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Neighborhood Resources Associated With Psychological Trajectories and Neural Reactivity to Reward After Trauma

E. Kate Webb, PhD; Jennifer S. Stevens, PhD; Timothy D. Ely, BA; Lauren A. M. Lebois, PhD; Sanne J H. van Rooij, PhD; Steven E. Bruce, PhD; Stacey L. House, MD, PhD; Francesca L. Beaudoin, MD, PhD; Xinming An, PhD; Thomas C. Neylan, MD; Gari D. Clifford, DPhil; Sarah D. Linnstaedt, PhD; Laura T. Germine, PhD; Kenneth A. Bollen, PhD; Scott L. Rauch, MD; John P. Haran, MD, PhD; Alan B. Storrow, MD; Christopher Lewandowski, MD; Paul I. Musey Jr, MD; Phyllis L. Hendry, MD; Sophia Sheikh, MD; Christopher W. Jones, MD; Brittany E. Punches, PhD, RN; Robert A. Swor, DO; Vishnu P. Murty, PhD; Lauren A. Hudak, MD, MPH; Jose L. Pascual, MD, PhD; Mark J. Seamon, MD; Elizabeth M. Datner, MD; Claire Pearson, MD; David A. Peak, MD; Robert M. Domeier, MD; Niels K. Rathlev, MD; Brian J. O'Neil, MD; Paulina Sergot, MD; Leon D. Sanchez, MD, MPH; Jutta Joormann, PhD; Diego A. Pizzagalli, PhD; Steven E. Harte, PhD; Ronald C. Kessler, PhD; Karestan C. Koenen, PhD; Kerry J. Ressler, MD, PhD; Samuel A. McLean, MD, MPH; Nathaniel G. Harnett, PhD

IMPORTANCE Research on resilience after trauma has often focused on individual-level factors (eg, ability to cope with adversity) and overlooked influential neighborhood-level factors that may help mitigate the development of posttraumatic stress disorder (PTSD).

OBJECTIVE To investigate whether an interaction between residential greenspace and self-reported individual resources was associated with a resilient PTSD trajectory (ie, low/no symptoms) and to test if the association between greenspace and PTSD trajectory was mediated by neural reactivity to reward.

DESIGN, SETTING, AND PARTICIPANTS As part of a longitudinal cohort study, trauma survivors were recruited from emergency departments across the US. Two weeks after trauma, a subset of participants underwent functional magnetic resonance imaging during a monetary reward task. Study data were analyzed from January to November 2023.

EXPOSURES Residential greenspace within a 100-m buffer of each participant's home address was derived from satellite imagery and quantified using the Normalized Difference Vegetation Index and perceived individual resources measured by the Connor-Davidson Resilience Scale (CD-RISC).

MAIN OUTCOME AND MEASURES PTSD symptom severity measured at 2 weeks, 8 weeks, 3 months, and 6 months after trauma. Neural responses to monetary reward in reward-related regions (ie, amygdala, nucleus accumbens, orbitofrontal cortex) was a secondary outcome. Covariates included both geocoded (eg, area deprivation index) and self-reported characteristics (eg, childhood maltreatment, income).

RESULTS In 2597 trauma survivors (mean [SD] age, 36.5 [13.4] years; 1637 female [63%]; 1304 non-Hispanic Black [50.2%], 289 Hispanic [11.1%], 901 non-Hispanic White [34.7%], 93 non-Hispanic other race [3.6%], and 10 missing/unreported [0.4%]), 6 PTSD trajectories (resilient, nonremitting high, nonremitting moderate, slow recovery, rapid recovery, delayed) were identified through latent-class mixed-effect modeling. Multinominal logistic regressions revealed that for individuals with higher CD-RISC scores, greenspace was associated with a greater likelihood of assignment in a resilient trajectory compared with nonremitting high (Wald z test = −3.92; $P < .001$), nonremitting moderate (Wald z test = −2.24; $P = .03$), or slow recovery (Wald z test = −2.27; $P = .02$) classes. Greenspace was also associated with greater neural reactivity to reward in the amygdala (n = 288; $t_{277} = 2.83$; adjusted P value = 0.02); however, reward reactivity did not differ by PTSD trajectory.

CONCLUSIONS AND RELEVANCE In this cohort study, greenspace and self-reported individual resources were significantly associated with PTSD trajectories. These findings suggest that factors at multiple ecological levels may contribute to the likelihood of resiliency to PTSD after trauma.

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Supplemental content

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: E. Kate Webb, PhD, Division of Depression and Anxiety Disorders, McLean Hospital, Mailstop 212, 115 Mill St, Belmont, MA 02478 (ekwebb@mclean.harvard.edu).

Each year, over 46 million people experience a trauma requiring medical attention, and approximately 10% to 20% will develop posttraumatic stress disorder (PTSD).[1] Previous efforts to differentiate trauma survivors who will be resilient vs those who develop PTSD may have been hindered, in part, because of an emphasis on individual-level factors without consideration of key neighborhood-level factors. Indeed, ecological frameworks propose multiple levels of influence on mental health, from individual-level resources such as psychological or cognitive abilities to cope with stress to neighborhood-level resources such as greenspace.[2] Characterizing the effect of neighborhood-level factors on PTSD development may improve the early identification of individuals most at risk for the disorder and our understanding of resiliency to PTSD after trauma.

Resilience in the context of trauma often refers to low or no symptoms after a traumatic event (ie, a resilient trajectory), an outcome influenced by both dynamic processes and factors that increase the likelihood of resiliency (ie, resilience factors).[3] Neighborhoods may provide a restorative environment that confers additional benefits beyond individual-level resilience factors or enhances individual-level factors.[4,5] For example, greenspace is associated with lower levels of stress, anxiety, and depression, even after adjusting for individual factors including socioeconomic status ([6-9] reviewed in[10]). In nearly 1 million individuals, childhood exposure to greenspace was associated with a lower risk of adulthood psychiatric disorders even after adjusting for parental history, socioeconomic factors, and urbanicity.[11] Notably, greenspace represents a complex socioenvironmental factor that may be associated with mental health through various pathways, such as buffering against harmful environmental exposures and supporting health-promotion behaviors (eg, exercise) or psychological restoration and mindfulness.[12-14]

In individuals exposed to trauma, greenspace was associated with less severe PTSD and trauma-related distress.[9] Greenspace attenuated the relationship between potentially traumatic events and general health in a sample of over 4500 individuals, even after adjusting for socioeconomic position and urbanicity.[15] Further, greenspace was associated with lower anxiety and depression via a greater capacity to cope with stress in trauma-naive college students.[6] Although additional work is needed to understand the mechanisms underlying the relationship between greenspace and PTSD development, these studies suggest that greenspace could be an important factor in resiliency to PTSD after trauma.

Factors that may increase the likelihood of resiliency to trauma are theorized to both dampen neurobiological stress-related mechanisms and activate reward-related circuitry; however, the latter is relatively understudied.[16,17] Individuals with PTSD often exhibit altered neural reward processing, including decreased activation in regions involved in processing rewards when exposed to monetary reward, including the nucleus accumbens, amygdala, and orbitofrontal cortex (OFC).[18] The nucleus accumbens is crucial for reinforcement learning and processes initial information about reward value and prediction error.[19] The OFC is involved in processing reward value and reward-related decision-making whereas the amygdala underlies encoding reward-related information, updating reward value, and coordinating approach behaviors.[19] Several studies[16,20,21] have documented that activation and altered resting-state connectivity of these regions are associated with self-reported individual resources, such as self-efficacy and perceived ability to cope with adversity. Neuroimaging work on greenspace has focused on threat-related mechanisms.[22] For example, acute exposure to a natural environment (via a 90-minute walk) is associated with decreased self-reported stress and diminished amygdala threat reactivity.[23] Together, the emerging work suggests that the relationship between greenspace and PTSD development may be partly explained by differences in underlying neural reactivity.

In the present study, we merged existing data from a large US-based study on trauma[1] with geospatial analytic techniques to evaluate whether greenspace was associated with PTSD trajectories after considering other self-reported and geocoded information. Based on previous work,[6] we also tested whether there was a significant association between greenspace and perceived individual resources.[6] We expected that greenspace would strengthen the association between individual resources and assignment in a recovery or resilient trajectory. As a secondary aim, we evaluated whether reward reactivity helped explain any associations between greenspace and trajectories. We expected greenspace would be associated with greater reward reactivity in the amygdala, nucleus accumbens, and the OFC and that greater reactivity would be related to assignment in a resilient trajectory.

Key Points

Question Is there an association between residential greenspace/perceived individual resources and posttraumatic stress disorder (PTSD) trajectories after trauma?

Findings In this longitudinal cohort study of 2597 recent trauma survivors in the US, geocoded and self-reported variables were associated with different posttraumatic stress disorder (PTSD) trajectories. In individuals reporting higher individual resources, a greater neighborhood resource (residential greenspace) was associated with an increased likelihood of assignment in a resilient trajectory compared with a nonremitting high, nonremitting moderate, or slow recovery trajectory.

Meaning Results suggest that individual and neighborhood factors were associated with psychological outcomes after trauma; interactions between factors at different ecological levels are important in understanding the likelihood of resiliency to PTSD after trauma.

Methods

Participants

Trauma survivors were recruited between September 2017 and June 2021 from emergency departments (EDs) within 72 hours of a traumatic injury.[1] Complete details of the larger study (the Advancing Understanding of Recovery After Trauma [AURORA] study) are reported elsewhere.[1,24] Procedures were approved by each site's institutional review board. Individuals provided written informed consent and were financially compensated for their participation. Exclusion and inclusion criteria are presented in the eMethods in Supplement 1. Approximately 2 weeks after trauma, a subset of participants underwent neuroimaging.[1,24,25] Scanning was conducted at 2 weeks to help facilitate the early detection of neural markers of PTSD development.[1] This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines.

Measures

Demographics and Injury Assessment

In the ED, participants self-reported their sex at birth, age, marital status, and ethnoracial group (race and ethnicity were queried separately and later merged into a single variable). Study participants self-identified with the following races and ethnicities: non-Hispanic Black, Hispanic, non-Hispanic White, and non-Hispanic other race, which included American Indian, Asian, Pacific Islander, and other. Injury characteristics, including physician-evaluated Injury Severity Scores (ISS) and self-reported head injury were recorded in the ED. At the 2-week visit, participants reported their annual household income, which was transformed into a semi-continuous variable such that every 1-unit increase corresponded to an additional \$20 000 to \$25 000 per year.

Psychometric Assessments

At 2 weeks after trauma, the 10-item Connor-Davidson Resilience Scale (CD-RISC) was administered to measure perceived individual resources.[26] Participants rated how accurately each of the statements (eg, "I am able to adapt to change") described them on a scale of 0 (not true at all) to 4 (true nearly all the time).[27] Childhood maltreatment and lifetime trauma were evaluated using 5-items of the 11-item Childhood Trauma Questionnaire–Short Form[28] and the Life Events Checklist for *DSM-5* (LEC-5),[29] respectively. The PTSD Symptom Checklist for *DSM-5* (PCL-5) was administered at the 2-week, 8-week, 3-month, and 6-month visits, and evaluated the presence and severity of symptoms.[26] Participants rated the severity of the 20-items on a scale of 0 (not at all) to 4 (extremely).[26] Additional details on assessments, including metrics of internal reliability, are provided in the eMethods in Supplement 1.

Neighborhood-Level Factors

Residential Greenspace | High-resolution (30-m) multiband satellite imagery from the Landsat 8 archive was extracted from Google Earth Engine[30,31] (eMethods and eFigure 2 in Supplement 1). Within ArcGIS Pro, version 3.0.0 (ESRI), a 100-m Euclidean buffer was created around each address as prior work revealed this size buffer shows peak associations with mental health outcomes.[32] Zonal spatial analyses were conducted to extract the mean Normalized Difference Vegetation Index (NDVI) values within each buffer.

Neighborhood Socioeconomic Disadvantage | Participants' home addresses were matched to the corresponding Area Deprivation Index (ADI), version 3.1 2019.[33-35] The ADI is available online[36] and is a weighted composite measure of neighborhood disadvantage that considers 17 census items spanning domains such as employment, income, and housing quality.

Magnetic Resonance Imaging Acquisition and Analysis

Neuroimaging data were collected across 5 sites with harmonized acquisition protocols on Siemens 3-T magnetic resonance imaging (MRI) scanners (eTable 1 in Supplement 1). As part of the modified card guessing game,[24] participants viewed cards with a question mark (2 seconds) before guessing whether the card's value was higher or lower than 5 (values randomly varied from 0-9). After a delay (2-4 seconds), the card's value and monetary outcome were displayed. Before the task, participants were informed that they would win \$1 for each correct guess and lose \$0.50 for each incorrect guess. A total of 40 cards were presented (20 gains and 20 losses).

Preprocessing was performed using fMRIPrep, version 1.2.2 (open source) as reported in previous work[24] (eMethods in Supplement 1). Gain and loss trials were modeled as separate events convolved with a canonical hemodynamic response function. "Gain > loss" was the contrast of interest. The mean across all voxels in each bilateral region of interest (ROI) was extracted from first-level contrasts and activity was averaged across hemispheres.

