

A. OVERALL COVER PAGE

Project Title: Personality-informed care model for 9/11-related comorbid conditions	
Grant Number: 5U01OH011321-05	Project/Grant Period: 09/01/2016 - 08/31/2021
Reporting Period: 09/01/2020 - 08/31/2021	Requested Budget Period: 09/01/2020 - 08/31/2021
Report Term Frequency: Final	Date Submitted: 01/06/2023
Program Director/Principal Investigator Information: ROMAN I KOTOV , PHD Phone Number: 6316327763 Email: roman.kotov@stonybrook.edu	Recipient Organization: STATE UNIVERSITY NEW YORK STONY BROOK STATE UNIVERSITY NEW YORK STONY BROOK The Office of Sponsored Programs STONY BROOK, NY 117943362 DUNS: 804878247 UEI: M746VC6XMNH9 EIN: 1146013200F7 RECIPIENT ID:
Change of Contact PD/PI: NA	
Administrative Official: MICHELE CANTON 100 Nicholls Road W-5510 Frank Melville Jr. Memorial Library Stony Brook, NY 11794 Phone number: 6316329029 Email: michele.canton@stonybrook.edu	Signing Official: MICHELE CANTON 100 Nicholls Road W-5510 Frank Melville Jr. Memorial Library Stony Brook, NY 11794 Phone number: 6316329029 Email: michele.canton@stonybrook.edu
Human Subjects: NA	Vertebrate Animals: NA
hESC: No	Inventions/Patents: No

B. OVERALL ACCOMPLISHMENTS

B.1 WHAT ARE THE MAJOR GOALS OF THE PROJECT?

The specific aims of the project have not been modified. The study involves recruitment of approximately 450 WTC responders, who will then be followed up one year and two years later, in order to:

1. Test if personality traits predict, controlling WTC diagnoses: (a) changes in WTC-related psychiatric and medical symptoms and (b) the link between them over 2 years.
2. Characterize mechanisms underpinning these effects, including elevated inflammation, altered cognitive processes, poor health behaviors, and interplay with stress, in real time and over the long-term.
3. Test if personality predicts functioning, doctor visits, and medication use over 2 years, controlling for symptoms.
4. Based on the model constructed in Aims 1-3, propose a system of interventions to address key vulnerabilities
5. Explore feasibility of this person-focused approach by testing one Aim 4 proposal in a proof-of-concept RCT; we hypothesize that personality-informed treatment (PT) will reduce target personality vulnerability and related mechanisms more than control treatment (CT).

Our original timeline called for protocol development, staffing and staff training, and material ordering to be completed in months 1-3, and recruitment of first wave to begin in month 4 and continue through the end of month 15. Wave 2 data collection is scheduled to take part over months 15-27, with the first 2 months of this period dedicated to Wave 1 data analysis to inform Wave 2 data collection launch. The study is currently on schedule and is meeting milestones specified in the original timeline.

B.1.a Have the major goals changed since the initial competing award or previous report?

Yes

Revised goals:

The specific aims of the project were to recruit large number of responders, who were then followed up annual for 3 years, in order to:

1. Test if personality traits predict, controlling WTC diagnoses:
(a) changes in WTC-related psychiatric and medical symptoms and (b) the link between them over time.
2. Characterize mechanisms underpinning these effects, including elevated inflammation, altered cognitive processes, poor health behaviors, and interplay with stress, in real time and over the long-term.
3. Test if personality predicts functioning, doctor visits, and medication use over 2 years, controlling for symptoms.
4. Based on the model constructed in Aims 1-3, propose a system of interventions to address key vulnerabilities.
5. Explore feasibility of this person-focused approach by describing one Aim 4 proposal and a control treatment (CT) to 30 participants each, and comparing treatment feasibility and treatment acceptability ratings.

B.2 WHAT WAS ACCOMPLISHED UNDER THESE GOALS?

File Uploaded : B2 Accomplishments.pdf

B.3 COMPETITIVE REVISIONS/ADMINISTRATIVE SUPPLEMENTS

For this reporting period, is there one or more Revision/Supplement associated with this award for which reporting is required?

No

B.4 WHAT OPPORTUNITIES FOR TRAINING AND PROFESSIONAL DEVELOPMENT HAS THE PROJECT PROVIDED?

NOTHING TO REPORT

B.5 HOW HAVE THE RESULTS BEEN DISSEMINATED TO COMMUNITIES OF INTEREST?

We published 16 papers and gave 12 presentations to scientific audiences.

B.6 WHAT DO YOU PLAN TO DO DURING THE NEXT REPORTING PERIOD TO ACCOMPLISH THE GOALS?

Not Applicable

TITLE PAGE

Project Title: Personality-informed care model for 9/11-related comorbid conditions	
Grant Number: 5U01OH011321-05	Project/Grant Period: 09/01/2016 - 08/31/2022
Reporting Period: 09/01/2016 - 08/31/2022	Date Submitted: 01/06/2023
Program Director/ Principal Investigator ROMAN I KOTOV , PHD Phone number: 631-638-1923 Email: roman.kotov@stonybrook.edu	Administrative Official Information STATE UNIVERSITY NEW YORK STONY BROOK STATE UNIVERSITY NEW YORK STONY BROOK The Office of Sponsored Programs STONY BROOK, NY 117943362 DUNS: 804878247 EIN: 1146013200F7
Change of Contact PD/PI: N/A	
Human Subjects: Yes HS Exempt: No Phase III Clinical Trial: No	Vertebrate Animals: No
hESC: No	Inventions/Patents: No

