Emotional reactivity to daily life stress in psychosis and affective disorder: an experience sampling study.

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Emotional reactivity to daily life stress in psychosis and affective disorder: an experience sampling study

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Objective: To investigate the emotional reactivity to small disturbances in daily life in patients with non-affective psychosis (NAP), bipolar disorder (BD) and major depression [major depressive disorder (MDD)].
Method: Forty-two patients with NAP, 38 with BD, 46 with MDD, and 49 healthy controls were studied with the experience sampling method to assess (i) appraised subjective stress of small disturbances in daily life and (ii) emotional reactivity, reflected in changes in positive affect (PA) and negative affect (NA).
Results: Multilevel regression analyses showed an increase in NA in MDD, a decrease in PA in BD and both an increase in NA and a decrease in PA in NAP in association with the subjectively stressful situations, compared with the control subjects.
Conclusion: Individuals with NAP, MDD and BD display differences in emotional stress reactivity. Type of mood disorder may exert a pathoplastic effect on emotional reactivity in individuals with MDD and BD. Individuals with NAP may be most vulnerable to the effects of daily life stress.

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Key words: stress – psychological; psychotic disorders; mood disorders

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Introduction

Vulnerability–stress models, according to which psychiatric symptoms emerge whenever cumulative stressors exceed the individual's vulnerability threshold, have been postulated to play a role in the aetiology and course of all major psychiatric disorders (1–4). Stressors such as life events and high expressed emotion (EE) environments have been found to precede the onset and recurrence of depression (5, 6), bipolar disorder (BD) (7, 8), and psychotic disorders (9, 10). Quantitative differences between these groups have also been reported, with the largest effects of both high EE (11, 12) and life events (13, 14) in depression. Rather than reactions to the extreme exposures that life events often represent, sensitivity to minor life events or daily hassles has been postulated to more closely resemble the underlying vulnerability for psychopathology, especially in schizophrenia (15). A recent study showed that increased emotional sensitivity to even smaller disturbances in daily life was present in patients with psychosis and their first-degree relatives, indicating that altered stress-sensitivity may be a marker for psychosis (16). The present study aims to extend these findings to other psychiatric disorders by comparing emotional reactivity with daily life stress in non-affective psychosis (NAP), BD and major depression [major depressive disorder (MDD)].

Material and methods

Subjects

The sample consisted of 50 patients with a lifetime history of NAP, 38 patients with a history of BD, 47 patients with primary MDD, and 50 healthy control subjects. The three patient samples were collected in separate, but similar studies. For the NAP subjects, interview and clinical record data were used to complete the Operational Criteria Checklist for Psychotic Illness (OCCPI) which in conjunction with the OPCRIT computer program

yielded the following DSM III-R diagnoses: schizophrenia ($n = 46$), schizo-affective disorder ($n = 3$) and atypical psychosis ($n = 1$) (17). The mean score on the Brief Psychiatric Rating Scale (18) for the NAP group was 38 [standard deviation (SD) = 9.8], indicating that most were in remission. All but five NAP subjects used medication, including typical antipsychotics (50%), atypical antipsychotics (45%), benzodiazepines (24%), antidepressants (19%), anticholinergics (14%), and lithium (5%). The healthy control group, recruited in the same study and assessed with the same methods, had no current or past history of psychiatric disorder. The BP group included individuals with a primary diagnosis of type I ($n = 31$) or type II ($n = 7$) bipolar disorder, as assessed with the Structured Clinical Interview for Axis I for DSM-IV (SCID) (19) by a research psychiatrist (R.H.). BP subjects had been in full or partial remission for at least 2 months and had been under regular treatment for at least 4 months. All BP patients used prophylactic medication, including lithium (95%), carbamazepine (11%), valproate (5%), antidepressants (11%), antipsychotics (18%), and benzodiazepines (16%). The MDD group consisted of outpatients with a current major depressive episode, as assessed with the SCID by a research psychiatrist (F.P.). Mean score on the Hamilton Rating Scale for Depression (20) was 23.9 (SD = 3.9), indicating moderate to severe depression. MDD subjects used no medications in the 2 weeks prior to and during the study, except for eight patients (17%) who used a small dose of benzodiazepines.

