# Digital Health
# in Ambulatory Assessment

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**5TH BIENNIAL CONFERENCE | UNIVERSITY OF LUXEMBOURG**
**15–17 JUNE 2017**

SAA 2017

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# EDITORIAL

In this volume all accepted contributions to the 5th Biennial Conference of the Society for Ambulatory Assessment are published. The number and quality of these contributions testify to the high standard of international research in ambulatory monitoring, the rapid advances in technology and data handling support- ing ambulatory assessment, and the importance of these developments for the rapidly expanding area of Digital Health. Converging technologies such as Internet applications, social networks, smartphones and wearable sensors in the area of health, are now beginning to transform our approach to health research, healthcare, and communication and access to information.

Abstracts in this volume are listed according to the type of presentation (keynote lectures, symposia, free oral presentations, poster presentations, workshops). To facilitate orientation, keynote lectures, symposia and free oral presentations are listed following their order in the program, while poster presentations are grouped under thematic headings. The author index at the end of the volume is designed to allow for the identification of contributions from individual authors.

Many people are involved in the selection and reviewing of submissions to a congress. I would like to express my heartfelt thanks to the colleagues of the scientific program committee for their support in the reviewing process, the result of which is brought together in the present volume. My co-workers from the organization team have provided invaluable support through attentive proof reading of submissions and other documents, indefatigable work commitment, professional handling of numerous communications, and creative ideas in the organization of this congress. I am extremely grateful for their support, without which this exciting congress would not have been possible.

Last but not least I would like to thank all colleagues attending this congress, who have shown their commit- ment by submitting their work and sharing their results with us. May I wish you all exciting reading, and an enjoyable and successful congress.

Claus Vögele
June 2017

# I. KEYNOTES

**KEYNOTE LECTURE 1**

### Moving behavioral monitoring and interventions into the digital era

Paul Wallace
*NIHR CRN Specialty Cluster Co-Lead and Emeritus Professor of Primary Care at the UCL*

The lecture will consider the opportunities for moving behavioral monitoring and interventions into the digital era as well as the challenges posed by such a move. It will illustrate the relevant issues with specific reference to the speaker's leadership of an international research program exploring the potential to digitalize screening and brief interventions for risky drinking. It will also consider recent developments in the use of digital technologies to enable patients to monitor aspects of their behavior and well-being, and explore the impact which such technologies can have on well-being. The potential to deploy a whole population approach to digital technologies for behavioral monitoring and interventions will be described in relation to an initiative currently in development in the North of England

**KEYNOTE LECTURE 2**

### Health 4.0 – How virtualization and big data are revolutionizing healthcare

Christoph Thuemmler
*Professor for eHealth at Edinburgh Napier University*

Due to demographic and socioeconomic challenges and also powered by technological progress, the way healthcare is being delivered is undergoing an accelerating rate of change. The healthcare model is in transition from a centralized, institutional focused system to a distributed, patient centric model. In the future, more and more care will be delivered in surgeries, care homes, day clinics – and over the Internet. In order to deliver the innovation that is in the pipeline of the pharmaceutical industry, telecom vendors, IT companies, the IOT community, payers, and regulators, potential solutions have to be adjusted to the requirements of "critical infrastructures" in the health domain to allow for a more distributed, parallelized approach under control of the patients who, in accordance with the general understanding in the Eurozone and elsewhere, own their data. The keynote will outline how the delivery of care will change, highlight the relevant technologies, and discuss some critical regulatory aspects. It will also introduce new business models arising from the new economic realities around the health and care domains.

**KEYNOTE LECTURE 3**

### Challenges remaining for the field of real-time, self-reported data

Arthur Stone
*Professor of Psychology and Director of the USC Dornsife Center for Self-Report Science at the University of Southern California*

Over the last 40 years there has been a pronounced shift in the techniques of measuring self-reports: It is now relatively common for ambulatory methods to query participants about their thoughts, feelings, social and physical environments, and symptoms. There nevertheless remain several issues that diminish the impact and application of real-time collection of self-reports, some of which have been mentioned in prior reviews. Among the issues to be discussed are: the self-selection of persons into real-time studies and into completed momentary self-reports, both of which are influenced by burden; the inadequacy of our psychometric understanding of momentary reports and the lack of application of "modern" psychometric techniques; that we do not have a thorough understanding of the meaning of questions asked in the moment; the nagging issue of reactivity of monitoring; and, the difference between truly momentary reports versus "momentary" assessments that cover a longer period. I argue that these issues call out for timely study and suggest several paths for doing so.

**Moving from 'cold' to 'warm' computational models of individual behavior: Cyberphysical systems to understand food intake**

Donna Spruijt-Metz
*Director of the USC mHealth Collaboratory at the University of Southern California's Center for Economic and Social Research*

We generate vast amounts of personal data that could, on a day-to-day basis, be saving our lives. However, these data vary greatly in their accessibility and are often siloed and/or unmergeable. These data also differ in the nature of the measure, type of inference, frequency of capture, precision, and rate/trajectory of change. We need dynamic models that learn as they go. These dynamic models should be seeded with received knowledge about groups ('cold' models). However, as they 'learn' the individual and grow along with the individual, they should become highly personalized 'warm', ever-adapting models. These are the kind of models that are needed to be able to intervene in real time, when people are in need and available. We have major transdisciplinary tasks ahead of us to develop modeling techniques that will optimize utilization of this multilevel, multidimensional data. This talk will offer some ideas on what might help us to get from here to there, using food intake as a case study.

# II. SYMPOSIA

## Social relationships, health and well-being in daily life

Chair(s): Gertraud (Turu) Stadler (University of Aberdeen)

Aims: This symposium examines the role of social processes for health and well-being in daily life. All studies use intensive longitudinal designs, with the first three presentations following individuals, and the last two presentations following couples over time. These designs allow the fine-grained description of social processes in daily life close to the time when they occur and minimize recall and reporting biases prevalent in classic studies of close relationships. Thus, this set of studies uses ambulatory assessment with mobile phones, wearable sensors, and physiological sampling to better understand social relationships, health and well-being in daily life.

Laws and colleagues show that interpersonal stressors impact subjective well-being more than other daily stressors. Ansell and colleagues describe the temporal trajectory of craving over the day, how it changes on days with higher interpersonal stress, and how craving is related to a consequential health behavior, drinking alcohol. Kuehnhausen and colleagues investigate the links between social support, physical activity, and well-being in daily life. The last two presentations in this symposium include both members of couples and follow them over time. Ditzen and colleagues study the co-regulation of couples' stress, fatigue, and cortisol in daily life. Klumb and colleagues examine in working parents how work stress is linked with affect and parenting behaviors.

*Topics: General ambulatory assessment*
*Keywords: close relationships, intensive longitudinal designs, couples, health, affect*

## PRESENTATIONS OF THE SYMPOSIUM

### Interpersonal stressors affect subjective well-being more than other types of stressors

Holly Laws[1], Emily Ansell[2]
*[1]School of Medicine, Yale, New Haven, CT, [2]Syracuse University, NY*

Background: Multiple laboratory studies indicate that interpersonal stressors have a more pronounced impact on individuals' health-related outcomes than other types of stressors. Fewer studies have examined the relative impact of interpersonal vs. other stressors in daily life. The present study compared the effects of different types of stressors (e.g., interpersonal, work) in a smartphone-based EMA study of daily stressors.

Methods: At the end of each of the 14 study days, 77 study participants rated their subjective well-being and the number and type of stressors they experienced.

Results: Multilevel models using contrasts to distinguish between types of stressors indicated that the impact of interpersonal stressors was significantly stronger in its association with Negative Affect (NA; $\chi2[1] = 5.26$, $p = .021$) and overall mental health (MH; $\chi2[1] = 9.63$, $p = .002$) than other daily stressors. Interestingly, distinguishing between stressor type yielded opposite direction associations with daily positive affect (PA). Interpersonal stressors were associated with decreased PA at trend level significance ($\gamma = -1.45$, $p = .089$), while experiencing more work stress than usual was associated with increased PA ($\gamma = .74$, $p = .004$, coefficient contrast $\chi2[1] = 7.85$, $p = .005$).

Conclusions: Findings indicate that interpersonal stressors may be more important sites for intervention than other daily stressors, providing a partial replication of findings from laboratory studies. The incidental finding that work stress may actually increase PA, while interpersonal stress decreased it, suggests that distinguishing between stressor types may be crucial in providing an accurate understanding of how stressors impact subjective well-being in daily life.

### The daily course of alcohol craving and the impact of interpersonal stress

Emily Ansell[1], Holly Laws[2]
[1]Syracuse University, NY, [2]School of Medicine, Yale, New Haven, CT

Background: Craving, or the preoccupation and anticipation stage of the addiction cycle, is an enhanced motivational state for substance use that results from exposure to cues and/or stressors. Although craving is now a clinical criterion of substance use disorders in DSM-5, it has been difficult to define normative and non-normative craving. The present analysis seeks to address this problem by examining the course of craving via intensive repeated assessments in daily life.

Methods: 77 participants completed multiple random and event contingent surveys per day over the course of 14 days; each survey included ratings of current alcohol craving. Multilevel models were used to characterize the average time course of alcohol craving during the day prior to consuming any alcohol.

Results: These models showed a linear positive trajectory of alcohol craving throughout the day. An additional analysis examined whether fluctuations in stress affected daily craving. On days with more interpersonal stress than usual, the intercept and slope of daily craving were significantly higher as well. Finally, steeper than usual craving slopes before the first drink predicted an increase in number of alcoholic drinks consumed that day.

Conclusions: These results point to the relevance of intensive repeated measurement as a method to identify meaningful within-person trajectories of craving. They are also the first known findings that illustrate the naturalistic trajectory of craving over the course of the day. Importantly, these findings indicate that inter-personal stress may upregulate an individual's alcohol motivational state within real world contexts.

### Social support, physical activity, and life satisfaction during student's first semester

Jan Kühnhausen[1], Johanna Schmid[1], Kenzie Snyder[2], Matthew Riccio[3], Gertraud (Turu) Stadler[4], Caterina Gawrilow[1]
[1]University of Tuebingen, Germany, [2]Columbia University, New York, NY, [3]New York University, New York, NY, [4]University of Aberdeen, Scotland, UK

Background: For many students, the beginning of their first university semester marks a transition to a novel situation with profound influence on their life satisfaction. Both social support and physical activity can contribute to higher satisfaction in stressful adaptation phases. At the same time, social support is highly associated with how physically active a person is. Investigating how those two factors influence each other and are interwoven to foster student's life satisfaction during the beginning of their studies is, therefore, an important endeavor.

Methods: In this study, 65 young adults (age: M = 22.2) took part in three measurement bursts in their first year of college, each lasting nine days. During each day, participants wore ActiGraphs to measure physical activity. On each evening, they answered a questionnaire about how much support they had needed, looked for, and received on that day in general and with regard to being physically active. On each morning and evening, participants reported their life satisfaction.

Results: Within-person results showed that young adults were less satisfied on days on which they needed more support and more satisfied on days on which they received more support. The role that physical activity and social support related to it play in this association is examined on a within- and between-person level in further analyses.

Conclusions: The results yield important insights into influences on life satisfaction during challenging transition periods – not only by illuminating influential factors, but also by showing how those factors are related to each other.

### Co-regulation of stress, fatigue, and cortisol in couples' everyday life

Johanna M. Doerr[1], Urs M. Nater[1], Corinne Spoerri[2], Ulrike Ehlert[2], Beate Ditzen[3]
[1]University of Marburg, Germany, [2]University of Zurich, Switzerland, [3]University of Heidelberg, Germany

Background: Knowledge about how fatigue develops, worsens, and what influences daily fatigue is still limited. As stress can influence fatigue, and being in a relationship either increases or decreases stress depending on the couple interaction, we investigated co-regulation of stress, fatigue, and biological markers in couples' everyday lives.

Methods: 40 couples (age: 28±5 years) reported fatigue and stress levels 4 times a day for 5 consecutive days (1,600 measurements). Interactions with the partner, salivary cortisol (measure of HPA axis activity), and alpha-amylase (measure of ANS activity) were analyzed at the same time points. Data was analyzed using multilevel models of distinguishable dyads to account for the nested design.

Results: Stress (women: $p \leq 0.001$, men: $p \leq 0.001$) and fatigue (women: $p = .003$, men: $p = .020$) were co-regulated within couples, and more so when partners had interacted with each other. Cortisol was co-regulated in both men and women (women: $p \leq 0.001$, men: $p \leq 0.001$), whereas regulation of alpha-amylase levels depending on the partner's levels was only present in women ($p = 0.002$). Valence of interaction was negatively associated with fatigue (women: $p \leq 0.001$, men: $p = 0.011$).

Conclusions: Fatigue and stress levels during the day seem to be co-regulated within couples with particularly strong associations when the partners interact with each other. These data suggest that in interventions to address stress and fatigue with clinical groups, a dyadic perspective might be implemented in order to improve individual well-being.

### Daily work-family processes: An examination of the mediating role of parenting behaviors for the effects of work stressors on affective strain

Petra L. Klumb, Sebastian Siegler, Regina Jensen, Dominik Schoebi
University of Fribourg, Switzerland

Background: Research on the linkage between work stress, employees' well-being, and family processes is an important topic in I&O research. There is an increasing number of diary studies revealing the spillover of work stress and strain into the family domain. The aim of this study was to look at the indirect effects of daily work stressors on affective strain via father's parenting behaviors.

Methods: For a period of eight consecutive workdays, 75 fathers holding a range of different jobs in a Swiss retail company took part in an intensive longitudinal study with four measurement occasions per day, three of which were included in the analysis (before work, at the end of the work day, and at the end of day). At all the occasions fathers reported their momentary affective state. After work, we assessed the number of tasks left unfinished and at the end of the day, fathers reported their behaviors towards their children (e.g., positive parenting behaviors), and we additionally assessed their partners' reports of those behaviors. We modeled the hypothesized relationships at the within-person level by means of a multilevel structural equation model with latent variables.

Results: We found a positive relationship between unfinished tasks and affective strain at the end of the work day. While positive parenting behaviors after work were negatively related to levels of affective strain at the end of day as well as the next morning, there was no indirect path from work stressors to affective strain via positive parenting behaviors. We were able to replicate the effects on the basis of mother's reports, but only as tendencies.

**Opportunities and methodological challenges of dynamical networks of intensive longitudinal everyday life data**

Chair(s): Peter Kuppens (Research Group of Quantitative Psychology and Individual Differences, University of Leuven, Leuven, Belgium)

In the field of psychiatry, there has been growing attention towards ecological momentary assessments of psychiatric symptoms, mood states, behaviors, and contexts. Particularly, the use of electronic diary study designs has made it feasible to obtain within person, intensive time-series data of these experiences. With this type of data, hypotheses based on the network approach to psychopathology can be tested. This theory hypothesizes that psychopathology may develop dynamically as a complex network, in which mood states and/ or symptoms act as nodes that activate each other over time. Continuous dynamic interactions between nodes may eventually create a cluster of co-occurring symptoms, which can be considered to be a mental disorder (Cramer, Waldorp, van der Maas, & Borsboom, 2010; Kendler, Zachar, & Craver, 2011). Therefore, network symptom dynamics may function as promising parameters to investigate underlying mechanisms of psychopathology and processes of vulnerability and resilience.

Currently, there is great interest in the network approach as exemplified by the increasing number of publications employing this method. However, there is also considerable debate regarding the type of research questions network analyses may be used for and the statistical methods used to construct networks.

In this symposium we present our most recent work on the temporal dynamics of diary data, which will illustrate the different types of research questions that can be addressed by network analyses. In addition, we will show state-of-the-art methodological techniques, such as (multilevel) Vector Autoregressive (VAR) modeling, permutation testing, impulse response function tests. Furthermore, we will present a critical note on the current standings of using the network approach within psychiatry and the direction in which we believe the future of psychological network modeling is headed.

First, Maurits Masselink will present the results of a diary study investigating the relation between self-esteem and depressive symptoms in everyday life with social factors as possible mediators. He used multilevel VAR models to investigate the dynamic associations between these constructs. This approach enables us to investigate the underlying mechanism of the relation between self-esteem and depression on a much more fine-grained level than is common.

Second, Charlotte Vrijen will present an electronic diary study with measures including positive affect, negative affect, and worrying. She used multilevel VAR models to compare everyday life network dynamics between young adults with and without a bias for happy facial emotions. Differences between these groups may provide clues to everyday life mechanisms underlying facial emotion identification bias as a vulnerability marker for depression.

Third, Robin Groen will present a unique longitudinal study on networks based on daily time-series measures of depressive symptoms in depressed patients. She used multilevel VAR models and permutation testing to compare network dynamics for patients with a more and less favorable course of Major Depressive Disorder (MDD).

Fourth, Neha Moopen will present her study on the dynamics of physical activity and depression symptoms. This study employed a novel combination of electronic diaries and actigraphy to measure symptomatology and physical activity in daily life. She used VAR modeling and impulse response function tests to construct personalized symptom networks for MDD patients and to visualize the dynamic effects of physical activity on these networks.

Last, Laura Bringmann will present a critical view on multilevel VAR-based networks. Several challenges will be considered, such as the interpretation of the edges in the network and the stability of centrality measures. Also future challenges and developments of dynamical networks will be discussed.

*Topics: Big data*
*Keywords: psychiatry, intensive longitudinal data, network approach, methodology, vector autoregressive modeling*

## PRESENTATIONS OF THE SYMPOSIUM

**Unraveling the self-esteem depression relation: Associations between self-esteem, depressive symptoms, and social factors in everyday life**

Maurits W. Masselink[1], Eeske van Roekel[2], Albertine J. Oldehinkel[1]
[1]*University Medical Center Groningen, University of Groningen, Groningen, The Netherlands, [2]Tilburg University, Tilburg, The Netherlands [2]University Medical Center Groningen, University of Groningen, Groningen, The Netherlands*

Most existing longitudinal research devoted to elucidating the mechanism underlying the relation between self-esteem and depression has the limitation that it does not investigate this mechanism in everyday life and does not take into account the possible unique associations with different symptoms of depression. We investigated the associations between self-esteem and the two core symptoms of depression, sad mood and lack of pleasure, in everyday life. In addition, we investigated whether these associations would be mediated by social factors. 138 participants (aged 18-24) filled in measurements of self-esteem, sad mood, happiness, time spent interacting with others, and time spent with friends, three times a day over a 30-day period. Multilevel Vector Autoregressive (VAR) modeling was used to investigate the contemporaneous and temporal associations (lag 1) between the measures. We found that self-esteem had positive contemporaneous associations with cheerfulness, social interaction, and time spent with friends, and a negative association with sad mood. Associations over time indicated positive reciprocal associations between self-esteem and cheerfulness and a somewhat weaker negative reciprocal association with sad mood. Associations between self-esteem, cheerfulness, and sad mood were not mediated by social factors. The results imply that on a moment-to-moment basis, the mechanism of the relation between self-esteem and depression may be especially driven by reciprocal relations between self-esteem and pleasure and only to a lesser extent by reciprocal associations between self-esteem and sad mood.

**Spread the joy: How a bias for happy facial emotions translates into everyday life network dynamics**

Charlotte Vrijen[1], Catharina A. Hartman[1], Peter de Jonge[2], Albertine J. Oldehinkel[1]
[1]*University Medical Center Groningen, University of Groningen, Groningen, The Netherlands, [2]Developmental Psychology, University of Groningen, Groningen, The Netherlands*

There are indications that a bias in identifying happy facial emotions may be a vulnerability marker for depression. However, the underlying mechanisms remain to be elucidated. We used a network approach to explore whether clues can be found in everyday life moment-to-moment dynamics of positive affect, negative affect, worrying, and being interested in one's surroundings. We compared the network of young adults (ages 18-24) with high sensitivity to happy emotions during a facial emotion identification task (high happy bias group, N = 25) to the network of young adults with low sensitivity to happy emotions (low happy bias group, N = 25). Analyses were based on three momentary assessments per day for a period of 30 days. We used multilevel Vector Autoregressive (VAR) modeling to estimate separate lag 1 networks and centrality indices for the high and low happy bias groups. We found that for the low happy bias group worrying and sadness were most central to the network, whereas for the high happy bias group positive affect was most central. For the high happy bias group, higher positive affect was further associated with lower negative affect at the next measurement. This was not found for the low happy bias group, which may suggest that positive feelings are less helpful to overcome negative feelings in individuals with less sensitivity to happy emotions. Several methodological concerns will be addressed during the presentation, for example, individual variation within the two groups, the need for robustness checks, and other reasons why results should be interpreted with caution.

**Dynamic symptom networks and risk for long-term symptom persistence in depressed patients**

Robin N. Groen[1], Evelien Snippe[1], Elisabeth H. Bos[2], Marieke C. Wichers[1]
[1]*University Medical Center Groningen, University of Groningen, Groningen, The Netherlands, [2]Developmental Psychology, University of Groningen, Groningen, The Netherlands*

It remains challenging to characterize which patients will experience lasting symptom reduction after treatment for Major Depressive Disorder (MDD). The network approach to psychopathology may help to reveal underlying mechanisms influencing patients' capacity for recovery. This exploratory study examined the potential of this method and compared networks of dynamic symptoms associations between patients with

persistent or reduced depressive symptoms after treatment. We expected to observe higher overall connectivity in the symptom network of patients with more persistent symptoms. Depressive symptoms of 69 participants were assessed, three days a week for a period of six weeks, as part of larger intervention study. Multilevel vector autoregressive modeling was used to estimate networks of dynamic symptom connections. Overall network connectivity was compared using permutation tests. The percentage change in depressive symptoms between pre-intervention and 6-month follow-up was used to distinguish between individuals with persistent or reduced depressive symptoms. Patients who experienced reductions of symptoms at follow-up showed different network dynamics than patients in whom symptoms persisted. The symptom 'feeling everything is an effort' appeared to be central in the dynamics of the persistent symptom network, while 'worrying too much about things' seemed more important for the dynamics within the reduced symptom network. Permutation testing showed no difference in overall connectivity between the two networks. The current study may suggest that the dynamics of MDD symptoms differ between individuals with a more and less favorable clinical outcome. This exploratory study's unique design has generated new questions, which will be discussed together with methodological considerations.

### The dynamics of physical activity and depression symptoms: An individualized approach

Neha Moopen[1], Sanne H. Booij[2], Marieke C. Wichers[2]
[1]*Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, The Netherlands*, [2]*University Medical Center Groningen, University of Groningen, Groningen, The Netherlands*

Physical activity has shown an inverse association with depression symptoms, but exercise interventions for depression have suggested only small to moderate effect sizes in alleviating complaints. These effects could be attributed to heterogeneity between individuals and symptoms in the response to physical activity. We aimed to elucidate these micro-level processes by investigating the dynamic effects of physical activity on depression symptoms as measured in daily life. Electronic diaries and accelerometers were used to measure depressive symptoms and physical activity, respectively, over a 30-day period. Vector Autoregressive (VAR) modeling was utilized to analyze the time series of 27 participants individually, and impulse response function tests were carried out to visualize the dynamic behavior of the symptom network and calculate dynamic effect sizes. The observed effects were considerably heterogeneous over time. While there was wide variation between participants' responses, physical activity was most consistently associated with an immediate reduction in vitality-vigor symptoms, followed by a decrease in cognitive-affective symptoms over longer time periods. The heterogeneity of response to physical activity would support the need for personalization of treatment. This study provides an opportunity to discuss the methodological considerations arising from the combination of different ambulatory assessment techniques and the individualized application of VAR modeling.

### Dynamical networks in psychology: More than a pretty picture?

Laura F. Bringmann
*Faculty of Behavioural and Social Sciences, University of Groningen, Groningen, The Netherlands*

In this talk, I provide different perspectives on dynamical networks in psychology based on the multilevel Vector Autoregressive (VAR) model. In a VAR model, the structure of the time-dependency within and between variables is explicitly modeled through a set of regression equations. Using a multilevel extension of a VAR model allows one to study the dynamics both within an individual as well as at group level. Besides a visualization of the interaction between symptoms, networks provide a new toolbox of analyses related to network research. For example, centrality analyses answer questions about how important a variable is in a network. As the network techniques reveal the dynamics of symptoms and also potentially lead to a whole new perspective on psychopathology, it seems like a real revolution is taking place. However, with increasing popularity also the criticism grows. For example, how well can the raw coefficients of a multilevel VAR, and thus the edges of the network, be interpreted? Furthermore, the exact meaning and significance of the centrality measures in networks remains unclear. I will discuss these and other challenges to the network approach, ultimately answering the question: Dynamical networks in psychology – more than a pretty picture?

### Ecological validity of laboratory results: From the scanner into the wild

Chair(s): Ulrich Ebner-Priemer (Karlsruhe Institute of Technology (KIT)), Tim Trull (University of Missouri)

A relatively untapped application of Ambulatory Assessment (AA) is to evaluate the ecological validity of laboratory results. Laboratory methods are often considered the best way to establish the causal relationships among influences and outcomes. However, although the internal validity of experimental methods is often quite high, there are relatively few demonstrations of the ecological validity or real-world relevance of the findings. For example, the decade of the brain witnessed an explosion of research aimed at establishing the neural correlates of a range of psychological features, especially emotional and cognitive processes. In a typical study, standardized stimuli that are believed to evoke these processes are presented to a participant while neural responses are measured using imaging techniques. The important question is whether these laboratory results translate into real-world emotional, cognitive, or behavioral experiences. To date, only a limited number of studies have taken this additional step of evaluating the ecological validity of laboratory imaging results. All presentations in this symposium combine AA with fMRI methods, focusing on depressive rumination, emotion dysregulation, non-exercise activity, and reward processing.

*Topics: General ambulatory assessment*
*Keywords: ambulatory assessment, fMRI, depressive rumination, emotion dysregulation, non-exercise activity, reward processing*

## PRESENTATIONS OF THE SYMPOSIUM

### Combined ambulatory assessment and fMRI to study depressive rumination

Christine Kuehner[1], Vera Zamoscik[1], Silke Huffziger[1], Christina Timm[1], Ulrich Ebner-Priemer[2], Peter Kirsch[1]
[1]*Central Institute of Mental Health Mannheim,* [2]*Karlsruhe Institute of Technology*

Repetitive rumination has been proposed as an important cognitive risk factor for the onset and course of depression. Laboratory work has underscored the detrimental role of rumination on cognitive, emotional, and biological health outcomes, whereas there have been few demonstrations of the ecological validity of such findings. We combined Ambulatory Assessment (AA) with functional Magnetic Resonance Imaging (fMRI) to establish neural correlates of daily life rumination in patients with remitted Major Depressive Disorder (rMDD). AA of momentary rumination, mood, and saliva cortisol was performed on two consecutive workdays with 10 assessments per day. Depressive symptoms and habitual rumination were additionally assessed at baseline and at a six-month follow-up. At baseline, participants also underwent an fMRI paradigm that induced negative mood by the recall of significant negative autobiographical life events. A higher connectivity of the Default Mode Network (DMN) with the bilateral parahippocampal gyri during negative mood induction was identified in rMDD compared to healthy controls. In this group, higher connectivity predicted higher levels of rumination and negative mood in daily life and a worsening of depressive symptoms and habitual rumination during the following six months. Our study demonstrates that the combination of fMRI and daily life assessments can add important knowledge to possible rumination-related mechanisms, by identifying a neural phenotype of cognitive reactivity associated with daily life perseverative cognition and a deteriorating course of depression over time. We are currently testing whether a short mindfulness-based attention training is able to influence DMN hyperconnectivity and daily life rumination in rMDD.

### Daily life correlates of MRI and fMRI indices of emotion dysregulation

Tim Trull, Anne Merrill, John Kerns
*University of Missouri*

We assessed the associations among MRI/fMRI indices of emotion dysregulation (e.g., vmPFC-amygdala resting state functional connectivity; implicit emotional conflict task; explicit reappraisal task) and daily life indicators of emotion dysregulation (e.g., affective instability; impulsive behaviors; physiology). Thirty-two women in treatment for a disorder of emotion dysregulation (i.e., DSM-5 mood, anxiety, or borderline personality disorder) completed a neural scanning session (structural scanning, task 1 functional scanning, task 2 functional scanning, resting state functional scanning, and diffusion tensor imaging), and then two weeks of Ambulatory Assessment (AA). AA included random (six times per day) and event-based (large mood change) surveys administered via smartphone, as well as physiological data from a smart shirt and from a wrist sensor. Results have implications for the generalization of neural correlates of emotion dysregulation to daily life experiences and behaviors of patients with emotion dysregulation disorders.

### Associations between non-exercise activity and brain gray matter volume in adults: Combining ambulatory assessment and magnetic resonance imaging data

Markus Reichert[1], Heike Tost[1], Urs Braun[1], Hans-Joachim Salize[1], Alexander Zipf[1], Andreas Meyer-Lindenberg[1], Ulrich Ebner-Priemer[2]
[1]*Central Institute of Mental Health Mannheim, *[2]*Karlsruhe Institute of Technology*

There is emerging evidence for beneficial effects of physical activity on brain structure and function in humans. However, in most existing studies physical activity data is based on questionnaire assessment, which is subject to retrospective biases. Moreover, these investigations focused on the impacts of exercise (such as jogging) on brain structures and functions within children and the elderly. Unfortunately, there is only little research on the influence of non-exercise activity (unstructured physical activity in everyday life, e.g., climbing stairs) on neural correlates in adults. We aimed to contribute to closing the gap of research on the influence of non-exercise activity on brain functioning in adults and, especially, to overcome limitations of existing studies with regards to the non-exercise activity assessment through combining Ambulatory Assessment (AA) with Magnetic Resonance Imaging (MRI) measures. Therefore, applying a baseline and a one-year follow-up measurement, we assessed non-exercise activity objectively via accelerometers in the everyday life of adults (n = 75) across 7 days. Thereafter, we acquired anatomical MRI data to assess changes in brain gray matter volume. All participants were recruited at the Psychiatric-Epidemiological Center (PEZ), Central Institute of Mental Health, Germany. Preliminary analyses show a significant positive correlation between non-exercise activity and gray matter volume in prefrontal areas (peak voxel at x = -3, y = 50, z = -8; T = 5.68, p = 0.012 FWE-corrected for multiple comparisons across the whole brain) after controlling for exercise, wear-time, and body mass index. We will present detailed data revealing the strengths of combining AA with (f)MRI data.

### From lab to life: Associating brain reward processing with daily life motivated behavior

Jindra Myrthe Bakker[1], Liesbet Goossens[1], Iris Lange[1], Stijn Michielse[1], Koen Schruers[1], Ritsaert Lieverse[1], Machteld Marcelis[1], Thérèse van Amelsvoort[1], Jim van Os[1], Poornima Kumar[2]
[1]*Maastricht University Medical Centre, *[2]*Harvard Medical School*

It has been shown that people with a Major Depression Diagnosis (MDD) have blunted striatal Reinforcement Learning (RL) signals. Blunted reward processing has been proposed to be an important endophenotype in depressive psychopathology, thereby making research in at risk groups crucial. It is known that people with sub-clinical symptoms of depression are at heightened risk of developing MDD. The current study therefore included adolescents and young adults (n = 76), of whom 33 reported sub-clinical depressive symptoms (Montgomery–Åsberg Depression Rating Scale (MADRS) ≥ 10). Reinforcement learning is a well-documented laboratory paradigm, but its associations with daily life affect and behavior remain largely unexplored. Such knowledge would be valuable for the development of a) more concrete targets for non-pharmacological therapeutic interventions and b) less invasive outcome measures for clinical trials. The main goal of the current study was therefore to associate RL brain signals, collected using functional Magnetic Resonance Imaging (fMRI), with daily life affect and behavior. The latter were assessed with an Experience Sampling Method (ESM) involving data collection 10 times a day for 15 days. It was found that RL brain signals in the basal ganglia correlated with MADRS scores across the whole sample. No associations were found between RL brain signals and average positive and negative affect ESM scores. However, associations were found between RL brain signals and ESM measures involving activity attributions as well as a measure indicating whether people were spending time doing activities they enjoyed.

### Exploring daily life activities and socio-affective functioning in healthy aging: Findings from ambulatory assessment studies

Chair(s): Christina Röcke (University of Zurich), Andrea Horn (University of Zurich)

Many regulatory models of aging suggest an interplay of resources from different domains, including well-being, health, cognition, activities, and interpersonal functioning. Ambulatory assessment methods have provided a much-needed avenue to capture the within-person interplay between various resources important for late life functioning. This symposium provides an overview of different studies relying on a variety of assessment methods which examine various aspects of this interplay and focus on healthy aging. Martin et al. use data from the RHYTHM study to examine how both trait and state attachment and psychological need satisfaction covary within older adults in daily life. Horn et al. take a look at the role of momentary rumination for the course of relationship quality in the daily lives of couples. Katana et al. present first data from the MOASIS project to show within-person couplings between physical activity and day-to-day affect in healthy older adults. Using data from the same project, Fillekes et al. show how self-reported and objective (i.e., GPS-based) mobility information in late life relate to one another. Finally, using conversational data assessed with the Electronically Activated Recorder (EAR) in both an American and a Swiss sample, Demiray et al. examine mental time travel (i.e., instances of autobiographical memory) evident in the ambient sound profiles. Together, these papers use both experience sampling and sensor-based ambulatory assessment to capture a wide range of later-life behaviors, experiences, and activities at the individual and the couple level.

*Topics: General ambulatory assessment*
*Keywords: daily activities, socio-affective functioning, healthy aging, couples*

## PRESENTATIONS OF THE SYMPOSIUM

### Attachment and psychological need satisfaction in older adults' daily life: Findings from the RHYTHM study

Annika A. Martin, Mathias Allemand, Mike Martin
*University of Zurich*

One important goal in healthy aging research is to examine what older adults do in daily life to maintain or even improve their well-being and subjective health. The RHYTHM (Realizing Healthy Years Through Health Maintenance) study is an intensive longitudinal study over 10 days with multiple assessments per day that focuses on self-perceptions, states and behaviors, and naturalistic activities in the daily life of older adults. What affects older adult's well-being in daily life? According to self-determination theory, three basic needs (competence, autonomy, and relatedness) are essential for well-being and seem to go along with health and positive adaptation to late life. However, little is known about which resources older adults use to remain satisfied or how these processes unfold over a short-term time period. This work thus uses data from the RHYTHM study to examine associations between attachment orientations (anxiety and avoidance) and psychological need satisfaction (N = 59, the study is ongoing). At baseline, attachment and need satisfaction were assessed at a trait level, and then sampled twice a day. Higher levels of trait attachment anxiety predicted a lower intraindividual mean but increased intraindividual variability (MSSD; Mean Square Successive Difference) in relatedness across the 10 days. Further, anxiety predicted lower intraindividual means in competence and higher variability in autonomy. Trait levels of attachment avoidance were not related with need satisfaction in any of the three domains. Results are discussed with regard to how attachment orientations relate to short-term and long-term processes of health maintenance and well-being in late life.

## Momentary rumination is associated with changes in psychological intimacy in couple's daily life: A dyadic ambulatory assessment study

Andrea B. Horn[1], Anik Debrot[2], Meinrad Perrez[3]
[1]University of Zurich, [2]University of Toronto, [3]University of Fribourg

Rumination is characterized by repetitive negative thoughts and can be seen as a dysfunctional, avoidant emotion regulation strategy, which represents a risk factor for mental health. It seems plausible that the self-focus that is constitutive for ruminative states is in conflict with responsive attention to the romantic partner. Therefore, this study aims at investigating the interpersonal impact of daily rumination in romantic relationships. Effects of momentary rumination on changes in feelings of intimacy in couples will be studied.

Within an ambulatory assessment framework, N = 102 adult couples reported current psychological intimacy with the partner, mood, and rumination four times a day during one week. Furthermore, trait rumination was assessed with the "Response Style Questionnaire".

A multi-level APIM showed that reports of own intimacy but also the partner's decreased at times of the day when rumination had been higher than usual. Controlling for current affect did not change the pattern, thus the associations seem not to be due to affective contagion between partners. Furthermore, between-person differences of trait rumination were controlled and did not seem to play a major role.

Results indicate significant interpersonal correlates of individual emotion regulation. The establishment and maintenance of psychological intimacy has been related with disclosure and responsive reactions to it. Rumination seems to impair this interactive process in couples' daily lives. The interplay between intra- and interpersonal processes related to momentary emotion regulation seems to be an important pathway that might be one explanation for the known associations between relationships and health.