ABSTRACT

Fifteen years after 9/11, many World Trade Center (WTC) responders continue to suffer from signature WTC-related physical and mental disorders. Prevalent and persistent comorbidity between these disorders challenges traditional treatments. The present proposal aims to explicate vulnerability and resilience factors in WTC responders, and use this knowledge to develop a person-focused care model for comorbid medical and psychiatric conditions. The proposal focuses on personality, which in preliminary cross-sectional studies of WTC responder population was among the strongest predictors of physical and mental disorders, persistence of symptoms, social and occupational impairment, and treatment utilization, even when controlling for WTC-related diagnoses. This is in line with the literature confirming that personality is one of the most powerful predictors of vulnerability and resilience in response to disasters, leading to large differences in illness course and treatment response, which person-focused medicine can recognize and address. However, longitudinal investigation is necessary to establish that personality predicts outcomes and elucidate specific mechanisms by which it affects illness course. Furthermore, the feasibility of personality-informed care model that targets personality vulnerability in addition to physical and mental disorders remains to be evaluated. The current study will recruit and follow 400 WTC responders from Long Island site of the WTC Health Program as they present for annual monitoring. In the observational part of the study, participants will complete a state-of-the-art personality assessment during the baseline visit. At that and at two subsequent annual visits, they will complete, during 1 week, daily measures of symptoms, lung function, cognitive processes, stressors, and functional impairment, and we will also obtain their diagnostic and services information. These analyses will determine which personality vulnerabilities uniquely contribute to worse illness course, functioning and treatment utilization, and clarify the underpinning mechanisms. Furthermore, this information will allow a construction of a predictive model and will identify key vulnerabilities that can be targets of treatment. The treatment part of the study will test the feasibility of improving health outcomes by treating personality vulnerabilities using an approach informed by the constructed model. We will target the most significant of these vulnerabilities in a proof-of-concept randomized clinical trial (RCT), where 60 patients with comorbid disorders who have the vulnerability will be randomized to personality-informed treatment (PT) vs. control treatment (CT). We hypothesize that PT will be more effective in changing this vulnerability and related mechanisms than CT. Taken together, the proposed study will be the first to rigorously investigate personality assessment as a tool of personality-informed medicine to predict and treat mental and physical comorbidity in WTC responders. This will inform the healthcare provision for WTC responders and will also be relevant to other health care systems.

SECTION 1

Significant or Key Findings (identify by specific aim or in parentheses after related findings/statements for each specific aim)

Aim 1. We found that baseline personality traits predict subsequent trauma-related mental and physical health outcomes, including symptoms of depression, posttraumatic stress disorder, sleep disturbance, respiratory problems, GERD, and pain. We also found that personality traits predict symptom chronicity better than diagnoses of mental disorders can.

Aim 2. We identified the following mechanisms that can explain effects of personality on health: poor sleep, low activity, and daily stressors. We found evidence of a cognitive mechanisms as well, including memory biases (enhanced encoding and recall) towards negatively-valenced emotional information.

Aim 3. Personality predicted greater exposure to stressful events, worse everyday functioning, greater treatment costs, BMI, and lower daily activity across three years. As further evidence on mechanisms of these associations, we find that poor sleep and stress reactivity predicted worse psychosocial functioning.

Aim 4. Our review of the literature identified three validated personality-informed treatments: Radically-Open Dialectical Behavior Therapy (RO-DBT) for low openness and low extraversion, the Unified Protocol (UP) for high neuroticism, and the PErsonality coACH (PEACH) for intentional personality change in any domain selected by the patient.

Aim 5. We found that responders who meet eligibility for a personality-informed treatment almost universally are interested in changing some aspect of their personality and large majority are willing to use PEACH to achieve this goal.

Translation of Findings

Observational data collected in this study clearly indicates that personality-informed treatments are very likely to be efficacious for reducing burden of WTC-related disorders and are acceptable to WTC responders. This evidence is very encouraging but requires confirmation in a randomized clinical trial. Moreover, inclusion of basic personality traits into monitoring assessment would help to identify responders at risk of future disorders or poor treatment outcomes.

Research Outcomes/Impact

The study revealed that a number of personality traits (e.g., depressivity, low positive emotionality, self-discipline, and straightforwardness) are significant contributors to mental and physical disorders in WTC responders. Importantly, several efficacious treatments exist for elevations on these traits, and we found that the aforementioned interventions are very acceptable to WTC responders. The overall implication of our findings for management of responders' health is that provision of personality-informed treatments targeting elevated trait vulnerabilities is very likely to reduce the burden of WTC-related disorders. This conclusion requires confirmation in a randomized clinical trial within the responder population.

SECTION 2. SCIENTIFIC REPORT

Aim 1 (test if personality traits predict WTC-related psychiatric and medical symptoms).

Oltmanns, J. R., Schwartz, H. A., Ruggero, C., Son, Y., Miao, J., Waszczuk, M., ... & Kotov, R. (2021). Artificial intelligence language predictors of two-year trauma-related outcomes. *Journal of Psychiatric Research*, 143, 239-245.

Background: Recent research on artificial intelligence has demonstrated that natural language can be used to provide valid indicators of psychopathology. The present study examined artificial intelligence-based language predictors (ALPs) of seven trauma-related mental and physical health outcomes in responders to the World Trade Center disaster.

Methods: The responders (N = 174, Mage = 55.4 years) provided daily voicemail updates over 14 days. Algorithms developed using machine learning in large social media discovery samples were applied to the voicemail transcriptions to derive ALP scores for several risk factors (depressivity, anxiousness, anger proneness, stress, and personality). Responders also completed self-report assessments of these risk factors at baseline and trauma-related mental and physical health outcomes at two-year follow-up (including symptoms of depression, posttraumatic stress disorder, sleep disturbance, respiratory problems, and GERD). Results: Voicemail ALPs were significantly associated with a majority of the trauma-related outcomes at two-year follow-up, over and above corresponding baseline self-reports. ALPs showed significant convergence with corresponding self-report scales, but also considerable uniqueness from each other and from self-report scales. Limitations: The study has a relatively short follow-up period relative to trauma occurrence and a limited sample size. Conclusions: This study shows evidence that ALPs may provide a novel, objective, and clinically useful approach to forecasting, and may in the future help to identify individuals at risk for negative health outcomes.

Waszczuk, M. A., Hopwood, C. J., Luft, B. J., Morey, L. C., Perlman, G., Ruggero, C. J., ... & Kotov, R. (2022). The prognostic utility of personality traits versus past psychiatric diagnoses: Predicting future mental health and functioning. *Clinical Psychological Science*, 10(4), 734-751.

