



## Why do trauma survivors become depressed? Testing the behavioral model of depression in a nationally representative sample

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### ABSTRACT

Despite accumulated evidence linking trauma exposure to major depressive disorder (MDD), there is limited understanding as to why some trauma survivors subsequently develop MDD. The behavioral model of depression points to a negative reinforcement cycle of trauma-related avoidance and depressed mood, but no study has evaluated this framework in trauma survivors. This study tested the hypothesis that traumatic stress symptom-related interference with daily activities and with relationships and self-medicating traumatic stress symptoms with alcohol and with drugs would predict MDD onset in a nationally representative sample after controlling for established risk factors. Data were drawn from Waves 1 and 2 of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) using two samples: adults reporting lifetime trauma exposure but no history of MDD at Wave 1 ( $n = 8301$ ) and a subset of those participants who met criteria for lifetime PTSD prior to Wave 1 ( $n = 1055$ ). Younger age, female gender, a greater number of different trauma types, traumatic stress-related interference with daily activities, and self-medicating traumatic stress symptoms with alcohol significantly predicted MDD onset in both groups. Findings underscore the role of traumatic stress-related interference and self-medication in the development of MDD.

### 1. Introduction

The connection between trauma exposure (e.g., natural disaster, mass shooting, physical or sexual assault) and major depressive disorder (MDD) is well established (Kessler et al., 1995; 2005; Pietrzak et al., 2011). Concurrent symptoms of traumatic stress and depression are associated with negative outcomes such as decreased quality of life, reduced work productivity and employment, increased medical disease burden, and greater suicide risk (e.g., DeBeer et al., 2014; Possemato et al., 2010; Ramsawh et al., 2014). Several etiological models have sought to explain the co-occurrence of traumatic stress and depressive symptoms (for a review, see Stander et al., 2014). Although it is important to consider equifinality when explaining psychiatric comorbidity, the hypothesis that traumatic stress is a causal risk factor for depression has garnered empirical support (Stander et al., 2014). Yet despite accumulated evidence indicating trauma exposure increases the risk for the first onset of depression, it is less understood why some people with a trauma history develop MDD.

The behavioral model of depression posits that depressed mood results from low rates of response-contingent positive reinforcement and inadequate social skills (Lewinsohn, 1974); in other words, a decrease in rewarding activities that are important (e.g., showing up for work) and/or enjoyable (e.g., meeting a loved one for lunch). Indeed, certain symptom criteria for posttraumatic stress disorder (PTSD) such as avoiding certain places, activities, conversations, or people (American Psychiatric Association [APA], 2000) resemble this decrease in behavioral activation. Although trauma-related avoidance might successfully prevent the recollection of traumatic memories, it also precludes opportunities to contact potential positive reinforcers in the environment. For example, a woman can avoid driving on a road where a life-threatening motor vehicle accident occurred if she decides to skip work (i.e., avoids trauma-related cues), but she will no longer have the chance to achieve a sense of mastery from completing a challenging work project. Similarly, a veteran who distances himself from friends minimizes the need to talk about his combat trauma, but he also prevents opportunities to deepen (or even maintain) the quality of his

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relationships. Notably, burgeoning research suggests that increasing the frequency of rewarding daily and interpersonal activities alleviates both depressive and traumatic stress symptoms (Jakupcak et al., 2006; Nixon and Nearmy, 2011; Strachan et al., 2012). Although common treatment response does not necessarily signify shared etiological or maintenance processes, these findings nevertheless offer indirect support for a behavioral model of co-occurring traumatic stress and depressive symptoms.

At the same time, psychosocial treatments derived from behavioral models of depression acknowledge the potential for alcohol and drug misuse to both stem from and maintain negative affect (Daughters et al., 2008; Magidson et al., 2011). Although alcohol and drugs may temporarily neutralize aversive somatic, cognitive, and affective states, they ultimately exacerbate psychiatric symptoms in the long term (see Blume et al., 2000; Bremner et al., 1996; Hutchison et al., 1997; Jacobsen et al., 2001; Tull et al., 2010). Thus, substance use is not only a form of avoidant coping itself, but also perpetuates the cycle of avoidant coping and depressed mood via negative reinforcement. Accumulated research documents the prevalence and deleterious long-term consequences of self-medicating traumatic stress symptoms with alcohol and drugs. Specifically, not only is self-medication common across samples of veterans, first responders, psychiatric patients, emerging adults, and the general population, but it is also associated with more severe psychopathology and greater risk of suicide (Bryan et al., 2016; Gaher et al., 2006; Herberman Mash et al., 2016; Leeies et al., 2010; Mirin and McKenna, 1975; North et al., 1999; Ouimette et al., 2010; Tull et al., 2010). This behavioral perspective is consistent with the self-medication hypothesis of drug and alcohol abuse (Chilcoat and Breslau, 1998; Khantzian, 1997; see also Cooper et al., 1995), which underscores how substance use functions to provide immediate, yet temporary, escape from psychological distress.