## Within-person relationship between physical activity and affect of healthy older adults: Findings from the MOASIS project

Marko Katana, Christina Röcke, Mike Martin, Lutz Jäncke, Mathias Allemand
University of Zurich

Many studies report a positive cross-sectional association between physical activity and positive affect. However, only a few studies focus on longitudinal everyday life data of healthy older adults. In the ongoing "Mobility, Activity, and Social Interaction Study" (MOASIS), affect and a number of other self-report measures as well as accelerometer data, GPS data, and audio sampling are assessed over 30 days to obtain daily life activity and experience profiles in healthy older adults. Using data from 27 participants with an average age of 72 years, the present study examined how physical activity was associated with daily affect on the within-person level. Physical activity was measured with an accelerometer computing the daily number of step counts. Daily affect was assessed by an end-of-day questionnaire distinguishing between positive and negative affect. The nested data within participants was analyzed by multilevel models with random intercepts and random slopes. Results have shown that on days with a higher number of step counts, higher positive affect was reported. However, there was no significant association between physical activity and negative affect. The results of the random slopes indicated significant interindividual differences in the intraindividual associations between physical activity and positive affect. In sum, this study provides a first look at individual trajectories of daily coupling between physical activity and affect of healthy older adults and lays the foundation for further investigation of within-person relationships with multiple measurement points per day.

## Comparing self-reported and GPS-based assessments of daily mobility in the context of research on healthy aging: Findings from MOASIS

Michelle P. Fillekes, Pia Bereuter, Robert Weibel
University of Zurich

Research has shown that older adults' daily mobility has an impact on the maintenance of their health and well-being. Healthy aging researchers increasingly move from using traditional commonly used self-reported measures on mobility to measures derived from GPS sensors that are said to be more objective. Consequently, the interesting question arises to what degree GPS-derived and self-reported indicators on mobility compare.

For the purpose of this research, we use GPS and self-reported data from the second pilot study (27 participants, 30 observation days) of the Mobility, Activity, and Social Interaction Study (MOASIS). Participants were asked to report on a daily basis the most distant life-space level (home, garden, neighborhood, etc.) they had attained and the estimated duration of active and passive movement outside their home for the respective day.

Based on GPS data available for the same period, we computed indicators that approximate the aforementioned two daily self-reported measures. Subsequently, we assessed the discrepancies between the corresponding GPS-derived and self-reported measures as well as factors potentially having an impact on these discrepancies. The preliminary comparison of self-reported and GPS-derived daily most distant life-space levels of the 27 participants showed that there is a tendency for participants to underestimate their life-space level.

We argue that it is crucial to be aware of the order of magnitude at which discrepancies occur between self-reported and GPS-derived indicators of mobility, as well as knowing the factors that contribute to such discrepancies when interpreting these indicators in a healthy aging context.

## Conversational time travel in everyday life: A naturalistic observation method

Burcu Demiray Batur[1], Matthias Mehl[2], Mike Martin[1]
[1]University of Zurich, [2]University of Arizona

Mental time travel is the ability to mentally project oneself backward or forward in time (to remember an event from one's past or to imagine an event from one's future). In two studies, we examined mental time travel in everyday conversations using a naturalistic observation method: Electronically Activated Recorder (EAR). EAR is a portable audio recorder that periodically records snippets of ambient sounds and speech. We developed and validated a coding scheme on conversational time travel using different samples, and we examined how much individuals talk about their past versus future. Study 1 included breast cancer patients and their spouses (52 American couples). Participants wore the EAR over one weekend and recording occurred every 9 minutes for 50 seconds. Study 2 included 33 young and 48 healthy older adults from Switzerland who wore the EAR for four days. 30-second recordings occurred randomly, on average four times per hour. Sound files that included speech were coded in terms of temporal focus (past, future, present) and autobiographical nature (self versus others) by two coders. Results were highly consistent across different age groups, cultures, and sampling rates. Only 22% of individuals' utterances were time-independent with no reference to time. The remaining 78% were mostly autobiographical (88% of time-dependent utterances were about one's self): Individuals mostly talked about their present situation (40-51% across samples). They talked about their past (13-19%) two to three times as much as their future (4-11%). Results are discussed in relation to the functions of mental time travel in healthy aging.

Innovative statistical approaches for the analysis of ambulatory assessment data

Chair(s): Michael A. Russell (The Pennsylvania State University)

Repeated ambulatory assessment of individuals affords myriad analytic possibilities and allows researchers to answer a variety of important questions in novel and exciting ways. This symposium presents a quartet of statistical approaches aimed at generating new insights from ambulatory assessment data.

Russell and colleagues demonstrate a dynamic systems modeling approach to understand the process of intervention-led change in a smoking cessation trial with Ecological Momentary Assessment (EMA) data, revealing both the initial (one-week) and expected long-term (60 days) impact of intervention conditions.

Lanza and colleagues use finite mixture modeling to analyze within-person variation in affective experiences collected via EMA and categorize individuals who show one general affective state versus those who show two. This may serve as a useful heuristic for understanding within-person processes such as stress reactivity.

Neubauer and colleagues use three approaches to retain more momentary data in lagged Multilevel Modeling (MLM) of affective inertia—two of which specify the temporal process of inertia a priori while one uses an exploratory approach. All three approaches retained more cases than traditional lag-1 analysis, and important insights were gleaned from both confirmatory and exploratory approaches.

Bolger and Zee use Bayesian MLM to analyze covariation in physiological states within heterosexual romantic dyads undergoing cardiovascular monitoring. Synchronicity and partner-to-partner influence in physiological states varied by conversation type, and dyads differed significantly from each other across all conversation types.

Modeling details and the potential of these modeling approaches for addressing additional research questions in ambulatory assessment designs will be discussed.

*Topics: General ambulatory assessment*
*Keywords: quantitative methods, statistics, dynamics, mixture models, multilevel models*

## PRESENTATIONS OF THE SYMPOSIUM

### Applying a dynamical systems modeling framework to understand intervention processes in adult smokers

Michael A. Russell[1], Korkut Bekiroglu[1], Constantino M. Lagoa[1], Stephanie T. Lanza[1], Megan E. Piper[2]
[1]*The Pennsylvania State University,* [2]*The University of Wisconsin at Madison*

Background: We applied a Dynamic Systems (DS) modeling framework to Ecological Momentary Assessment (EMA) data from a smoking cessation trial involving 1,504 adult smokers to examine the dynamic effects of intervention on key drivers of smoking relapse.

Method. Smokers who intended to quit were randomly assigned to one of five treatment conditions: nicotine patch (n = 262), nicotine lozenge (n = 260), bupropion pill (n = 264), patch + lozenge (n = 267), bupropion + lozenge (n = 262); or a placebo condition (n = 189). Participants then carried mobile devices to respond to EMA prompts querying key drivers of smoking relapse (craving, negative affect, cessation fatigue, and quitting self-efficacy) 4 times per day for two weeks after the target quit date.

Results. For each of the six groups (5 treatment groups and placebo), a system of four second-order lagged regression equations, one for each of the key drivers of relapse, was estimated simultaneously to determine model parameters across the 14 days of EMA data. Results showed that (1) although participants in the patch + lozenge, lozenge only, and patch only conditions showed the largest initial (one-week) changes in relapse-related related constructs, (2) model predictions suggested that combination therapies (patch + lozenge, buproprion + lozenge) would have the strongest long-term effects (after 60 days).

Conclusion. Our DS modeling approach allowed us to uniquely describe the temporal unfolding of intervention effects on the key drivers of smoking relapse, and to estimate both the initial and long-term impacts of each treatment condition on relapse-related constructs, thus illustrating the potential of these models to inform clinical practice. Implications for research and intervention will be discussed.

### Finite mixture modeling to understand within-person affect variability

Stephanie T. Lanza[1], Stacey B. Scott[2], Martin J. Sliwinski[1]
[1]*The Pennsylvania State University,* [2]*Stony Brook University*

Introduction: This study presents within-person Finite Mixture Modeling (FMM) as a new way to characterize within-individual affect variability. Unlike the classic approach of estimating within-person variance through OLS regression or multilevel modeling, this approach takes into account contextual influences that may in part drive the observed responses. FMM identifies underlying affective states that correspond to unique generating distributions of individuals' momentary subjective affect, while taking into account measurement error.

Method: We examine data from 226 adults (mean age 47.2; 67% female) who provided ecological momentary assessments five times per day for 14 days. For each individual, fit of momentary negative affect mixture models with one to three components were compared to identify the number of underlying states. We examined associations between individuals' sex and the number of affect states, and between an individual's momentary stress and momentary affect state.

Results: Results suggest that 22% of individuals have a single generating distribution, 78% have two generating distributions, and no individuals had more than two. Sex was not associated with the number of underlying affect states. For individuals with two generating distributions, momentary stress was significantly associated with momentary negative affect state.

Discussion: Individuals with two or more states may be considered responsive to momentary context; this assumption should be investigated. We conclude with strengths and limitations of this approach, as well as directions for future research on FMM to advance understanding of affect variability.

### Closing the gaps in intensive longitudinal data – Alternatives to deleting missing adjacent measurements in autoregressive multilevel models

Andreas B. Neubauer[1], Andreas Voss[1], Beate Ditzen[2]
[1]*University of Heidelberg,* [2]*University Hospital Heidelberg*

Multilevel autoregressive models are a prominent way to investigate lagged effects in Intensive Longitudinal Designs (ILDs), and they are, for example, used in research on affective inertia. However, the modeling strategy most often employed (using scores at the previous assessment as predictor of the current assessment) might be problematic for two reasons: First, uneven measurement intervals are being neglected; second, interspersed missing values can lead to a substantial reduction in available data points for the analysis. In this talk, we will present three alternative approaches: Two theory-driven approaches (assuming either a linear or exponential decay of inertia with increasing time between the assessments) and one more exploratory approach (a deviation of time-varying effect models that we refer to as delta Time Varying Effect Models, delta-TVEM). Results from an ILD (58 participants; five days; 10 assessments per day on current mood, tension, and stress) are presented to show that the three proposed methods yield a substantially higher number of available cases than the traditional approach (13% in the present example). Results from the theory-driven approaches suggest that a linear decay model provides the best fit. Findings from delta-TVEM suggest, however, that the effect of time between the assessments on inertia for tension is described by a non-linear function. The flexibility of the exploratory delta-TVEM approach is very helpful to gain initial insights into the dynamics of variables in ILDs that can inform subsequent confirmatory research.

### Using Bayesian multilevel models to analyze covariation in dyadic physiological data

Niall Bolger, Katherine Zee
*Columbia University*

We discuss conditions under which partners in heterosexual romantic dyads exhibit shared physiological states. Couples engaged in three conversations while undergoing cardiovascular monitoring. Using a Bayesian dyadic multilevel model to analyze the data, we observed three noteworthy trends: (1) time-lagged covariation (i.e., one partner's physiology predicting the other's at the next time point) depended on the type of conversation (i.e., whether dyads discussed a shared goal versus exchanged social support); (2) the male partner's physiology influenced the female partner's, but only when he received social support; and (3) across all conversations there was substantial between-dyad heterogeneity in effects. Recommendations for examining covariation using ambulatory data as well as advantages of implementing a Bayesian modeling approach are discussed.

**How can ecological momentary assessments add meanings to the findings from multimodal neuroimaging?**

Chair(s): Inez Myin-Germeys (Center for Contextual Psychiatry, Department of Neuroscience, KU Leuven, Leuven, Belgium)

Decades of advances in neuroscience have enabled insights into neural processing of critical external and internal stimuli: stressors, rewards, and emotions. This way, substantial deviations in neural responsiveness have been identified in clinical populations: functional Magnetic Resonance Imaging (fMRI), for instance, showed abnormal interconnectedness of subnetworks in individuals with Major Depressive Disorder (MDD), and Positron Emission Tomography (PET) demonstrated altered release of the neurotransmitter Dopamine (DA) in individuals liable to psychotic disorder. However, there has been little effort to connect the experimental neuroimaging findings to their behavioral and affective correlates in daily life, thereby severely limiting their ecological relevance.

This symposium presents Ecological Momentary Assessments (EMA) as an innovative add-on to neuroimaging studies and presents the ways in which EMA can enhance and validate the findings from fMRI and PET. To demonstrate the versatility of EMA, we highlight four neuroimaging paradigms, which were connected with their functional mechanisms in daily life (as assessed with EMA): 1. downregulation of negative affect in Prefrontal Cortex (PFC; assessed with fMRI) predicts affective reactivity to negative daily life events (J. Bastiaansen); 2. connectivity of functional subnetworks (assessed with resting-state fMRI) predicts affective instability in the everyday life of patients with remitted MDD (H. Riese); 3. stress-induced DA release in the PFC (assessed with PET) predicts daily life psychotic reactivity to stress in individuals liable to psychosis (I. Myin-Germeys); and 4. reward-induced DA release in the striatum (assessed with PET) predicts sensitivity to rewards of everyday life in individuals predisposed to psychosis (Z. Kasanova).

This symposium will therefore highlight four different research lines, all of which converge on a successful synthesis of neuroimaging findings with their ecologically relevant counterparts. The emphasis will be placed on two central themes: i) the adaptation of EMA protocols to suit the most widely used neuroimaging modalities: fMRI, resting-state fMRI, PET; and ii) the importance of careful conceptualization of the naturalistic mechanisms to correspond with the neuroimaging paradigm of interest: emotion regulation, affective instability, stress reactivity, reward sensitivity. By doing so, this symposium aspires to offer the combination of EMA and neuroimaging as a feasible way of revealing underlying neural mechanisms of emotions and behavior in daily life.

*Topics: General ambulatory assessment*
*Keywords: EMA, fMRI, PET, depression, psychosis*

## PRESENTATIONS OF THE SYMPOSIUM

**Striatal dopaminergic modulation of reinforcement learning predicts reward sensitivity in daily life**

Zuzana Kasanova
*Center for Contextual Psychiatry, Department of Neuroscience, KU Leuven, Leuven, Belgium*

Background: Abnormalities in reward learning in psychotic disorders have been proposed to be linked to dysregulated subcortical Dopaminergic (DA) neurotransmission, which is in turn a suspected mechanism for predisposition to psychosis. Experimental behavioral and functional neuroimaging studies have not, however, corroborated reward dysfunction in individuals at familial risk for psychosis, and increased striatal DA synthesis, believed to undermine reward signaling, has yielded inconsistent findings in this group.

Methods: We therefore explored the striatal dopaminergic modulation of reward processing and its behavioral correlates in individuals at genetic risk for psychosis. Specifically, we combined, for the first time, a DA D2/3 receptor [18F]fallypride PET during a probabilistic reinforcement learning (RL) task with a six-day Ecological Momentary Assessment (EMA) study of the subjective reactivity to rewards in the everyday life of 16 healthy First-Degree Relatives of patients with psychosis (FDR) and 16 Healthy Volunteers (HV) .

Results: We detected no group difference in the reward-induced DA release (p > 0.05). To the contrary, in both groups alike, accuracy in reward learning was associated with greater extent of reward-induced DA release in bilateral caudate, putamen, and right ventral striatum. Importantly, individual variability in reward-induced DA release in all regions predicted sensitivity to daily life rewards in both groups.

Conclusions: These findings suggest intact striatal dopaminergic modulation of reinforcement learning and reward sensitivity in individuals with familial predisposition to psychosis. Furthermore, this study suggests a key link between striatal reward-related DA release and reactivity to ecologically relevant rewards, thus opening an avenue for the inquiry into the DAergic basis of optimal and impaired goal-oriented behavior.

**Brain activation during an emotion regulation task is associated with negative affect in daily life**

Jojanneke A. Bastiaansen
*Interdisciplinary Center Psychopathology and Emotion regulation, Department of Psychiatry, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands*

Background: The neural substrate of emotion regulation has been well mapped. Individuals that are more successful in downregulating Negative Affect (NA) show augmented activity in Prefrontal Cortex (PFC) regions, together with more attenuated activity in the amygdala. Here, we combined fMRI and experience sampling to determine whether brain activation is associated with NA dynamics in daily life.

Methods: Sixty-nine female students (18-25 years) performed an emotion regulation fMRI task and repeated real-life assessments (14 days x 5) of affect and minor events. Individual t-maps were created for an instructed downregulation contrast (downregulate negative – attend negative) and an uninstructed regulation contrast (attend negative – attend neutral). Mean beta values were extracted from a priori defined regions of interest in bilateral amygdala and PFC and correlated to three daily life measures: baseline NA, NA variability, and NA reactivity to negative events.

Results: For the amygdalae, only the correlation between left amygdala downregulation and NA reactivity reached (nominal) significance. Activation of PFC explained 7-8% of the variance in NA reactivity; stronger recruitment during the attend negative condition was related to lower NA reactivity.

Conclusion: The degree to which individuals spontaneously engage regulation clusters in response to negative stimuli may have a bearing on real-life emotional experience.

**Mapping daily affective instability to functional brain subnetworks in remitted MDD patients**

Harriette Riese
*University of Groningen, University Medical Center Groningen, Interdisciplinary Center for Psychopathology and Emotion regulation, Department of Psychiatry, Groningen, The Netherlands*

Background: Altered reactivity in mood often persists in patients with Major Depressive Disorder (MDD). However, how daily affective instability is related to information processing in functional brain subnetworks in MDD patients remains unknown. We coupled affective instability and connectomics in brain subnetworks in remitted recurrent MDD patients (rrMDD).

Methods: Sixty-two rrMDD patients in stable remission (≥2 episodes) and 41 healthy controls (HC, matched for age, gender, educational level, socioeconomic status, ethnicity, handedness) completed Experience Sampling Methodology (ESM) to monitor daily affect (6 days, 10 times a day). Furthermore, we collected resting-state fMRI data and performed graph theory to obtain network measures of integration within (local efficiency) and between (participation coefficient) subnetworks. We quantified affective instability with the mean adjusted absolute successive difference. We determined differences in affective instability and network measures between rrMDD patients and HC, and the association between affective instability and network measures in rrMDD patients.

Results: Affective instability was increased in five negative mood/cognition variables in rrMDD patients compared to HC (p < 0.004). We also found that the default mode subnetwork has less connections with other subnetworks in rrMDD patients compared to HC (p = 0.026). For the combined ESM-fMRI analysis, rrMDD patients who showed i) more instability in feeling down, had less connections between the salience-reward subnetwork and other subnetworks (p = 0.025); ii) more instability in feeling irritated, had higher local efficiency coefficients in the cognitive control (p = 0.031) subnetwork.

Discussion: rrMDD patients showed more variability in negative mood which is related to differences in the integration within and between specific brain subnetworks.

**Psychotic reactivity to daily life stress and the dopamine system: A study combining experience sampling and [18F]fallypride positron emission tomography**

Inez Myin-Germeys
*Center for Contextual Psychiatry, Department of Neuroscience, KU Leuven, Leuven, Belgium*

Background: Stressful life events increase the risk for psychosis, and the subjective experience of stress related to daily life activities drives moment-to-moment variation in psychotic intensity. Positron Emission Tomography (PET) studies suggest that Dopaminergic (DAergic) activity mediates the behavioral response to an experimental stressor. However, it is not known how alterations in this DAergic stress response relate to the subjective experience of stress in real life situations assessed in momentary assessment studies. This study combined [18F]fallypride PET with an experience sampling ambulatory assessment approach to examine the association between the prefrontal DAergic response to experimentally induced stress and real life psychotic reactivity to the subjective experience of stress in daily life.

Methods: Healthy first-degree relatives of individuals with a psychotic disorder (N = 14) and healthy controls (N = 11) participated in (i) a psychosocial [18F]fallypride PET stress paradigm and (ii) an experience sampling study.

Results: Mixed multilevel random intercept models revealed that stress-induced [18F]fallypride displacement, indicative of DAergic activity, in Ventromedial Prefrontal Cortex (VMPFC) was associated with psychotic reactivity to daily life stress in the entire sample. Lower levels of [18F]fallypride displacement to stress predicted increased psychotic reactivity to daily life stress.

Conclusion: This study combined PET neuroimaging with real life behavioral assessments in the investigation of psychotic symptoms; we showed decreased [18F]fallypride displacement.

**Capturing within-person dynamics: Latest developments for the popular vector autoregressive model**

Chair(s): Eva Ceulemans (KU Leuven)

In the last decade we are witnessing an enormous increase in intensive longitudinal data. This kind of data makes it possible to study within-person dynamics, such as how emotions interact over time. A frequently used model to study these dynamics is the Vector Autoregressive (VAR) model. In a VAR model each variable is regressed on all variables (including itself) at previous measurement occasions. The resulting VAR coefficients can then serve as a basis for dynamical network structures. In this symposium, we present the latest developments for the VAR model. First, Noémi Schuurman presents a multilevel extension of a VAR model which allows analyzing a group of persons in a single framework. Second, Laura Bringmann presents a time-varying version of the VAR model. A VAR model assumes that the dynamics (i.e., the VAR parameters) are constant over time. However, it is likely that the parameters or its dynamics change over time. With the semi-parametric Time-Varying Vector Autoregressive (TV-VAR) method one can capture the time dynamics of the VAR coefficients. Third, in a standard VAR model only lagged effects are estimated. Julian Rubel will show, in his talk, the advantages of including both the contemporaneous and the lagged effects in one model by means of an application to an Experience Sampling Method (ESM) data set. Fourth, an assumption of the VAR model is equal time intervals between consecutive measurements. The talk of Oisín Ryan concerns the application of VAR models in the framework of continuous time, instead of discrete time. The utilities and implications of the new framework are discussed. Finally, the VAR model is a highly parametrized model. However, most researchers currently apply the model without verifying if it overfits the data. If the latter is the case, the estimated model will not properly predict new data. Kirsten Bulteel evaluates, in the final talk, whether VAR based models outpredict simpler models for three current psychological applications, using cross-validation techniques.

*Topics: Big data*
*Keywords: intensive longitudinal data, vector autoregressive modeling, multilevel modeling, time-varying modeling, time series analysis*

## PRESENTATIONS OF THE SYMPOSIUM

### Analyzing intensive longitudinal data using multilevel autoregressive models

Noémi Schuurman
*Universiteit Utrecht*

Vector autoregressive models can be used to model associations between variables and themselves over time (autoregressive effects), as well as bidirectional associations between these variables over time (cross-lagged effects) for single subjects. For example: how does worrying at this measurement occasion affect mood at the next occasion and vice versa for a specific person, or how does the positive affect of a wife affect that of her husband at the next measurement occasion, and vice versa. By extending these models to a multilevel context, we can perform these analyses for a group of subjects at once, while taking into account the fact that, for example, for some individuals worrying affects their mood a lot; while for others the effect is small.

As such, multilevel autoregressive models can provide a rich tool for analyzing intensive longitudinal data. Applying these models in practice can prove challenging, as they usually require the use of specialized (Bayesian) software. However, with the inclusion of dynamic SEM (dSEM) in the new version of Mplus, these models are readily available and easy to apply for many researchers. We will discuss the interpretation of multilevel VAR models guided by empirical examples.

## Changing dynamics: Time varying vector autoregressive models

Laura F. Bringmann[1], Emilio Ferrer[2], Ellen Hamaker[3], Denny Borsboom[4], Francis Tuerlinckx[5]
[1]*Rijksuniversiteit Groningen, [2]UC Davis, [3]Universiteit Utrecht, [4]Universiteit van Amsterdam, [5]KU Leuven*

Humans are complex dynamic systems, whose emotions, cognitions, and behaviors constantly fluctuate and interact over time. One can study, for example, the interaction or dynamics between emotions over time. However, in time the dynamics of a process are themselves prone to change. Consider, for example, external factors like stress, which can lower the self-predictability and interaction of emotions, and thus change the dynamics. In this case, there should not be a single representation of the emotion dynamics, but a movie representing the evolution of the network over time. We have developed a new data-driven model that can explicitly model the change in temporal dependency within an individual without pre-existing knowledge of the nature of the change: the semi-parametric Time-Varying Vector Autoregressive (TV-VAR) method. The TV-VAR method proposed here is based on the easy applicable and well-studied Generalized Additive Modeling (GAM) techniques, available in the software R. Using the semi-parametric TV-VAR method, one can detect and model changing dynamics for a single individual or system.

## A network model for integrating contemporaneous and directed effects

Julian A. Rubel[1], Aaron J. Fischer[2], Jonathan W. Reeves[2], Glenn Lawyer[3], W. Lutz[1]
[1]*University of Trier, [2]University of California, [3]Max Planck Institute for Informatics*

Background: Recently, network models have become increasingly popular in psychopathology research. Advocates for these models argue that the assumptions underlying network methods are a better match for psychopathology than factor-based methods, which rely on a latent disease-model conceptualization of symptoms. However, there are several important limitations to the current methods employed for the estimation of network models resulting mainly from the separate estimation of contemporaneous and directed models.

Aim: A fully integrated network model is proposed that addresses these shortcomings.

Methods: Idiographic models concurrently estimating all contemporaneous and lagged associations in a single multivariate Vector Autoregressive (VAR) structural equation model are applied to the data of 38 patients who participated in an ecological momentary assessment over a period of 14 days prior to psychotherapy. For the identification of cross-lagged relationships, an automatic search procedure based on Lagrange multiplier tests is applied. The spreading power of each variable in the networks are quantified with the Expected Force (ExF) metric.

Results: The model provided good fit to the intraindividual symptom dynamics of all individuals. The advantages of this approach over classical network modeling procedures are presented with data of exemplar participants.

Conclusions: The integrated network model can enhance our understanding of individual symptom dynamics, and the ExF metric is especially suited for this model.

## Dynamical network analysis: A continuous-time approach

Oisín Ryan
*Universiteit Utrecht*

Continuous Time (CT) First-Order Vector Autoregressive (VAR(1)) models, based on first-order stochastic differential equations, have been proposed as an alternative to the more widely used Discrete Time (DT) VAR(1) models for the analysis of intensive longitudinal data. CT VAR(1) models are useful in a practical sense as they deal well with measurements taken at unequal intervals, a typical characteristic of many momentary assessment designs. However, although the CT and DT versions of the VAR(1) model are related, the use of CT models also leads to important conceptual differences with respect to how effect estimates may be interpreted, in particular when the interest is in a system of three or more variables. Specifically the interpretation of lagged effects as representing direct links between processes may differ in the CT setting: This has implications for the conclusions that may be drawn with regards to the underlying causal relationships between process(es) of interest. In light of this, we present work examining the use of CT models to investigate path-specific effects, with a particular focus on the utility and implications of CT models for the estimation of dynamical network structures.

## VAR(1) based models do not outpredict AR(1) models in current psychological applications

Kirsten Bulteel, Merijn Mestdagh, Francis Tuerlinckx, Eva Ceulemans
*KU Leuven*

In psychology, modeling multivariate dynamical processes within a person is gaining ground. A popular model is the Lag-One Vector Autoregressive or VAR(1) model and its variants, in which each variable is regressed on all variables (including itself) at the previous time point. Many parameters have to be estimated in the VAR(1) model, however. The question thus rises whether the VAR(1) model is not too complex and overfits the data. If the latter is the case, the estimated model will not properly predict new unseen data. As a consequence, it cannot be trusted that the estimated parameters adequately characterize the individual from which the data at hand were sampled. In this paper, we evaluate for current psychological applications whether the VAR(1) model outpredicts simpler models, using Cross-Validation (CV) techniques to determine the predictive accuracy. As it is unclear whether one should use a standard CV technique or a variant that takes time dependencies into account, we first compare the relative performance of five CV techniques in a simulation study, showing that blocked CV has the best performance in general. Subsequently, we use blocked CV to assess to what extent the VAR(1) models predict unseen data for three recent psychological applications. We show that the VAR(1) based models do not outperform the AR(1) based ones.

## Ambulatory assessment of borderline personality disorder

Chair(s): Timothy Trull (University of Missouri), Ulrich Ebner-Priemer (Karlsruhe Institute of Technology)

The major theme of this symposium is to highlight new approaches to analyses of Ambulatory Assessment (AA) data from patients with Borderline Personality Disorder (BPD) that address important theoretical and conceptual issues concerning affect, affective patterns, and problematic behaviors.

Four papers will be presented and discussed that describe new uses of AA data to elucidate affect, affect patterns, alcohol use, and self-harm urges in outpatients with BPD. The first two papers (Hepp et al. and Wycoff et al.) focus on problematic behaviors in BPD that are associated with mood dysregulation (i.e., alcohol use and self-harm urges). These papers address major motivational theories of these problematic behaviors (e.g., mood regulation, coping). The final two papers explore patterns of affective experience among those with BPD in more detail. Knockler et al. examine emotional sequences in those with BPD, and the authors compare these to those characteristic of patients with PTSD and bulimia nervosa as well as healthy controls. Lane et al. compare the diurnal cycles and peak amplitudes of positive and negative affects among those with BPD and community drinkers.

*Topics: Big data, General ambulatory assessment*
*Keywords: borderline personality disorder, affective instability, self-harm, alcohol, diurnal cycling*

## PRESENTATIONS OF THE SYMPOSIUM

### Affect trajectories surrounding periods of self-harm urges in individuals with borderline personality disorder

Johanna Hepp[1], Ryan Carpenter[2], Timothy Trull[2]
[1]*Central Institute of Mental Health, Medical Faculty Mannheim/Heidelberg University,* [2]*University of Missouri*

Non-Suicidal Self-Injury (NSSI), the deliberate harming of own body tissue without suicidal intent, is a central symptom of Borderline Personality Disorder (BPD). The function for NSSI that has received the most empirical support is an emotion regulation function, that is, individuals harm themselves to alleviate negative tension or affect. To identify optimal time windows and ways to intervene prior to NSSI acts, we looked at phases where BPD individuals felt an urge to self-harm and modeled negative affect surrounding these urges. We hypothesized that negative affect would increase prior to and decrease following NSSI urges. Using ambulatory assessment, we measured feelings of hostility, sadness, and fear and presence or absence of NSSI urges in a sample of 56 BPD individuals for 21 days, 6 times a day. Data were analyzed using logistic multilevel models and multilevel growth curves. In the logistic multilevel model, we predicted NSSI urges with the momentary, daily, and person average scores of the negative affects. Results showed that NSSI urges were positively predicted by concurrent momentary hostility, sadness, and fear as well as daily sadness. Multilevel growth curve analyses indicated that, as predicted, negative affect increased prior to and then decreased following urges. Ideas on how to apply the current results to smartphone based interventions will be discussed.

### Drinking motives, momentary affective states, and alcohol use in daily life in individuals with borderline personality disorder

Andrea Wycoff[1], Johanna Hepp[2], Ryan Carpenter[1], Timothy Trull[1]
[1]*University of Missouri,* [2]*Central Institute of Mental Health, Medical Faculty Mannheim/Heidelberg University*

Existing research suggests an association between both enhancement and coping motives for drinking alcohol and features of Borderline Personality Disorder (BPD), including impulsivity and affective dysregulation. We hypothesized that self-reported motives of drinking to enhance positive affect and to cope with negative affect would moderate the relations between momentary affective states and drinking for individuals with BPD (N = 56). Participants completed a baseline measure of drinking motives and carried electronic diaries for 21 days. Ecological momentary assessments were collected on affective states and alcohol use. We examined the data using logistic multilevel models. Results suggest that enhancement motives and day-level positive affect play an important role in BPD individuals' drinking behavior, but that coping motives and negative affect may not. Additional motives will be discussed as they relate to affect and drinking in BPD.

### Specifity of emotion sequences in borderline personality disorder in comparison with posttraumatic stress disorder, bulimia nervosa, and healthy controls

Tobias Kockler[1], Wolfgang Tschacher[2], Philip Santangelo[1], Martin Bohus[3], Ulrich Ebner-Priemer[1]
[1]*Karlsruhe Institute of Technology,* [2]*University of Bern,* [3]*Central Institute of Mental Health Mannheim*

Although Borderline Personality Disorder (BPD) is ranked among the emotionally unstable personality disorders in ICD-10, previous research could not show the specifity of affective instability for BPD. Overall measures to assess momentary affective state like valence might not be sufficiently selective to capture BPD-specific affective instability. We used repeated assessments of basic emotions to analyze temporal sequences of specific emotions in order to further examine specificity in BPD. Forty-three BPD patients, 28 patients with posttraumatic stress disorder, 20 patients with bulimia nervosa, and 28 healthy controls carried an e-diary for 24 hours and were prompted every 15 minutes to assess their current perceived emotions. We will report the analysis of emotion sequences, which aims at revealing group differences with regard to activation, persistence, switching, and downregulation of emotions. Analysis of the relative frequencies of reported basic emotions, without consideration of the sequences, signifies a higher occurrence of anger in patients with BPD compared to the three control groups. Preliminary results hint at anger to play a central role in BPD-specific affective instability.

### Diurnal cycling and instability of positive and negative moods: A comparison of borderline personality and community individuals

Sean Lane[1], Timothy Trull[2]
[1]*Purdue University,* [2]*University of Missouri*

Individuals commonly experience cyclic patterns in their daily positive and negative moods. Those with stable cycles that oscillate close to a normative set point are thought to regulate their moods effectively. In contrast, individuals characterized by mood dysregulation, such as those with Borderline Personality Disorder (BPD), may be expected to have less stable cycles and/or those that vacillate more extremely. This perspective integrates conceptualizations of high moment-to-moment affective instability in BPD (i.e., low inertia) with one that suggests a pattern of more extreme, but systematic temporal variability. We examined the diurnal trajectories of positive and negative moods in a sample of 56 BPD individuals and a comparison group of community individuals (COM; n = 60) who carried electronic diaries for approximately 21 days. Participants completed random prompts of their positive and negative (anxiety, anger, depression) mood, on average, 6 times each day. Both BPD and COM individuals displayed similar curvilinear diurnal patterns of positive mood that peaked in late afternoon, though BPD individuals exhibited a marginally higher peak. While COM individuals showed essentially flat daily trajectories for all negative moods, BPD individuals were characterized by higher set points and larger curvilinear peak amplitudes for each of the negative moods, with each peaking in early afternoon. Across all moods, though BPD individuals displayed more systematic variability in their diurnal trajectories, they also exhibited more random moment-to-moment instability than COM individuals. Such analyses elucidate the temporal layers of emotional experience, which may provide different focal points for emotion regulation strategies.

**Methodological challenges in ESM research**

Chair(s): Harriette Riese (UMCG)

Experience Sampling Methodology (ESM) has been used for several decades now to monitor life experiences in an ecologically valid way, and is increasingly being applied in a wide range of research fields, including psychology, sociology, and health care settings. This is probably due to technological developments that ease performance of diary studies, such as the wide availability of smartphones. Furthermore, growing awareness about the use of repeated assessments of (psychological) symptoms makes it possible to acquire valuable insights about (psychological) dynamics that cannot be obtained with the use of single-administered questionnaires. However, although widely used, the methodological aspects of ESM still need further development to really be able to assess data needed to answer the research questions posed. In this symposium, we will present work on various methodological challenges in the context of ESM research.

First, results of a qualitative study on ESM research designs are presented. In this study, ESM researchers were explicitly asked to describe their choices and evaluate their rationales for a particular study design. These rationales are typically not provided in scientific papers but are highly relevant for the interpretation of the results (Riese). Second, a study will be presented on the reliability of positive and negative mood assessments and their sensitivity to (un)pleasant events. The findings from this study have immediate implications for the design of future ESM studies (Viechtbauer). Third, data of ESM studies were used to reveal factors that are related to response compliance during long-term daily monitoring. Although compliance rates were generally acceptable, notable daily and weekly fluctuations in compliance rates, and differences across mental health status groups were found (Rintala). Fourth, in an ongoing systematic review of ESM studies on symptom dynamics in patients suffering from mental disorders, the balance between the number of beeps per day (frequency) and number of days (duration) was examined on its relationship with compliance rate. Preliminary results suggest that a higher number of beeps per day decreases compliance rates in the patients (Vachon). Finally, our discussant (Myin-Germeys) will integrate the findings and conclusions of the presentations in this symposium. She will invite you to actively participate in the discussion on prioritizing our efforts to address various methodological challenges in future research. In this exciting symposium we aim to provide food for thought but also guidance for designing future ESM studies.

Conflicts of interest: All authors declare that they have no conflicts of interest.

*Topics: General ambulatory assessment*
*Keywords: experience sampling methodology, design*

## PRESENTATIONS OF THE SYMPOSIUM

### A qualitative approach to guide choices for an ESM study design

Karin A.M. Janssens[1], Elisabeth H. Bos[2], Judith G. M. Rosmalen[1], Marieke C. Wichers[1], Harriette Riese[1]
*[1]ICPE, UMCG, The Netherlands, [2]ICPE, UMCG, The Netherlands; Developmental Psychology, University of Groningen, The Netherlands*

Background: Guidelines for the best way to design Experience Sampling Methodology (ESM) studies are lacking, and rationales for a chosen study design are often not provided in papers. Therefore, we aimed to give a systematic overview of arguments for choosing a specific ESM design in order to optimize future designs.

Method: Forty-seven researchers participated in our semi-Delphi study. During the first assessment round, participants described their study design and explained the choices they made for their design. These explanations were categorized into four overarching themes: nature of the variables, reliability, feasibility, and statistics. During the second round, 81% of the participants rated the importance of the choices within these four themes.

Results: During the first round, rationales given for design choices were found to be related to the research question. During the second round, the nature of the variable(s) of interest (e.g., its occurrence rate) was found to be most important to make a decision about the measurement frequency and momentary or retrospective assessment. The nature of the variable(s) of interest and obtaining representative data were found to be most important for the chosen study duration. The reliability and planned statistical analyses were most important for the choice of (semi-)random or fixed assessment procedures.