For more detailed description of the inclusion criteria and sampling procedures see Ref. (16) for NAP and controls, and Ref. (22) for MDD.

Written informed consent, conforming to the local ethics committee guidelines, was obtained from all subjects.

Experience sampling method

The experience sampling method (ESM) is a repeated self-assessment technique. Previous applications of ESM in schizophrenia (23–25), depression (26), bipolar disorder (21), and panic disorder (27) have demonstrated the feasibility, validity, and reliability of the method in psychiatric populations (28). Subjects were studied in their normal daily life environment. They received a digital wristwatch and a set of ESM self-assessment forms collated in a booklet for each day. Ten times a day on six consecutive days, the watch emitted a signal ('beep') at unpredictable moments between 7:30 a.m. and 10:30 p.m. After each beep, subjects were asked to fill out an ESM self-assessment form concerning thoughts, current context (activity, persons present, location), appraisals of the current situation, and mood.

Measures

Assessment of mood. Mood states were assessed with eight ESM items rated on 7-point Likert scales (1 *not at all* to 7 *very*). Factor analyses (principal component analysis with Harris–Kaiser rotation) on all ESM reports identified two factors with eigenvalues greater than 1, together explaining 54% of the total variance. Two factor-based scales with equal weights for each item were created. The mood adjectives *down*, *guilty*, *lonely*, and *anxious* formed the negative affect (NA) scale (Cronbach's $\alpha = 0.85$ over the subject means). The mood adjectives *happy*, *cheerful*, and *satisfied* formed the positive affect (PA) scale (Cronbach's $\alpha = 0.97$ over the subject means). The item *angry* had low loadings on both factors and was therefore excluded from the analysis.

Assessment of stress. Stress was conceptualized as the subjective appraisal of minor disturbances that continually happen in the natural flow of daily life. Items were selected that reflected dissatisfaction with the current situation in two fields: activity and social situation.

1. *Activity-related stress*: Subjects judged their current activity on three self-report items (scored on 7-point Likert scales, 1 = *not at all* and 7 = *very*). The mean of the items 'I am not skilled to do this activity', 'This activity requires effort', and 'I would rather do something else' (formulated like this for NAP and controls and formulated as 'I enjoy my activity', reverse coded so that high scores reflect stress for BD and MDD) formed the *activity-related stress* scale ($\alpha = 0.75$ over the subject mean scores).
2. *Social stress*: Subjects were asked to evaluate the social context when other persons were present on a 7-point Likert scale. The item 'I would rather be alone' constituted the *social stress* measure.

Statistics

Experience sampling method data have a hierarchical structure, and multiple observations are nested within subjects. Initial pairwise group comparisons were performed on the subject averages for the independent (stress measures) and

dependent (mood measures) variables, using one-way analysis of variance with the Tukey multiple comparison procedure. Correlations between the independent variables and the dependent variables were calculated per subject and subsequently analysed as an individual-level variable, corrected with a Fisher Z transformation. A one-sample, two-tailed *t*-test with $\alpha = 0.05$ was conducted to test whether the mean of these individual-level correlation coefficients significantly deviated from zero.

To estimate the effect of the independent variables (stress) on the dependent variables (mood), a multilevel linear regression model was used (29). Data were analysed with the SAS PROC MIXED module (SAS Technical Report P-229, 1992). Multilevel or hierarchical linear modelling techniques are a variant of the more often used unilevel linear regression analyses and are ideally suited for the analysis of ESM data, in which repeated ESM observations (beep level) are nested within persons (subject level) (30). As observations from the same subject are more similar than observations from different subjects, the residuals are not independent. Multilevel regression techniques take this into account. Since observations from a subject that are closer to each other in time will be more similar than those further apart, their autocorrelation was modelled. The β's are the fixed regression coefficients of the predictors in the multilevel model and can be interpreted in the same way as the estimates in a unilevel analysis.

