Blackwell Munksgaard 2006: 18: 30–37
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ACTA NEUROPSYCHIATRICA

The usefulness of experience sampling in understanding the urge to move in anorexia nervosa

Pieters G, Vansteelandt K, Claes L, Probst M, Van Mechelen I, Vandereycken W. The usefulness of experience sampling in understanding the urge to move in anorexia nervosa.
Acta Neuropsychiatrica 2006: **18:**30–37. © Blackwell Munksgaard 2006

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Background: Physical hyperactivity has often been described in anorexia nervosa (AN) patients but up until now in-depth research has been scarce. Experience sampling methodology (ESM), a structured diary technique assessing momentary mental state at random times during the day, may be useful in studying hyperactivity in AN.
Methods: In two single case reports, ESM was used to investigate the variation across time of the urge to move in relation to potentially relevant eliciting conditions such as positive and negative emotions, weight preoccupation and attractiveness.
Results: Frequency distribution of the involved variables indicated substantial individual differences between patients. While both patients' tendency to be hyperactive was positively related to their weight preoccupation and negative emotions, in only one patient, the urge to move turned out to be significantly related to (the absence of) positive emotions.
Conclusions: ESM can be useful to test whether general theories of psychopathology apply to specific patients, and it may be conceived as an individually tailored approach to self-monitoring. As such, it may guide the clinician to devise therapeutic interventions in particular patients.

Keywords: anorexia nervosa; experience sampling methodology; hyperactivity

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Introduction

Since the earliest descriptions of anorexia nervosa (AN) by Lasègue and Gull in the 19th century, a marked to excessive degree of physical activity in contrast with the patients' serious underweight has attracted the attention of clinicians (1). For a long time, this surprising hyperactivity was viewed as one of the patients' means to lose weight and compensate for food intake. Only in the last decade the physical hyperactivity in anorexics, and thoughts and emotions relating to it, have received more systematic attention. Studies have been published on its incidence (2), extent (3), etiology (4,5), diagnostic and prognostic significance (6,7). Several mechanisms have been proposed to explain hyperactivity in eating disorders, and two hypotheses are particularly prominent. The first views under-eating and over-exercising as mutually reinforcing behaviors that are resistant to change and cause 'activity anorexia': by means of physical hyperactivity, AN patients burn calories and lose weight to feel more attractive (8–10). The second hypothesis states that AN patients use physical hyperactivity to regulate negative emotions or affects: hyperactivity acts as a form of mood regulation or coping with stress (4,5,11,12).

Although we are faced with a new interest in the phenomenon, the research literature is still limited probably because of the lack of clear criteria and reliable methodology for the assessment of hyperactive behavior. Only a small number of investigations have used actigraphy to monitor and quantify gross motor activity in AN patients (13–17). Most studies have been

based on traditional (retrospective) self-report questionnaires (see, for example 5,18). It has been shown that this approach can be problematic in psychiatric research (19,20). Shiffman and Stone (21) convincingly argue that such self-reports are prone to serious errors and biases arising from the characteristics of autobiographical memory. To avoid this pitfall, one can make use of experience sampling methodology (ESM) as a data collection method (22). It combines self and context observation by the same subject and can be used to generate a 'still picture' of the ecology of psychiatric disorders and to focus on the variation of clinical parameters in time and on the interaction between individual and environment (23). The method has also been described as ecological momentary assessment (24). In ESM research, participants typically carry a wrist watch or palm-top computer (25) that signals them randomly, a number of times a day, to fill in a questionnaire that assesses their emotions, thoughts, perceptions and behaviors at the moment of the beep. In addition, the context of the experience is described in terms of time, place, people involved and activities performed. In comparison with traditional forms of self-report, ESM data are less subject to bias introduced by recall and retrieval processes and have strong ecologic validity. They are also well-suited to explore the dynamic relationship between variables that interact over time such as eliciting factors, symptoms, emotions, cognitions and behavior (21). The validity of ESM is well established (26–28), and the methodology has been used in many areas of psychiatric research such as schizophrenia, depression, anxiety, somatization disorders, addiction (26,27,29–33) and eating disorders (34–37).