Discussion: No golden standard for the optimal ESM study design is opportune, since the design depends heavily upon the research question of the study. The current study can explicate and guide the specific choices that have to be made when designing an ESM study.

### Reliability of ESM assessments of mood and mood sensitivity

Wolfgang Viechtbauer
*Maastricht University, The Netherlands*

Background: Experience Sampling Method (ESM) studies often involve measurements of mood and their sensitivity to external conditions and events. A recurring question in this context is the reliability of the assessments themselves and the reliability of relationships found.

Aim: The purpose of this study was to investigate the reliability of mood assessments and mood sensitivity and to compare results across groups with different mental health status.

Methods: Analyses were conducted with a merged dataset of 9 ESM studies, all using similar designs involving 10 (semi)random assessments over multiple days (1,268 individuals, 35,625 momentary assessments). Positive and Negative Affect (PA/NA) were measured with 3 and 6 items, respectively. Reliability of PA/NA was assessed by fitting multilevel models with correlated random effects for all items at the subject and observation level and then factor analyzing the correlation matrices of the random effects. Mood sensitivity was examined in terms of the relationship of PA/NA with a rating of the (un)pleasantness of the most important event prior to each assessment. Reliability of this relationship was assessed by fitting multilevel models allowing for separate but correlated random effects across all days and examining the consistency thereof.

Results and Conclusions: Reliability of PA and NA was high across all groups (0.88-0.95 at the subject and 0.65-0.83 at the observation level). Reliability of the mood sensitivity relationship was also adequate regardless of whether PA or NA was used as the outcome (0.62-0.77), but lower in the group of depressed subjects (0.58 and 0.31 for PA and NA, respectively).

### An examination of response compliance with the experience sampling method

Aki Rintala[1], Martien Wampers[1], Inez Myin-Germeys[1], Wolfgang Viechtbauer[2]
*[1]Department of Neurosciences, Center for Contextual Psychiatry, KU Leuven, Leuven, Belgium, [2]Department of Neurosciences, Center for Contextual Psychiatry, KU Leuven, Leuven, Belgium; Department of Psychiatry and Neuropsychology, Maastricht University, Maastricht, The Netherlands*

Background: Intensive repeated measurement techniques, such as the Experience Sampling Method (ESM), put high demands on study participants and may lead to low response compliance, which in turn may affect data quality.

Aim: The purpose of this study was to investigate compliance in ESM studies.

Methods: Analyses were conducted using ESM datasets of 11 studies with a total of 80,435 momentary assessments from 1,502 individuals with different mental health status. All included studies used an ESM design with 10 signals (beeps) per day over a 4- to 6-day period. A variety of design and participant characteristics were examined using multilevel mixed-effects logistic regression models.

Results: Overall compliance was 83% (95% CI: 0.81 to 0.84). However, compliance differed across the characteristics examined. For example, compliance declined across days (p < 0.001) reaching a low on the 5th day with 77% (95% CI: 0.76 to 0.79). Compliance also varied significantly across the assessments within days (p < 0.001) with highest compliance between 12 p.m. and 1:30 p.m. (87%; 95% CI: 0.86 to 0.88) and lowest compliance between 7:30 a.m. and 9 a.m. (65%; 95% CI: 0.63 to 0.67). Patients with psychosis tended to be slightly less compliant than healthy controls (71% vs. 79%, respectively; p < 0.001).

Conclusions: Results show overall good compliance with the protocol. Compliance remains at acceptable levels despite fluctuations between and within days and group differences.

### Experience Sampling Method (ESM) designs in severe mental disorders: Methodological considerations

Hugo Vachon, Inez Myin-Germeys
*Department of Neurosciences, Center for Contextual Psychiatry, KU Leuven, Leuven, Belgium*

Background: Severe mental disorders involve daily symptomatic fluctuations at their core and are as such privileged targets for time sensitive methodologies such as ESM. In this view, an exponential number of studies rely on ESM in clinical psychology but the methodological aspects surrounding these designs have not been thoroughly investigated. One of the issues is the balance between number of beeps per day (frequency) and number of days (duration). The purpose of this systematic review was to examine the association between frequency and duration and compliance rate.

Methods: All ESM studies related to the follow-up of symptom dynamics in severe mental disorders (depression, bipolar disorder, psychotic disorder) and published between 2000 and 2016 were included.

Results: Over 104 studies were screened in this ongoing review. According to preliminary results (n = 45), the frequency of daily self-evaluations negatively predicts the compliance of ESM studies [F(1,36) = 5.061; p = 0.03] whereas the duration of the follow-up had no significant effect [F(1,36) = 0.002; p = 0.96]. When we included only those studies with contingent days of ESM (excluding those studies with separate weeks of ESM follow-ups), the effect of frequency was no longer significant.

Conclusions: Preliminary results indicate that frequency of daily self-evaluations involved in ESM studies may have an adverse effect on compliance. Evaluating its influence on the data quality remains challenging as high-frequency designs may also authorize the collection of larger amounts of data despite a lower compliance. The heterogeneity in ESM designs is a challenging issue, and methodological studies are highly needed to pinpoint this potential effect.

### Discussant

Inez Myin-Germeys
*Department of Neurosciences, Center for Contextual Psychiatry, KU Leuven, Leuven, Belgium*

The discussant will integrate and discuss the presentations.

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### Combining sensing technology and experience sampling to capture daily life

Chair(s): Sandrine R. Müller (University of Cambridge), Gabriella M. Harari (University of Texas at Austin)

Sensing technology can help researchers overcome many of the limitations of research into daily behavior to date. This unobtrusive and objective methodology offers the possibility to make much more accurate estimations of frequency of events and to obtain higher granularity of daily behavioral patterns than traditional forms of momentary assessment, allowing us to detect more subtle changes in behavior than ever before possible. In this session we showcase research projects demonstrating the variety of insights that can be gained into daily life by employing sensing technology. Topics covered include: 1) the use of wearable sensors to examine transmission of mental health risks in mother-infant interactions (Kaya de Barbaro; Georgia Institute of Technology, Emory University), 2) smartphone based research and the use of smartphone sensors for exploring the behavioral manifestation of personality (Gabriella Harari, University of Texas at Austin), 3) the use of experience sampling to study the implications of person-environment fit on people's happiness (Sandra Matz, University of Cambridge), 4) the use of experience sampling and mobile sensing to assess patterns of socializing and well-being among students, as well as the ethical, analytical, and practical challenges and considerations of these methods (Sandrine Müller, University of Cambridge). The presentations will be followed by a discussion (moderated by the chair, Sandrine Müller) on the possibilities of using digitally recorded, granular longitudinal data obtained from mobile sensors to help participants reflect on and adjust their behavior to promote positive outcomes.

*Topics: General ambulatory assessment*
*Keywords: smartphone sensing, experience sampling, social psychology*

## PRESENTATIONS OF THE SYMPOSIUM

### High-density markers of mother-infant bio-behavioral activity "in the wild": Developing a mobile-sensing paradigm to examine transmission of mental health risks

Kaya de Barbaro[1], Xuewen Yao[1], Beiwen Liu[1], Junqing Wang[2], Dominique Denbow[1], Alessandro Montanari[3], Geraint Jones[2], Nikki Newhouse[2], Aisling O'Kane[2], Sherryl Goodman[4]
[1]*Georgia Institute of Technology,* [2]*University College London,* [3]*University of Cambridge,* [4]*Emory University*

This presentation will motivate and detail a mobile-sensing paradigm that captures mother-infant interactions in day-to-day ambulatory settings, with the ultimate goal of examining and intervening upon the transmission of mental health disorders from mothers to children. Drawing from diverse literature on individual and family risk factors (e.g., Goodman & Gotlib, 1999; Bowlby, 1973; Kagan et al., 1988) we aim to capture daily markers of: 1) individual instances of infant distress (crying episodes), 2) parents' subsequent efforts to "regulate" or soothe their infant (e.g., picking up or rocking the infant), 3) assessments of maternal psychological distress (e.g., self-reported depressive symptoms collected via cell phone). Mothers and their infants wear wireless sensors to capture continuous (≥12Hz) measures of audio, motion (accelerometry, barometric pressure, relative distance), and physiological data. We will present data from an ongoing validation study of mother-infant pairs wearing this sensor suite in naturalistic "lab-home" sessions as well as in 12-48 hour "own-home" sessions. Preliminary analyses of own-home audio data (N = 8 16-hour recordings) indicate that the validity of commercially available automated crying detection algorithms (LENA©) can be increased by 20% (88.44% vs. 66.7%) by removing crying episodes with short (>2 sec) cry vocalizations. Preliminary modeling of lab-home data indicates that synchronized mother and infant motion sensors can be used to automatically classify holding vs. not-holding ("nearby") behaviors with 97% accuracy (N = 4; Random Forest Classifier). We will provide updated results from our ongoing study (anticipated N = 24) and detail the potential contributions of these unique methods to behavioral and developmental science.

### Using smartphone sensing to explore the behavioral manifestation of personality

Gabriella M. Harari
*University of Texas at Austin*

Existing procedures for measuring personality have relied almost entirely on self-reported thoughts, feelings, and behaviors. Consequently, we know very little about how people differ in terms of their actual behavior. Recently, advances in sensor technologies have made it possible to use smartphone sensors to provide researchers with an array of objective measures of behavior. Smartphone sensor data can also be combined

with participants' self-reports and location data to effectively capture the person, their behavior, and their situational information. The present talk will use a series of studies to demonstrate how sensing methods can be used to measure individual differences in people's everyday behaviors. The studies will highlight the breadth of behavior and the fidelity of measurement that is possible using sensing methods. For example, in one study I will show how we used a sensing application installed on participants' smartphones to collect data on participants' daily social interactions, activities, and locations throughout an academic term. The resulting data revealed moderate to high stability estimates for people's everyday behaviors, which varied across social interactions, activities, and locations. I will also discuss practical, technical, and analytic challenges to under-taking sensing research, and offer some solutions to these challenges. Overall, the studies demonstrate the viability of using sensing methods for measuring people's personalities in the context of their natural lives.

### Using experience sampling methods to study person-environment fit

Sandra Matz[1], Gabriella M. Harari[2], Sandrine R. Müller[1], Samuel D. Gosling[2]
*[1]University of Cambridge, [2]University of Texas at Austin*

What are the characteristics of a location that make people feel happy? Following an individual differences perspective, we tested the hypothesis that students would report higher levels of momentary happiness – as measured by their level of energy – when spending time in a location that reflects their own personality (psychological fit). Using experience sampling methods (Ecological Momentary Assessment, EMA) via a mobile app, 454 undergraduate students reported their current location from a list of 12 locations (e.g., home or bar) as well as their energy level 2 times a day over the course of 5 weeks (6,516 EMAs). In addition, students completed the BFI-44, a widely established measure of the Five Factor model of personality. Providing support for the psychological fit hypothesis, we find that students report higher levels of energy when they spend time in a location that matches their personality (defined as a location which is frequently visited by students of similar personalities). For example, extroverted students report higher levels of energy when spending time at a fraternity (high extroversion location score) rather than at home (low extroversion location score), while the opposite is true for introverts. Our findings highlight the need to understand location preference on the level of the individual: The degree of happiness that people experience in different locations might not be the same for everybody, but might vary according to the unique characteristics of the visitor.

### Patterns of socializing and well-being among students

Sandrine R. Müller[1], Abhinav Mehrotra[2], Cecilia Mascolo[1], Jason Rentfrow[1]
*[1]University of Cambridge, [2]University College London*

Successful adaptation to major life changes is crucial, but represents a struggle for many which can have devastating consequences for an individual's work, private life, and health. One especially stressful and prevalent change is the transition from school to university. We studied how the daily behaviors of well-adjusted, thriving first-year undergraduate university students differ from the behaviors of students who have trouble adjusting. Using experience sampling and mobile sensing via a smartphone app, first-year students (N = 118) reported their daily activities and emotional states (e.g., studying, socializing, exercising; feeling stressed, relaxed, sad) four times per day, on 14 days during the middle of the academic year and another 14 days during exam time. Providing evidence for the power of social connection, students who spent more time with friends, students who are more satisfied with their social life and students who feel more connected to others around them reported higher well-being and less homesickness. Students who report high well-being spend signifi-cantly more time socializing on a daily basis compared to students who are having a more difficult time – on average they spend 2.56 hours socializing per day during the week and 4.55 on weekend days, while their struggling peers spend only 1.70 and 3.40, respectively.

### Eating behavior and its determinants in daily life

Chair(s): Julia Reichenberger (University of Salzburg)

Unhealthy or hedonic eating is highly relevant for eating and weight disorders but is chronically difficult to manipulate or capture in the laboratory. Hence, examining eating behavior in daily life became increasingly prominent within the last few years. Not only is proper eating important in such research but also potential determinants of eating: Craving, stress, affect, and physical activity as well as self-regulatory capacities are studied in this symposium. Julia Reichenberger presents data on the dependencies of restriction intentions and actual restriction success and their relationships with eating styles. Dana Fisher will report on the relationship of stress with physical activity and healthy eating. Joshua M. Smyth will present data on how weight stigma can impact the motivation for weight control mediated via affect and self-regulation in overweight/obese individuals. Zarah Rowland will report on the role of self-regulation capacity and mindfulness on experiences of craving. Last, Jens Blechert will present findings on snack-related thoughts and their relationship with cravings and consumption as a function of trait craving. Overall, the symposium congregates a coherent set of variables known to influence eating in obesogenic environments.

*Topics: General ambulatory assessment*
*Keywords: craving, eating, stress, self-regulation, mindfulness*

## PRESENTATIONS OF THE SYMPOSIUM

### Relationship of stress on physical activity and healthy eating in daily life

Dana Fischer[1], Julia Reichenberger[2], Jens Blechert[2], Olga Pollatos[1]
*[1]University of Ulm, [2]University of Salzburg*

Stress is a major and continuously growing health problem in society. Although previous studies showed that Physical Activity (PA) is associated with a decreased perception of stress, during stressful periods individuals tend to minimize their PA and healthy eating because of limited time. Studies investigating effects of stress on PA in concert with healthy eating in daily life are scarce. The aim of the present study was to evaluate these relationships using Ecological Momentary Assessment (EMA). Fifty-three healthy students were investigated over seven days with a smartphone application. Specifically, participants were prompted every 2.5 hours, completed stress items, and self-reported on their PA level as well as healthy eating behavior. Higher stress levels related to less subsequent PA, whereas healthy eating was not influenced by stress. In turn, a higher PA level was associated with less subsequent stress. The beneficial effect of PA on stress perception and the decreased PA in stressful periods seems to play a crucial role for prevention. Therefore, short interventions fostering PA in stressful periods or apps functioning as reminders should be promoted. Healthy eating seems to be easier to keep up during stressful times, potentially because it is more habituated in this healthy sample. Further research is needed assessing why individuals spend more time with low effort activities compared to salutogenic behaviors like PA.

### Experiences of weight stigma, weight regulatory behaviors, and self-regulatory processes

Joshua M. Smyth
*Pennsylvania State University*

Weight stigma is a pervasive problem that negatively impacts the health of stigmatized individuals. Two Ecological Momentary Assessment (EMA) studies assessed the consequences of weight stigma in daily life on weight control behaviors and proxies for dynamic regulatory resources (e.g., affect, motivation, working memory).

In study 1, 46 largely overweight/obese community adults (24 women) completed EMA (after weight stigma experiences and at end of day) for 2 weeks, reporting mood and motivation for weight regulatory behaviors. At the episode level, lower positive affect following a stigma experience was associated with lower motivation for weight control behaviors in women (but not men). Greater frequency of stigma experiences on a given day predicted less motivation for weight control behaviors at end of day; these associations were mediated by low positive affect.

In study 2, 68 overweight/obese community adults (42 women) completed EMA (3xdaily, and after weight stigma) for one week, reporting stress, mood, and intentions and self-confidence for healthy eating and exercise; also, a mobile working memory task was conducted at each assessment. Weight stigma experiences were related to higher stress, worse mood, lower positive intentions, and lower rated self-confidence for healthy eating and exercise. Weight stigma experiences were associated with lower working memory, largely mediating the effects of weight stigma on lower self-confidence.

Weight stigma experiences have negative consequences on eating and weight control behaviors. These effects may be mediated by acute impairment of regulatory resources (affect, motivation, working memory). These results can inform efforts to reduce the negative impact of weight stigma.

### Indexing the intention-behavior gap: Food intake intentions and actual restriction in daily life

Julia Reichenberger[1], Joshua M. Smyth[2], Jens Blechert[1]
[1]*University of Salzburg,* [2]*Pennsylvania State University*

Restriction of food intake resembles a common, yet controversial practice to tackle overweight. In fact, most diets fail to produce long-term weight loss and instead induce a cycle of overeating-compensation alterna-tions. Predictors and mechanisms are largely unknown. Laboratory studies fall short of capturing the temporal structure of such cycles. Hence, naturalistic studies are needed comparing intentions with actual restriction and compensation for unsuccessful restriction. During evening reports of 10 successive days, 59 participants reported about todays' restriction as well as on their intention to restrict tomorrow. Intention-behavior gaps were implemented as differences between intention at t1 and restriction at t2, while compensation was implemented as difference between restriction at t1 and intention at t1. Several trait-level eating style questionnaires served as predictors. Participants scoring high on emotional eating, stress eating, and food craving exhibited stronger intention-behavior gaps: intentions outstood the actual restrictive behavior. The same eating styles also predicted higher compensation. Results suggest that emotional eating, stress eating, and food craving impact restrictive behavior in daily life. These individuals not only chronically overestimate their abilities to restrain in the future, they also regularly build overambitious dietary intentions. Such mecha-nisms might explain some of the pitfalls in weight loss dieting.

### How to control food cravings – Evidence of protective factors in the moment of desire

Zarah Rowland, Mario Wenzel, Thomas Kubiak
*University of Mainz*

Frequent and intense food cravings are associated with an increased risk to develop obesity and eating disorders. Therefore, an effective self-regulation of them is necessary to remain healthy. To improve self-regulation, in turn, it is crucial to identify external and inner conditions which either support or weaken the ability to regulate cravings.

The aim was to identify protective external cues (social environment, current activity, location, availability of food) and inner states (current mindfulness, negative and positive affect, and self-control capacity), which influence self-regulation in the moment of desire. This study was part of the SMASH study, a rand-omized controlled trial, with a final sample of N = 121 healthy students (female 78.51%) aged between 18 and 49 (M = 22.89, SD = 5.09). Data was collected during a 40-day Ambulatory Assessment (AA) period assessing several desire domains, environmental cues, and inner experiences six times per day via smartphones. Signals were randomly distributed between 10 a.m. and 8 p.m. Multilevel mixed effects logistic regression and mixed regressions revealed that participants high in state mindfulness and self-control capacity reported less intense desire strength, less conflicted food cravings leading to fewer instances of acting on them. External factors such as current activities (e.g., working) and the availability of food increased the probability of trying to resist the experienced food craving. Inner and external conditions were found to facilitate self-regulation of food cravings giving deeper insight in how to prevent acting upon them.

### Food cravings in lab and life

Jens Blechert, Anna Richard, Adrian Meule
*University of Salzburg*

Food craving refers to an intense momentary desire to consume a specific food. Some individuals report such cravings with elevated frequency and intensity. But what constitutes such a trait-like tendency to crave, and how is this related to actual eating? Data from a laboratory study documented increased implicit hedonic responses to chocolate in an implicit association test in high trait chocolate cravers compared to low trait chocolate cravers. Thoughts of chocolate seem to be difficult to regulate as high trait cravers show enhanced ventral striatal brain responding to chocolate images and report more thoughts about chocolate. In a subsequent Ecological Momentary Assessment (EMA) study, we found that high trait cravers reported more snack-related thoughts and stronger relationships of such thoughts with cravings and consumption. Together these data suggest that trait cravings represent a key determinant of appetitive behaviors such as implicit evaluations, reward system activity, snack thoughts, cravings, and consumption.

**Momentary mechanisms to disentangle long-term developments in psychopathology**

Chair(s): Ulrich Ebner-Priemer (Karlsruhe Institute of Technology (KIT)), Marieke Wichers (University Medical Center Groningen)

Within-subject momentary mechanisms are probably the key feature in e-diary research. They have been used in various disorders to describe psychopathological features, transdiagnostic mechanisms, and specificity across disorders. However, most studies focused on one specific time point, such as one week of assessment. Studies investigating within-subject momentary mechanisms during multiple time points (such as pre-treatment, post-treatment, and follow up) are still rare. Studies in this symposium combine within-subject momentary mechanisms (assessed with a high sampling frequency) within a longitudinal perspective, sometimes also called "measurement burst design". Studies presented include various disorders, such as post-traumatic stress disorder, major depression, and bipolar disorder. Altogether, they impressively illustrate the potential of using momentary mechanisms and dynamics to describe trajectories in developing psychopathology.

*Topics: General ambulatory assessment*
*Keywords: measurement burst design, momentary mechanisms, dynamic affect networks*

## PRESENTATIONS OF THE SYMPOSIUM

### Stress-induced dissociation – A momentary mechanism explaining adverse development after trauma?

Philip Santangelo[1], Kathlen Priebe[2], Franziska Friedmann[2], Martin Bohus[3], Ulrich Ebner-Priemer[1]
[1]*Karlsruhe Institute of Technology,* [2]*Humboldt-University Berlin,* [3]*Central Institute of Mental Health Mannheim*

Background: Stress-induced dissociative experience has been shown in patients with borderline personality disorder as well as, to a minor degree, in patients with anxiety disorder and major depression. It has been hypothesized that the stress-induced dissociative experience may be related to trauma, but studies investigating this relation are missing. In addition, studies investigating if this mechanism is related to treatment outcome are lacking.

Aims: This study aimed at i) relating momentary mechanisms, such as stress-induced dissociation and affective instability, to adverse developments after traumatic experiences and ii) investigating if these mechanisms are related to treatment outcome.

Methods: In this ongoing study, 120 PTSD patients are assessed three times (pre, midterm, post) over the course of specialized treatment program (DBT-PTSD). At each of the three assessments, participants carry an e-diary on two consecutive days during daily life. We used a high sampling frequency approach (i.e., brief assessments in 30-minute intervals) to assess momentary dissociative disturbances, stress, and affective states during 12 hours per day. In addition, 50 healthy controls and 50 traumatized healthy controls with a history of childhood interpersonal violence were assessed using the same e-diary protocol.

Results: Looking at the baseline assessment, we found a unique relation between adverse developments after traumatic experience. Using multilevel modeling, both momentary mechanisms (stress-induced dissociation and affective instability) differed between groups with and without psychopathological symptoms after traumatic experiences.

Discussion: Momentary mechanisms proved to be uniquely related to adverse development after traumatic experiences.

### Capturing personalized sequences of change over the course of treatment

Evelien Snippe[1], Ivan Nyklíček[2], Marieke Wichers[1]
[1]*University Medical Center Groningen,* [2]*Tilburg University*

Background: Little is known about the process leading up to recovery from depression. Studies so far used either pre-post treatment assessments or weekly assessments of depressive symptoms. Such studies might have failed to capture the sequence of change because 1) they did not map the change process continuously, e.g., using daily assessments, 2) they examined change at the group level, and 3) they examined depression as one uniform factor.

Aims: The aim of the study is to examine whether the sequence of change can be established with daily assessments of different mood states over the course of treatment within single individuals.

Methods: Items of the Depression, Anger, Tension, Fatigue, Energy, and Relaxation subscales of the Profile of Mood States (POMS-SF) were assessed daily over the course of an 8-week mindfulness-based stress reduction program. Courses of change in the different mood states were mapped over time within single individuals who provided at least 80% of daily assessments, had elevated levels of negative mood at baseline, and showed a decrease in negative mood over the course of treatment.

Results: Individuals differed in which aspects of mood changed over time and in the sequence of change in mood states. For example, in one individual anger decreased first, followed by a decrease in depression, whereas in another individual depression changed first, followed by a decrease in tension.

Conclusions: To understand processes of change in psychopathology, we need to capture the complete courses of change over longer periods of time within single individuals.

### Long-term monitoring of mood and behavior-related parameters like communication and physical and overall activity in patients with bipolar disorders

Esther Muehlbauer[1], Emanuel Severus[1], Holger Hill[2], Michael Bauer[1], Ulrich Ebner-Priemer[2]
[1]*Dresden University of Technology,* [2]*Karlsruhe Institute of Technology*

The detection of Early Warning Signs (EWS) in the course of bipolar disorders seems to have high potential in preventing new illness episodes and therefore is relevant for patients' personal well-being (level of psychosocial functioning and quality of life) as well as for economic costs (sick days, costs for health care system). The presented work examines whether behavior-related parameters are able to differentiate between euthymic, (hypo-)manic, and depressive episodes and whether they can predict new illness episodes. The detection of EWS for the prevention of new (hypo-)manic and depressive episodes is conducted via continuous ambulatory assessment. In detail, we monitored communication habits such as length of calls, number of dialed contacts, number and length of messages, as well overall activity like smartphone usage, number of steps, and traveled distance. Monitored activity data was complemented by a wrist-worn actigraphy sensor. In addition, patients answered end-of-the-day e-diaries regarding mood, sleep, and medication. 30 outpatient participants were included in the study for 12 months each. Psychopathological interviews for assessing current (hypo-)manic, depressive, and euthymic states took place on a fortnightly basis. Self-rated mood seemed to be an excellent predictor for clinically assessed psychopathology, which demonstrates the usefulness of mood charting. Manic symptoms correlated with wake-/sleep times, depressive symptoms were predicted mainly by sleep problems and early rising. Phone call parameters correlated more with manic symptoms, and text messaging parameters with depressive symptoms. Manic and depressive symptoms can be differentiated by number of steps, general use or activity of the smartphone, and the overall activity of the person.

### Dynamic affect networks and resilience against psychopathology in high-risk adolescents

Marieke Wichers, Anya Kuranova, Hanneke Wigman
*University Medical Center Groningen*

Background: Previous studies have suggested that psychopathology may arise as a consequence of the dynamic interplay between micro-level affect states. No study yet, however, has examined whether dynamic affect network characteristics relate to follow-up course of psychopathology.

Aims: We aim to examine empirically whether the dynamic network structure differs between individuals who do and do not develop psychopathology in the near future.

Methods: We used a sample of adolescents (n = 162), who scored above average on negative childhood experiences, as a high-risk population for developing psychopathology. At baseline, Experience Sampling (ESM) was performed (60 observations). Psychopathology was measured at baseline (SCL-90-R) and a year later. Network analyses were performed on ESM affect states.

Results: Although baseline mean levels of affect did not differ, network dynamics between affect states did differ between adolescents who would (group 1) or would not (group 2) develop psychopathology. Group 1 showed more connectivity in their networks between negative affective states than group 2. Also, in the first group, the node "feeling tired" showed the strongest influence on other nodes in the network and had the potential to activate a vicious loop between negative affect states and to downplay a loop between positive affect states. In the second group, the node "feeling cheerful" had the strongest influence on other nodes and could downplay a loop between negative affect states in the network.

Conclusions: These results support the idea that a network structure of micro-level affect states may reveal dynamics that have relevance for the future course of psychopathology.

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**SYMPOSIUM 13**

### Approaches to multilevel mediation in ambulatory assessment: Challenges, illustrations, and future directions

Chair(s): Corina Berli (Columbia University)

Mediation analysis is designed to test the causal mechanisms through which one variable affects another. When applied to ambulatory assessments the analysis requires a multilevel approach. However, researchers using ambulatory assessments are faced with multiple alternate mediation models, and some are being actively debated by methodologists. This symposium brings together research papers that address common types of mediation in the multilevel context, and of particular relevance with ambulatory assessments: First, Shrout and colleagues will discuss the scenario where predictor, mediator, and outcome variables vary at the within-person level (called 1-1-1 mediation), using an example of support events, self-efficacy, and mood. Next, Bolger and Laurenceau will discuss conceptual issues in assessing multilevel mediation, where X is a between-person variable and M and Y are within-person variables (called 2-1-1 mediation), using an example of personality processes in daily life. The final two papers are detailed empirical applications of 2-1-1 mediation models in the context of health behavior change interventions. Berli and colleagues analyze the effect of action control text messages to promote physical activity adherence, and Inauen and colleagues analyze the effect of smartphone-based support groups on healthy eating. These individual presentations will be followed by a moderated discussion of lessons learned, implications, and future directions (Discussant: Gertraud Stadler).

*Topics: Big data*
*Keywords: multilevel mediation, within- and between-person process, health behavior change interventions*

## PRESENTATIONS OF THE SYMPOSIUM

### Understanding within-person causal chains: The 1-1-1 mediation model

Patrick E. Shrout[1], Corina Berli[2], Jennifer Inauen[3]
[1]*New York University,* [2]*Columbia University,* [3]*Eawag / Columbia University*

Mediation models are hypothesized causal chains whereby the effect of a change on one variable (X) on subsequent change on another (Y) is explained by a change on an intervening variable (M). The classic mediation model is formulated for between-person variables, but a version can be formulated for within-person variation using multilevel models. Because the variation is all at the lowest level, it is called a 1-1-1 mediation model. We review the design and analysis implications of 1-1-1 models for data that are collected using ambulatory assessment. In this case the strength of the mediation process might vary from participant to participant – a situation sometimes called moderated mediation. We illustrate the analytic approaches to 1-1-1 mediation using simulated data that are based on examples of studies of daily support events, momentary self-efficacy, and momentary mood.

### 2-1-1 multilevel mediation: Conceptual problems linking levels of analysis

Niall Bolger[1], Jean-Philippe Laurenceau[2]
[1]*Columbia University,* [2]*University of Delaware*

Although quantitative psychologists now have effectively solved the statistical issues in assessing multilevel mediation, conceptual problems remain. In particular, the conceptual status of 2-1-1 mediation, where the X is a between-subject variable, and M and Y are within-subject variables, can be problematic. The 2-1 link, is of necessity between-subjects, but the 1-1 link can be assessed at both levels of analysis. What if, as is frequently the case in intensive longitudinal data, the between-subjects 1-1 link is markedly different (in magnitude and/or direction) from the within-subjects link? How should one calculate indirect effects? If one's conceptual goal is to understand within-person processes, the within-person 1-1 link is the logical one to use in calculating indirect effects. Doing so, however, will result in an estimate that bears no necessary relation to the total effect of X on Y. If one carries out a more standard 2-1-1 mediation analysis, the standard mediation decomposition of effects can be calculated, but this result can be questioned on conceptual grounds. We will illustrate these issues with intensive longitudinal data on personality processes in daily life.

### Mediators of an ecological momentary intervention to promote physical activity adherence

Corina Berli[1], Gertraud Stadler[2], Patrick E. Shrout[3], Niall Bolger[1], Urte Scholz[4]
[1]Columbia University, [2]University of Aberdeen / Columbia University, [3]New York University, [4]Universität Zürich

Health behavior change interventions targeting self-regulation skills have generally shown promising effects, but the mediating mechanisms remain poorly understood. We examined the mediators of physical activity adherence in a randomized controlled trial targeting action control (i.e., continuously monitoring and evaluating an ongoing behavior with regard to one's standards). 121 overweight individuals and their heterosexual partners were randomly allocated to an intervention (information + goal setting + action control text messages) or a control group (information only+ text messages reminding on daily diaries). Participants wore triaxial accelerometers to assess the main outcome (adherence to recommended daily physical activity level) and reported on the mediators action control, received social support from the partner, and self-efficacy in electronic end-of-day diaries across a period of 28 days (resulting in a 2-1-1 mediation design). On average, participants of the intervention group reported higher adherence to recommended daily activity levels, and higher action control, received support from the partner, and self-efficacy than participants of the control group. Using a traditional between-person approach, action control and social support from the partner, but not self-efficacy, emerged as mediating mechanisms, explaining 20%, 25%, and 12% of the stable differences in physical activity adherence. Applying a cross-level mediation approach, results suggest that the mediating process may also operate at the within-person level, albeit differently from the between-person level (contextual effect). Implications for the interpretation of results and best practices are discussed.

### How do smartphone-based support groups promote healthy eating? An application of the 2-1-1 mediation model

Jennifer Inauen[1], Niall Bolger[2], Patrick E. Shrout[3], Gertraud Stadler[4], Melanie Amrein[5], Pamela Rackow[6], Urte Scholz[5]
[1]Eawag / Columbia University, [2]Columbia University, [3]New York University, [4]University of Aberdeen / Columbia University, [5]Universität Zürich, [6]University of Aberdeen

Smartphone-based support groups can successfully promote healthy eating in daily life. However, it is unclear what psychological mechanisms can explain this effect. According to theory, likely mechanisms are received social support and action control (awareness of standards, self-monitoring, and self-regulatory effort). This study examines these mechanisms at the between-person and the within-person level. In this 2x2 randomized controlled trial, N = 203 adults were randomized to an intervention condition (social support) vs. control (information only), and an eating goal (eating more fruits and vegetables vs. eating fewer unhealthy snacks). After baseline, participants received information on their assigned eating goal, and then they completed a 13-day daily diary. During Days 4-10, participants in the intervention condition were asked to support each other in achieving their eating goal in smartphone groups. The primary outcome was daily servings of fruits and vegetables or unhealthy snacks consumed. The mediating mechanisms were self-reported daily received social support (informational, emotional, instrumental), and action control. The data were analyzed using a 2-1-1 multilevel mediation model, taking into account the temporal dynamics of the mediator and the outcome. The intervention successfully promoted healthy eating (d = 0.56, CI 95: 0.28, 0.84). Action control emerged as the only significant mediator, and partially explained the intervention effect on healthy eating both at the between-person and the within-person level (indirect/total effect: 31%). Interestingly, this study indicated that smartphone-based support groups promote healthy eating through increasing action control rather than received support. Perks and pitfalls of different approaches to 2-1-1 mediation in the context of change are discussed.

### Psychological processes and mechanisms underlying the development of psychosis in daily life: New evidence from experience sampling research

*Chair(s): Inez Myin-Germeys (KU Leuven, Belgium), Ulrich Reininghaus (Maastricht University, The Netherlands)*

Current models of psychosis have proposed several psychological mechanisms that may contribute across different phenomenological and temporal stages to the development of psychosis. However, our understanding of how these processes and mechanisms impact at different stages on, and increase the intensity of, psychotic experiences in individuals' daily lives, outside the research laboratory remains limited. This symposium brings together international researchers at the forefront of research into the role of psychological processes and mechanisms underlying the development of psychotic experiences in daily life using novel multilevel, network, and moderated mediation analytic techniques of experience sampling data. Inez Myin-Germeys will present novel data on momentary stress and affective and psychotic symptoms in individuals at clinical high risk for psychosis. Annelie Klippel will report new findings from an investigation of time-lagged networks of the relations between minor daily stress, momentary affect, psychotic experiences, and context in individuals varying in familial risk for psychosis using intensive longitudinal data obtained from six studies. Paula Cristóbal will present novel data on the impact of gene-environment interaction on the real-world expression of psychosis risk. Ulrich Reininghaus will report recent findings from multilevel moderated mediation models to investigate how stress, enhanced threat anticipation, and experiences of aberrant salience combine to increase the intensity of psychotic experiences in daily life. Maude Schneider will report new findings on the (lack of) association between social cognition and real-life social functioning from a large experience sampling study of patients with psychotic disorder and healthy controls. Wolfgang Viechtbauer will discuss these findings in the context of new challenges and directions for future research.

*Topics: General ambulatory assessment*
*Keywords: Psychological mechanisms, experience sampling methodology, network analysis, multilevel moderated mediation*

## PRESENTATIONS OF THE SYMPOSIUM

### Clinical high risk for psychosis: The association between momentary stress and affective and psychotic symptoms

Inez Myin-Germeys
*KU Leuven, Belgium*

Background: Stress reactivity is hypothesized to be an important mechanism in psychosis. In this study, we specifically aimed to investigate the role of stress reactivity in the very early stages of illness. We therefore investigated the associations between momentary stress and both affective and psychotic symptoms in everyday life of individuals at Clinical High Risk (CHR), compared to chronic psychotic patients and healthy controls, in search for evidence of early stress sensitization. We also assessed whether psychotic experiences in itself were a source of distress.

Method: The experience sampling method was used to measure affective and psychotic reactivity to everyday stressful activities, events, and social situations in 22 CHR patients, 24 patients with a psychotic disorder, and 26 healthy controls.

Results: Multilevel models showed significantly larger associations between Negative Affect (NA) and activity-related stress for CHR patients than for psychotic patients (p = 0.008) and for CHR compared to controls (p < 0.001). Similarly, the association between activity-related stress and psychotic symptoms was larger in CHR than in patients (p = 0.02). Finally, the association between NA and symptoms (p < 0.001) was larger in CHR than in patients.

Conclusion: Stress sensitization seems to play a role particularly in the early phase of psychosis development as results suggest that CHR patients are more sensitive to daily life stressors than psychotic patients. In this early phase, psychotic experiences also contributed to the experience of stress.