Statistical Analysis

All analyses were completed in R, version 4.1.2 (R Project for Statistical Computing). First, latent-class mixed-effect modeling was conducted using the hlme function in the lcmm package.[37] Participants who completed the PCL-5 for at least 2 of the 4 time points (2 week, 8 week, 3 month, and 6 month) were included Based on previous work, we compared 1 to 7 classes and selected the best model based on entropy, Bayesian information criterion (BIC), Akaike information criterion, sample-size adjusted Bayesian information criterion, and log-likelihood reductions.[38] Based on recommendations for reporting latent-class mixed-effect models, BIC and entropy were favored.[39-41] We also considered the average posterior probabilities to determine how certain the model was at distinguishing the class for each participant (<0.70 is recommended).[38] Finally, theoretical basis and parsimony were weighted heavily when determining the best model. At least 1% of participants were required to be assigned to a class, and classes were required to be interpretable based on previous work.[38] We further compared our approach, which allowed for nonlinear trajectories, with previously reported linear trajectories (analyses conducted using Mplus) from our group (eTable 2 in Supplement 1).[42,43]

Next, multinominal logistic regressions (multinom package) were conducted to evaluate the associations between self-reported and geospatially derived measures and PTSD trajectories. Continuous measures were grand mean-centered across the full sample. The mice package was used to handle missing data, which were imputed using predictive mean matching with 20 imputations. None of the variables in the main analyses had more than 10% missingness. The resilient group was set as the reference; therefore, the model included one contrast testing how variables contributed to the odds of falling into a specific trajectory compared to the resilient trajectory. We tested whether NDVI and CD-RISC were independently associated with trajectories after adjusting for age, income, ADI ranking, ISS, marital status (0 = unmarried), head injury (0 = did not hit head), LEC-5 score, and childhood maltreatment. These variables were selected as covariates based on previous work suggesting they contribute to PTSD trajectories in ED-recruited samples.[39,44] Our primary model examined whether an NDVI × CD-RISC interaction was prospectively associated with trajectory assignment. Wald z tests were used to examine the significance of each individual coefficient.

To evaluate whether neural reward reactivity was a possible pathway by which greenspace or CD-RISC was associated with a resilient trajectory, we first conducted general linear models (GLMs) to determine whether these factors were associated with responses in the amygdala, nucleus accumbens, and OFC after covarying for income, ADI ranking, sex, age, marital status, ISS, LEC-5 score, and childhood maltreatment. These 3 ROIs were tested because of their established roles in reward-related processing, their relationship with PTSD symptom severity in the AURORA study,[24] and to limit exploratory analyses and reduce the number of multiple-comparison corrections required. After identifying significant ROI(s), a 1-way analysis of variance (ANOVA) was conducted to determine whether reactivity was significantly different across the trajectories. Holm-Bonferroni correction was applied to each set of GLMs (eg, 3 tests examining the association of NDVI with the ROIs,) and a corrected α level of .05 was used for all statistical tests. A P value of <.05 was considered significant, and all P values were 2-sided. Study data were analyzed from January to November 2023.

Table 1. Sample Characteristics

Variable	No. (%) Full sample (N = 2597)	No. (%) MRI subsample (n = 288)
Sex at birth		
Female	1637 (63.0)	185 (64.2)
Male	960 (37.0)	103 (35.8)
Age, mean (SD), y	36.5 (13.4)	34.7 (13.0)
Ethnoracial group		
Non-Hispanic Black	1304 (50.2)	124 (43.1)
Hispanic	289 (11.1)	43 (14.9)
Non-Hispanic White	901 (34.7)	106 (36.8)
Non-Hispanic other[a]	93 (3.6)	13 (4.5)
Missing	10 (0.4)	2 (0.7)
Income		
<$19 000	793 (30.5)	88 (30.6)
$19 001-35 000	749 (28.8)	88 (30.6)
$35 001-50 000	331 (12.7)	37 (12.8)
$50 001-75 000	201 (7.7)	27 (9.4)
$75 001-100 000	165 (6.4)	19 (6.6)
>$100 000	182 (7.0)	29 (10.1)
Missing	176 (6.8)	0
Marital status		
Married	552 (21.3)	48 (16.7)
Unmarried	2031 (78.2)	240 (83.3)
Missing	14 (0.5)	0
Injury Severity Score, mean (SD) [missing]	2.4 (1.9) [1]	2.4 (1.9)
Childhood maltreatment, mean (SD) [missing]	9.4 (9.8) [264]	10.2 (10.6)
CD-RISC score, mean (SD) [missing]	22.6 (8.1) [138]	22.5 (7.3)
Normalized Vegetation Difference Index, mean (SD) [missing]	0.5 (0.1) [0]	0.4 (0.2)
Area Deprivation Index, mean (SD) [missing]	64.4 (27.7) [84]	56.9 (28.9)
Week 2 PTSD symptoms (PCL-5 scores), mean (SD) [missing][b]	31.1 (18.9) [232]	28.5 (16.7)
Week 8 PTSD symptoms (PCL-5 scores), mean (SD) [missing][b]	28.0 (19.5) [197]	26.1 (17.6)
Month 3 PTSD symptoms (PCL-5 scores), mean (SD) [missing][b]	25.1 (19.2) [334]	23.2 (17.9)
Month 6 PTSD symptoms (PCL-5 scores), mean (SD) [missing][b]	23.3 (18.7) [660]	21.1 (18.2)

Abbreviations: CD-RISC, Connor-Davidson Resilience Scale; MRI, magnetic resonance imaging; PCL-5, PTSD Symptom Checklist for *DSM-5*; PTSD, posttraumatic stress disorder.

[a] Other includes American Indian, Asian, Pacific Islander, and other.

[b] Participants were required to have completed PCL-5 at least twice (full sample: 232 missing week 2; 197 missing week 8; 334 missing month 3; 660 missing month 6; MRI sample: 0 missing week 2; 25 missing week 8; 39 missing month 3; 57 missing month 6).

Results

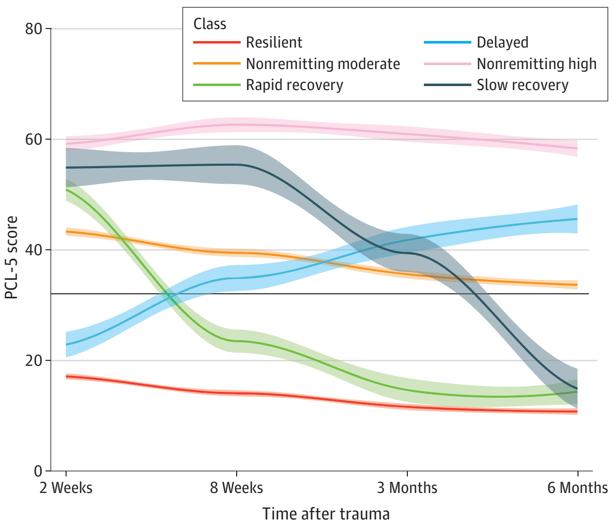
Sample Characteristics

A total of 2597 trauma survivors (mean [SD] age, 36.5 [13.4]; 1637 female [63%]; 960 male [37.0%]; 1304 non-Hispanic Black [50.2%], 289 Hispanic [11.1%], 901 non-Hispanic White [34.7%], 93 non-Hispanic other [3.6%], and 10 missing/unreported [0.4%]) were included in this analysis. eFigure 1 in Supplement 1 depicts the study flowchart. Demographic characteristics are presented in **Table 1**. Correlations between continuous self-report and geocoded variables are presented in eTable 3 in Supplement 1.

Identification and Prospective Associations with PTSD Trajectories

Latent-class mixed-effect models revealed a 6-group solution with a linear and quadratic term for time was the best fit to the data (**Figure 1** and eTable 4 [for fit indices] and eTable 5 [for fit indices with linear term] in Supplement 1). Plots for all fitted models (eFigure 3 in Supplement 1), details on model selection (average posterior probabilities in eTable 6 in Supplement 1), and characterization of the 6 identified trajectories (resilient, nonremitting high, nonremitting moderate, delayed, rapid recovery, and slow recovery) are provided in eMethods in Supplement 1. Group differences (pairwise comparisons with Holm-Bonferroni correction applied) between trajectories on both self-reported and geocoded measures were

Figure 1. Results of Latent-Class Mixed-Effect Modeling



The largest classes were the resilient (1318 [50.8%]), nonremitting moderate (734 [28.3%]), and nonremitting high (244 [9.4%]) trajectories, whereas the smallest classes were the delayed (108 [4.2%]), slow recovery (67 [2.6%]) and the rapid recovery (126 [4.9%]) groups. The solid black line represents the clinically significant cutoff for the Posttraumatic Stress Disorder Symptom Checklist for *DSM-5* (total score = 32).

also noted (eTable 7 in Supplement 1). There was no difference between classes on NDVI; however, CD-RISC scores were significantly higher in the resilient trajectory (mean [SD], 24.14 [8.42]) vs the rapid recovery (mean [SD], 21.31 [6.93]; *P* adjusted = .001), delayed (mean [SD], 21.96 [7.35]; *P* adjusted = .04), and moderate nonremitting trajectories (mean [SD], 21.25 [6.35]; *P* adjusted < .001). Further, individuals in the nonremitting high group (mean [SD], 1.83 [8.20]) had significantly lower CD-RISC scores compared with individuals in the resilient (*P* adjusted < .001), rapid recover (*P* adjusted = .04), delayed (*P* adjusted = .005), and nonremitting moderate groups (*P* adjusted < .001).

The logistic regression identified self-reported and geocoded variables that were associated with symptomatic class memberships compared with the resilient trajectory (eTable 8 in Supplement 1 for results without interaction term). NDVI was not related to class assignments. Higher CD-RISC scores significantly increased the likelihood of assignment in the resilient trajectory compared with a nonremitting high (Wald *z* test = −7.96; *P* < .001), nonremitting moderate (Wald *z* test = −6.51; *P* < .001), delayed (Wald *z* test = −2.49; *P* = .01), and rapid recovery (Wald *z* test = −2.91; *P* = .004) classes.

The primary model (**Table 2**) revealed that at higher scores of CD-RISC, higher NDVI was associated with increased likelihood of assignment in the resilient trajectory compared with the nonremitting high (Wald *z* test = −3.92; *P* < .001), nonremitting moderate (Wald *z* test = −2.24; *P* = .03), or slow recovery (Wald *z* test = −2.27; *P* = .02) classes even after considering the other variables (**Figure 2**). Details about significant covariates are provided in the eMethods in Supplement 1. A sensitivity analysis (eTable 9 in the Supplement) revealed covarying for baseline PTSD and medication use, only the significant interaction in the nonremitting high group compared with the resilient group remained (Wald *z* test = −3.09; *P* = .002), and there was no effect for the nonremitting moderate or slow-recovery groups. Further, an exploratory model examining income × CD-RISC scores was conducted (eTable 10 and eFigure 4 in Supplement 1).

Greenspace, Neural Responses to Reward, and PTSD

The results of the logistic regression in the MRI sample are presented in eTable 11 in Supplement 1). GLMs (eTable 12 in Supplement 1) revealed higher NDVI was associated with greater reactivity within the amygdala (n = 288; t_{277} = 2.83; β = 0.18; adjusted *P* = .02) (**Figure 3**A) after adjusting for covariates. There was no significant main effect of CD-RISC on amygdala reactivity. NDVI was not associated with reward responses in the nucleus accumbens (t_{277} = 1.71; β = 0.11; adjusted *P* = 0.18) (Figure 3B), or OFC (t_{277} = 0.76; β = 0.05; adjusted *P* = 0.45) (Figure 3C). Finally, there were no significant associations between NDVI and CD-RISC on reactivity (eTable 13 in Supplement 1).

A one-way ANOVA revealed that amygdala reactivity was not significantly different by trajectory groups ($F_{4,283}$ = 0.36; *P* = .84). Therefore, additional analyses testing whether greenspace was associated with trajectory assignment via amygdala reactivity were not conducted. Nucleus accumbens and OFC reactivity did not significantly differ by trajectory group (eMethods in Supplement 1).

Discussion

In this cohort study, we identified factors at multiple ecological levels that were prospectively associated with PTSD risk and resilience after trauma. We characterized 6 PTSD trajectories and identified a novel interaction between greenspace and CD-RISC scores in 3 classes (nonremitting high, nonremitting moderate, and rapid recovery). The majority of work on resilience factors and PTSD examines whether individual-level factors moderate the link between trauma exposure and symptoms. For example, self-reported internal resources and social support buffer against the impact of traumatic events on PTSD symptoms.[45-47] However, an individual's response to trauma occurs in the context of their environment and may be shaped by neighborhood influences. Our findings suggest that quantifying greenspace is relevant to understanding both PTSD trajectories and reward reactivity in recent trauma survivors.