To illustrate how these behavioral factors could lead someone exposed to trauma to develop MDD, consider a college-aged woman who experiences a sexual assault. Her traumatic stress symptoms interfere with her ability to keep up with coursework, but she finds that she can “quell” several of these symptoms (e.g., flashbacks, hypervigilance) if she self-medicates with alcohol. Though having a couple of drinks in the evening might not seem unusual for a college student, she nevertheless decreases opportunities to contact potential positive reinforcers. Rather than meeting up with friends after class, she habitually goes straight home to “unwind” (i.e., self-medicate) alone. After a few months, her friends stop inviting her to social events, she struggles to complete routine tasks like showing up for class, and her urges to drink to quell traumatic stress symptoms become more frequent. By the time she seeks help, she feels incompetent, socially isolated, and clinically depressed.

Behavioral theory has the potential to expand upon current models of MDD among trauma survivors, as several methodological issues limit findings of previous epidemiological work. For example, many studies on associations between trauma exposure and MDD are cross-sectional, which obfuscates the temporal ordering of trauma-related stress symptoms, alcohol/drug misuse, and MDD onset. Additionally, though findings from studies of traumatic stress and substance use disorders are often interpreted through the lens of the self-medication hypothesis (Chilcoat and Breslau, 1998; Khantzian, 1997), drug and alcohol use motivations are not always explicitly assessed. Similarly, many studies examine the role of PTSD diagnosis but overlook traumatic stress-related functional interference that can occur among trauma survivors—regardless of whether they meet diagnostic criteria for PTSD. A final issue is that previous related work often does not delineate MDD recurrence and onset (Kessler, 1997). From a conceptual standpoint, individuals with a history of depression may respond to trauma in qualitatively different ways than do their trauma-exposed counterparts without previous depression. From an analytic standpoint, failing to exclude individuals who have a history of depression confounds predictive models wherein the outcome is MDD diagnosis, considering that

approximately 50% of individuals who experience a depressive episode go on to have another episode within the next few years (Bircusa and Iacono, 2007). Investigations that limit samples to trauma survivors without a history of depression would allow for a more precise analysis of the predictors of subsequent MDD among people who experience a traumatic event.

Considering the limitations of existing research on co-occurring traumatic stress and depressive symptoms—and the potential implications of understanding this co-occurrence through the lens of behavioral theory—elucidating the predictors of initial MDD onset in a large sample of trauma-exposed adults addresses an important clinical need. Not only would such findings enhance conceptual models of concurrent depression and traumatic stress, but they could also inform psychological assessment and intervention. For example, trauma-focused treatments could better address the ways in which temporarily effective avoidant coping behaviors nevertheless exacerbate distress by helping trauma survivors simultaneously confront positive emotions as well as feared but safe trauma reminders (e.g., spend enjoyable time with a loved one in an uncomfortably crowded setting). Furthermore, although Level I and II trauma centers are mandated to routinely screen for alcohol use problems (Love and Zatzick, 2014), most clinical centers do not routinely screen for substance use motivations. Because self-medication is often overlooked, healthcare professionals may fail to identify problematic traumatic stress-related coping efforts if alcohol or drug use does not obviously deviate from socially acceptable or medically safe behavior.

The present study was designed to extend previous research by testing the behavioral model of depression in a nationally representative sample of adults who experienced a traumatic event but denied a history of major depression. To enhance the generalizability of our findings, we conducted analyses using two participant groups: adults without prior MDD who experienced a traumatic event (i.e., trauma-exposed group) and a subset of those individuals who met full diagnostic criteria for lifetime PTSD (i.e., PTSD group). In light of the literature reviewed above, we hypothesized that after controlling for established demographic, historical, and clinical correlates of depression, (a) traumatic stress-related interference with daily activities, (b) traumatic stress-related interference with relationships, (c) self-medicating traumatic stress symptoms with alcohol, and (d) self-medicating traumatic stress symptoms with drugs would each predict subsequent MDD onset in both groups.

## 2. Methods

### 2.1. Participants and procedure

Data were drawn from Waves 1 and 2 of the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), a face-to-face interview conducted by the National Institute on Alcohol Abuse and Alcoholism (NIAAA; for more details, see Grant and Kaplan, 2005; Grant et al., 2003; NIAAA, 2010). The NESARC received full ethical review and approval from the United States (U.S.) Census Bureau and the U.S. Office of Management and Budget (Grant and Dawson, 2006) and all participants provided informed consent to participate. Weighted sample data were adjusted to be nationally representative of the U.S. civilian, noninstitutional population with regard to demographic variables such as age, sex, race/ethnicity, and geographic region according to data provided by the U.S. Census Bureau (Grant et al., 2004; NIAAA, 2010).

Wave 1, conducted between 2001 and 2002, included 43,093 non-institutionalized U.S. adults residing in the 50 States and District of Columbia. Of these individuals, 34,653 (86.7%) completed the Wave 2 interview approximately three years later (mean inter-wave interval 1113 days; range 870 to 1470 days). In the trauma-exposed group ( $n = 8301$ ), we included respondents with Wave 1 and 2 data who reported lifetime exposure to a Criterion A traumatic event at Wave 1

( $n = 11,062$ ) but excluded those who met criteria for lifetime MDD at Wave 1 ( $n = 2761$ ). In the PTSD group, we only included the subset of these trauma-exposed individuals who met full diagnostic criteria for lifetime PTSD prior to Wave 1 ( $n = 1055$ ).

