone screening, a research coordinator described study procedures to potential participants and preliminarily determined eligibility. All participants gave written informed consent to participate. Study procedures were approved by the Institutional Review Board at UAMS and carried out in accordance with the Declaration of Helsinki. Participants were compensated \$30 per completed assessment visit for up to two assessment visits. Participants were also compensated for completing up to two fMRI visits. Compensation for completing the first fMRI visit was \$15 plus the amount received for a reward task, which ranged from \$20–\$35, for a total of \$35–\$50. Compensation for completing the second fMRI visit was \$30.

2.2. Participants

Ninety-five participants ages 19–50 were enrolled in the study (37 female, mean age = 37.8, SD = 8.8 years). Sixty-five participants met DSM-IV criteria for cocaine dependence and were classified as cocaine dependent in the present study. The remaining thirty participants endorsed no current or lifetime drug or alcohol dependence and were classified as non-drug dependent. This multi-group enrollment yielded a single sample with a wide dynamic range of the variables of interest. Standard exclusion criteria for magnetic resonance imaging

studies were applied to the sample. These criteria include the presence of a major medical disorder (e.g., cancer) or medically unstable medical disorders (e.g., hypertension, diabetes), pregnancy, claustrophobia, significant head injury resulting in loss of consciousness for more than 10 minutes, the use of medications known to alter hemodynamic coupling (e.g., beta blockers, diuretics), some orthodontic devices, and ferromagnetic implants (e.g., screws, aneurysm clips, pacemakers, etc.). One participant was excluded from the present analyses due to missing data for the Addiction Severity Index. Exclusion criteria also included presence of current (past-month) Axis I disorders [e.g., major depressive disorder (MDD), post-traumatic stress disorder (PTSD), generalized anxiety disorder (GAD)]. Non-cocaine-dependent participants were excluded if they endorsed current or lifetime drug or alcohol dependence, with the exception of nicotine dependence. Cocaine-dependent participants with current or lifetime dependence on other substances (nicotine, alcohol, and other illicit drugs) were included in the study if cocaine was the preferred drug of abuse. A second recruitment cohort was added to the study in an effort to increase the number of female participants who had experienced significant childhood maltreatment but were not cocaine-dependent. Exclusion criteria pertaining to current (past month) Axis I disorders were less stringent for the second cohort ($n = 11$) compared with the first ($n = 84$) and allowed for current Axis I disorders. Due to the clinical exclusion criterion for the larger first cohort, 1 (1.1%), 6 (6.4%) and 1 (1.1%) participants in the total sample fulfilled criteria for current MDD, PTSD, and GAD, respectively (Table 1). When compared with high-CTQ females in cohort 1, the participants in cohort 2 did not differ with respect to neuroticism, agreeableness, ASI scores, CTQ subtype scores, incidence of cocaine dependence, race, or education; therefore, the two cohorts were collapsed into one group.

Tables 1 and 2 describes the demographic and clinical characteristics of the participant sample, respectively. As a group, the participants had widely varying severity of childhood maltreatment histories and ASI scores, and 64 (68.1%) participants were cocaine-dependent. The cocaine-dependent participants had a median cocaine use frequency of 10 days in the preceding 30 days. Current and lifetime diagnoses of drug abuse and dependence in the cocaine dependent group are described in Supplementary Table 1. Co-morbidities of alcohol abuse and dependence were most frequently observed in the cocaine-dependent participants.

2.3. Assessments

The assessments used in the study include the Structured Clinical Interview for DSM-IV-TR (SCID-IV), NEO-Five Factor Inventory (NEOFFI), the Addiction Severity Index (ASI), and the Childhood Trauma Questionnaire Short Form (CTQ). The SCID-IV was conducted by a master's-level clinical research coordinator to determine inclusion and exclusion criteria pertaining to Axis I disorders (e.g., drug dependence, MDD, PTSD, GAD) (First et al., 2007). The SCID-IV is considered a gold standard in the research diagnosis of DSM-IV Axis I disorders. The NEO-FFI, ASI, and CTQ were used to quantify personality, daily functionality, and childhood maltreatment history, respectively.