Past psychiatric diagnoses are central to patient case formulation and prognosis. Recently, alternative classification models such as the Hierarchical Taxonomy of Psychopathology (HiTOP) proposed to assess traits to predict clinically relevant outcomes. In the current study, we directly compared personality traits and past diagnoses as predictors of future mental health and functioning in three independent, prospective samples. One sample was responders to World Trade Center disaster. Regression analyses found that personality traits significantly predicted future first onsets of psychiatric disorders (change in $[\Delta] R^2 = .06-.15$), symptom chronicity ($\Delta R^2 = .03-.06$), and functioning ($\Delta R^2 = .02-.07$), beyond past and current psychiatric diagnoses. Conversely, past psychiatric diagnoses did not provide an incremental prediction of outcomes when personality traits and other concurrent predictors were already included in the model. Overall, personality traits predicted a variety of outcomes in diverse settings beyond diagnoses. Past diagnoses were generally not informative about future outcomes when personality was considered. Together, these findings support the added value of personality traits assessment in case formulation, consistent with the HiTOP model.

Rogers, A. H., Zvolensky, M. J., Vujanovic, A. A., Ruggero, C. J., Oltmanns, J., Waszczuk, M. A., ... & Kotov, R. (2022). Anxiety sensitivity and Pain Experience: a prospective investigation among World Trade Center Responders. *Journal of Behavioral Medicine*, 1-7.

Chronic pain is a significant public health problem and is exacerbated by stress. The World Trade Center (WTC) Disaster represents a unique stressor, and responders to the WTC disaster are at increased risk for pain and other health complaints. Therefore, there is a significant need to identify vulnerability factors for exacerbated pain experience among this high-risk population. Anxiety sensitivity (AS), defined as fear of anxiety-related sensations, is one such vulnerability factor associated with pain intensity and disability. Yet, no work has tested the predictive effects of AS on pain, limiting conclusions regarding the predictive utility and direction of associations. Therefore, the current study examined the prospective associations of AS, pain intensity, and pain interference among 452 (Mage = 55.22, SD = 8.73, 89.4% male) responders to the WTC disaster completing a 2-week daily diary study. Using multi-level modeling, AS total score was positively associated with both pain intensity and pain interference, and that AS cognitive concerns, but not social or physical concerns, were associated with increased pain. These results highlight the importance of AS as a predictor of pain complaints among WTC responders and provide initial empirical evidence to support AS as a clinical target for treating pain complaints among WTC responders.

Waszczuk, M. A., Li, K., Ruggero, C. J., Clouston, S. A. P., Luft, B. J. & Kotov, R. (2018). Maladaptive personality traits and 10 year course of psychiatric and medical symptoms and functional impairment following trauma. *Annals of Behavioral Medicine*, 52 (8), 697–712.

Background: Personality is a major predictor of many mental and physical disorders, but its contributions to illness course are understudied.

Purpose: The current study aimed to explore whether personality is associated with a course of psychiatric and medical illness over 10 years following trauma.

Methods: World Trade Center (WTC) responders (N = 532) completed the personality inventory for DSM-5, which measures both broad domains and narrow facets. Responders' mental and physical health was assessed in the decade following the WTC disaster during annual monitoring visits at a WTC Health Program clinic. Multilevel modeling was used in an exploratory manner to chart the course of health and functioning, and examine associations of maladaptive personality domains and facets with intercepts (initial illness) and slopes (course) of illness trajectories.

Results: Three maladaptive personality domains—negative affectivity, detachment and psychoticism—were uniquely associated with initial posttraumatic stress disorder (PTSD); detachment and psychoticism were also associated with initial functional impairment. Five facets—emotional lability, anhedonia, callousness, distractibility and perceptual dysregulation—were uniquely associated with initial mental and physical health and functional impairment. Anxiousness and depressivity facets were associated with worse initial levels of psychiatric outcomes only. With regard to illness trajectory, callousness and perceptual dysregulation were associated with the increase in PTSD symptoms. Anxiousness was associated with greater persistence of respiratory symptoms.

Conclusions: Several personality domains and facets were associated with initial levels and long-term course of illness and functional impairment in a traumatized population. Results inform the role of maladaptive personality in the development and maintenance of chronic mental-physical comorbidity. Personality might constitute a transdiagnostic prognostic and treatment target.

Aim 2 (Characterize mechanisms underpinning these effects)

Waszczuk, M. A., Ruggero, C. J., Li, K., Luft, B. J. & Kotov, R. (2019). The role of modifiable health-related behaviors in the association between PTSD and respiratory illness. *Behaviour, Research and Therapy*, 115, 64-72.

Background. Posttraumatic stress disorder (PTSD) increases risk of future respiratory illness. However, mechanisms that underpin the association between these common and debilitating conditions remain unknown. The aim of this study was to identify modifiable, health-related behaviors they may explain the link between PTSD and respiratory problems.

Methods. World Trade Center responders (N=452, 89% male, mean age=55 years) completed baseline PTSD and sleep questionnaires, followed by 2-weeks of daily diaries, actigraphy and ambulatory spirometry to monitor lower respiratory symptoms, pulmonary function, activity levels, stressors, and sleep. Lipid levels were obtained from electronic medical records.

Results. Cross-sectional mediation analyses revealed that the association between PTSD and self-reported respiratory symptoms was explained by poor sleep, low activity, and daily stressors. The association between PTSD symptoms and pulmonary function was explained by insomnia and low activity.

Conclusions. A range of health-related daily behaviors and experiences, especially sleep disturbances and inactivity, may explain excess respiratory illness morbidity in PTSD. The findings were generally consistent across daily self-report and spirometry measures of respiratory problems. Targeting these behaviors might enhance prevention of and intervention in respiratory problems in traumatized populations.

Dietch, J. R., Ruggero, C.J., Schuler, K.L., Taylor, D.J., Luft, B.J., & Kotov, R. (2019). Posttraumatic stress disorder symptoms and sleep in the daily lives of World Trade Center responders. *Journal of occupational health psychology*, 24, 689-702.