## 2.2. Measures

The NESARC assesses psychiatric disorders and alcohol/drug use patterns in addition to demographic and background information. Specific variables taken from the NESARC interview for the present study are described next.

### 2.2.1. Demographic information and stressful life events

Relevant background information assessed at Wave 1 included: age; gender; education level; being fired or laid off from a job in the last 12 months; getting separated, divorced, or broken off from a steady relationship in the last 12 months; and experiencing a major financial crisis, bankruptcy, or being unable to pay bills on time in the last 12 months. These characteristics have been shown to relate to depression and were therefore controlled for in the analyses reported below (APA, 2000; Burcusa and Iacono, 2007; Kessler, 1997).

### 2.2.2. Trauma exposure

Lifetime trauma exposure prior to NESARC Wave 1 was assessed in accordance with the APA Diagnostic Statistical Manual, Fourth Edition (DSM-IV; APA, 2000). During the NESARC interview, participants were asked to indicate whether they had ever experienced 27 types of potentially traumatic events consistent with DSM-IV Criterion A (Pietrzak et al., 2011). Although this measure was administered at Wave 2, the assessment was restricted to experiences that occurred prior to the participant's Wave 1 interview date. Participants were then asked, "You just mentioned some extremely stressful events that happened to you or someone very close to you at some time in your life. Which of these experiences would you single out as the WORST stressful event?" Participants must have endorsed (a) feeling "extremely frightened, helpless, or horrified about what was happening" and (b) thinking that they or someone very close to them "might die, be seriously injured or permanently disabled" at the time of the index event for the experience to be considered a Criterion A trauma.

### 2.2.3. PTSD

Lifetime PTSD prior to Wave 1 was assessed according to APA (2000) DSM-IV diagnostic criteria. After participants identified their index trauma (as described above), 19 items assessed the 17 DSM-IV PTSD symptoms of re-experiencing, avoidance, and hyperarousal. This imbalance in items versus symptoms stemmed from two instances in which two separate NESARC questions were used to assess a single DSM criterion. Specifically, the questions "After that worst event happened did you: (1) Feel that you were reliving (that/that worst) event or that it was happening all over again?" and "(2) ...Find yourself acting as if (that/that worst) event was happening again, for example, reacting to sights or sounds like the ones you heard when it happened?" were used to determine whether the Cluster B criterion "Acting or feeling as if the traumatic event were recurring" was met. Similarly, the questions "After that worst event happened did you: (1) Try to stop thinking about or feeling anything about (that/that worst) event?" and "(2) ...Try to avoid conversations that had anything to do with it?" were used to determine whether the Cluster C criterion "Efforts to avoid thoughts, feelings, or conversations associated with the trauma" was met. Participants were classified as meeting criteria for lifetime PTSD if they endorsed at least one Criterion B symptom, at least three Criterion C symptoms, and at least two Criterion D symptoms associated with a Criterion A event that lasted for at least one month and also met DSM-IV criteria regarding associated impairment or distress prior to the Wave 1 assessment date.

### 2.2.4. Number of trauma types

We controlled for the number of types of traumatic events respondents had experienced in light of research demonstrating a dose-response relationship between the number of lifetime traumatic experience types and worse psychiatric outcomes (e.g., Briere et al., 2016; Follette et al., 1996). To this end, we summed the number of times a participant endorsed one of the 27 assessed trauma types and included this value in our analyses.

### 2.2.5. Time since index trauma and wave 1 assessment

We subtracted participants' age at the time of their index trauma from their age at the NESARC Wave 1 assessment date to create a variable representing the number of years between the index traumatic event and Wave 1.

### 2.2.6. Traumatic stress-related interference with daily activities and relationships

Within the trauma assessment module of the NESARC interview (in direct reference to traumatic stress symptoms), participants were separately asked, "Did any of these reactions interfere with your daily life?" and "Did any of these reactions cause you problems in your relationships or social life?" using a yes/no response format. These items were administered to all participants, regardless of whether they met full PTSD diagnostic criteria.

### 2.2.7. Self-medication with alcohol and drugs

Within the trauma assessment module of the NESARC interview (in direct reference to traumatic stress symptoms), participants were separately asked, "Did you EVER drink alcohol to improve your mood or to make yourself feel better when you were having some of these reactions to a stressful event?" and "Did you EVER take any drugs or medicines ON YOUR OWN, that is, without a prescription, in greater amounts or more often or longer than prescribed to help improve your mood or to make yourself feel better when you were having some of these reactions to a stressful event?" using a yes/no response format. These items were administered to all participants, regardless of whether they met full PTSD diagnostic criteria.