Multilevel linear regression analyses were conducted with standardized NA and PA as the dependent variables (standardized NA = NA/SD of NA in the whole sample). Thus, the effect of the independent variable (stress measures) was expressed in units SD of the dependent variable (NA and PA). According to Cohen (31), 0.8 SD can be considered a large effect size, and 0.2 SD a small effect size. A four-level categorical group variable was constructed with value labels 0 = controls, 1 = NAP, 2 = BD, and 3 = MDD. Group and the different stress measures were included as covariates as well as their interactions (stress by group), in the model: mood = B0 + B1 stress + B2 group + B3 stress*group. In addition to estimated intercepts and slopes for the four group categories, *F*-tests were conducted to assess whether the differences in intercepts and slopes were significant between the four group categories, with a Bonferroni correction for multiple comparisons. To control for possible differences between the four groups in levels of the dependent variables NA and PA, the mean scores per person on NA and PA were added to the analyses as possible confounders of the statistical effect of the group by stress interaction on mood.

Results

Subjects and descriptive statistics

Of the 186 subjects who entered the study, one control subject was excluded because of technical problems with the signalling device (see ESM). Two NAP subjects did not return the diary booklets. Six NAP, one BD, and one MDD patient completed fewer than 20 valid reports and were therefore excluded from the analyses. The final study sample thus consisted of 175 subjects (Table 1).

Table 1. Sociodemographic characteristics of the research sample

Sociodemographic variables	NAP	BD	MDD	C
Age	Mean: 31.9; range: 20–48	Mean: 46.2; range: 27–65	Mean: 40.3; range: 20–58	Mean: 35.2; range: 21–50
Sex				
Male	22	19	20	24
Female	20	19	26	25
Education (highest level achieved)				
Elementary school	24%	29%	41%	8%
Secondary school	67%	37%	46%	63%
Higher education	9%	34%	13%	29%
Marital status				
Married or living together	21%	53%	67%	82%
Divorced	5%	26%	15%	2%
Never married	74%	18%	7%	16%
Widowed		3%	11%	
Work situation				
Employed	24%	53%	55%	98%
Unemployed	0%	5%	4%	2%
Pensioner	0%	3%	0%	0%
Uncapable to work/sick leave	66%	36%	41%	0%
Sheltered work	10%	3%	0%	0%

The two stress measures were weakly correlated ($r = 0.20$, 95% CI: 0.15–0.26). The mood measures NA and PA showed a moderate negative intercorrelation ($r = -0.33$, 95% CI: −0.38 to −0.28). BD subjects experienced significantly more *activity-related stress* than all other groups (Table 2). MDD subjects also reported more *activity-related stress* than control subjects, who were not different from the NAP group. With respect to *social stress*, all groups reported equal amounts of experienced stress except for the MDD group, who scored significantly higher than the control subjects.

The MDD subjects reported significantly higher NA than all other groups; NAP subjects reported higher levels of NA than the control subjects. The MDD group also reported the lowest level of PA, significantly lower than the NAP and BD groups. The NAP and BD groups reported significantly lower PA than the controls.

Predictors of mood states

The multilevel random regression analyses showed that both stress measures were significantly associated with mood [model predicting NA: $B = 0.07$ (SE = 0.01), $P < 0.0001$ for activity-related stress and $B = 0.07$ (SE = 0.01), $P < 0.0001$ for social stress; model predicting PA: $B = -0.10$ (SE = 0.00), $P < 0.0001$ for activity-related stress and $B = -0.07$ (SE = 0.01) for social stress]. In addition, group was also significantly associated with both PA and NA in the same fashion as reported in the unilevel analyses presented in Table 2 (results not shown for multilevel analyses).

In the models of both NA and PA, significant interactions were apparent between group, on the one hand, and the two stress measures on the other (Table 3). For example, the effect of *activity-related stress* on PA was −0.15 for the NAP group, meaning that 1 unit change in *activity-related stress* resulted in a decrease in PA of 0.15 SD. The difference between the extremes of the scales (between 1 and 7 of the 7-point Likert scale) therefore was 0.9 SD (6×0.15 SD). In the same model, a one unit change in *activity-related stress* resulted in a 0.12 SD decrease in PA for the BD, a 0.08 SD decrease for the MDD, and a 0.06 SD

Table 2. Means (standard deviation)[a] and *F*-test statistics of the number of valid reports and the independent and dependent variables for psychosis, bipolar disorder, depression and control groups

