

## Curriculum Vitae

**Date Prepared:** September 27, 2016

**Name:** Scott P. Orr, Ph.D.

**Office Address:** PTSD Research Laboratory, Massachusetts General Hospital, Building 120 – 2<sup>nd</sup>  
Avenue, Charlestown, MA 02129

**Work Phone:** 617-643-7269

**Work E-Mail:** scott\_orr@hms.harvard.edu

**Work Fax:** 617-643-7340

### Education

09/69-06/71	A.A.S.	Gunsmithing	Trinidad State Junior College
09/71-06/74	B.A. <i>cum laude</i>	Psychology	University of Maine
09/75-10/77	M.A.	Psychology	New York University
09/77-06/82	Ph.D.	Psychology Advisor: John T. Lanzetta, Ph.D.	Dartmouth College

### Faculty Academic Appointments:

09/77-06/82	Graduate Research Assistant	Psychology	Dartmouth College
09/81-06/82	Senior Lecturer	Psychology	Dartmouth College
09/82-06/92	Instructor in Psychology	Nursing	Saint Joseph's College
09/83-03/85	Research Associate	Psychiatry	Dartmouth Medical School
03/85-06/87	Adjunct Research Associate	Psychiatry	Dartmouth Medical School
07/87-07/89	Lecturer	Psychiatry	Harvard Medical School

07/89-07/91	Instructor in Psychology	Psychiatry	Harvard Medical School
07/91-07/00	Assistant Professor of Psychology	Psychiatry	Harvard Medical School
07/00-	Associate Professor of Psychology	Psychiatry	Harvard Medical School

**Appointments at Hospitals/Affiliated Institutions:**

03/85-04/89	Research Psychologist	Research Service	Veterans Affairs Medical Center, Manchester, N.H.
10/98-10/04	Assistant in Psychology	Psychiatry Service	Massachusetts General Hospital, Boston, MA.
10/04-10/08	Associate Psychologist	Psychiatry Service	Massachusetts General Hospital
04/89-04/11	Medical Research Scientist	Research Service	Veterans Affairs Medical Center
10/08-10/12	Psychologist	Psychiatry Service	Massachusetts General Hospital
10/12-	Psychobiologist	Psychiatry Service	Massachusetts General Hospital

**Major Administrative Leadership Positions:  
Local**

08/00-04/11	Coordinator for Research and Development	Research Service	Veterans Affairs Medical Center
-------------	--	------------------	---------------------------------

**Other Professional Positions:**

1987-2012	Co-founder and Consultant, Center for Traumatic Stress and Psychophysiology Laboratory		Hadassah University Hospital, Hebrew University, Jerusalem, Israel
1992-2010	Co-founder and Consultant, Laboratory for Traumatic Stress Studies		Institute of Psychology, Russian Academy of Science, Moscow, Russia
1994-2002	Research Advisory Board		Centre for Behaviour Research and Therapy, Istanbul, Turkey

**Committee Service:  
Local**

1985-2000	Research & Development Committee		Manchester VAMC/Member
2000-2006	Human Subjects Subcommittee		Manchester VAMC/Ex Officio

2000-2011	Research & Development Committee	Manchester VAMC/Ex Officio
2006-2011	Institutional Review Board	Saint Anselm College/Member
2014-	Scientific Research Council, Home Base Program	MGH, Red Sox Foundation/ Member
<b>Regional</b>		
2009-2011	Research Planning Group	Department of Veterans Affairs –VISN 1/Member
<b>National</b>		
1989-1996	Executive Committee, Study #334	Veterans Affairs Cooperative Studies Program/Member
2006	Working Group to Inform Research: Mapping the Landscape of Deployment-related Adjustment and Mental Disorders	Veterans Affairs Office of Research and Development, National Institute of Mental Health, United States Army Medical Research and Materiel Command/Member
2009-2011	Field Research Advisory Committee	Department of Veterans Affairs Northeast Region/ Representative
2010-	Data Monitoring Committee, Study #566	Veterans Affairs Cooperative Studies Program/Member

**Professional Societies:**

1986-	International Society for Traumatic Stress Studies 1997 Program Committee
1987-	American Psychological Association
1989-	Association for Psychological Science 2012- Fellow
1990-	Society for Psychophysiological Research
1993-	Pavlovian Society

**Grant Review Activities**

2001-2004	Biobehavioral and Behavioral Processes 2 (BBBBP-2)/MESH	NIH Regular Member
-----------	--	-----------------------

2006-2009	Biomedical Laboratory and R&D Clinical Science, Career Development Review Committee	Department of Veterans Affairs Ad hoc Member
2007	United States Army Medical Research and Materiel Command, Congressionally Directed Medical Research Programs	Department of Defense Ad hoc member

### **Editorial Activities**

1992-2007	Consulting Editor	Journal of Psychopathology and Behavioral Assessment
2012-	Editorial Board	Biology of Mood and Anxiety Disorders
2013-	Editorial Advisory Board	Journal of Traumatic Stress

### **Ad Hoc Reviewer**

American Journal of Psychiatry

Archives of General Psychiatry

Behavior Research and Therapy

Biological Psychiatry

Biological Psychology

Clinical Psychology Review

Depression and Anxiety

International Journal of Human-Computer Studies

Journal of Abnormal Psychology

Journal of Affective Disorders

Journal of Consulting and Clinical Psychology

Journal of Personality and Behavioral Assessment

Journal of Traumatic Stress

Military Medicine

Psychiatry Research

Psychological Assessment

Psychological Bulletin

Psychophysiology

Science

Stress: The International Journal on the Biology of Stress

### Honors and Prizes

1977-1982	Dartmouth Fellowship	Dartmouth College	Science
1993	Certificate of Recognition of Demonstrated Leadership and Outstanding Achievements in the Profession of Psychology (Nova Psi)	Natl. Organization of VA Psychologists	Science
2007	Robert S. Laufer, Ph.D. Memorial Award for Outstanding Scientific Achievement in the Field of Traumatic Stress	Intl. Society for Traumatic Stress Studies	Science
2014	Mentorship Award for Exceptional Mentorship in the Research Arena	Department of Psychiatry at MGH	Teaching

### Funding Information

#### Past

1989-1992	Psychobiology of Post-Traumatic Stress Disorder Department of Veterans Affairs Merit Review PI (\$299,520) The goal of this study was to assess psychophysiologic basal activity and reactivity to stressors in veterans with PTSD in a non-laboratory setting.
1992-1995	Psychophysiologic Responses to Tones in Post-Traumatic Stress Disorder Department of Veterans Affairs Merit Review (No #) PI (\$294,300) The goal of this study was to assess startle using psychophysiologic measures of reactivity in veterans with PTSD.
1993-1996	Psychophysiologic Study of Child Abuse Imagery in Adults (PI: Pitman) R01 MH48559

Investigator

This project assessed psychophysiologic reactivity during recollections of sexual abuse experiences in adult women with PTSD related to childhood sexual abuse.

- 1994-1998 Incidence and Psychophysiology of Post-traumatic Stress Disorder in Breast Cancer Victims and Witnesses (PI: Pitman)  
Department of the Army (DAMD17-94-J-4365)  
Co-PI (\$724,375)  
This project assessed psychophysiologic reactivity during recollections of breast cancer related trauma in women with or without PTSD and in a witness of their trauma.
- 1995-1998 First- and Second-Order Conditioning in Combat-Related PTSD  
Department of Veterans Affairs Merit Review (No #)  
PI (\$388,400)  
This study used psychophysiologic measures to examine first- and second- order fear conditioning in combat veterans with PTSD.
- 1995-1999 Twin Study of Biologic Markers for PTSD (PI: Pitman)  
R01 MH54636  
Investigator  
This project focused on the assessment of a wide range of biological (psychophysiologic, electrophysiologic and brain imaging) measures in Vietnam veteran monozygotic twins discordant for combat exposure and PTSD.
- 1996-1999 Psychophysiology of PTSD in Female Nurse Vietnam Veterans (PI: Carson)  
Department of Veterans Affairs, HSRD NRI (NRI-95-049)  
Investigator  
The goal of this study was to compare psychophysiologic and electrophysiologic measures to emotional and non-emotional stimuli in female Vietnam nurse veterans with and without PTSD.
- 1999-2002 Beta-adrenergic Blockade of Increased Conditionability in PTSD  
Department of Veterans Affairs Merit Review (No #)  
PI (\$555,100)  
This study examined the effects of propranolol on the acquisition and extinction of conditioned fear responses in Vietnam veterans with PTSD.
- 2000-2006 Prospective Psychophysiological Study of Risk for PTSD  
R01 MH60315-01A1  
PI (\$1,379,425)  
This study prospectively assessed a set of cognitive, personality, psychophysiologic and neuroendocrine measures in firefighter and police trainees to determine which measures (or combination) could subsequently predict the development of PTSD upon exposure to a traumatic event.

- 2002-2007 Twin Study of Biologic Markers for PTSD (PI: Pitman)  
2R01 MH54636  
Investigator  
This project is a Competing Continuation of R01 MH54636 focused on the assessment of a wide range of biological (psychophysiologic, electrophysiologic and brain imaging) measures in Vietnam veteran monozygotic twins who are discordant for combat exposure and PTSD.
- 2003-2006 Predicting Chronic PTSD in Individuals Exposed to Trauma  
Department of Veterans Affairs Merit Review (No #)  
PI (\$762,300)  
This study examined whether psychophysiologic reactivity during recollection of a recent traumatic event could be used to predict the development of chronic PTSD.
- 2004-2007 Prefrontal Mechanisms in Retention of Fear (PI: Rauch)  
R21 MH072156-01  
Investigator  
The goal was to establish links between knowledge of extinction mechanisms in animals and those in humans, with particular relevance to PTSD. Pharmacological inactivation, neurophysiological recording and microstimulation in rats during conditioning/extinction protocols and fMRI and skin conductance recording during fear conditioning in humans were employed.
- 2004-2007 Context Effects in De Novo Fear Conditioning in Humans (PI: Otto)  
R21 MH072165-01  
Investigator  
This study was designed to link animal learning and clinical investigations by examining fear acquisition, extinction and context effects in a de novo fear conditioning paradigm in humans.
- 2004-2008 Post-trauma Prophylaxis of Post-traumatic Stress Disorder with Propranolol (PI: Pitman)  
R01 MH068603  
Investigator  
This project examined whether propranolol administered soon after a traumatic event (in the Emergency Room) could block memory consolidation and thereby reduce the severity and/or development of PTSD symptoms.
- 2006-2010 EEG Asymmetry and Autonomic Response to Threat in PTSD (PI: Metzger)  
Department of Veterans Affairs Merit Review (No #)  
Co-PI (\$882,900)  
The goal of this study was to examine whether asymmetry of EEG responses to emotional stimuli and threat differed between individuals with and without PTSD.
- 2007-2010 A psychophysiologic study of weakening traumatic combat memories with post-reactivation propranolol (Pitman: PI)  
U.S. Army Peer-Reviewed Medical Research Program (PRMRP), PR064519  
Investigator  
This study examined whether a single administration of propranolol following activation

of a PTSD-related traumatic memory could block re-consolidation of the memory.