The NEO-FFI is a well-validated instrument used to assess the five-factor model personality traits of neuroticism, extraversion, openness to experience, agreeableness and conscientiousness (McCrae and Costa, 2004; Saucier, 1998). The present study focused on

the traits neuroticism and agreeableness, as these traits have been associated with outcomes of childhood maltreatment histories (Brents et al., 2015). The NEO-FFI is a self-report survey composed of 60 items presented in a first-person, self-descriptive narrative (e.g., “I often feel tense and jittery” “I would rather cooperate with others than compete with them”). Respondents indicate how accurately the statement describes themselves using a 5-point Likert scale that ranges from 0 (“I strongly disagree”) to 4 (“I strongly agree”). Each item corresponds with a trait, and the item scores for each trait are summed to compute the trait score.

The ASI is a semi-structured interview that assesses problems during the previous 30 days in seven domains: medical, employment, alcohol, drug, legal, family, and psychiatric (McLellan et al., 1992). Scores for each domain range from 0 (no dysfunction) to 1 (maximal dysfunction). The ASI has been extensively used in addiction research for over 35 years to assess by self-report wide-ranging deficits in daily functioning in a diverse range of populations (McLellan et al., 1980,2006), including a large non-drug abusing normative sample of adult members of a large HMO (Weisner et al., 2000). Because the ASI evaluates quality-of-life problems that are not exclusively related to addiction, all participants completed the ASI regardless of their cocaine dependence status. A master’s-level research coordinator who was trained to conduct the interview administered the ASI to all participants.

The CTQ Short Form (CTQ) is a 28-item self-report questionnaire that uses a 5-point Likert scale (“never true” to “very often true”) to quantify early life exposure to abuse (physical, emotional and sexual) and neglect (physical and emotional) with acceptable-to-excellent within-factor reliability and high corroboration with therapist ratings (Bernstein et al., 2003). Response bias in the CTQ was assessed by the 3-item Minimization/Denial (MD) scale, which is designed to detect underreporting of CM. A response of “very often true” on any of the MD items, which hyperbolically idealize one’s childhood, indicated MD positivity (MacDonald et al., 2016). Approximately one-quarter ($n = 24$) of the sample exhibited evidence of underreporting their maltreatment, which is consistent with the previously reported incidence of minimization of maltreatment (MacDonald et al., 2015, 2016). A previous study showed that MD moderated the discriminative validity of the CTQ to predict clinical (high CTQ) versus community (low CTQ) participants; therefore, it was important to determine in the present study whether outcomes variables for MD-positive participants differ from those of MD-negative participants with similar CTQ scores. We first determined that CTQ total scores for MD-positive participants were significantly lower than MD-negative participants (Student’s two-tailed t -test, $p < 0.0001$, $t = 4.09$, $df = 91$), which may be due to minimization or may reflect lower maltreatment histories in the MD-positive group. To determine the effect of MD on outcome variables of interest while controlling for CTQ total scores, we identified and grouped MD-negative participants in the sample with CTQ total scores that were within 1 standard deviation of the mean CTQ total score for the MD-positive participants ($n = 37$). Means for the following variables were compared for this MD-negative subgroup versus the MD-positive group using Student’s two-tailed t -tests: neuroticism, agreeableness, all ASI domains, age, and years of education. Fisher’s exact test was used to determine group differences in the following variables: cocaine dependence, sex, race, and number of participants with education beyond high school. There were no

significant group differences between MD-positive and MD-negative participants; therefore, we concluded that MD of childhood adversity had little effect on the analyses undertaken in the present study.