	Mean (SD)						
	NAP ($n = 42$)	BD ($n = 38$)	MDD ($n = 46$)	C ($n = 49$)	*F* df = 3, 171	*P*	Tukey-HSD test
Valid reports	45 (10)	45 (9)	45 (10)	51 (5)	4.9	0.003	C > NAP, BD, MDD
Independent variables							
1. Activity-related stress (1–7)	2.5 (0.7)	3.7 (0.7)	2.7 (0.6)	2.4 (0.6)	39	0.0001	BD > NAP, MDD, C; MDD > C
2. Social stress (1–7)	1.8 (1.1)	1.7 (0.9)	2.2 (1.1)	1.5 (0.8)	4.2	0.007	MDD > C
Dependent variables							
1. NA (1–7)	1.7 (0.7)	1.5 (0.8)	2.5 (1.2)	1.1 (0.3)	22.7	0.0001	NA > C; MDD > NAP, BD, C
2. PA (1–7)	4.4 (1)	3.8 (1.3)	2.2 (0.8)	5.5 (0.8)	96.1	0.0001	C > NAP, BD > MDD

[a] For each subject, a mean was calculated over all reports, and the mean per subject was additionally aggregated over the group to obtain the group mean (SD).

Table 3. Multilevel model estimates for standardized NA and standardized PA

	Effect of stress on mood, stratified by group (slope stratified by group – *a*)[a]					
	NAP	BD	MDD	C	*F*[c] (df = 3, *x*)[d]	Bonferroni[e]
NA						
Activity-related stress[b]	0.13 (0.01)	0.02 (0.01)	0.10 (0.01)	0.03 (0.01)	19.47***	C, BD < MDD, NAP
Social stress[b]	0.08 (0.01)	0.06 (0.01)	0.09 (0.01)	0.03 (0.01)	6.42**	C < NAP, MDD
PA						
Activity-related stress[b]	−0.15 (0.01)	−0.12 (0.01)	−0.08 (0.01)	−0.06 (0.01)	15.11***	C, MDD < BD, NAP
Social stress[b]	−0.09 (0.01)	−0.10 (0.01)	−0.07 (0.01)	−0.04 (0.01)	4.23**	C < NAP, BD

[a] Estimated effects in the model: mood = B0 + B1 stress + B2 group + B3 stress*group + residuals. *a* = (B1 + B3)*stress for each group (SE).
[b] $n = 7949$ responses for models with *activity-related stress*, $n = 4615$ responses for models with *social stress*. The smaller *n* for *social stress* reflects the fact that *social stress* was only reported when subjects were in the presence of other people.
[c] *F* test for the stress by group interaction. A *post hoc* multiple comparison Bonferroni correction was used.
[d] $x = 7772$ for *activity-related stress* and $x = 4441$ for *social stress*.
[e] Indicates whether the differences in slope between the groups are significant.
** $P < 0.001$; *** $P < 0.0001$.

decrease for the control group. This is depicted in Fig. 1a, where the predicted values of PA for each group are calculated according to the formula: PA = intercept + slope for each of the seven levels of *activity-related stress*. Similarly, the model predicting NA with *activity-related stress* is depicted in Fig. 1b. For NA, the highest level of stress reactivity was found in MDD and NAP subjects, whereas the BD group did not differ significantly from the controls in stress-related NA. For PA, the NAP and BD subjects reported the largest decrease in PA related to subjective appraisals of stress, while the MDD group scored not significantly different from the controls. The *activity-related stress scale* differentiated more clearly between the three patient groups than *social stress,* for which no significant differences in stress-related NA or PA were found.

The mean per subject of NA and PA was evaluated as possible confounder but this resulted only in small changes to the parameters reported above. Most of the estimated coefficients were lowered by 25–30%, but three of four interaction effects remained significant and the differences between the groups were the same.