### The cascade of stress: A network approach to explore differential dynamics in individuals with varying familial risk for psychosis

Annelie Klippel
*KU Leuven, Belgium*

Background: Stress plays a central role in the development and persistence of psychosis. Network analysis may help to reveal mechanisms at the level of the micro-dynamic effects between stress, other daily experiences, and symptomatology. This is the first study to examine time-lagged networks of the relations between minor daily stress, momentary affect, psychotic experiences, and context in individuals varying in familial risk for psychosis. Intensive longitudinal data were obtained through six studies.

Methods: The combined sample consisted of 654 individuals varying in familial risk for psychosis: healthy control subjects (n = 244), first-degree relatives of psychotic patients (n = 165), and psychotic patients (n = 245). Using multilevel models combined with permutation testing, group-specific time-lagged network connections between daily experiences were compared between groups. Specifically, the role of stress was examined.

Results: Familial risk for psychosis was significantly related to both higher overall connectivity in the network and a higher number of significant network connections. In all populations, stress had a central position in the network and showed direct and significant connections with subsequent psychotic experiences. Furthermore, the higher the familial risk for psychosis the more variables 'loss of control' and 'anxious' were susceptible to influences by other network nodes.

Conclusion: These findings support the idea that minor daily stress may play an important role in the induction of a cascade of effects that may lead to psychotic experiences.

### Impact of gene-environment interaction on the real-world expression of psychosis risk: Linking genetic variation and early-life and momentary experiences

Paula Cristóbal-Narváez
*Departament de Psicologia Clínica i de la Salut, Universitat Autònoma de Barcelona (UAB), Barcelona, Spain*

Background: Several studies have indicated that the interaction of genetic and environmental factors produces vulnerability and resilience to mental disorders. However, there is a dearth of evidence investigating with ecological validity gene-environment interactions across the extended psychosis phenotype. This study examined whether genetic variation, early-life experiences, and momentary experiences impact on the expression of daily-life psychotic features. It also investigated the interaction of genetic variation with early-life or momentary experiences on psychotic-like symptoms in nonclinical and early-psychosis individuals.

Methods: The Experience Sampling Method (ESM) was used with 242 nonclinical and 86 early-psychosis participants during one week to assess momentary positive and negative experiences and psychotic-like symptoms. Participants completed measures of early-life experiences and were genotyped for genetic variation in FKBP5 gene.

Results: Both distal and proximal environmental factors, but not genetic variation, had an impact in the real-world expression of psychotic features in nonclinical and early-psychosis individuals. Compared to nonclinical subjects, early-psychosis individuals reported greater psychotic reactivity to environmental risk factors. However, as positive momentary experiences increased, early-psychosis participants experienced greater decreases in symptoms than their nonclinical counterparts. The risk FKBP5 haplotype interacted with distal environmental factors increasing psychotic-like symptoms, whereas the interaction of the protective FKBP5 haplotype and positive momentary experiences was associated with diminished psychotic features in help-seeking individuals.

Conclusions: Findings underscore the relevant role of gene-environment interactions on daily-life psychotic features. Understanding how genetic individual differences interact with both sides of environmental influences is essential for disentangling risk and resilience processes involved in the etiology of psychosis.

### Modeling the interplay between psychological processes and adverse, stressful contexts and experiences in pathways to psychosis

Ulrich Reininghaus
*Maastricht University, The Netherlands*

Background: Several integrated models of psychosis have implicated adverse, stressful contexts and experiences, and affective and cognitive processes in the onset of psychosis. In these models, the effects of stress are posited to contribute to the development of psychotic experiences via pathways through affective disturbance, cognitive biases, and anomalous experiences. However, attempts to systematically test comprehensive models of these pathways remain sparse. We aimed to investigate how stress, enhanced threat anticipation, and experiences of aberrant salience combine to increase the intensity of psychotic experiences.

Methods: We used the Experience Sampling Method (ESM) in 51 individuals with First-Episode Psychosis (FEP), 46 individuals with an At-Risk Mental State (ARMS) for psychosis, and 53 controls. We fitted multilevel moderated mediation models to investigate indirect effects across these groups.

Results: We found that the effects of stress on psychotic experiences were mediated via pathways through affective disturbance in all three groups. The effect of stress on psychotic experiences was mediated by threat anticipation in FEP individuals and controls but not in ARMS individuals. There was only weak evidence of mediation via aberrant salience. However, aberrant salience retained a substantial direct effect on psychotic experiences, independently of stress, in all three groups.

Conclusion: Our findings provide novel insights on the role of affective disturbance and threat anticipation in pathways through which stress impacts on the formation of psychotic experiences across different stages of early psychosis in daily life.

### Lack of association between theory of mind and daily-life social functioning requires a drastic conceptual reframing

Maude Schneider
*KU Leuven, Belgium; University of Geneva, Switzerland*

A better understanding of the mechanisms underlying social impairments in schizophrenia is essential. Theories of Mind (ToM) deficits are generally assumed to contribute to social difficulties but several studies failed to observe consistent associations between the two constructs. Furthermore, the association between ToM and real-life measures of social functioning remains unknown. We tested these associations using two measures of social functioning: the Social Functioning Scale (SFS) and real-life measures collected with Experience Sampling Methodology (ESM). 578 adults with a psychotic disorder and 349 controls completed the Picture Sequencing Task (ToM task) and the SFS. A subsample of 245 participants underwent a 6-day ESM protocol assessing the amount of time spent alone vs. with others, and the appraisal of the social context. Patients exhibited significant social impairments and ToM deficits compared to controls. However, robust regressions controlling for IQ, age, and gender revealed no significant effect of ToM on either of the SFS dimensions. Similarly, ToM score failed to predict real-life measure of the social context (% time spent alone vs. with others). Regarding the appraisal of the social context, higher ToM abilities were associated with decreased preference for being alone in controls (b = 0.08, p = 0.007) but not in patients. All the remaining associations were non-significant. Contrary to what is typically assumed, this study shows that ToM deficits do not underlie social impairments in schizophrenia. These findings will be interpreted in light of alternative conceptualizations of ToM and the growing literature on remediation programs targeting ToM impairments in patients at-risk for psychosis.

**Using ecological momentary assessment to understand daily life affective functioning in the context of psychopathology and risk across the lifespan**

Chair(s): Lauren M. Bylsma (University of Pittsburgh, Department of Psychiatry), Marlies Houben (KU Leuven)

Affective dysregulation and altered affective processing are often at the core of psychopathology across a range of disorders. Because affect is inherently dynamic, Ecological Momentary Assessment (EMA) techniques are ideal to track affective processes over time and can elucidate the true nature of these processes in daily life in relation to psychopathology. In this symposium, our five presenters illustrate the use of EMA to explore daily life affective dynamics in the context of psychopathological symptoms, diagnosis, and familial risk status across the lifespan. Along these lines, our first two presentations explore group differences in affective dynamics—Thompson examines how people think they should feel and react during their everyday lives, while Bylsma explores positive and negative affective dynamics in daily life in youth at high and low familial risk for depression. Next, Dejonckheere examines the nature of the relationship between momentary positive and negative affect with depressive symptoms in a subclinical sample to better understand emotional complexity and flexibility in the context of a range of depression symptomatology. Our last two presentations consider affective experience more broadly by investigating the ecological context in which affective experience is embedded—Horton et al. examines stress sensitivity and social contact in adolescents at high familial risk for schizophrenia; and, finally, Houben explores emotion regulation strategies in daily life of people with high levels of borderline personality disorder and the association of emotion regulation strategies with situational demands. Altogether, these studies demonstrate how EMA can elucidate affective processes in the context of psychopathology.

*Topics: General ambulatory assessment*
*Keywords: psychopathology, risk, affective dynamics, context, emotion regulation*

## PRESENTATIONS OF THE SYMPOSIUM

### Affect evaluation in people with and without internalizing disorders

Renee J. Thompson[1], Katharina Kircanski[2], Ian H. Gotlib[2]
*[1]Washington University in St. Louis, Department of Psychological & Brain Sciences, [2]Stanford University, Department of Psychology*

Background: Affect evaluation—how people think they should feel—is an important component of emotional experience. For example, affect evaluations inform people about whether they should increase or decrease their positive or negative affect and provide feedback to shape future experiences. We examined whether people with internalizing disorders evaluate their affective experiences more extremely than do people without psychiatric disorders.

Methods: We assessed how adults diagnosed with major depressive disorder and/or generalized anxiety disorder (clinical; n = 51) and healthy controls (n = 19) thought they should feel in the moment ("should" affect) and should have reacted to a recent event ("regretted" affect). We used experience sampling to repeatedly assess participants' current, should, and regretted affect over one week.

Results: With respect to should affect, participants, independent of diagnostic status, reported that they should be feeling more positive affect and less negative affect. The clinical participants' reports were more extreme than were those of the healthy control participants, even after accounting for mean affect. With respect to regretted affect, clinical participants reported regretting their affective reactions more frequently than did control participants. On the other hand, when they regretted their reactions, participants, independent of diagnostic status, typically thought they should have reacted with greater positive affect and less negative affect.

Conclusions: These findings highlight how people with internalizing disorders are generally more extreme in the affect evaluations than are healthy controls. Future research should examine which factors (e.g., distress tolerance, emotional avoidance) contribute to the association between affect evaluation and internalizing disorders.

**Positive and negative affective dynamics in daily life in youth at high and low familial risk for depression**

Lauren M. Bylsma[1], Jennifer S. Silk[2], Cecile D. Ladouceur[1]
*[1]University of Pittsburgh, Department of Psychiatry, [2]University of Pittsburgh, Department of Psychology*

Background: Offspring of a parent with a history of depression are at three times greater risk of developing depression themselves, suggesting the importance of identifying mechanisms conferring risk. Measures of affective dynamics may represent vulnerability factors for developing depression that are present even outside of depressive episodes. However, there is limited research with youth before their first depressive episode.

Methods: Youth participants were 29 high risk and 31 low risk adolescents (9-13yo, 52% female) who completed a 10-day experience sampling protocol (5 weekdays and 4 weekend days) using a smartphone app, with up to 4 reports on weekdays (after school) and 9 on weekends. Positive (PA) and Negative Affect (NA) composites were computed at each time point using 8 positive and 7 negative mood adjectives. Multilevel analyses examined group differences in daily life positive and negative affect, affective instability (MSSD), and inertia (autocorrelation).

Results: High risk youth exhibited less overall daily life PA (p < .01), but did not differ on overall NA. However, while the groups did not differ on PA instability, the high risk group exhibited greater NA instability (p < .05). The groups did not differ on either PA or NA autocorrelation.

Conclusions: Findings suggest that youth with a family history of depression who have not yet experienced depression themselves exhibit deficits in affective functioning in daily life, including lower overall PA and greater instability of NA. Specific indices of daily affective dynamics may be associated with vulnerability to developing depression even before clinically significant symptoms are present.

**The bipolarity of affect and depression**

Egon Dejonckheere[1], Merijn Mestdagh[1], Marlies Houben[1], Yasmine Erbas[1], Madeline Pe[1], Peter Koval[2], Annette Brose[3], Peter Kuppens[1]
*[1]KU Leuven, [2]Australian Catholic University, Melbourne, [3]Humbold-Universität zu Berlin*

Background: People differ in the extent to which they experience momentary Positive (PA) and Negative Affect (NA) rather independently or as bipolar opposites.

Aim: Here, we examine the proposition that the nature of the relation between PA and NA in a person's momentary emotional experience is indicative of psychological well-being, in particular vulnerability for depression, a mood disorder typically characterized by diminished PA (anhedonia) and/or increased NA (depressed mood).

Methods and Results: In three experience sampling studies we examined how positive and negative affective states are related within people's emotional experience in daily life and how the degree of bipolarity of this relation is associated with depressive symptom severity. In Studies 1 and 2, we show both concurrently and longitudinally how a stronger bipolar PA-NA relationship is associated with, and in fact is predicted by, higher depression severity, even after controlling for mean levels of PA and NA. In Study 3, these findings are replicated with depression's core symptoms, sadness and anhedonia, in participants with elevated depression scores.

Conclusion: Together, these results demonstrate that depressive vulnerability involves stronger bipolarity between PA and NA, reflecting reduced emotional complexity and flexibility.

### Stress sensitivity and social contact in adolescents at familial risk for schizophrenia

Leslie H. Horton[1], Jennifer S. Silk[2], Gretchen Haas[3]
[1]*University of Pittsburgh, Department of Psychiatry, [2]University of Pittsburgh, Department of Psychology,*
[3]*University of Pittsburgh, Department of Psychiatry; VISN4 MIRECC at VA Pittsburgh Health Care System*

Background: There is preliminary evidence that people at risk for schizophrenia report greater emotional reactivity to everyday stress in experience sampling studies. However, this has not been examined in younger adolescents prior to the typical age of risk for psychosis onset; thus, the developmental progression of stress sensitivity in this population remains unclear. Furthermore, little is known about how social relationships either buffer or increase stress in adolescents at risk for schizophrenia.

Methods: In the current study, we examined stress sensitivity, affect, and social functioning in a sample of adolescents ages 14-19 at Familial High Risk for schizophrenia (FHR), compared to age- and sex-matched Healthy Controls (HC). Adolescents completed Ecological Momentary Assessment (EMA) questionnaires over 3 consecutive weekends (m = 32 completed questionnaires).

Results and Conclusions: As expected, all adolescents reported greater negative affect in the context of stressors. FHR adolescents reported greater numbers of and emotional reactivity to stressors compared to HC adolescents. FHR adolescents also reported less overall positive affect across contexts, and greater reports of being alone and socially isolated. These findings suggest the presence of heightened stress sensitivity in adolescents at familial risk for schizophrenia, some of whom were as young as age 14. The tendency of FHR adolescents to experience more social isolation may deprive them of the stress-buffering benefit of social contact, and could contribute to increasing vulnerability to symptoms of mental disorders over time.

### Daily emotion regulation is less context dependent in people with more borderline personality disorder symptoms

Marlies Houben, Elise Kalokerinos, Peter Kuppens
*KU Leuven*

Background: Borderline Personality Disorder (BPD) is characterized by profound emotion dysregulation. Theory suggests that this dysregulation results from an increased vulnerability to high emotionality and an inability to regulate intense emotions. Although emotional vulnerability has been extensively examined, the role of Emotion Regulation (ER) ability in BPD has been relatively understudied.

Aim: The first aim was to examine which ER strategies are employed in daily life by people with more BPD symptoms, and second, to examine the degree to which this ER use occurred in response to situational demands, which would reflect optimal ER use.

Methods: In 2 waves of a longitudinal study (N = 202), young adults participated in one week of experience sampling, in which they repeatedly reported their emotions, ER use, and the intensity of negative events they encountered.

Results and Conclusions: Higher levels of BPD symptoms, above and beyond high levels of depressive symptoms, predicted an increased likelihood of using any ER strategy, including both putatively maladaptive (e.g., rumination) and adaptive strategies (e.g., reappraisal). Overall, participants were more likely to use any strategy when they were in situations demanding ER, i.e., when they had higher negative affect, and when they had experienced an intense negative event. However, for people with higher levels of BPD symptoms, these context-ER use relationships were weaker for many ER strategies. This indicates that although people with high levels of BPD symptoms are more likely to use ER strategies, their use of these strategies is less closely linked to situational demands.

### Capturing affective reactivity and regulation in daily life? Challenge accepted!

Chair(s): Inez Myin-Germeys (KU Leuven)

Dysregulated emotions play a prominent role in many psychiatric disorders. Researchers increasingly use experience sampling and related ambulatory methods to investigate affective functioning and affective dysregulation in daily life. However, how to best capture individuals' reactions to daily life stress or positive events (i.e., affective reactivity) and how they regulate these affective responses (i.e., emotion regulation) remains a challenging quest. To move the field forward, we need to know why and when one strategy is preferred over the other. This symposium addresses this need and aims to critically discuss current methods and operationalizations along a range of samples - including those with, or at risk for, psychopathology. Thomas Vaessen will start with an introduction on the broader concept of stress and will review different ways of operationalizing the stress response in daily life. Next, Sanne Booij advocates for multidimensional assessment of affective reactivity to stressful events in daily life and shows which combination of stress dimensions predicts affective reactivity best. Turning to positive events, Vera Heininga explores whether affective reactivity may differ by high/low arousal and illustrates how minor differences in methodological strategy can largely impact one's conclusions. Lauren Bylsma then shows how results on affective reactivity to positive and negative events in adolescents are impacted by different operationalizations of affective reactivity. Finally, Peter Koval presents several challenges in modeling the impact of emotion regulation strategies on positive and negative affect in daily life, based on an experience sampling study of 180 participants' spontaneous use of regulation strategies over 21 days.

*Topics: General ambulatory assessment*
*Keywords: affective functioning, affective dysregulation, emotion regulation, experience sampling, current methods and operationalizations*

## PRESENTATIONS OF THE SYMPOSIUM

### Ambulatory stress assessment: A review

Thomas Vaessen[1], Aki Rintala[2], Inez Myin-Germeys[2]
[1]*KU Leuven and Maastricht University, [2]KU Leuven*

Background: Stress has been associated with a broad range of somatic and mental disorders. Not only exposure to traumatic life events, but also smaller, daily stressors can put a vulnerable individual at risk. Such daily hassles can be measured with ambulatory assessment methods, but there appears to be a large variety in the ways these methods are employed and the precise concepts they are aimed to assess. We conducted a literature search in order to get an overview of the methods that have been carried out to measure stress in daily life.

Methods: PUBMED was searched for studies measuring stress in daily life using ambulatory assessment techniques with the following Boolean phrase: (stress AND ("mobile assessment" OR "mobile monitoring" OR "momentary assessment" OR "momentary monitoring" OR "remote assessment" OR "remote monitoring" OR "experience sampling" OR "event sampling")). The initial search yielded 306 results.

Results: The studies identified by the search showed a broad range of outcome measures, assessment schemes, technology, and study populations. Most studies used short questionnaires, heart rate (variability), or cortisol measures to assess stress. Between the questionnaires was a particularly large variety in outcome measures.

Discussion: The great variety in ambulatory stress assessment methods found is in part likely due to differences in the used definition of stress. The different strategies that have been used to measure stress in daily life are critically evaluated on their conceptual and psychometric features. Furthermore, the discussion extends to the definitions of "stress" and their respective usefulness in ambulatory assessment methods.

## Multidimensional event stressfulness predicts affective reactivity in depressed and non-depressed individuals

Sanne H. Booij[1], Elisabeth C.D. van der Stouwe[2], Nynke A. Groenewold[3], Elisabeth H. Bos[2], Peter de Jonge[2], Marieke C. Wichers[1]
[1]University Medical Center Groningen, [2]University of Groningen, [3]University of Cape Town

Background: Intensive Longitudinal Data (ILD) studies on affective reactivity to stressful events have used various dimensions of stress, such as unpleasantness, uncontrollability, and unpredictability. However, it remains unknown which combination of stress dimensions predicts affective reactivity best in depressed and non-depressed individuals.

Methods: Participants (27 depressed, 27 non-depressed) completed a diary thrice daily for a period of 30 days. Univariate multilevel analyses were performed to investigate the effect of unpleasantness, uncontrollability, and unpredictability of daily events on changes in subsequent Negative Affect (NA). Multivariable multilevel models were constructed to determine the optimal combination of stress dimensions and whether the strength of the predictions differed between the depressed and non-depressed groups.

Results: Unpleasantness was a stronger predictor of subsequent NA than uncontrollability and unpredictability. However, multivariable analyses showed that the combination of all three dimensions predicted subsequent NA best. The response in NA to this combination of stress dimensions was larger in the depressed than the non-depressed group, but this was mostly accounted for by an increased NA response to unpleasantness.

Conclusions: Affective reactivity to stressful events is increased in depression. This is in line with most previous studies in the ILD literature. Furthermore, the unpleasantness dimension (stressor intensity) captured affect reactivity better than uncontrollability and unpredictability, and performs best in discriminating depressed from non-depressed individuals. Nevertheless, for a more comprehensive assessment of affective reactivity to daily life stress, a multidimensional model of event stressfulness should be included.

## Positive affective reactivity in anhedonic individuals' daily life: Anything but flat and blunted

Vera E. Heininga[1], Eeske van Roekel[2], Joshua Ahles[2], Tineke Oldehinkel[1], Amy Mezulis[3]
[1]University Medical Center Groningen, [2]University Medical Center Groningen & Tilburg University, [3]Seattle Pacific University

Background: Individuals with anhedonia, the inability to enjoy daily activities, are often described as "flat" or "blunted" in their Positive Affect (PA). These observations are in line with depression theory and findings from laboratory studies, yet never examined in real-life.

Aim: We aimed to reveal PA functioning in daily life of anhedonic individuals and investigate whether they are as flat and blunted as commonly thought.

Method: Using an experience sampling study, we assessed PA experience three times a day for 30 days in 18- to 24-year-old Dutch individuals (20% males) with anhedonia (N = 69) and without anhedonia (N = 69; controls).

Results: Multilevel analyses showed that, compared to their healthy counterparts, individuals with anhedonia displayed more variability and instability in daily PA, but did not display blunted positive emotional reactivity. In fact, in their high-arousal PA experience, individuals with anhedonia showed a stronger PA reactivity response to positive experiences. In addition, we compared two statistical multilevel models that have been used interchangeably up till now and found that minor differences in methodological strategy can have a large impact on the conclusions of a study. That is, statistical significance depended on the in- or exclusion of the non-significant Level 2 interaction between inertia and anhedonia status.

Conclusions: Individuals with anhedonia may display less "flat" or "blunted" PA than generally thought, but replication using similar samples, timescales, and statistical techniques is warranted.

## Affective reactivity to daily life positive and negative events in youth at high and low familial risk for depression

Lauren M. Bylsma, Jennifer S. Silk, Cecile D. Ladouceur
University of Pittsburgh

Background: Depressed adults have been found to exhibit blunted affective reactivity in the laboratory; however, studies of affective reactivity in daily life reveal that adults may actually be more reactive to positive events relative to controls. Depressed youth have shown evidence of more reactive negative affect in daily life, but little is known about daily life affective reactivity in youth at high familial risk for depression.

Methods: Youth participants were 29 high risk and 31 low risk adolescents (9-13yo, 52% female) who completed a 10-day experience sampling protocol (5 weekdays and 4 weekend days) using a smartphone app, with up to 4 reports on weekdays (after school) and 9 on weekends. Positive and negative affect composites were computed at each time point using 8 positive and 7 negative mood adjectives. Multilevel analyses examined group differences in daily life positive and negative affect reactivity to positive and negative events.

Results: High risk youth exhibited both greater positive affective reactivity to positive events (p < .01) and greater negative affective reactivity to negative events (p < .05). Surprisingly, high risk youth also demonstrated greater negative affective reactivity to positive events and greater positive affective reactivity to negative events (p < .05). Results varied to some degree by how affective reactivity was defined.

Conclusions: High risk youth were found to be more labile overall to daily life emotional events. Results suggest the importance of examining positive and negative affect separately and carefully considering how to appropriately define and measure affective reactivity. Developmental considerations will also be discussed.

## Effectiveness of emotion regulation in daily life depends on context

Peter Koval[1], Jordan Hinton[2], Freya Hanly[2], Keana Loschiavo[2], John Gleeson[2], Peter Kuppens[3], Tom Hollenstein[4]
[1]University of Melbourne, [2]Australian Catholic University, [3]KU Leuven, [4]Queen's University

Background: Emotion Regulation (ER) is considered central to well-being. While ER research has grown rapidly in recent decades, most of our knowledge about ER still comes from artificial lab studies and global/retrospective reports, thus limiting our understanding of how ER naturally occurs in everyday contexts. Capturing ER processes as they naturally unfold in daily life presents a number of challenges including, i) identifying people's ER goals, which may not always be pro-hedonic; ii) disentangling the unique effects of different ER strategies, which may often be used simultaneously; and iii) accounting for contextual and dispositional moderators of the effectiveness of different ER strategies.

Methods: Participants (N = 186) reported their spontaneous use of nine ER strategies 9-10 times each day for 21 days, using a smartphone app. At each prompt, participants also rated their current emotions, ER goals, and contextual appraisals. Individual differences in personality, emotional style, and well-being were measured at baseline.

Results: Multilevel modeling analyses examined how the effectiveness of ER strategies varied depending on i) which other strategies deployed concurrently, ii) ER goals, and iii) contextual and dispositional factors. Results suggest that the consequences of ER strategies depend on when, and by whom, they are used.

Conclusions: Modeling the impact of different ER strategies in daily life is complicated by the fact that the effectiveness of ER strategies may depend on the specific context in which they are used, as well on dispositional factors relating to the person using them. Our findings caution against a 'one-size-fits-all' approach to ER.

**Ambulatory monitoring to improve clinical practice in mental health**

Chair(s): Philippe Delespaul (Maastricht University)

Most eHealth interventions in mental health are translations of traditional interventions in a digitized format. The aim is to reduce the need for scarce and expensive resources and contribute to 'health for all'. eHealth, however, is often a challenge to the skills of the clinicians and understandably is experienced as a threat. Even in the Netherlands, eHealth is not widely implemented.

mHealth, in contrast, can solve long-existing challenges to optimized treatment by improving personalized assessment strategies of fluctuations in mental states that reflect individual vulnerabilities and strengths. It can also move the therapy from the therapist office towards the daily life of patients and optimize coping and generalizability of interventions.

Modern mobile technology allows interventions that were required but could never be implemented before.

*Topics: Ecological eHealth interventions*
*Keywords: ESM, EMA, mHealth, PsyMate, personalized psychiatry*

## PRESENTATIONS OF THE SYMPOSIUM

### Introduction to mobile interventions in mental health

Philippe Delespaul
*Maastricht University*
(see abstract for the symposium)

### Demonstrating the applicability of an experience sampling tool for routine outcome measurement in mental health

Simone Verhagen, Julienne Berben, Philippe Delespaul, Jim Van Os, Richelle Lousberg
*Maastricht University*

Background: Routine Outcome Monitoring (ROM) is used in mental health care for benchmarking and treatment monitoring. ROM can be improved by using the Experience Sampling Method (ESM), allowing repeated momentary assessments in daily life and the monitoring of relevant ROM constructs. This is the first study that uses an ESM application (the PsyMate™) as a routine mobile-ROM (mROM) tool within a clinical setting. The overall aim is to demonstrate adequate psychometric properties of the PsyMate™ app. mROM assesses both symptom severity levels as well as daily life functioning.

Method: In a sample of 64 patients, an mROM protocol (ESM for 6 days, 10 semi-random moments a day) and a standard ROM instrument (HADS) were administered at baseline and follow-up (3 months later). We measured Positive Affect (PA), Negative Affect (NA), quality of sleep, social- and activity-related stress, tiredness, and feeling unwell.

Results: Subjects completed 52.7% of the measurements at baseline (N = 64) and 48.2% at follow-up (N = 29). Factor analysis and subsequent reliability analysis on PA and NA confirmed the two constructs. Significant and meaningful correlations were found between PA, NA, and HADS scores (ranging from r = .4 to r = .7). Multilevel analyses yielded significant change scores for all six measures, thereby showing sensitivity to change.

Conclusion: The mROM tool can be reliably used in a clinical setting: It shows adequate psychometric properties, concurrent validity, and sensitivity to change over time on relevant ROM constructs. The mROM tool uniquely contributes to ROM, because it assesses functioning in the daily life context.

**Experience sampling as intervention to increase positive affect and empowerment in depression**

Claudia Simons[1], Ingrid Kramer[2], Jessica Hartman[3], Claudia Menne-Lothmann[4], Philippe Delespaul[4], Jim van Os[4], Marieke Wichers[5]
*[1]GGZe, [2]Apanta, [3]Orygen, [4]Maastricht University, [5]Groningen University*

Background: The Experience Sampling Method (ESM) holds opportunities for ecologically valid, person-tailored interventions. Real-life self-monitoring combined with personalized feedback on positive affect experience may help increase insight into patterns of positive emotions and the context in which they are experienced, which may promote adaptive coping and resilience against depression.

Methods: Outpatients (n = 102) with a depression were randomly assigned to an experimental group (six-week intervention consisting of ESM self-monitoring and personalized feedback), pseudo-experimental group (six-week pseudo-intervention consisting of ESM self-monitoring without feedback), or control group (usual care). Effects were evaluated from pre- to post-intervention (empowerment and ESM measures of affect and behavior) and over 32 weeks follow-up (depression, costs, and quality of life).

Results: ESM intervention was associated with a clinically relevant decrease in depressive symptoms, a decrease that was significantly larger compared to the other groups. An economic evaluation tentatively suggested that ESM intervention is cost-effective. Although ESM intervention showed positive changes at immediate post-intervention, changes in affect, behavior and empowerment were only significantly different compared with the control but not the pseudo-intervention group.

Conclusion: Self-monitoring of daily life affect and context coupled with person-tailored feedback may be a promising clinical tool to enhance personalized treatment by providing insight into daily activities that enhance well-being.

**Taperingstrips and self-monitoring for dose-optimization of psychotropic medication**

Peter Groot
*Maastricht University*

Personalized pharmacotherapy is in need of instruments at the level of individual patients that allows the monitoring of effects and side-effects of medication as a function of the changing dose. This will help to address important problems in current medical practice.

1) Reduction and discontinuation of psychiatric medications can cause physical and psychological discontinuation and rebound symptoms. Withdrawal symptoms can be so severe that patients abort the dose reduction, regardless of the medication's efficacy. Withdrawal symptoms and relapse can be wrongly attributed to exacerbation of the original disorder. Consequently, patients continue their medications unnecessarily, adverse medication effects persist, and emotional distress and crisis can be worsened.

2) For an individual patient, the optimal dose of a drug must be high enough to have the desired effect on symptoms, and as low as possible to prevent unwanted side effects as much as possible. To reconcile these conflicting demands is difficult because the recommended doses in the literature are average doses based on group research. Consequently, many patients are prescribed doses which are not optimal and higher than necessary.

The use of taperingstrips in combination with self-monitoring using Experience Sampling Methodology (ESM; i.e., PsyMate) make it possible to address these questions and will be discussed.

### An n = 1 clinical network analysis of symptoms and treatment in psychosis

Maarten Bak[1], Marjan Drukker[1], Laila Hasmi[1], Jim van Os[2]
[1]*Department of Psychiatry and Psychology, School for Mental Health and Neuroscience, Maastricht University Medical Centre, Maastricht, The Netherlands,* [2]*Department of Psychiatry and Psychology, School for Mental Health and Neuroscience, Maastricht University Medical Centre (NL), and King's College London, King's Health Partners, Department of Psychosis Studies, Institute of Psychiatry, London (UK)*

Background: Dynamic relationships between the symptoms of psychosis can be shown in individual networks of psychopathology. In a single patient, data collected with the Experience Sampling Method (ESM—a method to construct intensive time series of experience and context) can be used to study lagged associations between symptoms in relation to illness severity and pharmacological treatment.

Methods: The patient completed, during 1 year (4 days per week), 10 daily random assessments. Five a priori selected symptoms were analyzed: 'hearing voices', 'down', 'relaxed', 'paranoia', and 'loss of control'. Regression analysis was performed including current level of one symptom as the dependent variable and all symptoms at the previous assessment (lag) as the independent variables. Resulting regression coefficients were printed in graphs representing a network of symptoms and were generated for different levels of severity: stable, impending relapse and full relapse.

Results: ESM data showed that symptoms varied intensely from moment-to-moment. Network representations showed meaningful relations between symptoms, e.g., 'down' and 'paranoia' fueling each other. During relapse, symptom levels and the level of clustering between symptoms markedly increased, indicating qualitative changes in the network. While 'hearing voices' was the most prominent symptom subjectively, the data suggested that a strategic focus on 'paranoia', as the most central symptom, had the potential to bring about changes affecting the whole network.

Conclusion: Construction of intensive ESM time series in a single patient is feasible and informative, particularly if represented as a network, showing both quantitative and qualitative changes as a function of relapse.

Bak, M., Drukker, M., Hasmi, L., & van Os, J. (2016). An n = 1 clinical network analysis of symptoms and treatment in psychosis. PloS one, 11(9), e0162811.

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**SYMPOSIUM 18**

### ESM in clinical practice: The possibilities, the pitfalls, and the promise

Chair(s): Fionneke Marijke Bos (University Medical Center Groningen), Ulrich Reininghaus (Maastricht University)

In research, the Experience Sampling Methodology (ESM) has been found to offer valuable insights into the daily lives of patients with psychiatric disorders. ESM allows patients to record their mood, symptoms, and activities multiple times a day. The large amount of information this approach yields per patient renders it possible to draw conclusions and make predictions on an individual basis. As such, it can greatly improve psychiatric treatment.

This symposium will explore several possible applications of ESM to clinical practice. First, we will present a qualitative study examining the wishes of patients and clinicians on how ESM should be applied to improve diagnostics, treatment, and relapse prevention in clinical practice. Second, we will discuss guidelines for the development of Ecological Momentary Interventions (EMIs), which deliver treatment in real-time in patients' own environments, thereby potentially helping patients when they need it the most. Another possible application of ESM to clinical practice is to offer ESM-derived feedback in weekly feedback sessions, for example, on which activities were rated as pleasurable by the patient. Our third talk will show several examples of such individual feedback reports from an ongoing Randomized Controlled Trial (RCT) with depressed patients. Fourth, we will discuss the results of a RCT investigating the effectiveness of ESM-derived lifestyle advice for young adults with anhedonia. Our fifth and final talk will discuss the integration of network models in the treatment of patients with anxiety disorder, in order to formulate new hypotheses and develop personalized treatment strategies.

*Topics: Ecological eHealth interventions*
*Keywords: experience sampling methodology, clinical practice, personalized treatment*

## PRESENTATIONS OF THE SYMPOSIUM

### What patients and clinicians want: A qualitative study

Fionneke Marijke Bos, Evelien Snippe, Richard Bruggeman, Marieke Wichers, Lian van der Krieke
*University Medical Center Groningen*

Research has shown that the Experience Sampling Methodology (ESM) offers unique and valuable insights into the daily lives of patients with psychiatric disorders. With ESM, it is possible to construct personalized models of patients' symptom dynamics, which may aid clinicians to draw conclusions and make predictions for an individual patient. However, the wishes of both patients and clinicians on how to use ESM in clinical practice are not yet clear.

We conducted focus groups and interviews with 42 patients and clinicians and assessed the possibilities, pitfalls, and promise of the application of ESM to clinical practice. The Qualitative Analysis Guide of Leuven (QUAGOL) was used to analyze the interviews and focus groups transcripts.

Patients and clinicians suggested several possible applications of ESM to improve diagnostics, treatment, and relapse prevention in clinical practice. They indicated that feedback derived from ESM assessments could offer them more insight into what influences their symptoms. This knowledge could motivate patients towards more helpful behavior and help them become more in control over their own treatment process. Clinicians perceived ESM as a tool to extend treatment outside the session. Both patients and clinicians stressed the importance of personalization and the possibility to collaboratively decide on the ESM items, the duration and frequency of the assessments, and the timing and content of the feedback. Pitfalls include an excessive negative focus on symptoms and 'being ill' instead of on strengths of the patient and what goes well.

Both clinicians and patients believe ESM and the feedback derived from it shows great promise for clinical practice. Their ideas can contribute to a valid and broadly supported implementation of ESM in clinical practice.

## Guidelines for the development of Ecological Momentary Interventions (EMIs)

Henrietta Steinhart[1], Ulrich Reininghaus[2], Inez Myin-Germeys[1]
[1]KU Leuven, [2]Maastricht University

Recent years have seen major technological advances in mobile communication technologies that have opened up new possibilities for the delivery of modern healthcare. Ecological Momentary Interventions (EMIs) involve treatment delivery in the real-world and in real-time, thereby providing treatment in patients' natural environments and at those moments when they need help the most. Although the many benefits of EMIs are increasingly acknowledged, the approach is still fairly new and development of these interventions has often not been conducted in a structured manner.

The current talk aims to provide the audience with a set of guidelines for the development of EMIs, with a special focus on the role of the Experience Sampling Methodology (ESM), which is essential for this momentary approach to change.

These guidelines will cover different aspects of the development process. The importance of identifying the appropriate theory and relevant evidence base for intervening on momentary targets, issues concerning different designs, components, and approaches of EMIs, as well as the role of ESM for the personalization of treatment will be addressed. Moreover, the potential impact of the target population on design choice and issues concerning hard- and software will be elaborated. Finally, user-friendliness, acceptability, and the evaluation of EMIs will be addressed. These guidelines will be illustrated with an EMI case example, ACT-DL, which is currently tested within a Randomized Controlled Trial (RCT).

Use of mobile technology and expansion of treatment into users' daily lives pose a whole new set of challenges that require careful preparation and consideration.