To test the above-mentioned hypotheses about hyperactivity in AN, we have used ESM in two single case studies that served as pilot studies to test the usefulness and applicability of this methodology in larger studies. The methodology and data analysis are described elsewhere in greater detail (38). This paper will focus on the usefulness of ESM to capture individual differences in the relation between hyperactivity, emotions and cognitions, and we will address the clinical potential and possible therapeutic relevance of this approach.

Materials and methods

Subjects

Patient 1 was 18 years old when she entered the specialized inpatient eating disorders unit for treatment of AN of the restrictive subtype. At admission, she had a body mass index (BMI) of 14.5 kg/m^2 (weight = 37.7 kg; height = 1.61 m) and presented with suicidal ideation and self-injurious behavior. Her illness started when she was 15 years old, after the death of her grandmother and the suicide of a classmate. Described as perfectionist but performing less-well academically, she suffered from obsessions and minor compulsions and 'hates her body'. There were strong tensions between her parents, who were on the verge of separating a few years before, when her father had an extramarital affair. She had some unsuccessful outpatient treatment with different therapists but had never been hospitalized before. At the moment of this study, she was already 5 weeks in the inpatient unit, and her BMI at that moment was 16.8 kg/m^2.

Patient 2, a 21-year-old woman, also suffered from AN of the restrictive type. Admitted with a BMI of 11.8 kg/m^2 (weight = 32.6 kg; height = 1.66 m), she presented with agitation, restlessness, and self-injurious behavior. Her illness had begun 2 years before admission, when she started nursing studies. She had received outpatient treatment and had been hospitalized several times in a regional hospital for short periods before being referred to the specialized eating disorder unit. She showed a strong fear of failure and studied in a perfectionist way. The family had high academic demands, and leisure activities were restricted when school results were below expectation. The patient was socially isolated and had never had an intimate relationship. Her father had been admitted repeatedly for alcohol abuse, and her brother showed signs of a mood disorder. At the moment of this study, she was already 4 weeks in the inpatient unit, and her BMI at that moment was 14.3 kg/m^2.

Methods

Both patients gave written informed consent before entering the study, and their description has been altered to guarantee anonymity. The Ethical Committee of the University Center in Kortenberg approved the research procedures. An experience sampling questionnaire was developed to be filled out by patients at each beep. Apart from items inquiring about the social situation at the moment of the beep, and the activity the subject was engaged in, it contained some specific items related to our research questions (see Table 1). Concerning hyperactivity, the

Table 1. Principal components analysis (PCA) with varimax rotation on eliciting conditions: separate analyses on two patients

	Patient 1: PCA		Patient 2: PCA			
Items: At this moment	C1	C2	C1	C2	C3	C4
I feel irritated (anger-disgust)	−0.22291	**−0.58450**	0.23082	−0.03213	0.01056	**0.79241**
I feel angry (anger-disgust)	0.49284	−0.42374	−0.30602	0.48896	−0.01587	**0.61531**
I feel tense (fear)	−0.12346	−0.35944	0.08432	**0.80901**	−0.06935	0.03172
I feel anxious (fear)	0.15234	0.07123	0.56515	**0.73583**	0.05592	0.14296
I feel ashamed (guilt-shame)	0.42768	−0.10837	−0.11231	**0.62234**	−0.29791	0.44580
I feel guilty (guilt-shame)	**0.75041**	−0.27167	**0.71242**	0.41654	−0.10528	0.20077
I feel sad (sadness)	0.47800	−0.04794	−0.08296	**0.64873**	−0.32061	0.01856
I feel lonely (sadness)	0.19858	0.01868	0.39047	**0.49349**	−0.14101	−0.18691
I feel satisfied (joy)	−0.54391	**0.58246**	−0.16257	−0.31104	**0.81595**	0.01996
I feel happy (joy)	−0.48764	**0.61373**	−0.45214	−0.14817	**0.79831**	0.10087
I feel appreciated (love)	−0.09898	**0.91578**	**−0.89843**	−0.01861	0.07429	0.17080
I feel affection (love)	0.06515	**0.85430**	**−0.84862**	−0.04678	0.11783	0.22542
I feel fat (attractiveness)	**0.86289**	0.09763	**0.85915**	0.08546	−0.31312	0.12605
I feel ugly (attractiveness)	**0.85998**	0.13319	0.84930	−0.02501	−0.24555	0.19387
I am thinking of losing weight (drive for thinness)	**0.90237**	0.08742	**0.88967**	0.00339	−0.29906	0.16999
I feel I have to burn calories (drive for thinness)	**0.90531**	0.08355	**0.40636**	0.06941	**−0.53828**	0.26450