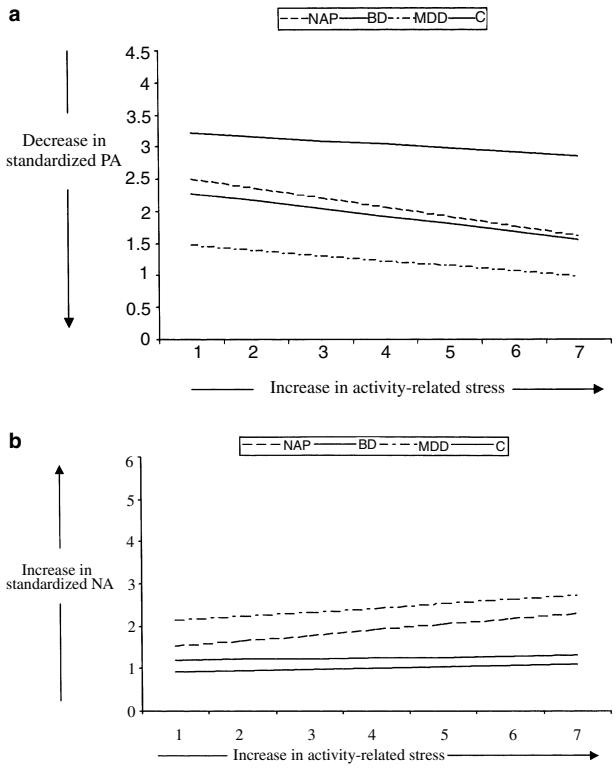

Fig. 1. (a, b) Effect of activity-related stress on PA in the four groups, derived from the statistical model: PA = inter-intercept + slope for each of the seven levels of activity-related stress.

Discussion

Subjective appraisals of stress and mood in daily life

The four groups differed significantly on the dependent mood measures NA and PA. The differences in mood were in the direction expected on the basis of current psychiatric status. MDD, in a current episode of depression, reported significantly higher NA and lower PA than all the other groups. These results correspond with those found in another ESM study of MDD patients in a current episode (26). The patients with NAP reported significantly higher NA and lower PA than the controls, consistent with the results found in an ESM study of actively ill patients with a diagnosis of schizophrenia, although the mean levels of NA and PA were higher and lower, respectively, in the actively ill patients compared with the remitted patients in the present study (24). The BD patients did not differ significantly from the controls on mean NA level, but they did report significantly lower levels of PA.

The present study focused on the subjective appraisals of minor dissatisfactions with the current situation that occur constantly in the realm of daily life. The appraisals of the current situation did not necessarily reflect the objective seriousness of an event. The differences in *activity-related* stress (with BD subjects reporting significantly more than all the other groups) might reflect differences in the amount of subjective stress a person experiences when confronted with an objective event. It has been hypothesized that NAP subjects experience more subjective stress than controls (32), although this has not been reported for BD. Alternatively, it is possible that BD patients in remission experience more activity-related stress because more is expected from them in terms of work and activities (33). Surprisingly, the NAP patients did not differ from the controls on appraisal of *social stress*. Apparently, patients were living a 'normal stressful' life that was adjusted to their impairment.

Emotional reactivity to daily life stress in psychosis and affective disorder

The results show an overall association between subjective appraisals of small disturbances in the natural flow of daily life and concurrent mood. The effect sizes were small but not negligible, especially considering that the kind of disturbances we assessed occur very frequently in daily life and may therefore have considerable cumulative effects. Furthermore, MDD patients were no different from controls in their PA response to

stress, but showed a significantly larger increase in NA compared with controls. BD were no different from controls in their NA response to stress, but showed a significantly larger decrease in PA compared with controls. NAP patients reported both a larger increase in NA and a larger decrease in PA than the controls in reaction to stress.

Emotional reactivity to daily life stress may constitute part of the underlying vulnerability for severe mental illness such as NAP (16). Previous ESM research has already provided evidence that altered stress-sensitivity is a vulnerability marker for psychosis. The results from the present study show that altered emotional stress-sensitivity is present in all investigated groups of patients, and although no healthy individuals at risk for MDD and BD were investigated and some of the effects are likely to be illness-related, it is attractive to speculate that altered emotional reactivity to daily life events is a general vulnerability marker for severe mental illness (34).

