Differences in mood instability in patients with bipolar disorder type I and II: a smartphone-based study

Background: Mood instability in bipolar disorder is associated with a risk of relapse. This study investigated differences in mood instability between patients with bipolar disorder type I and type II, which previously has been sparingly investigated.

Methods: Patients with bipolar disorder type I (n = 53) and type II (n = 31) used a daily smartphone-based self-monitoring system for 9 months. Data in the present reflect 15,975 observations of daily collected smartphone-based data on patient-evaluated mood.

Results: In models adjusted for age, gender, illness duration and psychopharmacological treatment, patients with bipolar disorder type II experienced more mood instability during depression compared with patients with bipolar disorder type I (B: 0.27, 95% CI 0.007; 0.53, p = 0.044), but lower intensity of manic symptoms. Patients with bipolar disorder type II did not experience lower mean mood or higher intensity of depressive symptoms compared with patients with bipolar disorder type I.

Conclusions: Compared to bipolar disorder type I, patients with bipolar disorder type II had higher mood instability for depression. Clinically it is of importance to identify these inter-episodic symptoms. Future studies investigating the effect of treatment on mood instability measures are warranted. Trial registration NCT02221336.
The association between mixed symptoms, irritability and functioning measured using smartphones in bipolar disorder

Objective: To (i) validate patient-evaluated mixed symptoms and irritability measured using smartphones against clinical evaluations; (ii) investigate associations between mixed symptoms and irritability with stress, quality of life and functioning, respectively, in patients with bipolar disorder. Methods: A total of 84 patients with bipolar disorder used a smartphone-based system for daily evaluation of mixed symptoms and irritability for nine months. Clinically evaluated symptoms, stress, quality of life and clinically rated functioning were collected multiple times during follow-up. Results: Patients presented mild affective symptoms. Patient-reported mixed symptoms and irritability correlated with clinical evaluations. In analyses including confounding factors there was a statistically significant association between both mixed symptoms and irritability and stress (P < 0.0001) and between irritability and both quality of life and functioning (P < 0.0001) respectively. There was no association between mixed mood and both quality of life and functioning. Conclusion: Mixed symptoms and irritability can be validly self-reported using smartphones in patients with bipolar disorder. Mixed symptoms and irritability are associated with increased stress even during full or partial remission. Irritability is associated with decreased quality of life and functioning. The findings emphasize the clinical importance of identifying inter-episodic symptoms including irritability pointing towards smartphones as a valid tool.

The effect of smartphone-based monitoring on illness activity in bipolar disorder: the MONARCA II randomized controlled single-blinded trial

Recently, the MONARCA I randomized controlled trial (RCT) was the first to investigate the effect of smartphone-based monitoring in bipolar disorder (BD). Findings suggested that smartphone-based monitoring sustained depressive but reduced manic symptoms. The present RCT investigated the effect of a new smartphone-based system on the severity of depressive and manic symptoms in BD. Randomized controlled single-blind parallel-group trial. Patients with BD, previously treated at The Copenhagen Clinic for Affective Disorder, Denmark and currently treated at community psychiatric centres, private psychiatrists or GPs were randomized to the use of a smartphone-based system or to standard treatment for 9 months. Primary outcomes: differences in depressive and manic symptoms between the groups. A total of 129 patients with BD (ICD-10) were included. Intention-to-treat analyses showed no statistically significant effect of smartphone-based monitoring on depressive (B = 0.61, 95% CI -0.77 to 2.00, p = 0.38) and manic (B = -0.25, 95% CI -1.1 to 0.59, p = 0.56) symptoms. The intervention group reported higher quality of life and lower perceived stress compared with the control group. In sub-analyses, the intervention group had higher risk of depressive episodes, but lower risk of manic episodes compared with the control group. There was no effect of smartphone-based monitoring. In patient-reported outcomes, patients in the intervention group reported improved quality of life and reduced perceived stress. Patients in the intervention group had higher risk of depressive episodes and reduced risk of manic episodes. Despite the widespread use and excitement of electronic monitoring, few studies have investigated possible effects. Further studies are needed.
Correlations Between Objective Behavioral Features Collected From Mobile and Wearable Devices and Depressive Mood Symptoms in Patients With Affective Disorders: Systematic Review