$n = 46$ for patient 1; $n = 46$ for patient 2. High loadings on the different components are in bold.

following items were included: 'I feel the urge to move' and 'I feel agitated'. Further, items were related to the two aforementioned hypotheses of eliciting conditions:

1. With respect to preoccupation with body weight and appearance (attractiveness), one item stemming from the Drive for Thinness scale and two items from the Attractivity Scale of the Dutch version of the Eating Disorder Inventory (39,40) were included, together with an item referring to the wish 'to burn calories'.
2. To test the relation between emotions and hyperactivity, we included a set of emotion words inspired by the work of Diener, Smith, and Fujita (41). Emotion words were generated in six categories: four negative emotion categories (anger-disgust, fear, shame-guilt, sadness) and two positive emotion categories (joy and love). All these items were presented in random order in the questionnaire.

On the same day, both patients received a wrist watch (Casio PC Unite Module No. 1910), a pencil and seven small booklets (one booklet a day) containing 10 experience sampling questionnaires (nine effective and one back-up) and were introduced (together) to the research procedure. From the morning of the next day on, they received nine beeps a day during 1 week (nine beeps $\times$ 7 days = 63 beeps), while they participated in the specialized inpatient treatment program. The beeps were programmed according to a stratified random interval time-series (27). This means that a day was subdivided into nine successive blocks of 90 min starting from 9:00 h. Within each block of 90 min, one beep was generated with each minute of the time block having the same probability of being selected. Such a randomization technique reduces the likelihood of anticipation and leads to less unwanted effects such as changing of behavior and/or anticipatory thoughts (27).

After each beep, patients had to indicate on a 7-point scale (0 = not applicable at all, 6 = completely applicable) to what extent the questions concerning hyperactivity and eliciting conditions were applicable to them just before the moment of the beep. At the end of each questionnaire, patients had to indicate what time it was at the moment they filled in the questionnaire. It was stressed that their time report had to be based on the wrist watch (and not on another device) and that they had to indicate the time when completing the questionnaire and not the time of the beep.

Statistics

An important rationale for the use of ESM is that the reliability of the assessment of an experience can be enhanced by reducing the time between the moment of the event or experience and the moment of the report. For this reason, it is common in ESM to exclude assessments that are reported outside a certain time window. In