- 2008-2010 PTSD Symptom Reduction by Propranolol Given After Trauma Memory Activation  
Department of Veterans Affairs Merit Review  
PI (\$783,200)  
This study examined whether multiple sessions of administering propranolol immediately following activation of a PTSD-related traumatic memory could block re-consolidation of the memory and thereby reduce PTSD symptom severity.
- 2008-2012 Developing Memory Reconsolidation Blockers as Novel PTSD Treatments (PI Pitman)  
US Army Medical Research Acquisition Act (W81XWH-08-2-0126)  
Investigator  
The major goal of this project was to test candidate drugs as memory reconsolidation blockers for a novel treatment approach to PTSD.
- 2009-2013 Twin Study of Biologic Markers for PTSD (PI: Shin)  
2R01 MH54636  
Investigator  
The major goal of this project was to utilize identical twins discordant for combat exposure in Vietnam to test for the familial vs. acquired origin of two PTSD markers: conditionability and amygdala fMRI response to masked faces.
- 2009-2013 Model of hippocampal-amygdala interaction: Implications for PTSD (PI: Myers)  
National Institute Alcohol Abuse and Addiction  
Investigator  
This project is developing a model to test the hypothesis that hippocampal system dysfunction is sufficient to generate the types of learning impairments observed in individuals with PTSD, such as resistance to extinction when a conditioned stimulus is no longer paired with the unconditioned stimulus.
- 2011-2013 Event-related P2 Slope as a Predictor of Responses to SSRIs in a Veteran Population  
CIMIT: Center for Integration of Medicine and Innovative Technology.  
PI (\$75,000)  
This study is assessing the ability of event-related P2 slope to predict response to SSRI treatment. Auditory dependence of the P2 event-related potential response to tones of varying intensities is thought to be strongly influenced by brain serotonin level.
- 2011-2014 Psychophysiology of Delayed Extinction and Reconsolidation in Humans  
(1 year NCE)  
US Army Medical Research Acquisition Act (W81XWH-11-2-0092)  
PI (\$1,012,641)  
The major goal of this project is to create an experimental assay in the form of an optimized Pavlovian differential fear conditioning paradigm using virtual reality, within which the relative strengths of various novel behavioral and pharmacological, reconsolidation-based interventions can be compared.



## **Current**

- 2016-2018      Mechanistic Studies on video guided acupuncture imagery treatment of pain (PI: Kong)  
National Center for Complementary and Integrative Health (R61 AT009310)  
Consultant  
The aim of this study is to use fMRI to investigate the underlying mechanisms of video-guided acupuncture imagery treatment, verum acupuncture, and sham acupuncture. The findings will enhance our understanding of the brain mechanisms of mind-body interaction, imagery treatment, acupuncture, and pain management.
- 2012-2017      Neural Mechanisms of Fear Extinction Across Anxiety Disorders (PI: Milad)  
National Institutes of Health (1R01MH097964-01A1)  
Consultant  
The major goal of this project is to compare and contrast psychophysiological and neuroimaging data during extinction and its subsequent recall across the different anxiety disorders.
- 2014-2016      Augmentation of Exposure Therapy for Social Anxiety Disorder Using Post-exposure Naps (PI: Pace-Schott)  
National Institutes of Health (1R21MH101567-01A1)  
Co-Investigator  
The goal of this project is to identify the effects of post-treatment naps in comparison to post-treatment wakefulness on the consolidation of therapeutically induced extinction of social fear in individuals with Social Anxiety Disorder.
- 2014-2017      Exploring the Boundaries of Post-Retrieval Extinction in Anxious Individuals (PI: Kredlow)  
National Institutes of Health (1F31MH103969-01)  
Consultant  
This study examines the efficacy and boundaries of a novel intervention strategy, called post-retrieval extinction, to diminish fear memories and reduce the return of fear in individuals with anxiety.
- 2015-2016      Pre-treatment Physiological Reactivity and Treatment Outcomes Among Veterans with PTSD (PI: Chapman)  
Department of Veterans Affairs (RX14-009)  
Co-Investigator  
The goal of this project is to determine whether Veterans who are psychophysiological non-reactive to trauma-related imagery benefit from prolonged exposure therapy to the same extent as Veterans who are reactive.

## **Report of Local Teaching and Training**

### **Teaching of students in courses:**

- |           |   |   |
|-----------|---|---|
| 1982-1992 | Introductory Psychology<br>Undergraduates, Nursing Students | Saint Joseph's College, North Windham, ME<br>3, 1-hr (or 1, 3-hr) sessions per week, per sem. |
| 1982-1992 | Developmental Psychology<br>Nursing Students                | Saint Joseph's College, North Windham, ME<br>3, 1-hr (or 1, 3-hr) sessions per week, per sem. |

### **Laboratory and Other Research Supervisory and Training Responsibilities:**

- |           |  |                                     |
|-----------|--|-------------------------------------|
| 1985-2000 | Supervision of doctoral students/<br>Manchester VAMC             | Weekly mentorship for 2-4 years     |
| 1992-1998 | Supervision of post-doctoral research<br>fellow/ Manchester VAMC | Daily/weekly mentorship for 6 years |

### **Formally Supervised Trainees and Faculty:**

- |           |   |  |
|-----------|---|--|
| 1985-1987 | Bruce Altman, Psy.D./ Clinical Psychologist<br>Supervised doctoral research   |  |
| 1987-1991 | Margaret Carson, Ph.D./ Professor of Nursing, Saint Anselm College, NH<br>Supervised doctoral research, received VA HSR&D grant for Nursing Research,<br>Published 2 peer-reviewed articles as first author.  |  |
| 1988-1992 | Tamara Gurvits, M.D./ Psychiatrist, Manchester VAMC (retired)<br>Mentor VA Career Development Award, published 3 peer-reviewed articles as first<br>author.   |  |
| 1992-1998 | Linda Metzger, Ph.D./ Research Psychologist, Manchester VAMC (deceased)<br>Supervised postdoctoral fellowship; published 8 peer-reviewed articles as first author;<br>received NIMH F32, R03 and VA Merit Review grants.  |  |
| 1995-1999 | Tuvia Peri, Ph.D./ Clinical Psychologist, Co-Director of psychology clinic, Bar-Ihlan<br>University, Israel<br>Co-supervised doctoral research, published 2 peer-reviewed articles as first author.   |  |
| 1996-2000 | Stephanie Williston, Ph.D./ Clinical Psychologist, Pastoral Counseling Services,<br>Manchester, NH.<br>Supervised doctoral research.  |  |
| 2002-2004 | Carl M. Marci, M.D./ Assistant Clinical Professor of Psychiatry, Harvard Medical School;<br>Director, Social Neuroscience Psychotherapy Research program, Massachusetts<br>General Hospital.<br>Supervised postdoctoral research fellowship, published 2 peer-reviewed articles as first<br>author.           |  |
| 2003-2006 | Devon Hinton, M.D./ Associate Clinical Professor of Psychiatry, Harvard Medical School;<br>Psychiatrist, The Center for Anxiety and Traumatic Stress Disorders, Massachusetts<br>General Hospital.<br>Mentor on NIH K23 Award, published 3 peer-reviewed articles as first author;<br>received NIH R01 grant. |  |

- 2004-2006 Uhlrike Buhlmann, Ph.D./ Professor of Clinical Psychology and Psychotherapy, University of Munster, Munster Germany  
Co-supervised postdoctoral research fellowship, published 1 peer-reviewed article as first author.
- 2006-2009 Kristalyn Salters-Pedneault, Ph.D./ Assistant Professor of Psychology, Eastern Connecticut State University, Willimantic, CT  
Co-Mentor for VA Career Development Award (CDA-2), published 1 peer-reviewed article as first author.
- 2008-2013 Suzanne Pineles, Ph.D./ Assistant Professor of Psychiatry, Boston University Medical Center, Boston, MA  
Co-Mentor for VA Career Development Award (CDA-2), published 4 peer-reviewed articles as first author.
- 2008-2013 Sabra Inslicht, Ph.D./ Assistant Adjunct Professor, University of California, San Francisco, CA  
Consultant for VA Career Development Award (CDA-2), published 1 peer-reviewed article as first author.
- 2010-2015 Peter Tuerk, Ph.D./ Assistant Professor, Medical University of South Carolina, Charleston, SC  
Supervised psychophysiological methods for VA Career Development Award-2.
- 2014- Maria Kredlow, M.A./Doctoral Candidate, Boston University, Boston, MA  
Consultant for National Research Service Award (F31); Dissertation Committee Member.
- 2015- Dawn Ionescu, M.D./Instructor, Harvard Medical School, Boston, MA  
Co-Mentor on NIH K23 Award.

**Informally Supervised Senior Investigators:**

- 2003-2007 Michael Otto, Ph.D./ Associate Professor of Psychology, Harvard Medical School; Professor of Psychology, Boston University and Director of the Translational Research Program at the Center for Anxiety and Related Disorders, Boston University.  
Supervised psychophysiological research, published 1 peer-reviewed psychophysiological article as first author.
- 2004-2006 Sabine Wilhelm, Ph.D./ Professor of Psychology in the Department of Psychiatry, Harvard Medical School; Director, Cognitive Behavioral Therapy Program; Director, OCD and Related Disorders Program, MGH.  
Supervised psychophysiological research, published 1 peer-reviewed article as second author.
- 2011- Naomi Simon, M.D./ Associate Professor of Psychiatry, Harvard Medical School; Director, Center for Anxiety and Traumatic Stress Disorders, Massachusetts

General Hospital; Chief Medical Officer, Red Sox Foundation and MGH Home Base Program

Supervised psychophysiological research, published 1 peer-reviewed psychophysiological article as first author.