Background: Several studies have recently reported on the correlation between objective behavioral features collected via mobile and wearable devices and depressive mood symptoms in patients with affective disorders (unipolar and bipolar...
disorders). However, individual studies have reported on different and sometimes contradicting results, and no quantitative systematic review of the correlation between objective behavioral features and depressive mood symptoms has been published. Objective: The objectives of this systematic review were to (1) provide an overview of the correlations between objective behavioral features and depressive mood symptoms reported in the literature and (2) investigate the strength and statistical significance of these correlations across studies. The answers to these questions could potentially help identify which objective features have shown most promising results across studies. Methods: We conducted a systematic review of the scientific literature, reported according to the preferred reporting items for systematic reviews and meta-analyses guidelines. IEEE Xplore, ACM Digital Library, Web of Sciences, PsychINFO, PubMed, DBLP computer science bibliography, HTA, DARE, Scopus, and Science Direct were searched and supplemented by hand examination of reference lists. The search ended on April 27, 2017, and was limited to studies published between 2007 and 2017. Results: A total of 46 studies were eligible for the review. These studies identified and investigated 85 unique objective behavioral features, covering 17 various sensor data inputs. These features were divided into 7 categories. Several features were found to have statistically significant and consistent correlation directionality with mood assessment (e.g., the amount of home stay, sleep duration, and vigorous activity), while others showed directionality discrepancies across the studies (e.g., amount of text messages [short message service] sent, time spent between locations, and frequency of mobile phone screen activity). Conclusions: Several studies showed consistent and statistically significant correlations between objective behavioral features collected via mobile and wearable devices and depressive mood symptoms. Hence, continuous and everyday monitoring of behavioral aspects in affective disorders could be a promising supplementary objective measure for estimating depressive mood symptoms. However, the evidence is limited by methodological issues in individual studies and by a lack of standardization of (1) the collected objective features, (2) the mood assessment methodology, and (3) the statistical methods applied. Therefore, consistency in data collection and analysis in future studies is needed, making replication studies as well as meta-analyses possible.
significant larger amount of spare time activities when feeling bad (z=−2.045, P=.041). Through a within-subject analysis of covariance, the patients were found to have a better day than the previous, if that previous day followed their diurnal rhythm (ρ=.265, P=.029). Furthermore, a second-order trend indicated that two hours of daily social activity was optimal for the patients (β2=−0.08, t (63)=−1.22, P=.23).

Conclusions: The data-driven statistical approach was able to find patterns within the behavioral traits that could assist the therapist in as well as help design future technologies for behavioral activation.

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Double-Loop Health Technology: Enabling Socio-technical Design of Personal Health Technology in Clinical Practice

Personal health technology is rapidly emerging as a response to the challenges associated with significant increase in chronic noncommunicable diseases. The overall design paradigm behind most of these applications is to manually and automatically sample data from sensors and smartphones and use this to provide patients with an awareness of their illness and give recommendation for treatment, care, and healthy living. Few of these systems are, however, designed to be part of a complex socio-technical care and treatment processes in existing healthcare systems and clinical pathways. In this chapter, we present a case of designing personal health technology for mental health, which is integrated into hospital-based treatment. This system helps patients to manage their disease by tracking and correlation behavior and disease progression and provide feedback to them, while also deployed as part of a clinical outpatient treatment. Hence, clinicians are “in the loop” and can monitor and provide feedback to patients. The chapter outlines the case and discusses lessons learned from it with respect to the socio-technical design of personal health technologies to be embedded as part of clinical treatment.

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Objective smartphone data as a potential diagnostic marker of bipolar disorder

Currently, the diagnosis in bipolar disorder relies on patient information and careful clinical evaluations and judgements with a lack of objective tests. Core clinical features of bipolar disorder include changes in behaviour. We aimed to investigate objective smartphone data reflecting behavioural activities to classify patients with bipolar disorder compared with healthy individuals. Objective smartphone data were automatically collected from 29 patients with bipolar disorder and 37 healthy individuals. Repeated measurements of objective smartphone data were performed during different affective states in patients with bipolar disorder over 12 weeks and compared with healthy individuals. Overall, the sensitivity of objective smartphone data in patients with bipolar disorder versus healthy individuals was 0.92, specificity 0.39, positive predictive value 0.88 and negative predictive value 0.52. In euthymic patients versus healthy individuals, the sensitivity was 0.90, specificity 0.56, positive predictive value 0.85 and negative predictive value 0.67. In mixed models, automatically generated objective smartphone data (the number of text messages/day, the duration of phone calls/day) were increased in patients with bipolar disorder (during euthymia, depressive and manic or mixed states, and overall) compared with healthy individuals. The amount of time the smartphone screen was 'on' per day was decreased in patients with bipolar disorder (during euthymia, depressive state and overall) compared with healthy individuals. Objective smartphone data may represent a potential diagnostic behavioural marker in bipolar disorder and may be a candidate supplementary method to the diagnostic process in the future. Further studies including larger samples, first-degree relatives and patients with other psychiatric disorders are needed.