Sleep disturbances are common in Posttraumatic Stress Disorder (PTSD) and can have major impacts on workplace performance and functioning. Although effects between PTSD and sleep broadly have been documented, little work has tested their day-to-day, temporal relationship particularly in those exposed to occupational trauma. The present study examined daily, bidirectional associations between PTSD symptoms and self-reported sleep duration and quality in World Trade Center (WTC) responders oversampled for PTSD. A sample of WTC responders (N = 202; 19.3% with current

PTSD diagnosis) were recruited from the Long Island site of the WTC health program. Participants were administered the Structured Clinical Interview for DSM-IV Disorders and completed daily assessments of PTSD symptoms and sleep duration and quality for seven days. PTSD symptoms on a given day were prospectively associated with shorter sleep duration ($\beta = -.13$) and worse sleep quality ($\beta = -.18$) later that night. Reverse effects were also significant but smaller, with reduced sleep duration (not quality) predicting increased PTSD the next day ($\beta = -.04$). Effects of PTSD on sleep duration and quality were driven by numbing symptoms whereas effects of sleep duration on PTSD were largely on intrusion symptoms. PTSD symptoms and sleep have bi-directional associations that occur on a daily basis, representing potential targets to disrupt maintenance of each. Improving PTSD numbing symptoms may improve sleep, and increasing sleep duration may improve intrusion symptoms in individuals with exposure to work-related traumatic events. Specific targeting of symptoms may maximize benefits to improve work performance and functioning.

Slavish, D.C., Ruggero, C.J., Briggs, M., Messman, B.A., Contractor, A.A., Miao, J., Olthmanns, J.R., Waszczuk, M.A., Luft, B.J., & Kotov, R. (accepted). Longitudinal associations between PTSD and sleep disturbances among World Trade Center responders. *Sleep Medicine*. <https://doi.org/10.1016/j.sleep.2022.11.021>

Objective/Background: Post-traumatic stress disorder (PTSD) is characterized by substantial disruptions in sleep quality, continuity, and depth. Sleep problems also may exacerbate PTSD symptom severity. Understanding how PTSD and sleep may reinforce one another is critical for informing effective treatments. **Patients/Methods:** In a sample of 452 World Trade Center 9/11 responders (mean age = 55.22, 89.4% male, 66.1% current or former police), we examined concurrent and cross-lagged associations between PTSD symptom severity, insomnia symptoms, nightmares, and sleep quality at 3 time points ~1 year apart. Data were analyzed using random intercept cross-lagged panel models. **Results:** PTSD symptom severity and sleep variables were relatively stable across time (intraclass correlation coefficients: 0.63 to 0.84). Individuals with more insomnia symptoms, more nightmares, and poorer sleep quality had greater PTSD symptom severity, on average. Within-person results revealed that greater insomnia symptoms and nightmares at Time 1 were concurrently associated with greater PTSD symptoms at Time 1. Insomnia symptoms were also concurrently associated with PTSD symptoms at Times 2 and 3, respectively. Cross-lagged and autoregressive results revealed that PTSD symptoms and nightmares predicted nightmares at the next timepoint. **Conclusions:** Overall, results suggest PTSD and sleep problems may be linked at the same point in time but may not always influence each other longitudinally. Further, individuals who experience more sleep disturbances on average may suffer from more debilitating PTSD. Evidence-based treatments for PTSD may consider incorporating treatment of underlying sleep disturbances and nightmares.

Imbriano, G., Waszczuk, M., Rajaram, S., Ruggero, C., Miao, J., Clouston, S., ... Kotov, R., & Mohanty, A. (2022).

Association of attention and memory biases for negative stimuli with post-traumatic stress disorder symptoms. *Journal of Anxiety Disorders*, 85, 102509.

Cognitive models have highlighted the role of attentional and memory biases towards negatively-valenced emotional stimuli in the maintenance of post-traumatic stress disorder (PTSD). However, previous research has focused mainly on attentional biases towards distracting (task-irrelevant) negative stimuli. Furthermore, attentional and memory biases have been examined in isolation and the links between them remain underexplored. We manipulated attention during encoding of trauma-unrelated negative and neutral words and examined the differential relationship of their encoding and recall with PTSD symptoms. Responders to the World Trade Center disaster (N = 392) performed tasks in which they read negative and neutral words and reported the color of another set of such words. Subsequently, participants used word stems to aid retrieval of words shown earlier. PTSD symptoms were associated with slower response times for negative versus neutral words in the word-reading task ($r = 0.170$) but not color-naming task. Furthermore, greater PTSD symptom severity was associated with more accurate recall of negative versus neutral words, irrespective of whether words were encoded during word-reading or color-naming tasks ($F = 4.11$, $p = 0.044$, $\eta^2 = 0.018$). Our results show that PTSD symptoms in a trauma-exposed population are related to encoding of trauma-unrelated negative versus neutral stimuli only when attention was voluntarily directed towards the emotional aspects of the stimuli and to subsequent recall of negative stimuli, irrespective of attention during encoding.

Aim 3 (Test if personality predicts functioning, doctor visits, and medication use).

Oltmanns, J. R., Ruggero, C., Miao, J., Waszczuk, M., Yang, Y., Clouston, S., ... & Kotov, R. (accepted). The Role of Personality in the Mental and Physical Health of World Trade Center Responders: Self-versus Informant-Reports. *Clinical Psychological Science*. PMC9670015.

Personality is linked to important health outcomes, but most prior studies have relied on self-reports, making it possible that shared-method variance explains the associations. The present study examined self- versus informant-reports of personality and multi-method outcomes. World Trade Center (WTC) responders and informants, 283 pairs, completed five-factor model personality measures and multi-method assessments of stressful events, functioning, mental disorders, 9/11-related treatment costs, BMI, and daily activity across three years. Self-reports were uniquely related to stressful events and functioning. Both self-reports and informant-reports showed incremental validity over one another for mental disorder diagnoses and treatment costs. For objective outcomes daily activity and BMI, informant-reports showed incremental validity over self-reports, accounting for all self-report variance and more. The findings suggest that informant-reports of personality provide better validity for objective health outcomes, which has implications for understanding personality and its role in mental and physical health.

Messman, B. A., Slavish, D. C., Briggs M., Ruggero, C. J., Luft, B. J., & Kotov, R. (under review). Daily sleep-stress reactivity and functional impairment in World Trade Center responders. *Annals of Behavioral Medicine*.

