22nd Annual Meeting of the

International Society for the Advancement of
RESPIRATORY PSYCHOPHYSIOLOGY

34th Symposium on Respiratory Psychophysiology

October 9 – 11, 2015
Hotel Fernando III
Seville, Spain

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2012 – Poonam Jaiswal, Dara Steinberg
2013 – Nina Eisenberg, Jessica Baeske
2014 – Milisyaris Aviles-Velez, Marta Walentynowicz
Past Meeting Locations and Program Chairs

1994 - Saint Flour, France; Gila Benchetrit and Ronald Ley
1995 - Toronto, Canada; Andrew Harver
1996 - Nijmegen, The Netherlands; Hans Folgering
1997 - Cape Cod, United States; Ronald Ley and Lawrence Schleifer
1998 - Perpignan, France; Francois Ceugniet and Jorge Gallego
   1999 - Granada, Spain; Berhard Dahme
2000 - San Diego, United States; Dick Gevirtz
2001 - Oxford, United Kingdom; Bill Gardner
2002 - Washington, United States; Thomas Ritz
2003 - Leuven, Belgium; Omer Van den Bergh
2004 - Princeton, United States; Paul Lehrer
2005 - Hamburg, Germany; Andreas von Leupoldt
2006 - Newport, United States; Beth McQuaid
2007 - Bristol, England; Adrian Kendrick and Sandy Jack
2008 - Ann Arbor, United States; Nicholas Giardino
   2009 - Berlin, Germany; Ilse Van Diest
2010 - New York, United States; Jonathan Feldman
2011 - Athens, Greece; Daphne Koinis Mitchell
2012 - Orlando, United States; Paul Davenport
   2013 - Leuven, Belgium; Elke Vlemincx
2014 - New Brunswick, United States; Paul Lehrer
2015 - Seville, Spain; Thomas Janssens and Thomas Ritz
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Friday, October 9th

18:30 - 20:00 Welcome Reception

Saturday, October 10th

08:00 – 08:30 Registration

08:30 – 10:20 **Symposium 1: Respiratory Symptom Perception**
Chair: Thomas Janssens

*An investigation of interoceptive processes across the senses*
SARAH N. GARFINKEL, MIRANDA F MANASSEI, MIRIAM ENGELS, CASSANDRA GOULD, AND HUGO D CRITCHLEY
BRIGHTON AND SUSSEX MEDICAL SCHOOL, UNIVERSITY OF SUSSEX, UNIVERSITATSKLINIKUM DUSSELDORF

*The benefit of doubt: The role of subjective certainty in the perception of bodily sensations*
SIBYLLE PETERSEN AND OMER VAN DEN BERGH
UNIVERSITY OF LUXEMBOURG

*Magnitude estimation of respiratory resistive loads in Parkinson’s disease*
KAREN W. HEGLAND, MICHELLE S. TROCHÉ, AND ALEXANDRA BRANDIMORE
UNIVERSITY OF FLORIDA AND COLOMBIA UNIVERSITY

*The effect of restrictive breathing devices on perception and exercise performance*
LOREN TOUMA, JORDAN SMITH, HSUI-WEN TSAI, PAUL W. DAVENPORT
UNIVERSITY OF FLORIDA

*Urge-to-cough as a clinical predictor of dysphagia in Parkinson’s disease*
MICHELLE S. TROCHÉ, KAREN W. HEGLAND, ALEXANDRA BRANDIMORE, AND BEATE SCHUMANN
COLOMBIA UNIVERSITY, UNIVERSITY OF FLORIDA, AND UNIVERSITY HOSPITAL RWTH

10:20 – 10:40 Coffee Break
10:40 – 12:30  Symposium 2: Regulation of Breathing Behavior and Airway Function
Chair: Elke Vlemincx

Unraveling the breathing puzzle
TATIANA M. ANDERSON, ALFREDO J. GARCIA III, AND JAN-MARINO RAMIREZ
DEPARTMENT OF NEUROLOGICAL SURGERY AND PEDIATRICS, UNIVERSITY OF WASHINGTON SCHOOL OF MEDICINE

Acute effects of maternal hostility versus warmth on airway function in children with asthma.
BEATRICE L. WOOD, BRUCE D. MILLER, AND CHIUNYU HSU
UNIVERSITY OF BUFFALO

Insecurely attached asthmatic children show vagal bias and increased airway resistance in a laboratory stress paradigm
BRUCE D. MILLER, BEATRICE L. WOOD, AND CHIUNYU HSU
UNIVERSITY OF BUFFALO

Exhaled nitric oxide during academic examination stress in health and asthma
THOMAS RITZ, ANA F. TRUEBA, JIAYAN LIU, RICHARD J. AUCHUS, AND DAVID ROSENFIELD
SOUTHERN METHODIST UNIVERSITY, UNIVERSIDAD SAN FRANCISCO DE QUITO, UNIVERSITY OF MICHIGAN MEDICAL CENTER, AND UT SOUTHWESTERN MEDICAL CENTER

Preliminary analysis of data from a two-center trial of heart rate variability biofeedback to treat mild and moderate asthma
PAUL LEHRER, FREDERICK WAMBOLDT, CHARLES IRVIN, MILYSYARIS AVILES, JESSICA GRAVES, SHOU-EN LU, ANTHONY SCARDELLA, BEATRIX HAMM, HAROLD NELSON ROBERT WOOD JOHNSON MEDICAL SCHOOL, NATIONAL JEWISH HEALTH, UNIVERSITY OF VERMONT, AND RUTGERS SCHOOL OF PUBLIC HEALTH

12:30 – 14:00  Lunch (on your own)

14:00 – 15:00  Keynote Address
Chair: Jan-Marino Ramirez

Neonatal Stress and Sex-specific Manifestations of Respiratory Disorders
RICHARD KINKEAD
UNIVERSITÉ LAVAL
15:00 – 16:15 **Poster Session & Coffee**

16:30 – 17:30 **Presidential Address**

Chair: Walton T. Roth

_Therapeutic Capnography for Anxiety and Asthma: Efficacy and Mechanisms_

ALICIA E. MEURET

*SOUTHERN METHODIST UNIVERSITY*

17:30 – 18:00 **Award for Distinguished Contributions to Respiratory Psychophysiology**

Chair: Omer van den Bergh

WALTON T. ROTH

*STANFORD UNIVERSITY MEDICAL SCHOOL & VA PALO ALTO HEALTH CARE SYSTEM*
Sunday, October 11th

09:00 – 10:30 Symposium 3: Neuroimaging of the Interaction of Dyspnea and Emotional Processing: New Insights for Clinical Populations
Chair: Karleyton C. Evans

Electrophysiological responses to affective pictures during the anticipation and perception of breathlessness
ANDREAS VON LEUPOLDT, PHILIPP REICHERTS, MIRJAM LIV WEINSTEIN-RIECHMANN, MATTHIAS J. WIESER, & GEORGIANA JURAVLE
UNIVERSITY OF LEUVEN, UNIVERSITY MEDICAL CENTER HAMBURG-EPPENDORF, UNIVERSITY OF WÜRZBURG

Structural and functional correlates of anxious responses to hypercapnia: Cortico-limbic evidence for a respiratory subtype of panic disorder
KARLEYTON C. EVANS, TIAN-YUE SONG, JARRED P. ZIMMERMAN, DONALD G. MCLAREN
MASSACHUSETTS GENERAL HOSPITAL AND HARVARD MEDICAL SCHOOL

Engagement of the prefrontal cortex in response to dyspnea-related cues in COPD
MARI HERIGSTAD, ANJA HAYEN, ELEANOR EVANS, KYLE T. S. PATTINSON
UNIVERSITY OF OXFORD, OXFORD BROOKES UNIVERSITY, AND UNIVERSITY OF READING

Opioids decrease the unpleasantness of dyspnoea via actions in the medial prefrontal cortex
ANJA HAYEN, VISHVARANI WANIGASEKERA, MARI HERIGSTAD, KYLE T. S. PATTINSON
UNIVERSITY OF OXFORD, UNIVERSITY OF READING, AND OXFORD BROOKES UNIVERSITY

10:30 – 10:45 Coffee Break

10:45 – 11:45 Keynote Address
Chair: Paul W. Davenport

Breathlessness and Threat in the Human Periaqueductal Gray Matter
KYLE T. S. PATTINSON
OXFORD UNIVERSITY

11:45 – 13:00 Lunch (on your own)
13:00 – 14:30 **Symposium 4: Explaining Medically Unexplained Symptoms**
Chair: Paul Lehrer

A breath of air: Nocebo-effects in dyspnea.
ELKE VLEMINCX, CHRISTIAN SPRENGER, & CHRISTIAN BÜCHEL
UNIVERSITY OF LEUVEN AND UNIVERSITY MEDICAL CENTER HAMBURG-EPPENDORF

Asthma and odors: the role of risk perception in asthma exacerbation
PAMELA DALTON AND CRISTINA JAÉN
MONELL CHEMICAL SENSES CENTER

Not getting used to the smell – chemical intolerance as a lack of habituation
LINUS ANDERSSON AND ANNA-SARA CLAESON
UMEÅ UNIVERSITY

Conditioned cough and urge to cough in a category learning task
THOMAS JANSSENS, LIEVEN DUPONT, & OMER VAN DEN BERGH
UNIVERSITY OF LEUVEN

14:30 – 14:45 Coffee Break

14:45 – 15:45 **Symposium 5: Management of Respiratory Illness: Cognition and Emotion**
Chair: Daphne Koinis-Mitchell

Asthma illness representations: do they really change over time?
KIMBERLY ARCOLEO & JONATHAN FELDMAN
THE OHIO STATE UNIVERSITY COLLEGE OF NURSING AND YESHIVA UNIVERSITY

Role of exacerbation triggers and trigger control perceptions in COPD
CHELSEY A. WERCHAN, ASHTON M. STEELE, THOMAS JANSSENS, MARK W. MILLARD, & THOMAS RITZ
SOUTHERN METHODIST UNIVERSITY, UNIVERSITY OF LEUVEN, AND BAYLOR UNIVERSITY MEDICAL CENTER

The impact of loneliness during pulmonary rehabilitation in patients with COPD
THOMAS REIJNDERS, KONRAD SCHULTZ, SIBYLLIE PETERSEN, & ANDREAS VON LEUPOLDT
UNIVERSITY OF LEUVEN, CLINIC BAD REICHENHALL, AND UNIVERSITY OF LUXEMBOURG
15:45 – 16:45 **Keynote Address**  
Chair: Andreas von Leupoldt

**Importance of Patient’s Perception in COPD Assessment**  
JOSE LUIS LOPEZ-CAMPOS  
UNIVERSIDAD DE SEVILLA

16:45 – 17:00 Coffee Break

17:00 – 18:00 **Symposium 6: Management of Respiratory Illness: Symptom Monitoring and Cognitive Function**  
Chair: Thomas Ritz

**Using Ecological Momentary Assessment to Describe Variability in Daily Child Asthma Symptoms**  
ROBIN S. EVERHART, SAMANTHA A. MIADICH, AND KRISTIN E. HERON  
VIRGINIA COMMONWEALTH UNIVERSITY AND OLD DOMINON UNIVERSITY

**Sleep and Night Awakenings in Urban Children with Asthma: Do Objective and Subjective Measurements Correspond to One Another?**  
BROWN MEDICAL SCHOOL AND UNIVERSITY OF COLORADO-BOULDER

**Associations among central nervous system neuronal integrity, asthma control, and cognitive function: Preliminary findings**  
JULIET L. KROLL, ASHTON M. STEELE, AMY E. PINKHAM, CHANGHO CHOI, DAVID A. KAHN, MARYAM SAIFI, SHARON DEOL, E. SHERWOOD BROWN & THOMAS RITZ  
SOUTHERN METHODIST UNIVERSITY, UNIVERSITY OF TEXAS AT DALLAS, AND UNIVERSITY OF TEXAS SOUTHWESTERN MEDICAL CENTER

