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Daniel Z Lieberman

Susan Swayze

Frederick K Goodwin

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Daniel Z. Lieberman, M.D.
Susan Swayze, Ph.D.
Frederick K. Goodwin, M.D.

Dr. Lieberman and Dr. Goodwin are affiliated with the Department of Psychiatry and Behavioral Sciences, George Washington University School of Medicine and Health Sciences, 2150 Pennsylvania Ave, N.W., Washington, DC 20037 (e-mail: dlieberman@mfa.gwu.edu). Dr. Swayze is with the Graduate School of Education and Human Development, George Washington University, Washington, D.C. William M. Glazer, M.D., is editor of this column.

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Abstract

Mood stabilizing medication is an essential part of the treatment of bipolar disorder, however most patients experience residual symptoms, functional impairment, and syndromic relapse. The addition of an appropriate psychotherapy has been shown to improve outcomes, but very few patients have access to clinicians who are trained in bipolar-specific modalities. We describe a fully automated Internet-based program that combines an adaptation of the NIMH Life Chart Methodology with social rhythm stabilization. Sixty-four participants used the program for 90 days. They performed daily mood ratings, and recorded the time of five key daily activities using the social rhythm metric (SRM). At the end of the 90 day period social rhythm stability increased by 31%. There were statistically significant relationships between time in the study and SRM score ($p<.001$), and between SRM and mood symptom rating ($p<.001$), although the effect size for the latter was small ($r=-.143$). Because evidence-based bipolar-specific

psychotherapy is difficult for most patients to access, an option that can be provided at almost no cost, regardless of geographic location, and at any time of day is potentially important.

Introduction

Bipolar disorder is an illness of chronic and recurrent instability. Mood stabilizing medications play an essential role in the treatment of bipolar patients, but they are rarely fully effective by themselves. Residual symptoms of mood instability often persist despite careful medication management. The addition of a bipolar-specific psychotherapy has been shown to be superior to medication management alone (1).

Stabilization of daily routines is a component of a number of evidence-based bipolar-specific psychotherapies, but it plays the most prominent role in interpersonal and social rhythm therapy (IPSRT) (2). Irregular routines are widely targeted by bipolar psychotherapies because they have the potential to destabilize mood.

Despite the demonstrated efficacy of IPSRT and other bipolar-specific psychotherapies, most patients are unable to access this type of treatment. Developing an effective treatment is only the first step. Before patients can actually benefit, the treatment must be made widely available. This essential step may be the most challenging. Simple dissemination strategies, such as conferences or educational materials, have been shown to result in little or no changes in health outcomes related to treatment practices (3).

A number of computer-aided psychotherapies (CP) have been developed to address these challenges. An effective CP can allow a clinician with non-specific therapy skills to deliver an evidence-based therapy with a high degree of fidelity to the intervention as it was used in clinical trials. CP can lower the cost of therapy by allowing most treatment tasks to be delegated to patient-computer interactions. CP can also help overcome barriers of distance and time for patients who do not live near a trained therapist, or who have work or child care responsibilities that conflict with available treatment times.

MoodChart: Social rhythm stabilization therapy for people with bipolar disorder

MoodChart (patients: www.moodchart.org, clinicians: www.moodchart.org/demo) is a free, open-source program that combines social rhythm stabilization with an online implementation of the National Institute of Mental Health Life Chart Methodology (4). The source code can be obtained from the corresponding author. Mood charting was included as part of the therapeutic intervention because it has the potential to increase a patient's understanding of the chronic, relapsing course of bipolar disorder; and because it graphically integrates a large amount of fine grained data in a way that can lead to better clinical communication with a treating clinician.

The primary weakness of the traditional mood chart is that adherence to the charting task is difficult to maintain long term. MoodChart reduces this problem by sending daily rating emails containing nine embedded links that can be clicked to record the standard NIMH-LCM mood levels. Consequently, recording daily mood is completed with a single click. Users receive multimedia training on selecting the appropriate rating, and each email reinforces accurate ratings by including a brief summary of the rating conventions.

Clicking on link opens a page in which users subjects are able to optionally record hours slept, levels of irritability and anxiety, and monthly weight. Daily events can be recorded in free-form text. No personal data is included in the email or on the web page that opens in response to clicking the mood link in the email. In order to view charts, users must sign in with a user name and password. The only piece of identifying information stored online is an encrypted email address.

Rating via email eliminates the need for users to incorporate a new routine into their lives. The email interface also capitalizes on the fact that checking email is generally performed on a highly consistent basis, and is subject to strong behavioral reinforcement. Like slot machines, email checking follows a variable interval reinforcement schedule,

which creates a steady rate of response (5). Most emails are mundane, but occasionally and unpredictably one arrives that is novel, important, and rewarding. In a randomized study, participants who used the Internet chart rated twice as many days compared to users assigned to the conventional paper chart (6).