2011- Daniel A. Geller, M.D./ Associate Professor of Psychiatry, Harvard Medical School; Director, Pediatric OCD and Tic Disorder Program, Massachusetts General Hospital  
Supervised psychophysiological research.

#### **Local Invited Presentations:**

1997 Blood, sweat, and fears: the psychophysiology of PTSD / Colloquium  
Department of Psychology, Harvard University

#### **Report of Regional, National and International Invited Teaching and Presentations**

##### **Regional**

1991 Imagery and startle paradigms for the investigation of PTSD/ Colloquium  
Dartmouth Medical School, Hanover, NH

##### **National**

1987 Physiology of PTSD imagery in Vietnam combat veterans/ Invited Address  
Center for Stress Recovery, Cleveland, OH

1988 Assessment of emotion during imagery in Vietnam combat veterans/ Invited Talk  
Conference on Emotion: Image and action, University of Florida, Gainesville, FLA

1988 Facial expressions of emotion: conditioned excitation and inhibition/ Invited Talk  
Conference on Emotion: Image and action, University of Florida, Gainesville, FLA

1991 The acoustic startle response in PTSD and its habituation/ Invited Talk  
National Center for Post-Traumatic Stress Disorder, Boston, MA

1995 Overview of the Psychophysiology of PTSD/ Colloquium  
VA Medical Center, Cleveland, OH

1996 Psychophysiological reactivity to trauma-related imagery in PTSD: Diagnostic and  
theoretical implications of recent findings/ Invited Talk  
New York Academy of Sciences, New York, NY

1998 Psychophysiological evidence for heightened emotional reactivity to trauma-related cues  
in PTSD: what do the findings tell us?/ Invited Talk  
National Institute of Mental Health, Rockville, MD

2006 Mapping the Landscape of Deployment Related Adjustment and Mental Disorders:  
Diagnostic accuracy and PTSD/ Plenary Talk

Veterans Affairs Office of Research and Development, National Institute of Mental Health, and United States Army Medical Research and Materiel Command, Rockville, MD.

- 2008 Psychophysiological and electrophysiological markers of PTSD: Acquired or Preexisting?/  
Plenary Talk  
American College of Neuropsychopharmacology National Meeting, Scottsdale, AZ
- 2010 Psychophysiological predictors of risk for PTSD/ Invited Talk  
National Institute of Mental Health and U.S. Army, Rockville, MD
- 2011 ACNP Biomarkers Study Group/ Plenary Talk  
American College of Neuropsychopharmacology National Meeting, Waikoloa, Hawaii
- 2013 Psychophysiological markers for PTSD/ Plenary Talk  
Society of Biological Research National Meeting, San Francisco, AZ

### **International**

- 1992 Overview of imagery and startle research in post-traumatic stress disorder/ Invited  
Address  
Institute of Psychology, Russian Academy of Science, Moscow, Russia
- 1996 Psychophysiological assessment of PTSD in Chernobyl clean-up workers/ Plenary Talk  
Second World Conference of the International Society for Traumatic Stress Studies,  
Jerusalem, IL
- 2002 Physiologic responses to tones in twins discordant for combat exposure/ Plenary Talk  
International Society for Traumatic Stress Studies Annual Meeting, Baltimore, MD
- 2004 Psychophysiology 101: introduction to measures and methods/ Pre-meeting Training  
Institute, Organizer and Plenary Talk  
International Society for Traumatic Stress Studies Annual Meeting, New Orleans, LA

### **Report of Scholarship**

#### **Peer-Reviewed Publications in print or other media**

Research investigations

1. **Orr SP**, Lanzetta JT. Facial expressions of emotion as conditioned stimuli for human autonomic responses. *J Pers Soc Psychol* 1980;38:278-282.
2. Lanzetta JT, **Orr SP**. The influence of facial expressions on the classical conditioning of fear. *J Pers Soc Psychol* 1980;39:1081-1087.
3. Lanzetta JT, **Orr SP**. Stimulus properties of facial expressions and their influence on the classical conditioning of fear. *Journal of Motivation and Emotion* 1981;5:225-234.

4. **Orr SP**, Lanzetta JT. Extinction of an emotional response in the presence of facial expressions of emotion. *Journal of Motivation and Emotion* 1984;8:55-66.
5. Tassinary LG, **Orr SP**, Wolford G, Napps ES, Lanzetta JT. The role of awareness in affective information processing: An exploration of the Zajonc hypothesis. *Bulletin of the Psychonomic Society* 1984;22:489-492.
6. Lanzetta JT, **Orr SP**. Excitatory strength of expressive faces: effects of fear and happy expressions and context on a conditioned fear response. *J Pers Soc Psychol* 1986;50:190-194.
7. Pitman RK, **Orr SP**. Test of the conditioning model of neurosis: Differential aversive conditioning of angry and neutral facial expressions. *J Abnorm Psychol* 1986;95:208-213.
8. Pitman RK, Kolb B, **Orr SP**, Singh MM. Ethological study of facial behavior in nonparanoid and paranoid schizophrenics. *Am J Psychiat* 1987;144:99-102.
9. **Orr SP**, Pitman RK. Electrodermal psychophysiology of anxiety disorder: Orienting response habituation and spontaneous fluctuation. *Bio Psychiat* 1987;22:653-656.
10. Pitman RK, Kolb B, **Orr SP**, de Jong J, Yadati S, Singh MM. On the utility of ethological data in psychiatric research: The example of facial behavior in schizophrenia. *Ethol Sociobiol* 1987;8:111S-1116S.
11. Pitman RK, **Orr SP**, Fogue DF, de Jong JB, Claiborn JM. Psychophysiology of PTSD imagery in Vietnam combat veterans. *Arch Gen Psychiat* 1987;44:970-975.
12. van der Kolk BA, Greenberg MS, **Orr SP**, Pitman RK. Endogenous opioids, stress induced analgesia, and posttraumatic stress disorder. *Psychopharmacol Bull* 1989;25:417-421.
13. Pitman RK, **Orr SP**, Steketee GS. Psychophysiological investigations of post-traumatic stress disorder imagery. *Psychopharmacol Bull* 1989;25:426-431.
14. Pitman RK, **Orr SP**. Twenty-four hour urinary cortisol and catecholamine excretion in combat-related post-traumatic stress disorder. *Bio Psychiat* 1990;27:245-247.
15. Pitman RK, **Orr SP**, Fogue DF, Altman B, deJong JB, Herz LR. Psychophysiological responses to combat imagery of Vietnam veterans with post-traumatic stress disorder vs. other anxiety disorders. *J Abnorm Psychol* 1990;99:49-54.
16. **Orr SP**, Claiborn JM, Altman B, de Jong JB, Fogue DF, Herz LR, Pitman RK. Psychometric profile of PTSD, anxious, and healthy Vietnam veterans: Correlations with psychophysiological responses. *J Consult Clin Psych* 1990;58:329-335.
17. Pitman RK, van der Kolk BA, **Orr SP**, Greenberg MS. Naloxone-reversible analgesic response to combat-related stimuli in post-traumatic stress disorder: A pilot study. *Arch Gen Psychiat* 1990;47:541-544.

18. Pitman RK, **Orr SP**, Lowenhagen MJ, Macklin ML, Altman A. Pre-Vietnam contents of PTSD veterans' service medical and personnel records. *Compr Psychiat* 1991;32:1-7.
19. Shalev AY, **Orr SP**, Pitman RK. Psychophysiologic response during script-driven imagery as an outcome measure in post-traumatic stress disorder. *J Clin Psychiat* 1992;53:324-326.
20. Shalev AY, **Orr SP**, Peri P, Schreiber S, Pitman RK. Physiologic responses to loud tones in Israeli PTSD patients. *Arch Gen Psychiat* 1992;49:870-975.
21. **Orr SP**, Pitman RK, Lasko NB, Herz LR. PTSD imagery in World War II and Korean combat veterans. *J Abnorm Psychol* 1993;102:152-159.
22. **Orr SP**, Pitman RK. Psychophysiologic assessment of veterans attempting to simulate PTSD during personal combat imagery. *Bio Psychiat* 1993;33:127-129.
23. Kuhne AA, **Orr SP**, Baraga E. Psychometric evaluation of post-traumatic stress disorder: the Multidimensional Personality Questionnaire as an adjunct to the MMPI. *J Clin Psychol* 1993;49:218-225.
24. Shalev AY, **Orr SP**, Pitman RK. Psychophysiologic assessment of traumatic imagery in Israeli civilian PTSD patients. *Am J Psychiat* 1993;150:620-624.
25. Gurvits TV, Lasko NB, Schachter SC, Kuhne AA, **Orr SP**, Pitman RK. Neurological status of Vietnam veterans with chronic PTSD. *J Neuropsych Clin N* 1993;5:183-188.
26. Pitman RK, **Orr SP**, Lasko NB. Effects of intranasal vasopressin and oxytocin on physiologic responding during personal combat imagery in Vietnam veterans with PTSD. *Psychiat Res* 1993;48:107-117.
27. Lasko NB, Gurvits TV, Kuhne AA, **Orr SP**, Pitman RK. Aggression and its correlates in Vietnam veterans with and without chronic post-traumatic stress disorder. *Compr Psychiat* 1994;35:1-10.
28. Kohn Y, Newman ME, Lerer B, **Orr SP**, Pitman RK. Absence of reduced platelet adenylate cyclase activity in Vietnam veterans with PTSD. *Bio Psychiat* 1995;37:205-208.
29. **Orr SP**, Lasko NB, Shalev AY, Pitman RK. Physiologic responses to loud tones in Vietnam veterans with post-traumatic stress disorder. *J Abnorm Psychol* 1995;104:75-82.
30. Rauch SL, van der Kolk BA, Fisler RE, Alpert NM, **Orr SP**, Savage CR, Fischman AJ, Jenike MA, Pitman RK. A symptom provocation study of posttraumatic stress disorder using positron emission tomography and script-driven imagery. *Arch Gen Psychiat* 1996;53:380-386.
31. Pitman RK, **Orr SP**, Altman B, Longpre RE, Poire RE, Macklin ML, Michaels MJ, Steketee GS. Emotional processing and outcome of imaginal flooding therapy in Vietnam veterans with chronic posttraumatic stress disorder. *Compr Psychiat* 1996;37:409-418.