Greenspace alone was not associated with a resilient trajectory, nor was it independently associated with any of the other trajectories. There are 2 possible explanations as to how individual and neighborhood resources may interact which warrant future work. First, individual resources, such as the ability to think clearly under pressure, may be necessary to access the possible protective features of urban green space. Second, greenspace may support the development, maintenance, and expansion of an individual's capacity to cope with stress.[48] For example, individuals living in more advantaged neighborhoods with more access to greenspace may be faced with isolated stressors as opposed to chronic life stress. An individual's perception of their individual-level resources may be reinforced when they

Table 2. Self-Report and Geocoded Variables Associated With Class Membership (Full Sample)[a]

Variable	Trajectory class (statistical tests relative to the resilient trajectory)														
	High nonremitting			Moderate nonremitting			Delayed			Slow recovery			Rapid recovery		
	Coefficient (SE)	Wald z	P value	Coefficient (SE)	Wald z	P value	Coefficient (SE)	Wald z	P value	Coefficient (SE)	Wald z	P value	Coefficient (SE)	Wald z	P value
Intercept	−2.32 (0.17)	−13.51	<.001	−1.08 (0.11)	−10.02	<.001	−2.40 (0.20)	−11.96	<.001	−3.57 (0.30)	−11.95	<.001	−2.61 (0.21)	−12.58	<.001
Sex at birth (male)[b]	0.36 (0.16)[c]	2.28[c]	.02[c]	0.54 (0.10)[c]	5.17[c]	<.001[c]	−0.07 (0.21)	−0.34	.73	0.34 (0.27)	1.25	.21	0.38 (0.20)	1.86	.06
CD-RISC	−0.08 (0.01)[c]	−8.27[c]	<.001[c]	−0.04 (0.01)[c]	−6.64[c]	<.001[c]	−0.03 (0.01)[c]	−2.47[c]	.01[c]	−0.03 (0.02)	−1.72	.09	−0.04 (0.01)[c]	−3.00[c]	.003[c]
NDVI	−0.52 (0.58)	−0.93	.35	0.24 (0.36)	0.60	.55	−0.24 (0.74)	−0.35	.72	1.04 (0.99)	1.02	.31	0.39 (0.70)	0.55	.55
ISS	0 (0.04)	0.09	.93	0 (0.03)	0.16	.86	0.01 (0.05)	0.24	.81	0.12 (0.06)[c]	2.12[c]	.03[c]	0.09 (0.05)[c]	2.07[c]	.04[c]
Age	0.01 (0.01)[c]	2.18[c]	.03[c]	0.01 (0)[c]	3.34[c]	.001[c]	0.01 (0.01)	1.15	.25	−0.01 (0.01)	−0.56	.58	−0.02 (0.01)[c]	−2.00[c]	.046[c]
Income	−0.20 (0.06)[c]	−3.16[c]	.002[c]	−0.11 (0.04)[c]	−2.79[c]	.005[c]	0.04 (0.07)	0.60	.55	−0.26 (0.12)[c]	−2.21[c]	.03[c]	−0.08 (0.07)	−1.10	.27
ADI ranking	0	1.40	.16	0	1.52	.13	0	0.19	.85	0.01 (0.01)[c]	1.99[c]	.046[c]	0	−0.07	.94
Marital status (unmarried)	−0.29 (0.21)	−1.33	.18	−0.01 (0.13)	−0.06	.95	−0.17 (0.27)	−0.64	.52	−0.02 (0.36)	−0.05	.96	−0.30 (0.29)	−1.05	.29
Childhood maltreatment	0.07 (0.01)[c]	9.53[c]	<.001[c]	0.05 (0.01)[c]	9.21[c]	<.001[c]	0.05 (0.01)[c]	4.59[c]	<.001[c]	0.06 (0.01)[c]	5.24[c]	<.001[c]	0.05 (0.01)[c]	4.75[c]	<.001[c]
Head injury (did not hit head)	0.43 (0.15)[c]	2.80[c]	.005[c]	0.34 (0.10)[c]	3.36[c]	.001[c]	0.09 (0.21)	0.42	.68	0.45 (0.27)	1.67	.10	0.19 (0.20)	0.96	.34
LEC-5	0.05 (0.01)[c]	6.18[c]	<.001[c]	0.03 (0.01)[c]	6.10[c]	<.001[c]	0.01 (0.01)	1.04	.30	0.03 (0.01)[c]	2.17[c]	.03[c]	0.01 (0.01)	0.89	.38
NDVI × CD-RISC	−0.29 (0.07)[c]	−3.92[c]	<.001[c]	−0.11 (0.05)[c]	−2.24[c]	.03[c]	−0.03 (0.09)	−0.36	.72	−0.29 (0.13)[c]	−2.27[c]	.02[c]	−0.14 (0.09)	−1.55	.12

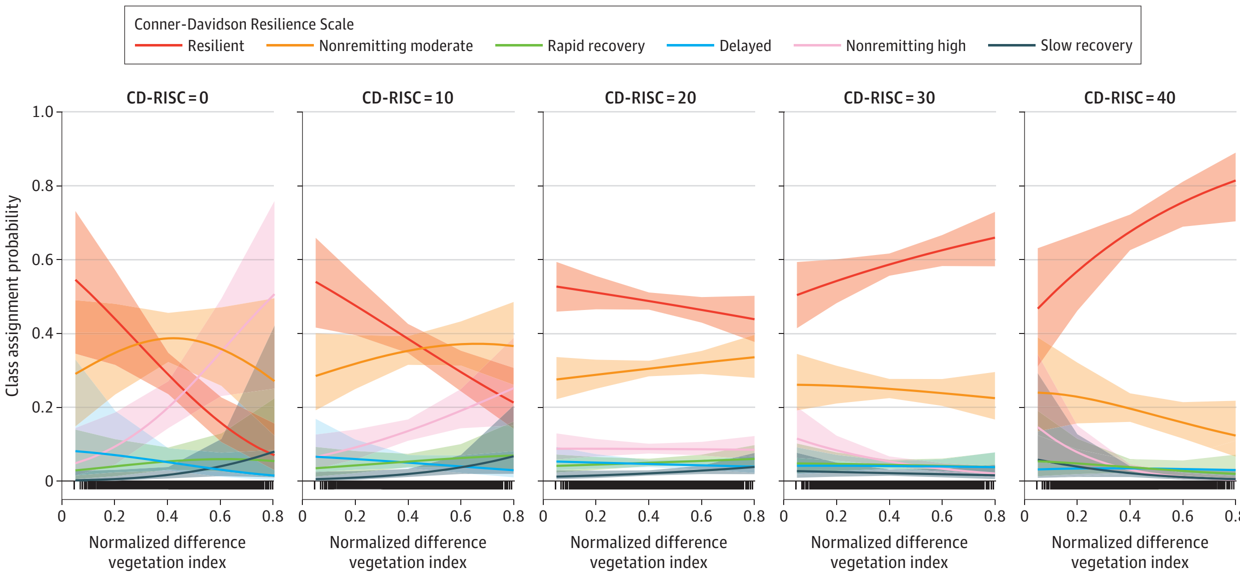
Abbreviations: ADI, Area Deprivation Index (national ranking); CD-RISC, Connor-Davidson Resilience Scale (total score); ISS, Injury Severity Score; LEC-5, Life Events Checklist for *DSM-5* (total score); NDVI, Normalized Difference Vegetation Index.

[a] Continuous measures were grand-mean centered in the full sample.

[b] The reference group for dichotomous variables is provided in parentheses.

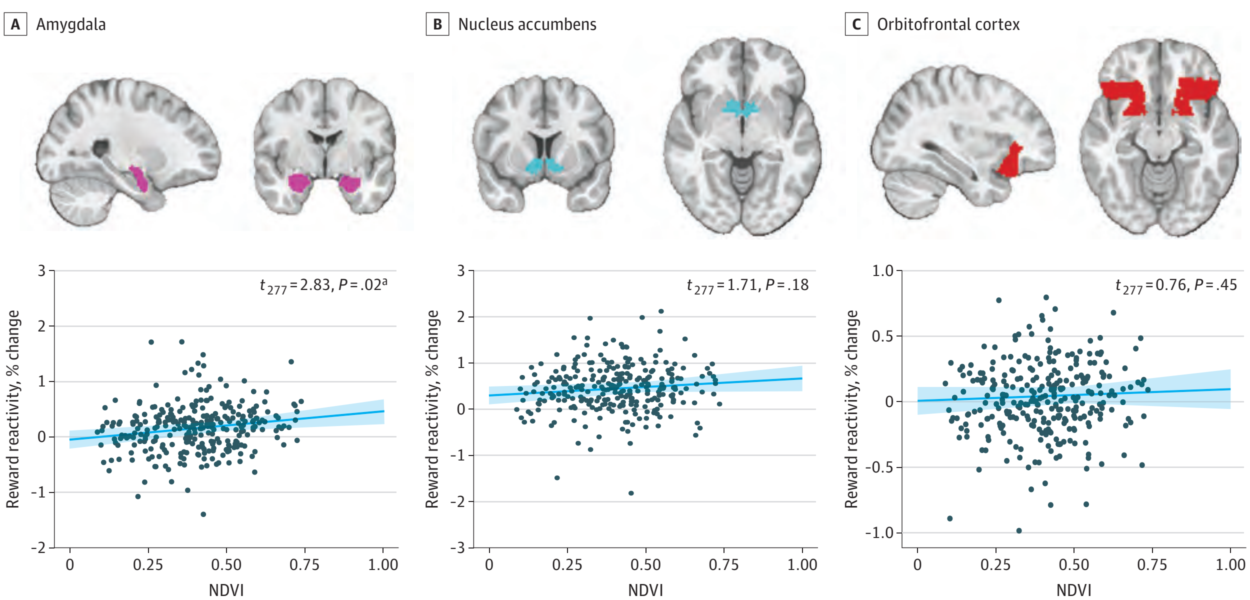
[c] Numbers correspond to uncorrected $P < .05$.

Figure 2. Association Between Neighborhood and Individual Resources and Posttraumatic Stress Disorder Trajectory Assignment



There was a significant association between greenspace and Connor-Davidson Resilience Scale (CD-RISC) scores on class assignment, such that individuals reporting higher levels of perceived internal resources with higher residential greenspace had an even greater likelihood of assignment in the resilient trajectory compared with the nonremitting high, nonremitting moderate, and slow recovery classes.

Figure 3. Greenspace and Neural Responses to Reward



Greater residential greenspace was associated with neural responses to reward in the amygdala (A) but not in the nucleus accumbens (B) or orbitofrontal cortex (C) after adjusting for sex at birth, Connor-Davidson Resilience Scale, Injury Severity Score, age, income, area deprivation index, marital status, Life Events Checklist for *DSM-5*, and childhood maltreatment. These are marginal effects plots depicting predicted values of neural responses across normalized difference vegetation index (NDVI) values (shaded line: 95% CIs for the marginal effects; data points: observed data; *P* values are Holm-Bonferroni adjusted.

[a]Adjusted P < .05.

overcome a single event and may wane when faced with unrelenting adversity.[49] Previous work supports both explanations, highlighting that neighborhood and individual factors dynamically interact to support resiliency across the lifespan.[50,51]

Although the contribution of the amygdala to aversive learning is well-known, this region also plays a role in determining the value of stimuli, forming cue-reward associations, and coordinating approach behavior.[52] Greenspace is associated with reduced threat-related amygdala activity[22]; however, the present study was, to our knowledge, the first to show an association between greenspace and reward reactivity. One possible pathway by which greenspace is associated with amygdala reactivity to reward may be through increased attentional capacity to identify stimuli as rewarding. The Attention Restoration Theory[53] suggests exposure to greenspace reduces attentional demands and ultimately replenishes cognitive resources required to attend to stimuli. Greater attentional capacity may facilitate amygdala activity while updating reward values during the task, although future work is required to directly test this pathway.

In contrast to our hypotheses, amygdala reactivity was not associated with PTSD trajectories. Previous work suggests trauma exposure may change how the amygdala responds to reward. For example, amygdala responses to happy vs neutral faces and gains vs losses are significantly lower in participants with PTSD and depression.[54] Earlier work from the AURORA study found participants with low reactivity to reward and high threat reactivity were more likely to have more severe PTSD symptoms.[24] In general, greater activation of reward circuitry is related to better trauma outcomes[55]; however, our findings suggest that the association between greenspace and reward circuitry may not be the pathway supporting resilience to PTSD after trauma.

One explanation is that we examined PTSD trajectories, operationalizing resilience as low or no PTSD symptoms, rather than examining transdiagnostic markers such as anhedonia (ie, inability to experience pleasure) or rumination (ie, negative repetitive thoughts). Anhedonia is a dimension of both PTSD and depression and is consistently associated with neural responsivity to reward.[56,57] Following a 90-minute walk in a natural setting, individuals exhibited both decreased rumination symptoms and lower resting-state activity in the subgenual prefrontal cortex, which plays a role in self-referential thought. Future work on greenspace may benefit by using a transdiagnostic dimensional approach and/or defining posttraumatic resilience as the absence of any form of posttraumatic dysfunction.

Limitations

This study has some limitations. The study recruitment sites were predominantly in urban areas of the Midwest, South, and Northeast, precluding an examination of the moderating effect of urbanicity.[58] Assumptions about the intrinsic therapeutic value offer little space for regional differences and individual preferences. Relatedly, individuals may change residence and have varying levels of greenspace throughout their lifespan. Unfortunately, we did not query the participant's residential history or record address changes across the study. Future directions may include investigating how various aspects of natural infrastructure and different terrains impact mental health with a keen focus on time-varying and moderating effects. In addition, we did not capture information regarding greenspace use. Therefore, this study cannot conclude whether the observed effects reflect any use, passive engagement, or active use.[59,60] Cross-sectional work has suggested greenspace is associated with more physical activity.[61] Future work should consider examining objective measures of physical activity, greenspace, and PTSD in trauma survivors.

Finally, CD-RISC may be capturing other constructs such as positive emotionality (disposition to experience positive emotions),[62] and conflating both traitlike characteristics and dynamic changes in self-reported resilience.[63] Bonanno[64] suggested that single assessments of self-reported resilience such as the CD-RISC often fail to predict PTSD outcomes because they do not capture resilience as a flexible process that is sensitive to context and temporal dynamics. Indeed, an individual's perception of their ability to cope may be influenced by their PTSD symptoms as well as other factors (eg, emotion regulation strategy preference) not measured in this study.