18:00 – 19:00 **Student Awards and Business Meeting**
Symposium 1 Abstracts: Respiratory Symptom Perception

Chair: Thomas Janssens

**An investigation of interoceptive processes across the senses**
SARAH N. GARFINKEL, MIRANDA F. MANASSEI, MIRIAM ENGELS, CASSANDRA GOULD, AND HUGO D CRITCHLEY
BRIGHTON AND SUSSEX MEDICAL SCHOOL, UNIVERSITY OF SUSSEX, UNIVERSITATSKLINIKUM DUSSELDORF

**The benefit of doubt: The role of subjective certainty in the perception of bodily sensations**
SIBYLLE PETERSEN AND OMER VAN DEN BERGH
UNIVERSITY OF LUXEMBOURG

**Magnitude estimation of respiratory resistive loads in Parkinson’s disease**
KAREN W. HEGLAND, MICHELLE S. TROCHÉ, AND ALEXANDRA BRANDIMORE
UNIVERSITY OF FLORIDA AND COLOMBIA UNIVERSITY

**The effect of restrictive breathing devices on perception and exercise performance**
LOREN TOUMA, JORDAN SMITH, HSUI-WEN TSAI, PAUL W. DAVENPORT
UNIVERSITY OF FLORIDA

**Urge-to-cough as a clinical predictor of dysphagia in Parkinson’s disease**
MICHELLE S. TROCHÉ, KAREN W. HEGLAND, ALEXANDRA BRANDIMORE, AND BEATE SCHUMANN
COLOMBIA UNIVERSITY, UNIVERSITY OF FLORIDA, AND UNIVERSITY HOSPITAL RWTH
Magnitude estimation of respiratory resistive loads in Parkinson’s disease

Karen W. Hegland¹, PhD/CCC-SLP, Michelle S. Troche², PhD/CCC-SLP, Alexandra Brandimore¹, PhD/CCC-SLP

¹Department of Speech, Language, and Hearing Sciences, University of Florida, ²Department of Biobehavioral Sciences, Teachers College, Columbia University, New York, NY, USA

Background: Patients with Parkinson’s disease (PD) under-report physiologic symptoms, including those related to airway protection. We have recently completed studies showing patients with PD have a blunted perception of the urge-to-cough compared to control participants. The urge-to-cough is a respiratory sensation, and we propose that this blunted perception is related to an overall reduction in respiratory sensitivity. The goal of this study was to determine differences in the perceptual ratings of respiratory resistive loads between people with PD and age, sex matched controls.

Method(s): Participants (14 with PD; 13 healthy) were fitted with a facemask connected to a non-rebreathing valve in-line with a differential pressure transducer and a resistive loading manifold. Five different resistive loads were delivered upon inspiration in a randomized block design. Participants rated the magnitude (ME) of breathing difficulty following each load presentation on a modified Borg scale. Airflow and mouth pressure were also recorded. A multivariate ANOVA was used to compare the ME slope, airflow and mouth pressure between PD and control groups. Alpha was p<.05.

Result(s): Participants with PD had a significantly lower ME slope compared with controls (F(5) = 7.697; p<.001). There were not differences for airflow (F(5) = 0.813; p=.543) or mouth pressure (F(5) = .947; p=.454).

Discussion: Results show that participants with PD had blunted sensation of inspiratory resistive loads compared with control participants. This supports our hypothesis that reduced upper airway sensation in PD may relate to overall blunting of respiratory sensation. Further study is required to determine the mechanisms mediating these differences.
The effect of restrictive breathing devices on perception and exercise performance

Loren Touma, Jordan Smith, Hsui-Wen Tsai, Paul W. Davenport

Department of Physiological Sciences, University of Florida, Gainesville, FL

An individual’s exercise performance is the integration of the physiological response and the psychophysiological assessment of the task. Somatosensory perceptions are part of the affective motivation for task performance. We hypothesized that by selectively increasing the difficulty of breathing during exercise there would be an increase in the sense of breathlessness without changing other somatosensations resulting in a breathlessness mediated increase of their Urge-to-Stop (UtS). Each subject participated in a control (no restricted breathing device) and an experimental trial (with restricted breathing device). Subjects completed a 1.6 mile exercise task on a treadmill with 6 periodic inclines. SAM and perceptions of breathlessness (RPB), exercise effort (RPE), claustrophobia (RPC), chest pressure (RPCP), temperature (RPT), and UtS were recorded before and after the walking task. During the walking tasks participants respired through a facemask. \( \text{O}_2 \) consumption (\( \text{VO}_2 \)), \( \text{CO}_2 \) production (\( \text{VCO}_2 \)), heart rate (HR), respiratory rate (RR), and RPB, RPE, RPC, RPCP, RPT and UtS recorded at the end of each incline. The restricted breathing trial resulted in a significant increase in RPB, RPCP, RPT and UtS. There were no significant changes in RPE and RPC. The mean increase during the experimental trial in RPB (191%), RPCP (186%) and UtS (203%) were similar. These results suggest that during the experimental task, increasing only the resistance to breathing affected somatosensation of multiple modalities. The increase in breathing resistance significantly increased the subject’s UtS which decreased their ability to perform the exercise task suggesting breathlessness modulation of affective state is a determinant of task motivation and exercise performance.
Urge-to-cough as a clinical predictor of dysphagia in Parkinson’s disease

Michelle S. Troche¹, PhD/CCC-SLP, Karen W. Hegland², PhD/CCC-SLP, Alexandra Brandimore², PhD/CCC-SLP, Beate Schumann³, M.Sc.

¹Department of Biobehavioral Sciences, Teachers College, Columbia University, New York, NY, USA, ²Department of Speech, Language, and Hearing Sciences University of Florida, Gainesville, FL, USA, ³Department of Neurology, University Hospital RWTH Aachen, Aachen NRW, Germany

Background: Patients with Parkinson’s disease (PD) have progressive and pervasive disorders of airway protection. Much research and clinical interest has been placed on disorders of swallowing (dysphagia), but we have recently completed several studies highlighting the deficits of reflex cough and a blunted urge-to-cough (UTC) in patients with PD. The goal of this study was to identify the most salient and robust clinical predictors of swallowing dysfunction in people with PD.

Method(s): Sixty-four participants (20 females; 44 males) completed measures of voluntary cough, reflex cough, and swallowing function. Penetration-aspiration scores served as the primary outcome measure. Clinical predictors included disease severity, disease duration, cough airflow, and cough sensitivity measures. ROC analysis was performed to identify predictors of dysphagia in PD. Alpha was set at p<.05.

Result(s): Disease duration was the only factor which significantly discriminated between patients with normal swallowing and abnormal swallowing (p = 0.027, sensitivity: 71%, specificity: 55.4%). However, UTC sensitivity (log-log linear slope) was the only variable which significantly discriminated between patients with mild dysphagia and severe dysphagia (P = 0.017, sensitivity: 85.7%, specificity 73.2%).

Discussion: It is important to identify the factors which influence and predict airway protective outcomes in people with PD; a population in which aspiration pneumonia is a leading cause of death. Results from this study highlight the idea that a patient’s perceived magnitude of a cough-inducing stimulus is an important factor to consider in the screening and rehabilitation of airway protective deficits in PD.
An investigation of interoceptive processes across the senses

Sarah N Garfinkel1,2 Miranda F Manassei, Miriam Engels1,3, Cassandra Gould1,2 and Hugo D Critchley1,2

1. Psychiatry, Brighton and Sussex Medical School, 2. Sackler Centre for Consciousness Science, University of Sussex, 3. Universitätsklinikum Dusseldorf

Background: Interoception refers to sensitivity to stimuli originating from within the body. To date, the majority of studies investigating interoceptive processes have focused on cardiac sensitivity, either using heartbeat detection tests or self-report measures. However, little is known about potential discrepancies in interoceptive accuracy across the senses or how this interoceptive channel can alter stimulus processing.

Methods: Tests of interoceptive accuracy were employed across cardiac, respiratory and gastric axes, to contrast with exteroceptive somatosensory accuracy (touch acuity). Interoceptive accuracy (objective performance) was dissociated from interoceptive awareness (correspondence between confidence and accuracy). The interoceptive channel was further interrogated by presenting stimuli (CS [neutral shapes] / CS+ [neutral shapes followed by shock]) at distinct points in the cardiac cycle (systole, when the heart is beating, versus diastole).

Results: Preliminary results (N=20) suggest initial evidence for divergent interoceptive axes, with an emerging association between cardiac and gastric accuracy that was dissociable from respiratory and touch acuity. Moreover, a dissociation between interoceptive accuracy and interoceptive awareness was observed for cardiac interoception, but preliminary results suggest this dissociation was less evident across other senses. Finally, aversive stimuli (CS+) processed at systole elicited a greater SCR response and were rated as less pleasant than those processed at diastole, effects that were exaggerated for high-trait anxious individuals.

Discussion: Sensitivity to different interoceptive axes diverge across the senses and are not uniform in their dissociation between accuracy and awareness. Finally, time-locking stimuli to distinct bodily-phases can provide additional insight into how the body-brain axis can alter stimulus processing.
The benefit of doubt: The role of subjective certainty in the perception of bodily sensations

Sibylle Petersen, PhD, Omer Van den Bergh, PhD

University of Luxembourg, Research Unit INSIDE, Institute for Health and Behaviour, 7220 Walferdange, Luxembourg

**Background:** The decision whether a sensation is a sign of normal bodily functions or already a symptom is not always clear cut, but sensations can be perceived as ambiguous. Little is known, however, on subjective strategies for disambiguation and their relationship with fear of bodily sensations and interoceptive bias.

**Methods:** We present results from two studies on the perception of respiratory resistance (N=60) and heat pain (N=62). In both studies, stimuli were increasing in eight steps in intensity and presented repeatedly in random order. In the experimental condition, participants were asked to assign stimuli to one of two intensity categories and rank stimuli within categories (A1, A2, A3, A4, and B1, B2, B3, B4). In the control condition, participants received no categorization information and were asked to rank stimuli according to magnitude from 1-8. Participants rated subjective certainty for each classification/ranking decision and completed questionnaires on anxiety, fear of bodily sensations, and intolerance of ambiguity.

**Results:** Higher fear of bodily sensations was positively related to intolerance of ambiguity as well as to higher subjective certainty for classification/ranking decisions. In the categorization condition, participants accentuated subjectively between stimuli at the shared category border (compared to the ranking condition). Furthermore, higher fear of bodily sensations was related to higher bias, but only under high subjective certainty.