2.4. Data analysis

Statistical analyses were performed using R, version 3.1.2 (R Core Team, 2016). The `Boot` and `lm` functions from the R packages `car` (Fox and Weisberg, 2011) and `stats` (R Core Team, 2016), respectively, were used for bootstrapping regressions to determine the confidence intervals for the mediation and moderation effects. We used 5,000 bootstrap sampling iterations, with replacement, for each regression. Where appropriate, multiple comparison corrections were made using the Bonferroni method ($\alpha = 0.05$). For regression analyses of CTQ total and ASI scores, corrections were made for seven comparisons (confidence level = 99.3%) reflecting the seven ASI domains. Secondary regression analyses of each of the five CTQ-defined mal-treatment subtypes and ASI scores for the Family and Psychiatric domains were corrected for 10 comparisons (confidence level = 99.5%). Results of regression analyses performed without bootstrapping are also reported to allow for the comparison of R^2 , p-values, and Akaike information criterion (AIC) between models including or omitting cocaine dependence as a covariate. AIC was determined using the AIC function in the R package `stats` (R Core Team, 2016).

2.4.1. Mediation analysis—Path coefficients for mediation models were generated by performing sequential bootstrapped linear regression analyses (Baron and Kenny, 1986), and statistical significance of mediation was determined using the distribution-of-product strategy (Preacher and Hayes, 2004). First, total effect of the model (path c) was determined by regressing the independent variable (CTQ score) against the dependent variable (ASI score). The independent variable was then regressed against the mediator (path a), and the mediator was regressed against the dependent variable (i.e., ASI scores predicted by CTQ score) while controlling for the independent variable (path b and c' , respectively) (Baron and Kenny, 1986). Although this method is historically one of the most widely used for mediation analysis, its use has been challenged in recent years (MacKinnon et al., 2002); therefore, we tested significance of mediation using the alternative distribution-of-the-product strategy (Preacher and Hayes, 2004). This approach tests whether the magnitude of the mediation (or indirect) effect (path $a \times \text{path } b$) is significantly greater than 0 by generating the bootstrapped distribution of the path $a \times \text{path } b$ product. We considered mediation present if the Bonferroni-corrected confidence interval of the distribution did not contain 0 (Preacher and Hayes, 2004). The percentage of the total effect due to mediation was subsequently determined by decomposing the path coefficients as follows:

$$c = c' + ab,$$

$$ab = c - c'$$

$$(c - c') \div c \times 100 = \text{PTE}$$

where PTE = percent of total effect due to mediation, c = total effect, c' = direct effect, and ab = indirect (mediation) effect.

2.4.2. Moderation analysis—We assessed moderation effects using multiple linear regression of mean-centered z-scores for the effect of maltreatment, agreeableness, and maltreatment*agreeableness interaction on ASI scores (Baron and Kenny, 1986). Statistical significance of the interaction term, controlling for the main effects, indicated a moderator effect. We graphically represented moderation by categorizing participants as having either low or high agreeableness, depending on tercile membership, and regressing CTQ score against ASI score for each agreeableness category. These regressions were considered statistically significant if the Bonferroni-corrected confidence interval of the bootstrapped regression coefficients did not contain 0.

3. Results

3.1. Neuroticism mediated the effects of childhood maltreatment history on family and psychiatric dysfunction

We first tested the study hypothesis that neuroticism mediates the relationship between childhood maltreatment history and functional disability in adulthood as measured by the ASI. For the first prerequisite step of the three-variable mediation analyses, we determined that CTQ total score predicted only the family and psychiatric subscores of the ASI (Path *c*, Fig. 1A and B) but no other ASI subscores. Therefore, we limited the mediation analyses to the ASI-Family and ASI-Psychiatric outcome variables. For the second step, CTQ total score predicted neuroticism (Path *a*, Fig. 1A and B). Controlling for CTQ total score in the third step of the mediation analyses, neuroticism positively predicted both family and psychiatric functioning (Path *b*, Fig. 1A and B; Table 3). The direct effects of CTQ total score on ASI scores were disrupted by controlling the analysis for neuroticism (Path *c'*, Fig. 1A and B; Table 3), suggesting that neuroticism mediated the relationship between CTQ total score and ASI subscores. Neuroticism mediated 69% and 72% of the total effects of CTQ total score on ASI-Family and ASI-Psychiatric scores, respectively. The indirect effect of neuroticism (Path *a* x Path *b*) was significantly greater than zero in both mediation analyses at the 99% confidence level (Supplementary Table 2), further supporting the mediation effect of neuroticism. The influence of cocaine dependence was examined by including cocaine dependence as a covariate in each model. The observed mediation relationships were largely unaffected by controlling for cocaine dependence (Table 3), suggesting that neuroticism stably mediates the effects of childhood maltreatment history on adult family and psychiatric dysfunction regardless of cocaine dependence status.