Conclusions

Results of this cohort study have important implications for the clinical care of trauma survivors and trauma-informed policy efforts. For example, efforts to improve access and quality of urban greenspace may benefit the millions of individuals exposed to trauma each year. In addition, perceptions of individual resources, which can be targeted through individual interventions (eg, cognitive behavioral therapy) may be further enhanced by greenspace exposure. In conclusion, this study adds to the emerging evidence that disentangling heterogeneity in trauma outcomes requires consideration of factors at multiple ecological levels.

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Author Affiliations: Department of Psychiatry, Harvard Medical School, Boston, Massachusetts (Webb, Lebois, Germine, Rauch, Pizzagalli, Ressler, Harnett); Division of Depression and Anxiety Disorders, McLean Hospital, Belmont, Massachusetts (Webb, Lebois, Pizzagalli, Ressler, Harnett); Department of Psychiatry and Behavioral Sciences, Emory University School of Medicine, Atlanta, Georgia (Stevens, Ely, van Rooij); Department of Psychological Sciences, University of Missouri-St Louis, St Louis (Bruce); Department of Emergency Medicine, Washington University School of Medicine, St Louis, Missouri (House); Department of Epidemiology, Brown University, Providence, Rhode Island (Beaudoin); Department of Emergency Medicine, Brown University, Providence, Rhode Island (Beaudoin); Institute for Trauma Recovery, Department of Anesthesiology, University of North Carolina at Chapel Hill, Chapel Hill (An, Linnstaedt); Departments of Psychiatry and Neurology, University of California San Francisco, San Francisco (Neylan); Department of Biomedical Informatics, Emory University School of Medicine, Atlanta, Georgia (Clifford); Department of Biomedical Engineering, Georgia Institute of Technology and Emory University, Atlanta (Clifford); Institute for Technology in Psychiatry, McLean Hospital, Belmont, Massachusetts (Germine, Rauch); The Many Brains Project, Belmont, Massachusetts (Germine); Department of Psychology and Neuroscience, University of North Carolina at Chapel Hill, Chapel Hill (Bollen); Department of Sociology, University of North Carolina at Chapel Hill, Chapel Hill (Bollen); Department of Psychiatry, McLean Hospital, Belmont, Massachusetts (Rauch); Department of Emergency Medicine, University of Massachusetts

Chan Medical School, Worcester (Haran); Department of Emergency Medicine, Vanderbilt University Medical Center, Nashville, Tennessee (Storrow); Department of Emergency Medicine, Henry Ford Health System, Detroit, Michigan (Lewandowski); Department of Emergency Medicine, Indiana University School of Medicine, Indianapolis (Musey); Department of Emergency Medicine, University of Florida College of Medicine -Jacksonville, Jacksonville (Hendry, Sheikh); Department of Emergency Medicine, Cooper Medical School of Rowan University, Camden, New Jersey (Jones); Department of Emergency Medicine, Ohio State University College of Medicine, Columbus (Punches); Ohio State University College of Nursing, Columbus (Punches); Department of Emergency Medicine, Oakland University William Beaumont School of Medicine, Rochester, Michigan (Swor); Department of Psychology, Temple University, Philadelphia, Pennsylvania (Murty); Department of Emergency Medicine, Emory University School of Medicine, Atlanta, Georgia (Hudak); Department of Surgery, Department of Neurosurgery, University of Pennsylvania, Philadelphia (Pascual); Perelman School of Medicine, University of Pennsylvania, Philadelphia (Pascual, Seamon); Department of Surgery, Division of Traumatology, Surgical Critical Care and Emergency Surgery, University of Pennsylvania, Philadelphia (Seamon); Department of Emergency Medicine, Jefferson Einstein Hospital, Jefferson Health, Philadelphia, Pennsylvania (Datner); Department of Emergency Medicine, Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, Pennsylvania (Datner); Department of Emergency Medicine, Wayne State University, Ascension St John Hospital, Detroit, Michigan (Pearson); Department of Emergency Medicine, Massachusetts General Hospital, Boston (Peak); Department of Emergency Medicine, Trinity Health-Ann Arbor, Ypsilanti, Michigan (Domeier); Department of Emergency Medicine, University of Massachusetts Medical School-Baystate, Springfield (Rathlev); Department of Emergency Medicine, Wayne State University, Detroit Receiving Hospital, Detroit, Michigan (O'Neil); Department of Emergency Medicine, McGovern Medical School at UTHealth, Houston, Texas (Sergot); Department of Emergency Medicine, Brigham and Women's Hospital, Boston, Massachusetts (Sanchez); Department of Emergency Medicine, Harvard Medical School, Boston, Massachusetts (Sanchez); Department of Psychology, Yale University, New Haven, Connecticut (Joormann); Department of Anesthesiology, University of Michigan Medical School, Ann Arbor (Harte); Department of Internal Medicine-Rheumatology, University of Michigan Medical School, Ann Arbor (Harte); Department of Health Care Policy, Harvard Medical School, Boston, Massachusetts (Kessler); Department of Epidemiology, Harvard T.H. Chan School of Public Health, Harvard University, Boston, Massachusetts (Koenen); Department of Emergency Medicine, University of North Carolina at Chapel Hill, Chapel Hill (McLean); Institute for Trauma Recovery, Department of Psychiatry, University of North Carolina at Chapel Hill, Chapel Hill (McLean).

Author Contributions: Drs Webb and Harnett had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Webb, Stevens, Lebois, Neylan, Germine, Peak, Joormann, Pizzagalli, Harte, Koenen, Ressler, McLean, Harnett.
Acquisition, analysis, or interpretation of data: Webb, Stevens, Ely, Lebois, van Rooij, Bruce, House, Beaudoin, An, Neylan, Clifford, Linnstaedt, Germine, Bollen, Rauch, Haran, Storrow, Lewandowski, Musey, Hendry, Sheikh, Jones, Punches, Swor, Murty, Hudak, Pascual, Seamon, Datner, Pearson, Peak, Domeier, Rathlev, O'Neil, Sergot, Sanchez, Pizzagalli, Kessler, Koenen, Ressler, Harnett.
Drafting of the manuscript: Webb, Hudak, Harnett.
Critical review of the manuscript for important intellectual content: Stevens, Ely, Lebois, van Rooij, Bruce, House, Beaudoin, An, Neylan, Clifford, Linnstaedt, Germine, Bollen, Rauch, Haran, Storrow, Lewandowski, Musey, Hendry, Sheikh, Jones, Punches, Swor, Murty, Pascual, Seamon, Datner, Pearson, Peak, Domeier, Rathlev, O'Neil, Sergot, Sanchez, Joormann, Pizzagalli, Harte, Kessler, Koenen, Ressler, McLean, Harnett.
Statistical analysis: Webb, Murty.
Obtained funding: Webb, Neylan, Clifford, Germine, Kessler, Koenen, Ressler.
Administrative, technical, or material support: Stevens, Ely, Bruce, House, Beaudoin, An, Neylan, Clifford, Linnstaedt, Germine, Bollen, Haran, Musey, Hendry, Sheikh, Jones, Punches, Hudak, Datner, Pearson, Peak, Rathlev, O'Neil, Sergot, Sanchez, Joormann, Kessler, Ressler.
Supervision: Stevens, van Rooij, Bruce, House, Haran, Storrow, Lewandowski, Hendry, Jones, Punches, Seamon, Domeier, Joormann, Ressler, McLean, Harnett.

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Supplementary Online Content

Webb EK, Stevens JS, Ely TD, et al. Neighborhood resources associated with psychological trajectories and neural reactivity to reward after trauma. *JAMA Psychiatry*. Published online July 31, 2024. doi:10.1001/jamapsychiatry.2024.2148

This supplementary material has been provided by the authors to give readers additional information about their work.

1. Supplementary Methods

1.1. Satellite Imagery Preprocessing.

To obtain the highest quality data (i.e., during summer months) and evaluate greenspace immediately before the study period, we acquired satellite images between May 1st, 2017, through September 30th, 2017. Images with less than 20% cloud cover were considered useable. In Google Earth Engine (1,2), images underwent preprocessing steps including atmospheric correction and Top of Atmosphere reflectance conversion to remove effects from water vapor and sun position. Computation of the normalized difference vegetation index (NDVI) was performed in GEE with the following equation: NDVI = (near-infrared band – red band / near-infrared band + red band) (3). Raw NDVI values ranged from -1 to 1, with greater values representing denser vegetation and lower numbers reflecting snow or water. The NDVI rasters and the coordinates of the participants' home addresses were then entered into ArcGIS Pro Version 3.0.0 (ESRI, 2018) for further processing. To avoid penalizing natural infrastructure, bodies of water were masked out (i.e., set as empty values). As part of this process, final NDVI values were transformed to range from 0 to 1 (see **eFigure 2**).

1.2. Participants - Inclusion/Exclusion Criteria.

Individuals were eligible for the study if they were between 18-75 years old, able to read and write in English, and alert/oriented. Qualifying traumatic events included motor vehicle collisions, physical or sexual assaults, falls greater than 10 feet, or an experience that otherwise met *Diagnostic and Statistical Manual of Mental Disorders 5th edition* (DSM-5) criterion A for PTSD (4) and that the research team agreed that was a plausible qualifying event. Participants were excluded if they: sustained a solid organ injury greater than grade 1 or had a significant hemorrhage, were intubated, required general anesthesia, or were likely to be admitted for more than three days.

Additional exclusion criteria applied for the neuroimaging portion of the study (see supplement), including the presence of metal or ferromagnetic material in the body, claustrophobia, a history of neurodegenerative disorders, or a history of seizures.

1.3. MRI Preprocessing in fMRIPrep

Results included in this manuscript come from preprocessing performed using fMRIPrep v1.2.2 (5,6). **eTable2** describes the harmonized MRI acquisition parameters across each site. Each T1w (T1-weighted) volume was corrected for INU (intensity non-uniformity) using N4BiasFieldCorrection v2.1.0 (7) and skull-stripped using antsBrainExtraction.sh v2.1.0 (using the OASIS template). Brain surfaces were reconstructed using recon-all from FreeSurfer v6.0.1, and the brain mask estimated previously was refined with a custom variation of the method to reconcile ANTs-derived and FreeSurfer-derived segmentations of the cortical gray-matter of Mindboggle (8).

Spatial normalization to the ICBM 152 Nonlinear Asymmetrical template version 2009c (9) was performed through nonlinear registration with the antsRegistration tool of ANTs v2.1.0 (10), using brain-extracted versions of both T1w volume and template. Brain tissue segmentation of cerebrospinal fluid (CSF), white-matter (WM) and gray-matter (GM) was performed on the brain-extracted T1w using fast (FSL v5.0.9). Functional data was slice-time corrected using 3dTshift from AFNI v16.2.07 and motion corrected using mcflirt (FSL v5.0.9). This was followed by co-registration to the corresponding T1w using boundary-based registration with six degrees of freedom, using bbregister (FreeSurfer v6.0.1). Motion correcting transformations, BOLD-to-T1w transformation and T1w-to-template (MNI) warp were concatenated and applied in a single step using antsApplyTransforms (ANTs v2.1.0) using Lanczos interpolation.

Frame-wise displacement was calculated for each functional run using the implementation of Nipype. ICA-based Automatic Removal Of Motion Artifacts (AROMA) was used to generate aggressive noise regressors as well as to create a variant of data that is non-aggressively denoised (11). For more details of the pipeline see https://fmriprep.readthedocs.io/en/stable/workflows.html. An overall motion threshold was also implemented such that any participant's task data with >15% volumes and ≥1-mm framewise displacement were excluded.

In first-level analyses, gain and loss trials were modeled as separate events convolved with a canonical hemodynamic response function. *Gain* > *loss* was the contrast for the region of interest extraction (ROI). ROIs were selected based on previous work (12) and defined anatomically using the Automated Anatomical Atlas (12). Reward ROIs included the nucleus accumbens, OFC, and amygdala.

1.4. Psychometric Assessments.

At two-weeks post-trauma, the 10-item Connor-Davidson Resilience Scale (CD-RISC) was administered to measure perceived individual resources (13). The CD-RISC demonstrates good internal reliability (α= .85) (14). Childhood maltreatment was evaluated using 5-items of the 11-item Childhood Trauma Questionnaire-Short Form (15). These items were selected to both sufficiently assess childhood maltreatment and minimize participant burden (16). Together, these items have been shown to have high reliability (α= .92) (16). Participants reported how often they experienced each of the items, which captured both abuse and neglect, using a 5-point Likert scale (from 0: *never* to 4: *very often*). The total score was the sum of all the items.

Lifetime trauma exposure to 17 potentially traumatic/stressful events was evaluated using the Life Events Checklist for DSM-5 (17). Participants indicated whether they had experienced, witnessed, or learned about the event. A total score was created by summing all responses, with higher numbers indicating a more extensive trauma history. The LEC-5 has excellent internal consistency (α = .91).

The PTSD Symptom Checklist for DSM-5 (PCL-5) was administered at the 2-week, 8-week, 3-month, and 6-month study visit, and evaluated the presence and severity of various posttraumatic stress symptoms (13). Prior work indicates the PCL-5 has excellent internal consistency (α = .94) and test-retest reliability (*r* = .82) (18).