**Discussion:** Fear of bodily sensations are positively related to more pronounced subjective disambiguation strategies. Stronger disambiguation may be a process linking anxiety and bias in interoception.
Symposium 2 Abstracts: Regulation of Breathing Behavior and Airway Function
Chair: Elke Vlemincx

Unraveling the breathing puzzle
TATIANA M. ANDERSON, ALFREDO J. GARCIA III, AND JAN-MARINO RAMIREZ
DEPARTMENT OF NEUROLOGICAL SURGERY AND PEDIATRICS, UNIVERSITY OF WASHINGTON SCHOOL OF MEDICINE

Acute effects of maternal hostility versus warmth on airway function in children with asthma.
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Insecurely attached asthmatic children show vagal bias and increased airway resistance in a laboratory stress paradigm
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Exhaled nitric oxide during academic examination stress in health and asthma
THOMAS RITZ, ANA F. TRUEBA, JIAYAN LIU, RICHARD J. AUCHUS, AND DAVID ROSENFIELD
SOUTHERN METHODIST UNIVERSITY, UNIVERSIDAD SAN FRANCISCO DE QUITO, UNIVERSITY OF MICHIGAN MEDICAL CENTER, AND UT SOUTHWESTERN MEDICAL CENTER

Preliminary analysis of data from a two-center trial of heart rate variability biofeedback to treat mild and moderate asthma
PAUL LEHRER, FREDERICK WAMBOLDT, CHARLES IRVIN, MILISYARIS AVILES, JESSICA GRAVES, SHOU-EN LU, ANTHONY SCARDELLA, BEATRIX HAMM, HAROLD NELSON
ROBERT WOOD JOHNSON MEDICAL SCHOOL, NATIONAL JEWISH HEALTH, UNIVERSITY OF VERMONT, AND RUTGERS SCHOOL OF PUBLIC HEALTH
During rest, breathing alternates between inspiration and an expiratory phase, termed postinspiration. The inspiratory phase gives also rise to sighs and gasps, while postinspiration is also the critical phase for swallowing, vomiting, breath-holding and vocalization. During strained breathing postinspiration is prolonged. An additional expiratory phase is conditionally recruited under high metabolic demand, termed active expiration. The three phases of mammalian respiration, inspiration, postinspiration and active expiration, are controlled by neuronal circuits in the brainstem. However, exactly where and how the different phases are generated is a matter of an ongoing debate that began almost 200 years ago. An excitatory network, the preBötzinger complex, has been discovered 25 years ago and implicated in the generation of inspiration and sighs. The generation of active expiration has been attributed to the so called pFRG (parafacial respiratory group), but the location for the generation of postinspiration has remained elusive. Using optogenetic, electrophysiological and histological approaches, we found a novel excitatory network caudal to the facial nucleus that is responsible for the generation of postinspiration. This network can be independently controlled from inspiration by neuromodulators such as somatostatin. This newly discovered network has its own independent rhythmogenic properties. Based on these findings we propose the hypothesis that breathing emerges through the interaction between different excitatory rhythmogenic networks. These networks can be differentially controlled by neuromodulators. Inhibitory interactions between these rhythmogenic networks establish the relative timing, but are not responsible for the generation of these phases.
Acute effects of maternal hostility versus warmth on airway function in children with asthma.

Beatrice L. Wood, Bruce D. Miller, ChiunYu Hsu

Departments of Psychiatry, Pediatrics and Neuroscience, University at Buffalo, Buffalo, NY USA

Background. Studies show that chronic family stress alters cytokine function in asthmatic children, and acute familial stress predicts subsequent asthma attacks. The aim of this study was to determine whether maternal hostility worsened airway function during stressful family interaction, and whether maternal warmth buffered the effect of stressful interaction on pulmonary function.

Methods. Children with asthma (n=277, aged 7-13, 55% male, medication withheld) and their families were studied. Families were digitally recorded during 6 stress-inducing interaction tasks: build a card house, discuss a child difficulty, discuss a sad event/loss with the child, resolve a parent-child conflict, resolve a parent-parent conflict, and tell what they liked best about each other. Maternal child interactions were rated for hostility and warmth according to the Iowa Family Interaction Rating Scales, a reliable and valid rating system. Airway function (FEV1) was assessed before and after the protocol. The sample was stratified into two groups: 1) Children whose pulmonary function improved (FEV1 pre-post increase greater than 1 SD;N=27); 2) children whose pulmonary function worsened (FEV1 pre-post decrease greater than 1SD;N=25). We contrasted the groups according to maternal hostility and warmth towards the child.

Results. There was no difference between the groups in the degree of maternal hostility towards the child expressed during the stressful interaction tasks. In contrast, children with improved pulmonary function had mothers who expressed greater warmth (p<.01).

Conclusions. These findings suggest that maternal warmth may buffer the impact of stressful family interaction on airway function in children with asthma.
Insecurely attached asthmatic children show vagal bias and increased airway resistance in a laboratory stress paradigm

Bruce D. Miller, Beatrice L. Wood, ChiunYu Hsu

Departments of Psychiatry, Pediatrics and Neuroscience, University at Buffalo

**Background:** Insecure attachment has been associated with problems in psychobiologic development, particularly with regard to regulation of response to stress. This study examined cardio-respiratory responses of securely versus insecurely attached asthmatic children in a laboratory film stress paradigm. We proposed that insecure attachment would potentiate ANS dysregulation (vagal bias) and impair airway function in response to emotional stress.

**Method:** We studied 94 asthmatic children (single maternal families) under laboratory conditions using the film “E.T., The Extraterrestrial” to evoke emotional stress. The Relatedness Questionnaire indexed relational security with mother; the Child Depression Inventory indexed depressive symptoms; the Spielberger State Trait Anxiety Inventory indexed anxiety. Asthma disease activity was assessed by NHLBI criteria. The child viewed the film while continuous ECG and impedance measures of heart beat and aortic blood flow were used to measure vagal (RSA) and sympathetic (pre-ejection period, PEP) activation. ANS dysregulation was indexed by vagal bias: Zrsa-Zpep. Pulmonary function was measured by airflow (FEV1) and respiratory resistance (Rint).

**Results:** Children categorized as having insecure, versus secure, attachment with their mothers had significantly higher depressive and trait anxiety symptoms (t=-3.56, p<.001; t=-5.16, p<.001), greater vagal bias in the death scene (t=-1.98, p<.05) and increased airway resistance (t=-2.0, p<.05). Mothers who had insecure attachment with their children showed higher depressive symptoms (t=-2.27, p<.05) than mothers who had secure attachment with their children.

**Discussion:** These findings support the proposition that insecure mother-child attachment contributes to stress vulnerability, depression and ANS dysregulation which potentiate disease activity in asthmatic children.
Exhaled nitric oxide during academic examination stress in health and asthma

Thomas Ritz\textsuperscript{1}, Ana F. Trueba\textsuperscript{1,2}, Jiayan Liu\textsuperscript{3}, Richard J. Auchus\textsuperscript{4,4}, and David Rosenfield\textsuperscript{1}

\textsuperscript{1}Department of Psychology, Southern Methodist University, Dallas, TX, USA
\textsuperscript{2}Quito Brain and Behavior Laboratory, Department of Psychology, Universidad San Francisco de Quito, Quito, Ecuador
\textsuperscript{3}Department of Internal Medicine, University of Michigan Medical Center, Ann Arbor, MI, USA
\textsuperscript{4}Department of Internal Medicine, UT Southwestern Medical Center, Dallas, TX, USA

\textbf{Background.} Adverse effects of psychological stress on asthma are well established, but less is known about effects of longer lasting stress on airway inflammatory markers in asthma. We therefore examined changes in FeNO, lung function, and endogenous cortisol levels in an academic finals stress paradigm with college students, which allowed us to study effects of naturalistic life stress lasting for several days.

\textbf{Methods.} We enrolled 35 students with asthma and 74 healthy controls for assessment during a low-stress period in the academic term and during the high-stress final exam period. Two assessments were scheduled finals 3 to 5 days apart. FeNO, spirometric lung function (forced expiratory volume in the 1st s, FEV1, peak flow), salivary cortisol, negative affect, and stress levels were measured at these three time points. Analyses controlled for medication use, cold symptoms, sex, and age.

\textbf{Results.} Negative affect, stress levels, and cortisol increased during finals, but effects were less pronounced in students with asthma. FeNO decreased gradually from low-stress baseline to the late final exam period. Students with asthma showed FeNO decreases that exceeded clinically relevant levels (-11.5ppb). FEV1 gradually decreased in both groups. Initial depression and perceived stress were associated with more pronounced FeNO decreases, as were greater cortisol increases during exam stress.

\textbf{Conclusion.} FeNO is substantially reduced in longer lasting stress in asthma, an effect that is exacerbated by habitual perceived stress, depressive mood, and stress cortisol. The fact that lung function was also reduced poses problems for the interpretation of FeNO in asthma management.
Preliminary analysis of data from a two-center trial of heart rate variability biofeedback to treat mild and moderate asthma

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Background: We conducted a two-center trial (Rutgers and National Jewish Health) of heart rate variability biofeedback (HRVB) for patients with mild or moderate asthma who were symptomatic but not taking inhaled steroids. Subjects were randomly assigned to HRVB or a control condition consisting of EEG alpha biofeedback (Fp to Oz), listening to relaxing music, and doing paced breathing at normal resting frequency (about 15 breaths/min)

Methods: Sixty-eight patients were accepted in the study, of which 55 completed. We analyzed data with a mixed models procedure, using the compound symmetry model, as chosen by the Akaike information criterion.

Results: Averaged over both conditions there was a significant improvement on a methacholine challenge test, PC20FEV1 F(1,45) = 11.8, p < .002), adjusted for gender, height, weight, and age. Although the groups did not differ in mean pre-post test changes, there was a significant improvement in the HRV biofeedback group of approximately one doubling dose, t(to) = 2.51, p < .03, but no change in the EEG + paced breathing group, t(25) = 1.59, p < .13. For a measure of generalized anxiety, there was no Groups x Session interaction, but a t-test showed a greater improvement in the HRV biofeedback group between first and last treatment sessions than in the control group, t(92) = 2.15, p < .04.

As a treatment fidelity measure we examined changes in respiration rate and low frequency heart rate variability (LF HRV), and found significant decreases in respiration rate to about 6/min, F92,133) = 41.22, p < .0001, and an increase in LF HRV, F(2,133) = 59.59, p < .0001

In an exploratory analysis, we examined correlations between pretest pulmonary function measures and pretest items on tests of psychological disturbance. For generalized anxiety (the GAD7) and depression (the PHQ8), we found baseline levels of percent expected FEV1 to be negatively correlated with report of restlessness (r = -0.22, p< .04), worrying (r= -.26, p < .02), poor appetite (r = -.23, p < .03) and feeling down depressed or hopeless (r = .21, p < .05). There is also a negative correlation for the Nijmegan item ‘lacking respiration (air)’ (r = .22, p < .04), and for ‘angered’ on the
Perceived Stress Scale (r = -.24, p < .02). There were no significant correlations between total scores on any of the tests and spirometry measures.

We are currently performing mixed models analyses on daily peak flow data, albuterol use, exhaled nitric oxide, and measures of depression, hyperventilation, and perceived stress. We also are analyzing extensive psychophysiological data, including end-tidal CO2, pulse amplitude, pulse transit time, finger temperature, and EEG alpha, beta, and theta waves.

**Discussion:** Subjects in both groups improved in asthma and anxiety, with perhaps a small edge to HRVB. It is possible that results reflect regression to the mean, particularly for asthma. There are modest negative correlations between particular items relating to emotional/physical experience and percent expected FEV1.
Neonatal Stress and Sex-Specific Manifestation of Respiratory Disorders.

Richard Kinkead

Université Laval

**Background:** The respiratory control system is a complex neural circuit that integrates a continuous flow of sensory information and produces a motor output driving pulmonary ventilation. Because tight regulation of arterial blood gases is essential from the beginning of life, it has been presumed that the neural system regulating breathing is fixed, following a genetically predetermined developmental pattern. However, this long standing notion has evolved with data showing that the networks regulating breathing are “plastic”, such that performance of the adult system can be persistently modified by chronic or intermittent hypoxia or changes in physiological demands.

The perinatal period is critical to respiratory control development and several studies have revealed striking manifestations of respiratory plasticity where perinatal exposure to excessive or insufficient respiratory stimuli alters the developmental trajectory of the respiratory control system. Conversely, exposure to the same conditions outside this critical period has little effect on respiratory regulation. Central nervous system (CNS) development, as a whole, requires a variety of stimuli to achieve optimal function. During early life, signals originating from sensors responding to respiratory stimuli (O2 and CO2) provide sensory guidance which is essential to proper respiratory control development. By contrast, the impact of stressors and stimuli that are not directly relevant to respiratory homeostasis has been virtually ignored.