### 2.2.8. MDD

MDD was assessed at Waves 1 and 2 according to DSM-IV (APA, 2000) criteria. Participants who met criteria for lifetime MDD at Wave 1 were excluded from analyses; meeting criteria for MDD between Waves 1 and 2 served as this study's outcome. At the beginning of the MDD diagnostic module, participants were asked to indicate whether they had experienced a period of at least two weeks that was characterized by depressed mood or a loss of interest in things they used to enjoy. Next, 19 items assessed the DSM-IV symptoms of appetite/weight change, sleeping disturbance, psychomotor changes, fatigue or decreased energy, sense of worthlessness or guilt, difficulties concentrating or making decisions, and thoughts about death or dying. Participants were classified as meeting criteria for MDD if they endorsed at least two weeks of either depressed mood or anhedonia in addition to at least four other symptoms of depression.

### 2.2.9. Alcohol and drug use disorders

We elected to control for lifetime alcohol use disorder (AUD) and drug use disorder (DUD) in order to isolate alcohol and drug use motivation from severity in our analyses. Lifetime AUD and DUD were assessed at Wave 1 according to DSM-IV criteria (APA, 2000). Because alcohol abuse and dependence were collapsed in DSM-5 (APA, 2013), we combined participants meeting criteria for abuse or dependence into a single AUD group in the current study. We similarly designated participants meeting criteria for any drug abuse or dependence disorder as having DUD (APA, 2013).

### 2.3. Data analytic strategy

Statistical analyses were conducted using SAS 9.3 supplemented with the SUDAAN software package, which adjusts for population-level variables and methodological sampling bias (e.g., survey design, non-response, and sample attrition; Research Triangle Institute [RTI], 2008). The SUDAAN add-on has been used in multiple reports of NESARC data (e.g., NIAAA, 2010) and is explained in detail elsewhere (RTI, 2008). We also controlled for the length of time between participants' assessments in all analyses reported below.

After characterizing sample demographic, background, and clinical characteristics, we computed bivariate (Spearman) correlations between inter-assessment MDD onset and other study variables separately in the trauma-exposed and PTSD samples. Next, we conducted chi-square analyses to examine the relationship between study variables and inter-assessment MDD onset separately in each participant group. We then tested logistic regression models predicting MDD onset separately in each participant group. Regression model effect sizes were approximated based on recommendations by Chinn (2000) and Tabachnick and Fidell (2007).

## 3. Results

### 3.1. Sample characteristics

#### 3.1.1. Trauma-exposed group ( $n = 8301$ )

The trauma-exposed sample was 59.04% female ( $n = 4901$ ) and had a mean age of 47.20 years old ( $SD = 16.81$ ). Participants in this group experienced a median number of 3 types of lifetime traumatic events prior to Wave 1 ( $M = 3.61$ ,  $SD = 2.17$ ), the worst of which occurred a median 12 years prior to the Wave 1 assessment ( $M = 17.44$ ,  $SD = 16.62$ ). Nearly 9% ( $n = 737$ ) met criteria for MDD between Waves 1 and 2. Regarding our focal predictors, 10.11% ( $n = 839$ ) reported traumatic stress-related interference in daily activities, 9.47% ( $n = 786$ ) reported traumatic stress-related interference with relationships, 3.28% ( $n = 272$ ) reported self-medicating traumatic stress symptoms with alcohol, and 0.76% ( $n = 63$ ) reported self-medicating traumatic stress symptoms with drugs.

#### 3.1.2. PTSD group ( $n = 1055$ )

The PTSD sample was 67.68% female ( $n = 714$ ) and had a mean age of 46.46 years old ( $SD = 15.93$ ). Participants in this group experienced a median number of 4 types of traumatic events prior to Wave 1 ( $M = 4.91$ ,  $SD = 2.80$ ), the worst of which occurred a median 18 years prior to the Wave 1 assessment ( $M = 21.02$ ,  $SD = 16.08$ ). Approximately 23% ( $n = 243$ ) met criteria for MDD between Waves 1 and 2. Regarding our focal predictors, 56.68% ( $n = 598$ ) reported traumatic stress-related interference in daily activities, 55.92% ( $n = 590$ ) reported traumatic stress-related interference with relationships, 17.44% ( $n = 184$ ) reported self-medicating traumatic stress symptoms with alcohol, and 4.83% ( $n = 51$ ) reported self-medicating traumatic stress symptoms with drugs.

### 3.2. Spearman correlations

Spearman correlations were first computed in each participant group to examine the bivariate relationship between inter-assessment MDD onset and other study variables. As shown in Table 1, MDD onset between Waves 1 and 2 in the trauma-exposed group was significantly associated with being younger, being female, having a high school education or less, reporting financial instability or divorce/separation in the 12 months prior to Wave 1, endorsing a greater number of types of lifetime traumatic events, reporting traumatic stress-related interference with daily activities, reporting traumatic stress-related interference with interpersonal relationships, self-medicating traumatic stress symptoms with alcohol, and self-medicating traumatic stress symptoms with drugs. These same variables *except* recent financial instability, recent divorce/separation, and self-medicating traumatic stress symptoms with drugs were significantly correlated with MDD onset between NESARC assessments in the PTSD group. Time since index trauma at Wave 1 was correlated with subsequent MDD in the PTSD group only. MDD onset was not significantly correlated with AUD, DUD, or recently being fired/laid off at Wave 1 in either group.