32. Pitman RK, **Orr SP**, Altman B, Longpre RE, Poire RE, Macklin ML. Emotional processing during eye movement desensitization and reprocessing therapy of Vietnam veterans with chronic posttraumatic stress disorder. *Compr Psychiat* 1996;37:419-429.
33. Gurvits TV, Shenton ME, Hokama H, Ohta H, Lasko NB, Gilbertson MW, **Orr SP**, Kikinis R, Jolesz FA, McCarley RW, Pitman RK. Magnetic resonance imaging study of hippocampal volume in chronic, combat-related posttraumatic stress disorder. *Bio Psychiat* 1996;40:1091-1099.
34. **Orr SP**, Solomon Z, Peri T, Pitman RK, Shalev AY. Physiologic responses to loud tones in Israeli veterans of the 1973 Yom Kippur War. *Bio Psychiat* 1997;41:319-326.
35. Shalev AY, Peri P, **Orr SP**, Bonne O, Pitman RK. Auditory startle responses in help-seeking trauma survivors. *Psychiat Res* 1997;69:1-7.
36. Metzger LJ, **Orr SP**, Lasko NB, McNally RJ, Pitman RK. Seeking the source of emotional Stroop interference effects in PTSD: a study of P3s to traumatic words. *Integr Phys Beh Sci* 1997;32:43-51.
37. Shalev AY, Peri T, Gelpin E, **Orr SP**, Pitman RK. Psychophysiological assessment of mental imagery of stressful events in Israeli civilian posttraumatic stress disorder patients. *Compr Psychiat* 1997;38:269-273.
38. Metzger LJ, **Orr SP**, Lasko NB, Pitman RK. Auditory event-related potentials to tone stimuli in combat-related posttraumatic stress disorder. *Bio Psychiat* 1997;42:1006-1015.
39. **Orr SP**, Lasko NB, Metzger LJ, Pitman RK. Physiologic responses to non-startling tones in Vietnam veterans with post-traumatic stress disorder. *Psychiat Res* 1997;73:103-107.
40. **Orr SP**, Meyerhoff JL, Edwards JV, Pitman RK. Heart rate and blood pressure resting levels and responses to generic stressors in Vietnam veterans with posttraumatic stress disorder. *J Trauma Stress* 1998;11:155-164.
41. Macklin ML, Metzger LJ, Litz BT, McNally RJ, Lasko NB, **Orr SP**, Pitman RK. Lower precombat intelligence is a risk factor for posttraumatic stress disorder. *J Consult Clin Psych* 1998;66:323-326.
42. Shalev AY, Pitman RK, **Orr SP**, Peri T, Freedman S, Brandes D. Prospective study of PTSD and depression following trauma. *Am J Psychiat* 1998;155:630-637.
43. Shalev AY, Sahar T, Freedman S, Peri T, Glick N, Brandes D, **Orr SP**, Pitman RK. Prospective study of heart rate response to trauma and the subsequent development of PTSD. *Arch Gen Psychiat* 1998;55:553-559.
44. Keane TM, Kolb LC, Kaloupek DG, **Orr SP**, Blanchard EB, Thomas RG, Hsieh FY, Lavori PW. Utility of psychophysiological measurement in the diagnosis of posttraumatic stress disorder: results from a Department of Veterans Affairs Cooperative Study. *J Consult Clin Psych* 1998;66:914-923.



45. **Orr SP**, Lasko NB, Metzger LJ, Berry NJ, Ahern CE, Pitman RK. Physiologic assessment of women with PTSD resulting from childhood sexual abuse. *J Consult Clin Psych* 1998;66:906-913.
46. Shin LM, McNally RJ, Kosslyn SM, Thompson WL, Rauch SL, Alpert NM, Metzger LJ, Lasko NB, **Orr SP**, Pitman RK. Regional cerebral blood flow during script-driven imagery in childhood sexual abuse-related posttraumatic stress disorder: a positron emission tomographic investigation. *Am J Psychiat* 1999;156:575-584.
47. Metzger LJ, **Orr SP**, Berry NJ, Ahern CE, Lasko NB, Pitman RK. Physiologic reactivity to startling tones in women with PTSD. *J Abnorm Psychol* 1999;108:347-352.
48. Dougherty DD, Shin LS, Alpert NM, Pitman RK, **Orr SP**, Lasko M, Macklin ML, Fischman AJ, Rauch SL. Anger in Healthy Men: A PET study using script-driven imagery. *Bio Psychiat* 1999;46:466-472.
49. Rauch SL, Shin LM, Dougherty D, Alpert NM, **Orr SP**, Lasko NB, Macklin ML, Fischman AJ, Pitman RK. Neural activation during sexual and competitive arousal in healthy men. *Psychiat Res-Neuro* 1999;91:1-10.
50. Macklin ML, Metzger LJ, Lasko NB, Berry NJ, **Orr SP**, Pitman RK. Five-year follow-up of EMDR therapy of PTSD. *Compr Psychiat* 2000;41:1-4.
51. Shalev AY, Peri T, Brandes D, Freedman S, **Orr SP**, Pitman RK. Auditory startle responses in trauma survivors with PTSD: a prospective study. *Am J Psychiat* 2000;157:255-261.
52. Peri T, Ben-Shakhar G, **Orr SP**, Shalev AY. Psychophysiological assessment of aversive conditioning in posttraumatic stress disorder. *Bio Psychiat* 2000;47:512-519.
53. Gurvits TV, Gilbertson MW, Lasko NB, Tarhan AS, Simeon D, Macklin ML, **Orr SP**, Pitman RK. Neurologic soft signs in chronic post-traumatic stress disorder. *Arch Gen Psychiat* 2000;57:181-186.
54. Rauch SL, Whalen PJ, Shin LM, McInerney SC, Macklin ML, Lasko NB, **Orr SP**, Pitman RK. Exaggerated amygdala response to masked facial stimuli in posttraumatic stress disorder: a functional MRI study. *Bio Psychiat* 2000;47:769-776.
55. **Orr SP**, Metzger LJ, Lasko NB, Macklin ML, Peri T, Pitman RK. *De novo* conditioning in trauma-exposed individuals with and without post-traumatic stress disorder. *J Abnorm Psychol* 2000;109:290-298.
56. Shin LM, Dougherty DD, **Orr SP**, Pitman RK, Lasko NB, Macklin ML, Alpert NM, Fischman AJ, Rauch SL. Activation of anterior paralimbic structures during guilt-related script-driven imagery. *Bio Psychiat* 2000;48:43-50.
57. Carson MA, Paulus LA, Lasko NB, Metzger LJ, Wolfe J, **Orr SP**, Pitman RK. Psychophysiological assessment of post-traumatic stress disorder in Vietnam nurse veterans who witnessed injury or death. *J Consult Clin Psych* 2000;68:890-897.

58. Gilbertson MW, Gurvits TV, Lasko NB, **Orr SP**, Pitman RK. Multivariate assessment of explicit memory function in combat veterans with PTSD. *J Trauma Stress* 2001; 14:413-432.
59. Shin LM, Whalen PJ, Pitman RK, Bush G, Macklin ML, Lasko NB, **Orr SP**, McInerney SC, Rauch SL. An fMRI study of anterior cingulate function in posttraumatic stress disorder. *Bio Psychiat* 2001;50:932-942.
60. Metzger LJ, Carson MA, Paulus LA, Lasko NB, Paige SR, Pitman RK, **Orr SP**. Event-related potentials to auditory stimuli in female Vietnam nurse veterans with posttraumatic stress disorder. *Psychophysiology* 2002;39:49-63.
61. Pitman RK, Sanders KM, Zusman RM, Healy AR, Cheema F, Lasko NB, Cahill L, **Orr SP**. Pilot study of secondary prevention of post-traumatic stress disorder with propranolol. *Bio Psychiat* 2002;51:189-192.
62. Pitman RK, Lanes DM, Williston SK, Guillaume JL, Metzger LJ Gehr GM, **Orr SP**. Psychophysiological assessment of posttraumatic stress disorder in breast cancer patients. *Psychosomatics* 2002;42:133-140.
63. Gurvits TG, Carson MA, Metzger LJ, Croteau HB, Lasko NB, **Orr SP**, Pitman RK. Absence of selected neurological soft signs in Vietnam nurse veterans with post-traumatic stress disorder. *Psychiat Res* 2002;110:81-85.
64. Gilbertson MW, Shenton ME, Ciszewski A, Kazai K, Lasko NB, **Orr SP**, Pitman RK. Smaller hippocampal volume predicts pathologic vulnerability to psychological trauma. *Nat Neurosci* 2002;5:1242-1247.
65. Gurvits TG, Lasko NB, Repak, AL, Metzger LJ, **Orr SP**, Pitman RK. Performance on visuospatial copying tasks in individuals with chronic posttraumatic stress disorder. *Psychiat Res* 2002;112:263-268.
66. Pole N, Neylan TC, Best SR, **Orr SP**, Marmar CR. Fear-potentiated startle and posttraumatic stress symptoms in urban police officers. *J Trauma Stress* 2003;16:471-479.
67. **Orr SP**, Metzger LJ, Lasko NB, Macklin ML, Shalev AY, Hu F, Pitman RK. Psychophysiological responses to sudden, loud tones in monozygotic twins discordant for combat exposure: relationship to posttraumatic stress disorder. *Arch Gen Psychiat* 2003;60:283-288.
68. Shin LM, Shin PS, Heckers S, Krangel TS, Macklin ML, **Orr SP**, Lasko NB, Segal E, Makris N, Richert K, Levering J, Schacter DL, Alpert NM, Fischman AJ, Pitman RK, Rauch SL. Hippocampal function in posttraumatic stress disorder. *Hippocampus* 2004;14:292-300.
69. Shin LM, **Orr SP**, Carson MA, Rauch SL, Macklin ML, Lasko NB, Peters PM, Metzger LJ, Dougherty DD, Cannistraro PA, Alpert NM, Fischman AJ, Pitman RK. Regional cerebral blood flow in amygdala and medial prefrontal cortex during traumatic imagery in male and female Vietnam veterans with PTSD. *Arch Gen Psychiat* 2004;61:168-176.