3.2. Agreeableness was protective against family dysfunction associated with childhood maltreatment history

We initially tested agreeableness as a mediator of the effects of childhood maltreatment history on ASI scores. We determined that agreeableness was not a mediator, as CTQ score did not predict agreeableness (Path *a*; data not shown). We next tested agreeableness as a negative moderator of CTQ-ASI associations. As in the mediation analyses (Section 3.1), ASI-Family and ASI-Psychiatric scores were predicted by CTQ total score and therefore were the only outcome variables in the moderation analyses. Agreeableness did not moderate the effect of CTQ total score and ASI-Psychiatric scores (data not shown). However, agreeableness interacted with CTQ total score to predict ASI-Family scores ($\beta =$

−0.05227, $p < 0.007$; Table 4). As displayed in Fig. 2, CTQ total score positively predicted ASI-Family score for individuals with low trait agreeableness (red circles), but there was no relationship between CTQ and ASI-Family for individuals with high trait agreeableness (blue crosses). These data collectively suggest that agreeableness negatively moderated family dysfunction associated with childhood maltreatment history. We next examined the role of cocaine dependence in this moderation analysis. Controlling for cocaine dependence slightly increased the adjusted R^2 (from 0.195 to 0.226), decreased the AIC (from −39.65 to −42.29) and eliminated the interaction effect between agreeableness and maltreatment severity (Table 4). This finding suggests that cocaine dependence contributes to family dysfunction related to childhood maltreatment history in this sample, and that the protective effect of agreeableness against childhood maltreatment-related family dysfunction is significantly influenced by cocaine dependence status.

3.3. Emotional abuse history was the predominant maltreatment subtype causing personality mediated and moderated dysfunction

To identify the specific maltreatment subtypes that place individuals at highest risk for personality-related functional disability in adulthood, we repeated the mediation and moderation analyses but replaced the CTQ total score with the scores for subtypes of childhood abuse (physical, emotional, sexual) and neglect (physical, emotional). First, the CTQ scores for each of the five maltreatment subtypes were tested as predictors of ASI-Family and ASI-Psychiatric scores. The CTQ scores for emotional abuse and emotional neglect significantly predicted ASI-Family scores, while CTQ emotional abuse scores predicted ASI-Psychiatric scores (Path *c*, Fig. 3A–C). No other CTQ subtype predicted ASI-Family or ASI-Psychiatric scores; therefore mediation and moderation analyses were limited to CTQ emotional abuse and neglect scores. Both emotional abuse and emotional neglect predicted neuroticism (Path *a*, Fig. 3A–C). Neuroticism predicted ASI-Family and ASI-Psychiatry (Path *b*), and controlling for neuroticism eliminated or reduced the association of emotional maltreatment exposure on ASI-Family and ASI-Psychiatry scores (Fig. 3, Path *c* $\hat{\gamma}$). Neuroticism mediated 76% and 58% of the total effect of emotional abuse on ASI-Family and ASI-Psychiatric scores, respectively, and 35% of the total effect of emotional neglect on ASI-Family. Cocaine dependence exerted little influence on outcomes of the emotional abuse mediation analyses (Supplementary Table 3). In contrast, controlling for cocaine dependence eliminated the mediating effect of neuroticism on the association of emotional neglect and ASI-Family scores (Supplementary Table 4), suggesting that the mediating role of neuroticism in the relationship between childhood emotional neglect and family problems in this sample depends on cocaine dependence status.

Agreeableness significantly moderated the relationship between emotional abuse and ASI-Family scores (Table 4); early life emotional abuse predicted ASI-Family score in adults with low trait agreeableness (Fig. 4). Including cocaine dependence as a covariate in the moderation analysis increased the adjusted R^2 and lowered the AIC, but did not affect the main or interaction effects (Table 4). Cocaine dependence also significantly predicted ASI-Family scores in the model. These findings suggest that cocaine dependence contributes to the overall variance in ASI-Family score without significantly influencing the negative

moderating effect of agreeableness on the association between emotional abuse and family dysfunction.