Given the conceptual similarity of our focal predictors, we also computed bivariate correlations between traumatic stress-related interference with daily activities and interpersonal relationships, as well as between self-medicating traumatic stress symptoms with alcohol and drugs in each participant group. Traumatic stress-related interference

**Table 1**  
Spearman correlations between study variables and meeting criteria for MDD between NESARC waves 1 and 2 in trauma-exposed and PTSD groups.

| Variable  | Spearman's rho<br>Trauma-exposed | PTSD    |
|---|----------------------------------|---------|
| <b>Demographics</b>   |                                  |         |
| Age   | −0.07**                          | −0.16** |
| Gender (female)   | 0.08**                           | 0.07*   |
| Education level   | −0.05**                          | 0.07*   |
| <b>Stressful life events</b>                                |                                  |         |
| Fired or laid off   | 0.02                             | −0.02   |
| Financial crisis or bankruptcy                              | 0.07**                           | 0.05    |
| Divorce or separation                                       | 0.06**                           | 0.06    |
| <b>Clinical variables</b>                                   |                                  |         |
| Number of trauma types                                      | 0.12**                           | 0.14**  |
| AUD   | −0.02                            | 0.01    |
| Time since index trauma at Wave 1                           | −0.01                            | −0.06*  |
| DUD   | 0.02                             | −0.01   |
| <b>Focal predictors</b>                                     |                                  |         |
| Traumatic stress-related interference with daily activities | 0.20**                           | 0.11**  |
| Traumatic stress-related interference with relationships    | 0.20**                           | 0.09*   |
| Self-medicating traumatic stress symptoms with alcohol      | 0.11*                            | 0.09*   |
| Self-medicating traumatic symptoms with drugs               | 0.08**                           | 0.06    |

Note: MDD = major depressive disorder; PTSD = posttraumatic stress disorder; AUD = alcohol use disorder; DUD = drug use disorder;

\*  $p < 0.05$ ;

\*\*  $p < 0.001$ .

**Table 2**

Chi-square test of independence between study variables and meeting criteria for MDD between NESARC waves 1 and 2.

| Risk factor   | Trauma-Exposed<br>MDD onset |       | $\chi^2$ | <i>p</i> | PTSD<br>MDD onset |       | $\chi^2$ | <i>p</i> |
|---|-----------------------------|-------|----------|----------|-------------------|-------|----------|----------|
|   | <i>n</i>                    | (%)   |          |          | <i>n</i>          | (%)   |          |          |
| Age <sup>a</sup>  |                             |       | 20.21    | < 0.001  |                   |       | 11.31    | 0.001    |
| Below median  | 418                         | 10.33 |          |          | 144               | 28.45 |          |          |
| Above median  | 319                         | 6.69  |          |          | 99                | 16.30 |          |          |
| Gender  |                             |       | 23.62    | < 0.001  |                   |       | 3.18     | 0.079    |
| Male  | 214                         | 6.25  |          |          | 65                | 18.34 |          |          |
| Female  | 523                         | 10.37 |          |          | 178               | 24.28 |          |          |
| Education Level   |                             |       | 6.06     | 0.016    |                   |       | 0.55     | 0.462    |
| High school or less   | 142                         | 10.84 |          |          | 62                | 24.64 |          |          |
| More than high school                                       | 595                         | 8.12  |          |          | 181               | 21.57 |          |          |
| Fired or laid off   |                             |       | 0.96     | 0.331    |                   |       | 0.75     | 0.391    |
| No  | 683                         | 8.36  |          |          | 226               | 22.49 |          |          |
| Yes   | 48                          | 9.98  |          |          | 15                | 17.05 |          |          |
| Financial crisis or bankruptcy                              |                             |       | 11.94    | < 0.001  |                   |       | 1.25     | 0.268    |
| No  | 605                         | 7.91  |          |          | 195               | 21.30 |          |          |
| Yes   | 124                         | 13.68 |          |          | 46                | 26.79 |          |          |
| Divorce or separation                                       |                             |       | 15.87    | < 0.001  |                   |       | 4.68     | 0.034    |
| No  | 659                         | 8.10  |          |          | 215               | 21.22 |          |          |
| Yes   | 71                          | 16.76 |          |          | 26                | 37.08 |          |          |
| Number of trauma types <sup>b</sup>                         |                             |       | 46.86    | < 0.001  |                   |       | 7.97     | 0.006    |
| Below median  | 287                         | 5.76  |          |          | 99                | 17.82 |          |          |
| Above median  | 450                         | 12.25 |          |          | 144               | 26.83 |          |          |
| Time since index trauma at Wave 1 <sup>c</sup>              |                             |       | 1.80     | 0.184    |                   |       | 0.29     | 0.595    |
| Below median  | 382                         | 8.96  |          |          | 136               | 22.97 |          |          |
| Above median  | 355                         | 7.97  |          |          | 107               | 21.26 |          |          |
| AUD   |                             |       | 0.45     | 0.503    |                   |       | 0.32     | 0.575    |
| No  | 552                         | 8.63  |          |          | 173               | 21.53 |          |          |
| Yes   | 185                         | 8.06  |          |          | 70                | 23.49 |          |          |
| DUD   |                             |       | 2.62     | 0.110    |                   |       | 0.02     | 0.896    |
| No  | 660                         | 8.25  |          |          | 217               | 22.05 |          |          |
| Yes   | 77                          | 10.63 |          |          | 26                | 22.74 |          |          |
| Traumatic stress-related interference with daily activities |                             |       | 53.42    | < 0.001  |                   |       | 7.45     | 0.008    |
| No  | 517                         | 6.72  |          |          | 82                | 17.66 |          |          |
| Yes   | 220                         | 25.75 |          |          | 161               | 25.96 |          |          |
| Traumatic stress-related interference with relationships    |                             |       | 57.70    | < 0.001  |                   |       | 2.40     | 0.126    |
| No  | 530                         | 6.95  |          |          | 87                | 19.50 |          |          |
| Yes   | 207                         | 24.98 |          |          | 156               | 24.37 |          |          |
| Self-medicating traumatic stress symptoms with alcohol      |                             |       | 19.34    | < 0.001  |                   |       | 6.02     | 0.017    |
| No  | 666                         | 7.86  |          |          | 186               | 20.05 |          |          |
| Yes   | 71                          | 26.89 |          |          | 57                | 31.37 |          |          |
| Self-medicating traumatic stress symptoms with drugs        |                             |       | 11.93    | 0.001    |                   |       | 1.57     | 0.215    |
| No  | 714                         | 8.25  |          |          | 226               | 21.56 |          |          |
| Yes   | 23                          | 33.47 |          |          | 17                | 30.94 |          |          |