Background. How much sleep is impacted by stress (“sleep reactivity to stress”), and how much stress is impacted by sleep (“stress reactivity to sleep”) are trait-like characteristics of individuals and predict depression, anxiety, and insomnia. However, pathways between reactivity and functional impairment (e.g., impairment in social relationships and interpersonal functioning) have not been explored, which may be a critical pathway in understanding the link between reactivity and the development of psychological disorders. **Purpose.** We examined associations between reactivity and changes in functional impairment among a cohort of 9/11 World Trade Center responders. **Methods.** Data from 452 responders (Mage = 55.22 years; 89.4% male) were collected between October 2014 and February 2016. Four baseline sleep and stress reactivity indices (i.e., sleep duration and efficiency reactivity to stress; stress reactivity to sleep duration and efficiency) were calculated from 14 days of sleep and stress data using random slopes from multilevel models. Functional impairment was assessed approximately one year and two years after baseline via semi-structured interviews. Latent change score analyses examined associations between baseline reactivity indices and changes in functional impairment. **Results.** Greater baseline sleep efficiency reactivity to stress was associated with decreases in functioning. Additionally, greater stress reactivity to sleep duration and efficiency was associated with lower functioning at timepoint one. **Conclusion.** Findings confirm sleep and stress reactivity as trait-like characteristics of individuals that may predict disruptions in psychosocial functioning. Identifying individuals with high reactivity who could benefit from preventative treatment may help promote better social integration and relationships.

Aim 4 (propose a system of interventions to address key vulnerabilities).

We reviewed the central role personality plays in treatment of psychopathology, described principles of personality-informed treatment, and identified empirically-supported recommendations for treatment of key trait vulnerabilities.

The five personality trait domains are associated with mental illness. The trait domain of neuroticism shows the strongest relationship with numerous mental disorders. These effect sizes are very large (typically, Cohen’s $d > 1.00$ and some up to $d = 2.25$). Moreover, neuroticism predicts onsets of depressive and anxiety disorders with accumulating evidence for prediction of eating, schizophrenia, and substance use disorders. Societal costs attributable to neuroticism exceed costs of all common mental disorders combined. Likewise, low conscientiousness and low agreeableness are strongly associated with mental disorders, especially ADHD, antisocial personality disorder, and substance use disorders. Low extraversion shows more specific associations, but some of the links are very strong, especially for social anxiety disorder and persistent depressive disorder.

In people with mental disorders, personality traits predict illness chronicity and treatment outcome. Neuroticism and low extraversion predict persistence of depression and anxiety symptoms over time. In a psychiatric sample with diverse disorders, both traits predicted worse long-term outcomes for illness chronicity and everyday functioning. Low conscientiousness, low agreeableness, and lower openness also predicted outcomes in that sample but with more

specific and smaller effects. In treatment settings, conscientiousness, agreeableness, openness, and low neuroticism were reported to predict better treatment response. The most consistent predictors of symptom improvement in treatment are neuroticism and extraversion.

Also, personality of the patient affects treatment delivery. Conscientiousness is associated with engagement in treatment, such as session attendance and medication adherence. Agreeableness facilitates treatment alliance, leading to better outcome. Neuroticism predicts worse medication adherence and session attendance. The trait domains are thought to affect homework compliance in psychotherapy.

Mental health treatments can incorporate personality traits in one of three ways. The first approach is to change a problematic trait to improve therapy outcomes. For example, neuroticism is implicated in chronicity of a broad array of disorders and worse response to standard treatments. Accordingly, treatment that specifically targets and reduces neuroticism may have a broad array of benefits for many forms of psychopathology. Indeed, therapies have been developed to broadly target neuroticism and lead to improvements in more specific forms of psychopathology. Second, treatment delivery can be adapted to work more effectively with personality of this patient. For example, therapy with patients who have low levels of conscientiousness may be tailored more towards work in-session as opposed to homework outside of session. Therapists working with patients who have high levels of agreeableness may benefit from being aware of the possibility for false enthusiasm or exaggerated motivation to please the therapist. Third, treatment can be selected among empirically-supported options based on personality of the patient. For example, patients with depressive disorder who are low in trust may be more likely to respond to antidepressant medication than cognitive behavioral therapy (CBT). As such evidence accumulate, they can be used to match treatments to patients.

Focus of this report is on the first method of personality-informed care—changing a problematic trait to improve outcomes—because it has been more studied than the two others. A historically common but erroneous assumption that personality is fixed. In fact, extensive evidence established that personality traits are malleable and that personality traits change over time. When naturally followed, traits show a range of rank-order stabilities, but all reflect substantial change in response to life experiences. Moreover, mean levels of traits show major changes over a person's life, typically toward greater maturity. Importantly, personality change can be dramatically accelerated via intervention. In a meta-analysis of 207 personality change experiments and pre-post test designs, interventions changed personality traits at $d = .37$, on average. Neuroticism showed the most change ($d = .57$), followed by extraversion on average. Not only is personality change possible, but people often actively seek to change their personality. A vast majority of people expressed a desire to change, especially become more conscientiousness and emotionally stable. In a large study ($N = 1178$) of personality change, 66% of participants sought to change traits related to either neuroticism or extraversion when given the methods to do it.

In fact, personality change can serve as a mechanism of therapeutic action. For example, evidence is emerging that effects of antidepressants on mental health are mediated by personality change, at least in part. However, the vast majority of psychotherapies are limited by focus on acute symptom change and disorders rather than dimensions. Many were designed to change problematic behaviors, emotions or cognitions rather than more basic traits, and likely do not take full advantage of personality change as a mechanism of action.

Some treatments have been developed specifically to target personality. Radically-Open Dialectical Behavior Therapy (RO-DBT) focuses on a spectrum of excessive self-control, called overcontrol. RO-DBT postulates that the core of certain difficult-to-treat mental illnesses, such as chronic depression, anorexia nervosa, and obsessive-compulsive personality disorder, is emotional loneliness secondary to maladaptive social signaling and low openness. Tactics are used to increase openness to experience and signal friendliness and connectedness. The Unified Protocol (UP) was developed to target the personality domain of neuroticism and consequently improve emotional disorders such as anxiety and depression. The UP targets neuroticism through five modules exploring thoughts, physical sensations, and behaviors that give rise to emotional dysregulation. It is effective at reducing neuroticism compared to both symptom-focused CBT ($d = -.32$) and wait-list control ($d = -.43$). A recent review found 15 studies with 1,244 participants found that the UP has a large effect-size on reductions in symptoms of emotional disorders. The PErsonality coACH (PEACH) is a smartphone application that is was designed to provide fully digital guidance for intentional personality change. The application uses four change mechanisms found from the clinical literature: raising awareness to discrepancies between actual and desired personality, using reflection and psychoeducation to target thoughts and feelings, using intention and behavioral activation to target behaviors, and using a team, diary, resources, and future thinking to activate strengths. PEACH showed personality changes in participants compared to controls at moderate effect sizes (e.g., $d = -.54$ for

neuroticism or $d = .58$ for extraversion) in a sample of $N = 1,523$. These changes persisted at three months after the intervention and were evident in informant-ratings of personality as well as in self-ratings. There is also a body of research demonstrating that attention to characteristic interpersonal problems in therapy facilitates improvement. Interpersonal problems are often conceptualized along the dimensions of agency and communion, which lie at 45 degree angles to the agreeableness and extraversion trait domains of the five-factor model. In cognitive behavior therapy for anxiety disorder, adding motivational interviewing techniques to address problems with nonassertiveness (deficits in agency) and exploitability (maladaptive communion) improved outcomes. In treating bulimia nervosa, patients who were overly communal benefitted more from CBT, while patients who were overly domineering benefitted more from interpersonal therapy.