4. Discussion

The mechanisms that relate childhood maltreatment history to poor medical, social, and psychiatric outcomes for many, but not all, individuals are poorly understood. Accumulating evidence suggests that the personality trait of neuroticism contributes to, and agreeableness protects against, many of the long-term adverse effects of childhood maltreatment history. Clarifying the roles of neuroticism and agreeableness in functional outcomes related to childhood maltreatment history would inform the development of interventions to prevent and treat early trauma-related mental health disorders. We were particularly interested in characterizing the association of childhood abuse and neglect with adult multi-domain functioning in the context of substance use disorders.

This study tested the overall hypothesis that neuroticism facilitates and agreeableness diminishes the relationship between childhood maltreatment history and poor daily functioning independent of cocaine dependence. This hypothesis was tested by performing mediation and moderation analyses in a sample that was enriched in participants who were cocaine-dependent and/or had experienced moderate-to-severe maltreatment as children. The most salient finding of this study was that increased neuroticism fully mediated the effect of severity of childhood maltreatment history on family and psychiatric functioning, as measured by the ASI, independent of cocaine dependence. These results suggest that neuroticism is a predominant intermediate mechanism that links early life maltreatment to poor familial relations and psychiatric outcomes in adulthood and thus represents a potential target for novel interventions to mitigate the long-term adverse effects of childhood maltreatment history. To our knowledge this is the first report of trait neuroticism as the mediating variable between childhood maltreatment exposure and diminished family and psychiatric functioning as measured by the ASI. The lack of effect by cocaine dependence in this sample of participants that were selected as being largely free of diagnoses of other Axis I disorders (i.e., depression, anxiety, etc) supports a robust relationship between child maltreatment history and compromised adult functioning that supersedes psychiatric diagnoses. This finding is notable in light of Ormel and colleagues' previous questioning of the usefulness of neuroticism as an index of vulnerability to psychopathology (Ormel et al., 2004). These authors proposed that the use of neuroticism to explain psychopathy is inherently circular and that neuroticism instead most adequately describes mean distress levels over a protracted period of time. In the present study, the robust effect of neuroticism on functionality in the absence of diagnosable Axis I psychiatric disorders partially supports this view in that maltreatment predicts diminished adult functioning by elevating persistent levels of distress, but not specific to the functional correlates of substance use disorder or other psychiatric diagnoses.

Agreeableness negatively moderated the relationship between childhood maltreatment history and family dysfunction. Controlling for cocaine dependence eliminated this effect, suggesting that the moderating effect of trait agreeableness on the association between CTQ total score and ASI-Family scores may represent an adaptive response to early trauma

exposure that confers a graded property of functional resilience to the adverse effects of early trauma exposure. Additionally, this adaptive influence of trait agreeableness is absent when cocaine dependence is manifested. These findings suggest an etiological mechanism for cocaine dependence related to the loss of the protective influence of and agreeableness in maltreated individuals. Previous longitudinal studies of five-factor personality trait expression in mal-treated children suggests that risky personality traits (including low agreeableness) emerge and stabilize in maltreated youth at an early age (Rogosch and Cicchetti, 2004; Oshri et al., 2013), preceding substance use disorder and contributing to the risk of abusing drugs (Oshri et al., 2011). Furthermore, adolescents with conduct and substance use disorder were significantly less agreeable than unaffected siblings of similar age, and low agreeableness predicted severity of substance use (Anderson et al., 2007). These findings suggest a causal relationship in which low agreeableness precedes drug use and contributes to its development, instead of chronic drug use contributing to low agreeableness.