Studies on rodents, primates, and humans consistently show that maternal stimuli play a key role in proper CNS programming of the newborn. In rats, prolonged (1h or more) maternal separation interferes with normal mother-infant interactions and this stress has been used extensively by researchers in neuroendocrinology and behavioural sciences to assess the effects of adverse postnatal environments on CNS development. Over the past decade, we have taken advantage of this knowledge and used neonatal maternal separation (NMS) as a tool to investigate the impact of a non-respiratory environmental stress on respiratory control development. During this presentation, I will review evidence indicating that neonatal stress (in the form of NMS) has persistent and sex-specific consequences on the developmental trajectory of the neural circuits that regulate breathing; the effects observed to date on the reflexive responses to respiratory stimuli (O2 and CO2) indicate that NMS predisposes to cardio-respiratory disorders. I will discuss evidence indicating that neonatal stress disrupts the balance between excitatory and inhibitory modulation within key respiratory structures contribute to the respiratory phenotype observed following NMS. Together, this research points to new factors in the etiology of respiratory diseases related to neural control dysfunction such as sleep disordered breathing and panic disorders.
Chair: Karleyton C. Evans

**Electrophysiological responses to affective pictures during the anticipation and perception of breathlessness**

ANDREAS VON LEUPOLDT, PHILIPP REICHERTS, MIRJAM LIV WEINSTEIN-RIECHMANN, MATTHIAS J. WIESER, & GEORGIANA JURAVLE
UNIVERSITY OF LEUVEN, UNIVERSITY MEDICAL CENTER HAMBURG-EPPENDORF, UNIVERSITY OF WÜRZBURG

**Structural and functional correlates of anxious responses to hypercapnia: Cortico-limbic evidence for a respiratory subtype of panic disorder**

KARLEYTON C. EVANS, TIAN-YUE SONG, JARRED P. ZIMMERMAN, DONALD G. MCLAREN
MASSACHUSETTS GENERAL HOSPITAL AND HARVARD MEDICAL SCHOOL

**Engagement of the prefrontal cortex in response to dyspnea-related cues in COPD**

MARI HERIGSTAD, ANJA HAYEN, ELEANOR EVANS, KYLE T. S. PATTINSON
UNIVERSITY OF OXFORD, OXFORD BROOKES UNIVERSITY, AND UNIVERSITY OF READING

**Opioids decrease the unpleasantness of dyspnoea via actions in the medial prefrontal cortex**

ANJA HAYEN, VISHVARANI WANIGASEKERA, MARI HERIGSTAD, KYLE T. S. PATTINSON
UNIVERSITY OF OXFORD, UNIVERSITY OF READING, AND OXFORD BROOKES UNIVERSITY
Electrophysiological responses to affective pictures during the anticipation and perception of breathlessness

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Background: Recent research demonstrated affective processes to have an impact on the perception and neural processing of breathlessness. However, little is known about the reverse influence of breathlessness on affective processes, as well as its modulation by anxiety.

Methods: Here we investigated by means of visually-evoked brain potentials in the electroencephalogram how the perception vs. anticipation of resistive-load-induced breathlessness influences neural correlates of affective processing. High and low anxious participants viewed affective pictures of positive, neutral, or negative content under conditions of perceived breathlessness, anticipated breathlessness, or an unloaded baseline.

Results: Overall, the picture-evoked P1 was significantly more positive in high as compared to low anxious individuals. The picture-evoked P2 was less positive during breathlessness as compared to baseline. Furthermore, the early picture-evoked LPP (300-500 ms) was significantly less positive during both perceived and anticipated breathlessness as compared to baseline. Across conditions, the late LPP (600-1000 ms) indicated the expected results (i.e., a more positive response for positive and negative pictures as opposed to neutral ones) for the low anxious group. In turn, for the high anxious group only the positive pictures elicited the typical more positive LPP response.

Discussion: Taken together, these results highlight the impact of perceived and anticipated breathlessness on the neural processing of affective picture stimuli, as well as its modulation by individual anxiety levels.

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Structural and functional correlates of anxious responses to hypercapnia:

Cortico-limbic evidence for a respiratory subtype of panic disorder

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**Background:** A respiratory subtype of panic disorder (PD-R) is hypothesized to account for heightened sensitivity to inhaled carbon dioxide (CO2; hypercapnia) in the majority of PD patients (~60%). The pathophysiology underlying PD-R is controversial with debate over several theories: primary-respiratory, genetic, metabolic, cortico-limbic. We investigated potential structural and functional cortico-limbic correlates of PD-R using MRI.

**Methods:** Twenty-seven medication-free panic patients and 24 matched healthy controls (HCs) underwent structural then function MRI (fMRI) during hypercapnic (~5% CO2) challenges. Evaluable data included 25 PD and 22 HC subjects. Prior to imaging, hypercapnic mock-scan trials prospectively identified 12 patients as PD-R based on exaggerated dyspnea and panic responses. Image analyses with SPM8 tested for group effects on structural and functional scans.

**Results:** Compared to PD and HC subjects, PD-R subjects had significantly greater gray matter in the bed nucleus stria-terminalis (BNST; an amygdaloid structure) and less gray matter in the anterior cingulate cortex (ACC). Hypercapnia during fMRI, evoked comparable increases in ventilation (32.5%), and global CBF (37.4%) across all subjects. However, greater anxiety/panic responses were evoked in PD-R patients compared to PD and HC subjects, and PD-R patients exhibited significantly greater anxiety-related fMRI signal in the BNST and less anxiety-related fMRI signal in the ACC.

**Discussion:** The current multimodal neuroimaging findings provide the first cortico-limbic evidence supporting a respiratory subtype of PD. The BNST is known to respond to sustained threat. We propose insufficient ACC down-regulation of exaggerated BNST responses facilitated anxiety/panic in PD-R patients in response to the interoceptive stimulus of hypercapnia.

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Engagement of the prefrontal cortex in response to dyspnea-related cues in COPD

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Background: Dyspnea in COPD is influenced by a range of psychological processes, particularly anxiety. Such processes might serve to amplify the perception of respiratory sensations. Understanding these is important for treatment development.

Methods: We investigated dyspnea and dyspnea-related anxiety in COPD using a word-cue task during functional neuroimaging, an approach which stems from pain imaging research. COPD patients (n=41) and healthy age-matched controls (n=40) was shown dyspnea-related word cues followed by visual analogue scale (VAS) ratings of cue-related breathlessness and anxiety during FMRI. Individual brain activation maps were correlated with subjective VAS ratings and also compared with relevant behavioural measures including Dyspnea-12 and St.Georges Respiratory Questionnaire (SGRQ) scores.

Results: COPD patients showed activation in the anterior insula, lateral/medial prefrontal cortex (lPFC/mPFC), anterior cingulate cortex (ACC) and precuneus correlating with dyspnea VAS ratings. mPFC and ACC activity also correlated with depression, fatigue and dyspnea vigilance questionnaire scores. VAS ratings correlated with Dyspnea-12 (r=0.51, P=0.002) and SGRQ (r=0.80, P<0.0001) scores. In controls, activations were observed in the lPFC, anterior insula, putamen, caudate, angular/supramarginal gyrus and superior frontal gyrus. Activation in the anterior insula was common between groups.

Discussion: Our findings show that dyspnea ratings in COPD correlate with engagement in dyspnea-(insula/ACC) and fear-related regions (mPFC/ACC) of the brain. Some of the variability in response to the task can be linked to patient-reported measures of depression, fatigue and vigilance. This supports the role of psychological processes in the dyspnea of COPD.
Opioids decrease the unpleasantness of dyspnoea via actions in the medial prefrontal cortex

Anja Hayen1,2, Vishvarani Wanigasekera1, Mari Herigstad1,3, Kyle T. S. Pattinson1

1 Nuffield Department of Clinical Neurosciences, University of Oxford; 2 Department of Psychology, University of Reading; 3 Clinical Health Care, Oxford Brookes University.

Background: Opioids relieve dyspnoea, but little is known about their mechanisms of action in the brain. This study investigates the neural correlates of the remifentanil-induced decrease in perceived respiratory unpleasantness.

Methods: In a double-blind, randomised, placebo-controlled crossover study, 19 participants rated the perceived intensity and unpleasantness of mild (−3cmH2O) and strong (−11cmH2O) inspiratory loading on visual analogue scales (VAS) during intravenous infusions of remifentanil (0.7ng/ml effect site concentration) or saline (placebo; counterbalanced), whilst undergoing BOLD FMRI in a Siemens 3T Trio Scanner. Sedation, tension and contentment were measured with the Bond-Lader mood scale (VAS).

Results: Remifentanil did not change perceived intensity of dyspnoea (70%VAS, p=0.275), but reduced respiratory unpleasantness (63-53%VAS, p=0.036). This change did not correlate with increased sedation (26-40%VAS, r=0.149, p=0.544), contentment (23-32%VAS, r=-0.476, p=0.039) or decreased tension (40-21%VAS, r=0.292, p=0.225).

Imaging: Saline: Activity in the right parahippocampal gyrus correlated with unpleasantness and activity in the lateral occipital cortex correlated with intensity ratings. Activity in the lateral prefrontal cortex (PFC), right insula, and paracingulate gyrus correlated with both intensity and unpleasantness ratings.

Change with remifentanil: Decreased activity in the medial and lateral PFC correlated with decreased unpleasantness. Activity in the lateral PFC, right premotor and lateral occipital cortex correlated with dyspnea intensity.

Discussion: This study highlights the unique role of the medial PFC in opioid-induced reduction of dyspnoea suffering, contributing to the exploration of neural opioid-mechanisms with the aim of understanding and improving treatment.
Breathlessness and threat in the human periaqueductal gray matter.

Kyle T. S. Pattinson

Oxford University

**Background:** The sensation of breathlessness is influenced by brainstem respiratory drive combined with emotional and behavioural factors derived from higher centres in the cortex, yet how these are linked remains poorly understood. Patients with respiratory disease often have abnormal respiratory drive (e.g. abnormal hypoxic and hypercapnic ventilatory responses), coupled with psychological morbidity (anxiety, panic, depression). Thus it is important to determine how "physiology" and "psychology" interact if progress in developing new treatments is to be made. Animal research into the control of respiration has mostly focused upon the brainstem, usually in reduced preparations. Human functional magnetic resonance imaging (FMRI) has, on the other hand, been most successful in determining activity in cortical centres. FMRI in the brainstem is an emerging area of research, traditionally limited by poor resolution at standard field strengths (1.5 or 3 tesla). A major (yet tiny) nucleus linking these basic and higher functions is the periaqueductal gray matter (PAG). In animal models it has been identified as having respiratory and behavioural threat functions. The PAG is situated in the midbrain, and measures 4 x 4 x 13 mm and is further subdivided into 8 separate columns (4 on each side). These separate columns have differing functions and connect differently across the brain. In this lecture I shall explain how, using ultra high field (7 tesla) FMRI, we have started to unravel the differing roles of the PAG substructure in respiratory threat detection and breathlessness. I shall further explain how these findings may help us understand and develop novel treatments for breathlessness in clinical populations in which emotional factors play such an important role.
Symposium 4 Abstracts: Explaining Medically Unexplained Symptoms

Chair: Paul Lehrer

**A breath of air: Nocebo-effects in dyspnea.**
ELKE VLEMINCX, CHRISTIAN SPRENGER, & CHRISTIAN BÜCHEL
UNIVERSITY OF LEUVEN AND UNIVERSITY MEDICAL CENTER HAMBURG-EPPENDORF

**Asthma and odors: the role of risk perception in asthma exacerbation**
PAMELA DALTON AND CRISTINA JAÉN
MONELL CHEMICAL SENSES CENTER

**Not getting used to the smell – chemical intolerance as a lack of habituation**
LINUS ANDERSSON AND ANNA-SARA CLAESON
UMEÅ UNIVERSITY

**Conditioned cough and urge to cough in a category learning task**
THOMAS JANSSENS, LIEVEN DUPONT, & OMER VAN DEN BERGH
UNIVERSITY OF LEUVEN
A breath of air: Nocebo-effects in dyspnea.

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Background: In pain research, placebo and nocebo effects have been shown to significantly influence pain experience, resulting in important implications for pain treatment. However, the study of placebo and nocebo effects related to respiration and respiration related symptoms is very limited. The aim of this study was to investigate nocebo effects related to dyspnea.