70. McNally RJ, Lasko NB, Clancy SA, Macklin ML, Pitman RK, **Orr SP**. Psychophysiological responding during script-driven imagery in people reporting abduction by space aliens. *Psychol Sci* 2004;15:493-497.
71. Hinton D, So V, Pollack M, Pitman RK, **Orr SP**. The psychophysiology of orthostatic panic in Cambodian refugees attending a psychiatric clinic. *Psychopathology and Behavioral Assessment* 2004;26:1-14.
72. Metzger LJ, Paige SR, Carson MA, Lasko NB, Paulus LA, Pitman RK, **Orr SP**. PTSD arousal and depression symptoms associated with increased right-sided parietal EEG asymmetry. *J Abnorm Psychol* 2004;113:324-329.
73. Marci CD, Moran EK, **Orr SP**. Physiologic evidence for the interpersonal role of laughter during psychotherapy. *J Nerv Ment Dis* 2004;192:689-695.
74. Thompson R, Gupta S, Miller K, Mills S, **Orr S**. The effects of vasopressin on human facial responses related to social communication. *Psychoneuroendocrino* 2004;29:35-48.
75. Shin LM, Wright, CI, Cannistraro P, Wedig M, McMullin K, Martis B, Macklin ML, Lasko NB, Cavanagh S, Krangel TS, **Orr SP**, Pitman RK, Rauch SL. An fMRI study of amygdala and medial prefrontal cortex responses to overtly presented fearful faces in posttraumatic stress disorder. *Arch Gen Psychiat* 2005;62:273-281.
76. Milad MR, **Orr SP**, Pitman RK, Rauch SL. Context modulation of memory for fear extinction in humans. *Psychophysiology* 2005;42:456-464.
77. Elman I, Ariely D, Mazar N, Aharon I, Lasko NB, Macklin ML, **Orr SP**, Lukas SE, Pitman RK. Probing reward function in post-traumatic stress disorder with beautiful facial images. *Psychiat Res* 2005;135:179-183.
78. Gilbertson MW, Paulus, LA, Williston SK, Gurvits TV, Lasko NB, Pitman RK, **Orr SP**. Neurocognitive function in monozygotic twins discordant for combat exposure: relationship to posttraumatic stress disorder. *J Abnorm Psychol* 2006;115:484-495.
79. Milad MR, Quinn BT, Pitman RK, **Orr SP**, Fischl B, Rauch SL. Thickness of ventromedial prefrontal cortex in humans is correlated with extinction memory. *P Natl Acad Sci USA* 2005;102:10706-10711.
80. Rauch SL, Milad MR, **Orr SP**, Quinn BT, Fischl B, Pitman RK. Orbitofrontal thickness, retention of fear extinction, and extraversion. *NeuroReport* 2005;16:1909-1912.
81. Gurvits TV, Metzger LJ, Lasko NB, Cannistraro PA, Tarhan AS, Gilbertson MW, **Orr SP**, Charbonneau AM, Wedig MM, Pitman RK. Subtle neurological compromise as a vulnerability factor for combat-related post-traumatic stress disorder: results of a twin study. *Arch Gen Psychiat* 2006;63:571-576.

82. **Orr SP**, Milad MR, Metzger LJ, Lasko NB, Gilbertson MW, Pitman RK. Effects of beta blockade, PTSD diagnosis, and explicit threat on the extinction and retention of an aversively conditioned response. *Bio Psychol* 2006;73:262-271.
83. Hinton D, Chhean D, Pich V, Pollack M, **Orr SP**, Pitman RK. Assessment of posttraumatic stress disorder in Cambodian refugees using the Clinician-Administered PTSD Scale: psychometric properties and symptom severity. *J Trauma Stress* 2006;19:405-409.
84. Thompson RR, George K, Walton JC, **Orr SP**, Benson J. Sex-specific influences of vasopressin on human social communication. *P Natl Acad Sci USA* 2006;103:7889-7894.
85. Otto MW, Leyro TM, Christian K, Deveney CM, Reese H, Pollack MH, **Orr SP**. Prediction of "fear" acquisition in healthy control participants in a *de novo* fear-conditioning paradigm. *Behav Modif* 2007;31:32-51.
86. Milad MR, Goldstein JM, **Orr SP**, Wedig MM, Klibanski A, Pitman RK, Rauch SL. Fear conditioning and extinction: The influence of sex and menstrual cycle phase, *Behav Neurosci* 2006;120:1196-1203.
87. Buhlmann U, Wilhelm S, Deckersbach T, Rauch SL, Pitman RK, **Orr SP**. Physiologic responses to loud tones in individuals with obsessive-compulsive disorder, *Psychom Med* 2007;69:166-172.
88. Shin LM, Bush G, Whalen PJ, Handwerker K, Cannistraro PA, Wright CL, Lasko NB, **Orr SP**, Pitman RK, Rauch SL. Dorsal anterior cingulate function in posttraumatic stress disorder, *J Trauma Stress* 2007;20:701-712.
89. Milad MR, Wright CI, **Orr SP**, Pitman RK, Quirk, GJ, Rauch SL. Recall of fear extinction in humans activates the ventromedial prefrontal cortex and hippocampus in concert, *Bio Psychiat* 2007;62:446-454.
90. Carson MA, Metzger LJ, Lasko NB, Paulus LA, Morse AE, Pitman RK, **Orr SP**. Physiologic reactivity to startling tones in female nurse veterans with PTSD, *J Trauma Stress* 2007;20:657-666.
91. Marci CD, Ham J, Moran E, **Orr SP**. Physiologic correlates of perceived therapist empathy and social-emotional process during psychotherapy. *J Nerv Ment Dis* 2007;195:103-111.
92. Milad MR, Quirk GJ, Pitman RK, **Orr SP**, Fischl B, Rauch SL. A role for the human dorsal anterior cingulate cortex in fear expression, *Bio Psychiat* 2007;62:1191-1194.
93. Brunet A, **Orr SP**, Tremblay J, Robertson K, Nader K, Pitman RK. Effect of post-retrieval propranolol on psychophysiological responding during subsequent script-driven traumatic imagery in post-traumatic stress disorder, *J Psychiat Res* 2008;42:503-506.

94. Metzger LJ, **Orr SP**, Miller GA, Paige SR, Pitman RK. Intensity Dependence of the Auditory P2 in Monozygotic Twins Discordant for Vietnam Combat: Associations with PTSD. *J Rehabil Res Dev* 2008;45:437-449.
95. Gilbertson MW, Williston SK, Paulus, LA, Lasko NB, Gurvits TV, Shenton ME, Pitman RK, **Orr SP**. Configural cue performance in identical twins discordant for posttraumatic stress disorder: theoretical implications for the role of hippocampal function. *Bio Psychiat* 2007;62:513-520.
96. Milad MR, **Orr SP**, Lasko NB, Chang Y, Rauch SL, and Pitman RK. Presence and acquired origin of reduced recall for fear extinction in PTSD: Results of a twin Study. *J Psychiat Res* 2008;42:515-520.
97. Metzger LJ, Clark CR, McFarlane AC, Veltmeyer MD, Lasko NB, Paige SR, Pitman RK, **Orr SP**. Event-related potentials to auditory stimuli in monozygotic twins discordant for Combat: association with PTSD. *Psychophysiology* 2009;46:172-178.
98. Metzger LJ, Carson MA, Lasko NB, Paulus LA, **Orr SP**, Pitman RK, Yehuda R. Basal and suppressed salivary cortisol in female Vietnam nurse veterans with and without PTSD. *Psychiat Res* 2008;161:330-335.
99. Pineles SL, Vogt DS, **Orr SP**. Personality and fear responses during conditioning: Beyond extraversion. *Pers Indiv Differ* 2008;46:48-53.
100. Holt DJ, Lebron-Milad K, Milad MR, Rauch SL, Pitman RK, **Orr SP**, Cassidy BS, Walsh JP, Goff DC. Extinction memory is impaired in schizophrenia. *Bio Psychiat* 2009;65:455-463.
101. Pace-Schott EF, Milad MR, **Orr SP**, Rauch SL, Stickgold R, Pitman RK. Sleep promotes generalization of extinction of conditioned fear. *Sleep* 2009;32:19-26.
102. Pineles SL, Orr MR, **Orr SP**. An alternative scoring method for skin conductance responding in a differential fear conditioning paradigm with a long-duration conditioned stimulus. *Psychophysiology* 2009;46:984-995.
103. Shin LM, Lasko NB, Macklin ML, Karpf RD, Milad MR, **Orr SP**, Goetz JM, Fischman AJ, Rauch SL, Pitman RK. Resting metabolic activity in cingulate cortex and vulnerability to posttraumatic stress disorder. *Arch Gen Psychiat* 2009;66:1099-1107.
104. Milad MR, Pitman RK, Ellis CB, Gold A, Shin LM, Lasko NB, Zeidan MA, Handwerker K, **Orr SP**, Rauch SL. Neurobiological basis of failure to recall extinction memory in posttraumatic stress disorder. *Bio Psychiat* 2009;66:1075-1082.
105. Salters-Pedneault K, Ruef AM, **Orr SP**. Personality and psychophysiological profiles of police officer and firefighter recruits. *Pers Indiv Differ* 2010;49:210-215.
106. Hinton DE, Hofmann SG, **Orr SP**, Pitman RK, Pollack MG, Pole N. A psychobiocultural model of orthostatic panic among Cambodian refugees: flashbacks, catastrophic cognitions, and

reduced orthostatic blood-pressure response. *Psychological Trauma: Theory, Research, Practice and Policy* 2010;2:63-70.

107. Shin LM, Bush G, Milad MR, Lasko NB, Handwerker Brohawn K, Hughes KC, Macklin ML, Gold AL, Karpf RD, **Orr SP**, Rauch SL & Pitman RK. Exaggerated activation of dorsal anterior cingulate cortex during cognitive interference: A monozygotic twin study of posttraumatic stress disorder. *Am J Psychiat* 2011;168:979-985.

108. Gold AL, Shin LM, **Orr SP**, Carson MA, Rauch SL, Macklin ML, Lasko NB, Metzger LJ, Dougherty DD, Alpert NM, Fischman AJ, Pitman RK. Decreased regional cerebral blood flow in medial prefrontal cortex during trauma-unrelated stressful imagery in Vietnam veterans with post-traumatic stress disorder. *Psychol Med* 2011;41:2563-2572.

109. Pitman RK, Milad MR, Igoe SA, Vangel MG, **Orr SP**, Tsareva A, Gamache K, Nader K. Systemic mifepristone blocks reconsolidation of cue-conditioned fear; propranolol prevents this effect. *Behav Neurosci* 2011;125:632-638.

110. Hoge EA, Worthington JJ, Nagurney JT, Chang Y, Kay EB, Feterowski CM, Katzman AR, Goetz JM, Rosasco ML, Zusman RM, Pollack MH, **Orr SP**, Pitman RK. Effect of acute post-trauma propranolol on PTSD outcome and physiological response during script-driven imagery. *CNS Neurosci Ther* 2012;18:21-27.