Of the maltreatment subtypes, emotional abuse predicted ASI-Family and ASI-Psychiatry scores and emotional neglect predicted ASI-Family. Neuroticism and agreeableness mediated and negatively moderated, respectively, the associations between emotional maltreatment and ASI scores. These results suggest that emotional maltreatment leads to enduring problems in the family and psychiatric domains more profoundly than does physical or sexual abuse, especially for individuals who express high neuroticism or low agreeableness. This finding gain importance as emotional neglect and abuse are the two most prevalent forms of childhood maltreatment history (Hovens et al., 2010) and they are highly associated with depression and anxiety in adulthood (Hovens et al., 2010). Previous studies have emphasized the outsized contribution of childhood emotional maltreatment to chronic adverse outcomes. For example, having a history of childhood emotional neglect was the only maltreatment subtype independently associated with reduced odds of four-year remission from depression and anxiety disorders (Hovens et al., 2015). Also, childhood emotional abuse history was preferentially associated with detrimental five-factor personality trait expression in adulthood (Hengartner et al., 2015). The association effects of emotional abuse history with poor psychiatric outcomes may be driven by the development of early maladaptive schema, which are defined as “broad, dysfunctional, and pervasive patterns consisting of memories, emotions, cognitions, and bodily sensations about oneself and relationships with others” (Calvete, 2014). In a longitudinal study of adolescents, emotional abuse history and neuroticism were found to independently promote early maladaptive schema, which increased symptoms of depression and anxiety (Calvete, 2014). Of translational importance, the present study identifies modifiable risk factors, neuroticism and agreeableness, as targets for therapeutic intervention in attempts to decouple emotional mal-treatment history from later family and psychiatric problems. The efficacy of a personality-targeted alcohol use prevention intervention for high-risk adolescents supports this strategy (Conrod et al., 2013).

Additionally, the present study determined that childhood mal-treatment history positively predicted ASI-Family and ASI-Psychiatry, but not other ASI domains (medical, employment, alcohol, drug, legal). This finding suggests that adulthood family and

psychiatric functions are more sensitive to childhood maltreatment history compared with other adulthood problems measured by the ASI.

This study has clear limitations that require consideration when interpreting its results. First, participants were not recruited from the population at random; participants with trauma histories, cocaine dependence, and without current DSM-IV Axis I disorders (with the exception of cocaine dependence) were targeted for enrollment. Considering the strong association between childhood maltreatment history and Axis I disorders, the participant sample in this study may not be fully representative of abused individuals in the general population. The interpretation of the results of this study is primarily applicable to functioning for individuals who do not have Axis I psychiatric disorders. However, the study's recruitment approach offered interpretive advantages by making the sample more homogenous, including less confounding by Axis I disorders and reduced sample variance, resulting in greater statistical power due to sample stratification for the relatively small sample size. Furthermore, oversampling for cocaine dependence and childhood maltreatment history allowed disentangling of the variables of interest. Because cocaine dependence was the primary substance use disorder in this study, care must be taken to avoid generalizing the findings of this study to dependence on other types of drugs of abuse. Second, the study design was reliant on retrospective self-report of the presence, severity, and type of childhood maltreatment exposure; a longitudinal prospective study spanning from childhood to adulthood is a superior approach to characterize the causal relationships between childhood maltreatment history, personality, and ASI scores in adulthood. Third, the instruments used to quantify personality, medical, social, and psychiatric functioning were also self-report surveys; participant bias and perception can confound results. Fourth, while there has been criticism for the causal steps approach (Baron and Kenny, 1986) for having low statistical power (MacKinnon et al., 2002), our more stringent approach likely reduces Type I error, which enhances our confidence in the positive findings of the present study. Fifth, because of the relatively small sample size used in this study, we were unable to analyze or control for possible effects of sex, age, race, etc., on the association of study variables. Finally, we did not use dimensional assessments of depression or anxiety symptoms in this study and therefore could not assess the potential effects of clinically subthreshold symptoms of depression or anxiety on the study variables.