Method: Expectancy effects were created by the following instructions and conditioning procedure. First, in two acquisition blocks, one of two odors (1-hexanol, methyl hexanoate, CS+ and CS-, counterbalanced) predicted an inspiratory resistance of 0.81kPa/l/s (US), whereas the other odor predicted no resistance. In the next two test blocks, both odors were paired with an inspiratory resistance of 0.32kPa/l/s. Participants were told that, in two of four blocks, they would be inhaling a substance with a specific odor that induced dyspnea, whereas in the two other blocks, they would be inhaling a control substance that also had a specific odor but would not induce dyspnea. Participants rated dyspnea intensity in response to both ‘substances’.

Results: Although participants were exposed to inspiratory resistances of equal magnitude after exposure to both odors in the test phase, dyspnea was rated significantly more intense in response to the odor that was paired with the higher respiratory resistance during acquisition than in response to the odor that was paired with no resistance.

Discussion: This study shows important dyspnea related nocebo effects, created by the combination of learning and instruction. The present findings have important implications for the assessment of respiratory symptoms.
Asthma and odors: the role of risk perception in asthma exacerbation

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Background: Fragrances and strong odors have been characterized as putative triggers that may exacerbate asthma symptoms and many asthmatics readily avoid odors and fragranced products. However, the mechanism by which exposure to pure, non-irritating odorants can elicit an adverse reaction in asthmatic patients is still unclear and may involve both physiological and psychological processes. The aim of this study was to investigate how beliefs about an odor’s relationship to asthmatic symptoms could affect the physiological and psychological responses of asthmatics.

Methods: Asthmatics classified as ‘moderate-persistent’, according to NIH criteria, were exposed for 15 minutes to a fragrance which was described either as eliciting or alleviating asthma symptoms. During exposure, participants were asked to rate odor intensity, perceived irritation and subjective annoyance while physiological parameters such as electrocardiogram, respiratory rate, and end tidal carbon dioxide (etCO\textsubscript{2}) were recorded. Before, immediately after, and at 2 and 24 hours post-exposure, participants were required to subjectively assess their asthma symptom status using a standardized questionnaire. We also measured asthma status at each of those time points using objective parameters of broncho-constriction (spirometry) and measures of airway inflammation (exhaled nitric oxide, FeNO).

Results: Predictably, manipulations of perceived risk altered both the quality ratings of the fragrance as well as the reported levels of asthma symptoms. Significantly, perceived risk also modulated the inflammatory airway response.

Discussion: Stress elicited by smelling an odor merely perceived as harmful can affect airway physiology and impact asthma exacerbations. The mechanism underlying this effect is currently being investigated.
Not getting used to the smell – chemical intolerance as lack of habituation

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Department of Occupational and Public Health Sciences, University of Gävle, Sweden

BACKGROUND: Chemical intolerance is a prevalent, medically unexplained symptom characterized by diverse symptoms following weak chemical exposure. The symptom-eliciting exposures are often odorous, and include perfume, fabric softeners and fragrant flowers. Several explanatory mechanisms have been proposed, but empirical data is scarce. By reanalyzing data from previous studies, we aimed to find a criterion for chemical intolerance based on reactions to actual chemical exposure.

METHOD: We grouped participants from six previous studies based on their pattern of habituation to weak olfactory (amyl acetate and n-butanol) and trigeminal (CO₂ and acrolein) compounds. In two studies utilizing event-related potentials, and one functional magnetic resonance imaging study, stimuli were presented intranasally using a dynamic olfactometer. An exposure chamber that allowed full body exposure was used in the remaining three studies.

RESULTS: Individuals who did not habituate to weak chemical exposure, compared with those who did, reported (1) increasing symptoms during the course of the exposure, (2) greater problems with odors in everyday life, and (3) greater levels of everyday distress. They (4) performed worse on cognitively demanding tasks during exposure, and differed in measures of (5) the autonomic nervous system (respiratory rate and pulse rate variability), (6) low-level inflammation and oxidative stress, and (7) the so called pain matrix of the brain.

DISCUSSION: Lack of habituation to weak chemical exposure may be a fruitful method of defining a sub-group of chemical intolerance.
Conditioned cough and urge-to-cough in a category learning task

Thomas Janssens, Lieven Dupont, & Omer Van den Bergh

KU Leuven (University of Leuven)

Introduction: Cough is an important symptom of allergic rhinitis (AR) and upper respiratory tract infections, and can occur in response to a variety of triggers. Sometimes however, there is no clear relationship between cough responses and underlying pathophysiology, resulting in a diagnosis of cough hypersensitivity or somatic cough syndrome. In this study, we investigated the role of category information and symptom experiences on cough and urge-to-cough, using classical conditioning procedures.

Methods: After a cough threshold test, individuals with AR (n=24) and a healthy control group (n=24) received a mock allergy challenge, consisting of 20 unique pictures of allergens, which were exemplars of two trigger categories. Pictures of one trigger category (CS+) were followed by inhalation of citric acid (C3 dose, 8/10 trials) or saline (2/10 trials). Pictures of the other trigger category (CS-) were always followed by saline. Apart from main analyses, we explored interactions with Trait Negative Affect (NA).

Results: Main analysis did not show conditioned cough or urge-to-cough. However, individuals with AR showed increased urge-to-cough ratings and number of coughs in response to citric acid trials during acquisition. Inclusion of NA showed that group differences in cough and urge to cough were moderated by NA, and increased NA was associated with greater differences in urge-to-cough and cough response between CS+/CS- saline trials.

Discussion: Our findings suggest that category-based learning of cough and urge-to-cough are moderated by NA and AR status. Furthermore, AR and NA may be risk factors for reduced habituation of cough and urge-to-cough.
Symposium 5 Abstracts: Management of Respiratory Illness: Cognition and Emotion
Chair: Daphne Koinis-Mitchell

Asthma illness representations: do they really change over time?
KIMBERLY ARCOLEO & JONATHAN FELDMAN
THE OHIO STATE UNIVERSITY COLLEGE OF NURSING AND YESHIVA UNIVERSITY

Role of exacerbation triggers and trigger control perceptions in COPD
CHELSEY A. WERCHAN, ASHTON M. STEELE, THOMAS JANSSENS, MARK W. MILLARD, & THOMAS RITZ
SOUTHERN METHODIST UNIVERSITY, UNIVERSITY OF LEUVEN, AND BAYLOR UNIVERSITY MEDICAL CENTER

The impact of loneliness during pulmonary rehabilitation in patients with COPD
THOMAS REIJNDERS, KONRAD SCHULTZ, SIBYLLE PETERSEN, & ANDREAS VON LEUPOLDT
UNIVERSITY OF LEUVEN, CLINIC BAD REICHENHALL, AND UNIVERSITY OF LUXEMBOURG
Asthma Illness Representations: Do They Really Change Over Time?

Kimberly Arcoleo, PhD, MPH1 & Jonathan Feldman, PhD2

1The Ohio State University, College of Nursing, Columbus, OH; 2Yeshiva University, Ferkauf Graduate School of Psychology, Bronx, NY

Background: The Common Sense Model (CSM) of Self-Regulation illustrates illness representations (IRs) changing over time as individuals gain experience with assessing symptoms, making treatment decisions and appraising outcomes. Few studies have examined longitudinal changes in asthma IRs, and fewer regarding parents’ perception of their child’s asthma.

Methods: 1 year study of 300 Latina mothers & 300 children ages 5–12 w/asthma recruited from 2 school-based health centers & Breathmobile in Phoenix, AZ & 1 pediatric asthma & allergy clinic in Bronx, NY. Interviews & child PFTs @ baseline and 3, 6, 9, & 12 months; medical record reviews @ 12 months. SEM examined sociodemographic predictors of longitudinal changes in parental asthma IRs over one year.

Results: Parental IRs changed over time and differed significantly between Mexican and Puerto Rican parents (F=6.34, p=.01). Fixed effects for higher number of family members with asthma and time-varying effects for higher levels of social support and quality of the healthcare provider relationship were consistently predictive of IRs aligned with the professional model over 1 year while higher child panic was associated with IRs aligned with the lay model.

Discussion: Support for the CSM theoretical model was established. We demonstrated the critical role that the healthcare provider relationship and social support play in parents’ IR alignment with the professional model of asthma management. High levels of children’s panic reported by parents (linked with lay model IRs) illustrate the need for identifying and intervening to reduce panic in order to achieve optimal outcomes for their children.
Role of exacerbation triggers and trigger control perceptions in chronic obstructive pulmonary disease

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Background: Chronic Obstructive Pulmonary Disease (COPD) is one of the leading causes of mortality worldwide and is often characterized by symptoms of airflow limitation, breathlessness, and increased cough. Prevention and identification of exacerbations, in which patients experience a significant worsening of their symptoms, is vitally important to slow overall declines in functioning and improve patients’ quality of life. The present study sought to develop a reliable and valid measure of perceived triggers of exacerbations in patients with COPD, the COPD Exacerbation Trigger Inventory (CETI), as well as examine how patient perceptions of controllability of such triggers relates to overall quality of life and disease status.

Methods: Participants (n=192) were recruited through local clinics and online to complete surveys of the CETI, demographic information, disease specific information including medications and comorbidities, and the COPD Assessment Test (CAT). The CETI included a free response section on patients’ individual top triggers, combined with ratings of their controllability.

Results: Exploratory fixed factor analyses identified a stable 5-factor structure (6-7 items each) that demonstrated excellent internal consistency (Cronbach’s alpha = .90-.94). Such factors were found to be predictive of health status, exacerbation frequency, emergency room visits, and healthcare utilization. Participants found triggers related to dust, air pollution, smoking, and physical activity to be the most easily controlled, whereas those related to psychological factors, climate, infection, respiratory symptoms and sleep to be more difficult to control. Greater perceived controllability of triggers was associated with lower CAT scores, indicating higher overall quality of life and less impact of the disease on functioning.

Discussion: Overall, the results of the present study indicate that the CETI is a reliable and valid measure of perceived exacerbation triggers in patients with COPD. Such perceptions of trigger types and controllability may prove useful in both research and clinical settings with this population and contribute to increased knowledge regarding patient care and treatment. Future research should continue to explore the associations between perceptions of exacerbation triggers and other clinical indicators of COPD, as well as how such perceptions might influence patients’ physical health and overall quality of life.
The impact of loneliness during pulmonary rehabilitation in patients with COPD

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Background: Psychological factors such as negative affect have been demonstrated to impact course and treatment of chronic obstructive pulmonary disease (COPD). However, little is known about the respective impact of social factors. Subjectively experienced loneliness has been shown to predict morbidity in several other chronic diseases, but little is known on its impact on COPD. Moreover, the associations of loneliness with disease-specific fears in COPD are unknown. Therefore, this study firstly examined the associations between loneliness and outcome measures of a pulmonary rehabilitation program (PR) as well as disease-specific fears.

Methods: Before and after a 3-week inpatient PR program, patients with COPD (N = 104) underwent a 6-min walking test to measure functional exercise capacity. Loneliness was assessed with the Loneliness Scale. In addition, the Medical Outcomes Study 36-item short form and the COPD Anxiety Questionnaire were administered as measures of health-related quality of life (QoL) and disease-specific fears.

Results: Multiple regression analyses showed that at the start of PR, higher levels of loneliness were associated with worse levels of functional exercise capacity and QoL, and more fear of physical activity and fear of disease progression, even after controlling for the effects of age, sex, lung function, and smoking status. Interestingly, patients who reported a stronger decrease in loneliness from start to end of PR showed greater improvement in functional exercise capacity and QoL, and a stronger decrease in fear of physical activity and fear of disease progression during PR.