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Supporting smartphone-based behavioral activation: A simulation study

Behavioral activation has shown to be a simple yet effective therapy for depressive patients. The method relies on extensive collection of patient reported activity data on an hourly basis. We are currently in the process of designing a smartphone-based behavioral activation system for depressive disorders. However, it is an open question to what degree patients would use this approach given the high demand for user input. In order to investigate this question, we collected paper-based behavioral activation forms from 5 patients, covering in total 18 weeks, 115 days, and 1,614 hours of self-reported activity data. In this paper we present an analysis of this data and discuss the implications for the design of a smartphone-based system for behavioral activation.

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Mental health issues affect a significant portion of the world's population and can result in debilitating and life-threatening outcomes. To address this increasingly pressing healthcare challenge, there is a need to research novel approaches for early detection and prevention. In particular, ubiquitous systems can play a central role in revealing and tracking clinically relevant behaviors, contexts, and symptoms. Further, such systems can passively detect relapse onset and enable the opportune delivery of effective intervention strategies. However, despite their clear potential, the uptake of ubiquitous technologies into clinical mental healthcare is rare, and a number of challenges still face the overall efficacy of such technology-based solutions. The goal of this workshop is to bring together researchers interested in identifying, articulating, and addressing such issues and opportunities. Following the success of last year's inaugural workshop, we aim to continue facilitating the UbiComp community in developing a holistic approach for sensing and intervention in the context of mental health.

Activity-based Collaboration for Interactive Spaces
Activity-based computing (ABC) is a conceptual and technological framework for designing interactive systems that offers a better mapping between the activities people conduct and the digital entities they use. In ABC, rather than interacting directly with lower-level technical entities like files, folder, documents, etc., users are able to interact with ‘activities’ which encapsulate files and other low-level resources. In ABC an ‘activity’ can be shared between collaborating users and can be accessed on different devices. As such, ABC is a framework that suits the requirements of designing interactive spaces. This chapter provides an overview of ABC with a special focus on its support for collaboration ('Activity Sharing') and multiple devices ('Activity Roaming'). These ABC concepts are illustrated as implemented in two different interactive spaces technologies; ReticularSpaces [1] and the eLabBench [2, 3]. The chapter discusses the benefits of activity-based collaboration support for these interactive spaces, while also discussing limitations and challenges to be addressed in further research.
Big Data hvor N=1
Forskningen vedrørende anvendelsen af 'big data' indenfor sundhed er kun lige begyndt, og kan på sigt blive en stor hjælp i forhold til at tilrettelægge en mere personlig og helhedsorienteret sundhedsindsats for multisyg. Personlig sundhedssteknologi, som kort præsenteres i dette kapitel, rummer et stor potentiale for at gennemføre 'big data' analyser for den enkelte person, det vil sige hvor N=1. Der er store teknologiske udfordringer i at få lavet teknologier og metoder til at indsamle og håndtere personlige data, som kan deles, på tværs på en standardiseret, forsvarlig, robust, sikker og ikke mindst anonym facon.

Can smartphone-based electronic markers discriminate between patients with bipolar disorder, healthy first-degree relatives and healthy control individuals

Can smartphone-based electronic markers discriminate between patients with bipolar disorder, healthy first-degree relatives and healthy control individuals

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Collaborative Affordances of Medical Records
This article proposes the concept of Collaborative Affordances to describe physical and digital properties (i.e., affordances) of an artifact, which affords coordination and collaboration in work. Collaborative Affordances build directly on Gibson (1977)'s affordance concept and extends the work by Sellen and Harper (2003) on the affordances of physical paper. Sellen and Harper describe how the physical properties of paper affords easy reading, navigation, mark-up, and writing, but focuses, we argue, mainly on individual use of paper and digital technology. As an extension to this, Collaborative Affordances focuses on the properties of physical and digital artifacts that affords collaborative activities. We apply the concept of Collaborative Affordances to the study of paper-based and electronic patient records in hospitals and detail how they afford collaboration through four types of Collaborative Affordances; being portable across patient wards and the entire hospital, by providing collocated access, by providing a shared overview of medical data, and by giving clinicians ways to maintain mutual awareness. We then discuss how the concept of Collaborative Affordances can be used in the design of new technology by providing a design study of a ‘Hybrid Patient Record’ (HyPR), which is designed to seamlessly blend and integrate paper-based with electronic patient records.