The aforementioned interventions are well-suited for trait vulnerabilities involved in World Trade Center related physical and mental disorders. However, no randomized clinical trials yet tested such interventions in this population, which presents an important opportunity for science and public health.

Aim 5 (Explore feasibility of this person-focused approach).

We recruited a sample of 62 WTC responders who met the following criteria. Inclusion criteria were (1) WTC responders receiving care through SBU-WTC-HP and (2) has elevated (>35) PCL-17 scores. Exclusion criteria were (a) lack of English fluency or (b) major neurocognitive impairment (MOCA < 18) preventing engagement with the intervention. We surveyed participants about (a) interest in personality change and (b) acceptability of a PEACH treatment (described above). Of those, 85.5% indicated a desire to change aspects of their personality, broadly described. When asked about specific traits, all except one participant indicated a desire to change at least one trait: 93.5% endorsed wishing to change traits related to detachment (e.g., “be more active with others”), 87.1% to traits related to neuroticism (e.g., “worry less often”) and 67.7% for traits related to psychoticism (e.g., “not get lost in my thoughts so often”). Participants were later described the PEACH application, and $>90\%$ ($n = 56$ of 62) said they had a smartphone and would sign up for the self-guided personality-based intervention if it were offered.

Publications

Findings of the study were reported in 16 published/submitted peer-reviewed papers:

- Waszczuk, M. A., Li, K., Ruggero, C. J., Clouston, S. A. P., Luft, B. J. & Kotov, R. (2018). Maladaptive personality traits and 10 year course of psychiatric and medical symptoms and functional impairment following trauma. *Annals of Behavioral Medicine*, 52 (8), 697–712.
- Waszczuk, M. A., Ruggero, C. J., Li, K., Luft, B. J. & Kotov, R. (2019). The role of modifiable health-related behaviors in the association between PTSD and respiratory illness. *Behaviour, Research and Therapy*, 115, 64-72.
- Carlew, A. R., Schuler, K. K., Ruggero, C. J., Callahan, J., Luft, B., & Kotov, R. (2019). Factor structure of the CVLT-II Short Form: Evidence from a trauma-exposed sample. *Assessment*, 26, 976–983.
- Dietch, J. R., Ruggero, C.J., Schuler, K.L., Taylor, D.J., Luft, B.J., & Kotov, R. (2019). Posttraumatic stress disorder symptoms and sleep in the daily lives of World Trade Center responders. *Journal of occupational health psychology*, 24, 689-702.
- Dornbach-Bender, A., Ruggero, C. J., Schuler, K., Contractor, A. A., Waszczuk, M., Kleva, C. S., Bromet, E., Luft, B., & Kotov, R. (2020). Positive and negative affect in the daily life of world trade center responders with PTSD: An ecological momentary assessment study. *Psychological trauma: theory, research, practice, and policy*, 12, 75-83.
- Oltmanns, J. R., Schwartz, H. A., Ruggero, C., Son, Y., Miao, J., Waszczuk, M., ... & Kotov, R. (2021). Artificial intelligence language predictors of two-year trauma-related outcomes. *Journal of Psychiatric Research*, 143, 239-245.
- Ruggero, C. J., Schuler, K., Waszczuk, M. A., Callahan, J. L., Contractor, A. A., Bennett, C. B., ... & Kotov, R. (2021). Posttraumatic stress disorder in daily life among World Trade Center responders: Temporal symptom cascades. *Journal of Psychiatric Research*, 138, 240-245.
- Schuler, K., Ruggero, C. J., Mahaffey, B., Gonzalez, A., L. Callahan, J., Boals, A., ... & Kotov, R. (2021). When hindsight is not 20/20: ecological momentary assessment of PTSD symptoms versus retrospective report. *Assessment*, 28(1), 238-247.

- Imbriano, G., Waszczuk, M., Rajaram, S., Ruggero, C., Miao, J., Clouston, S., ... Kotov, R., & Mohanty, A. (2022). Association of attention and memory biases for negative stimuli with post-traumatic stress disorder symptoms. *Journal of Anxiety Disorders*, 85, 102509.
- Kauffman, B. Y., Kotov, R., Garey, L., Ruggero, C. J., Luft, B. J., & Zvolensky M. J. (2022). The association between Body Mass Index and anxious arousal, depressive, and insomnia symptoms among World Trade Center responders. *Health Behavior Research*, 5, 3.
- Rogers, A. H., Zvolensky, M. J., Vujanovic, A. A., Ruggero, C. J., Oltmanns, J., Waszczuk, M. A., ... & Kotov, R. (2022). Anxiety sensitivity and Pain Experience: a prospective investigation among World Trade Center Responders. *Journal of Behavioral Medicine*, 1-7.
- Oltmanns, J. R., Ruggero, C., Miao, J., Waszczuk, M., Yang, Y., Clouston, S., ... & Kotov, R. (accepted). The Role of Personality in the Mental and Physical Health of World Trade Center Responders: Self-versus Informant-Reports. *Clinical Psychological Science*. PMC9670015.
- Slavish, D.C., Ruggero, C.J., Briggs, M., Messman, B.A., Contractor, A.A., Miao, J., Oltmanns, J.R., Waszczuk, M.A., Luft, B.J., & Kotov, R. (accepted). Longitudinal associations between PTSD and sleep disturbances among World Trade Center responders. *Sleep Medicine*. <https://doi.org/10.1016/j.sleep.2022.11.021>
- Briggs M., Slavish, D. C., Messman, B. A., Ruggero, C. J., Luft, B. J., & Kotov, R. (under review). Bidirectional Associations between Daily Positive Affect and Sleep in World Trade Center Responders. *Sleep Health: Journal of the National Sleep Foundation*.
- Messman, B. A., Slavish, D. C., Briggs M., Ruggero, C. J., Luft, B. J., & Kotov, R. (under review). Daily sleep-stress reactivity and functional impairment in World Trade Center responders. *Annals of Behavioral Medicine*.
- Slavish, D. C., Ruggero, C. J., Schuler, K., Schwartz, J. E., Luft, B. J., & Kotov, R. (under review). Effects of daily posttraumatic stress disorder symptoms on heart rate variability. *Psychosomatic Medicine*.