The present study suggests that the relationships between childhood maltreatment history and poor daily functioning are mediated by neuroticism (for family and psychiatric functionality) and negatively moderated by agreeableness (for family functionality), and that individuals with histories of emotion maltreatment are most susceptible to childhood maltreatment-related effects on family and psychiatric functionality. These findings suggest that at-risk individuals with histories of moderate-to-severe childhood maltreatment who are experiencing interpersonal and/or psychiatric problems may benefit from interventions that reduce neuroticism and increase agreeableness.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Scientific editing was provided by Madison Hedrick, MA, and DeAnn Hubberd, MA, of the Science Communication Group at the University of Arkansas for Medical Sciences. This work was supported by NIDA (R01-DA019999 and T32-DA022981).

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Fig. 1.

Neuroticism as a mediator of childhood maltreatment history effects on adult family and psychiatric disability. CTQ total score was positively predictive of neuroticism (path a), and ASI scores for the family (A) and psychiatric (B) domains in adulthood (path c). Controlling the latter regression analyses for neuroticism eliminated the relationship between CTQ total and ASI scores (path c'), but neuroticism significantly predicted ASI scores while controlling for CTQ total score (path b). As indicated in the insets, models incorporating both CTQ total score and neuroticism were highly predictive of variance in ASI-family (adjusted $R^2 = 0.188$, $p < 3.891 \times 10^{-5}$) and ASI-psychiatric scores (adjusted $R^2 = 0.3394$, $p < 4.453 \times 10^{-9}$). These results indicate that neuroticism fully mediated the adverse effects of childhood maltreatment history on familial (A) and psychiatric (B) functionality in adulthood ($^{***}p < 0.005$, ns = not significant, $n = 94$).

Fig. 2.

Interaction effect of agreeableness and childhood maltreatment history on family dysfunction in adulthood. CTQ total scores significantly predicted familial dysfunction in participants with lower (1st) tercile agreeableness scores [red circles and solid line; $n = 32$, $p < 0.05$, bootstrapped unstandardized $\beta = 0.004869$ (95% CI: 0.002037, 0.009630)]. This relationship was not present in participants with upper (3rd) tercile agreeableness scores [blue crosses and dashed line; $n = 28$, $p > 0.05$, bootstrapped un-standardized $\beta = -0.0008831$ (95% CI: -0.002802 , 0.002026)]. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Fig. 3.

Neuroticism as a mediator of the effects of childhood emotional mal-treatment history on family and psychiatric dysfunction in adulthood. Neuroticism mediated the adverse effects of childhood emotional abuse history, as measured by the CTQ, on familial (A) and psychiatric (B) function in adulthood. Neuroticism also mediated the effects of childhood emotional neglect history (C) on familial dysfunction (* $p < 0.05$, ** $p < 0.01$, *** $p < 0.005$, $n = 94$).

Fig. 4.

Agreeableness negatively moderates the effects of childhood emotional abuse on familial dysfunction in adulthood. Childhood emotional abuse history, as measured by the CTQ, significantly predicted familial dysfunction in participants with lower (1st) tercile agreeableness scores [red; $n = 32$, $p < 0.05$, bootstrapped unstandardized $\beta = 0.02374$ (95% CI: 0.01485, 0.03627)]. This relationship was not present in participants with upper (3rd) tercile agreeableness scores [blue; $n = 28$, $p > 0.05$, bootstrapped unstandardized $\beta = -0.004706$ (95% CI: -0.01278 , 0.003857)]. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Table 1

Demographic data.

Number of subjects, <i>n</i>	94
Cocaine dependent, <i>n</i> (%)	64 (68.1)
Age, years (SD)	37.8 (8.8)
Female sex, <i>n</i> (%)	37 (39.3)
<u>Race, <i>n</i> (%)</u>	
White, non-Hispanic origin	71 (23.4)
Black, non-Hispanic origin	22 (75.5)
Asian or Pacific Islander	1 (1.1)
Education, subjects > high school, <i>n</i> (%)	40 (42.5)
Unemployed, <i>n</i> (%)	56 (59.6)

Table 2

Participant childhood maltreatment history, psychopathology, and functionality.