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Helbredstjek af dansk sundhedsteknologi: Sektorudviklingsrapport
Sådan kan samarbejde mellem industrien, universiteterne og sundhedsvæsenet skabe gode løsninger til forebyggelse, diagnostik, patientbehandling og rehabilitering

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Reducing the rate and duration of Re-ADMISsions among patients with unipolar disorder and bipolar disorder using smartphone-based monitoring and treatment - the RADMIS trials: Study protocol for two randomized controlled trials

Background: Unipolar and bipolar disorder combined account for nearly half of all morbidity and mortality due to mental and substance use disorders, and burden society with the highest health care costs of all psychiatric and neurological disorders. Among these, costs due to psychiatric hospitalization are a major burden. Smartphones comprise an innovative and unique platform for the monitoring and treatment of depression and mania. No prior trial has investigated whether the use of a smartphone-based system can prevent re-admission among patients discharged from hospital. The present RADMIS trials aim to investigate whether using a smartphone-based monitoring and treatment system, including an integrated clinical feedback loop, reduces the rate and duration of re-admissions more than standard treatment in unipolar disorder and bipolar disorder. Methods: The RADMIS trials use a randomized controlled, single-blind, parallel-group design. Patients with unipolar disorder and patients with bipolar disorder are invited to participate in each trial when discharged from psychiatric hospitals in The Capital Region of Denmark following an affective episode and randomized to either (1) a smartphone-based monitoring system including (a) an integrated feedback loop between patients and clinicians and (b) context-aware cognitive behavioral therapy (CBT) modules (intervention group) or (2) standard treatment (control group) for a 6-month trial period. The trial started in May 2017. The outcomes are (1) number and duration of re-admissions (primary), (2) severity of depressive and manic (only for patients with bipolar disorder) symptoms; psychosocial functioning; number of affective episodes (secondary), and (3) perceived stress, quality of life, self-rated depressive symptoms, self-rated manic symptoms (only for patients with bipolar disorder), recovery, empowerment, adherence to medication, wellbeing, ruminations, worrying, and satisfaction (tertiary). A total of 400 patients (200 patients with unipolar disorder and 200 patients with bipolar disorder) will be included in the RADMIS trials. Discussion: If the smartphone-based monitoring system proves effective in reducing the rate and duration of readmissions, there will be basis for using a system of this kind in the treatment of unipolar and bipolar disorder in general and on a larger scale.

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The Bipolar Illness Onset study: research protocol for the BIO cohort study
Bipolar disorder is an often disabling mental illness with a lifetime prevalence of 1%-2%, a high risk of recurrence of manic and depressive episodes, a lifelong elevated risk of suicide and a substantial heritability. The course of illness is frequently characterised by progressive shortening of interepisodic intervals with each recurrence and increasing cognitive dysfunction in a subset of individuals with this condition. Clinically, diagnostic boundaries between bipolar disorder and
other psychiatric disorders such as unipolar depression are unclear although pharmacological and psychological treatment strategies differ substantially. Patients with bipolar disorder are often misdiagnosed and the mean delay between onset and diagnosis is 5-10 years. Although the risk of relapse of depression and mania is high it is for most patients impossible to predict and consequently prevent upcoming episodes in an individual tailored way. The identification of objective biomarkers can both inform bipolar disorder diagnosis and provide biological targets for the development of new and personalised treatments. Accurate diagnosis of bipolar disorder in its early stages could help prevent the long-term detrimental effects of the illness. The present Bipolar Illness Onset study aims to identify (1) a composite blood-based biomarker, (2) a composite electronic smartphone-based biomarker and (3) a neurocognitive and neuroimaging-based signature for bipolar disorder. The study will include 300 patients with newly diagnosed/first-episode bipolar disorder, 200 of their healthy siblings or offspring and 100 healthy individuals without a family history of affective disorder. All participants will be followed longitudinally with repeated blood samples and other biological tissues, self-monitored and automatically generated smartphone data, neuropsychological tests and a subset of the cohort with neuroimaging during a 5 to 10-year study period. The study has been approved by the Local Ethical Committee (H-7-2014-007) and the data agency, Capital Region of Copenhagen (RHP-2015-023), and the findings will be widely disseminated at international conferences and meetings including conferences for the International Society for Bipolar Disorders and the World Federation of Societies for Biological Psychiatry and in scientific peer-reviewed papers. NCT02888262.