1.5. Selection and Characterization of PTSD trajectories

The six-group solution (resilient, nonremitting high, nonremitting moderate, slow recovery, rapid recovery, and delayed trajectory) with a linear and quadratic term for time was selected as the best fit for the data. Although entropy was slightly higher in the five-class solution (5-class entropy = .72 vs. 6-class entropy = .71), BIC, AIC, SABIC, and log-likelihood were lower in the six-class solution. The 7-class solution had the lowest BIC, AIC, SABIC, and reductions in log-likelihood but the lowest entropy (.69). In addition, the 7-class solution lacked parsimony and theoretical basis, identifying two similar nonremitting moderate classes. Posterior probabilities (all > .70) suggested that individuals were more likely to be classified into their assigned group compared to an alternative group indicating reasonable accuracy of the six-class model (reported in **eTable6**). Therefore, we selected the six-group solution over the 7-group solution to ensure the interpretability of the classes.

The six symptom classes corresponded with a resilient (low symptoms across time), nonremitting high (symptoms far exceed the clinically relevant cut-off of PCL-5 total score of 32 across time), nonremitting moderate (symptoms slightly above the clinically relevant cut-off across time), slow recovery (elevated symptoms slowly decreasing across time), rapid recovery (elevated symptoms decreasing to below the PCL-5 cut-off score by 8-weeks post-trauma), and delayed trajectory (increasing symptoms across time).

Prior investigations reveal that the majority of trauma survivors experience no or low symptoms (resilient trajectory) whereas a subset is highly symptomatic (nonremitting trajectory). While resilient and nonremitting classes frequently emerge, additional trajectories including nonremitting moderate, rapid recovery, delayed, and slow recovery, may also emerge (19,20). Differences between the number and type of trajectories identified may be influenced by sample characteristics. For example, Tomas et al., (2022) compared two ED samples (admitted and discharged) and identified a unique delayed class in the hospitalized sample which was not present in individuals who were discharged. Another study identified 5 trajectories (resilient, nonremitting/chronic, recovery, delayed, and worsening/recovery) among 9/11 police responders and a 6-class solution among 9/11 non-traditional responders (resilient, recovering, delayed, chronic, moderate-low, and nonremitting moderate) (21). While the trajectories identified in the current analysis align well with prior work, future work directly examining differences in trajectories between samples (e.g., interpersonal violence vs. motor vehicle vs. war-related events) is warranted.

Significant differences (pairwise comparisons with Holm-Bonferroni correction applied) between the trajectories are presented in **eTable7**. There was no significant difference between the rapid and slow recovery groups on 2-week PCL-5 symptoms; however, at 8 weeks, there was a significant difference between all the groups. The 3-month PCL-5 scores did not differ between the delayed vs. the slow recovery or between the slow recovery vs. the moderate group. Finally, at 6 months post-injury, there was no significant difference between the rapid and slow recovery groups, with both groups exhibiting low symptoms (but still elevated compared to the resilient group). ADI was significantly higher (reflective of greater neighborhood disadvantage) in the nonremitting high, nonremitting moderate, and slow recovery groups compared to the resilient group.

Income was significantly lower in the rapid recovery vs. the resilient trajectory, and lower in the nonremitting high vs resilient and delayed trajectories. Income was also significantly lower in the slow recovery and nonremitting moderate classes compared to the resilient class. Individuals in the rapid recovery trajectory were significantly younger than those assigned to the resilient and nonremitting moderate trajectories. Individuals in resilient trajectory had lower lifetime trauma history (LEC-5 scores) compared to individuals in the nonremitting high and moderate trajectories whereas those in the rapid recovery class had lower trauma load than the nonremitting high class. There was a significant difference in childhood maltreatment between the resilient trajectory (lower CTQ scores) and all other trajectories. The rapid recovery group had significantly lower CTQ scores compared to the nonremitting high group. In addition, the nonremitting high group was exposed to greater childhood maltreatment compared to the delayed group.

1.6. Covariates and PTSD Trajectories

Beyond the NDVI x CD-RISC term of interest, there were several significant predictors of trajectories in the full model (presented in the main text **Table 3**). Females were more likely to be assigned either of the nonremitting high (Wald's $z = 2.28$, $p = .02$) and nonremitting moderate classes (Wald's $z = 5.17$, $p < .001$) versus a resilient class. Higher ISS was associated with an increased likelihood of a slow recovery (Wald's $z = 2.12$, $p = .03$) or rapid recovery (Wald's $z =$

2.07, p = .04) trajectory compared to a resilient trajectory. ADI was associated with assignment in the slow recovery group versus the resilient group (Wald's z = 1.99, p = .046). Lower income was also associated with an increased likelihood of falling into a nonremitting high (Wald's z = -3.16, p = .002), nonremitting moderate (Wald's z = -2.79, p = .005), or slow recovery class (Wald's z = -2.21, p = .03) compared to a resilient class.

In line with prior work, childhood maltreatment increased the likelihood of assignment in the nonremitting high (Wald's z = 9.53, p <.001), nonremitting moderate (Wald's z = 9.21, p < .001), delayed (Wald's z = 4.59, p < .001), slow recovery (Wald's z = 5.24, p < .001), and rapid recovery (Wald's z = 4.75, p < .001) trajectories compared to a resilient trajectory. Lifetime trauma increased the likelihood of assignment in the nonremitting high (Wald's z = 6.18, p < .001), nonremitting moderate (Wald's z = 6.10, p < .001), and slow recovery (Wald's z = 2.17, p = .03) groups compared to the resilient group. Finally, a head injury/hitting head during the traumatic event increased the likelihood of assignment in the nonremitting high (Wald's z = 2.80, p = .005) or nonremitting moderate (Wald's z = 3.36, p = .001) groups compared to the resilient group. Taken together these results align well with prior work finding that lower income, older age, female sex, and greater childhood maltreatment are associated with more severe and chronic PTSD (19,22–24). Our work also aligns with other ED-recruited trauma survivors which suggests more severe injuries (as reflected by higher ISS or head injury) can result in more severe PTSD symptoms (19,23). However, analyses of the injury characteristics were limited to two variables, and further research in this area is needed (e.g. examining the effect of objective measures of traumatic brain injury).

1.7. Sensitivity Analysis with Baseline PTSD Symptoms and Medication Use

We examined whether the NDVI x CD-RISC interaction in the full sample held after adjusting for baseline/pre-existing PTSD symptoms and medication use (0: *no medication;* as reported at 2 weeks post-injury; included selective serotonin reuptake inhibitors and/or serotonin and norepinephrine reuptake inhibitors, and/or benzodiazepines). Only 1722 individuals (66.3%) completed a PCL-5 querying their PTSD symptoms in the 30 days prior to the traumatic event (n = 841 screened positive). Only 1398 (53.8%) completed the medication screen (n = 291 screened positive). Even when these variables (imputed with the *mice* package using predictive mean matching with 20 imputations) were included in the multinominal logistic regression, individuals with higher CD-RISC scores who had greater greenspace exposure had an increased likelihood of assignment in a resilient trajectory compared to a nonremitting high trajectory (Wald's z = -3.09, p = .002; **eTable9**).

1.8 Interaction Between Individual-level Factors

We also tested whether an Income x CD-RISC interaction was present in the full sample after adjusting for covariates (**eTable10**). This analysis revealed that at higher scores of CD-RISC, greater annual household income was associated with increased likelihood of assignment in the resilient trajectory compared to the nonremitting high (Wald z test = -5.73; p < .001), nonremitting moderate (Wald z test = -4.58; p < .001), delayed (Wald z test = -3.06; p = .002, rapid recovery (Wald z test = -2.89; p = .004), or slow recovery classes (Wald z test = -3.75, p < .001) even after considering the other variables (depicted in **eFigure4**).

1.9 Prediction of PTSD Trajectories in MRI Sample

A multinomial logistic regression model predicting PTSD trajectories (as assigned from the full sample trajectory analyses) was conducted in the MRI subset sample (**eTable11**). However, the rapid recovery (n = 4) and slow recovery classes (n = 13) were combined into a single recovery group to ensure sufficient sample sizes in each class. Thus, there were 5 classes: resilient (n = 165), nonremitting moderate (n = 71), recovery (n = 17), delayed (n = 17) and nonremitting high (n = 18). There was no significant interaction between CD-RISC scores and NDVI (ps > .05).

1.10. ROI Reward Reactivity Between Classes

One-way ANOVAs revealed that nucleus accumbens and OFC reactivity to reward did not differ by PTSD trajectory classes (nucleus accumbens: $F(4,283) = 0.54$, $p = .704$; OFC: $F(4,283) = 1.01$, $p = .405$).

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eTable1. Harmonized MRI sequences across study sites

	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
SCANNER	SIEMENS TIM 3T TRIO	SIEMENS TIM 3T TRIO	SIEMENS MAGNETOM 3T PRISMA	SIEMENS 3T VERIO	SIEMENS MAGNETOM 3T PRISMA
HEAD COIL	12 Channel	12 Channel	20 Channel	12 Channel	20 Channel
MODALITY					
T1-WEIGHTED	**TR** = 2530ms, **TEs** = 1.74/3.6/5.46/7.32ms, **TI** = 1260ms, **flip angle** = 7, **FOV** = 256mm, **slices** = 176, **Voxel size** = 1mm x 1mm x 1mm	**TR** = 2530ms, **TEs** = 1.74/3.6/5.46/7.32ms, **TI** = 1260ms, **flip angle** = 7, **FOV** = 256mm, **slices** = 176, **Voxel size** = 1mm x 1mm x 1mm	**TR** = 2300ms, **TE** = 2.96ms, **TI** = 900ms, **flip angle** = 9, **FOV** = 256mm, **slices** = 176, **Voxel size** = 1.2mm x 1.0mm x 12mm	**TR** = 2530ms, **TEs** = 1.74/3.65/5.51/7.72ms, **TI** = 1260ms, **flip angle** = 7, **FOV** = 256mm, **slices** = 176, **Voxel size** = 1mm x 1mm x 1mm	**TR** = 2300ms, **TE** = 2.98ms, **TI** = 900ms, **flip angle** = 9, **FOV** = 256mm, **slices** = 176, **Voxel size** = 1.2mm x 1.0mm x 12mm
DIFFUSION WEIGHTED IMAGING	**TR** = 7700ms, **TE** = 85ms, **FOV** = 212mm, **flip angle** = 90, **Volumes** = 71 (64 **b**=1000 s/mm^{2,} 7 b0), **PA-encoded**, **Voxel size** = 2mm x 2mm x 2mm	**TR** = 7700ms, **TE** = 85ms, **FOV** = 212mm, **flip angle** = 90, **Volumes** = 71 (64 **b**=1000 s/mm^{2,} 7 b0), **PA-encoded**, **Voxel size** = 2mm x 2mm x 2mm	**TR** = 7000ms, **TE** = 74ms, **FOV** = 212mm, **flip angle** = 90, **Volumes** = 71 (64 **b**=1000 s/mm^{2,} 7 b0), **PA-encoded**, **Voxel size** = 2mm x 2mm x 2mm	**TR** = 12000ms, **TE** = 85ms, **FOV** = 212mm, **flip angle** = 90, **Volumes** = 71 (64 **b**=1000 s/mm^{2,} 7 b0), **PA-encoded**, **Voxel size** = 2mm x 2mm x 2mm	**TR** = 7700ms, **TE** = 67ms, **FOV** = 212mm, **flip angle** = 90, **Volumes** = 71 (64 **b**=1000 s/mm^{2,} 7 b0), **PA-encoded**, **Voxel size** = 2mm x 2mm x 2mm
FMRI	**TR** = 2360ms, **TE** = 30ms, **flip angle** = 70, **FOV** = 212mm, **slices** = 44, **Voxel size** = 3mm x 2.72mm x 2.72mm, 0.5 mm gap	**TR** = 2360ms, **TE** = 30ms, **flip angle** = 70, **FOV** = 212mm, **slices** = 44, **Voxel size** = 3mm x 3mm x 3mm, 0.5 mm gap	**TR** = 2360ms, **TE** = 29ms, **flip angle** = 70, **FOV** = 212mm, **slices** = 44, **Voxel size** = 3mm x 2.72mm x 2.72mm, 0.5 mm gap	**TR** = 2360ms, **TE** = 30ms, **flip angle** = 70, **FOV** = 212mm, **slices** = 42, **Voxel size** = 3mm x 2.72mm x 2.72mm, 0.5 mm gap	**TR** = 2360ms, **TE** = 29ms, **flip angle** = 90, **FOV** = 210mm, **slices** = 44, **Voxel size** = 3mm x 3mm x 2.5mm, 0.5 mm gap

eTable2. Overlap between new and previously reported trajectories

Prior linear trajectories*	New Non-linear Trajectories					
	Resilient	Nonremitting moderate	Rapid recovery	Delayed	Slow recovery	Nonremitting high
Low	**1252**	98	**86**	4	4	0
High - decreasing	0	15	22	0	**55**	0
Moderate	66	**609**	18	**85**	8	42
High	0	12	0	19	0	**202**

Note: There was considerable overlap between the previously reported 4 trajectories (see ref 25) and the 6 trajectories from the current approach. Numbers in bold represent overlap with the largest number of participants in each class.

eTable3. Pearson's correlations between study measures in the full and MRI sample