Discussion: This study shows that subjective loneliness is associated with relevant treatment outcomes and disease-specific fears in patients with COPD. Therefore, loneliness should be subject to further study as it could play a significant role in disease progression in patients with COPD.
Background: Chronic obstructive pulmonary disease (COPD) is a complex heterogeneous disease, in which several factors interplay to give the final clinical expression. As a chronic respiratory condition, it has traditionally been considered an inexorably progressive airflow obstruction in terms of forced expiratory volume in 1 second (FEV₁) deterioration. This worsening in FEV₁ has been described as constantly progressing, only intermittently interrupted by exacerbations, and associated with an increase of symptoms in a parallel fashion. However, this paradigm has been recently challenged by the available evidence. First, the progression of the lung function deterioration is not as clear as previously described with some patients not declining FEV₁ or even improving lung function. Second, recent studies have pointed out that COPD-related symptoms are not consistently perceived by patients in the same way, showing not only seasonal variation, but also changes in symptom perception during a week or even within a single day and with no obvious relationship with FEV₁. Accordingly, several studies have shown that FEV₁, despite being an extremely important parameter to predict the progression of the disease, is a poor surrogate marker for symptoms perception. Patient-reported outcomes (PROs) have gained popularity as a measure of the impact of treatment from the patients’ perspective, since they represent the individuals’ perception of their health status, beyond any physiological limitations. Several such PROs, therefore, are currently included in multidimensional COPD evaluation. This multidimensional approach helps identify different patient types and individualize pharmacological treatment. During the conference, we will be reviewing the evidence on symptoms perception and its variability in COPD and how to use this clinical expression for a personalised care.
Using Ecological Momentary Assessment to Describe Variability in Daily Child Asthma Symptoms
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Sleep and Night Awakenings in Urban Children with Asthma: Do Objective and Subjective Measurements Correspond to One Another?
BROWN MEDICAL SCHOOL AND UNIVERSITY OF COLORADO-BOULDER

Associations among central nervous system neuronal integrity, asthma control, and cognitive function: Preliminary findings
JULIET L. KROLL, ASHTON M. STEELE, AMY E. PINKHAM, CHANGHO CHOI, DAVID A. KAHN, MARYAM SAIFI, SHARON DEOL, E. SHERWOOD BROWN & THOMAS RITZ
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Using Ecological Momentary Assessment to Describe Variability in Daily Child Asthma Symptoms

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Background: Daily and contextual factors related to caregiver functioning and child asthma behaviors likely contribute to fluctuations in child asthma symptoms. This study used ecological momentary assessment delivered via smartphones to capture the daily experiences of urban families that may contribute to increased asthma symptoms.

Methods: Study participants included 60 children with asthma (ages 7-12) and their caregivers (89% African American) from low-income, urban families. Families completed a baseline session; caregivers completed twice daily surveys on smartphones for two weeks.

Results: Daily surveys generated 709 observations. Forty-two percent of the variability in daily asthma symptoms was between participants ($\tau_{00}=.1425, z=4.47, p<.001$) and 58% was within person ($\sigma^2=.1933, z=15.69, p<.001$). On days when caregivers reported increased child asthma symptoms, caregivers also reported feeling less comfortable in their neighborhoods ($\gamma_{10}=-.06, t=-3.30, p<.001$) and feeling less able to control child asthma at home ($\gamma_{10}=.13, t=3.21, p<.001$). There were differences in daily asthma symptoms by average level of caregiver quality of life (QOL; $\gamma_{01}=.12, t=3.30, p=.002$); caregivers with higher QOL had children with fewer daily asthma symptoms.

Discussion: Findings suggest that variability in daily asthma symptoms among urban children is explained, in part, by caregivers’ daily perceptions of comfort in their neighborhood and perceptions of their ability to control asthma at home. Caregiver QOL may also contribute to daily reports of asthma symptoms. Future work is needed that focuses on strategies (both asthma and non asthma-related) for supporting urban caregivers in their daily lives as they care for children with asthma.
Sleep and Night Awakenings in Urban Children with Asthma: Do Objective and Subjective Measurements Correspond to One Another?


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Background: Nocturnal asthma symptoms increase nighttime awakenings, especially in urban children with poorly controlled asthma. Frequent night awakenings can increase daytime sleepiness and negatively impact school outcomes. Self/caregiver report of nocturnal awakenings is an important component of asthma severity and control. We assessed the extent to which caregivers accurately report children’s nighttime awakenings. We examined the frequency of night awakenings in an urban sample of children with persistent asthma through objective and subjective measurements during a 4-week period. The co-occurrence daily asthma activity and night awakenings was also examined.

Method: Data are from Project NAPS – Nocturnal Asthma and Performance in School, a longitudinal study of asthma, sleep, and academic performance in urban and ethnically diverse children (ages 7-9). This report includes children with persistent asthma and data during the fall/winter 4-week monitoring period (n=304). Asthma control was assessed with the Asthma Control Test (Liu et al., 2007). Daily objective assessments of night awakenings were measured via actigraphy, and asthma was assessed daily via home spirometry (AM2), and a daily diary.

Results: Results from objective sleep assessments showed that children woke up a mean of 5 times per night (SD=3, range=5-14) and woke at least once on the majority of nights monitored (M=95% of nights, SD=8%, range=62% - 100%). Poorer asthma control was associated with more wakings per night (r=-.18, p<.05) and more variability in awakenings (r=-.2, p<.01). Nocturnal wakings by actigraphy were related to daily objective lung function (FEV1 % predicted), F=1.4, p<.05. Caregivers markedly underreported the frequency with which their children woke at night due to asthma. For example, 50% reported their children woke ‘not at all’, while data from objective measurements indicated that all children woke one or more nights during monitoring. Objective measurement of children’s night awakenings was not related to caregiver report of night wakings (r=-.02). However, objectively measured variability in the # of wakings per night was associated with a higher frequency of caregiver-reported awakenings (r=.19, p<.05). Nighttime asthma symptoms (by daily diary) were associated with mean number of objectively measured awakenings per night (multilevel analyses, F=1.5, p<.05).
Discussion: Results from objective measurements of sleep suggest that caregivers of children with asthma may under-report the frequency of their children’s night awakenings. Objective assessments of night wakings corresponded with objective assessments of lung function, as well as daily symptom reports. Children with persistent asthma may wake during the night much more frequently than their caregivers realize; this has implications for asthma morbidity, asthma control, and daytime functioning. Daily, real-time assessments of night wakings may be more precise than questions focusing on 4-week recall.
Associations among central nervous system neuronal integrity, asthma control, and cognitive function: Preliminary findings

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Background: Recent research on asthma across the life span has shown that older patients suffer from more cognitive impairments than healthy controls. However, central nervous system (CNS) pathways associated with such impairments are unknown. Magnetic resonance spectroscopy (MRS) can measure concentrations of metabolites in brain tissue to determine functionality and degeneration of neurons. This technique could help explore associations between asthma, cognitive function, and neuronal integrity.

Methods: We therefore tested in asthmatics associations between left hippocampal metabolites and 1) the Asthma Control Questionnaire (ACQ) and Asthma Control Test (ACT) and 2) cognitive function with the Montreal Cognitive Assessment (MoCA) and an affect labeling task. Seven participants with asthma underwent a 3T MRS scan with volumes of interest placed in the left hippocampus. Total N-acetylaspartate (NAA) and Myo-Inositol (MI) concentrations were calculated in reference to creatine (Cr) and water.

Results: Total levels of MI, a putative marker of glial inflammation, were significantly correlated with reduced asthma control on both the ACT and ACQ one hour preceding scan. NAA, a marker of neuronal integrity, was significantly correlated with higher asthma control. Higher cognitive function (MoCA) was significantly correlated with lower MI and higher asthma control, and better performance in affect labeling was correlated with lower MI.

Discussion: These preliminary findings suggest that patients with lower asthma control are burdened with mild cognitive impairments, which are reflected in glial inflammation and compromised CNS neuronal integrity. Our study is a first step in elucidating CNS pathways and shared mechanisms between cognitive functioning and asthma control.

Keywords: Magnetic Resonance Spectroscopy (MRS), asthma control
Interactive Poster Discussion

ALEXANDRA E. BRANDIMORE, MICHELLE S. TROCHE, KAREN W. HEGLAND
The Influence of Age on Perception of the Urge-to-Cough in Healthy Older Adults

Y. ESSER, H. HANSMAN, J. VAN DIXHOORN
Anxiety, hyperventilation complaints and dysfunctional breathing

MARI HERIGSTAD, ANJA HAYEN, ANDREA REINECKE, KYLE T.S. PATTINSON
A cue-based task for exploring emotional processing of dyspnea in COPD during functional Neuroimaging

MICHAELA HERZOG, JOSEF SUCEC, PAUL W. DAVENPORT, PEI-YING S. CHAN, ILSE VAN DIEST, OMER VAN DEN BERGH, ANDREAS VON LEUPOLDT
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Interoceptive fear generalization in panic disorder; a comparative study between panic patients and healthy controls

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PEDRO VARGAS, JOSE GONZALEZ-ALONSO, & ALISON MCCONNELL
Evaluation of the independent influences of breathing frequency and tidal volume upon respiratory sinus arrhythmia, blood pressure and baroreflex sensitivity in healthy men.

MARTA WALENTYNOWICZ, ILSE VAN DIEST, FILIP RAES, & OMER VAN DEN BERGH
Retrospective symptom (over)reporting: the role of processing styles

CHELSEY WERCHAN, JULIET L. KROLL, KYLIE BARFIELD, ASHLEY SCHNEIDER, MADELEINE BOUDREAUX, & THOMAS RITZ
Dietary Nitrate Supplementation during Final Exam Stress in Health and Asthma: Preliminary Findings

RUTH WUYTS, ELKE VLEMINCX, ILSE VAN DIEST, & OMER VAN DEN BERGH
The influence of slow vs. normal paced breathing training on relaxation and stress reactivity and recovery in high worriers

NADIA ZACHARIOUDAKIS, SIBYLLE PETERSEN, & OMER VAN DEN BERGH
Comparing the Interoceptive Classification Task with the Heartbeat Detection Task
THE INFLUENCE OF AGE ON PERCEPTION OF THE URGE-TO-COUGH IN HEALTHY OLDER ADULTS

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Background: Reflex cough is an airway protective mechanism that serves to detect and forcefully eject aspirate material. The urge-to-cough (UTC) is a respiratory sensation that precedes a reflex cough response, and there is some evidence that the UTC is blunted in neurodegenerative patient populations. However, no study has evaluated the influence of aging alone on reflex cough sensitivity. Thus, the aim of this study was to examine UTC sensitivity in healthy older adults (HOAs).

Methods: Twenty-eight HOA (14 female; 56-81 years) participants were fitted with a facemask connected to a one-way inspiratory valve and differential pressure transducer. Five different concentrations of capsaicin were delivered upon inspiration in a randomized block design. Participants rated perception of the UTC on a modified Borg scale following each presentation of capsaicin. The slope and intercept of the log-log representations of the UTC and corresponding capsaicin concentration were used to compare groups.

Results: The UTC increased with increasing capsaicin concentration in HOAs. The perceived magnitude of the UTC was significantly reduced in HOAs (lower intercept) compared to historical data from healthy young adults (p= .005); however, the slope of the line of best fit was not significantly different between the age groups.

Discussion: The results showed that HOAs are as sensitive to differences in stimulus intensity as healthy young adults; however, the perceived magnitude is reduced across all stimulus intensity levels. This supports the hypothesis that the presence of neurodegenerative disease affects the sensitivity to cough-inducing stimuli beyond the influence of aging alone.
Anxiety, hyperventilation complaints and dysfunctional breathing.

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Introduction: The label ‘hyperventilation complaints (HV)’ is still being used to identify a patient group. However, they may also be identified as ‘anxiety’ or as ‘dysfunctional breathing (DB)’. We studied the complaints and response to breath regulation of patients with anxiety, HV complaints or dysfunctional breathing.

Method: Data from an existing database of subjects with breathing and tension related problems, who were referred for breathing and relaxation therapy from 2006-2011, were included when they were classified under 1) anxiety (n=254), 2) HV (n=388) or 3) DB (n=156) by the therapist. The individual problems at entry were categorised in a qualitative analysis by two researchers in 21 groups of complaints. Treatment outcome was evaluated as change in these complaints (strongly improved, yes/no) and with two questionnaires, Nijmegen Questionnaire (NQ) and the General Function Questionnaire (GFQ).