111. Zeidan MA, Lebron-Milad K, Thompson-Hollands J, Im JJY, Dougherty DD, Holt DJ, **Orr SP**, Milad MR. Test-retest reliability during fear acquisition and fear extinction in humans. *CNS Neurosci Ther* 2012;18:313-317.

112. **Orr SP**, Lasko NB, Macklin ML, Pineles SL, Chang Y, Pitman RK. Predicting post-trauma stress symptoms from pre-trauma psychophysiologic reactivity, personality traits and measures of psychopathology. *Biology of Mood & Anxiety Disorders* 2012;2:8.

113. Pineles SL, Rasmusson AM, Yehuda R, Lasko NB, Macklin ML, Pitman RK, **Orr SP**. Predicting emotional responses to potentially traumatic events from pre-exposure waking cortisol levels: A longitudinal study of police and firefighters. *Anxiety Stress Copin* 2012;26:241-253. doi:10.1080/10615806.2012.672976.

114. Levi-Gigi E, Kéri S, Myers CE, Lencovsky Z, Sharvit-Benbaji H, **Orr SP**, Gilbertson MW, Servatius RJ, Tsao JW, Gluck MA. Individuals with post-traumatic stress disorder show a selective deficit in generalization of associative learning. *Neuropsychology* 2012;26(6):758-767. doi:10.1037/a0029361.

115. Hall T, Galletly CA, Clark CR, Veltmeyer M, Metzger L, Gilbertson M, **Orr SP**, Pitman, RK, McFarlane A. The relationship between hippocampal asymmetry and working memory processing in pombat-related PTSD- a monozygotic twin study. *Biology of Mood & Anxiety Disorders* 2012;2(21). doi:10.1186/2045-5380-2-21.

116. Inslicht SS, Metzler TJ, Garcia NM, Pineles SL, Milad MR, **Orr SP**, Marmar CR, Neylan TC. Sex differences in fear conditioning in posttraumatic stress disorder, *J Psychiat Res* 2013;47(1):64-71. doi:10.1016/j.jpsychires.2012.08.027.
117. Moustafa AA, Gilbertson MW, **Orr SP**, Herzallah MM, Servatius RJ, Myers CE. A model of amygdala-hippocampal-prefrontal interaction in fear conditioning and extinction in animals. *Brain Cognition*, accepted.
118. Pineles SL, Suvak MK, Liverant GI, Gregor K, Wisco BE, Pitman RK, **Orr SP**. Psychophysiological reactivity, subjective distress, and their associations with PTSD diagnosis. *J Abnorm Psychol*, 2013;122(3):635-644. doi:10.1037/a0033942.
119. Bauer MR, Ruef AM, Pineles SL, Japuntich SJ, Macklin ML, Lasko NB, **Orr SP**. Psychophysiological assessment of PTSD: A potential *Research Domain Criteria* construct. *Psychol Assessment*, 2013;25:1037-1043. doi:10.1037/a0033432.
120. Bui E, **Orr SP**, Jacoby R, Keshaviah A, LeBlanc N, Milad M, Pollack M, Simon N. Two weeks of pretreatment with escitalopram facilitates extinction learning in healthy individuals. *Hum Psychopharm Clin*, 2013;28:447-456. doi:10.1002/hup.2330.
121. Mueller-Pfeiffer C, Zeiffro T, O'Gorman R, Michels L, Bauman P, Wood N, Spring J, Rufer M, Pitman RK, **Orr SP**. Cortical and cerebellar modulation of autonomic responses to loud tones. *Psychophysiology*, 2014;51:60-69.
122. Pace-Schott EF, Spencer RMC, Vijayakumar S, Ahmed N, Verga PW, **Orr SP**, Pitman RK, Milad MR. Extinction of conditioned fear is better learned and recalled in the morning than in the evening. *J Psychiat Res*, accepted.
123. Brunet A, Thomas E, Saumier D, Ashbaugh AR, Azzoug A, Pitman RK, **Orr SP**, Tremblay J. Trauma reactivation plus propranolol is associated with durably low physiological responding during subsequent script-driven imagery. *Can J Psychiat*, 2014;59(4):228-232.
124. Pace-Schott EF, Tracy LE, Rubin Z, Mollica AM, Ellenbogen JM, Bianchi MT, Milad MR, Pitman RK, **Orr SP**. Interactions of time of day and sleep with between-session habituation and extinction memory in young adult males. *Exp Brain Res*, 2014;232:1443-1458. doi:10.1007/s00221-014-3829-9
125. Otto MW, Moshier SJ, Kiner DG, Simon NM, Pollack MH, **Orr SP**. De Novo fear conditioning across diagnostic groups in the affective disorder: evidence for learning impairments. *Behav Ther*, accepted.
126. Spring J, Wood N., Mueller-Pfeiffer C, Milad MR, Pitman RK, **Orr SP**. Pre-reactivation propranolol fails to reduce skin conductance reactivity to fear-conditioned stimuli. *Psychophysiology*, 2015;52(3):407-415. doi:10.1111/psyp.12326

127. Wood NE, Rosasco ML, Suris AM, Spring JD, Marin M-F, Lasko NB, Goetz JM, Fischer AM, **Orr SP**, Pitman RK. Pharmacological blockade of memory reconsolidation in posttraumatic stress disorder: three negative psychophysiological studies. *J Psychiat Res*, accepted.
128. Pace-Schott EF, Rubin Z, Tracy LE, Spencer RMC, **Orr SP**, Verga PW. Emotional trait and memory associates of sleep timing and quality. *J Psychiat Res*, accepted.
129. Anastasides N, Beck KD, Pang KCH, Servatius RJ, Gilbertson MW, **Orr SP**, Myers CE. Increased generalization of learned associations is related to re-experiencing symptoms in veterans with symptoms of post-traumatic stress. *Stress*, 2015;18(4):484-489. doi:10.3109/10253890.2015.1053450
130. Egorova N, Park J, **Orr SP**, Kirsch I, Gollub RL, Kong J. Not seeing or feeling is still believing: conscious and non-conscious pain modulation after direct and observational learning. *Scientific Reports*, 2015;5:1689. doi:1038/srep16809
131. Pineles SL, Nillni YI, King MW, Patton SC, Bauer MR, Mostoufi SM, Gerber MR, Hauger R, Resick PA, Rasmusson AM, **Orr SP**. Extinction retention and the menstrual cycle: Different associations for women with posttraumatic stress disorder. *J Abnorm Psychol*, accepted.
132. McGuire JF, Orr SP, Wu MS, Lewin AB, Small BJ, Phares V, Murphy TK, Wilhelm SW, Pine DS, Geller DA, Storch EA. Fear conditioning and extinction in youth with obsessive compulsive disorder. *Depress Anxiety*, accepted.
133. Fricchione J, Greenberg MS, Spring J, Wood N, Mueller-Pfeiffer C, Milad MR, Pitman RK, **Orr SP**. Delayed extinction fails to reduce skin conductance reactivity to fear-conditioned stimuli. *Psychophysiology*, accepted.
134. Familoni BO, Gregor K, Dodson TS, Krzywicki AT, Lowery BN, **Orr SP**, Suvak MK, Rasmusson AM. Sweat pore reactivity as a surrogate measure of sympathetic activity in trauma-exposed individuals with and without posttraumatic stress disorder. *Psychophysiology*, accepted.
134. Basden S L, **Orr SP**, Otto MW. Impaired de novo fear conditioning in opiate-dependent outpatients. *Cognitive Ther Res*, accepted.
135. McGuire JF, **Orr SP**, Essoe JK-Y, McCracken JT, Storch EA, Piacentini J. Extinction Learning in Childhood Anxiety Disorders, Obsessive Compulsive Disorder and Posttraumatic Stress Disorder: Implications for Treatment. *Expert Rev Neurother*, 2016;16(10):1155-1174. doi:10.1080/14737175.2016.1199276
136. Koch J, Flemming J, Zeffiro T, Rufer M, **Orr SP**, Mueller-Pfeiffer C. Effects of posture and stimulus spectral composition on peripheral physiological responses to loud sounds. *PLoS ONE*, 2016; 11(9): e0161237. doi: 10.1371/journal.pone.0161237

Other peer-reviewed publications



1. Pitman RK, **Orr SP**. The black hole of trauma. *Bio Psychiat* 1990;27:469-471.
2. Pitman RK, **Orr SP**. Modulation of the startle response in children with PTSD. *Am J Psychiat* 1990;147:815-816.
3. Pitman RK, **Orr SP**. Psychophysiological testing for post-traumatic stress disorder: forensic psychiatric application. *B Am Acad Psych Law* 1993;21:37-52.
4. Pitman RK, **Orr SP**. Once bitten, twice shy: beyond the conditioning model of PTSD. *Bio Psychiat* 1993;33:145-146.
5. Pitman RK, Saunders LS, **Orr SP**. Psychophysiological testing for post-traumatic stress disorder. *Trial* 1994;30:22-26.
6. **Orr SP**. Psychophysiological reactivity to trauma-related imagery in PTSD: diagnostic and theoretical implications of recent findings. *Ann NY Acad Sci* 1997;821:114-124.
7. **Orr SP**, Roth WT. Psychophysiological assessment: clinical applications for PTSD. *J Affect Disorders* 2000;61:225-240.
8. Pitman RK, Gilbertson MW, Gurvits TV, May FS, Lasko NB, Metzger LJ, Shenton ME, **Orr SP**. Clarifying the origins of biological abnormalities in PTSD through the study of identical twins discordant for combat exposure. *Ann NY Acad Sci* 2006;1071:242-254.
9. Pitman RK, Rasmusson AM, Koenan KC, Shin LM, **Orr SP**, Gilbertson MW, Milad R, Liberzon I. Biological studies of post-traumatic stress disorder. *Nature Reviews Neuroscience*, 2012; 13:769-787. doi:10.1038/nrn3339

Non-peer reviewed scientific or medical publications/materials in print or other media

1. Pitman RK, **Orr SP**. Psychophysiology of post-traumatic stress disorder. In Lerer B, Gershon S (Eds.): *New Directions in Affective Disorders*. New York: Springer-Verlag 1989:447-450.
2. Pitman RK, **Orr SP**, van der Kolk BA, Greenberg MS, Meyerhoff JL, Mougey EH. Analgesia: A new dependent variable for the biological study of PTSD. In Wolf E, Mosnaim AD (Eds.): *Post-Traumatic Stress Disorder; Biological Mechanisms and Clinical Aspects*. Clinical Insights Series. Washington, D.C.: American Psychiatric Press 1990:140-147.
3. **Orr SP**. Psychophysiological studies of PTSD. Giller E (Ed.): *Biological Assessment and Treatment of PTSD*. Washington: American Psychiatric Press 1990:137-157.
4. Saunders LS, Pitman RK, **Orr SP**. Providing objective proof of mental harm through psychophysiological testing for post-traumatic stress disorder. *Trial Bar News* 1993;15:72-80.