We also made 12 presentations on results of the project:

- Kotov, R. & Waszczuk, M. A. (2016, November). From Daily Burden to Personality-Informed Care: Better Assessment Means Better Treatment. Oral presentation at the World Trade Center Research Principal Investigators Autumn-Winter Meeting. New York City, New York, USA.
- Waszczuk, M. A., Li, K., Ruggero, C. J., Clouston, S. A. P., Luft, B. J. & Kotov, R. (2017, March). Personality and 10 year course of psychiatric and medical symptoms and functional impairment following trauma. Poster presentation at the American Psychopathological Association. New York City, New York, USA.
- Schuler, K. L., Ruggero, C. J., & Kotov, R. (November, 2017). Temporal Relations among PTSD symptoms: A person-specific analysis of the symptoms in daily life. Poster presentation at the 33rd annual meeting of the International Society for Traumatic Stress Studies, Chicago, IL.
- Schuler, K. L., Dietch, J. R., Ruggero, C. J., Taylor, D. J., & Kotov, R. (May, 2017). Relationships between Posttraumatic Stress Disorder (PTSD) Symptoms and Sleep in Daily Life. Poster presented at the 29th annual convention of the Association for Psychological Science, Boston, MA
- Schuler, K. L. & Ruggero, C. J. (May, 2017). Multicollinearity in Hierarchical Linear Modeling: A Monte Carlo Simulation Study. Poster presented at the 29th annual convention of the Association for Psychological Science, Boston, MA.
- Kleva, C. S., Waszczuk, M. A., and Kotov, R. (2018, March). Associations between specific dimensions of personality and internalizing psychopathology. Poster presentation at the American Psychopathological Association. New York City, New York, USA.
- Ruggero, C.J., Dornbach-Bender, A., Schuler, K.L., Contractor, A., Callahan, J., & Kotov, R. (2018) Positive affect and PTSD: Evidence from ecological momentary assessment and structural studies reveal a unique disturbance profile. Symposium presentation at the annual meeting of the International Society for Traumatic Stress Studies (ISTSS), Washington, D.C.
- Crugnola, W., Ruggero, C. J., Kotov, R. & Waszczuk, M. A. (2019, March). Associations between pro-inflammatory marker IFN- γ , psychiatric symptoms, and sickness behaviors in 9/11 responders. Poster presentation at the American Psychopathological Association. New York City, New York, USA.
- Valentine, J., Ruggero, C. J., Kotov, R. & Waszczuk, M. A. (2019, March). Personality vulnerabilities moderate the effects of 9/11 trauma exposure on long term psychiatric outcomes in responders. Poster presentation at the American Psychopathological Association. New York City, New York, USA.

- Mazzone, M., Ruggero, C. J., Kotov, R. & Waszczuk, M. A. (2019, March). The burden of 9/11-related conditions and everyday social functioning of World Trade Center responders. Poster presentation at the American Psychopathological Association. New York City, New York, USA.
- Schuler, K.L & Ruggero, C.J. (2019). Psychometric analysis of the PTSD Checklist for DSM-5 (PCL-5) in World Trade Center responders: An application of IRT graded response model. Poster presented at the annual meeting of the Association for Psychological Science (APS), Washington, DC.
- Dornbach-Bender, A., Ruggero, C.J., Schuler, K.L., Kotov, R.. (2019). Daily Fluctuations of Negative Affect: A Better Predictor of PTSD Symptoms. Poster to be presented at the annual meeting of the American Psychological Association, Washington, DC.

Inclusions

We enrolled 452 participants in the study. Their demographic distribution closely mirrored that of the population served at the Long Island site of the WTC Health Program. Specifically, participants were 404 White, 32 Black, 4 Asian, and 12 Other. They were 89.4% male. At baseline their ages ranged 32 to 82 (mean 55 years).

C. OVERALL PRODUCTS

C.1 PUBLICATIONS

Are there publications or manuscripts accepted for publication in a journal or other publication (e.g., book, one-time publication, monograph) during the reporting period resulting directly from this award?

Yes

Publications Reported for this Reporting Period

Public Access Compliance	Citation
N/A: Not NIH Funded	Imbriano G, Waszczuk M, Rajaram S, Ruggero C, Miao J, Clouston S, Luft B, Kotov R, Mohanty A. Association of attention and memory biases for negative stimuli with post-traumatic stress disorder symptoms. Journal of anxiety disorders. 2022 January;85:102509. PubMed PMID: 34891061; PubMed Central PMCID: PMC8996384; DOI: 10.1016/j.janxdis.2021.102509.
N/A: Not NIH Funded	Oltmanns JR, Ruggero C, Miao J, Waszczuk M, Yang Y, Clouston SAP, Bromet EJ, Luft BJ, Kotov R. The Role of Personality in the Mental and Physical Health of World Trade Center Responders: Self- versus Informant-Reports. Clinical psychological science : a journal of the Association for Psychological Science. 2022;1. PubMed PMID: 36407479; PubMed Central PMCID: PMC9670015; DOI: 10.31234/osf.io/c4gbf.

Non-compliant Publications Previously Reported for this Project

Public Access Compliance	Citation
N/A: Not NIH Funded	Carlew AR, Schuler KL, Ruggero CJ, Callahan JL, Luft BJ, Kotov R. Factor Structure of the CVLT-II Short Form: Evidence From a Trauma-Exposed Sample. Assessment. 2019 September;26(6):976-983. PubMed PMID: 29577732; DOI: 10.1177/1073191118763726.