Results: Anxiety and HV patients score equally high on NQ and GFQ at entry, DB patients score lower. Anxiety/panic as an explicit complaint was more present in anxiety patients (77%) than in HV (42%) and almost absent in DB (5%). Physical tension was more present in anxiety patients (50%) than in HV (25%) and DB (16%). However, the response to treatment in these two complaints was less positive for anxiety patients. Breathing problems were less present in anxiety patients (32%) than in HV patients (61%) and in DB patients (75%), but the response was equally positive (>70%).

Conclusion: Although there is large overlap, patients with anxiety, hyperventilation and dysfunctional breathing are clearly different.
A cue-based task for exploring emotional processing of dyspnea in COPD during functional neuroimaging

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Background: Dyspnea in COPD is influenced by psychological processes, including anxiety. Understanding these is important for treatment development. We created a task using word cues to interrogate dyspnea and dyspnea-related anxiety in COPD for use in functional neuroimaging.

Methods: Dyspnea-related cues were initially identified through discussions with health professionals/academics. Multiple cues were chosen to allow generation of average brain-response maps in functional neuroimaging. The task consisted of computerised cue presentation followed by visual analogue scale ratings of cue-related breathlessness and anxiety. It was tested in COPD patients in three stages: (1) paper-based test assessing cue relevance (n=11); (2) computerised test addressing relevance/tolerability (n=18); (3) test before and after pulmonary rehabilitation (n=34) investigating reliability, sensitivity and validity (compared with Dyspnea-12 (D12) and St.George Respiratory Questionnaires (SGRQ)).

Results: The final task (stage 3) showed high reliability (Cronbach’s alpha=0.90) and correlated with D12 (r=0.51,P=0.002) and SGRQ (r=0.80,P<0.0001). The anxiety component was sensitive to clinical change (reduced ratings (p=0.0012), correlating with changes in D12 (r=0.51,P=0.002) and SGRQ (r=0.62,P<0.0001).

Discussion: We have developed a cue-based task that is sensitive to clinical change and in agreement with validated measures of dyspnea. The task is well tolerated by patients, even during FMRI. A recently published FMRI study (Herigstad et.al.(2015), CHEST) using the task in COPD patients demonstrated that dyspnea ratings correlate with engagement in dyspnea- (insula/anterior cingulate cortex (ACC)) and fear-related brain regions (medial prefrontal cortex/ACC). Cue-based tasks may thus be useful for interrogating psychological factors of dyspnea in such fragile patient groups.
The Reliability of Respiratory Sensory Gating Measured with Respiratory-Related Evoked Potentials

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Background: Respiratory sensory gating (RSG) is the neural filtering of redundant respiratory sensory stimuli. Using electroencephalography (EEG), RSG can be assessed by respiratory-related evoked potentials (RREP) being elicited with a paired inspiratory occlusion paradigm. In this paradigm RSG is evidenced by a smaller RREP N1 peak amplitude for the second occlusion (S2) compared to the first occlusion (S1) and by a N1 peak S2/S1 ratio of approximately 0.5. However, little is known about the test-retest reliability of these measurements of RSG.

Methods: The present study examined the one-week test-retest reliability of the N1 peak amplitude for S1 and S2 as well as the N1 peak S2/S1 ratio in healthy volunteers with normal lung function. RREPs were induced by paired inspiratory occlusions (150 milliseconds) with an inter-stimulus interval of 500 milliseconds while high-density EEG was measured.

Results: Results confirmed a significantly smaller N1 peak amplitude for S2 compared to S1 at both time points (p's <0.01). The intraclass and zero-order correlations indicated good to excellent test-retest reliability of the N1 peak amplitude for S1 (r's >0.9, p's <0.05) and S2 (r's >0.7, p's <0.05). A poorer test-retest reliability was found for the N1 peak S2/S1 ratio (r's >0.25, p's = n.s.).

Discussion: Results indicate that the RREP N1 peak amplitude for S1 and S2 is a reliable measurement to study RSG over a one-week interval. The poorer test-retest reliability of the N1 peak S2/S1 ratio might be related to the relatively low number of presented inspiratory occlusions.
Beyond distraction? The effect of slow deep breathing on pain

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Background: Slow deep breathing techniques (SDB) are commonly employed to reduce pain. This study aimed to explore underlying mechanisms. First, the study sought to investigate to what extent focusing attention on one's own breathing can reduce pain. In addition, we aimed to investigate whether two different ratios of inspiratory to expiratory phase (i/e ratio) during SDB (6 breaths/min) can attenuate pain beyond distraction.

Methods: This study induced unpleasant heat stimuli with three intensities (1 to 3 degree Celsius above pain threshold) in participants (n=48) during the completing of four different breathing conditions. Three conditions involved different types of instructed, paced breathing: one at the participant's natural frequency, a SDB pattern with a low i/e ratio (2 sec in/ 6 sec out, with 0.5 sec pause between inspiration and expiration and 1.5 sec pause after expiration) and a SDB pattern with a high i/e ratio (6 sec in/ 2 sec out plus 2 sec pauses). A last condition served as a control and involved spontaneous breathing.

Results: The results revealed an overall significant effect of pain reduction by paced breathing at natural frequency and SDB comparing to spontaneous breathing. The SDB pattern with a low i/e ratio significantly attenuated pain more than a paced breathing at natural frequency (more than the effect of distraction) while the intensity of pain increased.

Conclusion: The findings indicated that paying attention to breathing significantly attenuate pain, but not to the same extent as SDB. To conclude, the hypoalgesic effect of SDB is partially caused by the distractive effect of voluntary changing one's breathing pattern. However, beyond the distraction effect, also other mechanisms apparently contribute to the analgesic effect of SDB with a low inspiratory/ expiratory time ratio.
Psychophysiological correlates of affective picture processing during perceived and anticipated breathlessness

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**Background:** Recent research indicates that affective processes influence bodily threat sensations, such as breathlessness. However, little is known about the reverse influence of breathlessness on affective processes, as well as the contribution of anxiety to this process. Here we investigated how the perception vs. anticipation of resistive-load-induced breathlessness (RLIB) influences affective picture processing.

**Methods:** High and low anxious participants viewed pictures of positive, neutral, or negative affective content under conditions of perceived RLIB, anticipated RLIB, or else, an unloaded baseline. We monitored skin conductance, heart rate, respiratory parameters, as well as gathered affective ratings of arousal and valence during picture viewing.

**Results:** Results indicated significantly elevated skin conductance levels during both perceived and anticipated RLIB relative to baseline, without a difference between these two conditions. Moreover, participants exhibited significantly lowered heart rate to positive and negative pictures, relative to the neutral ones, although no difference was observed between the anticipated and perceived RLIB. As expected, valence ratings increased linearly from negative to neutral and positive pictures, while arousal ratings proved significantly higher for negative as compared to positive and neutral pictures. Ratings of arousal were higher under conditions of perceived and anticipated RLIB, whereas valence ratings were lower for the RLIB conditions, relative to baseline. Ratings of both arousal and valence were comparable across perceived and anticipated RLIB conditions. Furthermore, high anxious participants demonstrated overall significantly lower mean inspiratory flow and expiratory time as compared to low anxious participants. Interestingly, low anxious participants showed significantly longer expiratory times when presented with the negative pictures.

**Discussion:** These findings complement ERPs results from our lab on affective picture processing and suggest that not only perceived, but also anticipated breathlessness impacts on the processing of affective stimuli, a process which is partly moderated by intrinsic anxiety levels.
The effect of dietary nitrate supplement on exhaled nitric oxide

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Background: Nitric oxide (NO) is a molecule that plays an important role in the airways' innate immune response, and the fraction of exhaled nitric oxide (FeNO) has been utilized to capture airway nitric oxide in those with respiratory disease and healthy individuals. Deficits in NO are linked to loss of bronchoprotective effects in airway challenges and have predicted symptoms of respiratory infection. While dietary nitrate supplements are marketed to enhance exercise performance, no studies to date have examined the impact of dietary nitrite on airway nitric oxide. We therefore examined the effect of the dietary nitrate supplement beetroot juice on FeNO in healthy individuals. We hypothesized that one dose of dietary nitrate supplement will significantly increase FeNO.

Methods: Our sample consisted of SMU students and faculty without any lung disease history (n=39). Participants visited the lab for two sessions. At the first session, beetroot juice was administered (70ml) following baseline FeNO measurements, with additional measurements 45 and 90 minutes afterwards. Identical procedures were followed with water (70ml) on a control day. Four subjects participated in an extended protocol to determine durational impact of nitrate consumption with additional measurements for both sessions at 135 and 180 minutes after baseline.

Results: There was a large and significant increase in FeNO (ppb) over time on the experiment day only. FeNO elevations are maintained consistently after 135 minutes.

Discussion: Consumption of dietary nitrate supplement elevates airway nitric oxide and subsequent research is needed to explore its potential to prevent airway infection.
Nurse-led intervention to assess airway defenses in the neurologically impaired patient

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Background: The human airway is protected by various airway defense mechanisms, including cough and swallow, which are controlled by a complex network of the central and peripheral nervous systems. Damage to these neurological systems can result from head injury, trauma, stroke, or neurodegenerative disease. Neurologic diseases and injuries are associated with impaired airway protective mechanisms and increased risk of pulmonary infection (Bolser, 2010). Nurses are frequently the clinical service providers first encountered by patients upon admission to a healthcare facility, and thus hold a central role in determination of a patient’s ability to tolerate food, liquid, or medications by mouth. Nurses play a critical role in early identification and screening of patients at risk for impaired airway defense mechanisms. While nurses routinely conduct neural assessments, they may not be familiar with the importance of effective cough and swallow as indicators or byproducts of neurological dysfunction. We present an overview of the neural bases of cough and swallow, related airway protection terms for the bedside nurse to understand, and provide detailed guidelines for screening and referral in instances where cough and/or swallow dysfunction is suspected. A thorough review of nursing assessment of respiration, cough, and swallow is presented in this poster.

Discussion: Impaired cough and swallow are consequences of neurological dysfunction and pose an increased risk for aspiration/mortality. Nurses provide early identification and frequent screening to reduce negative airway outcomes in the neurologically injured patient.
Interoceptive fear generalization in panic disorder; a comparative study between panic patients and healthy controls

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Background: Fear conditioning and fear generalization to interoceptive sensations have been hypothesized to play an important role in the pathogenesis of panic disorder. The present study aimed to investigate whether panic patients (N=12) differ from healthy controls (N=28) on (a) fear acquisition to respiratory sensations, (b) fear generalization to similar respiratory sensations and (c) interoceptive ratings of these sensations during fear generalization.

Method: A paired versus unpaired group design was used in which the conditioned stimulus (CS) was an inspiratory resistive load (15 cmH20/l/s); the unconditioned stimulus (US) was an inspiratory breathing occlusion (Pappens et al., 2012). The paired group (N=20, 6 patients) received 8 acquisition trials during which the CS was consistently and immediately followed by the US. The unpaired group (N=20, 6 patients) received 8 trials of unpaired CS-US presentations. During both pre-exposure and the generalization test following acquisition, the CS and 4 additional resistive loads of different intensities (5-10-20-25 cmH20/l/s) were presented 3 times each. Measurements included self-reported US-expectancy, ratings of intensity and unpleasantness of the loads, startle eyeblink response, electrodermal response and respiration.

Results: Only the paired group raised their US-expectancies during the CS load throughout acquisition, indicating successful CS-US contingency learning. Load intensity influenced US-expectancies during generalization as well as the interoceptive ratings throughout pre-exposure and generalization. Due to a relatively low sample size, differences between patients and healthy controls were not significant.

Conclusion: Despite the need for additional recruitment, the present findings already provide a replication and further validation of this IFC-paradigm with panic-relevant stimuli.