## Personalized feedback based on the experiencing sampling method as a tool to boost depression treatment (ZELF-i): Common patterns and individual differences

Jojanneke Bastiaansen[1], Maaike Meurs[1], Renee Stelwagen[2], Marieke Wichers[1], Albertine Oldehinkel[1]
[1]University Medical Center Groningen, [2]GGZ Friesland

One of the key reasons the Experience Sampling Method (ESM) is thought to have great potential for clinical practice is that it allows personalized feedback. A recent study suggested that systematic self-monitoring through ESM and personalized feedback on Positive Affect (PA) and activities may be an effective therapeutic tool for depressed patients (Kramer et al., 2014). This calls for further research in regular outpatient care. In this presentation, I will discuss whether information obtained with ESM is meaningful and sensitive to individual differences by means of (anonymized) individual feedback reports from an ongoing pragmatic multi-site randomized controlled trial (ZELF-i).

In this study, patients with depressive complaints are randomly allocated to one of three study arms: a control group receiving no additional intervention, and two experimental groups engaging in 28 days of ESM (5 times per day) and receiving weekly personalized feedback on PA and activities ("Do"-module) or negative affect (NA) and thinking patterns ("Think"-module).

Preliminary exploration (n = 12) revealed that most depressed individuals showed no diurnal mood pattern (e.g., lower mood in the morning), but the degree of day-to-day mood fluctuations showed large individual differences. Also, the activities that were reported as most pleasurable (Do-module), and the amount of daily hassles and uplifts (Think-module) varied widely. In addition to descriptive data, I will present commonalities and individual differences in outcomes of vector autoregression models, which are applied to provide feedback on temporal relationships between sets of variables [e.g., PA and physical activity (Do-module), or NA and rumination (Think-module)].

## Personalized lifestyle advice as a means to reduce anhedonia: An ecological momentary intervention

Eeske van Roekel, Charlotte Vrijen, Vera Heininga, Maurits Masselink, Elske Bos, Albertine Oldehinkel
University Medical Center Groningen

Anhedonia is a major public health concern and has proven particularly difficult to counteract. It has been hypothesized that anhedonia can be deterred by engagement in rewarding social and physical events. The main aim of the present study was to examine the effects of personalized lifestyle advice based on observed individual patterns of lifestyle factors and experienced pleasure in anhedonic young adults. Participants (N = 69; M age = 21.5, SD = 2.0; 79.7% female) were selected through an online screening survey among young adults. Inclusion criteria were persistent anhedonia and willingness to perform a tandem skydive. Participants filled out questionnaires on their smartphones for two consecutive months (3x per day). After the first month, they were randomly assigned to one of three groups: (1) no intervention, (2) lifestyle advice, and (3) lifestyle advice and tandem skydive. To examine the effectiveness of the advice, the momentary questionnaire data (Positive Affect [PA]; pleasure, and Negative Affect [NA]) were analyzed using Interrupted Time Series Analyses (ITSA) in a multilevel model. Further, we explored whether individuals changed their lifestyle behavior, and whether changes in behavior were associated with improvement. The momentary data showed higher PA and pleasure ratings in the month following the intervention in the two intervention groups than in the control group. More specifically, increases in physical activity and decreases in worrying were associated with improvement. These findings indicate that providing personalized lifestyle advice based on experience sampling methodology to anhedonic young adults can be an effective way to increase PA and pleasure.

## Connecting the dots: Using personalized feedback on daily dynamics of psychopathology in clinical practice

Date van der Veen[1], Sacha Epskamp[2], Robert Schoevers[1], Michelle Servaas[1], Harriëtte Riese[1]
[1]University Medical Center Groningen, [2]University of Amsterdam

When dealing with complex psychiatric disorders, protocolled treatment strategies often fail and the clinician needs to personalize care through 'case conceptualization'. This procedure to gain understanding of how personal factors like symptoms, context, behavior, and beliefs interact shows poor reliability (Kuyken et al., 2005). New methods need to be developed to guide intervention selection. With the network approach to psychopathology (Borsboom & Cramer, 2013) as a theoretical backbone and Experience Sampling Methodology (ESM) as a method to obtain personalized and ecologically valid data, we conducted a proof-of-principle study to investigate if personalized feedback on daily dynamics of psychopathology and resilience could improve personalized treatment strategies.

Four female patients with complex anxiety disorders who received intensive treatment in our tertiary clinic were included. Additional to their care-as-usual, personalized ESM diaries were filled out on smartphone five times a day for two weeks, at three occasions during their treatment trajectory (baseline, halfway, and at the end). Items were used for (contemporaneous and temporal) network modeling (Epskamp et al., 2012). These were discussed with the patients to formulate hypotheses on symptom dynamics and appropriate interventions. The procedure was evaluated with a semi-structured interview.

Patients report the method as feasible and useful. Intensive assessment through a personalized experience sampling methodology diary provided sufficient valid data for network modeling. The networks proved valuable for the patient and therapist in formulating new hypotheses. This resulted in clear rationales for interventions and a personalized treatment strategy.

Thus, this method could increase insight in symptom dynamics and enhance self-management.

## Studying long-term marriages using daily diaries: Insights gained from a dyadic approach

Chair(s): Anita DeLongis (University of British Columbia), Christiane Hoppmann (University of British Columbia)

Married couples lives are inextricably intertwined, with members of the dyad each impacting the other's health and well-being across the lifespan. However, the everyday life processes that lead to these long-term effects are not well understood. The papers in this symposium all used intensive longitudinal designs with daily records to gain insight into day-to-day health and well-being linkages in the marital dyad. Michalowski et al., Drewelies et al., and Muller et al. all studied older couples in long-term marriages using daily reports from each member of the dyad. Michalowski found that prospective memory and affect are linked between members of the couple, whereas Drewelies et al. found actor-partner effects of affect on perceptions of control in each member of the couple. Muller et al. studied older couples in which one member of the dyad had been diagnosed with colorectal cancer. Among cancer patients, fatigue is an important outcome playing a large role in quality of life. Muller et al. found inter-couple linkages in rumination and support that accounted for day-to-day variation in patient fatigue. Finally, Stephenson and DeLongis examined divorce outcomes in couples in stepfamilies, combining twice daily records with standardized interviews with each member of the couple at three points across 20 years. These researchers found that day-to-day family and marital tension were associated with depression and declines in long-term marital satisfaction, ultimately significantly increasing the risk for divorce.

*Topics: General ambulatory assessment*
*Keywords: actor-partner effects, couples, aging, health, well-being*

## PRESENTATIONS OF THE SYMPOSIUM

### Prospective memory is linked with fluctuations in own and partner affect in the everyday lives of older couples

Victoria Michalowski[1], Pavel Kozik[1], Peter Graf[1], Denis Gerstorf[2], Maureen C. Ashe[1], Kenneth Madden[1]
[1]*University of British Columbia,* [2]*Humboldt University*

Prospective memory is important for maintaining functional independence in day-to-day life, particularly so in older adults. Importantly, prospective memory performance may not only differ between persons, but it can also vary within persons; for example, prospective memory performance can differ depending on time-varying social contextual or emotional factors. This project uses up to 28 simultaneous daily life assessments of affect and prospective memory from 119 older adult couples (M age = 70 years; M relationship duration = 41 years) to examine how time-varying affective experiences of older adults and their respective partners are associated with everyday fluctuations in prospective memory performance. Preliminary findings from multi-level models in this project suggest that not only does one's own affect have links with prospective memory performance, but that the partner's affect also matters. Specifically, partner's momentary negative affect was associated with reduced prospective memory performance, while own and partner's momentary positive affect was associated with improved prospective memory performance. These associations were specific to negatively valenced prospective memory tasks. Taken together, socioemotional contexts should be considered for prospective memory performance in the everyday lives of older adults.

### Dyadic associations of perceived control with negative affect among older couples

Johanna Drewelies[1], Hannah Schade[1], Gizem Hülür[2], Christiane Hoppmann[3], Nilam Ram[4], Denis Gerstorf[1]
[1]*Humboldt University Berlin,* [2]*University of Zurich,* [3]*University of British Columbia,* [4]*Pennsylvania State University*

Daily control beliefs have been shown to be linked to affective well-being. However, it is an open question whether individual perceived control relates to affective well-being of close long-term partners in people's everyday lives. Using one week of daily reports from N = 89 couples (mean relationship length = 55 years; mean age = 76 years), we examined how daily perceived control links to negative affect at both actor and partner levels and how such associations differ by gender. Our multilevel models covary for relevant individual and couple differences in sociodemographic characteristics, comorbidity, cognitive functioning, and key relationship variables. In line with and extending earlier reports, results revealed that more perceived daily control is indeed associated with lower negative affect. Most importantly, for wives but not husbands we

found that more perceived daily control was additionally associated with lower negative affect of the partner. We also found a significant actor-partner interaction effect suggesting multiplicative associations of actor and partner perceived control with negative affect. We discuss possible mechanisms underlying gender-specific partner interrelations of how perceived control facilitates daily affective well-being and consider implications arising from our results.

### The interplay of spouse support, patient catastrophizing, and daily fatigue in post-treatment cancer patients

Fabiola Müller[1], Ellen Stephenson[2], Anita DeLongis[2], Ans Smink[1], Marrit A. Tuinman[1], Mariet Hagedoorn[1]
[1]*University Medical Center Groningen,* [2]*Unversity of British Columbia*

Objective: Adapting a daily diary approach, this study aimed to investigate how negative cognitions about fatigue may contribute to the ongoing fatigue in cancer patients. Fatigue was in turn examined as a factor interfering with the patient's daily life activities and the marital relationship. Support from the spouse was investigated as a protective factor.

Method: One-hundred and one post-treatment colorectal cancer patients (n = 67 male, mean age 64 years) and their spouses completed daily diaries (14 days, 3 times daily) on patient levels of fatigue, catastrophizing thoughts about fatigue (e.g., worrying the fatigue might get worse), interference with daily life as well as the marital relationship and spouse support.

Results: Within-day multilevel modeling analyses demonstrated that (1a) daily catastrophizing positively predicts daily fatigue and (1b) daily fatigue in turn positively predicts subsequent daily catastrophizing indicating a daily vicious circle of fatigue and negative cognitions. (2) Both, high daily fatigue and catastrophizing predict increased interference. Finally, (3) spousal support protected the marital relationship from the otherwise negative impact of patient fatigue.

Conclusion: Catastrophizing may maintain fatigue in post-treatment cancer patients while support from the spouse may protect patients from negative outcomes related to their fatigue. Interventions that target catastrophizing thoughts are promising to improve fatigue and fatigue interference in post-treatment cancer patients. Involving the spouse and integrating daily diaries into these interventions can help target problematic cognitions and partner interactions and therefore increase effectiveness of interventions.

### Combining daily diary with longitudinal data: 20-year prospective study of divorce among couples in stepfamilies

Ellen Stephenson, Anita DeLongis
*University of British Columbia*

Although the divorce rate in first-marriages has stabilized after years of increase, the divorce rate among those in remarriages continues to increase. We collected data from both members of 170 couples, and followed up for 20 years using a mixed method approach that combined interviews with standardized questionnaires and daily diary methods. Our findings indicate that day-to-day family tension and stress, and ways of coping with this tension, are associated with changes in marital tension over the course of both days and years. Although interpersonal withdrawal was found to be an effective way of reducing daily marital tension in the short-term, frequent use of this coping strategy was associated with decreased marital quality over the years. Maintaining high marital quality has important consequences for both day-to-day and long-term well-being. We found high marital adjustment was associated with less reactivity to daily family tension and stress, and that increases in both emotional and marital distress decreased marital stability over time. High family tension levels also played a role in divorce above and beyond the effects of marital quality alone. The results of this study shed light on the long-term effects of daily stress in stepfamilies.

# III. ORAL PRESENTATIONS

**First evidence of an increase in restlessness during antidepressant tapering preceding depressive relapse in individual patients: A pilot study**

Chair(s): Gertraud (Turu) Stadler (University of Aberdeen)

Arnout Christiaan Smit, Evelien Snippe, Marieke Wichers
*University Medical Center Groningen, University of Groningen, The Netherlands; a.c.smit@umcg.nl*

Early signals of an upcoming depressive relapse in individual patients could help monitor the risk of relapse. In a pilot study, we examined whether a change in feeling restless during antidepressant tapering would precede a significant increase in depressive symptoms.

Six patients with a history of depression answered diary questionnaires three times a day in one continuous period before, during, and after tapering of their antidepressants (an average of 382.5 questionnaires per patient). Two patients relapsed after tapering.

During evaluation interviews, one of the relapsed patients mentioned the first change he noticed was an increase in restlessness, whereas one of the successfully tapered patients described the opposite. In response to this remarkable difference, regression of the diary item "I feel restless" on medication dosage was performed to look for objective evidence of this description.

The two relapsed patients showed a strongly significant increase ($p < .001$) of restlessness as medication went down. None of the successfully tapered patients showed evidence of an increase in restlessness as they tapered their antidepressant use, and two even showed a strongly significant decrease ($p < .001$). Despite the small sample size, it is unlikely ($p < .05$) that this difference between relapsing and successful tapering patients was the result of a coincidence.

These findings provide preliminary evidence that increasing restlessness during antidepressant tapering may be an individual predictor for the risk of relapse. To assess the consistency of this predictor and investigate different hypotheses for what caused these results, a larger study (at least 45 patients) will start February 2017.

*Topics: Ecological eHealth interventions*
*Keywords: experience sampling method / ecological momentary assessment, time series, depressive relapse, antidepressant tapering, early warning signals*

**Fostering self-regulation to overcome academic procrastination by using Interactive Ambulatory Assessment (IAA)**

Simone N. Loeffler[1], Juergen Stumpp[2], Stephan Grund[1], Ulrich W. Ebner-Priemer[1]
[1]*Karlsruhe Institute of Technology, Germany;* [2]*movisens GmbH, Karlsruhe, Germany; simone-nadine.loeffler@kit.edu*

Interactive Ambulatory Assessment (IAA) offers a new methodological approach to investigate and facilitate self-regulation directly in students' daily learning routine. The aim of the present study was to analyze effects of an interactive technology-based support system on academic procrastination. 89 students were randomly assigned to the intervention (IG, N = 43) and the control group (CG; N = 46). During the preparation phase for an academic deadline IG and CG answered questions referring to their working and procrastination behavior presented with electronic diaries every morning and evening. The smartphones of the IG were additionally fitted with intervening features. In particular, the participants of the IG were provided daily with automated feedback concerning their learning and working behavior as well as their procrastination tendency. Additionally, the IG received suggestions related to adequate strategies to overcome procrastination respectively to foster self-regulation based on the individual reasons for procrastination. The strategies were presented within a technology-based tutorial which consisted of eight self-contained modules referring to goal orientation, time management, self-motivation, emotional regulation, fear and self-doubt, activation as well as relaxation. Multilevel model analyses revealed a significant decrease in self-reported procrastination for the IG over the course of the preparation phase in comparison to the CG. In a follow-up measurement with electronic diaries a few weeks later, the IG maintained the reduced procrastination tendency and even increased effectively used working time over the course of the preparation phase for a second academic deadline. Differences between experience sampling and retrospective questionnaire data will be discussed.

*Topics: Ecological eHealth interventions*
*Keywords: procrastination, Interactive Ambulatory Assessment (IAA), self-regulation, intervention*

**Brief ecological mindfulness meditation interventions may buffer against emotional reactivity to stress**

Barbara J. Lehman[1], Dusti R. Jones[2], Diana M. David[3]
[1]*Western Washington University, United States of America;* [2]*The Pennsylvania State University, United States of America;* [3]*Western Washington University, United States of America; barbara.lehman@wwu.edu*

Mindfulness Meditation (MM) interventions may promote emotional and physical health. This research examines the effects of an e-health MM intervention to help disentangle the daily processes by which MM may promote emotional health. Two studies test the effect of brief MM interventions on daily and within-day emotional responses to stress, collected via iPod (Study 1) or participant smartphone (Study 2). In both studies, the MM intervention included a 2-hour in-person session with a MM instructor followed by flexible practice sessions using ambulatory recordings. Study 1 suggested that in contrast to a waitlist control group, undergraduates randomly assigned to MM showed less extreme reductions in daily discrete positive emotions (happiness, satisfaction, relaxation) on days when they reported relatively more stress. However, condition did not moderate the link between daily stress and the negative emotions of anxiety or sadness. In Study 2, which was advertised as a stress management study rather than a MM intervention, undergraduates were randomly assigned to MM or to a parallel cognitively active poetry analysis condition. Analyses suggested that these two interventions were similarly effective, and that condition did not moderate the within-day associations between stress and discrete positive or negative emotions. Together, these results suggest that brief e-health interventions can reduce the effects of daily and within-day stress on emotions. Novice meditators may benefit from expectations for the success of MM. Future research should include both cognitively active comparison groups and waitlist controls, and further examine the effects of MM on daily and momentary psychological processes.

*Topics: Ecological eHealth interventions, General ambulatory assessment*
*Keywords: mindfulness meditation, emotions, stress, e-health intervention*

## Ecological momentary assessment of intrusions: A comparison of different event- and time-based sampling modes

Frank H. Wilhelm[1], Lisa M. Grünberger[1], Michael Liedlgruber[1], Julina Rattel[1], Julia Reichenberger[1], Stephan F. Miedl[1], Jens Blechert[2]
[1]Clinical Stress and Emotion Laboratory, Division of Clinical Psychology, Psychotherapy, and Health Psychology, University of Salzburg, Austria; [2]Centre for Cognitive Neuroscience, University of Salzburg, Austria; frank.wilhelm@sbg.ac.at

Intrusions, i.e., stressful recollections of traumatic events, are a core symptom of posttraumatic stress disorder. Clinical and analogue research (e.g., using the trauma film paradigm) has used both event and time based intrusion sampling but the characteristics of these different sampling modes in terms of reactivity, compliance, and other quality indicators have not been compared systematically. Seventy-two healthy participants watched highly aversive film clips in the laboratory and were asked to enter film related intrusions for three days via an electronic diary application on their smartphone. Participants were randomly assigned to three groups representing different assessment modes: Event-Based (EB, entering intrusions immediately after occurrence), Time-Based-5 (TB5, five prompts per day about every three hours), and Time-Based-1 (TB1, one prompt at 9 p.m.). Subsequently, participants filled out a questionnaire assessing diary compliance and reactivity. Groups did not differ on total number of reported intrusions (M+/-SD = 3.5+/-3.9). Self-reported reactivity and non-compliant behaviors were generally low and did not differ between groups (0-100 scales; reactivity: 26.6+/-11.7; non-compliance: 17.8+/-15.8). In both TB conditions, percentage of missed entries was low (TB1: 16.0+/-18.9; TB5: 11.5+/-10.5; p > .05). In the EB group, 21.7+/-29.3% of intrusion entries were backfilled at a later time. Only in the TB5 condition did aversive film ratings predict intrusion frequency (B = .04, p = .007). Results indicate that the different intrusion sampling modes are comparable with respect to reported intrusion frequency, compliance, and reactivity. Individual differences in emotional reactivity to films, a presumed basis for intrusion formation, were best captured by five prompted entries per day.

*Topics: Ecological eHealth interventions*
*Keywords: momentary assessment*

## I can do it: Tablet usage is associated with increased physical activity and decreased loneliness in older adults

Theresa Pauly, Jennifer C. Lay, Pavel Kozik, Christiane A. Hoppmann
*University of British Columbia, Canada; tpauly@psych.ubc.ca*

Many older adults were not exposed to new technology during their work lives and are hesitant to adopt it. Yet new technologies, such as tablet computers, may facilitate older adults' everyday activities, thus having great potential to improve quality of life. This study examines different types of tablet usage and their association with changes in physical activity and social well-being. We used data from 92 older adults (age 51-85), who participated in a social engagement project that enabled them to keep the iPad mini they had used for data collection for 6 months following the study, and answered biweekly questionnaires on tablet usage during this time. Before and after this 6-month period, participants further reported their physical activity and loneliness. Data were analyzed using multiple regression controlling for age, gender, relationship status, and education. Participants who used the tablet more frequently for physical activity functions reported greater increases in moderate physical activity and a tendency for increased walking time (p < .10) after the 6-month period, compared to participants who used these functions less frequently. However, these more active participants also showed greater increases in sitting time. Furthermore, participants who more often used the tablet for social engagement functions showed greater decreases in loneliness. This study provides support that tablet technology, if used for physical and social engagement functions, may improve physical activity and social well-being in older adults. This attests that new technology may be an underutilized, high-potential platform to deliver programs that improve older adults' health and well-being.

*Topics: Ecological eHealth interventions*
*Keywords: older adults, technology, tablet computers, physical activity, loneliness*

## Do fluctuations in positive affective and physical feeling states predict physical activity and sedentary time?

Jaclyn P. Maher[1], Eldin Dzubur[1], Jimi Huh[1], Chih-Ping Chou[1], Donald Hedeker[2], Genevieve F. Dunton[1]
[1]University of Southern California, United States of America; [2]University of Chicago, United States of America; jmaher@usc.edu

Background: Higher levels of positive affect and feelings of energy and vitality are associated with greater Physical Activity (PA) and lower Sedentary Time (ST). However, whether fluctuations in these feelings contribute to these behaviors is unclear.

Aim: This study examined associations between mean levels and within-person variability in positive affect and feeling energetic and participants' overall levels of PA and ST.

Methods: This analysis combined data from four Ecological Momentary Assessment (EMA) studies (age range: 8-74 years) with ambulatory monitoring via waist-worn accelerometry (N = 625). Positive affect and energy were assessed through EMA several times per day across 4-7 days. Accelerometer data was used to create the following behavioral outcomes: minutes of moderate-to-vigorous PA (MVPA), meeting MVPA guidelines (children: 60 minutes/day, adults: 30 minutes/day), minutes of ST per hour of accelerometer wear, meeting guidelines for ST (<40 minutes/hour). A two-stage analytic approach was used to test the study aim. In the first stage, mixed-effect location scale modeling decomposed mean levels and variability in positive affect and energy. In the second stage, a linear or logistic regression (depending on whether outcome was continuous or dichotomous, respectively) was tested to investigate associations between mean levels and variability in EMA ratings and the behavioral outcome.

Results: Greater variability but not mean level of feeling energetic was associated with lower odds of meeting MVPA guidelines (β = -0.43, p < 0.05).

Conclusions: Fluctuations in physical feeling states may deplete self-regulatory resources involved in planning and implementing PA behavior. Alternatively, being more physically active may stabilize one's perceived energy levels.

*Topics: Big data, General ambulatory assessment*
*Keywords: mood, exercise, sitting, ecological momentary assessment, free-living*

## A circumplex approach to investigating the association of momentary mood to physical activity and sedentary behavior in working adults

Jinhyuk Kim[1], David E. Conroy[2], Joshua M. Smyth[1]
[1]Department of Biobehavioral Health, The Pennsylvania State University; [2]Departments of Kinesiology and Human Development and Family Studies, The Pennsylvania State University; juk423@psu.edu

There is growing interest in the within-person association between mood and physical activity and inactivity in daily life, particularly affective antecedents to periods of active or sedentary behavior. We explored this issue using a circumplex-derived approach to momentary mood, with distinct indicators of emotional valence and arousal, and by temporally lagging analyses to examine momentary mood effects on subsequent activity and sedentary behavior. A community sample of working adults (n = 115; M age = 41.2; 75.7% Female) completed Ecological Momentary Assessments (EMA) 6 times a day for 3 consecutive days asking about current affect states (sad, happy, tired, and interested); these affect states were used to generate momentary circumplex dimensions (arousal and valence). Participants also wore an ActiHeart device that assessed physical activity; we used indicators of activity counts and sedentary duration for one-hour time windows surrounding each EMA. Multilevel modeling used arousal and valence to predict activity and sedentary behaviors in the upcoming hour, controlling for the previous hour. Neither circumplex dimension predicted changes in physical activity. Lower sedentary behavior was predicted by a high level of arousal (p = 0.047). Valence was unrelated to sedentary behaviors. The arousal and valence interaction term was unrelated to changes in activity and sedentary behaviors. We found that arousal predicted sedentary behaviors in working adults, but that valence was unrelated to upcoming activity and sedentary behaviors. This suggests that separating arousal components out of mood measures when predicting sedentary behavior may be important, and understanding arousal may contribute to improved management of inactivity in daily life.

*Topics: General ambulatory assessment*
*Keywords: physical activity, sedentary behavior, arousal, valence, ambulatory assessment*

## Examining daily stress, diurnal cortisol, and physical activity in children using ecological momentary and ambulatory assessment

Genevieve Dunton[1], Jaclyn Maher[1], Chaelin Ra[1], Eldin Dzubur[1], Wangjing Ke[1], Reout Arbel[1], Tara Gruenewald[2], Gayla Margolin[1]
[1]University of Southern California, United States of America; [2]California State University Long Beach, United States of America; dunton@usc.edu

Background: Chronically stressed children engage in lower levels of physical activity, yet little is known about how daily cortisol patterns are associated with physical activity.

Aim: This study examined associations among daily stress, diurnal cortisol, physical activity, and sedentary time in children using ecological momentary and ambulatory assessment.

Methods: Children (N = 118, ages 8-12) completed a seven-day study with Ecological Momentary Assessment (EMA) of perceived stress (randomly prompted up to seven times per day) and accelerometer monitoring of daily Moderate-to-Vigorous Physical Activity (MVPA) and Sedentary Time (ST). On four of those days, children provided four salivary cortisol samples per day (waking, waking plus 30 minutes, afternoon, and bedtime) to capture the Cortisol Awakening Response (CAR) and Diurnal Cortisol Slope (DCS). Multilevel models examined the within-subjects (i.e., day-level) effects of perceived stress on CAR and DCS, and of CAR and DCS on MVPA and ST. Models controlled for between-subjects effects, age, sex, and weekend versus weekday.

Results: Days with higher perceived stress had a flatter DCS (WS coef. = 0.01, p = .004). On days with a lower CAR, children performed more ST (WS coef. = -0.06, p = .032). On days with a flatter DCS, children performed less MVPA (WS coef. = -0.24, p = .083).

Conclusions: Daily variations in diurnal cortisol patterning reflected changes in self-reported perceived stress. The finding that children engaged in more sedentary time and less physical activity on days with a lower CAR and flatter DCS—both indicators of elevated stress—suggests a potential role of the Hypothalamic-Pituitary-Adrenal (HPA) axis in physical activity motivation and implementation.

*Topics: General ambulatory assessment*
*Keywords: ecological momentary assessment, accelerometers, cortisol, stress, physical activity*

## Fatigue in the work place: Two real-time studies of energy expenditure, stress, and perceived reward in hospital nurses

Derek Johnston[1], Julia Allan[1], Cheryl Bell[1], Barbara Farquharson[2], Martyn Jones[3], Marie Johnston[1]
[1]University of Aberdeen, United Kingdom; [2]Edinburgh Napier University, United Kingdom; [3]University of Dundee, United Kingdom; d.johnston@abdn.ac.uk

Background: It is widely agreed that subjective fatigue increases over any prolonged period of work, but this has seldom been verified in real life. Two views have dominated theorizing on fatigue for a century: depletion of limited energy resource theories and motivation theories emphasizing changing goals. In 2 studies of nurses we examined the increase in fatigue at work and contrasted the capacity and motivation views.

Methods: In study 1, 100 nurses completed electronic diaries assessing fatigue, work demands, stress, control, and reward approximately every 90 minutes, over two 12-hour work periods. Energy expenditure was assessed continuously using the Actiheart system. In study 2, 254 nurses completed similar diary measures, over 3 work periods of 9.5 hours.

Results: In both studies, fatigue increased over the work period in virtually all participants, was greater if the work period had been stressful, and was reduced if work had been perceived as rewarding or as allowing more control. Fatigue was unrelated to demand in study 1 while in study 2, demand earlier in the shift did not relate to fatigue but the demand assessed at the same time as fatigue was associated with less fatigue. Fatigue was unrelated to energy expended.

Conclusions: These studies confirm that fatigue increases with time spent working. However there is no support for a resource depletion model as neither energy expenditure nor demand increased fatigue. There is more support for a motivational model as participants were less fatigued when reward and control were higher and stress less.

*Topics: General ambulatory assessment*
*Keywords: work, fatigue, resource depletion, motivation, goals*

## Clinical evaluation of pediatric congenital heart disease using ambulatory impedance cardiography

Ineke Nederend[1,2], Eco de Geus[1], Nico Blom[2], Derk Jan ten Harkel[2]
[1]VU Amsterdam, The Netherlands; [2]Leiden University Medical Center (LUMC), The Netherlands; i.nederend@vu.nl

Background: Survival after Ventricular Septal Defect (VSD) repair is excellent but in adulthood late residua including conduction disease, arrhythmia, and heart failure are not uncommon. This study aims to evaluate 24h autonomic nervous system control, exercise capacity, cardiac function, and physical activity in children after VSD repair.

Methods: 34 patients after VSD repair and a healthy age-matched control group underwent 24h monitoring of autonomic nervous system control using impedance cardiography, an echocardiogram, and maximal exercise testing.

Results: Age of the patients and controls ranged from 8-18y. Mean age at operation was 1.7y (range 4 weeks – 7 years), time after intervention 9.9y. 24h monitoring showed more ventricular ectopy in patients (Median, IQR; 1,4 vs. 0,1; p = 0.019), a higher resting respiratory rate (19±2 vs. 18±1; p = 0.024), and lower Low Frequency (LF) power heart-rate variability (logLF 3.2±0.3 vs. 3.3±0.6; p = 0.031) during sleep. Exercise capacity was significantly less in patients compared to controls (VO2 peak 40.1±7 vs. 44.6±7 ml/kg/min; p = 0.001) while physical activity was not different between the two groups (46.2±19 METs in controls vs. 39.1±17 in patients; p = 0.116). Right ventricular function, measured by Tissue Doppler Imaging was less in patients compared to controls (S':0.10±0.02 vs. 0.12±0.02 E':0.12±0.03 vs. 0.15±0.03 A':0.06±0.02 vs. 0.09±0.02, all ps < 0.001) but was not related to VO2 peak (r = 0.057; p = 0.754).

Conclusions: 10 years after surgical correction of a VSD, autonomic nervous system control is not different but exercise capacity and right ventricular function are decreased compared to healthy controls. Post-surgical outcome in these patients may be less benign than currently assumed.

*Topics: General ambulatory assessment*
*Keywords: impedance cardiography, ambulatory, pediatric congenital heart disease, autonomic nervous system*

## Relationship between negative affect, daily life stress, and abdominal symptoms in irritable bowel syndrome

Yawen Chan[1], Suzanne, H.W. So[1], Arthur, D.P. Mak[2], Justin, C.Y. Wu[3]
[1]Department of Psychology, The Chinese University of Hong Kong, Hong Kong S.A.R. (China); [2]Department of Psychiatry, The Chinese University of Hong Kong, Hong Kong S.A.R. (China); [3]Institute of Integrative Medicine, The Chinese University of Hong Kong, Hong Kong S.A.R. (China); yawenchan@cuhk.edu.hk

Background: Negative affect and daily life stress have been implicated in the psychopathology of irritable bowel syndrome. Using Experience Sampling Method (ESM), this study tested how negative affect and stress relate to bowel symptoms momentarily in the flow of daily life.

Methods: Twenty-seven participants with Irritable Bowel Syndrome – Diarrhea subtype (IBS-D) and 30 healthy controls were assessed using ESM for 14 consecutive days. Moment-to-moment associations between negative affect, stress, and various bowel symptoms (abdominal pain, abdominal distension, urgency to defecate, and diarrhea) were modeled by multi-level linear regression.

Results: The groups were comparable on average level and daily fluctuations of negative affect and stress across 14 days. Among IBS patients, time-lagged analysis revealed that momentary level of negative affect predicted subsequent experience of diarrhea (p = 0.005); momentary level of stress did not predict subsequent bowel symptoms (p > 0.05). Conversely, momentary level of stress was predicted by severity of abdominal pain (p = 0.028), abdominal distension (p = 0.002), and urgency to defecate (p = 0.011) in the previous moment, whereas negative affect was predicted by level of urgency to defecate (p = 0.007) and diarrhea (p < 0.001) in the previous moment. Among controls, momentary levels of stress and negative affect did not predict experience of abdominal symptoms. Conversely, abdominal fullness predicted a reduced level of stress in the next moment (p = 0.024), whereas level of abdominal pain predicted an increased level of negative affect in the next moment (p = 0.042).

Conclusions: Moment-to-moment interaction between negative affect and bowel symptoms in IBS patients suggested a reinforcing cycle that may maintain IBS symptoms.

*Topics: General ambulatory assessment*
*Keywords: irritable bowel syndrome, emotion, stress, experience sampling*

**Tomorrow's gonna suck! Associations of anticipatory stress and perseverative cognition with stress level during the next day and sleep quality**

Andrea C. Kramer[1], Andreas B. Neubauer[1], Andreas Voss[1], Beate Ditzen[2]
[1]Heidelberg University, Germany; [2]University Hospital Heidelberg, Germany;
andrea.kramer@stud.uni-heidelberg.de

Anticipation of tomorrow's demands and preoccupation with today's stressors are thought to influence sleep quality and stress levels during the next day. Given findings on the Cortisol Awakening Response (CAR), suggesting that both anticipatory stress and sleep quality are associated with a stronger CAR, sleep quality might further act as suppressor of the negative effects of anticipatory stress and perseverative cognition. The aim of the present study was to investigate the relationship between anticipatory stress, perseverative cognition, and subjective sleep quality as well as their predictive validity concerning next day's stress adopting a micro-longitudinal approach. To that end, we examined these associations using ambulatory assessment across 5 consecutive days with up to 21 assessments per day. Hierarchical linear modeling was used to examine the impact of perseverative cognition and anticipated stress (assessed in the evening) on subjective sleep quality and stress levels of the next day. Subjective sleep quality was largely unaffected by perseverative cognition and anticipatory stress. However, both anticipatory stress and perseverative cognition predicted the stress level experienced during the next day, independent of sleep quality and previous day's stress. These findings show the predictive validity of anticipatory stress assessed in the evening and provide further implications for the anticipation hypothesis of the CAR.

*Topics: General ambulatory assessment*
*Keywords: anticipatory stress, perseverative cognition, sleep quality, daily stress*

**The landscape and importance of non-cancer conversations among couples coping with breast cancer**

Megan Robbins
*University of California, Riverside, United States of America; megan.robbins@ucr.edu*

Social interactions are undoubtedly important when couples cope with breast cancer; yet they are rarely studied where they naturally unfold. Using the Electronically Activated Recorder (EAR), previous analyses revealed that 4.3% (SD = 5.6) of couples' conversations were about cancer, and that spouses' engagement in substantive conversations about cancer with patients was associated with patients' improved adjustment over a two-month period. Cancer conversations are clearly important for successful coping; however, one advantage of the EAR is to discover the implications of more mundane conversation. Fifty-two couples coping with breast cancer wore the EAR over one weekend and self-reported well-being while the patient was on treatment. The EAR sampled 50 s of ambient sound every 9 min during waking hours. The data revealed the most common topics in couples' everyday lives while they coped with cancer: people ("She'll meet a far nicer boy;" M = 11.1%, SD = 1.9), work ("We might need some employees;" M = 10.6%, SD = 6.0), leisure ("Oh, he got the ball back;" M = 9.1%, SD = 5.2), eating ("A little more salsa?" M = 8.2%, SD = 4.0), body ("I about wore my arm out;" M = 6.8%, SD = 4.0), home ("It's cold in that garage;" M = 6.7%, SD = 4.2), and money ("I had to pay;" M = 6.4%, SD = 4.6). When couples discussed mundane topics, the conversations tended to be non-emotional and substantive ("Dresses are coming back for women;" M = 31.4%, SD = 14.2) or practical ("6:00 or 7:00?" M = 21.3%, SD = 9.9), rather than emotional ("I was really having a tough time;" M = 1.4%, SD = 3.0). Among the different types, substantive conversation was most consistently associated with better well-being for patients, but not spouses.

*Topics: General ambulatory assessment*
*Keywords: coping, Electronically Activated Recorder (EAR), social support*

**A comparison between retrospective und repeated momentary judgments of teaching quality**

Tanja Lischetzke, Susanne Weis
*University of Koblenz-Landau, Germany; lischetzke@uni-landau.de*

Students' Evaluations of Teaching quality (SETs) are typically assessed retrospectively. Research in other areas (e.g., daily emotional experience or pain) has shown that retrospective ratings deviate from repeatedly assessed momentary ratings and are prone to biases such as peak/recency effects. To date, it has not yet been examined whether retrospective SETs are subject to similar biases. Therefore, we aimed to scrutinize whether retrospective SETs differ from momentary SETs and whether they are biased by peak/recency effects. In addition, we tested whether biases would be larger for longer vs. shorter retrospective time frames (end-of vs. mid-semester SETs). In two lectures, we collected momentary SETs on three teaching quality facets (Organization and Instructional Skills, Instructor Enthusiasm, Classroom Climate) at the end of each lesson. At the middle and at the end of the semester, students additionally completed retrospective SETs. Multi-group-multilevel models for mid-semester data (lecture 1: 441 judgments of 92 students, lecture 2: 205 judgments of 47 students) revealed a retrospective overestimation for Instructor Enthusiasm and Classroom Climate (but not for Organization and Instructional Skills). Analyses of the end-of-semester data yielded a similar picture. Averaged momentary SETs and retrospective SETs were highly correlated. Nonetheless, the peak and/or the last (most recent) of momentary SETs predicted retrospective SETs beyond the mean of momentary SETs. Differential effects for the teaching quality facets as to whether peak, recency, or both effects were found point at the possibility that the mechanisms that underlie the formation of retrospective judgments might depend on characteristics of the content domain.