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Behavioral activities collected through smartphones and the association with illness activity in bipolar disorder
Smartphones are useful in symptom-monitoring in bipolar disorder (BD). Objective smartphone data reflecting illness activity could facilitate early treatment and act as outcome in efficacy trials. A total of 29 patients with BD presenting with moderate to severe levels of depressive and manic symptoms used a smartphone-based self-monitoring system during 12 weeks. Objective smartphone data on behavioral activities were collected. Symptoms were clinically assessed every second week using the Hamilton Depression Rating Scale and the Young Mania Rating Scale. Objective smartphone data correlated with symptom severity. The more severe the depressive symptoms (1) the longer the smartphone’s screen was "on"/day, (2) more received incoming calls/day, (3) fewer outgoing calls/day were made, (4) less answered incoming calls/day, (5) the patients moved less between cell towers IDs/day. Conversely, the more severe the manic symptoms (1) more outgoing text messages/day sent, (2) the phone calls/day were longer, (3) the fewer number of characters in incoming text messages/day, (4) the lower duration of outgoing calls/day, (5) the patients moved more between cell towers IDs/day. Further, objective smartphone data were able to discriminate between affective states. Objective smartphone data reflect illness severity, discriminates between affective states in BD and may facilitate the cooperation between patient and clinician.
Dedicated workspaces: Faster resumption times and reduced cognitive load in sequential multitasking

Studies show that virtual desktops have become a widespread approach to window management within desktop environments. However, despite their success, there is no experimental evidence of their effect on multitasking. In this paper, we present an experimental study incorporating 16 participants in which a traditional Windows 7 environment is compared to one augmented by virtual desktops. Within the experimental condition, each virtual desktop acts as a dedicated workspace devoted to an independent goal-oriented task, as opposed to the control condition where only one single workspace is available to perform the same tasks. Results show that adopting virtual desktops as dedicated workspaces allows for faster task resumption (10 s faster on average) and reduced cognitive load during sequential multitasking. Within our experiment the majority of users already benefited from using dedicated workspaces after three switches to a previously suspended task, as the time lost on setting up workspaces was compensated for by faster subsequent task resumption. These results provide a strong argument for supporting goal-oriented dedicated workspaces within desktop environments.
Designing Context-Aware Cognitive Behavioral Therapy for Unipolar and Bipolar Disorders
This position paper presents our preliminary design of context-aware cognitive behavioral therapy for unipolar and bipolar disorders. We report on the background for this study and the methods applied in the ongoing design process. The paper ends by presenting and discussing different design options. We hope this will be useful input for further discussion at the workshop.

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Electronic self-monitoring of mood using IT platforms in adult patients with bipolar disorder: A systematic review of the validity and evidence
Background: Various paper-based mood charting instruments are used in the monitoring of symptoms in bipolar disorder. During recent years an increasing number of electronic self-monitoring tools have been developed. The objectives of this systematic review were 1) to evaluate the validity of electronic self-monitoring tools as a method of evaluating mood compared to clinical rating scales for depression and mania and 2) to investigate the effect of electronic self-monitoring tools on clinically relevant outcomes in bipolar disorder.

Methods: A systematic review of the scientific literature, reported according to the Preferred Reporting items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines was conducted. MEDLINE, Embase, PsycINFO and The Cochrane Library were searched and supplemented by hand search of reference lists. Databases were searched for 1) studies on electronic self-monitoring tools in patients with bipolar disorder reporting on validity of electronically self-reported mood ratings compared to clinical rating scales for depression and mania and 2) randomized controlled trials (RCT) evaluating electronic mood self-monitoring tools in patients with bipolar disorder.