Note: Percentages weighted via SUDAAN software; *n* values represent observed (unweighted) responses;

<sup>a</sup> Median = 45 years old for trauma-exposed group and 45 years old for PTSD group;

<sup>b</sup> Median = 3 for trauma-exposed group and 4 for PTSD group;

<sup>c</sup> Median = 12 for trauma-exposed group and 18 for PTSD group.

variables were strongly associated in the trauma-exposed group ( $r = 0.65$ ,  $p < 0.001$ ) and moderately associated in the PTSD group ( $r = 0.37$ ,  $p < 0.001$ ). Self-medication variables were moderately associated in both the trauma-exposed group ( $r = 0.37$ ,  $p < 0.001$ ) and PTSD group ( $r = 0.39$ ,  $p < 0.001$ ).

### 3.3. Chi-square analyses

Chi-square tests of independence were conducted to examine the relationship between participant characteristics and subsequent MDD onset in both the trauma-exposed and PTSD samples. As shown in Table 2, being younger, recent divorce/separation, experiencing a greater number of trauma types, traumatic stress-related interference with daily activities, and self-medicating traumatic stress symptoms with alcohol were all significantly associated with meeting criteria for MDD between NESARC assessments in each group. Being female, having a high school education or less, recent financial instability, traumatic stress-related interference with relationships, and self-medicating traumatic stress symptoms with drugs were also significantly

associated with MDD onset in the trauma-exposed (but not PTSD) group.

### 3.4. Multivariate logistic regressions

We tested multivariate logistic regression models using a logit transformation and Taylor Series (linearization) variance estimation method to identify unique predictors of meeting diagnostic criteria for MDD between assessment waves in each sample. As seen in Table 3, the odds of someone in the trauma-exposed group meeting criteria for MDD between NESARC Waves 1 and 2 were greater for someone who was younger, was female, had a high school education or less, reported divorce/separation in the 12 months prior to Wave 1, experienced a greater number of lifetime trauma types, reported traumatic stress-related interference with daily activities, and self-medicated their traumatic stress symptoms with alcohol. These same variables *except* education level and divorce/separation in the 12 months prior to Wave 1 predicted MDD onset in the PTSD group (see Table 4). Traumatic stress-related interference with daily activities and self-medicating traumatic

**Table 3**  
Logistic regression predicting MDD Onset between NESARC Waves 1 and 2 in the trauma-exposed group.

|   | Met criteria for MDD between assessment waves |                 |             | $\eta^2$       | <i>p</i>       |
|---|---|-----------------|-------------|----------------|----------------|
|   | OR  | 95% CI<br>Lower | Upper       |                |                |
| Age   | <b>0.99</b>                                   | <b>0.98</b>     | <b>0.99</b> | < <b>0.001</b> | < <b>0.001</b> |
| Gender (female)   | <b>1.89</b>                                   | <b>1.48</b>     | <b>2.41</b> | <b>0.030</b>   | < <b>0.001</b> |
| Education level   | <b>0.72</b>                                   | <b>0.54</b>     | <b>0.96</b> | <b>0.008</b>   | <b>0.026</b>   |
| Fired or laid off   | 0.85  | 0.54            | 1.34        | 0.002          | 0.487          |
| Financial crisis or bankruptcy                              | 1.28  | 0.90            | 1.82        | 0.005          | 0.160          |
| Divorce or separation                                       | <b>1.55</b>                                   | <b>1.11</b>     | <b>2.18</b> | <b>0.014</b>   | <b>0.012</b>   |
| Number of trauma types                                      | <b>1.15</b>                                   | <b>1.09</b>     | <b>1.20</b> | <b>0.001</b>   | < <b>0.001</b> |
| Time since index trauma at Wave 1                           | 1.00  | 0.99            | 1.01        | < 0.001        | 0.486          |
| AUD   | 0.93  | 0.72            | 1.20        | < 0.001        | 0.556          |
| DUD   | 0.97  | 0.67            | 1.40        | < 0.001        | 0.872          |
| Traumatic stress-related interference with daily activities | <b>2.84</b>                                   | <b>1.89</b>     | <b>4.28</b> | <b>0.077</b>   | < <b>0.001</b> |
| Traumatic stress-related interference with relationships    | 1.32  | 0.82            | 2.13        | 0.006          | 0.252          |
| Self-medicating traumatic stress symptoms with alcohol      | <b>1.79</b>                                   | <b>1.05</b>     | <b>3.06</b> | <b>0.025</b>   | <b>0.033</b>   |
| Self-medicating traumatic stress symptoms with drugs        | 1.07  | 0.42            | 2.73        | < 0.001        | 0.882          |