*Topics: General ambulatory assessment*
*Keywords: momentary vs. retrospective ratings, peak/recency effects, students' evaluations of teaching*

**A multi-sample, multi-method analysis of the obtrusiveness of and participants' adherence with the Electronically Activated Recorder (EAR) method**

Anne Milek[1], Allison M. Tackman[1], Charles L. Raison[2], David A. Sbarra[1], Matthias R. Mehl[1]
[1]University of Arizona, United States of America; [2]University of Wisconsin-Madison, United States of America;
mehl@email.arizona.edu

In this talk, we report findings from a multi-sample, multi-method analysis of the obtrusiveness of and participants' adherence with the Electronically Activated Recorder (EAR) method. The EAR is a mobile-phone based observational ambulatory assessment method that operates by intermittently recording snippets of ambient sounds around participants. Conceptually, the EAR shares the elements of in vivo and in real-time assessment with experience sampling methods but switches the assessment mode from self-report to behavioral observation. Methodological considerations around ensuring high data quality therefore revolve around both aspects known from traditional ambulatory assessment research (e.g., importance of partici-pant-researcher rapport) and elements unique to the EAR (e.g., potential for evaluation apprehension resulting from the unobtrusive audio recording). Replicating and extending prior research by Mehl and Holleran (2007), we analyzed demographic, dispositional, and life-style predictors of self-reported and behaviorally-assessed obtrusiveness of and participants' compliance with the EAR in four adult samples (total N = 406 participants). In general, we observed base rates of obtrusiveness and compliance that were similar to what Mehl and Holleran (2007) reported. We also present results on how these base rates differ by study characteristics (e.g., monetary incentive) as well as the participants' demographic (e.g., age, gender, relationship status) and dispositional characteristics (e.g., Big Five personality traits, depression).

*Topics: General ambulatory assessment*
*Keywords: naturalistic observation, unobtrusive observation, behavioral observation, ecological momentary assessment, experience sampling*

**Smartphones as research tools in ambulatory assessment:**
**Effects of own or loan devices on adherence, response attrition, usability, and reactivity**

Wolff Schlotz[1], Fabian Greb[1], Jochen Steffens[1,2]
[1]Max-Planck-Insitute for Empirical Aesthetics, Germany; [2]Technische Universität Berlin, Germany;
wolff.schlotz@aesthetics.mpg.de

Not all potential participants in ambulatory assessment studies own a smartphone, and the variety of hardware potentially compromises reliability of research protocol implementation. Thus, despite being costly and less convenient, loan devices often need to be used. However, it is unclear if using own or loan devices might systematically bias assessments so that devices could not be mixed without affecting results of ambulatory assessment studies. We therefore investigated if using an own device (OD, n = 56) or loan device (LD, Motorola Moto G3, n = 57) affected participant experience and behavior using behavioral data and retrospective self-reports from a 10-day study on correlates of music listening in daily life. Participants were M = 25 years (range: 18-41); 55% were female. In a combined time- and event-based design, participants received 15,106 prompts and activated 704 event-related assessments in total. Groups did not differ significantly in the frequency of missed responses and reported events, response attrition over study duration, handling errors (erroneously pressed event-button), and frequency of listening to music, activities, social situations, or mood. Retrospectively, participants reported similar levels of representativeness of study days and content with prompt frequency. Compared to OD users, users of LDs tended to better keep up reporting events (p = .091), responded more quickly to prompts (p = .009), reported less sports activity (p = .037), lower wakefulness increase (p = .004), and slightly lower usability of the app (p = .061). Taken together, we found little evidence for effects of using ODs or LDs on adherence, attrition, usability, or reactivity. Systematic bias of studies mixing ODs and LDs is unlikely.

*Topics: General ambulatory assessment*
*Keywords: loan smartphone, response attrition, adherence, usability, reactivity*

**Instrumenting ecological momentary assessment with a wearable smartbutton**

Jakob Eg Larsen[1,3], Thomas Blomseth Christiansen[2,3]
[1]Technical University of Denmark, Denmark; [2]Konsulent Blomseth; [3]TOTTI Labs; jaeg@dtu.dk

In recent years we have seen an uptake of various electronic solutions, such as smartphones, to instrument ecological momentary assessment. While an advantage is that a smartphone is likely with the user, the process of unlocking, launching an app, and entering data into a smartphone is tedious. Thus, it may be perceived as too much of a burden and interruption in daily life, which may lead users to not enter data.

To address this problem we have constructed a wearable wristband with a single smartbutton that can be used as a simple instrument to make fast ecological momentary assessments. The smartbutton communicates wirelessly with our smartphone app that logs the time and location an assessment is made.

We suggest the advantage of this approach is a minimum interruption during regular daily life, as assessments happen sub-second. In addition, the smartbutton has a relatively long battery life (6+ months) meaning that the user does not need to be burdened with recharging.

Results have been obtained from initial deployment as part of the treatment process of a war veteran suffering from PTSD. A psychologist and the veteran agreed on a protocol for the use of the instrument for ecological momentary assessment of symptoms. The obtained data has helped the psychologist identify specific triggers of anxiety.

We suggest this type of instrumentation of ecological momentary assessment can be an alternative where short non-interrupting interactions are required especially when the frequency of assessments needs to be high.

*Topics: General ambulatory assessment*
*Keywords: wearable, smartbutton, smartphone, sub-second interaction, PTSD*

**Do peritraumatic affect dynamics during conflict predict subsequent PTSD and depression?**

Talya Greene, Marc Gelkopf
University of Haifa, Israel; tgreene@univ.haifa.ac.il

Little is known about emotional dynamics during periods of trauma exposure, such as during conflict, and how well they predict subsequent psychopathology. Experience Sampling Methods (ESM) were used to study peritraumatic Positive Affect (PA) and Negative Affect (NA) during the 2014 Israel-Gaza conflict in 181 Israeli civilians, including 85 Psychiatric Rehabilitation (PR) service users. During the conflict, summary reports were made twice daily for 30 days via mobile phone. Assessments of Posttraumatic Stress Disorder (PTSD) and depression were conducted 2 months later.

Latent class analyses were conducted entering each individual's NA and PA mean, affect valence mean (NA minus PA), and their NA, PA, and affect valence instability scores (mean successive squares difference). The best fitting model consisted of four classes: 1) An unstable, moderately positive group (n = 23); 2) a stable negative group (n = 24); 3) a stable positive group (n = 52); and 4) a stable, moderately positive group (n = 107). Females and PR service users were more likely to be in the first two groups. The stable negative group had high odds of meeting criteria for PTSD or depression at 2 months post-conflict, while the stable positive group had low odds of meeting criteria for PTSD or depression at 2 months. The two moderately positive groups were at medium risk of psychopathology, although the unstable group had higher odds of developing PTSD or depression.

This study highlights the role of peritraumatic affect as a strong predictor of subsequent psychopathological outcomes and indicates that affect valence may be a particularly useful predictor.

*Topics: General ambulatory assessment*
*Keywords: ambulatory assessment; daily diary; psychopathology, affect instability, affect valence*

**Reciprocal associations between positive emotions and motivation in daily life:**
**Network analyses in anhedonic individuals and healthy controls**

Eeske van Roekel[1,2], Vera E. Heininga[1], Evelien Snippe[1], Albertine J. Oldehinkel[1]
[1]University of Groningen, University Medical Center Groningen; [2]Tilburg University; g.h.vanroekel@uvt.nl

Anhedonia reflects a dysfunction in the reward system, which can be manifested in an inability to enjoy pleasurable situations (i.e., lack of positive emotions), but also by a lack of motivation to engage in pleasurable activities (i.e., lack of motivation). Little is known about the interrelations between positive emotions and motivation in daily life, and whether these associations are altered in anhedonic individuals. In the present study, we explored the reciprocal, lagged associations between positive emotions and motivation in a network model, in anhedonic individuals (N = 66) and healthy controls (N = 68). Participants (aged between 18-24 years) filled out momentary assessments of affect 3 times per day for 30 consecutive days. Our results showed that (1) being relaxed, a low approach emotion, was most central in the network for healthy controls, whereas feeling cheerful, a moderate approach emotion, was most central in the network of anhedonic individuals; (2) anhedonic individuals and healthy controls had similar moment-to-moment transfer of positive emotions; and (3) anhedonic individuals had stronger pathways from positive emotions to motivation than healthy controls. Taken together, our findings suggest that low levels of positive emotions lead to decreased motivation in the anhedonic group, which could instigate a negative spiral of low pleasure and low motivation. On a more positive note, we showed that cheerfulness was highly central in the network of anhedonic participants. Hence, interventions may focus on increasing cheerfulness in anhedonic individuals, as this will likely have the greatest impact on other positive emotions and motivations.

*Topics: General ambulatory assessment*
*Keywords: anhedonia, network analyses, experience sampling method, positive emotions, motivation*

## Diurnal variation of affect: A comparison among depression, psychosis, and a control population

Jessica A Hartmann[1,2], Claudia JP Simons[1,3], Wolfgang Viechtbauer[1], Ritsaert Lieverse[1],
Claudia Menne-Lothmann[1], Frenk Peeters[1], MERGE Collaborators[1], Inez Myin-Germeys[4], Marieke Wichers[5]
[1]Maastricht University Medical Centre, Department of Psychiatry and Psychology, School for Mental Health and Neuroscience, Maastricht, The Netherlands; [2]Orygen, The National Centre of Excellence in Youth Mental Health, University of Melbourne, Australia; [3]GGzE, Institute for Mental Health Care Eindhoven and De Kempen, Eindhoven, The Netherlands; [4]Center for Contextual Psychiatry, Department of Neuroscience, KU Leuven, Leuven, Belgium; [5]University Center for Psychiatry, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands; jessica.hartmann@orygen.org.au

Background: Positive (PA) and Negative Affect (NA) have been demonstrated to differentially unfold over the day. While PA shows a quadratic diurnal variation, NA remains stable across the day. There are indications for a deviant diurnal variation of PA and NA in mental illness; however, the evidence is preliminary.

Aims: To characterize and compare the diurnal variation of PA and NA in depression, psychosis, and the general population.

Methods: A naturalistic design comprising a pooled sample of 1,537 participants derived from 12 experience-sampling studies, consisting of repeated daily assessments of NA and PA over five to six days. Three groups (depression, psychosis, control) were formed based on their initial diagnostic status. Multilevel modeling was used to predict NA and PA by 10 dummy-coded time-points per group; subsequently, coefficients were compared across groups.

Results: Time of day significantly predicted PA in all groups, showing a diurnal variation comparable to an inverted U. The depression group differed significantly from the control group at time-point 10 ($z = 3.10$, $p < .001$), demonstrating a weaker decrease of PA at the end of the day (~9:45 p.m.). NA decreased significantly more in the depression group than the control group from approximately 3:45 p.m. onward.

Conclusion: The typical decline of PA towards the night, observable in the control population, seemed to be weakened in depression. Furthermore, NA showed a stronger diurnal variation in depression as visible in a clear decrease of NA over the day. These differential patterns seemed to be specific for depression.

*Topics: General ambulatory assessment*
*Keywords: experience sampling; positive affect; diurnal variation; depression; psychosis*

## Relationships between the Big Five personality traits and sleep quantity and quality: A multi-method study

Allison M. Tackman, David A. Sbarra, Matthias R. Mehl
University of Arizona, United States of America; tackman@email.arizona.edu

Of the Big Five personality traits, conscientiousness is most consistently associated with reduced mortality, largely because conscientious people engage in healthy behaviors (e.g., physical activity) and avoid unhealthy ones (e.g., alcohol and tobacco consumption). This multi-method study examines how sleep, an important but understudied health behavior in the social-personality literature, is also associated with conscientiousness. Participants from two samples (total N = 433) provided subjective, self-reports of their sleeping behavior during the past month using the Pittsburgh Sleep Quality Index (PSQI). Participants also wore an Actiwatch for 7 consecutive nights, which is a common ambulatory assessment method for assessing objective sleep. Subjective sleep quantity and quality were operationalized using the sleep duration component and the global score of the PSQI, respectively, and objective sleep quantity and quality were operationalized using actigraphy total sleep time and sleep efficiency, respectively. There were no reliable associations between any of the Big Five personality traits and sleep quantity. Regarding sleep quality, however, participants high in conscientiousness self-reported and experienced better sleep quality ($r = .15$, 95% CI [.04, .24], and $r = .12$ [.02, .22]) whereas participants high in neuroticism self-reported but did not actually experience worse sleep quality ($r = -.25$ [-.34, -.17], and $r = -.06$ [-.14, .03]). In addition to identifying a novel health behavior that can be examined in future research as a mediator underlying the conscientiousness-mortality link, this study highlights the importance of examining both subjective and objective measures of a behavior, which do not always agree.

*Topics: General ambulatory assessment*
*Keywords: sleep quantity, sleep quality, Big Five personality traits, actigraphy, ambulatory assessment*

## Studying time-lagged effects using ambulatory assessment data: It is time to go continuously

Rebecca Margaretha Kuiper
University Utrecht, The Netherlands; r.m.kuiper@uu.nl

The emergence of devices, such as smartphones, led to an exponential increase in real-time self-report data studies in the social and medical sciences. In these data, referred to as Ambulatory Assessment (AA) data or Experience Sampling Method (ESM) data, participants record their, for example, feelings or symptoms multiple times a day for several consecutive days. AA data offer the unique opportunity to model everyday processes as they unfold over time and to investigate cross-lagged relationships, that is, the effects variables have on each other. The latter are of interest when researchers want to examine hypotheses such as 'Stress causally dominates anxiety'. Moreover, researchers' hypotheses can be at subgroup level and/or at person level (e.g., 'Stress is the driving force for Anne'). Allowing for such differentiation is important in the development of person-tailored treatments: For example, if Anne's driving force is stress, while Bill's is anxiety, then Anne is likely to benefit from stress management, whereas Bill probably improves more when his anxiety is treated.

Unfortunately, the existing techniques for analyzing cross-lagged relationships in ESM data fall short. In this presentation, I will discuss what types of models can be estimated (discrete-time models and multilevel continuous-time models) and what their pros and cons are; and what type of statistical techniques for evaluating hypotheses exists for these models. Then, I will propose what models and evaluation techniques should be developed (by me) to gain better insight into the way processes affect each other over time and to evaluate their hypotheses regarding these relationships (e.g., hypotheses regarding causal dominance, such as posed above).

*Topics: General ambulatory assessment*
*Keywords: cross-lagged relationships, multilevel (multivariate) continuous-time model, model selection*

## Cross-instrument validity, reproducibility, and feasibility of ambulatory heart rate (variability) monitors

Yoram K. Kunkels[1], Arie M. van Roon[2], Marieke C. Wichers[1], Harriëtte Riese[1]
[1]Interdisciplinary Center Psychopathology and Emotion Regulation (ICPE), Department of Psychiatry, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands; [2]Department of Vascular Medicine, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands; y.k.kunkels@umcg.nl

Background: Ambulatory Heart Rate (Variability) (HR(V)) monitors have enjoyed increased interest recently. However, doubts about their performance suggests that they could put users at risk for unwittingly crossing safe HR thresholds, while also decreasing their usefulness for obtaining valid scientific measurements. We will therefore compare HR(V) measurements from two recently released, ambulatory HR(V) monitors (Ithlete Finger Sensor, Cortrium C3) to those of the well validated and widely used VU-AMS monitor. Our goal is to test and compare the validity and reproducibility of data obtained with, and feasibility of, these newly developed monitors.

Methods: During two standardized laboratory sessions, 50 participants (age: 18-35 years) will be monitored with the three monitors, in various postures and activities: supine, standing, sitting, paced breathing, mental stress, and walking, which all last five minutes. Laboratory sessions are separated by monitoring in naturalistic setting with the Ithlete and Cortrium monitors during two weeks, five times a day, for five minutes. Average HR (bpm) and Root Mean Square of the Successive Differences (RMSSD; ms), and evaluation ratings of the monitors will be obtained.

Results: Data of five participants are currently available. Preliminary results indicate average HR and RMSSD values obtained with the VU-AMS during laboratory tasks to be in the physiological plausible range [e.g., sitting (HR: 68.50±7.49, RMSSD: 55.49±27.44) and mental stress (HR: 75.12±9.34, RMSSD: 46.64±10.94)]. Valid data from the Ithlete and Cortrium monitors were obtained but not analyzed yet.

Discussion: Preliminary results indicate that the research design is suited for reliable data acquisition needed to perform the ongoing study.

Conflict of Interest Statement: The authors declare that the presented research did not include any commercial or financial relationship that could be construed as a potential conflict of interest.

*Topics: General ambulatory assessment*
*Keywords: ambulatory assessment, Heart Rate Variability (HRV), cross-instrument, validation, feasibility*

**Missing data in ecological momentary assessments: Identifying when and who**

Jacqueline Mogle[1], Stacey Scott[2], Joshua Smyth[1], Martin Sliwinski[1]
[1]*Penn State University, United States of America;* [2]*Stony Brook University, United State of America;*
*stacey.scott@stonybrook.edu*

Introduction: Missing data is common in intensive ambulatory surveys of behavior, affect, and health. However, who is more likely to miss surveys may differ from when individuals are more likely to miss surveys. Determining informative predictors of missingness (i.e., auxiliary variables) would allow researchers to account for trait and momentary variables that might otherwise bias analyses.

Method: As part of a larger study, adults (n = 241, M age = 47.2; 67% female) completed momentary surveys 5 times daily for 14 days. Surveys assessed trait and momentary stress, affect, and rumination. We used multilevel logistic models (using lagged momentary responses) to determine whether trait- or momentary-level stress, affect, or rumination were associated with missing momentary surveys after controlling for personality and demographic variables as well as day in study, day of week, and time of day.

Results: Compliance with momentary surveys was 79%. At the trait-level, individuals reporting greater typical levels of rumination were less likely to miss momentary surveys (OR = 0.738, 95% CI: 0.570-0.955). At the momentary level, however, surveys were more likely to be missed following a report characterized by more rumination (OR = 1.074, 95% CI: 1.002-1.152). Neither trait nor momentary stress nor affect predicted the likelihood of missing surveys.

Discussion: Predictors of missingness varied depending on the level of analysis (trait vs. momentary). This implies different auxiliary variables are required to account for missingness depending on the level of analysis. Future research should consider the processes underlying missingness in ambulatory studies particularly when missingness is related to the primary constructs of interest.

*Topics: General ambulatory assessment*
*Keywords: missing data, auxiliary variables, rumination*

# IV. POSTERS

## A. DISENTANGLING THE RELATIONSHIP BETWEEN STRESS SENSITIVITY, AFFECT, AND PSYCHOPATHOLOGY

**The impact of daily hassles on negative affect – Do people high and low in neuroticism differ?**

Lara Mey[1], Andrea Chmitorz[2,4], Karolina Kurth[1], Mario Wenzel[1,4], Raffael Kalisch[3,4], Oliver Tüscher[2,4], Thomas Kubiak[1,4]
[1]*Health Psychology, Institute for Psychology, Johannes Gutenberg University Mainz, Mainz, Germany;*
[2]*Department of Psychiatry and Psychotherapy, University Medical Center Mainz, Mainz, Germany;*
[3]*Neuroimaging Center Mainz (NIC), University Medical Center Mainz, Mainz, Germany;* [4]*Deutsches Resilienz-Zentrum (DRZ), University Medical Center Mainz, Mainz, Germany; lara.k.mey@gmail.com*

Background: There is evidence for the influence of a high individual stressor load caused by Daily Hassles (DH) on Negative Affect (NA). The personality dimension of neuroticism may exacerbate the effect. However, most of the findings are based on retrospective data. There are only few studies assessing the association using an ecologically valid approach.

Objective: This study aimed to examine the association between DH and NA in relation to neuroticism via Ecological Momentary Assessment (EMA).

Methods: 43 participants between the ages of 18 and 30 (mean age: 24.4 years; 61% female) completed a four-week EMA assessment. Each day, participants reported the occurrence of DH since the last assessment, the subjective severity of the occurred events as well as their current affect state at five random measurement points between 9 a.m. and 8 p.m. Associations between NA and daily stressor load at the same measurement point and daily stressor load at the previous measurement were analyzed using multilevel hierarchical modeling. Neuroticism was also considered.

Results: Preliminary analyses show that a higher stressor load is associated with elevated levels of NA at the same measurement point. We expect this association to be stronger for individuals with high neuroticism scores.

Discussion: This study adds to the existing evidence on the association between individual stressor load and negative affect. It sheds *light on the impact of neuroticism using an ecologically valid approach*.

*Topics: General ambulatory assessment*
*Keywords: daily hassles, negative affect, neuroticism, EMA*

**Stress sensitivity as a putative mechanism linking childhood trauma and psychopathology in youth's daily life: An experience sampling study**

Christian Rauschenberg[1], Jim van Os[1,2], Dimitri Cremers[3], Matthieu Goedhart[3,4], Jan N. M. Schieveld[5], Ulrich Reininghaus[1,6]

[1]Department of Psychiatry and Neuropsychology, School for Mental Health and Neuroscience, Maastricht University, Maastricht, The Netherlands; [2]Psychosis Studies Department, Institute of Psychiatry, Psychology & Neuroscience, King's College, London, UK; [3]Tilburg School of Humanities, Tilburg University, Tilburg, The Netherlands; [4]Mutsaers Foundation and Educational Institute Wijnberg, Venlo, The Netherlands; [5]Department of Psychiatry and Psychology, Division of Child and Adolescent Psychiatry, Maastricht University Medical Centre (MUMC+), Maastricht, The Netherlands; 6Health Service and Population Research Department, Centre for Epidemiology and Public Health, Institute of Psychiatry, Psychology & Neuroscience, King's College, London, UK; c.rauschenberg@student.maastrichtuniversity.nl

Objective: Evidence has accumulated that links Childhood Trauma (CT) with a range of psychopathologies, including psychosis. However, evidence on underlying mechanisms remains limited. The present study aimed to investigate whether elevated stress sensitivity, characterized by an increased intensity of (i) negative affect and (ii) psychotic experiences in response to minor stressors in daily life, is an important mechanism through which CT impacts on mental health in help-seeking adolescents and young adults.

Method: The Experience Sampling Method (ESM) was used to measure momentary stress, negative affect, and psychotic experiences in 43 help-seeking adolescents and young adults (cases), 16 siblings of cases, and 40 controls. Childhood trauma as well as depressive, anxiety, and psychotic symptoms were assessed.

Results: Associations between momentary stress (event-related, activity-related, and social stress) and (i) negative affect and (ii) psychotic experiences were modified by physical and emotional abuse and, partially, emotional and physical neglect, but not sexual abuse in cases and controls. While there was strong evidence for increased negative affect and psychotic experiences in cases comparing high vs. low levels of CT, a pattern of resilience was evident in controls with less intense negative affect or no marked differences in the magnitude of associations. Less consistent findings were observed in siblings.

Conclusions: Stress sensitivity may be an important risk or resilience mechanism through which CT impacts on mental health in youth. Thus, interventions directly targeting elevated stress sensitivity in youth's daily life (e.g., using ecological momentary interventions) may be a promising novel therapeutic approach.

*Topics: General ambulatory assessment*
*Keywords: youth mental health, childhood trauma, stress sensitivity, resilience, ecological momentary assessment*

**Negative affect and ADHD symptom fluctuations in adolescents' daily life**

Merle Reuter[1,2,3], Lea Biermann[1], Caterina Gawrilow[1,2,3]
[1]Department of Psychology, Eberhard Karls University Tübingen, Germany; [2]LEAD Graduate School & Research Network, Eberhard Karls University Tübingen, Germany; [3]IDeA Interdisciplinary Research Center for Individual Development and Adaptive Education, Frankfurt, Germany; merle.reuter@uni-tuebingen.de

Background: Attention Deficit Hyperactivity Disorder (ADHD) is a psychiatric disorder frequently diagnosed in children and adolescents showing symptoms of inattention, impulsivity, and hyperactivity. Along with those symptoms, children with ADHD also suffer from an increased affective lability compared to children without ADHD (Sobanski et al., 2010). Whether this negative affect is intra- and interindividually correlated with more pronounced ADHD symptoms in children without a diagnosed psychiatric disorder was examined in this pilot study.

Methods: Children between the ages of 10 and 14 years (N = 18) rated their ADHD symptoms (Lidzba et al., 2013), negative affect (Steyer et al., 1997), and anger (Janke & Janke, 2005) over nine consecutive days. Items from the original questionnaires were adapted to daily measurement and assessed via smartphones once or three times a day.

Results: Children and adolescents experience more ADHD symptoms when they feel angrier ($\rho$ = .32). Analyses revealed no significant correlations between negative affect and ADHD symptoms. Mixed model analyses will be discussed on the poster.

Conclusions: This research suggests that ADHD symptoms co-occur with anger in children and adolescents with no psychiatric disorder. An important practical implication of this research is that cognitive-behavioral treatments could be improved by including interventions to reduce negative affect and anger. Further research is necessary which includes objective measures of attention, a larger sample size, and more time points of measurement. These research implications were considered in another study design that will be presented on the poster.

*Topics: General ambulatory assessment*
*Keywords: attention deficit hyperactivity disorder, affect, anger, ambulatory assessment*

**Increased affective reactivity to daily life stress: A non-specific vulnerability marker for psychopathology?**

Sanne H. Booij, Evelien Snippe, Bertus F. Jeronimus, Marieke Wichers, Johanna T.W. Wigman
University Medical Center Groningen, University of Groningen, The Netherlands; s.h.booij@umcg.nl

Increased affective reactivity to daily life stress has been found in individuals with psychosis and depression, as well as in those at risk for these conditions. This suggests that it may be a non-specific vulnerability marker for psychopathology. However, firm conclusions on this topic cannot be drawn yet: although depressive and psychotic symptoms often co-occur, affective reactivity has never been examined in relation to both psychotic and depressive symptoms simultaneously. The presence of depressive symptoms may confound the relationship between psychotic symptoms and increased emotional reactivity, or vice versa. We examined this possibility in a general population sample (n = 411) by means of an experience sampling study with three measurements a day (t = 90). Three types of subjective stressors were assessed: appraisal of activities, appraisal of social interactions, and the physical discomfort someone experienced. Affective reactivity was conceptualized as both the Positive Affect (PA) and Negative Affect (NA) response to these stressors. By means of mixed model analyses, it was examined whether affective reactivity was related to depressive and/or psychotic symptoms. The PA response to activities and NA response to social interactions were positively related to depressive symptoms, and psychotic symptoms did not confound this relationship. In contrast, no association was found between psychotic experiences and affective reactivity to any of the daily life stressors (a sensitivity analysis in a subsample with increased symptoms confirmed these findings). Hence, the results suggest that increased affective reactivity is a marker for depression, rather than for psychopathology in general.

*Topics: Ecological eHealth interventions, General ambulatory assessment*
*Keywords: affect, vulnerability marker, depression, psychosis, general population*

**How demands and resources constitute threats and challenges in everyday-life**

Maurizio Sicorello[1], Andreas Neubauer[1], Andreas Voss[1], Beate Ditzen[2]
[1]*Heidelberg University, Germany;* [2]*University Hospital Heidelberg, Germany; sicorello@stud.uni-heidelberg.de*

The biopsychosocial model of threat and challenge postulates postulates two distinct motivational states which arise from a mismatch between Resources and Demands ($\Delta$RD). According to the model, a threat state occurs in situations when demands outweigh resources, whereas a challenge state results from resources outweighing demands. While the model has been tested in various experimental and correlational studies, there have been, to our knowledge, no attempts to investigate its propositions in an ecologically valid setting using ambulatory assessment. To address this gap in the literature, we used ecological momentary assessment in a study comprising 58 participants who received 10 daily questionnaires over a 5-day period. At each prompt, participants reported their current level of demands, resources, as well as an evaluation whether they perceive themselves to be in a threat or challenge state. We found that $\Delta$RD predicts the position on the threat-challenge continuum, but only if the absolute level of current demands is considered as well: With increasing discrepancy between demands and resources, participants increasingly report being in a threat state, but only if current demands are high in absolute terms. The findings of this study contribute to the ambulatory assessment of physiological markers related to states of positive and negative arousal.

*Topics: General ambulatory assessment*
*Keywords: stress, threat, challenge, resources, demands*

# B.    MOOD, BIPOLAR, AND PSYCHOTIC DISORDERS

**(How) Does suicidal ideation fluctuate? An investigation with psychiatric inpatients using ecological momentary assessment**

Nina Hallensleben[1], Lena Spangenberg[1], Thomas Forkmann[2], Dajana Rath[2], Ulrich Hegerl[3], Anette Kersting[4], Thomas W. Kallert[5], Heide Glaesmer[1]
[1]Department of Medical Psychology and Medical Sociology, University of Leipzig, Germany; [2]Institute of Medical Psychology and Medical Sociology, University Hospital of RWTH Aachen University, Germany; [3]Department of Psychiatry and Psychotherapy, University of Leipzig, Germany; [4]Clinic of Psychosomatic Medicine and Psychotherapy, University of Leipzig, Germany; [5]Department of Psychiatry, Psychosomatic Medicine, and Psychotherapy, HELIOS Park-Klinikum Leipzig, Germany; Nina.Hallensleben@medizin.uni-leipzig.de

Background: The fluctuating nature of Suicidal Ideation (SI) has been described previously, but longitudinal studies investigating the dynamics of SI are scarce.

Aim: Our aim is to investigate the fluctuation of SI in an inpatient sample across 6 days and up to 60 measurement points using smartphone-based Ecological Momentary Assessments (EMA).

Method: Twenty inpatients with unipolar depression and current and/or lifetime suicidal ideation rated their momentary SI 10 times per day over a 6-day period. Relative Mean Squared Successive Difference (rMSSD) was calculated as a measure of variability. Correlations of rMSSD with severity of depression, number of previous depressive episodes, and history of suicidal behavior were examined.

Results: All participants completed at least 80% of all assessments for the entire sampling period of 60 measurement points. To illustrate fluctuation, we present patients' individual trajectories of SI across 6 days graphically. rMSSD values ranged from 0.2 to 21.4. No significant correlations of rMSSD with parameters of depression and suicidality could be found.

Conclusions: Our study suggests that it is feasible to collect data of psychiatric inpatients on suicidality using EMA. Furthermore, it demonstrates the dynamic nature and the diversity of trajectories of SI in depressive inpatients. The prediction of fluctuation of SI might be of high clinical relevance but seems to be complex. However, the results of this study are strongly limited through the small sample size. Further research using EMA and sophisticated analyses with larger samples is necessary to shed light on the dynamics of SI.

*Topics: Digital health in global health, General ambulatory assessment*
*Keywords: suicidal ideation, fluctuation, ecological momentary assessment, psychiatric inpatients, depression*

**Predicting acute suicidal ideation by momentary perceived burdensomeness and thwarted belongingness**

Dajana Rath[1], Nina Hallensleben[2], Heide Glaesmer[2], Lena Spangenberg[2], Thomas Forkmann[1]
[1]*Institute of Medical Psychology and Medical Sociology, University Hospital of RWTH Aachen University, Germany;* [2]*Department of Medical Psychology and Medical Sociology, University of Leipzig, Germany; drath@ukaachen.de*

Empirical evidence for factors specifically contributing to suicidality is rather limited. The Interpersonal Theory of Suicide (IPTS, Joiner, 2005) hypothesizes two interpersonal cognitive-affective dynamic states influencing acute suicidal ideation: Perceived Burdensomeness (PB) and Thwarted Belongingness (TB). The simultaneous presence of these constructs is assumed to cause active suicidal ideation. This ambulatory assessment study investigates whether state PB and TB are positively associated with acute suicidal ideation, even when controlling for the well-known risk factors age, gender, depression, and hopelessness.

Thirty-eight inpatients with depressive disorders and current and/or lifetime suicidal ideation reported on their momentary PB, TB, depressiveness, hopelessness, and suicidal ideation ten times per day for six days via Ecological Momentary Assessment (EMA). Hierarchical linear modeling (HLM) was used for analyzing associations between PB, TB, and suicidal ideation on Level 1 (controlling for age, gender, depressiveness, and hopelessness on Level 2).

Multilevel analyses revealed that PB ($\beta$ = 0.39, SE $\beta$ = 0.05, p < .001) and TB ($\beta$ = 0.30, SE $\beta$ = 0.07, p < .001) at Level 1 are significantly and positively associated with suicidal ideation – over and above age ($\beta$ = 0.04, SE $\beta$ = 0.02, p < .05), gender ($\beta$ = 0.81, SE $\beta$ = 0.55, p = .150), depressiveness ($\beta$ = 0.10, SE $\beta$ = 0.04, p < .05), and hopelessness ($\beta$ = 0.16, SE $\beta$ = 0.05, p < .01) at Level 2.

This is the first study with an intensive real-time assessment of PB and TB in order to predict acute suicidal ideation. Although the study is still in progress, first results reveal the predictive power of state PB and TB for acute suicidal ideation beyond the well-known risk factors age, gender, depressiveness, and hopelessness.

*Topics: Digital health in global health, General ambulatory assessment*
*Keywords: acute suicidal ideation, perceived burdensomeness, thwarted belongingness, EMA*

**Real-time assessment of auditory hallucinations using a smartphone app: Results from a pilot study**

Josef J. Bless[1,2], Runar Smelror[3,4], Ingrid Agartz[3,4], Kenneth Hugdahl[1,2,5]
[1]*Department of Biological and Medical Psychology, University of Bergen, Norway;* [2]*NORMENT Centre for Psychosis Research, University of Bergen, Norway;* [3]*NORMENT, KG Jebsen Centre for Psychosis Research, Division of Mental Health and Addiction, Institute of Clinical Medicine, University of Oslo, Oslo, Norway;* [4]*Department of Psychiatric Research, Diakonhjemmet Hospital, Oslo, Norway;* [5]*Division of Psychiatry, Haukeland University Hospital, Bergen, Norway; josef.bless@uib.no*

A challenge in current research on Auditory Hallucinations (AHs) is that the assessment of symptom dimensions largely depends on structured interview scales, such as the PANSS, PSYRATS, etc. In order to collect more ecologically valid data, we developed a smartphone app that can be used by patients to report on their experience in real-time, i.e., when the voices are actually present. The aim of this study was to investigate feasibility of the app and whether it can provide new phenomenological information on the temporal fluctuations of AHs in adolescent patients with Early-Onset Schizophrenia (EOS).

Using the experience sampling method, one adolescent EOS patient used the app for a period of 16 days, during which the patient received random reminders five times per day, to answer questions on five dimensions relevant to AHs: Control, Content, Localization, Intensity, and Influence. The answers were registered on Visual Analog Scales (VASs) implemented in the app.

The patient responded to the notifications in 87% of the cases and, in addition, completed the questions 15 times on own initiative. In 73% of all responses, the patient indicated to experience AHs at the time of response.
The results from the VASs showed that AH dimensions are not stable but fluctuate over time, however, only localization (voices coming from outside – inside the head) correlated significantly with the number of days in use. The localization of voices was correlated with control over voices (no – full) as well as voice content (negative – positive).

*Topics: Ecological eHealth interventions, General ambulatory assessment*
*Keywords: auditory hallucinations, app, mHealth, self-report*

**Modulation of stress reactivity by the social context: Relevance for social functioning in psychosis?**

Maude Schneider[1,2], Ulrich Reininghaus[3], Martine van Nierop[1], Mayke Janssens[4], Inez Myin-Germeys[1]
[1]*KU Leuven, Belgium;* [2]*University of Geneva;* [3]*Maastricht University;* [4]*Open University, Heerle; Maude.Schneider@kuleuven.be*

Previous studies have shown that patients with psychosis are characterized by increased reactivity to stress. However, little is known about the impact of contextual factors on stress reactivity. The main goal of this study was to examine the modulating role of the social context on stress, Negative Affect (NA), and stress reactivity in patients with psychosis and healthy controls using Experience Sampling Methodology (ESM). In controls, we hypothesized that being in a social context (vs. alone) would be associated with decreased stress, NA, and stress reactivity, but that this effect would be different in patients. Secondly, we explored whether the social context moderated the association between stress reactivity and clinical outcome.

121 patients with psychosis and 109 controls participated in this study. Multilevel regression analyses were conducted. Results replicated that patients with psychosis are characterized by increased stress reactivity. Both groups reported lower levels of activity-related stress, NA, and stress reactivity when in the company of others (vs. alone). Stress reactivity was unrelated to the severity of psychotic symptoms or quality of life. However, higher stress reactivity when alone was associated with poorer social functioning in patients with psychosis.