The 5 item version of the Social Rhythm Metric II (SRM) is used to record the times of daily activities that are thought to be relevant to mood stability. These activities are time of awakening, first contact with another person, the start of work (which can include paid work, volunteer work, housework, child care, or school), dinner time, and bedtime.

Pilot testing of online social rhythm stabilization

The ability of the automated program to stabilize daily rhythms was evaluated in a single arm study. Participants were recruited via Internet search engine advertising. They were required to have bipolar I, II, or NOS, and complete 90 days of prospective mood rating prior to enrollment in order to select a sample that would be most likely to consistently record the times of daily activities over the duration of the study.

The primary outcome measure was change in the SRM over a period of 3 months. The SRM was calculated by averaging the number of times activities were performed within 45 minutes of the habitual time over a 7 day period (2). With this scale, scores range from 0 (none of the activities are performed at the habitual time on any of the days) to 7 (all the activities are performed at the habitual time every day). For the first seven days of the study, participants were asked to record the times of daily activities without attempting to make any changes. This initial seven day period allowed a baseline SRM to be calculated.

At the beginning of the second week, participants set target times, and then worked on consistently performing activities at the target time. In order to help participants track their success, a "hit rate" was calculated, and displayed on the participant's mood chart. The hit rate was the percent of time each activity was performed with 45 minutes of the target time over the past seven days. Counters were also displayed on the chart page

indicating the total number of days rated, and the total number of consecutive days rated. The counters were used to motivate participants to rate consistently, based on game research indicating that opportunities to accumulate points reinforces game playing behavior (7).

A secondary analysis addressed the question of whether greater rhythm stability would reduce mood symptoms. Total symptom burden (TSB) was defined as the sum of the depression score and the mania score, and the relationship between SRM and TSB was explored.

Sixty-four participants gave informed consent, and were enrolled in the study. Most participants were women with at least some college education who reported a diagnosis of bipolar II disorder. Overall, adherence to rating was high during the 90 day study. The mean number of days rated was 84.8 (SD 11.0), which provided a total of 5,376 days of data to analyze.

At baseline, the mean SRM was 3.63 (SD 0.93), and increased to 4.76 (SD 1.19) at day 90. Nearly all of the increase in the SRM occurred during the first 30 days of the study (on day 30, the mean SRM was 4.62, SD 1.11). There was a statistically significant relationship between SRM and the number of days of program use ($r=.128$, $p<.001$, Figure)

A longitudinal mixed model analysis showed a significant interaction between days in the study and SRM (estimate .00626, SE .00268, df 157.607, t 2.331, $p=.021$).

Participants were more likely to report depressed days than manic days, and the severity of depression was greater. On average participants rated 36.4 (SD 25.1) days depressed, and 15.8 (SD 18.0) days manic. There was a significant negative correlation between SRM and the Total Symptom Burden (TSB). $r=-.143$, $p<.001$, and mixed model analysis showed a negative interaction between the two (estimate -.0877, SE .0262, df 183.443, t –3.346, $p=.001$).

Discussion

Participants using an automated, online adaptation of social rhythm therapy increased their mean SRM from 3.6 at baseline to 4.7 by the end of the study. A score of 5 (indicating that, on average, activities are performed around their usual times on weekdays, but not on weekends) might appear to represent a typical score for a healthy person, however a survey of randomly selected people from a university alumni list found a mean SRM of 3.43 (8). Consequently, the SRM of 4.7 achieved at day 90 in this study may represent a supra-normal level of daily rhythm stability. Swartz has compared rhythm stabilization in bipolar patients with dietary control in diabetics (9). Just as diabetics have to maintain tight control of their intake of carbohydrates, fats, and other potentially unhealthy foods, bipolar patients may benefit from supra-normal rhythm stability, because of fragile circadian systems that are easily dysregulated.

A secondary aim of the study was to evaluate the effect of daily rhythm stabilization on mood. The relationship between SRM and TSB was statistically significant, but the effect size was small. One interpretation of this result is that the program did not help participants in clinically meaningful ways. Alternatively, one might view the successful treatment of bipolar disorder as involving multiple components that can act in synergistic ways. For example, increased daily rhythm stability may create an environment in which medication adherence is more likely to occur, or could increase the quality of social relationships, and enhance the level of environmental support.