Note: OR = odds ratio; CI = confidence interval; bolded text denotes statistical significance;  $\eta^2$  = approximated effect size.

stress symptoms with alcohol each had a significant, small effect on subsequent MDD in both samples (Cohen, 1988). Contrary to hypotheses, traumatic stress-related interference with relationships and self-medicating traumatic stress symptoms with drugs did not significantly predict MDD onset in either sample.

#### 4. Discussion

Despite the established link between trauma and depression (Kessler et al., 2005, 1995; Pietrzak et al., 2011; Stander et al., 2014), less is known about why some trauma survivors subsequently develop MDD. Moreover, studies seeking to explain the co-occurrence of depressive and traumatic stress symptoms are often limited by methodological issues such as cross-sectional design, samples including individuals with a history of depression, and assessment of diagnoses but not symptom-related interference or alcohol/drug use motivations. The present study was designed to address these gaps in the literature through the lens of behavioral theory using a nationally representative sample of trauma survivors who denied a history of MDD.

Findings were generally consistent across samples and in partial support of our hypotheses. Whereas traumatic stress-related interference with daily activities and self-medication with alcohol were associated with MDD onset in correlational, chi-square, and logistic regression analyses, traumatic stress-related interference with relationships and self-medication with drugs were only significant in

correlational analyses. Our finding that number of trauma types predicted MDD diagnosis aligns with past research (Briere et al., 2016; Follette et al., 1996), yet other factors associated with depression in previous studies (e.g., AUD) were not significant unique predictors of MDD onset in this nationally representative sample. More broadly, our findings underscore the importance of reaching a subset of trauma survivors who go on to become depressed, as nearly 9% of trauma-exposed adults and 23% of adults with lifetime PTSD experienced initial MDD onset between assessment waves.

Though depression is likely influenced by a constellation of psychological, biological, and contextual factors, our findings lend partial, preliminary support for the behavioral model of depression among trauma survivors—a population at risk of more severe psychiatric comorbidity and other negative outcomes (Bryan et al., 2016; Gaher et al., 2006; Herberman Mash et al., 2016; Leeies et al., 2010; Mirin and McKenna, 1975; North et al., 1999; Ouimette et al., 2010; Tull et al., 2010). Such findings are promising from a clinical perspective, as behavioral responses to trauma (unlike historical or demographic variables) can be modified. Prevention and early intervention programs for this population could draw from efficacious MDD treatments to equip trauma survivors with the psychoeducation and set of healthy coping strategies that protect against a negative reinforcement cycle of depressed mood. Self-help resources, general public websites, and literature displayed in mental health clinics could also include corrective information about counterproductive coping strategies (e.g., self-

**Table 4**  
Logistic regression predicting MDD onset between NESARC waves 1 and 2 in the PTSD group.

|   | Met criteria for MDD between assessment waves |                 |             | $\eta^2$       | <i>p</i>     |
|---|---|-----------------|-------------|----------------|--------------|
|   | OR  | 95% CI<br>Lower | Upper       |                |              |
| Age   | <b>0.98</b>                                   | <b>0.96</b>     | <b>0.99</b> | < <b>0.001</b> | <b>0.001</b> |
| Gender (female)   | <b>1.67</b>                                   | <b>1.06</b>     | <b>2.62</b> | <b>0.020</b>   | <b>0.027</b> |
| Education level   | 0.67  | 0.40            | 1.12        | 0.012          | 0.124        |
| Fired or laid off   | 0.42  | 0.14            | 1.27        | 0.054          | 0.122        |
| Financial crisis or bankruptcy                              | 1.27  | 0.72            | 2.24        | 0.004          | 0.410        |
| Divorce or separation                                       | 1.61  | 0.89            | 2.92        | 0.017          | 0.115        |
| Number of trauma types                                      | <b>1.10</b>                                   | <b>1.03</b>     | <b>1.19</b> | <b>0.001</b>   | <b>0.008</b> |
| Time since index trauma at Wave 1                           | 1.00  | 0.99            | 1.02        | < 0.001        | 0.916        |
| AUD   | 1.16  | 0.75            | 1.79        | 0.002          | 0.507        |
| DUD   | 0.72  | 0.37            | 1.40        | 0.008          | 0.326        |
| Traumatic stress-related interference with daily activities | <b>1.63</b>                                   | <b>1.07</b>     | <b>2.49</b> | <b>0.018</b>   | <b>0.024</b> |
| Traumatic stress-related interference with relationships    | 0.85  | 0.53            | 1.36        | 0.002          | 0.495        |
| Self-medicating traumatic stress symptoms with alcohol      | <b>1.77</b>                                   | <b>1.09</b>     | <b>2.88</b> | <b>0.024</b>   | <b>0.022</b> |
| Self-medicating traumatic stress symptoms with drugs        | 0.95  | 0.38            | 2.38        | < 0.001        | 0.919        |