These results indicate that being in the company of others is associated with better outcome and that the influence of the social context on stress reactivity is similar in patients with psychosis and healthy controls. Interestingly, patients who are highly stress reactive when alone tend to engage in less social activities, which might be interpreted as a safety behavior.

*Topics: General ambulatory assessment*
*Keywords: psychosis, social functioning, stress reactivity*

### Reality check: An experience sampling study of the relationship between theory of mind and social functioning of patients with schizophrenia

Marieke Helmich[1,2,3], Marieke Wichers[1], Ulrich Reininghaus[2,3], Anne-Kathrin Fett[3,4]
[1]University of Groningen, University Medical Center Groningen, Interdisciplinary Center for the Pathophysiology and Emotion Regulation, Department of Psychiatry, Groningen, The Netherlands; [2]Department of Psychiatry and Psychology, Maastricht University Medical Centre, Maastricht, The Netherlands; [3]King's College London, Institute of Psychiatry, Psychology and Neuroscience, Department of Psychosis Studies, London, United Kingdom; [4]Vrije Universiteit Amsterdam, Faculty of Psychology and Education, Department of Educational Neuroscience, Amsterdam, The Netherlands; m.a.helmich@umcg.nl

Numerous studies have indicated the importance of social cognition for functional outcomes in schizophrenia. In particular, Theory of Mind (ToM), the ability to infer other people's thoughts and feelings, has been associated with broadly defined questionnaire measures of social functioning, but has not been studied in relation to social engagement in daily life.

This study investigated the relationship between ToM performance and social engagement in real life: The frequency of social interaction was measured with experience sampling and the Eyes Task (ET) was used to get an estimate of ToM ability. The sample consisted of 15 patients with non-affective psychosis (mean age = 41.7) and 15 healthy controls (mean age = 35.7).

Patients spent significantly (p < 0.05) more time alone than controls, and performed worse on the ET (p < 0.01). However, ET performance did not account for differences in the frequency of social engagement in daily life (p = .367).

The results show reduced social engagement in patients. However, less frequent social contact in patients could not be explained by social cognitive deficits. This is in contrast to a multitude of earlier findings of studies that primarily used cross-sectional measures of more broadly defined social functioning. While the current findings highlight the potential importance of fine-grained and ecologically valid measures of social functioning, future research should aim to replicate them in a larger sample, with additional ToM measures.

*Topics: Digital health in global health, General ambulatory assessment*
*Keywords: theory of mind, schizophrenia, experience sampling, social functioning*

### Moment-to-moment dynamics between mood symptoms and maladaptive coping behaviors in patients with bipolar disorder

Michelle Hoi-ting Leung[1], Suzanne Ho-wai So[1], Nate Tsz-kit Kwok[1], Iris Hoi-ching Ng[1], Pui-shuen Chan[1], Chloe Chor-wing Lo[1], Shirley Na[1], Arthur Dun-ping Mak[2], Sing Lee[2]
[1]Department of Psychology, The Chinese University of Hong Kong, Hong Kong S.A.R.; [2]Department of Psychiatry, The Chinese University of Hong Kong, Hong Kong S.A.R.; shwso@psy.cuhk.edu.hk

Background: It has been suggested that inability to regulate emotions and engagement in maladaptive coping behaviors maintain symptoms of bipolar disorder and affect clinical prognosis (Pavlikova et al., 2013).

Objective: Using time-lagged analyses, this study modeled the dynamic relationship between momentary levels of emotions and coping behaviors in patients with bipolar disorder.

Method: Patients with bipolar disorder (type I/II) were assessed by the Experience Sampling Method (ESM; 10 times a day for 6 days). ESM items included Positive Affect (PA) and Negative Affect (NA), as well as coping behaviors based on the Response Style Questionnaire. We also examined cognitive appraisals of internal states at baseline.

Results: The sample consisted of 45 patients. Momentary level of PA positively predicted level of (p < .001) and increase in (p < .01) adaptive coping in the next moment. PA predicted level of (p < .001) and change in (p < .05) rumination negatively whereas NA predicted level of (p < .001) and change in (p < .05) rumination positively. Conversely, engagement in rumination predicted increase in NA and decrease in PA in the next moment (ps < .001). Engagement in adaptive coping predicted decrease in NA and increase in PA in the next moment (ps < .01). The negative interactions between PA and rumination were particularly marked among patients in an active manic/depressed episode than those who were not in an active episode. Exploratory analysis revealed that various cognitive appraisals of internal states had differential effects on the interactions.

Conclusions: Our results supported moment-to-moment interaction between affective states and coping, which is particularly marked during active episodes of bipolar disorder.

*Topics: General ambulatory assessment*
*Keywords: bipolar disorder, experience sampling, emotions, coping, appraisal*

### Sleep/wake patterns in the change of mood in bipolar disorder – First results of the SWITCH-BD study

Stefan Knapen, Rixt Riemersma-van der Lek, Robert Schoevers
University of Groningen, University Medical Center Groningen, Department of Psychiatry, Research School of Behavioural and Cognitive Neurosciences (BCN), Interdisciplinary Center for Psychopathology and Emotion Regulation (ICPE); s.e.knapen@umcg.nl

Background: Patients with bipolar disorder suffer from changes in mood to either side of the spectrum, from a depressive episode to a manic episode. How a mood episode develops is still largely unknown. For manic episodes, changes in sleep are reported as the most common early warning signals, and sleep problems also precede depressive episodes.

Aims: This study aims to find how changes in sleep and the sleep/wake pattern precede changes in mood in patients with bipolar disorder.

Methods: Ten patients with bipolar disorder type 1 are included in the study. The patients fill in a daily dairy for 180 days and wear a MotionWatch8 to assess the sleep/wake rhythm. Daily diary consists of at least 10 emotion items, mood symptoms from the Lifechart, and the Social Rhythm Metric (SRM). Furthermore, patients complete the Inventory for Depressive Symptoms (IDS-SR) and the Altman Self-Rating Mania scale (ASRM) weekly.

Results: The study is currently still in progress, data of the first 10 weeks is reported as preliminary results. All patients completed over 90% of the questionnaires. Of the 10 patients, 7 went through a mild depressive period (IDS ≥ 14) of which 3 also experience moderate symptoms (IDS ≥ 26). Two patients went through a period with manic symptoms (ASRM ≥ 6).

Conclusions: From these preliminary results it can be concluded there were at least three patients with a large change in mood. Preceding factors will be studied after the full study period is completed in March 2017.

*Topics: General ambulatory assessment*
*Keywords: bipolar disorder, sleep, circadian rhythm, biological markers, actigraphy*

### The modulation of physical activity by clinical states in bipolar disorder

Holger Hill[1], Esther Mühlbauer[2], Emanuel Severus[2], Ulrich Ebner-Priemer[1]
[1]*Karlsruhe Institute of Technology (KIT), Germany;* [2]*University Hospital Carl Gustav Carus, Technische Universität Dresden, Germany; holger.hill@kit.edu*

Bipolar disorder is, among other factors, associated with behavioral changes, i.e., higher activities in manic/hypomanic phases and lower activities in depressive phases compared to the euthymic states.

Currently, several research groups investigate if objectively measured behavioral changes (i.e., smartphone usage, physical activity) are suited as early warning signs for an upcoming depressive or manic/hypomanic episode. The detection of an altered behavior should in turn cue a therapeutic intervention to reduce the negative impact of the upcoming episode.

In a pilot study on smartphone usage, we assessed, in addition, physical activity with hip-worn accelerometers in a subsample of 27 outpatients for up to one year (in total about 3,800 measured days). Clinical ratings to assess manic/hypomanic or depressive symptoms were performed every two weeks.

Based on the accelerometer raw data (measured as m/s$^2$) we analyzed mean activity (movement acceleration intensity) and movement frequency.

The results revealed a lower activity in the depressive state and a higher activity in the manic/hypomanic state. Movement frequency was in general negatively correlated with mean activity. Circadian rhythmicity revealed an activity peak around 12 h in the depressive state and a biphasic pattern (peaking around 12 a.m. and 5 p.m.) in the manic/hypomanic state.

The detection of early warning signs in bipolar disorder can be improved with multiple facets of objectively measured behavior. The assessment of physical activity should be a valuable contribution to cover different aspects of behavior.

*Topics: General ambulatory assessment*
*Keywords: bipolar disorder, physical activity, acceleration, movement frequency*

## C.  ECOLOGICAL MOMENTARY ASSESSMENT OF EMOTION REGULATION STRATEGIES AND COGNITIVE/BEHAVIORAL TRAINING INTERVENTIONS

### Development and evaluation of a smartphone-based positivity training – Study concept

Angela Kunzler[1,2], Andrea Chmitorz[1,2], Isabella Helmreich[1,2], Dirk Lehr[3], Klaus Lieb[1,2], Michèle Wessa[1,4]
[1]*Deutsches Resilienz-Zentrum (DRZ), University Medical Center Mainz, Germany;* [2]*Department of Psychiatry and Psychotherapy, University Medical Center Mainz, Germany;* [3]*Department of Health Psychology and Applied Biological Psychology, Institute of Psychology, Leuphana University of Lüneburg, Germany;* [4]*Department of Clinical Psychology and Neuropsychology, Institute of Psychology, Johannes Gutenberg University Mainz, Germany; Angela.Kunzler@unimedizin-mainz.de*

Background: There is strong evidence that cognitive biases towards negative stimuli determine mental dysfunctions. Cognitive Bias Modification (CBM) aims at reducing negativity biases using computer paradigms and disorder-specific stimuli. However, patients with emotional dysfunctions also lack a healthy bias towards positive cues. To date, only few CBM studies focused on inducing a positivity bias.

Aims: (1) To develop a smartphone-based positivity training that promotes approach tendencies towards positive cues and distancing from negative ones. (2) To investigate the effectiveness of the positivity training in modifying action tendencies.

Methods: An uncontrolled pre-post-study will be conducted. Healthy participants at risk for mental dysfunctions will be included by selecting individuals with a high number of stressors and low trait optimism. The smartphone-based training will be provided for up to five minutes every day for a period of two weeks. Training stimuli include positive and negative pictures from validated picture databases that have to be swiped downwards or upwards on the display. As primary outcome, action tendencies towards affective stimuli will be assessed using the approach-avoidance task. To examine intervention effects on stress reactivity, frequency and impact of microstressors on current mood will be measured via ecological momentary assessment during the training. In the analysis, repeated-measures ANCOVA and multilevel modeling will be performed.

Perspectives: The study is the first investigating a smartphone-based positivity training. Our design allows for an ecologically valid assessment of effects. Given the high smartphone-usage worldwide, the training may have the potential to serve as a microintervention preventing symptoms of mental dysfunctions.

*Topics: Ecological eHealth interventions, General ambulatory assessment*
*Keywords: positivity bias, cognitive bias modification, smartphone, intervention, ecological momentary assessment*

## POSTER 15 — Emotion regulation in real-life: An investigation of regulation flexibility

Fiona Maccallum, Richard Bryant
*University of New South Wales, Australia; fmaccallum@unsw.edu.au*

Background: Emotion regulation is fundamental to psychological health. The circumstances of daily life regularly require that we reduce, amplify, or otherwise modulate our emotional responses to maintain a sense of well-being and meet personal goals. Recent evidence suggests that emotion regulation flexibility is central to psychological resilience. Despite this emerging consensus, much of the work to date is laboratory based. We know little about how emotion regulation flexibility is adaptively expressed in the real world.

Aim: In this study we combined laboratory based and Ecological Momentary Assessment (EMA) methodology to examine emotion regulation flexibility in daily life.

Method: 90 first year university students completed lab based experimental measures of Emotion Regulation Flexibility (EF) and then participated in an 8 day EMA study assessing mood, stressors, and emotion regulation strategies several times a day. Multi-level modeling was used to examine relationships between EF, day to day functioning, and psychological well-being.

Results and Conclusions: EF interacted with between and within-person differences in stressor frequency to influence subsequent mood states; EF appeared to act as a buffer against the impact of negative life events on a daily basis. Strategy use between individuals with high and low EF was also explored. The findings from this study are discussed in terms of theoretical models of emotion regulation and methodological benefits and challenges of modeling EF behavior in real world investigations.

*Topics: General ambulatory assessment*
*Keywords: emotion regulation, flexibility, well-being*

## POSTER 16 — The effects of mindfulness on affect

Mario Wenzel, Zarah Rowland, Thomas Kubiak
*Johannes Gutenberg University Mainz, Germany; wenzelma@uni-mainz.de*

Background: While there is ample evidence suggesting links between mindfulness, affect, and well-being, process level data on how mindfulness exerts its influence on affect is scarce. We aimed at gaining a deeper understanding of how mindfulness improves well-being by investigating the effects of a low-level mindfulness intervention on affective dynamics in daily life within an analytical dynamic systems framework.

Methods: The SMASH Study is a six-week randomized controlled trial, which combined an Ambulatory Assessment (AA) with 7 weekly meetings where participants either engaged into computer-based mindfulness training or were allocated to a waitlist control condition. A total of 121 healthy students (female 78.51%, aged between 18 and 49, M = 22.89, SD = 5.09) indicated their current affect and state mindfulness six times a day for 40 consecutive days via smartphones. The end of the study overlapped with the end of the semester where academic examination took place.

Results: The mindfulness intervention was effective in increasing momentary mindfulness. The density parameters of the network based on multilevel vector autoregressive models revealed that only controls reported a denser negative affect network and less interconnected positive affect during an exam period at the end of the study. In turn, participants in the mindfulness condition did not show any changes in negative or positive affect density.

Conclusions: Training mindfulness may have worked as a stress buffer at the end of term preventing negative affects to become more persistent in participants who practiced mindfulness.

*Topics: Ecological eHealth interventions, General ambulatory assessment*
*Keywords: network approach, affective dynamics, mindfulness*

## POSTER 17 — Ecological momentary assessment of a mindfulness-based program in college freshmen

Steriani Elavsky[1], Jacqueline Mogle[2], Moe Kishida[2], Kamila Dvorakova[2], Mark Greenberg[2]
*[1]Masaryk University, Czech Republic; [2]Penn State University, USA; elavsky@fss.muni.cz*

The transition to college can result in a high stress burden and lead to maladaptive health behaviors. Mindfulness-based stress reduction programs have been utilized to help students deal with the pressures of transitioning into college. In this study, we report on preliminary effects of an eight-session college-adapted mindfulness program [Learning to Breathe (L2B)] on mindfulness, psychological flexibility, and rumination. First-year college students (N = 109; M age = 18.2, SD = 0.4 years) were recruited into a randomized waitlist controlled trial during the Fall 2014 - Spring 2015 academic year. In addition to completing traditional pre/post assessments, a randomly selected half of students (n = 52) from the intervention and control groups completed three 8-day bursts of Ecological Momentary Assessments (EMA) at the beginning, middle, and end of the trial. Each burst consisted of four pseudo-random survey prompts plus an end-of-day self-initiated assessment. Compliance with the EMA procedures was high in both groups (> 91%), although participants were more likely to miss first-morning assessment. Multilevel analysis revealed significant (p < .05) improvement in mindfulness in the intervention group at burst 2 and marginally significant improvements in psychological flexibility and rumination (ps = .054 and .052, respectively). Heterogeneous variance models indicated greater across-burst variability in the intervention group for all outcomes. This substantial variability in the intervention group suggests the need for moderators to identify those individuals who most benefited from the mindfulness program. The current results suggest mindfulness-based interventions effectively reduced rumination and increased psychological flexibility. Future research should address whether these effects are mediated by increases in mindfulness.

*Topics: General ambulatory assessment*
*Keywords: EMA, ecological momentary assessment, mindfulness, college health*

## POSTER 18 — Cognitive avoidant coping and variability in perceived arousal: Evidence for the intolerance of arousal hypothesis

Andreas Richard Schwerdtfeger[1,2], Eva-Maria Rathner[3,2]
*[1]University of Wuppertal, Germany; [2]University of Graz, Austria; [3]University of Ulm, Germany; anschwerdtfeger@uni-wuppertal.de*

According to the model of coping modes (Krohne, 1993), two interindividually stable cognitive coping dimensions can be distinguished: Vigilance (VIG) and Cognitive Avoidance (CAV). Whereas vigilance refers to attending closely to the threatening aspects of a given situation, CAV aims to divert attention away from threat-related cues. It has been hypothesized that individuals who consistently use CAV strategies are not able to tolerate emotional arousal well. This study aimed to examine the relationship between CAV and perceived arousal prior to a stressful event. Two samples (study 1: n = 28 women awaiting foot surgery, mean age: 57.3 years; study 2: n = 31 women awaiting a psychological laboratory stress task, mean age: 38.9 years) were combined for the purpose of the study. Participants were monitored throughout 3 consecutive days prior to a planned surgery (study 1) or to psychological stress tasks (Trier Social Stress Test and Cold Pressor Task). Affect was recorded by means of an affect grid asking for momentary valence and arousal 5 times a day. CAV was positively associated with the intraindividual standard deviation of arousal (r = .40, p = .005), but not valence (r = .18, n.s.). There were no significant associations with mean arousal and mean valence, and VIG was unrelated to both dimensions. The findings suggest that the disposition to divert attention away from threatening cues is accompanied by a more pronounced variability in perceived emotional arousal, which is compatible with the hypothesis of intolerance of arousal as an explicative basis for CAV.

*Topics: General ambulatory assessment*
*Keywords: affect grid; arousal; coping; EMA; model of coping modes*

## POSTER 19 — Meaningful moments for behavior change: Lessons learned from the 'StandUp' RCT

Jan-Philipp Lange, Martina Kanning
*University of Konstanz, Germany; jan-philipp.lange@uni-konstanz.de*

Up to 40 percent of preventable deaths can be linked to health-related behaviors and habits, such as physical inactivity, diet, alcohol, or tobacco use. Developing successful lifestyle interventions to change unhealthy behaviors and habits is of highest priority.

However, everyday life activities are mainly unconscious and habitual, which may be one reason why to date many lifestyle interventions fail to result in lasting change.

mHealth interventions, which automatically detect behavior and deliver tailored content exactly when needed and behavior change is most likely, offer an attractive approach to address these challenges. But, as results from the 'StandUp' RCT show, mHealth interventions are not automatically superior to traditional psycho-educative treatments.

The 'StandUp' study examined the effect of a smartphone app to reduce prolonged sitting in a three-arm Randomized Controlled Trial (RCT). During the two-week intervention period, smartphone group subjects received real-time prompts to break up prolonged sitting based on their physical activity.

No significant differences between groups and pre-post measurements were found for accelerometer-monitored Sedentary Behavior (SB). But, only Smartphone users reduced the number of prolonged sedentary bouts and significantly increased awareness of their own SB.

To increase the effect of mHealth interventions, more sophisticated tailoring is needed. The systematic use of machine learning and Ecological Momentary Assessment (EMA) could not only lead to a better understanding of the interindividual patterns of targeted behaviors and their determinants prior to the intervention, but also inform the development of highly personalized and Just-In-Time Adaptive Interventions (JITAIs).

*Topics: Ecological eHealth interventions*
*Keywords: digital behavior change intervention, just-in-time adaptive intervention, mHealth, sedentary behavior, prolonged sitting*

## POSTER 20 — Keep calm and train your brain to relax: Differential efficiency of mobile neurofeedback training in a primary prevention setting

Tiana Schauls[2], Martine Hoffmann[1], Laurence Casali[6], Danièle Beckius[1], Michèle Pisani[4], Axel Kowalski[5], Gilles Michaux[3,2]
[1]*RBS-Center fir Altersfroen, Cellule de Recherche, Itzig;* [2]*University of Luxembourg, Esch-Belval;* [3]*Zentrum für Gesundheitsförderung, ZithaKlinik, Hôpitaux Robert Schuman, Luxembourg;* [4]*Institut für Psychologische Gesundheitsförderung, Luxembourg;* [5]*Neurofit Akademie, Krefeld;* [6]*Privat Praxis; martine.hoffmann@rbs.lu*

There is mounting evidence that Neurofeedback Training (NFT) can significantly improve cognitive functioning in a variety of cognitive disorders, most notably in ADHD. Moreover, neurofeedback is a promising method for optimizing cognitive performances and relaxation in highly stressful contexts, though few controlled efficiency studies have been conducted so far.

The present quasi-experimental field study examines the usefulness of NFT on a preventive premise to improve vigilance and relaxation in a moderately stressed sample of middle-aged employees (M = 52, SD = 5 years). A seven-week NFT program was contrasted with a mindfulness-based and a sophrology-based practice. The NFT (n = 8) consisted of a weekly 20 minutes EEG frequency training to increase high alpha frequencies (10-12 Hz) while simultaneously decrease theta activity (4-7 Hz) in order to optimize attention and working memory performance in aging adults. Moreover, high beta activity (20-30 Hz) was trained to decrease in order to reduce mental pressure/arousal. The comparison group subjects (n = 8) were trained a well-defined cognitive strategy in order to improve the ability to mindfully relax. Training-associated changes in stress perception, perceived chronic stress, and vigilance/concentration were assessed pre-post treatment with standardized psychometric tests (FAIR-2; TICS; ASS-SYM).

Results highlighted a significant training-related reduction of self-reported stress in both groups (F[1,12] = 6.84, p = .02, $\eta$2 = .36). Furthermore, the NFB group, unlike the comparison group, showed a significant improvement in the vigilance/concentration test (F[1,12] = 10.62, p = .01, $\eta$2 = .50). On a neurophysiological level this effect corresponds to the pattern of a pre-post decline of the high beta/theta ratio (F[1,7] = 9.24, p = .02, $\eta$2 = .57) thus suggesting the relative superiority of the NFT method compared to the contrasted relaxation practices in the present pilot study.

*Topics: General ambulatory assessment*
*Keywords: neurofeedback, primary prevention, mental health, cognitive performance*

## POSTER 21 — Emotion intensity and emotion regulation before exams

Anna-Lena Rottweiler[1], Ulrike Nett[2]
[1]*Universität Ulm, Germany;* [2]*Universität Augsburg, Germany; anna-lena.rottweiler@uni-ulm.de*

Many different emotion regulation strategies are used when negative emotions occur. In an achievement context, especially before exams, it is very important to regulate negative emotions to reduce undesirable effects like bad test performance. However, which emotion regulation strategies do students chose before taking exams? Do they change strategies with more intense achievement anxiety?

We hypothesized that anxiety becomes more intense when exams approach and that the used strategies change from cognitive (for low-intensity emotions) to behavioral strategies (for high-intensity emotions).

116 first-year university students answered short questionnaires on smartphones six times a day during two periods of 7 days (five weeks and one week before the exam). Achievement emotions and emotion regulation strategies (cognitive and behavioral) were measured when students were thinking about the upcoming exam.

As hypothesized, achievement anxiety becomes more intense when exams approach (M exam day = 2.50 (.131); M one week before = 1.74, (.095); M five weeks before = 1.40 (.095)). Two-level multicorrelation analysis shows that reappraisal correlates negatively with anxiety (r within = -.12, p < .001; r between = -.23, p < .003), while distraction (r between = .20, p < .029), rumination (r within = .142, p < .001; r between = .21, p = .001), and social support (r within = .06, p = .001) are correlated positively with anxiety.

This demonstrates that behavioral strategies like social support and distraction as well as the cognitive strategy rumination are more likely applied when anxiety becomes more intense, while the cognitive strategy reappraisal becomes less attractive. Except for rumination, results confirm our hypothesis. This shows that students choose different strategies to regulate low and high achievement anxiety and that behavioral strategies might be more effective when anxiety increases.

*Topics: General ambulatory assessment*
*Keywords: achievement emotions, emotion regulation strategies, emotion intensity, freshman, exams*

# D. EMA AS A PREDICTIVE AND DIAGNOSTIC TOOL

**Ambulatory heart rate variability and electrodermal activity reflect sleep quality in people with and without fibromyalgia**

Anna Louise Kratz, Sardar Ansari, Marlena Duda, Xiuwen Chen, Kristen Pickup, John Murphy, Esther Bay, David A. Williams, Daniel J. Clauw, Kayvan Najarian
*University of Michigan, United States of America; alkratz@med.umich.edu*

Autonomic Nervous System (ANS) activity during sleep is a potential mechanism underlying unrefreshed sleep in Fibromyalgia (FM). We examined whether ambulatory Heart Rate Variability (HRV) and Electrodermal Activity (EDA) during sleep: 1) differentiate people with and without FM; and 2) are associated with self-reported sleep quality. Twenty adults with FM and 20 age- and sex-matched controls wore the E4 Wristband for 7 days and recorded self-report of sleep each morning on an 11-point scale (0 = totally unrefreshed-10 = totally refreshed). The FM group reported significantly ($p < 0.001$) lower levels of refreshed sleep (mean = $4.08 \pm 1.43$) compared to the control group (mean = $7.04 \pm 2.02$). Twenty-five HRV features including time- and frequency-domain and non-linear features (computed from 5 minutes moving windows) as well as 10 EDA peak features (computed in 30 seconds moving windows) were extracted using MATLAB and averaged over the entire sleep period. Logistic regression was used to differentiate the FM group from the control group. The combination of HRV and EDA features accounted for 78.47% of the variance between groups. The logistic regression model was trained/tested using 75% and 25% of the nights, respectively. Together, these features classify group membership with area under the curve = 0.83. Moreover, HRV and EDA features accounted for 77% of the within-person variance in self-reported sleep quality. Findings suggest that HRV/EDA features collected during sleep correspond with subjective sleep and are able to differentiate between ANS activity during sleep for those with and without FM. Ambulatory measures of ANS may be useful in studying mechanisms underlying unrefreshed sleep in FM.

*Topics: Ecological eHealth interventions*
*Keywords: heart rate variability, electrodermal activity, sleep, fibromyalgia*

**Filling the gap: Device-based assessment through a mobile application in the Luxembourg Parkinson Cohort**

Christian Stallinger[1,2], Venkata P. Satagopam[1], Peter Banda[1], Christine Suver[3], Andrew Trister[4], Stephen Friend[4], Rejko Krüger[1,2]
[1]*Luxembourg Centre for Systems Biomedicine (LCSB), University of Luxembourg, Luxembourg;*
[2]*Centre Hospitalier de Luxembourg, Luxembourg;* [3]*SAGE Bionetworks, Seattle, USA;* [4]*Apple, Cupertino, USA;*
*christian.stallinger@uni.lu*

Objective: The project focuses on the integration of Device-Based Assessment (DBA) through a mobile application in the Luxembourg Parkinson Cohort (HELP-PD*) to monitor symptoms of Parkinsonism.

Background: Clinical scales (e.g., MDS-UPDRS) have limitations due to variations of Parkinsonism. Effect size and lack of continuous observation of symptoms add to this problem, potentially obscuring relevant short-term and gradual changes. Both the concept of using mobile phone sensors for DBA in the context of Parkinsonism and their capability of precise measurements have been validated. The validation and correlation in cohorts remain necessary to translate into clinical decision support.

Methods: We integrated the mPower app into a deeply phenotyped cohort. It combines a traditional survey-based approach with data gained through sensor- and task-based assessments. Anonymized longitudinal data from the app then correlated with conventional HELP-PD data. As of January 2017, 15 HELP-PD participants with Idiopathic Parkinson's Disease (IPD) are using mPower.

Results: We successfully integrated the modified mPower app into HELP-PD's database infrastructure. The additional integration of the eGaIT-system for in-depth gait analysis is currently pending. Having started in June 2016, the system is currently fully functional and usage is steady.

Conclusion: The implementation of novel technologies like mPower allows for a more direct participation of patients in their treatment and future research. Objective, high quality data will aid patient stratification and identification of markers for therapeutic outcome. It allows for the observation of symptoms beyond traditional clinical settings. Future applications may include self-management and monitoring in integrated care and clinical trials settings.

*Health in the Elderly Luxembourgish Population with a focus on Parkinson's Disease.

*Topics: Big data, Ecological eHealth interventions*
*Keywords: Parkinson's disease, mHealth*

## The detection and prediction of couple conflict using mobile sensing technologies

Adela Timmons, Theodora Chaspari, Sohyun Han, Yehsong Kim, Shrikanth Narayanan, Gayla Margolin
*University of Southern California, United States of America; adelatim@usc.edu*

With the advent of mobile sensing technologies, it is becoming increasingly feasible to passively measure important psychological processes in daily life. In the current study, we use machine learning methodology to automatically detect and predict naturally occurring episodes of relationship conflict in couples' daily lives. Nineteen young-adult dating couples wore mobile physiological monitors assessing their ongoing electrodermal activity and heart rate over one full day. Each partner carried a smartphone that collected GPS coordinates and six-minute audio recordings every 12 minutes. Partners also completed hourly self-report surveys indicating whether they expressed annoyance towards each other. Voice activity detection was used to automatically identify periods of speech and non-speech for each partner; we then extracted estimates of each person's vocal pitch and intensity (Baucom et al., 2012) and used 19 preset dictionaries from the Linguistic Inquiry and Word Count program (Pennebaker, Chung, Ireland, Conzales, & Booth, 2007) to analyze speech content (negative emotion words, swearing, etc.). To detect periods of conflict, we employed relief feature selection to identify the most relevant features for our task and binary decision tree classification. Using physiological, vocal, linguistic, and GPS data, our system reached up to 86.8% classification accuracy for detecting episodes of naturally occurring conflict (sensitivity = 82.1; specificity = 91.5) and 64.4% classification accuracy for predicting conflict before it occurred. Results from this preliminary system have the potential to be used to develop just-in-time adaptive interventions to predict conflict and send behavioral prompts designed to interrupt negative interpersonal cycles and promote adaptive relationship functioning.

Topics: Ecological eHealth interventions
Keywords: couples, conflict, machine learning

## Unravel the roots of procrastination: Predicting the postponement of goal-directed actions in students' everyday life

Lena Maria Wieland, Matthias F. Limberger, Ulrich W. Ebner-Priemer
*Karlsruhe Institute of Technology (Germany), Chair of Applied Psychology; lena.wieland@kit.edu*

Background: Persons who procrastinate do not follow their intentions, they postpone working on important tasks, while expecting this to be to their disadvantage (van Eerde, 2003). Although everyone holds some predisposition to procrastinate (trait procrastination), to predict an actual delay of an intended action (state procrastination), we have to consider that motivational, volitional, and emotional factors alternate during an individual passes through the action phases.

Aim: We aim to examine the change processes underlying the emergence of procrastination and to identify variables that predict the postponement of goal-directed actions in real life.

Methods: Using e-diaries over 7 days, students reported intentions to work on daily goals (planning phase) and whether goal-directed actions were performed or postponed (action phase). We measured variables relevant to the (non-)execution of the intended behavior (subjective value, aversiveness, effort, etc.), as well as mood several times a day. Data were collected in two waves (n = 29 November 2015, n = 40 March 2016).

Results and Conclusions: Models based on first-wave data confirm that the change process underlying the emergence of postponements is a within-person process. Low outcome expectation during planning (OR = 0.65, p < .01), a low subjective value (OR = 0.77, p = .01), and high aversiveness (OR = 0.61, p < .01) of the goal at the time of intended action significantly predict postponements. We will present results based on the full (merged) dataset and expect that predictions will be strengthened using the amplified sample. These findings will help to develop an ambulatory assessment intervention to support individuals in following their intentions.

*Topics: General ambulatory assessment*
*Keywords: e-diaries, procrastination, predicting behavior, goal pursuit*

## Anger and hostility questionnaires in the 10-12 year prediction of ambulatory blood pressure and heart rate

Martti Tapani Tuomisto[1,2], Lauri Parkkinen[1], Jyrki Ollikainen[3], Ilkka Pörsti[4]
[1]*Faculty of Social Sciences (Psychology), University of Tampere, Tampere, Finland;* [2]*Finnish Institute for Behavioral Science, Tampere, Finland;* [3]*Faculty of Natural Sciences, University of Tampere, Tampere, Finland;* [4]*Faculty of Medicine and Life Sciences, University of Tampere, Tampere, Finland; martti.tuomisto@uta.fi*

Anger and hostility questionnaires were used to predict 24-hour Blood Pressure (BP) and Heart Rate (HR) after 10-12 years of follow-up. The participants (N = 64) were healthy, age-matched, middle-aged, and newly detected WHO-classified normotensive, borderline hypertensive, and hypertensive men recruited through routine health examinations. They underwent a relaxation baseline followed by standardized behavioral challenges. The groups were combined because the diagnostic BPs were normally distributed. The psychometric questionnaires were the following: Buss-Durkee Hostility Scale; Cook-Medley Hostility Scale; Harburg Anger Scale; Spielberger State, Trait, Anger Expression, and Cognitive-Somatic Anger Scales, and Novaco Anger Scale. The scales with best correlations with the predicted variable were chosen for hierarchical regression analyses, which revealed that all the predicted models were significant in the prediction of 10-12 year follow-up Systolic and Diastolic BP (SBP, DBP) and HR when respective relaxation baselines in the initial study were used as a predictor in addition to the questionnaire scores. The best psychometric tests were the Spielberger and Novaco Anger scales. The combination of the scales and a baseline SBP, DBP, or HR improved the predicted models by 13, 11, and 6 percent, respectively, compared to the baseline BP or HR alone (the total R2s were .36, .22, and .25, respectively). It is relevant to remark that the groups were not selected because of anger or hostility, and some potential predictive variables were not controlled for. In conclusion, some anger scales have good predictive potential regarding future BP and HR.

*Topics: General ambulatory assessment*
*Keywords: anger, psychometric scales, blood pressure, heart rate, ambulatory*

## Predictors of pace-of-life within and between subjects

Stefan Stieger[1], David Lewetz[2], Ulf-Dietrich Reips[1]
[1]*University of Konstanz, Germany;* [2]*University of Vienna, Austria; stefan.stieger@uni-konstanz.de*

People's pace-of-life is moving into the focus of scientific research in many different research fields (e.g., psychology, medicine). In psychology, an overly high pace-of-life is often associated with health issues such as burnout and reduced life satisfaction, but paradoxically also with positive outcomes such as high well-being. In general, the scientific evidence is rather scattered and inconsistent. To analyze potential predictors of pace-of-life, we conducted a smartphone-app study by using an experience sampling approach (i.e., two measurements per day for three weeks; 6,000+ single assessments). We assessed concepts which were recently suggested to be associated with pace-of-life such as well-being, psychological pressure, sleep quality, sleep duration, and duration of meals. Furthermore, we assessed pace-of-life with two different measures – a Visual Analogue Scale VAS (direct measure) as well as a tapping task (indirect measure). Psychological pressure was the strongest (positive) predictor of pace-of-life on both levels – between – as well as within-subjects. Well-being was also a positive predictor of pace-of-life but only on a between-subject level. Sleep quality failed to predict any variance in pace-of-life whereas lower sleep duration was associated with higher pace-of-life but only on a within-subject level. On the other hand, lower duration of meals was associated with higher pace-of-life, but only on a between-subject level. The VAS explained substantially more variance than the tapping task. The results underline the multifaceted nature of the concept pace-of-life. It might be advisable to differentiate between stimulating aspects of pace-of-life (i.e., eustress) and negative aspects of pace-of-life (i.e., distress) in future studies.

*Topics: General ambulatory assessment*
*Keywords: pace-of-life, mobile experience sampling, smartphone, multilevel modeling*

**POSTER 28**

**Arm-worn inertial sensors can detect shoulder movement asymmetry during activities of daily living for clinical diagnostics and assessment**

Stijn M.P. Martens[1], Matthijs Lipperts[2], Ralph Waalbeehm[3], Steven Samijo[3], Bernd Grimm[3]
[1]*Dept. Health & Life Science, Maastricht University, The Netherlands;* [2]*Dept. Medical Physics, St. Anna Hospital, Geldrop, The Netherlands;* [3]*AHORSE Research Foundation, Dept. Orthopaedic Surgery, Zuyderland Medical Center, The Netherlands; smp.martens@student.maastrichtuniversity.nl*

Introduction: Ambulant assessment of shoulder activity could be highly valuable for clinical diagnosis or objective outcome assessment as patient self-reported shoulder questionnaires perform poorly. This study investigates if movement asymmetry between contralateral shoulders during Activities of Daily Living (ADL) produces parameters useful for clinical diagnosis or assessment.

Methods: 24 patients (age: 53.3±10.5, f/m = 9/15) with various, unilateral pathologies were measured and compared with 28 measurements in 23 matched healthy controls (age: 54.4±6.2, f/m = 10/13). Shoulder activity was recorded for 11.2±2.7 hours during a day by adhesively taping a wearable 9D-Inertial Measurement Unit (IMU) to the Hueter triangle of both upper arms. High intensity events were counted as the amount of 0.5s intervals in which the acceleration vector was >0.1g, >0.5g, or the angular rate vector of the gyroscopes was >150deg/s. Relative event asymmetry (%) between contralateral shoulders, (affected/un-affected, dominant/non-dominant sides) were calculated as outcome parameters and groups were compared using (non-) parametric statistics after testing data distributions.