Results: A total of 13 published articles were included. Seven articles were RCTs and six were longitudinal studies. Electronic self-monitoring of mood was considered valid compared to clinical rating scales for depression in six out of six studies, and in two out of seven studies compared to clinical rating scales for mania. The included RCTs primarily investigated the effect of heterogeneous electronically delivered interventions; none of the RCTs investigated the sole effect of electronic mood self-monitoring tools. Methodological issues with risk of bias at different levels limited the evidence in the majority of studies.

Conclusions: Electronic self-monitoring of mood in depression appears to be a valid measure of mood in contrast to self-monitoring of mood in mania. There are yet few studies on the effect of electronic self-monitoring of mood in bipolar disorder. The evidence of electronic self-monitoring is limited by methodological issues and by a lack of RCTs. Although the idea of electronic self-monitoring of mood seems appealing, studies using rigorous methodology investigating the beneficial as well as possible harmful effects of electronic self-monitoring are needed.

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The Personal Health Technology Design Space

Interest is increasing in personal health technologies that utilize mobile platforms for improved health and well-being. However, although a wide variety of these systems exist, each is designed quite differently and materializes many different and more or less explicit design assumptions. To enable designers to make informed and well-articulated design decisions, the authors propose a design space for personal health technologies. This space consists of 10 dimensions related to the design of data sampling strategies, visualization and feedback approaches, treatment models, and regulatory constraints.
Voice analysis as an objective state marker in bipolar disorder

Changes in speech have been suggested as sensitive and valid measures of depression and mania in bipolar disorder. The present study aimed at investigating (1) voice features collected during phone calls as objective markers of affective states in bipolar disorder and (2) if combining voice features with automatically generated objective smartphone data on behavioral activities (for example, number of text messages and phone calls per day) and electronic self-monitored data (mood) on illness activity would increase the accuracy as a marker of affective states. Using smartphones, voice features, automatically generated objective smartphone data on behavioral activities and electronic self-monitored data were collected from 28 outpatients with bipolar disorder in naturalistic settings on a daily basis during a period of 12 weeks. Depressive and manic symptoms were assessed using the Hamilton Depression Rating Scale 17-item and the Young Mania Rating Scale, respectively, by a researcher blinded to smartphone data. Data were analyzed using random forest algorithms. Affective states were classified using voice features extracted during everyday life phone calls. Voice features were found to be more accurate, sensitive and specific in the classification of manic or mixed states with an area under the curve (AUC)=0.89 compared with an AUC=0.78 for the classification of depressive states. Combining voice features with automatically generated objective smartphone data on behavioral activities and electronic self-monitored data increased the accuracy, sensitivity and specificity of classification of affective states slightly. Voice features collected in naturalistic settings using smartphones may be used as objective state markers in patients with bipolar disorder.

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Voice analysis as an objective state marker in bipolar disorder

General information
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Smartphone data as an electronic biomarker of illness activity in bipolar disorder

Objectives
Objective methods are lacking for continuous monitoring of illness activity in bipolar disorder. Smartphones offer unique opportunities for continuous monitoring and automatic collection of real-time data. The objectives of the paper were to test the hypotheses that (i) daily electronic self-monitored data and (ii) automatically generated objective data collected using smartphones correlate with clinical ratings of depressive and manic symptoms in patients with bipolar disorder.

Methods
Software for smartphones (the MONARCA I system) that collects automatically generated objective data and self-monitored data on illness activity in patients with bipolar disorder was developed by the authors. A total of 61 patients aged 18–60 years and with a diagnosis of bipolar disorder according to ICD-10 used the MONARCA I system for six months. Depressive and manic symptoms were assessed monthly using the Hamilton Depression Rating Scale 17-item (HDRS-17) and the Young Mania Rating Scale (YMRS), respectively. Data are representative of over 400 clinical ratings. Analyses were computed using linear mixed-effect regression models allowing for both between individual variation and within individual variation over time.

Results
Analyses showed significant positive correlations between the duration of incoming and outgoing calls/day and scores on the HDRS-17, and significant positive correlations between the number and duration of incoming calls/day and scores on the YMRS; the number of and duration of outgoing calls/day and scores on the YMRS; and the number of outgoing text messages/day and scores on the YMRS. Analyses showed significant negative correlations between self-monitored data (i.e., mood and activity) and scores on the HDRS-17, and significant positive correlations between self-monitored data (i.e., mood and activity) and scores on the YMRS. Finally, the automatically generated objective data were able to discriminate between affective states.