5. Pitman RK, **Orr SP**, Bursztajn HJ. *Vinal v. New England Telephone: admission of PTSD psychophysiological test results in a civil trial. American Academy of Psychiatry and the Law Newsletter* 1993;18:67-69.
6. **Orr SP**. An overview of psychophysiological studies of PTSD. *PTSD Quarterly* 1994;5:1-7.
7. Pitman RK, **Orr SP**. Psychophysiology of emotional memory networks in post-traumatic stress disorder. In McGaugh JL, Weinberger NM, Lynch G (Eds.): *Brain and Memory: Modulation and Mediation of Neuroplasticity*. New York: Oxford University Press 1995:75-83.
8. Tarabrina NV, Lazebnaya EO, Zelenova MT, Lasko NB, **Orr SP**, Pitman RK. Psychophysiological responses of Chernobyl liquidators. *Psikhologicheskij Zhurnal (Moscow)* 1996;17:30-45.
9. **Orr SP**, Kaloupek DG. Psychophysiological assessment of PTSD. Wilson JP, Keane TM (Eds.): *Assessing Psychological Trauma and PTSD: A Handbook for Practitioners*. New York: Guilford Publications 1997:69-97.
10. **Orr SP**, Pitman RK. Neurocognitive risk factors for PTSD. In Yehuda R (Ed.): *Risk Factors for Posttraumatic Stress Disorder*. Washington, D.C.: American Psychiatric Press 1999:125-141.
11. Pitman RK, Shalev AY, **Orr SP**. Post-traumatic stress disorder: emotion, conditioning, and memory. In Gazzaniga MS (Ed.): *The Cognitive Neurosciences*. Cambridge, MA: MIT Press 1999:1133-1147.
12. Pitman RK, **Orr SP**, Shalev AY, Metzger LJ, Mellman, TA. Psychophysiological alterations in post-traumatic stress disorder. *Seminars in Clinical Neuropsychiatry* 1999;4:234-241.
13. **Orr SP**, Metzger LJ, Pitman RK. Psychophysiology of Posttraumatic Stress disorder. *Psychiat Clin N Am* 2002;25:271-293.
14. **Orr SP**, Metzger LJ, Miller MW, Kaloupek DG. Psychophysiological assessment of PTSD. Wilson JP, Keane TM (Eds.): *Assessing Psychological Trauma and PTSD: A Handbook for Practitioners (2<sup>nd</sup> Edition)*. New York: Guilford Publications 2004:289-343.
15. **Orr SP**, McNally RJ, Rosen GM, Shalev AY. Psychophysiological reactivity: implications for conceptualizing PTSD. Rosen GM (Ed.): *Posttraumatic Stress Disorder: Issues and Controversies*. United Kingdom: John Wiley & Sons, Ltd 2004:101-126.
16. Metzger LJ, Gilbertson MW, **Orr SP**. Electrophysiology of PTSD. Vasterling J, Brewin C (Eds.): *Neuropsychology of PTSD: Biological, Clinical, and Cognitive Perspectives*. New York: Guilford Publications 2005:83-102.
17. Gilbertson MW, **Orr SP**, Rauch SL, Pitman RK. Trauma and posttraumatic stress disorder. Stern TA, Rosenbaum JF, Fava M, Biederman J, Rauch SL (Eds.): *Massachusetts General Hospital Comprehensive Clinical Psychiatry*. Philadelphia: Mosby Elsevier 2008:465-480.
18. Rosen GM, Lilienfeld SO, **Orr SP**. Searching for PTSD's biological signature. Rosen GM, Frueh BC (Eds.): *Clinician's Guide to Posttraumatic Stress Disorder*. Hoboken, NJ: John Wiley & Sons, Ltd 2010:97-118.

19. Milad MR, Igoe S, **Orr SP**. Fear conditioning in rodents and humans. J Raber (Ed.): *Animal Models of Behavioral Analysis*. New York: Springer Publishing Company 2011:111-132.

## **Thesis**

**Orr SP**. *Excitatory and Inhibitory Properties of Human Facial Expressions of Emotion*. Doctoral Dissertation.

## **Abstracts, Poster Presentations and Exhibits Presented at Professional Meetings:**

1. Sheynin J, Shikari S, Ostovich J, Beck KD, Pang KCH, Servatius RJ, Gilbertson MW, **Orr SP**, Myers CE. (2013, April) Harm avoidant personality and female gender facilitate avoidance behavior on a computer-based paradigm. *Organization for the Study of Sex Differences Annual Meeting*, Weehawken, NJ: Poster.
2. Wood NE, Spring JD, Marin MF, Lasko NB, **Orr SP**, Pitman RK. (2013, May). Effect of Pre-reactivation mifepristone and D-cycloserine on subsequent physiological responding during traumatic imagery in PTSD. *Society for Biological Psychiatry Annual Meeting*, San Francisco, CA PA: Poster.
3. Spring JD, Wood NE, Marin MF, Lasko NB, Mueller-Pfeiffer C, Milad MR, Pitman RK, **Orr SP**. (2013, May). Pre-reactivation propranolol fails to reduce skin conductance reactivity to fear-conditioned stimuli. *Society for Biological Psychiatry Annual Meeting*, San Francisco, CA PA: Poster.
4. Pitman RK, Marin MF, Vitek ME, **Orr SP**, Goldberg J. (2013, May). Post-traumatic stress disorder symptoms and their relationship to trauma exposure. *Society for Biological Psychiatry Annual Meeting*, San Francisco, CA PA: Poster.
5. Rosenbaum BL, Bui E, Holt DJ, , **Orr SP**, Pitman RK, Milad MR. (2013, May). Do socioeconomic factors really predict variance in conditioned fear? *Society for Biological Psychiatry Annual Meeting*, San Francisco, CA PA: Poster.
6. Pace-Schott EF, Mollica AG, Tracy LE, Ellenbogen JM, Bianchi MT, Milad MR, **Orr SP**, Pitman RK. (2013, June) Retention of Extinction Memory and Inter-Session Habituation are Associated with Intervening Sleep Architecture: Preliminary Findings. *Associated Professional Sleep Societies*, Baltimore, MD: Poster.
7. Sheynin J, Moustafa AA, Servatius RJ, Gilbertson MW, **Orr SP**, Myers CE. (2013, June) Computer-based approach for studying avoidance behavior: behavioral findings, computational modeling and implications for PTSD. *Collaborative Research in Cognitive Neuroscience Annual Meeting*, Cambridge, MA: Poster.
8. Pineles SL, Nillni YI, Patton SC, Resick PA, Rasmusson AM, **Orr SP**. (2013, November) Menstrual Cycle Effects on Conditioned Fear Acquisition in Women with and without PTSD. *International Society for Traumatic Stress Studies Annual Meeting*, Philadelphia, PA: Symposia (Abstract #596).

9. Inslicht S, Metzler T, Rucker E, Hodges M, Garcia N, Milad M, **Orr SP**, Marmar C, Neylan T. (2013, November) Sex Differences in Fear Extinction Learning and Memory in Trauma Exposed Individuals. *International Society for Traumatic Stress Studies Annual Meeting*, Philadelphia, PA: Poster (Abstract #893).
10. Mueller-Pfeiffer C, Zeffiro T, O'Gorman R, Michels L, Baumann P, Wood N, Spring J, Rufer M, Pitman RK, **Orr SP**. (2014, March). Cortical modulation of autonomic responses to salient auditory stimuli. *Annual Meeting of the German Society for Psychotraumatology*, Hamburg, Germany: Symposia.
11. Pace-Schott EF, Rubin Z, Verga PW, Spencer RMC, **Orr SP**, Milad MR. (2014, May) Chronotype, Sleep Quality and Extinction Memory, an Actigraphic Study. *Associated Professional Sleep Societies*, Minneapolis, MN: Poster.
12. Pace-Schott EF, Tracy LE, Rubin Z, Spencer RMC, **Orr SP**, Milad MR. (2014, May) Relationship of Neuroticism to Retrospective and Actigraphically Measured Sleep and Chronotype. *Associated Professional Sleep Societies*, Minneapolis, MN: Poster.
13. Pace-Schott EF, Rubin Z, Tracy, L, Verga PW, Spencer RMC, **Orr SP**, Milad MR. (2014, May) Emotional trait and memory associates of sleep quality and chronotype. *Society for Biological Psychiatry Annual Meeting*, New York, NY: Poster.
14. Brunet A, Saumier D, Tremblay J, **Orr SP**, Pitman RK. (2014, May) Randomized placebo-controlled trial of propranolol plus trauma memory reactivation for PTSD. *Society for Biological Psychiatry Annual Meeting*, New York, NY: Poster.
15. McGuire JF, Geller DA, **Orr SP**, Lewin AB, Small BJ, Murphy TK, Wilhelm S, Pine DS, Storch EA. (2014, November) Examining Fear Learning and Extinction In Youth with OCD. *Association for Behavioral and Cognitive Therapies Annual Meeting*, Philadelphia, Pennsylvania: Symposium.
16. Koch J, Flemming J, Zeffiro T, Michael R, **Orr SP**, Mueller-Pfeiffer C. (2014, November) Peripheral physiological responses to salient sounds. *International Society for Traumatic Stress Studies Annual Meeting*, Miami, FL: Poster (#FRI 297).
17. Pace-Schott EF, **Orr SP**, Pitman RK, Germaine A, Milad MR. (2014, November) Sleep effects on the consolidation and generalization of extinction and habituation – relevance to development and perpetuation of PTSD. *International Society for Traumatic Stress Studies Annual Meeting*, Miami, FL: Symposia.
18. Myers CE, Servatius RJ, Gilbertson MW, **Orr SP**. (2014, November) Post-traumatic stress disorder (PTSD) and generalization of learned associations: more severe re-experiencing symptoms are associated with better generalization. *Society for Neuroscience Annual Meeting*, Washinton, DC: Poster (#262.20/RR11).
19. Shin LM, VanElzaker MB, Staples-Bradley LK, Dubois S, Hughes KC, Lasko NB, Dahlgren MK, Panic P, Offringa R, Hakim BI, Carter NJ, Davis FC, White ET, Laifer LM, Korus RE, Chan TH, Shen

NM, **Orr SP**, Pitman RK. (2014, November). Behavioral and brain responses to ambiguous facial expressions in posttraumatic stress disorder. *Society for Neuroscience Annual Meeting*, Washinton, DC: Poster (#427.04/BB2)

20. Dahlgren MK, Van Elzakker M, Staples LK, Dubois SJ, Hughes KC, Lasko NB, Offringa R, Laifer LM, Korus RE, Sangermano LM, Russell JA, Kaur N, **Orr SP**, Pitman RK, Shin LM (2015, April). Cognitive interference deficits as a familial vulnerability factor in posttraumatic stress disorder: a monozygotic twin study. *Anxiety and Depression Association of America Annual Conference*, Miami, FL: Poster.