C.2 WEBSITE(S) OR OTHER INTERNET SITE(S)

NOTHING TO REPORT

C.3 TECHNOLOGIES OR TECHNIQUES

NOTHING TO REPORT

C.4 INVENTIONS, PATENT APPLICATIONS, AND/OR LICENSES

Have inventions, patent applications and/or licenses resulted from the award during the reporting period? No

If yes, has this information been previously provided to the PHS or to the official responsible for patent matters at the grantee organization? No

C.5 OTHER PRODUCTS AND RESOURCE SHARING

NOTHING TO REPORT

D. OVERALL PARTICIPANTS

D.1 WHAT INDIVIDUALS HAVE WORKED ON THE PROJECT?

Commons ID	S/K	Name	Degree(s)	Role	Cal	Aca	Sum	Foreign Org	Country	SS
RKOTOV	Y	Kotov, Roman I	PHD	PD/PI	2.5	0.0	0.0			NA
BJLUFT	N	LUFT, BENJAMIN J	MD,BA	Co-Investigator	0.6	0.0	0.0			NA
EBROMET	N	BROMET, EVELYN J	PHD,BA,MOTH	Co-Investigator	1.0	0.0	0.0			NA
DANKLEIN	N	Klein, Daniel N	PHD,BA	Significant Contributor	0.0	0.1	0.0			NA
ADAMGONZALEZ	N	Gonzalez, Adam	PHD	Co-Investigator	0.5	0.0	0.0			NA
SCLOUSTON	N	CLOUSTON, SEAN	MA,BA,PHD	Co-Investigator	1.2	0.0	0.0			NA
WASZCZUKM	N	Waszczuk, Monika Aldona	PHD	Co-Investigator	1.2	0.0	0.0			NA
	N	Miao, Jiaju	MA	Graduate Student (research assistant)	12.0	0.0	0.0			NA
	N	Mazzone, Glenn	BA	Technician	12.0	0.0	0.0			NA
	N	Walker, Corinne	BA	Technician	12.0	0.0	0.0			NA
	N	Yang, Xiaohua	PhD	Technician	1.2	0.0	0.0			NA

Glossary of acronyms:

S/K - Senior/Key

Cal - Person Months (Calendar)

Aca - Person Months (Academic)

Sum - Person Months (Summer)

Foreign Org - Foreign Organization Affiliation

SS - Supplement Support

RS - Reentry Supplement

DS - Diversity Supplement

OT - Other

NA - Not Applicable

D.2 PERSONNEL UPDATES

D.2.a Level of Effort

Not Applicable

D.2.b New Senior/Key Personnel

Not Applicable

D.2.c Changes in Other Support

Not Applicable

D.2.d New Other Significant Contributors

Not Applicable

D.2.e Multi-PI (MPI) Leadership Plan

Not Applicable

E. OVERALL IMPACT**E.1 WHAT IS THE IMPACT ON THE DEVELOPMENT OF HUMAN RESOURCES?**

Not Applicable

E.2 WHAT IS THE IMPACT ON PHYSICAL, INSTITUTIONAL, OR INFORMATION RESOURCES THAT FORM INFRASTRUCTURE?

NOTHING TO REPORT

E.3 WHAT IS THE IMPACT ON TECHNOLOGY TRANSFER?

Not Applicable

E.4 WHAT DOLLAR AMOUNT OF THE AWARD'S BUDGET IS BEING SPENT IN FOREIGN COUNTRY(IES)?

NOTHING TO REPORT

G. OVERALL SPECIAL REPORTING REQUIREMENTS SPECIAL REPORTING REQUIREMENTS

G.1 SPECIAL NOTICE OF AWARD TERMS AND FUNDING OPPORTUNITIES ANNOUNCEMENT REPORTING REQUIREMENTS

NOTHING TO REPORT

G.2 RESPONSIBLE CONDUCT OF RESEARCH

Not Applicable

G.3 MENTOR'S REPORT OR SPONSOR COMMENTS

Not Applicable

G.4 HUMAN SUBJECTS

G.4.a Does the project involve human subjects?

Not Applicable

G.4.b Inclusion Enrollment Data

File(s) uploaded:

CumulativeInclusionEnrollmentReport.pdf

G.4.c ClinicalTrials.gov

Does this project include one or more applicable clinical trials that must be registered in ClinicalTrials.gov under FDAAA?

G.5 HUMAN SUBJECTS EDUCATION REQUIREMENT

NOT APPLICABLE

G.6 HUMAN EMBRYONIC STEM CELLS (HESCS)

Does this project involve human embryonic stem cells (only hESC lines listed as approved in the NIH Registry may be used in NIH funded research)?

No

G.7 VERTEBRATE ANIMALS

Not Applicable

G.8 PROJECT/PERFORMANCE SITES

Not Applicable

G.9 FOREIGN COMPONENT No foreign component
G.10 ESTIMATED UNOBLIGATED BALANCE Not Applicable
G.11 PROGRAM INCOME Not Applicable
G.12 F&A COSTS Not Applicable

Cumulative Inclusion Enrollment Report

This report format should NOT be used for collecting data from study participants.

Study Title:

Comments:

Racial Categories	Ethnic Categories									Total
	Not Hispanic or Latino			Hispanic or Latino			Unknown/Not Reported Ethnicity			
	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	
American Indian/ Alaska Native										
Asian										
Native Hawaiian or Other Pacific Islander										
Black or African American										
White										
More Than One Race										
Unknown or Not Reported										
Total										

I. OVERALL OUTCOMES

I.1 What were the outcomes of the award?

The study followed physical and mental health trajectories of 452 responders for three years. It revealed that several personality traits (e.g., depressivity, low positive emotionality, self-discipline, and straightforwardness) are significant contributors to mental and physical disorders in WTC responders. Importantly, efficacious treatments exist for elevations on these traits. We observed that WTC responders with trait vulnerabilities find the aforementioned personality-informed interventions acceptable and nearly all of them are willing to participate in such a treatment. The implication of our findings is that provision of personality-informed treatments that target elevated trait vulnerabilities is very likely to reduce the burden of WTC-related disorders. It is also likely that this treatment strategy would be effective in other populations with chronic conditions, such as depression, asthma, chronic obstructive pulmonary disease, gastroesophageal reflux disease, chronic pain, and cancer. This conclusion requires confirmation in randomized clinical trials.