	Full Sample (N = 2,597)							
Measure	NDVI	CD-RISC	ADI	Income	Childhood Maltreatment	ISS	Age	LEC-5
NDVI								
CD-RISC	**.05***							
ADI	**-.08***	**-.06***						
Income	**.15***	**.15***	**-.36***					
Childhood Maltreatment	**-.07***	**-.18***	**.10***	**-.19***				
ISS	**.08***	.03	**-.07***	**.11***	**-.04***			
Age	**.08***	**.11***	**-.07***	**.17***	**-.07***	**.09***		
LEC-5	.01	**.04***	**-.07***	**.09***	**.15***	**.03**	**.09***	
	MRI Sample (*n* = 288)							
NDVI								
CD-RISC	.03							
ADI	**-.24***	-.06						
Income	**.20***	**.18***	**-.24***					
Childhood Maltreatment	-.03	**-.25***	**.13***	**-.23***				
ISS	.04	.11	-.03	**.18***	-.06			
Age	**.14***	.06	**-.17***	**.21***	-.06	.11		
LEC-5	-.01	.02	**-.16***	.09	**.19***	<.01	.07	

Abbreviations: **ADI:** Area Deprivation Index (national ranking); **CD-RISC:** Connor-Davidson Resilience Scale (total score); **ISS**: Injury Severity Score; **LEC-5:** Life Events Checklist for DSM-5 (total score); **PCL-5:** PTSD Checklist for DSM-5 (total symptom severity); **NDVI:** Normalized Difference Vegetation Index; *Notes:* correlations derived following mean imputation; *** *p* < .05.**

eTable4. Fit indices for the latent class mixed effect models (non-linear solutions)

Class	*loglik*	*AIC*	*BIC*	*entropy*	*SABIC*	*%class1*	*%class2*	*%class3*	*%class4*	*%class5*	*%class6*	*%class7*
1	-36051.57	72117.15	72158.18	1.00	72135.94	100.00						
2	-35935.00	71892.00	71956.48	0.63	71921.53	66.92	33.08					
3	-35837.10	71704.21	71792.14	0.65	71744.48	9.90	63.53	26.57				
4	-35780.36	71598.72	71710.10	0.68	71649.73	9.97	23.30	3.23	63.50			
5	-35735.19	71516.38	71651.21	0.72	71578.13	23.64	9.51	1.54	62.30	3.00		
6	**-35696.96**	**71447.91**	**71606.19**	**0.71**	**71520.40**	**28.26**	**50.75**	**4.85**	**4.16**	**2.58**	**9.40**	
7	-35663.85	71389.70	71571.42	0.69	71472.93	51.06	17.71	11.47	4.24	2.43	2.96	10.13

Abbreviations: **Loglik**: log likelihood; **AIC:** Akaike information criterion**; BIC:** Bayesian information criterion**; SABIC:** Sample-size adjusted Bayesian information criterion.

eTable5. Fit indices for latent class mixed modeling analysis (linear solutions)

Class	loglik	AIC	BIC	entropy	SABIC	%class1	%class2	%class3	%class4	%class5	%class6	%class7
1	-36057.05	72124.09	72153.41	1.00	72137.52	100.00						
2	-35952.84	71921.69	71968.58	0.63	71943.17	66.04	33.96					
3	-35881.39	71784.78	71849.26	0.65	71814.31	11.32	23.03	65.65				
4	-35837.53	71703.06	71785.13	0.72	71740.65	1.31	65.15	24.07	9.47			
5	-35802.14	71638.28	71737.94	0.71	71683.92	1.93	29.42	9.43	53.14	6.08		
6	-35784.01	71608.02	71725.26	0.71	71661.72	1.31	5.70	9.86	30.54	48.75	3.85	
7	-35770.79	71587.58	71722.41	0.69	71649.33	1.19	4.16	16.21	40.47	5.43	27.19	5.35

Abbreviations: **Loglik**: log likelihood; **AIC:** Akaike information criterion**; BIC:** Bayesian information criterion**; SABIC:** Sample-size adjusted Bayesian information criterion.

eTable6. Average posterior probabilities for non-linear solution 6-class solution

	Mean of posterior probabilities in each class					
Class	*prob1*	*prob2*	*prob3*	*prob4*	*prob5*	*prob6*
1	**0.70**	0.10	0.05	0.05	0.04	0.07
2	0.07	**0.88**	0.03	0.02	0.00	0.00
3	0.12	0.10	**0.74**	0.00	0.04	0.00
4	0.16	0.08	0.00	**0.70**	0.00	0.05
5	0.14	0.03	0.05	0.00	**0.76**	0.02
6	0.14	0.00	0.00	0.03	0.04	**0.79**

Note: Numbers in bold represent average posterior probability for classification in that class for observation classified in the specific class.

eTable7. Trajectory characteristics

	Assigned Trajectory					
Variable	Rapid recovery (*n* = 126)	Nonremitting high (*n* = 244)	Resilient (*n* = 1318)	Delayed (*n* = 108)	Slow recovery (*n* = 67)	Nonremitting moderate (*n* = 734)
Sex at birth (% female and [*n*])	67.46 [85]	68.85 [168]	55.61 [753]	57.41 [62]	67.16 [45]	71.39 [524]
Hit head (% yes and [*n*])	57.93 [73]	60.65 [148]	49.47 [652]	52.78 [57]	64.18 [43]	57.63 [423]
Age in years (*Mean*)	32.60[a]	36.23	36.44[a]	37.15	33.94	37.44[a]
Income (*Mean*)	2.26[a]	1.98[b]	2.67[abc]	2.61[b]	1.93[c]	2.29[c]
Marital Status (% married and [*n*])	14.28 [*n* = 18]	15.16 [*n* = 37]	23.36 [*n* = 308]	21.29 [*n* = 23]	16.41 [*n* = 11]	21.25 [*n* = 156]
ISS (*Mean*)	2.67	2.36	2.42	2.45	2.81	2.39
Childhood Maltreatment (*Mean*)	11.33[a]	15.33[ab]	6.64[abc]	10.89[bc]	14.00[c]	12.50[bc]
LEC-5 (*Mean*)	8.33[b]	11.83[ab]	7.75[a]	8.92	9.87	10.52[a]
CD-RISC score (*Mean*)	21.31[a]	18.83[b]	24.14[abc]	21.96[b]	21.64	21.25[bc]
NDVI (*Mean*)	0.45	0.43	0.45	0.44	0.45	0.44
ADI (*Mean*)	64.84	68.75[a]	62.26[ab]	63.36	73.27[b]	66.41[b]
WK2 PCL-5 scores (*Mean*)	50.90[a]	58.83[ab]	17.35[abc]	22.94[abcd]	54.33[bcde]	42.62[abcde]
WK8 PCL-5 scores (*Mean*)	23.52*	62.41*	14.08*	34.61*	55.21*	39.33*
M3 PCL-5 scores (*Mean*)	15.39[a]	60.27[ab]	11.80[abc]	41.67[abcd]	39.30[abcd]	35.57[abcd]
M6 PCL-5 scores (*Mean*)	14.79[a]	57.55[ab]	10.79[abc]	43.66[abcd]	17.21[bcde]	33.22[abcde]

Abbreviations: **ADI:** Area Deprivation Index (national ranking); **CD-RISC:** Connor-Davidson Resilience Scale (total score); **ISS**: Injury Severity Score; **LEC-5:** Life Events Checklist for DSM-5 (total score); **PCL-5:** PTSD Checklist for DSM-5 (total symptom severity); **NDVI:** Normalized Difference Vegetation Index. *Notes:* Significant differences between trajectories that withstood Holm-Bonferroni correction for multiple comparisons are noted with row-level superscript letters ([a-d]). * notes all trajectories were significantly different.

eTable8. Self-report and geocoded variables associated with class membership (full sample; no interaction term)

	Trajectory Class *(statistical tests relative to the resilient trajectory)*																			
	Nonremitting High				**Nonremitting Moderate**				**Delayed**				**Slow recovery**				**Rapid recovery**			
Variable	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*
Intercept	-2.29	0.17	-13.46	<.001	-1.08	0.11	-10.07	<.001	-2.40	0.20	-11.98	<.001	-3.56	0.30	-11.95	<.001	-2.61	0.21	-12.60	<.001
Sex at Birth [*male*]	0.34	0.16	2.15	.032	0.53	0.10	5.14	<.001	-0.07	0.21	-0.35	.728	0.32	0.27	1.16	.248	0.37	0.20	1.83	.067
CD-RISC	-0.08	0.01	-7.96	<.001	-0.04	0.01	-6.51	<.001	-0.03	0.01	-2.49	.013	-0.03	0.02	-1.66	.097	-0.04	0.01	-2.91	.004
NDVI	-0.06	0.55	-0.10	.917	0.14	0.36	0.39	.695	-0.37	0.73	-0.51	.609	0.99	0.98	1.01	.313	0.31	0.70	0.44	.657
ISS	<0.01	0.04	0.09	.930	<0.01	0.03	0.15	.884	0.01	0.05	0.24	.806	0.12	0.06	2.12	.034	0.10	0.05	2.08	.038
Age	0.01	0.01	2.22	.026	0.01	0.00	3.38	.001	0.01	0.01	1.15	.249	-0.01	0.01	-0.55	.582	-0.02	0.01	-1.98	.048
Income	-0.21	0.06	-3.28	.001	-0.11	0.04	-2.86	.004	0.04	0.07	0.60	.548	-0.27	0.12	-2.28	.023	-0.09	0.07	-1.15	.251
ADI	<0.01	0.00	1.31	.190	<0.01	0.00	1.49	.136	<0.01	0.00	0.18	.855	0.01	0.01	1.95	.052	0.00	0.00	-0.09	.928
Marital Status [*unmarried*]	-0.27	0.21	-1.25	.213	<0.01	0.13	-0.01	.998	-0.17	0.27	-0.63	.528	<0.01	0.36	0.01	.993	-0.29	0.29	-1.02	.307
Childhood maltreatment	0.07	0.01	9.61	<.001	0.05	0.01	9.23	<.001	0.05	0.01	4.60	<.001	0.06	0.01	5.30	<.001	0.05	0.01	4.75	<.001
Head injury [*did not hit head*]	0.43	0.15	2.78	.005	0.33	0.10	3.33	.001	0.08	0.21	0.40	.686	0.45	0.27	1.68	.093	0.18	0.19	0.94	.348
LEC-5	0.05	0.01	6.19	<.001	0.03	0.01	6.08	<.001	0.01	0.01	1.03	.301	0.03	0.01	2.12	.035	0.01	0.01	0.87	.385

Abbreviations: **ADI:** Area Deprivation Index (national ranking); **CD-RISC:** Connor-Davidson Resilience Scale (total score); **ISS***:* Injury Severity Score; **LEC-5:** Life Events Checklist for DSM-5 (total score); **NDVI:** Normalized Difference Vegetation Index. *Notes:* continuous measures were grand-mean centered in the full sample; the reference group for dichotomous variables is provided in brackets; **bolded** numbers correspond to uncorrected $p < .05$.

eTable9. Self-report and geocoded variables associated with class membership (full sample; interaction term; adjusting for baseline PTSD and medication use)

Variable	Trajectory Class (*statistical tests relative to the resilient trajectory*)																			
	Nonremitting high				**Nonremitting moderate**				**Delayed**				**Slow recovery**				**Rapid recovery**			
	Coefficient	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*
Intercept	-2.39	0.18	-13.08	<.001	-1.00	0.11	-8.94	<.001	-2.32	0.20	-11.37	<.001	-3.58	0.31	-11.69	<.001	-2.52	0.21	-11.93	<.001
Sex at Birth [*male*]	0.36	0.17	2.11	.035	0.55	0.11	5.09	<.001	-0.07	0.21	-0.34	.730	0.33	0.28	1.18	.237	0.40	0.21	1.97	.048
CD-RISC	-0.08	0.01	-7.25	<.001	-0.04	0.01	-5.77	<.001	-0.03	0.01	-2.17	.030	-0.02	0.02	-1.41	.157	-0.03	0.01	-2.76	.006
NDVI	-0.54	0.62	-0.88	.381	0.20	0.38	0.53	.593	-0.31	0.74	-0.41	.679	1.01	1.01	1.00	.316	0.34	0.71	0.48	.628
ISS	0.00	0.04	-0.07	.946	0.00	0.03	-0.12	.901	0.01	0.05	0.14	.885	0.12	0.06	1.96	.050	0.09	0.05	1.90	.058
Age	0.01	0.01	1.47	.141	0.01	0.00	2.73	.006	0.01	0.01	0.95	.343	-0.01	0.01	-0.80	.424	-0.02	0.01	-2.05	.041
Income	-0.07	0.07	-1.00	.317	-0.04	0.04	-1.01	.312	0.08	0.07	1.12	.263	-0.15	0.12	-1.28	.201	-0.04	0.08	-0.51	.613
ADI	0.00	0.00	0.72	.474	0.00	0.00	0.97	.333	0.00	0.00	0.12	.905	0.01	0.01	1.76	.078	0.00	0.00	-0.30	.767
Marital Status [*unmarried*]	-0.33	0.23	-1.44	.151	-0.01	0.14	-0.04	.970	-0.18	0.27	-0.64	.523	-0.07	0.37	-0.19	.851	-0.29	0.29	-1.00	.317
Childhood maltreatment	0.04	0.01	5.11	<.001	0.03	0.01	5.81	<.001	0.04	0.01	3.49	<.001	0.04	0.01	3.13	.002	0.04	0.01	3.50	<.001
Head injury [*did not hit head*]	0.19	0.16	1.17	.242	0.22	0.10	2.15	.031	0.02	0.21	0.07	.941	0.27	0.27	0.97	.330	0.12	0.20	0.62	.533
LEC-5	0.04	0.01	5.58	<.001	0.03	0.01	5.82	<.001	0.01	0.01	1.00	.319	0.03	0.01	2.06	.040	0.01	0.01	0.88	.376
Pre PCL-5 symptoms	0.08	0.01	14.61	<.001	0.05	0.00	12.02	<.001	0.03	0.01	3.89	<.001	0.07	0.01	7.61	<.001	0.03	0.01	4.71	<.001
Medication use [*no medications*]	0.01	0.20	0.04	.968	0.10	0.14	0.75	.450	0.19	0.27	0.69	.488	0.24	0.33	0.72	.471	-0.06	0.27	-0.20	.838
NDVI x CD-RISC	-0.24	0.08	-3.09	.002	-0.09	0.05	-1.71	.087	-0.02	0.10	-0.21	.833	-0.25	0.13	-1.93	.053	-0.13	0.09	-1.40	.160