Key words: Panic, Interoceptive fear conditioning, Generalization, Resistive load.
Test-Retest Reliability of Respiratory-Related Evoked Potentials

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Background: The respiratory-related evoked potential (RREP) in the electroencephalogram (EEG) is a non-invasive technique to study the neuronal processing of respiratory stimuli. RREPs have increasingly been used to study the interactions between psychological factors and respiratory sensations. However, little is known about the test-retest reliability of the RREP.

Methods: The present study examined the one-week test-retest reliability of the RREP in ten healthy volunteers with normal lung function. RREPs were induced by inspiratory occlusions of 150 milliseconds while 128-channel EEG was continuously measured. The mean amplitudes for the five RREP components (Nf, P1, N1, P2 and P3) were studied.

Results: The results of the intraclass and zero-order correlations indicated a good test-retest reliability of RREP components N1, P2 and P3 (r’s >0.6, p’s < 0.05). A poorer test-retest reliability was observed for the Nf and P1 component (r < 0.34, p = n.s.).

Discussion: The RREP components N1, P2 and P3 showed a good test-retest reliability over a period of one week. The poorer test-retest reliability of the Nf and P1 component was most likely related to the relatively small number of presented inspiratory occlusions. Overall, the present results indicate that the RREP components N1, P2 and P3 can reliably be used in test-retest study designs.

Keywords: Test-Retest Reliability; Respiratory-Related Evoked Potentials
Baseline heart rate variability and the inhibition of pain in an offset analgesia paradigm

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Background: Reduced pain inhibitory capacity is a characteristic of functional syndromes such as fibromyalgia and IBS, and is predictive of the development of chronic pain. Reduced baseline heart rate variability (HRV) has been associated with these syndromes as well. As HRV has been proposed as an index of flexible and adaptive regulation to the changing environment, the purpose of this study was to investigate the relationship between HRV and pain inhibition capacity.

Method: Sixty-five healthy students participated in this study. HRV parameters were derived from 8-minute baseline ECG recording. An offset analgesia paradigm was administered to assess pain-related inhibitory capacity. Pain ratings during constant noxious heat stimulation to the arm (continuous trials, 15 sec) were compared with ratings during noxious stimulation comprising a 1°C rise and return of temperature (offset trials, 15 sec). Offset analgesia is defined by the reduction in self-reported pain following the 1°C decrease relative to pain at the same time point during continuous heat stimulation.

Results: Analyses indicated an overall inhibition effect: a faster recovery in pain ratings followed offset trials compared to continuous trials. Although different HRV measures tended to be associated with larger differences between the constant and the offset trials reflecting a higher pain inhibition capacity, these results were not significant.

Conclusion: There was no convincing evidence for an association between baseline HRV and pain inhibitory capacity.

Keywords: pain inhibition, heart rate variability
The effects of physical activity, mindfulness meditation, or heart rate variability biofeedback on executive functioning, worrying, and mindfulness

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**Background:** In contemporary western societies stress is highly prevalent. Stress can have a negative effect on executive functioning, worrying and mindfulness, which could reduce productivity and quality of life. This randomized controlled trial compared the efficacy of self-help physical activity (PA), mindfulness meditation (MM), and heart rate variability biofeedback (HRV-BF) on attentional control, executive functioning, worrying, self-compassion, and mindful awareness.

**Methods:** 76 participants (20 males; mean age 25.8, range 18-40) were randomly allocated to PA, MM, or HRV-BF. The interventions consisted of psycho-education and an introduction to the specific intervention techniques and five weeks of daily exercises at home. The PA exercises consisted of a vigorous-intensity activity of free choice, the MM exercises consisted of guided mindfulness meditation, and the HRV-BF exercises consisted of slow breathing with a heart rate variability biofeedback device. Participants received daily reminders for their exercises and were contacted weekly to monitor their progress. They completed questionnaires prior to, directly after, and six weeks after the intervention.

**Results:** Results indicated an overall beneficial effect consisting of reduced worrying and improved attentional control, executive functioning, self-compassion, and mindful awareness. No significant between-intervention effect was found.

**Discussion:** Results suggest that PA, MM, and HRV-BF are equally effective in reducing worrying and improving executive functioning and mindfulness. These self-help interventions provide easily accessible help for people with adverse consequences of stress.
Evaluation of the independent influences of breathing frequency and tidal volume upon respiratory sinus arrhythmia, blood pressure and baroreflex sensitivity in healthy men.

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Background: Slow breathing exerts a potent effect upon blood pressure regulation, but the independent influences of breathing frequency (fR) and tidal volume (VT) upon the interplay of respiratory sinus arrhythmia (RSA), mean arterial pressure (MAP) and the baroreflex sensitivity (BRS) are poorly understood. We hypothesised that the fR and VT would exert independent effects upon RSA, MAP and BRS.

Methods Part 1: the relationship between fR and cardiovascular outcomes was characterised, and the fR (between 4 and 10 b.min⁻¹) that maximised RSA in each of 14 healthy men was identified. Part 2: the optimal fR identified in part 1 was implemented across a range of VTs (20 to 40% FVC). PaCO₂ was controlled using added dead-spaces. A bespoke biofeedback system specified the respiratory flow rates.

Results: RSA, MAP and BRS exhibited a bell-shaped response to changes in fR, with a peak at 6 b.min⁻¹ for all variables. A significant main effect for fR upon RSA (p<.05) and BRS (p<.05) was detected, but MAP showed no significant relationship to fR (p>.05). RSA increased linearly with increments in VT, peaking at the highest VT tested (40% FVC; p<.05). A positive main effect for VT upon MAP (p<.05) was found, but post-hoc analysis found no differences between VTs (p>.05). VT induced changes in BRS were not significant (p>.05).

Discussion: Independent effects of fR and VT upon RSA were found in all participants, whilst only changes in fR affected BRS. It is possible that VTs above 40% FVC might elicit even higher RSA and BRS.

Keywords: Respiratory sinus arrhythmia, Baroreflex Sensitivity
Retrospective symptom (over)reporting: the role of processing styles

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Background. Symptom overreporting occurs frequently in medical settings. The current study examined the effect of processing style (PS) focusing either on sensory-perceptual or on affective-motivational aspects of the somatic experience during experimentally induced dyspnea and pain on retrospective symptom reports in high and low habitual symptom reporters (HSR).

Methods. Dyspnea (rebreathing) and pain (cold by thermode) were induced during two experimental sessions in healthy female students (N=45) varying in habitual symptom reporting. Within-subject manipulation of sensory and affective PS took place at the encoding phase. Dyspnea and pain ratings were collected during the sessions and after 2 weeks. Breathing behavior was recorded during dyspnea trials, while state negative affect (NA) and symptom measures were collected after each trial.

Results. State NA and symptom ratings were elevated in affective PS condition, and decreased during the subsequent sensory PS session. This difference did not occur when sensory PS was induced first. Furthermore, an affective PS led to an increase in retrospective dyspnea reporting over the course of 2 weeks.

Discussion. The processing focus applied during symptom encoding may explain previously observed bias in retrospective symptom reporting. The results are relevant to understand the mechanisms underlying overreporting of symptoms and medically unexplained symptoms.
Dietary Nitrate Supplementation during Final Exam Stress in Health and Asthma: Preliminary Findings

Werchan. C. A., Kroll, J. L., Barfield, K., Schneider, A., Boudreaux, M., & Ritz, T.

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**Background.** Past research has demonstrated significant changes in immune response and airway inflammation during times of stress. Specifically, significant decreases in the fraction of exhaled nitric oxide (FeNO) in both healthy and asthmatic undergraduate students have been found during times of final exam stress. Additionally, research suggests that dietary supplementation of nitric oxide may have beneficial cardiovascular effects which may offset the physiological consequences of stress. The current study aimed to explore the psychological and airway health effects of dietary nitric oxide supplementation via beetroot juice during times of final exam stress.

**Methods** Participants were 76 undergraduate students (60 healthy, 16 asthmatic) who were randomly assigned to either a control group (no supplementation) or an experimental group which received 7 daily doses of beetroot juice beginning the day before final exams. Participants completed 1 baseline session during a time of low stress and 2 sessions during a time of high stress (final exams). Sessions included self-report questionnaires and physiological measures (spirometric lung function, respiratory resistance, blood pressure, saliva, FeNO, and heart rate).

**Results** Preliminary results indicate that asthmatic participants taking beetroot juice benefited by fewer respiratory symptoms during stress phases. Intake of beetroot juice and higher FeNO levels during final exams were associated with lower levels of sickness and cold symptoms seven days after the finals.

**Discussion** The present study demonstrates symptomatic benefits for asthmatic participants receiving nitrate during stress phases as well as general immune-protective effects for all participants. These preliminary results highlight the need for further investigation of the impact of dietary nitrate supplementation on the susceptibility to illness in times of stress. Further research is needed to explore potential long-term effects of nitrate supplementation in asthma.
The influence of slow vs. normal paced breathing training on relaxation and stress reactivity and recovery in high worriers.

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1 Health Psychology, University of Leuven, Leuven, Belgium

Background. Treatment protocols for various stress-related disorders often include slow regular breathing instructions. However, the clinically validated effects of these breathing techniques are not well understood. From a dynamic systems perspective, breathing should not be controlled for too long and should be characterized by complex variability. A lack of structured respiratory variability or excess random variability compromises the respiratory system. In this study we investigated the influence of four weeks of slow vs. normal paced breathing training on subjective relaxation and physiological stress reactivity and recovery in high worriers.

Methods. A slow (8 bpm) and normal (14 bpm) breathing pattern (10 minutes each) was induced in each participant (N=36) by auditory pacing. Respiratory, cardiovascular and EMG parameters were continuously recorded using the NeXus-10 (MindMedia BV). After each breathing pattern, relaxation questionnaires were administered. Half of the participants practiced slow paced breathing at home for four weeks, half of them normal paced breathing. Participants underwent the same procedure in the lab after training.

Results. Overall, slow paced breathing induced higher self-reported relaxation than natural (baseline) and normal paced breathing. However, after training stress had more impact on self-reported relaxation in the slow breathing group, but only after normal paced breathing. Physiological data during both breathing exercises and in response to mental stress reactivity and recovery will be addressed.

Discussion. Preliminary results confirm the within-session increase in self-reported relaxation in response to slow breathing. Training effects point to differential effects and will be further investigated. Data-analysis is in progress and results on respiration and EMG will be reported.
Comparing the interoceptive classification task with the heartbeat detection task

Nadia Zacharioudakis, Sibylle Petersen, & Omer Van den Bergh

KU Leuven, Research Group on Health Psychology

Background. The heartbeat detection task (HDT) is a standard measure of interoceptive accuracy, but in its tracking version, it does not allow testing interoceptive sensitivity and bias as separate constructs. Furthermore, by definition, it does not allow testing different perceptual modalities using the same protocol, such as comparing accuracy in the perception of dyspnea versus pain.

Methods. We compared results from a HDT with results from the Interoceptive Classification Task (ICT), a task that allows distinguishing between interoceptive sensitivity and bias and can be used in different modalities. We invited 32 healthy participants to complete the respiratory version of the ICT using eight different respiratory loads and the HDT, counting their heartbeats for three time intervals (25, 35, and 45 seconds). Participants also completed questionnaires on negative affect, anxiety, depression and stress and rated subjective certainty about their performance in the ICT.

Results. Higher error scores in the HDT were related to a stronger tendency to overestimate loads in the ICT. The HDT error score and bias assessed in the ICT correlated both with stress and depression, but not with anxiety. The relationship between HDT index and anxiety was significantly moderated by subjective certainty about interoceptive decisions. Anxiety, stress, and depression were significantly related to reduced sensitivity for differences between higher intensities as assessed in the ICT. No significant correlation was found between heartbeat detection and sensitivity assessed with the ICT.

Discussion. The ICT can be applied with as much ease as the HDT. Results of this study suggest that by differentiating between bias and sensitivity, the ICT can be a useful addition for research that aims at understanding the relationship between interoception and affect.
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www.isarp.org
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Saturday, October 10
8:30pm
Casa Robles
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