This was a single arm, open label study, therefore causality cannot be inferred from the results. It is possible increased SRM scores were independent of the effects of the Internet program. Individuals often enter studies during periods of symptom exacerbation, and then improve as a result of spontaneous regression to the mean.

Although this mechanism cannot be ruled out, the study design made it less likely. Prior to enrollment, all subjects used the program to rate their mood for 90 days. All the change

in SRM occurred during the first 30 days following enrollment. Therefore, out of a total of 6 months, it is unlikely that regression to the mean or spontaneous improvement occurred only during month 4, but not during months 1, 2, 3, 5, or 6.

Conclusions

The use of a fully automated Internet adaptation of social rhythm stabilization was associated with a 30% increase in the social rhythm metric, and a small, though statistically significant, decrease in symptoms of abnormal mood. This result should be considered in the context of a risk benefit analysis. Although adverse effects were not measured in this study, it is generally believed that the adverse effects of psychotherapy are minimal. Because evidence-based bipolar-specific psychotherapy is difficult for most patients to access, an option that can be provided at almost no cost, regardless of geographic location, and at any time of day is potentially important.

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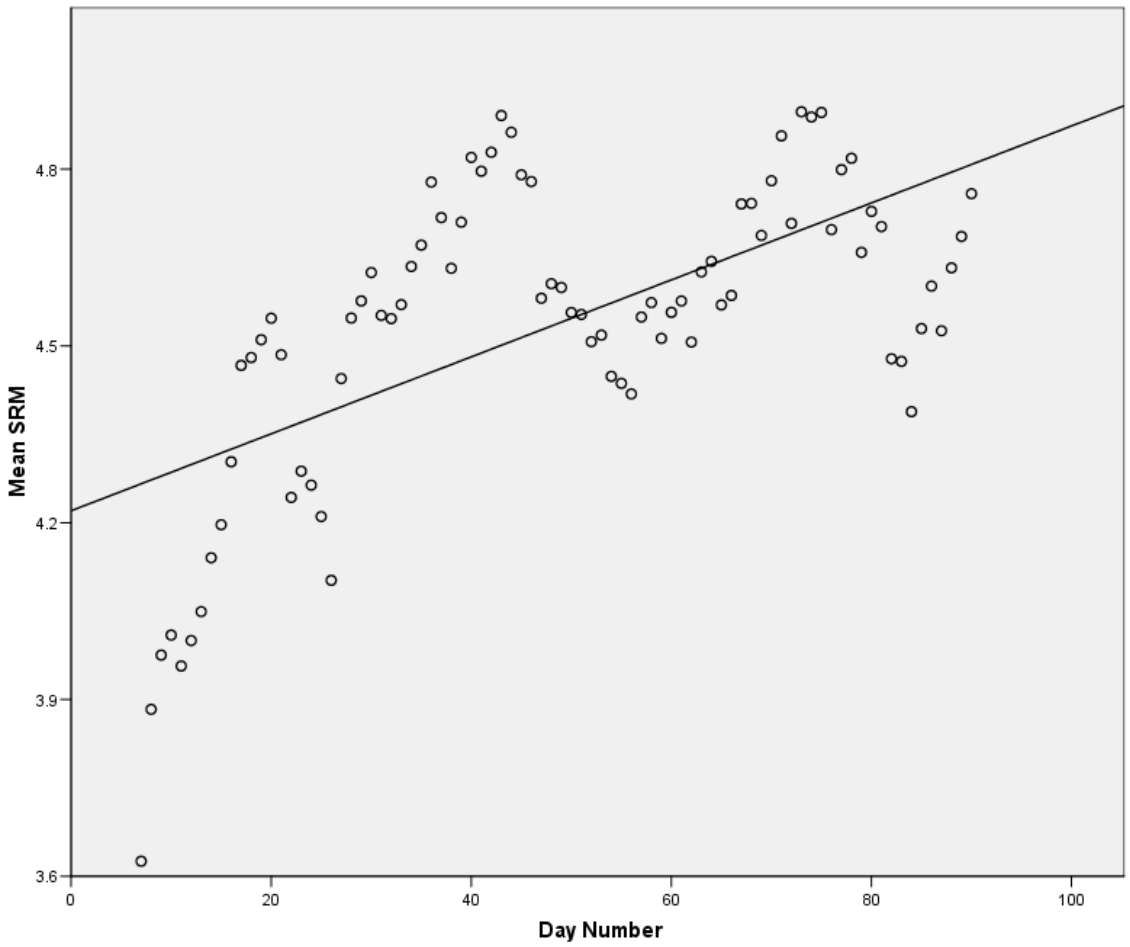

Figure. Mean Social Rhythm Metric Score (SRM) by study day.