21. VanElzakker MB, Dubois SJ, Davis FC, Staples LK, Hughes KC, Dahlgren MK, Offringa R, Lasko NB, **Orr SP**, Pitman RK, Shin LM. (2015, April). Brain responses to ambiguous facial expressions in posttraumatic stress disorder (PTSD). *Anxiety and Depression Association of America Annual Conference*, Miami, FL: Symposia.

22. Tanev KS, Pace-Schott EF, Resick P, Griffin MG, Pitman RK, **Orr SP**. (2015, May). Positive association between nightmares and heart rate response to loud tones supports parasympathetic dysfunction in PTSD. *Society for Biological Psychiatry Annual Meeting*, Toronto, ON: Poster.

23. McGuire J, **Orr S**, Wu M, Lewin A, Small B, Gomez A, Murphy T, Wilhelm S, Pine D, Storch E and Geller D. (2015, December). Fear Conditioning and Extinction in Pediatric Obsessive-Compulsive Disorder. *American College of Neuropsychopharmacology Annual Meeting*, Hollywood, FL: Poster.

24. VanElzakker MB, Shomstein S, Staples-Bradley L, Dubois SJ, Lasko NB, **Orr SP**, Pitman RK, Shin LM. (2016, March). Propensity for Exogenous Attention Capture is a Vulnerability Factor for PTSD: An Identical Twin Study. *Anxiety and Depression Association of America Annual Conference*, Philadelphia, PA: Poster.

25. Pace-Schott EF, Bottary R, Rosencrans P, Vijayakumar S, **Orr SP**, Lasko NB, Goetter E, Baker A, Bianchi MT, Gannon K, Hofmann SG, Simon NM. (2016, June). Effects of post-exposure naps, home sleep quality and chronotype on treatment outcome in exposure therapy for social anxiety: preliminary findings. *Associated Professional Sleep Societies*, Denver, CO: Symposia.

26. Curreri A J, Pineles S L, **Orr SP**. (2016, October). Event-related P2 slope as a predictor of response to SSRIs in a veteran population. *Association for Behavioral and Cognitive Therapies Annual Meeting*, New York, NY: Poster.

27. McGuire JF, **Orr SP**, Geller D, Wu MS, Small BJ, Lewin AB, Wilhelm S, Murphy TK, Pine DS, Storch EA. (2016, October). Fear Extinction in Pediatric Obsessive-Compulsive Disorder. *American Academy of Child and Adolescent Psychiatry Annual Meeting*, New York, NY: Symposium.

28. McGuire JF, **Orr SP**, Geller D, Wu MS, Small BJ, Lewin AB, Wilhelm S, Murphy TK, Pine DS, Storch EA. (2016, October). Fear Learning and Extinction in Youth with Obsessive-Compulsive

Disorder. *Association for Behavioral and Cognitive Therapies Annual Meeting*, New York, NY: Symposium.

29. Kredlow MA, Pineles SL, Inslicht SS, Milad MR, Otto MW, **Orr SP**. (2016, November). Assessment of skin conductance in African American and non-African American participants in fear conditioning research: Implications for PTSD research. *International Society for Traumatic Stress Studies Annual Meeting*, Dallas, TX: Poster.

30. Pineles SL, Irvine J, Webb A, Nillni YI, Resick PA, **Orr SP**, Rasmusson A M. (2016, November). Neurobiological Mechanisms of Menstrual Cycle Effects on Extinction Retention among Women with and without PTSD. *International Society for Traumatic Stress Studies Annual Meeting*, Dallas, TX: Symposium.

31. Amalathas A, Curreri A, Resick P, Rasmusson A, **Orr S**, Pineles, S. (2016, November). Trauma and Psychophysiological Reactivity: Menstrual Phase, Posttraumatic Stress Disorder, and Performance on a Loud Tones Task. *International Society for Traumatic Stress Studies Annual Meeting*, Dallas, TX: Poster.

## **Narrative Report**

### **Introduction**

My doctoral research as an experimental psychologist, nearly 40 years ago, applied fear-conditioning concepts and psychophysiological methods to the investigation of emotion-eliciting properties of facial expressions. This work demonstrated that facial expressions of emotion have conditioned-stimulus-like properties that are capable of evoking particular emotional responses, such as fear, in someone observing the expression. Facial expressions of emotion now commonly serve as target stimuli in studies of emotion. Following my graduate training, I completed a 26-year research career at the Manchester, NH VAMC, where I conducted state-of-the-art psychophysiological research on posttraumatic stress disorder in order to improve our understanding of this disorder and develop new treatments. Since coming to HMS in 1987, and MGH in 1998, I have continued this effort as Associate Director of the PTSD Psychophysiology Laboratory,

### **Area of Excellence: Investigation**

In the early 1980's, posttraumatic stress disorder (PTSD) was viewed with suspicion by many clinicians and received little attention from clinical researchers. My early clinical research focused on empirically testing whether individuals who met the diagnostic criteria for PTSD (DSM-III at that time) could be *objectively* discriminated from individuals who had been exposed to similar traumatic events, but who were not so diagnosed. I was instrumental in designing a highly innovative study that integrated psychophysiological measures with a standardized task for evoking emotional imagery. The findings from this work played an important role in the introduction of what is now the DSM-5 PTSD diagnostic criterion, "Marked physiologic reactivity after exposure to trauma-related stimuli." Over the past 30 years, this methodology and its variations have been shown to be highly reliable and have become widely used to assess PTSD. The laboratory system and protocol I developed for this research has been duplicated in dozens of research facilities around the world.

Exaggerated startle was recognized early on as a symptom of PTSD (DSM-III-R, PTSD symptom D.5); however, this recognition was not based on empirical evidence. In order to objectively test for the

presence of exaggerated startle, I designed a standardized protocol to administer a series of brief loud-tone stimuli capable of generating a startle response while simultaneously recording psychophysiological reactivity. Results from a series of studies provided clear evidence of increased HR, SC, and eye-blink EMG responses in individuals with PTSD, providing objective support for exaggerated startle as a PTSD sign. As work progressed, a pattern of results emerged demonstrating that individuals with PTSD showed heightened HR reactivity to loud tones that was highly reliable across studies. Importantly, this line of work led to our finding that the heightened HR reactivity to loud tones in PTSD is not pre-existing, but rather is associated with the development of the disorder. At present, this is the only biological marker for which there is compelling support that the feature is acquired with the development of PTSD.

Alterations in fear conditioning, extinction learning and extinction retention are likely implicated in the development and/or maintenance of PTSD. I designed and conducted one of the first studies of conditioned fear in individuals with PTSD, which demonstrated increased acquisition and slower extinction of a conditioned fear response in individuals with the disorder. I conducted one of the first truly prospective studies of PTSD to examine whether measures of conditioned fear could be used to predict the development of PTSD. This study found that the combination of lower cognitive ability and poorer extinction of a conditioned facial EMG response predicted the severity of posttraumatic stress symptoms following exposure to a traumatic event. I have also contributed to a new line of PTSD fear-conditioning research that has adapted animal conditioning models so as to allow for psychophysiological examinations of the effects of context, extinction retention, renewal and reinstatement. Most recently, my lab has developed a fear-conditioning protocol that produces robust conditioned fear in humans. This protocol has now been used to test the efficacy of several pharmacological and behavioral interventions for the blockade of fear memory reconsolidation.

My contributions have also included work done in collaboration with neuroscientists on the identification of brain structures and functioning that characterize the pathophysiology of PTSD. In some of this work, I have assisted with integrating psychophysiological recordings with neuroimaging. Findings from this work have helped to identify hippocampal, dACC, vmPFC and amygdala structural and functional differences between individuals with and without PTSD.

In 2007, I was the sole recipient of the *Award for Outstanding Scientific Achievement in the Field of PTSD* from the 2,400-member International Society for Traumatic Stress Studies. My consultation regarding PTSD and psychophysiological methodology is regularly sought by investigators at the local, national and international levels.

### **Teaching and Education**

I taught undergraduate psychology courses from 1982-1992. However, most of my teaching has involved hands-on psychophysiological training and mentorship of local, national and international investigators. I have provided research mentorship and training for HMS residents, post-docs and junior and senior faculty, as well as to national and international researchers. In 2002, I founded a MGH psychophysiology journal club that has provided new and established investigators an opportunity to discuss psychophysiological methods, data, and research ideas. In 2014, I received the Department of Psychiatry at Massachusetts General Hospital Mentorship Award for *Exceptional Mentorship in the Research Arena*.

### **Supporting Activity: Administration**

From 2000 to 2011, I was Coordinator for Research and Development at the VA Medical Center in Manchester, NH. I am retired from the VA and currently serve as the Associate Director of the Posttraumatic Stress Disorder and Psychophysiology Laboratory at the Massachusetts General Hospital.

### **Summary**

As a member of the HMS faculty, I have conducted innovative research on the psychobiology of PTSD using psychophysiological, electrophysiological and neuroimaging methods. Through my mentorship at the local, national, and international levels, I have helped to train the next generation of investigators in research methodology, data analysis, and psychophysiological techniques. As a consultant, I have enabled many local, national, and international investigators to establish psychophysiology laboratories and thereby add psychophysiological measures to their research designs. My laboratory has provided hands-on psychophysiological training to many local investigators, as well as to national and international investigators.