<u>CTQ scores, mean (SD)</u>	
Total	51.1 (22.6)
Physical abuse	10.1 (5.2)
Emotional abuse	11.5 (6.0)
Sexual abuse	9.2 (6.8)
Physical neglect	8.6 (4.3)
Emotional neglect	11.7 (5.8)
<u>Current Axis I Disorders, <i>n</i> (%)</u>	
MDD	1 (1.1)
PTSD	6 (6.4)
GAD	1 (1.1)
<u>Lifetime Axis I Disorders, <i>n</i> (%)</u>	
MDD	33 (35)
PTSD	12 (12.8)
Mania	1 (1.1)
Bipolar I	1 (1.1)
Panic disorder, Agoraphobia	1(1.1)
GAD	1 (1.1)
<u>ASI scores, mean (SD)</u>	
Medical	0.15 (0.25)
Employment	0.64 (0.32)
Alcohol	0.14 (0.18)
Drug	0.12 (0.12)
Legal	0.09 (0.17)
Family	0.18 (0.21)
Psychiatric	0.12 (0.16)

SD, standard deviation; CTQ, childhood trauma questionnaire; MDD, major depressive disorder; PTSD, post-traumatic stress disorder; GAD, generalized anxiety disorder; ASI, Addiction Severity Index.

Neuroticism mediates the effect of childhood maltreatment on adult family and psychiatric dysfunction with little influence by cocaine dependence.

Table 3

Family	<i>MODEL 1: ASI_Fam ~ CTQ_TOTAL + N Adjusted R² = 0.188 p-value = 3.891 × 10⁻⁵ AIC = -50.84</i>	<i>MODEL 2: ASI_Fam ~ CTQ_TOTAL + N + Coc Adjusted R² = 0.1916 p-value = 7.981 × 10⁻⁵ AIC = -50.28</i>
Predictor	Coef	Coef
CTQ Total	0.0009736	0.0009153
Neuroticism	0.01005*	0.009253*
Cocaine	—	0.05564
Psychiatric	<i>MODEL 1: ASI_Psy ~ CTQ_TOTAL + N Adjusted R² = 0.3394 p-value = 4.453 × 10⁻⁹ AIC = -109.33</i>	<i>MODEL 2: ASI_Psy ~ CTQ_TOTAL + N + Coc Adjusted R² = 0.334 p-value = 2.193 × 10⁻⁸ AIC = -111.03</i>
Predictor	Coef	Coef
CTQ Total	0.0007057	0.0006492
Neuroticism	0.01004*	0.009900*
Cocaine	—	0.01395

Unstandardized bootstrapped coefficients (R = 5000), n = 94.

* $p < 0.007$.

Cocaine dependence contributes to the moderating effects of agreeableness on the relationship between childhood maltreatment and adult familial dysfunction.

Table 4

Total maltreatment severity		<i>MODEL 1: ASI_Fam ~ CTQ_TOTAL</i> * A Adjusted $R^2 = 0.195$ p -value = 6.031 $\times 10^{-5}$ AIC = -39.65	<i>MODEL 2: ASI_Fam ~ CTQ_TOTAL</i> * A + Coc Adjusted $R^2 = 0.226$ p -value = 2.538×10^{-5} AIC = -42.29
Predictor	Beta values		
CTQ total	0.06618 *		0.06086 *
Agreeableness	-0.04477		-0.03631
Cocaine	—		0.09451 *
CTQ Total X agreeableness	-0.05227 *		-0.05470
Emotional abuse severity		<i>MODEL 1: ASI_Fam ~ CTQEA</i> * A Adjusted $R^2 = 0.2073$ p -value = 3.148 $\times$ 10^{-5} AIC = -41.06	<i>MODEL 2: ASI_Fam ~ CTQEA</i> * A + Coc Adjusted $R^2 = 0.2528$ p -value = 5.932 $\times$ 10^{-6} AIC = -45.55
Predictor	Beta values		
CTQEA	0.05784 **		0.05785 **
Agreeableness	-0.03971		-0.02809
Cocaine	—		0.1086 **
CTQ EA X agreeableness	-0.05354 **		-0.05482 **

Regressions were performed using Fisher Z-transformed independent variables in bootstrapped multiple regression analyses. $n = 94$.

* $p < 0.007$.

** $p < 0.005$.