Results: High intensity asymmetry scores for the 0.1g, 0.5g, and 150deg/s event thresholds were positive and significantly higher for healthy controls (3.22% ±2.29, 0.895% ±1.18, 0.57% ±1.01) than shoulder patients with negative mean asymmetry (-0.66% ±3.22, -0.13% ±0.93, and -0.11% ±0.62; p < 0.006). Negative asymmetry (< -0.1%) was nearly absent in healthy controls (1/84 values) but common in patients (34/72 values).

Discussion & Conclusion: Ambulant assessment of shoulder activity during ADL is feasible with IMUs. Intensity event count asymmetry produce parameters to diagnose or assess shoulder function.

*Topics: Digital health in global health, General ambulatory assessment*
*Keywords: inertial sensors, shoulder function, activities of daily living, outcome assessment, clinical application*

**POSTER 29**

**Activity monitors detect lower levels and different patterns of physical activity in spinal stenosis patients.**

Anouk Stoffels[1], Matthijs Lipperts[2], Wouter van Hemert[1], Kim Rijkers[3], Bernd Grimm[1]
[1]*AHORSE Research Foundation, Dept. Orthopaedic Surgery, Zuyderland Medical Center, The Netherlands;* [2]*Dept. Medical Physics, St. Anna Hospital, Geldrop, The Netherlands;* [3]*Dept. Neurosurgery, Zuyderland Medical Center, Heerlen, The Netherlands; aaf.stoffels@alumni.maastrichtuniversity.nl*

Introduction: Spinal stenosis is a common orthopedic condition that affects Physical Activity (PA) quantitatively and qualitatively by, e.g., displaying intermittent claudication, the frequent interruption of walking bouts. Objectively measured PA may serve diagnostics, indication for treatment, or intervention outcome assessment.

Subjects & Methods: Nine patients (m/f = 5/4, age: 67.4 ± 7.7 years) diagnosed with spinal stenosis but without decompressive surgery and other musculoskeletal complaints were measured and compared to 28 healthy controls (m/f = 17/11, age: 67.4 ± 7.6 years). PA was measured using a wearable accelerometer (GCDC X8M-3) worn during waking hours on the lateral upper leg for 4 consecutive days. Data was analyzed using previously validated activity classification algorithms.

Results: Spinal stenosis patients showed much lower PA than age-matched healthy controls with regards to all parameters like, e.g., daily step count (2,946 vs. 8,039, -63%, p < 0.01), relative daily time (%) upright (8.6% vs. 28.3%, -70%, p < 0.01), and increased relative sitting time (80.3% vs. 58.8%, p <0.01). Also, qualitative parameters such as walking cadence was reduced in stenosis patients (83.7 vs. 97.8 steps/min). No stenosis patient ever walked ≥ 1,000 steps without interruption. Relative walking bout distribution showed significantly more short walking bouts of 10-50 steps (p < 0.05).

Discussion & Conclusion: Spinal stenosis greatly reduced physical activity to levels where the risk for general health (overall mortality), cardiovascular health, or endocrinological health is significantly increased. Besides a general reduction in PA, also disease specific changes in the activity pattern seem to be detectable and may be diagnostically used to differentiate stenosis from other spinal conditions.

*Topics: Digital health in global health, General ambulatory assessment*
*Keywords: spine, Stenosis, physical activity, activity monitoring, health impact*

# E.    PHYSICAL ACTIVITY, INTERPERSONAL FUNCTIONING, AND HEALTH

**POSTER 30**

**mHealth 50+: Daily mobile health tracking by older adults in Switzerland**

Alexander Seifert[1,2]
[1]*University Research Priority Program "Dynamics of Healthy Aging", University of Zurich, Zurich, Switzerland;* [2]*Center of Competence for Gerontology, University of Zurich, Zurich, Switzerland; alexander.seifert@uzh.ch*

Background: Today, many people use mobile devices for health-related self-tracking; however, how does the older population practice self-tracking? Considerable portions of the older population face substantial barriers to accessing such new mobile technologies and thus reap less benefit of their advantages.

Aims: Considering this background, we examine the use of smartphones and fitness-activity armbands for health-related tracking by older adults. We focus on three questions: (1) How many older adults use mobile devices for digital health tracking? (2) Has digital tracking, in their own view, had an effect on their fitness status? (3) Are those interviewed willing to provide their activity data for research purposes?

Methods: The pilot study at the end of 2016 is based on a telephone survey of 1,013 people aged >50 years living in Switzerland.

Results and Conclusions: (1) Of those interviewed, 56% use a smartphone and 11% use a fitness-armband daily, thereof one-third use apps for tracking their movement and health-related activities. (2) Individuals who track their activity are healthier than those who do not, but to establish causality, further longitudinal data is needed. (3) 49% of all individuals would give their health-related data to a researcher if the purpose is specified. The results indicate that a sample of older Swiss adults currently uses mobile devices for health-related self-tracking for various reasons. For ambulatory assessment studies, the participants' digital data can be used, for example, to analyze a baseline of movement behavior before conducting further research.

*Topics: Digital health in global health*
*Keywords: self-monitoring, elderly, health-related tracking, fitness-activity armbands*

**Mobility, activity, and social interactions in the daily lives of healthy older adults: Study protocol of the MOASIS project**

Christina Röcke, Mathias Allemand, Robert Weibel, Mike Martin
*University of Zurich, Switzerland; christina.roecke@uzh.ch*

Late life development is characterized by multidirectional trajectories of long-term change and stability in psychological functioning including health. Micro-longitudinal research approaches have extended the classical long-term longitudinal aging studies to incorporate short-term fluctuations and dynamics in psychological domains such as well-being, stress, and health, and they have enriched our understanding of the processes of stability and change throughout adulthood. Little is known, however, about how healthy older adults in fact structure and shape their daily lives in terms of the activities carried out in the mobility, physical, and social domains. The Mobility, Activity, and Social Interactions Study (MOASIS) uses a custom-built mobile sensor to collect GPS data, accelerometer information, and ambient sound recordings in a single device to obtain objective information on mobility (i.e., spatial activity), physical activity, and social activities in 150 older adults aged 65 years and older across 30 days. These sensor-based assessments are complemented by experience sampling of affect, stress, and self-reported mobility and physical activity information as well as cognitive performance using smartphones. The project represents a collaboration between lifespan psychologists, gerontologists, and geographical information scientists and a combination of mobility and activity trackers, experience sampling of self-report and the iEAR app to obtain rich within-person profiles of daily life activities, performance, experiences, and the context in which these occur. Eventually, the goal is to use the within-person profile information as a starting point to develop smart interventions that help maintain health and quality of life in old age. The poster presents the study protocol of this ongoing study.

*Topics: Digital health in global health, Ecological eHealth interventions*
*Keywords: aging, physical activity, mobility, social interactions, iEAR*

**Homesickness in social context: An ambulatory assessment study in first-year university students**

Marije aan het Rot[1], Maaike Nauta[1], Henk Schut[2], Margaret Stroebe[1,2]
*[1]University of Groningen, The Netherlands; [2]Utrecht University, The Netherlands; m.aan.het.rot@rug.nl*

Background: Homesickness among university students is rather common and associated with various psychological problems. However, most past studies assessed homesickness at single time points, using retrospective measures such as the Utrecht Homesickness Scale (UHS). Further, the affective state of missing home has rarely been seen as separate from having adjustment difficulties. Furthermore, the interpersonal correlates of homesickness have not been considered.

Aim: To increase insight into homesickness as it is experienced in real time.

Methods: Participants were 34 Dutch and 48 international psychology students living away from their parental home. They first completed the UHS and then recorded their social interactions for 14 days. Records were made on participants' smartphones via the online software TEMPEST (Robotic Bit, Netherlands). Participants recorded, among other variables, their affective state during each interaction, and the context in which each social interaction occurred. The list of affect items included validated pleasant and unpleasant affect items and a new item, "homesick".

Results: The "Missing home" factor of the UHS positively predicted real-time homesickness levels in international but not Dutch students. Homesickness levels varied by contact mode (e.g., phone), location (e.g., current home), and type of interaction partner (e.g., parent). When participants felt more homesick, they experienced less pleasant affect and more unpleasant affect.

Conclusions: Our results highlight homesickness as an interpersonal phenomenon. Ambulatory assessment can be used to examine within-person variation in homesickness across social situations. Homesick international students may be at higher risk for mood problems than homesick Dutch students.

*Topics: General ambulatory assessment*
*Keywords: ambulatory assessment, homesickness, social interaction, affect, within-person variation*

**Interpersonal functioning in victims of bullying: An ecological momentary assessment study**

Minita Franzen[1], Linda Booij[2,3], Wendy Craig[3], Marije aan het Rot[1]
*[1]University of Groningen, The Netherlands, The; [2]Centre Hospitalier Universitaire Sainte-Justine / Concordia University, Montreal, Canada; [3]Department of Psychology, Queen's University, Kingston, Canada; m.franzen@rug.nl*

Background: The risk of suffering adverse effects from bullying is influenced not only by certain personal characteristics but potentially by situational factors, such as victims' relations with others. We examined naturally occurring social interactions of individuals with and without a history of bullying victimization. Specifically, we studied the influence of situational aspects on the association between victimization and interpersonal behavior, affect, and perceptions.

Methods: For 14 consecutive days, 30 psychology freshmen with and 120 without a self-reported history of victimization in their senior high-school year (80% female) used their smartphones to record how they behaved, felt, and perceived others in social interactions soon after they occurred. Interpersonal behaviors and perceptions were assessed in terms of dominance, submissiveness, agreeableness, and quarrelsomeness. Further, participants indicated their relationship with the interaction partner (e.g., friend, parent, colleague).

Results: When interaction partners were perceived as more dominant, only participants with a history of victimization reported more negative affect and perceived partners as less agreeable. Unexpectedly, participants with a history of victimization reported overall higher levels of dominant behavior than non-victims. During interactions with friends, romantic partners, or family members, only participants with a history of victimization behaved less dominantly compared to controls during interactions with others.

Conclusions: Differences in interpersonal functioning between victims of bullying and controls may largely occur only in specific situations. Situational aspects such as who the interaction partner is or how they are perceived might need to be taken into account when examining the association between victimization and interpersonal functioning.

*Topics: General ambulatory assessment*
*Keywords: bullying, peer victimization, interpersonal functioning, social interactions, ecological momentary assessment*

**Unraveling the association between family disorganization and children's sleep quality: A test and replication study using moderated mediation analyses**

Saskia Euser[1,2], Nienke Borkent[3], Claudia I Vrijhof[1,2], Marinus H van IJzendoorn[1,2]
*[1]Centre for Child and Family Studies, Leiden University, The Netherlands; [2]Consortium on Individual Development, The Netherlands; [3]Clinical Child and Family Studies, VU University Amsterdam, The Netherlands; s.euser@fsw.leidenuniv.nl*

Children's sleep quality can be affected by high levels of family disorganization, but the processes that account for this association remain largely unknown. We examined whether children's sleep regularity mediates the relation between family disorganization and children's sleep quality and whether this effect is moderated by children's self-regulatory skills. In total, data from 213 families with a three- to four-year-old twin were included in the current study. Co-twins were randomly divided into a test (N = 195, 49.7% boys, M age = 3.77 years, SD = 0.57) and replication sample (N = 198, 49.5% boys, M age = 3.77 years, SD = 0.58). Sleep efficiency was measured using MicroMini-Motionlogger actigraphs during four consecutive nights. Sleep regularity was measured both with actigraphy and parent reports via a smartphone app. In addition, parents reported on family disorganization and children's self-regulatory skills via questionnaires. A moderated mediation model was tested separately for the two samples using the Preacher and Hayes process macro. Preliminary results of the test sample indicated no direct effect between family disorganization and sleep quality, but a small significant indirect effect was found between family disorganization and sleep quality through sleep regularity around falling asleep; higher family disorganization was positively associated with sleep regularity, leading in turn to higher sleep efficiency. Moderation effects for self-regulation were only found in the model with regularity around waking up as mediator; conditional indirect effects were larger for children with higher effortful control. Analyses of the replication sample are currently ongoing and will shed more light on the replicability of our findings.

*Topics: General ambulatory assessment*
*Keywords: actigraphy, sleep quality, family disorganization, moderated mediation*

## POSTER 35

### The relationship between activity guidelines and knee osteoarthritis patients' adherence

Maik Sliepen[1], Elsa Mauricio[1], Dieter Klein[1], Bernd Grimm[2], Dieter Rosenbaum[1]
[1]Universitätsklinikum Münster, Germany; [2]Zuyderland Medical Center, The Netherlands;
mpl.sliepen@uni-muenster.de

Introduction: Knee Osteoarthritis (KOA) is associated with lower extremity pain and reduced functionality, resulting in low physical activity levels. To promote a healthy lifestyle and reduce the risk of disease development, distinct physical activity guidelines have been recommended by health-promoting institutions (e.g., the World Health Organization).

Aim: To establish the percentage of KOA patients meeting the different physical activity guidelines.

Methods: Thirty-five clinically diagnosed KOA patients were monitored for 1 week using a Stepwatch Activity Monitor. Four different activity guidelines have been proposed: (1) 7,000 daily steps, (2) 10,000 daily steps, (3) 150 minutes of Moderate-to-Vigorous Physical Activity (MVPA) per week, and (4) 150 minutes of MVPA per week in minimally 10-minute bouts. Biserial correlations between the achievement of guidelines and activity parameters were determined ($\alpha = 0.05$).

Results: The participants (BMI: 27.5±4.6 kg/m2, age: 60±10 yrs.) were predominantly female (55%). The percentage of patients achieving the recommendations varied greatly between the guidelines: (1) 94%, (2) 74%, (3) 31%, and (4) 0%. Only the number of daily steps ($r = 0.48–0.72$) and the average cadence ($r = 0.47–0.65$) were significantly related to the successful achievement of guidelines.

Discussion: The percentage of patients achieving the different recommendations varies greatly (0-94%). The higher the patients' cadence and daily steps during daily life, the more likely they are to successfully achieve distinct guidelines, as these are based on either daily steps or their intensity. It should be noted that this study included relatively active patients, which might decrease the generalizability towards other KOA populations.

*Topics: General ambulatory assessment*
*Keywords: physical activity guidelines, physical activity assessment, knee osteoarthritis*

## POSTER 36

### Momentary feelings and not physical symptoms are associated with end-of-the-day Health-Related Quality of Life (HRQoL) among cardiac patients.

Justine Netjes[1], Iris Hartog[1], Pythia Nieuwkerk[1], Jose Henriques[2], Michael Scherer-Rath[4], Hanneke van Laarhoven[3], Mirjam Sprangers[1]
[1]Department of Medical Psychology, Academic Medical Center, The Netherlands; [2]Department of Cardiology, Academic Medical Center, The Netherlands; [3]Department of Medical Oncology, Academic Medical Center, The Netherlands; [4]Faculty of Philosophy, Theology and Religious Studies, Radboud University Nijmegen, The Netherlands; j.e.netjes@amc.uva.nl

Background: Experience Sampling (ES) is a promising method to investigate the impact of feelings and physical symptoms on Health-Related Quality of Life (HRQoL) of cardiac patients but has not yet been applied.

Methods: Fourteen cardiac patients scheduled to undergo coronary revascularization at an academic medical center participated in our ES study. They completed a beep questionnaire, 10 times a day, about Positive (PA) and Negative Affect (NA) (4 items each) and Physical Symptoms (6 items) (PS) on a 7-point Likert scale during 7 days prior to revascularization. At the end of each day they completed the EQ5D-VAS (0 = worst, 100 = best imaginable health state) and a question about overall quality of life during that day (1 = very poor, 7 = excellent) to assess HRQoL. We investigated if momentary PA, NA, and PS were independently associated with the two measures of end-of-the-day HRQoL in mixed linear models with a random intercept.

Results: In bivariate analyses, higher scores on NA and PS were significantly associated with a worse and higher scores on PA with a better end-of-the-day HRQoL on both measures. When PA, NA, and PS were simultaneously entered in a multivariate model, only NA remained significantly associated with the EQ5D-VAS ($p < 0.001$), whereas only PA remained significantly associated with the overall quality of life question ($p < 0.001$).

Conclusion: Momentary feelings but not physical symptoms were independently predictive of HRQoL in cardiac patients scheduled to undergo revascularization. Although the terms "health status" and "quality of life" are often used interchangeably, they appear to have different meaning to patients and are predicted by different momentary feelings.

*Topics: General ambulatory assessment*
*Keywords: health-related quality of life, experience sampling, cardiac patients, affect, physical symptoms*

## POSTER 37

### Frail elderly living at care facilities are physically less active to harmful levels compared to peers living at home

Yvonne Goertz[1], Ivo Buil[1], Inge Jochem[2], Machiel Smid[3], Walther Sipers[3], Ide Heyligers[1], Bernd Grimm[1]
[1]AHORSE Research Foundation, Dept. Orthopaedic Surgery, Zuyderland Medical Center, The Netherlands; [2]Orbis Care, Zuyderland Medical Center, Sittard, The Netherlands; [3]Dept. Geriatric Medicine, Zuyderland Medical Center, Heerlen, The Netherlands; yvonnegoertz@hotmail.com

Introduction: The senior population keeps rising and with it the medical and health economic challenges to treat frail elderly. Frail seniors may become permanent residents of a care facility or continue living independently at home. The impact of Physical Activity (PA) on general health and conditions common in frail elderly such as hip fractures, fall risk, dementia, or diabetes is increasingly recognized. However, it remains unknown if habitual PA is different between frail elderly living at home or a care facility.

Methods: Habitual PA was monitored in n = 75 subjects during 4 days using an ambulant inertial sensor (GCDC HAM-IMU) worn on the lateral upper leg and analyzed previously validated activity classification algorithms (Matlab). Two groups of elderly diagnosed as frail (e.g., Groninger Frailty Indicator > 3) and matched for gender, age, and frailty related clinical measures (e.g., GFI, GDS, MMSE, Tinetti, SF12) were compared either living at home (f/m = 34/26, age: 80.0 yrs ± 5.5) or at a care facility (f/m = 10/5, age: 83.6 yrs ± 6.4).

Results and Discussion: Despite equal frailty and clinical measures, care facility residents were significantly less active (daily steps: 3,007±2,350 vs. 5,057±2,435, -41%, p = 0.002) and more sedentary (sitting-bouts > 30 min: 5.3±1.6 vs. 3.9±1.8, +36%, p < 0.006) towards thresholds with detrimental health effects (e.g., < 3,000 steps) than subjects living at home.

Conclusion: In current care facilities, activation programs for frail elderly are not as effective on habitual PA as living independently at home but can leave patients to deleterious PA levels. Improvements are required considering the effort and costs.

*Topics: Digital health in global health, General ambulatory assessment*
*Keywords: physical activity, frail elderly, care facility, fall risk, health economics*

# F. QUESTIONNAIRE/MEASURE DEVELOPMENT AND METHODOLOGICAL CHALLENGES IN EMA

## Validation of a retrospective questionnaire for daily hassles with ecological momentary assessment

Karolina Kurth[1], Andrea Chmitorz[2,4], Lara Mey[1], Mario Wenzel[1,4], Raffael Kalisch[3,4], Oliver Tüscher[2,4], Thomas Kubiak[1,4]
[1]Health Psychology, Institute for Psychology, Johannes Gutenberg University Mainz, Mainz, Germany; [2]Department of Psychiatry and Psychotherapy, University Medical Center Mainz, Mainz, Germany; [3]Neuroimaging Center Mainz (NIC), University Medical Center Mainz, Mainz, Germany; [4]Deutsches Resilienz-Zentrum (DRZ), University Medical Center Mainz, Mainz, Germany; karolina_kurth@gmx.de

Background: There is strong evidence on the impact of microstressors (e.g., 'daily hassles') on mental health. The existing microstressor questionnaires assess not only objective stressors but also consequences of those stressors (e.g., cognitions), which may result in spurious associations. To overcome this limitation, we developed a questionnaire for the retrospective assessment of microstressors focusing on their occurrence. Ecological Momentary Assessment (EMA) has been developed to increase accuracy of data by assessing behaviors as they occur and is a useful method for assessing potential recall bias.

Objective: To assess the reliability of the retrospective microstressor questionnaire using EMA.

Methods: 43 participants between the ages of 18 and 30 (mean age: 24.4 years; 61% female) completed a four-week EMA assessment. Microstressors were assessed five times per day with EMA and with daily and weekly recall by questionnaire. Sensitivity and specificity analyses and correlations were conducted to examine the correspondence between averaged momentary and self-report recall data.

Results: Preliminary analyses show a high correspondence between recall questionnaire data and momentary reports with a correlation for the frequencies of microstressors across all items of the questionnaire of $r = 0.73$.

Conclusion: The results of our study provide evidence on the feasibility of our approach for stressor monitoring and the validity of the microstressor questionnaire.

*Topics: General ambulatory assessment*
*Keywords: daily hassles, ecological momentary assessment, stressor monitoring, validity, recall*

## e-Readiness of social and health care professionals: A key for unlocking the potential of eHealth and eWelfare?

Kaisa Malinen[1], Jaana Mäkelä[1], Eija Sevón[2], Mari Punna[1], Sanna Sihvonen[1], Essi Heimovaara-Kotonen[1], Suvi Salminen[1]
[1]JAMK University of Applied Sciences, Finland; [2]University of Jyväskylä, Finland; kaisa.malinen@jamk.fi

Nowadays a wide variety of eHealth/eWelfare solutions that have a potential to be integrated as a part of the public social and health service repertoire exists. Professionals of the field play a crucial role in unlocking the potential of eHealth/eWelfare in supporting their clients' health and well-being. Professionals' skill, attitudes, and own experiences of eHealth/eWelfare guide their use of these solutions with their clients. This study examines skills, attitudes, and experiences of social and health care professionals related to the use of mobile applications in supporting their own and their clients' well-being.

Data were collected as a part of "the Mobile technology in supporting personnel's occupational well-being and clients' self-directedness" project funded by the European Social Fund. Web-survey data were collected from Finnish social and health care professionals (N = 56) who took part in an intervention during which they were encouraged to utilize mobile applications for enhancing their own well-being. The results showed that, all in all, professionals viewed mobile technology as a promising opportunity for the social and health services. Professionals, especially men and those under the age of 50, experienced the use of different features of mobile technology easily, but they needed competences for utilizing mobile applications for supporting their own well-being. Their self-confidence in using applications with their clients was, however, weak. Professionals' experiences of the usability and beneficiality of applications varied largely depending on the application used, which highlights the need for guidelines for the use of mobile applications in social and health services.

*Topics: Digital health in global health, Ecological eHealth interventions*
*Keywords: eHealth, eWelfare, professionals, mobile applications, competence*

## The vast majority of cardiac patients is unable or unwilling to participate in an experience sampling study to assess patient-reported outcomes

Justine Netjes[1], Iris Hartog[1], Pythia Nieuwkerk[1], Jose Henriques[2], Hanneke van Laarhoven[3], Michael Scherer-Rath[4], Mirjam Sprangers[1]
[1]Department of Medical Psychology, Academic Medical Center, The Netherlands; [2]Department of Cardiology, Academic Medical Center, The Netherlands; [3]Department of Medical Oncology, Academic Medical Center, The Netherlands; [4]Faculty of Philosophy, Theology and Religious Studies, Radboud University Nijmegen, The Netherlands; j.e.netjes@amc.uva.nl

Background: Experience Sampling (ES) is a promising method for investigating the impact of feelings and physical symptoms on Health-Related Quality of Life (HRQoL) of patients with somatic diseases. We investigated how many patients with cardiac disease were able and willing to participate in an ES study.

Methods: Consecutive cardiac patients referred for coronary revascularization were asked to participate in an HRQoL study using standard questionnaires. Consenting patients were additionally invited to participate in an ES study, involving a beep questionnaire administered 10 times a day during 7 days by an electronic device, before and two times after revascularization. Patients were eligible for the ES study if coronary revascularization was scheduled within 7 days, they owned a smartphone, and had continuous Internet access. Patients completed standard questions about demographics and HRQoL (EQ5D) at enrollment.

Results: A total of 53 of the 106 (50%) patients enrolled in the HRQL study were eligible for the ES study. Of those, 14 (26%) consented to participate in the ES study. Patients declining participation more often reported difficulties with mobility (p = 0.03), daily activities (p = 0.03), and pain/discomfort on the EQ5D (p = 0.001) and were more often living alone (p = 0.09, all chi-squared tests) compared with patients that did participate in the ES study.

Conclusion: The vast majority of patients was unable or unwilling to participate in an ES study. Patients for whom participation was deemed most relevant by the researchers, i.e., those reporting problems with mobility, daily activities, and pain/discomfort, were least likely to participate. ES may thus underestimate outcomes of those for which the cardiac interventions are designed.

*Topics: General ambulatory assessment*
*Keywords: experience sampling, feasibility, cardiac patients, patient reported outcomes*

**Fragmentation as a novel measure of mood stability assessed by electronic diaries**

Jordan Johns[1,2], Vadim Zipunnikov[1], Junrui Di[1], Joel Swendsen[3], Kathleen Merikangas[2]
[1]Department of Biostatistics, Johns Hopkins University, United States of America; [2]Genetic Epidemiology Research Branch, National Institute of Mental Health; [3]University of Bordeaux, PSL Research University; jordan.johns@jhu.edu

Introduction: Traditional methods for analysis of Ecological Momentary Assessment (EMA) data commonly focus on summarizing and modeling subject-specific variability, stability, and mean. We propose a novel statistical framework that quantifies subject-specific stability via fragmentation analysis. We apply this method to a study of rhythms of emotion as trait markers of people with the full range of mood disorders.

Methods: Data analyzed, from a large community-based sample of 342 participants in the Washington D.C. metropolitan area, consists of mood state information collected 4 times per day over a period of 14 days measured on a Likert scale of 1-7 over two mood domains including mood (happy to sad) and attention/focus (distracted to focused). We apply a two-step approach. At step one, we normalize the mood scores at the subject level by subtracting the subject-specific mean and dividing by the subject-specific standard deviation. At step two, the normalized mood scores are dichotomized into normal and abnormal states, defined as inside and outside of the one standard deviation range, respectively. Based on dichotomized scores, subject-specific fragmentation measures based on the average duration in each state were calculated and regressed on mood disorder subtype, then adjusted for age, sex, BMI, and Mean of the Squared Successive Differences (MSSD), a standard measure of the subject-specific stability.

Results: There was more fragmentation in time spent in the normal state of attention among those with BPI (p = 0.004) and MDD (p = 0.017), compared to controls whereas those with BPI had less fragmentation at the extreme levels of attention (p = 0.021). Periods of time spent at normal mood state more fragmented for those with MDD than controls (p = 0.039). There were no differences between those with BPI or MDD vs. controls in fragmentation of periods of time spent at either extreme or normal levels of energy compared to controls.

Discussion: These findings suggest that those with BPI have more fluctuation and less stability of attention levels, and less stability for those with MDD at normal levels of mood and attention than controls. The lack of differences in mood fluctuation in those with BPI support previous findings that attention may be a core domain underlying BPI disorder. This work also demonstrates that fragmentation methods can characterize stability of emotional states beyond the information provided by the traditional summaries of variability and stability.

*Topics: General ambulatory assessment*
*Keywords: EMA, fragmentation, mood disorder*

**Mindfulness: Development of a state measure and its relationship with positive and negative affect in daily life**

Annette Brose[1,2], Elisabeth S. Blanke[1]
[1]Humboldt-Universitaet zu Berlin, Germany; [2]KU Leuven, Belgium; annette.brose@hu-berlin.de

Mindfulness is most commonly defined as a multidimensional mode of being attentive to, and aware of, momentary experiences while taking a nonjudgmental and accepting stance. These qualities have been linked to two different facets of affective well-being: Being attentive is proposed to lead to an appreciation of experiences as they are, and thus to Positive Affect (PA). Accepting unpleasant experiences in a nonjudgmental fashion has been hypothesized to reduce Negative Affect (NA). Previous research so far only considered such differential associations at the trait level, although a mindful mode may be best understood as a state of being. In the present research, we therefore developed a multivariate measure of mindfulness that captures variation at the trait and state level using an experience sampling methodology with smartphones. Additionally, we tested how different facets of state mindfulness are related to PA and NA. We collected data from 70 university students (20–30 years of age) using an experience sampling technology. Multilevel confirmatory factor analyses could corroborate three dimensions at both levels of analysis: awareness, nonjudgmental acceptance, and present moment attention. As expected, participants experienced more PA when they were attentive to the present moment, and less NA when they nonjudgmentally accepted momentary experiences. Furthermore, only nonjudgmental acceptance buffered the impact of daily hassles on affective well-being. The study contributes to a more fine-grained understanding of the within-person mechanism relating mindfulness to affective well-being in daily life. The results suggest that interventions may address specific facets of mindfulness to enhance different aspects of well-being.

*Topics: General ambulatory assessment*
*Keywords: mindfulness, affect, within-person dynamics, multilevel CFA*

**Development of a novel measure of emotion differentiation that uses open-ended descriptions of momentary affective states**

Charlotte Arndt, Tanja Lischetzke
University of Koblenz-Landau, Germany; arndtch@uni-landau.de

Emotion Differentiation (ED) has been conceptualized as a trait that facilitates emotion regulation and increases well-being. Yet basic questions remain unanswered about how best to assess it and whether favorable outcomes can be observed only during times of stress or also as individuals go about their "normal" daily lives. The goal of the present research was to develop a novel behavioral (specificity) measure of ED that more closely matches the definition of the construct than previous behavioral measures due to its reliance on open reports of emotional experience (instead of closed-ended lists of emotion terms). We conducted two daily diary studies (N = 111, N = 190) in which we included different measures of ED (global self-report and the specificity measure in both studies, ICC measure of ED in Study 2). The different ED measures were largely unrelated to each other. Self-reported ED was related to global self-reports of adaptive outcomes but unrelated to daily measures of well-being. In both studies, the specificity measure of negative (but not positive) ED showed a positive association with daily life satisfaction and pleasant-unpleasant mood, but in Study 2, this association held only on days that presented a challenge to a person's well-being (i.e., days with a negative event).

*Topics: General ambulatory assessment*
*Keywords: emotion differentiation, well-being, daily diary, assessment*

# V. PRECONFERENCE SESSIONS

**EXPERT MEETING**

**Dynamic systems modeling**

Gertraud (Turu) Stadler[1,2], Megan Robbins[3], Niall Bolger[2], Steven Boker[4]
[1]*University of Aberdeen, United Kingdom;* [2]*Columbia University, New York, NY;* [3]*University of California, Riverside, CA;* [4]*University of Virginia, VA; gertraud.stadler@abdn.ac.uk, megan.robbins@ucr.edu, bolger@psych.columbia.edu, smb3u@eservices.virginia.edu*

This expert meeting continues the dialogue started with the Dynamic Systems Modeling conferences in Arizona 2014 and Aberdeen 2016. Then as now, the goal is to facilitate greater collaboration between social/health scientists (who have theories and big data sets relevant to social interaction) and computational scientists (who have the mathematical sophistication and computational power to develop and test complex theories with big data sets). We hope to bring together leaders from both communities to foster discussion, sharing of resources, and cumulative knowledge production. We are planning an expert meeting format capped at 60 attendees, including brief presentations from all attendees, structured small-group interactions, and opportunities for informal social exchange.

*Topics: General ambulatory assessment*
*Keywords: dynamic systems modeling*

**PRECONFERENCE WORKSHOP 1**

**Designing tailored triggers and alerts for behavioral assessment and interventions**

Frederick Muench, Amit Baumel
*Northwell Health, United States of America; fmuench@northwell.edu, abaumel@northwell.edu*

There is now ample evidence that text messaging and brief text reminders can be a powerful behavioral health intervention for a range of disorders. Despite the popularity of messaging, there are wildly different types of messages and little attention has been paid to the tone, structure, and grammatical style of messages as an intervention or as a means to promote ambulatory assessment. Many interventions have focused primarily on content while ignoring features such as whether messages are questions vs. statements or short vs. long in general and whether specific client characteristic moderate message preferences. Similarly, there has been little attention paid to maximizing tone and structure of Ecological Momentary Assessment (EMA) language in text messages, push alerts, and other EMA triggers.

This workshop is designed to assist researchers and providers in writing tailored targeted brief messages (text messages, push alerts, emails) to foster health behavior assessment and change. We will focus on how to write different types of messages to maximize impact based on the latest literature (including our own published and unpublished work) for distinct behavioral goals including: appointment attendance, medication adherence, short targeted goal based health behaviors, and sustained behavior change. We also examine the role of interactivity, assessment reinforcement, and social triggers. Aside from tone and structure of messages, special attention will be devoted on how to write goal based messaging, goal revision messaging, interactive messaging, and messaging for specific conditions. Moderators of messaging characteristics such as need for cognition and goal importance will be discussed.

*Topics: Ecological eHealth interventions, General ambulatory assessment*
*Keywords: triggers, text messaging, EMA, push alerts, mHealth*

**PRECONFERENCE WORKSHOP 2**

**Executable ambulatory assessment protocols in HTML5**

Nikolaos Batalas[1,2], Marije aan het Rot[3], Vasilios Javed Khan[2], Panos Markopoulos[2]
[1]*Robotic Bit, Eindhoven, The Netherlands;* [2]*Department of Industrial Design, Eindhoven University of Technology, The Netherlands;* [3]*Department of Psychology, University of Groningen, The Netherlands; n.batalas@tue.nl*

Background: Researchers tend to communicate their Ambulatory Assessment (AA) protocols to the community in natural language, which can contain ambiguities. While protocols could be expressed as algorithms and ultimately written as program code, these formats are not easily read by most researchers. However, the applicability of AA will grow in diversity, criticality (e.g., evidence-based health care), and complexity (e.g., ecological momentary intervention). Therefore, the expression, communication, and modification of AA protocols in accessible but also formal and unambiguous ways need to be considered. The quality of scientific discourse on AA stands to gain from higher rigor in protocol descriptions, which is achievable through a formal language.

Aim: This workshop will provide experience with our platform, TEMPEST, to researchers interested in using AA methods. TEMPEST has been designed to (1) enable non-programmers to create AA protocols as HTML5 documents, and (2) manage AA studies on a diversity of devices, while hiding the underlying technical complexity. We aspire to provide an approach for sharing AA protocols that is modular and future-proof, with clear semantics for human understanding and computational execution.

Method: Participants will be instructed in creating their own AA protocols, gaining hands-on experience with TEMPEST and insight into its possibilities.

Result: We hope to identify researchers' attitudes towards AA protocol specifications and gather further requirements for system development.

Conclusion: The workshop will accentuate the imminent issue of AA protocol specification and investigate the fitness of TEMPEST as a proposed approach.

*Topics: General ambulatory assessment*
*Keywords: ambulatory assessment protocols, HTML5*

**PRECONFERENCE WORKSHOP 3**

**Mobile sensing for ambulatory assessment – Technological possibilities and applications**

Jürgen Stumpp, Robert Zetzsche
*movisens GmbH, Germany; Stumpp@movisens.com*

Mobile sensing is increasingly becoming part of our everyday life due to the evolution of the smartphone into a powerful sensing device. Popular consumer smartphones are equipped with the sensors to monitor a diverse range of human activities and commonly encountered contexts. This is particularly useful for the research field of ambulatory assessment. In the presentation we will show what smartphones can do now and will be able to do in the future. We show examples of studies that utilize smartphone usage tracking, embedded sensors, such as accelerometer, microphone, and camera, and external sensors like ECG monitors.

We also discuss context-aware studies with location monitoring, geofencing as well as SMS and telephone usage monitoring. Social sensing, to track interactions with other people, is currently a technological challenge. We will present different technical approaches on how to achieve social sensing with smartphones. Apart from the wide possibilities, mobile sensing has currently some limitations because of smartphone diversification, battery consumption, and limitations of the operating system, which we will discuss. We also show an approach on how to simplify the analysis of the resulting datasets and use it for interactive ambulatory assessment.

*Topics: Digital health in global health, General ambulatory assessment*
*Keywords: mobile sensing, context monitoring, social sensing, EMA, experience sampling*

# VI. SATELLITE SESSIONS

## Physiological sensors for interactive ambulatory assessment

Stefan Hey
*movisens GmbH, Germany*

In many applications, a parallel assessment of physiological (objective) data, measured by mobile sensors, and subjective data, assessed with experience sampling methods, is required. In this workshop, we will demonstrate how physiological sensors and smartphones can be used to implement an interactive ambulatory assessment approach. To do this, the sensors analyze different parameters in real time and transmit the results via Bluetooth Smart. This data is processed through individually configurable algorithms and can be used to trigger forms in your experience sampling platform. By implementing one of already existing algorithms, you can isolate physiological moments of psychological stress, high activity levels, heart rate thresholds amongst many more, and use these moments to trigger a questionnaire in your EMA/ESM study. It is possible to select different algorithms for each individual participant, and also further customize the existing algorithms within groups. The solutions presented in this workshop were developed for specific applications and as such, represent a small sampling of what is possible with this innovative technology.

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