Abbreviations: **ADI:** Area Deprivation Index (national ranking); **CD-RISC:** Connor-Davidson Resilience Scale (total score); **ISS***:* Injury Severity Score; **LEC-5:** Life Events Checklist for DSM-5 (total score); **NDVI:** Normalized Difference Vegetation Index. *Notes:* continuous measures were grand-mean centered in the full sample; the reference group for dichotomous variables is provided in brackets; **bolded** numbers correspond to uncorrected $p < .05$.

eTable10. Self-report and geocoded variables associated with class membership (full sample; with Income x CD-RISC interaction)

Variable	Trajectory Class *(statistical tests relative to the resilient trajectory)* Nonremitting High				Nonremitting Moderate				Delayed				Slow recovery				Rapid recovery			
	Coefficient	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*
Intercept	-2.32	0.17	-13.35	<.001	-1.05	0.11	-9.75	<.001	-2.37	0.20	-11.79	<.001	-3.59	0.30	-11.81	<.001	-2.59	0.21	-12.43	<.001
Sex at Birth [*male*]	0.33	0.16	2.06	.039	0.53	0.10	5.08	<.001	-0.08	0.21	-0.37	.709	0.32	0.27	1.16	.247	0.36	0.20	1.80	.072
CD-RISC	-0.09	0.01	-8.99	<.001	-0.05	0.01	-6.82	<.001	-0.03	0.01	-2.53	.011	-0.05	0.02	-2.75	.006	-0.04	0.01	-3.23	.001
Income	-0.30	0.07	-4.05	<.001	-0.09	0.04	-2.24	.025	0.07	0.07	0.89	.374	-0.31	0.13	-2.42	.015	-0.07	0.08	-0.94	.348
NDVI	0.02	0.55	0.03	.977	0.15	0.36	0.40	.686	-0.35	0.73	-0.47	.636	1.06	0.98	1.08	.280	0.33	0.70	0.47	.637
ISS	0.01	0.04	0.25	.802	0.01	0.03	0.32	.750	0.02	0.05	0.36	.721	0.13	0.06	2.24	.025	0.10	0.05	2.17	.030
Age	0.01	0.01	2.30	.021	0.01	0.00	3.45	.001	0.01	0.01	1.22	.222	0.00	0.01	-0.42	.673	-0.02	0.01	-1.91	.056
ADI	0.00	0.00	1.08	.280	0.00	0.00	1.43	.154	0.00	0.00	0.13	.895	0.01	0.01	1.84	.065	0.00	0.00	-0.15	.884
Marital Status [*unmarried*]	-0.27	0.22	-1.23	.217	0.00	0.13	0.03	.976	-0.17	0.27	-0.62	.534	0.01	0.36	0.02	.987	-0.29	0.29	-1.00	.315
Childhood maltreatment	0.07	0.01	9.71	<.001	0.05	0.01	9.30	<.001	0.05	0.01	4.69	<.001	0.07	0.01	5.39	<.001	0.05	0.01	4.83	<.001
Head injury [*did not hit head*]	0.44	0.16	2.81	.005	0.34	0.10	3.40	.001	0.09	0.21	0.45	.650	0.46	0.27	1.68	.092	0.19	0.20	0.98	.329
LEC-5	0.05	0.01	6.41	<.001	0.03	0.01	6.23	<.001	0.01	0.01	1.19	.234	0.03	0.01	2.30	.021	0.01	0.01	1.00	.316
Income x CD-RISC	-0.05	0.01	-5.73	<.001	-0.02	<.001	-4.58	<.001	-0.03	0.01	-3.06	.002	-0.05	0.01	-3.75	<.001	-0.03	0.01	-2.89	.004

Abbreviations: **ADI:** Area Deprivation Index (national ranking); **CD-RISC:** Connor-Davidson Resilience Scale (total score); **ISS***:* Injury Severity Score; **LEC-5:** Life Events Checklist for DSM-5 (total score); **NDVI:** Normalized Difference Vegetation Index. *Notes:* continuous measures were grand-mean centered in the full sample; the reference group for dichotomous variables is provided in brackets; **bolded** numbers correspond to uncorrected $p < .05$.

eTable11. Self-report and geocoded variables associated with class membership (MRI sample; with NDVI x CD-RISC interaction)

	Trajectory Class *(statistical tests relative to the resilient trajectory)*															
	Nonremitting High				**Nonremitting Moderate**				**Delayed**				**Recovery***			
Variable	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*	*Coefficient*	*SE*	*Wald Z*	*p-value*
Intercept	-5.14	1.10	-4.67	<.001	-1.49	0.37	-4.00	<.001	-2.73	0.61	-4.44	<.001	-3.48	0.74	-4.69	<.001
Sex at Birth [*male*]	1.88	0.86	2.17	.030	0.62	0.35	1.79	.074	0.15	0.54	0.28	.781	0.48	0.60	0.80	.425
CD-RISC	-0.20	0.05	-4.16	<.001	-0.10	0.03	-3.61	<.001	-0.08	0.04	-2.02	.044	-0.07	0.04	-1.72	.086
NDVI	1.90	3.10	0.61	.539	-1.60	1.18	-1.36	.174	-0.29	2.00	-0.15	.883	2.95	2.11	1.40	.162
ISS	-0.12	0.21	-0.56	.575	0.04	0.09	0.40	.689	-0.09	0.16	-0.53	.598	0.03	0.16	0.21	.834
Age	0.03	0.02	1.09	.276	0.00	0.01	0.04	.967	0.01	0.02	0.51	.610	-0.05	0.03	-1.69	.090
Income	-0.05	0.25	-0.19	.847	-0.06	0.12	-0.51	.612	-0.01	0.18	-0.05	.960	-0.05	0.19	-0.26	.792
ADI	0.00	0.01	-0.04	.969	0.01	0.01	2.15	.032	0.01	0.01	0.66	.511	0.00	0.01	-0.15	.883
Marital Status [*unmarried*]	-14.25	0.00	-2.06E+06	<.001	0.08	0.50	0.15	.878	0.42	0.76	0.55	.582	0.74	0.87	0.86	.392
Childhood maltreatment	0.05	0.03	1.99	.047	0.04	0.02	2.29	.022	-0.03	0.03	-0.76	.446	0.05	0.03	2.13	.033
Head injury [*did not hit head*]	1.40	0.70	2.01	.045	0.28	0.32	0.88	.380	0.48	0.54	0.89	.375	0.84	0.61	1.39	.166
LEC-5	0.07	0.03	2.07	.038	0.04	0.02	1.99	.046	0.00	0.03	0.07	.941	0.03	0.03	1.10	.272
NDVI x CD-RISC	0.02	0.33	0.06	.953	-0.22	0.16	-1.36	.173	0.07	0.26	0.29	.775	0.23	0.25	0.91	.365

Abbreviations: **ADI:** Area Deprivation Index (national ranking); **CD-RISC:** Connor-Davidson Resilience Scale (total score); **ISS***:* Injury Severity Score; **LEC-5:** Life Events Checklist for DSM-5 (total score); **NDVI:** Normalized Difference Vegetation Index. *Notes:* continuous measures were grand-mean centered in the full sample; the reference group for dichotomous variables is provided in brackets; **bolded** numbers correspond to uncorrected $p < .05$; * rapid and slow recovery groups from the full trajectory analysis were combined.

eTable12. General linear models for reward reactivity

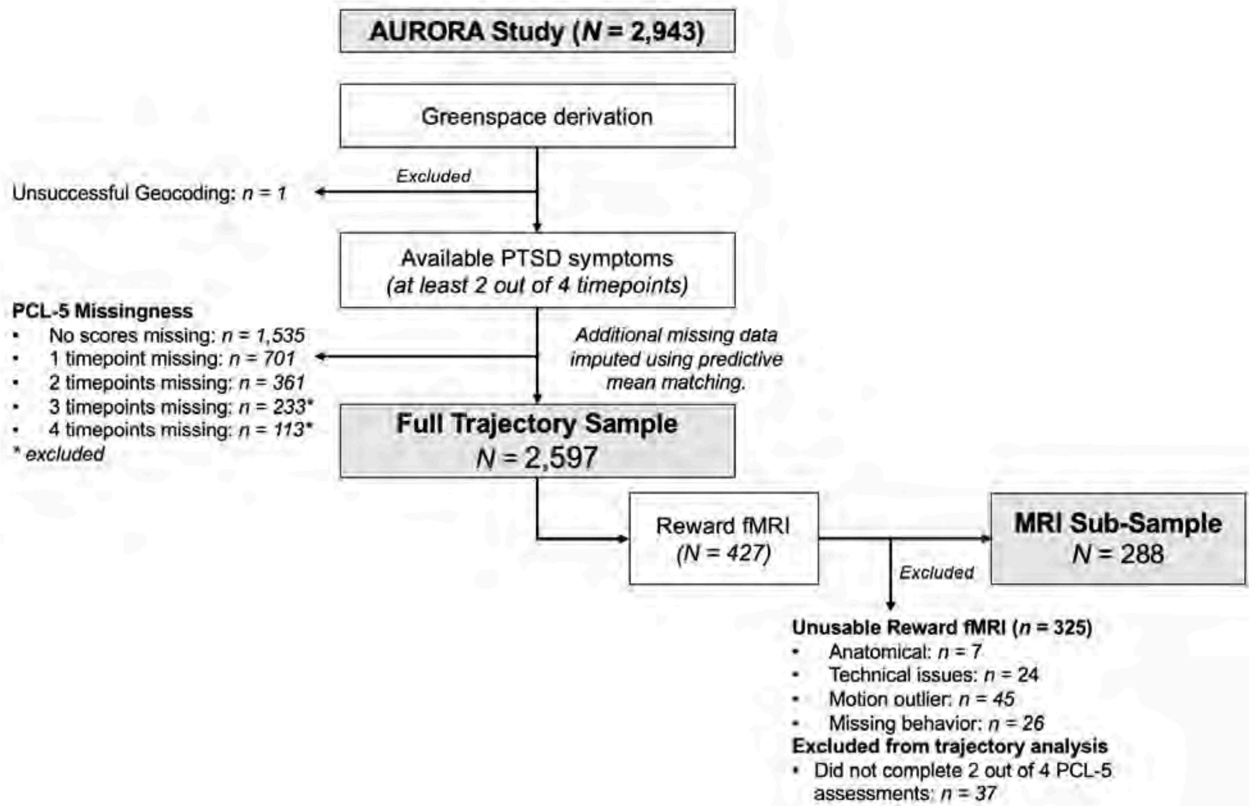
Region	*Standardized Coefficient*	*t-statistic*	*Uncorrected p-value*
Amygdala			
Intercept	-	3.86	<.001
Sex at Birth [*male*]	-0.02	-0.33	0.745
CD-RISC	0.00	-0.01	0.994
NDVI	**0.18**	**2.83**	**0.005**+
ISS	-0.01	-0.20	0.840
Age	-0.11	-1.71	0.088
Income	0.02	0.36	0.717
ADI	0.07	1.06	0.290
Marital Status [*unmarried*]	0.06	0.93	0.351
Childhood maltreatment	-0.02	-0.27	0.784
LEC-5	-0.04	-0.67	0.506
Nucleus Accumbens			
Intercept	-	8.52	0.000
Sex at Birth [*male*]	0.01	0.13	0.899
CD-RISC	0.11	1.78	0.077
NDVI	0.11	1.71	0.088
ISS	-0.06	-1.02	0.309
Age	-0.02	-0.27	0.791
Income	0.05	0.77	0.441
ADI	0.10	1.62	0.107
Marital Status [*unmarried*]	-0.02	-0.22	0.825
Childhood maltreatment	0.06	0.97	0.332
LEC-5	0.04	0.67	0.502
Orbitofrontal Cortex			
Intercept	-	1.59	0.113
Sex at Birth [*male*]	-0.08	-1.40	0.163
CD-RISC	0.01	0.15	0.881
NDVI	0.05	0.76	0.450
ISS	-0.01	-0.09	0.930
Age	0.07	1.10	0.272
Income	0.08	1.15	0.250
ADI	0.06	0.94	0.351
Marital Status [*unmarried*]	0.05	0.76	0.450
Childhood maltreatment	0.10	1.49	0.136
LEC-5	-0.09	-1.50	0.136

Abbreviations: **ADI:** Area Deprivation Index (national ranking); **CD-RISC:** Connor-Davidson Resilience Scale (total score); **ISS***:* Injury Severity Score; **LEC-5:** Life Events Checklist for DSM-5 (total score); **NDVI:** Normalized Difference Vegetation Index. *Notes:* continuous measures were grand-mean centered in the full sample; the reference group for dichotomous variables is provided in brackets; **bolded** numbers correspond to uncorrected $p < .05$. + Survived correction for multiple comparisons.