Conclusions
Automatically generated objective data and self-monitored data collected using smartphones correlate with clinically rated depressive and manic symptoms and differ between affective states in patients with bipolar disorder. Smartphone apps represent an easy and objective way to monitor illness activity with real-time data in bipolar disorder and may serve as an electronic biomarker of illness activity.

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Projects:

Open-access data platform for behavioural monitoring and visual analytics for mental health
Nunes Vilaza, G., PhD Student, Department of Applied Mathematics and Computer Science
Bardram, J. E., Main Supervisor, Copenhagen Center for Health Technology
15/10/2018 → 26/10/2021
Project: PhD

Software Architecture and Platform for Multi-study and Multi-source Digital Phenotyping Research
Kumar, D., PhD Student, Department of Applied Mathematics and Computer Science
Bardram, J. E., Main Supervisor, Department of Applied Mathematics and Computer Science
Dragoni, N., Supervisor, Department of Applied Mathematics and Computer Science
01/02/2018 → 31/01/2021
Award relations: Software Architecture and Platform for Multi-study and Multi-source Digital Phenotyping Research
Project: PhD

Patient Training for Gaze Controlled Telepresence
Zhang, G., PhD Student, Department of Management Engineering
Hansen, J. P., Main Supervisor
Bardram, J. E., Supervisor
Forskningsrådssstipendium
01/02/2018 → 31/01/2021
Award relations: Patient Training for Gaze Controlled Telepresence
Project: PhD

Design Toolbox for Personal Health Technology
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Bardram, J. E., Main Supervisor, Department of Applied Mathematics and Computer Science
Bækgaard, P., Supervisor, Department of Applied Mathematics and Computer Science
Offentlig finansiering
01/02/2018 → 31/01/2021
Award relations: Design Toolbox for Personal Health Technology
Project: PhD

Computer- and Smartphone-based Assessment of Cognitive Functioning in Affective Disorders in Young People
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Kessing, L. V., Supervisor
Marie Curie (EU-stipendium)
01/06/2017 → 31/05/2020
Award relations: Computer- and Smartphone-based Assessment of Cognitive Functioning in Affective Disorders in Young People
Project: PhD

In-situ and Personalized Cognitive Behavioural Therapy for Mental Health
Rohani, D. A., PhD Student, Department of Applied Mathematics and Computer Science
Bardram, J. E., Main Supervisor, Department of Applied Mathematics and Computer Science
Kessing, L. V., Supervisor
Puthusserypady, S., Supervisor, Department of Electrical Engineering
Samfinansieret - Andet
01/09/2016 → 31/08/2019
Award relations: In-situ and Personalized Cognitive Behavioural Therapy for Mental Health
Project: PhD

Machine learning for smartphone-based monitoring and treatment of unipolar and bipolar disorders
Busk, J., PhD Student, Department of Mathematics
Winther, O., Main Supervisor
Bardram, J. E., Supervisor
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01/03/2016 → 15/06/2019
Award relations: Machine learning for smartphone-based monitoring and treatment of unipolar and bipolar disorders
Project: PhD

Engineering Systems Design in Healthcare
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Maier, A., Main Supervisor
Forchhammer, H. B., Supervisor
Bardram, J. E., Examiner
Andersen-Ranberg, K., Examiner
Clarkson, P. J., Examiner
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15/12/2014 → 14/02/2019
Award relations: Engineering Systems Design in Healthcare
Project: PhD

Data mining and visualization of human behavior data sets
Cuttone, A., PhD Student, Department of Mathematics
Larsen, J. E., Main Supervisor
Jørgensen, S. L., Supervisor
Bardram, J. E., Examiner
Musolesi, M., Examiner
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Technical University of Denmark
01/08/2013 → 15/03/2017
Award relations: Data mining and visualization of human behavior data sets
Project: PhD

RADMIS: Reducing the rate and duration of re-admission among patients with unipolar and bipolar disorder using smartphone-based monitoring and treatment
According to WHO, depression is becoming a leading cause of disability. The RADMIS project seeks to design smartphone-based monitoring and treatment technology for depressive patients. The goal is to establish the efficacy of this technology by measuring re-admission and clinical outcome.
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Innovation Fund Denmark: DKK11,000,000.00
01/03/2016 → 01/09/2019
Collaborators: Psychiatric Center Copenhagen, Rigshospitalet
Award relations: Reducing the rate and duration of re-admission among patients with unipolar and bipolar disorder using smartphone-based monitoring and treatment
Project: Research