Note: Bolded text denotes statistical significance.

medication). In addition, findings suggest that careful screening for problematic alcohol use among trauma survivors, including information about use *motivations*, could enhance understanding of the shared context of self-medication and heightened risk for disorders such as MDD.

Empirically supported trauma-focused interventions—namely, Prolonged Exposure (Foa et al., 2007) and Cognitive Processing Therapy (Resick et al., 2017)—explicitly address the maladaptive long-term effects of avoidance in terms of traumatic stress symptom maintenance. Yet findings from the current study highlight the importance of addressing traumatic stress-related avoidance as it relates to potential depressive symptoms as well. One candidate therapy that could inform MDD prevention and early intervention programs for trauma survivors is Brief Behavioral Activation Treatment for Depression (Lejuez et al., 2011, 2001). A unique aspect of this approach is the emphasis on identifying a patient's personal values within important life areas (e.g., the value of being “a good parent” in the “family relationships” life area). The rationale for incorporating a values framework into depression treatment derives from the assumption that individuals are more likely to implement adaptive strategies for coping with negative affect when they are naturally reinforcing and personalized versus arbitrarily selected. This approach might be especially useful in the context of treating trauma survivors whose coping behaviors may not be objectively harmful (e.g., self-medicating with a medically safe amount of alcohol), but are nevertheless discordant with personal values (e.g., “succeed in school”).

Strengths of this study include the use of a large and nationally representative sample, hypothesis testing in both a trauma-exposed and PTSD sub-group of participants, direct assessment of alcohol and drug use motivations, and standardized interview assessment protocol administered by trained evaluators. However, our findings are also subject to limitations such as reliance on self-report, dichotomous (rather than continuous) assessment of predictors, and DSM-IV diagnostic criteria. Additionally, although traumatic stress-related interference is thought to result as a consequence of behavioral avoidance, interview items assessing specific trauma-driven avoidance behaviors in daily/social settings would afford a more precise test of the behavioral model of depression in trauma survivors. Given the potential overlap between interference and self-medication predictors, future research might also take different approaches to assessing behavioral variables (e.g., as latent constructs or collapsed into single “interference” and “self-medication” predictors).

Another limitation is the retrospective reporting of traumatic stress-related symptoms, interference, and self-medication; because these variables were assessed at the Wave 2 interview, inaccurate recall may have biased participant responses. Future research assessing trauma-related variables at the initial assessment wave would provide a truly prospective test of the behavioral model of depression in trauma survivors. Improved assessment sequencing would also allow for more sophisticated statistical analytic approaches. For example, it would be useful to test for potential mediation and/or moderation effects on the link between trauma exposure and subsequent MDD. In addition to traumatic stress-related interference and self-medication, constructs such as self-efficacy, social support, and a sense of life purpose/meaning might be especially important variables to consider. Because it was unknown whether participants endorsing MDD onset between assessment waves still met MDD criteria at the time of Wave 2 assessment, future studies should also control for potential mood-related reporting bias.

This study is also limited by how self-medication with drugs was determined. Specifically, the NESARC did not specify which drug(s) or medicine(s) respondents used to alleviate traumatic stress symptoms, making it difficult to disentangle the potentially differential effects of drug type on the development of MDD. It is possible certain drugs increase the risk for depression via a cycle of negative reinforcement more so than do other drug types (e.g., central nervous system

depressants versus central nervous system stimulants; Bremner et al., 1996; Jacobsen et al., 2001). Furthermore, the prevalence of self-medicating with drugs was substantially lower than that of self-medicating with alcohol in both samples (1%–5% versus 3%–17%). Considering that participants might have been hesitant to report illicit substance use, future studies could incorporate corroborative data (e.g., from family members or romantic partners) as well as specify drug types. Finally, although excluding NESARC respondents who reported a history of major depression at Wave 1 allowed for a more precise analysis of initial MDD onset risk factors, our findings may not generalize to trauma survivors with a history of depression.

In conclusion, although substantial research documents the link between trauma exposure and depressive symptoms, predictive and explanatory models of this co-occurrence are in need of additional empirical evidence. The current study provides preliminary support for the behavioral model of depression in a large, nationally representative sample of trauma-exposed adults. Traumatic stress-related avoidance (and consequent impairment) across multiple life domains and self-medicating traumatic stress symptoms with substances might be promising targets for MDD prevention and intervention efforts for trauma survivors. Future research applying intensive longitudinal data collection and more sophisticated data analytic approaches will be instrumental to improving the conceptual understanding and treatment of co-occurring PTSD and MDD.

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