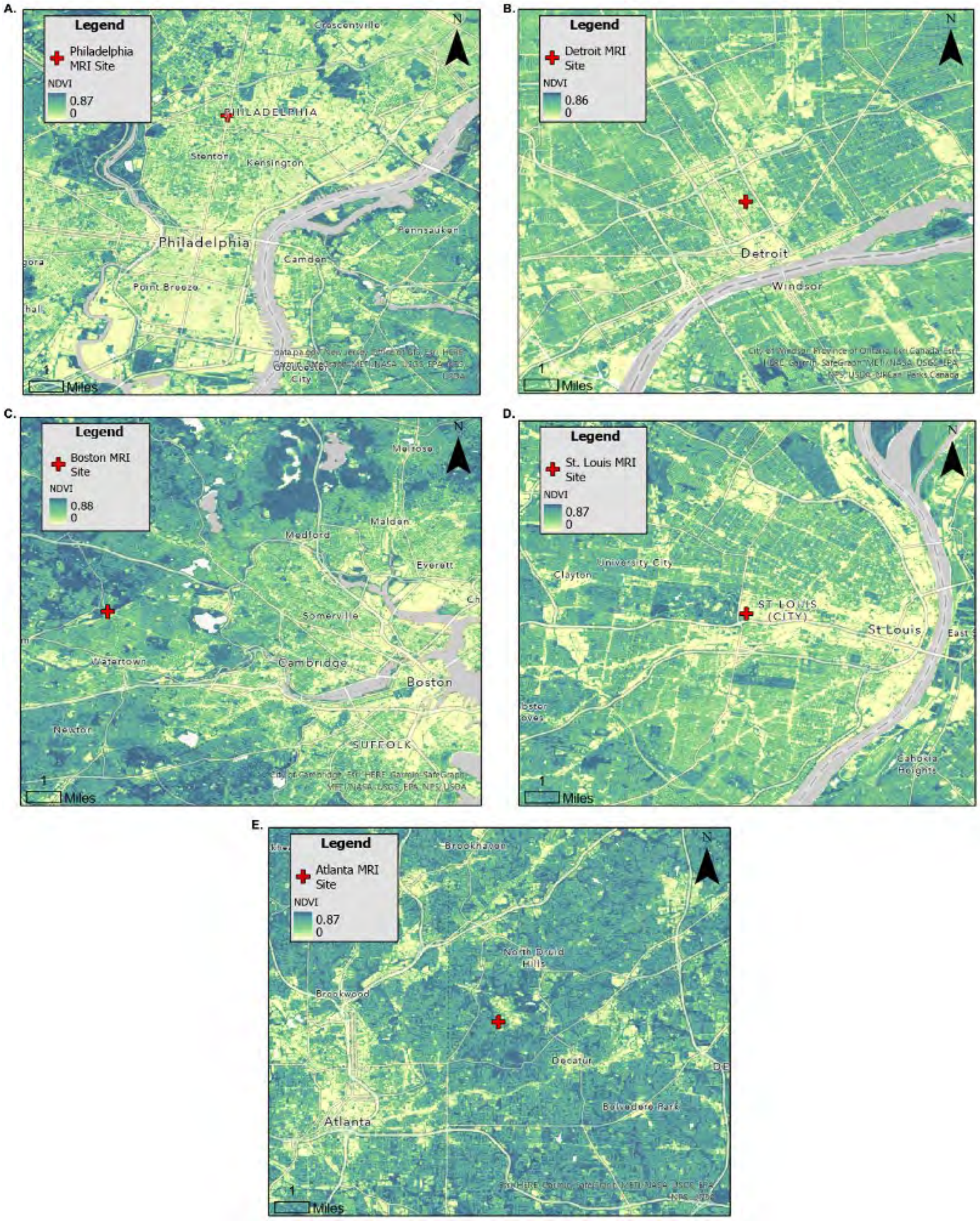
eTable13. General linear models for reward reactivity

Region	*Standardized Coefficient*	*t-statistic*	*Uncorrected p-value*
Amygdala			
Intercept	-	3.92	<.001
Sex at Birth [*male*]	-0.02	-0.38	0.705
CD-RISC	-0.02	-0.26	0.794
NDVI	**0.18**	**2.88**	**0.004**
ISS	-0.01	-0.24	0.808
Age	-0.11	-1.64	0.102
Income	0.03	0.39	0.701
ADI	0.07	1.09	0.279
Marital Status [*unmarried*]	0.07	0.95	0.343
Childhood maltreatment	-0.02	-0.27	0.788
LEC-5	-0.04	-0.73	0.467
NDVI x CDRISC	-0.07	-1.10	0.273
Nucleus Accumbens			
Intercept	-	8.46	<.001
Sex at Birth [*male*]	0.01	0.15	0.880
CD-RISC	0.12	1.84	0.067
NDVI	0.11	1.69	0.093
ISS	-0.06	-1.00	0.319
Age	-0.02	-0.30	0.768
Income	0.05	0.76	0.447
ADI	0.10	1.60	0.110
Marital Status [*unmarried*]	-0.02	-0.23	0.820
Childhood maltreatment	0.06	0.97	0.334
LEC-5	0.04	0.70	0.485
NDVI x CDRISC	0.03	0.50	0.618
Orbitofrontal Cortex			
Intercept	-	1.60	0.111
Sex at Birth [*male*]	-0.08	-1.41	0.16
CD-RISC	0.01	0.08	0.934
NDVI	0.05	0.77	0.444
ISS	-0.01	-0.10	0.922
Age	0.07	1.11	0.267
Income	0.08	1.16	0.249
ADI	0.06	0.94	0.349
Marital Status [*unmarried*]	0.05	0.76	0.449
Childhood maltreatment	0.10	1.49	0.137
LEC-5	-0.09	-1.51	0.133
NDVI x CDRISC	-0.02	-0.27	0.788

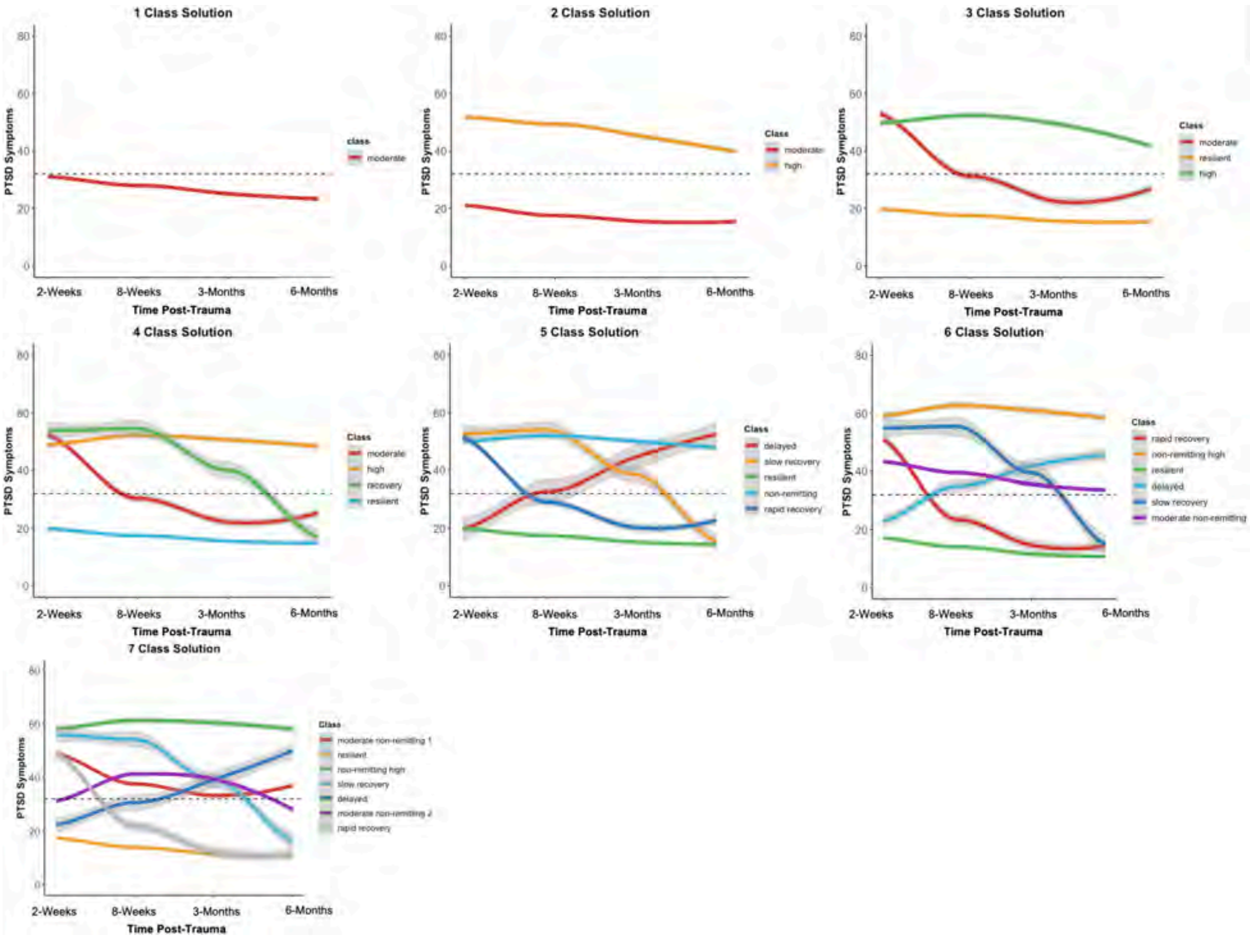
Abbreviations: **ADI:** Area Deprivation Index (national ranking); **CD-RISC:** Connor-Davidson Resilience Scale (total score); **ISS***:* Injury Severity Score; **LEC-5:** Life Events Checklist for DSM-5 (total score); **NDVI:** Normalized Difference Vegetation Index. *Notes:* continuous measures were grand-mean centered in the full sample; the reference group for dichotomous variables is provided in brackets; uncorrected *** *p* < *.05***.



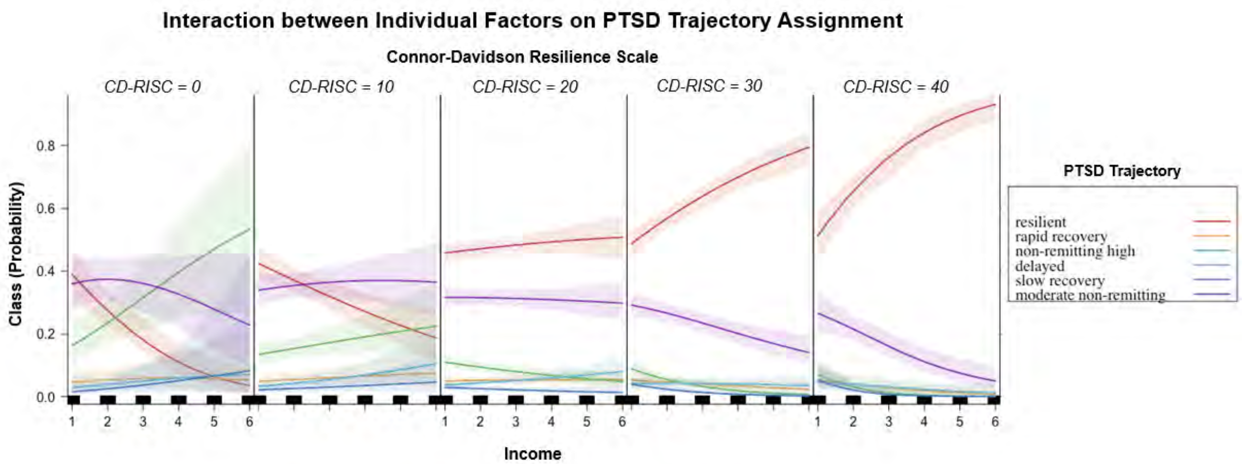
eFigure1. Flowchart of AURORA study participants who met inclusion criteria for the full trajectory analysis or the fMRI reward reactivity analyses.



eFigure2. Greenspace (between May 1st, 2017, through September 30th, 2017), as quantified by the Normalized Difference Vegetation Index (NDVI), surrounding each of the five study scan sites near **[A]** Philadelphia, Pennsylvania, **[B]** Detroit, Michigan, **[C]** Boston, Massachusetts, **[D]** St. Louis, Missouri, and **[E]** Atlanta, Georgia.



eFigure3. Results of the latent class mixed effect models with 1 to 7 classes. The 6-class solution fit well (see fit indices in Table 2 of main text), was parsimonious, and had strong theoretical justification.



eFigure4. There was a significant interaction between income and CD-RISC scores in predicting class, such that individuals reporting higher levels of perceived internal resources with higher income had an even greater likelihood of assignment in the resilient trajectory compared to the nonremitting high, nonremitting moderate, delayed, rapid recovery, and slow recovery classes.