Several studies have reported quantitative variation in indicators of risk for psychiatric disorders, especially in effect size of social adversity (34). For example, the effect of life events is most pronounced in affective disorder (9, 13, 14), as is the effect of high levels of EE in family environments (11, 12). Recent research in MDD patients, on the other hand, reported reduced NA reactivity to negative daily events compared with healthy controls (22). The present study found quantitative differences in emotional stress-reactivity between the three groups of patients in the study. Emotional reactivity to minor events was not consistently higher in MDD than in the other groups. On the contrary, the results suggest that patients with NAP were most vulnerable, in that they experienced both an increase in NA and a decrease in PA in response to small disturbances in their daily life, whereas MDD only differed from controls in stress-related increases in NA and BD in stress-related decreases in PA. The difference in findings may be related to the different operationalizations of stress (Life Events vs. daily events vs. continuous small disturbances in daily life), and to the fact that the life event and high EE studies were focusing on direct causal links between stress and illness episodes, while emotional-stress sensitivity as assessed in this study may constitute part of the underlying vulnerability.

It could be argued, that, given the current findings, the importance of stress-sensitivity, especially for minor daily hassles, is more important in NAP than has previously been acknowledged. For example, the personality characteristic Neuroticism, which was originally conceived as a measure indicating vulnerability to stress (35), has been widely investigated as a risk factor for the development of depression (36). However, a high level of neuroticism long before the onset of the illness appears to be an equally strong risk factor for schizophrenia (37, 38), which again suggests an area of shared vulnerability in the realm of daily life stress sensitivity between non-psychotic affective disorder and NAP.

The differences in emotional reactivity between the two mood disorders apparently reflect a pathoplastic effect of mood disorder on stress-reactivity. The type of mood disorder thus influences the expression of the emotional vulnerability to stress, in this case resulting in an increase in NA for the MDD group and a decrease in PA for the BD group compared with the healthy controls.

An alternative explanation, equally relevant from the clinical point of view, for the differences in reactivity between the groups is that reactivity is to some extent dependent on overall mood levels. The MDD group consisted of patients in a current episode of the illness so that they were experiencing higher NA and lower PA than the BD and NAP subjects. However, when individual mood levels were included in the model, a significant stress by group interaction effect on mood remained. This indicates that any differences in overall levels of NA and PA can only partially explain the results.

The differences between the groups may also be related to differences in stress and coping, which may mediate the effects of stress on mood (39–41). However, the present study used appraised stress as the primary independent measure. Furthermore, coping efforts appear to have little effect on mood in within-day assessments (42).

Methodological issues

The present results should be viewed in the light of several methodological issues. First, the data are based on subjective reports. Although subjective reports are considered less reliable (e.g. do all subjects interpret or answer the questions identically?), they can be valid whereas the validity of objective approaches cannot be taken for granted (43). Secondly, the present study was a cross-sectional study, which made it impossible to establish causal relationships. Therefore, it is impossible to determine whether stress measures influenced mood, or mood influenced the subjective appraisals of stress. However, either explanation has clinical relevance. Thirdly, the data were collected from three separate but similar studies. The lack of comparable items in the booklets

meant that social stress could only be assessed with a single item. In addition, the MDD group was in an active phase of the illness compared with the NAP group and the BD group who were currently in remission. Although we controlled for mean differences in NA and PA level, this study should be replicated with patient groups who are all in remission. Even so, the fact that MDD patients were in an episode is unlikely to have biased the results as remitted patients with NAP rather than actively ill patients with MDD showed the most generalized effects across PA and NA dimensions.

Clinical implications

It is likely that emotional vulnerability to daily life stress is not merely a neutral indicator of vulnerability. Increased sensitivity to stress may be causally related to the development of psychopathological symptoms and the high rates of recurrence of symptoms seen in clinical practice. Longitudinal designs will clarify the role of stress-sensitivity in symptom formation and relapse rates. If such an association were established, reduction of sensitivity to stress would, for example, be a credible therapeutic target. Cognitive-behavioural therapy is effective in reducing relapse rates in both affective and psychotic disorders (44–47). It is attractive to hypothesize that part of the effect of cognitive-behavioural therapy on reduction of relapse rates is mediated through increased resilience to daily life stresses.

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