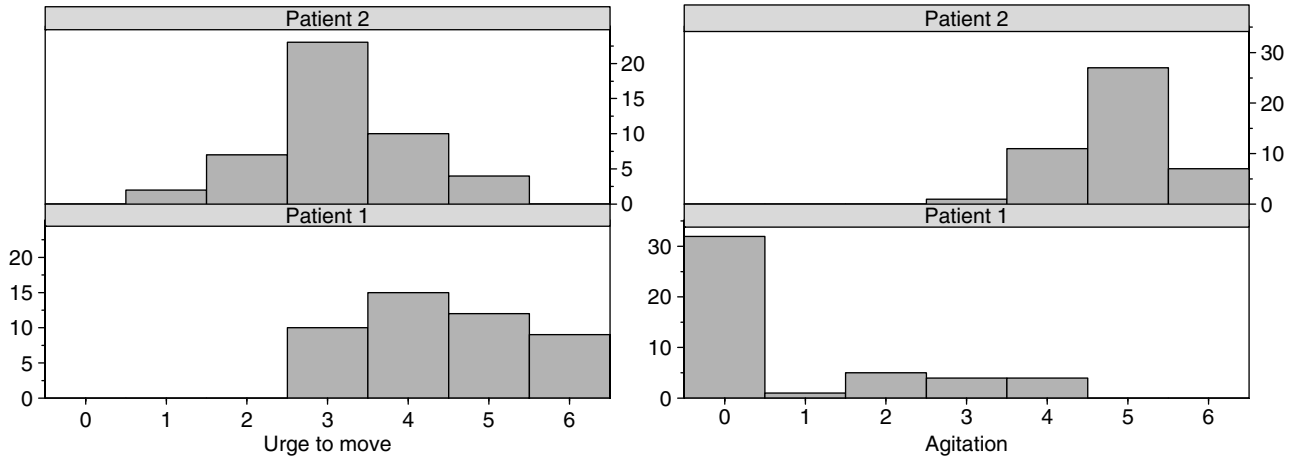


Fig. 1. Frequency distribution of 'urge to move' (left) and 'agitation' (right) in patient 1 (below) and patient 2 (above).

this study, a 20-min time reliability window was chosen; this choice was based on research by Delespaul (27). Coincidentally, in both patients, 46 (73%) of the 63 data records were valid (falling within the 20-min time window), which is acceptable for an ESM study.

The frequency distribution of scoring categories (0–6) on different variables are expressed in histograms to allow for comparison between patients ($n = 46$ in both patients). The frequency distributions of the hyperactivity and eliciting condition items are given in Figs 1–4, which makes it possible to compare both patients' answers on these variables.

To test to which extent the hyperactivity variables were related to the aforementioned eliciting conditions, for each patient, we performed separate multiple regression analyses with 'feeling the urge to move' and 'feeling agitated' as criterion variables and the items referring to eliciting conditions ($n = 16$) as predictors. As inspection of the intrasubject correlations between these eliciting condition items (across time moments) revealed these to be very high, implying multicollinearity between the predictors, a principal component analysis with varimax rotation was performed on the eliciting condition items to deal with the multicollinearity problem. The choice of the number of factors was based on a scree test, whether Eigen values were above one (Kaiser's criterion) and on the interpretability of the results. In this way, the scores on the principal components indicate which eliciting conditions tend to co-occur across time within each patient. Subsequently, the obtained component scores were used as predictors in the multiple regression analyses with 'feeling the tendency to move' and 'feeling agitated' as criteria.

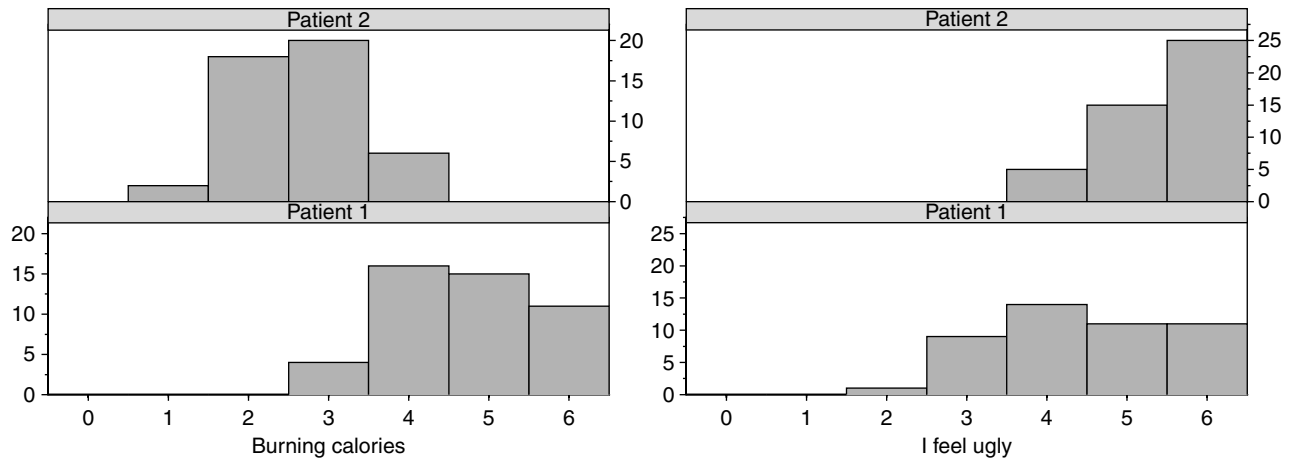


Fig. 2. Frequency distribution of 'burning calories' (left) and 'I feel ugly' (right) in patient 1 (below) and patient 2 (above).

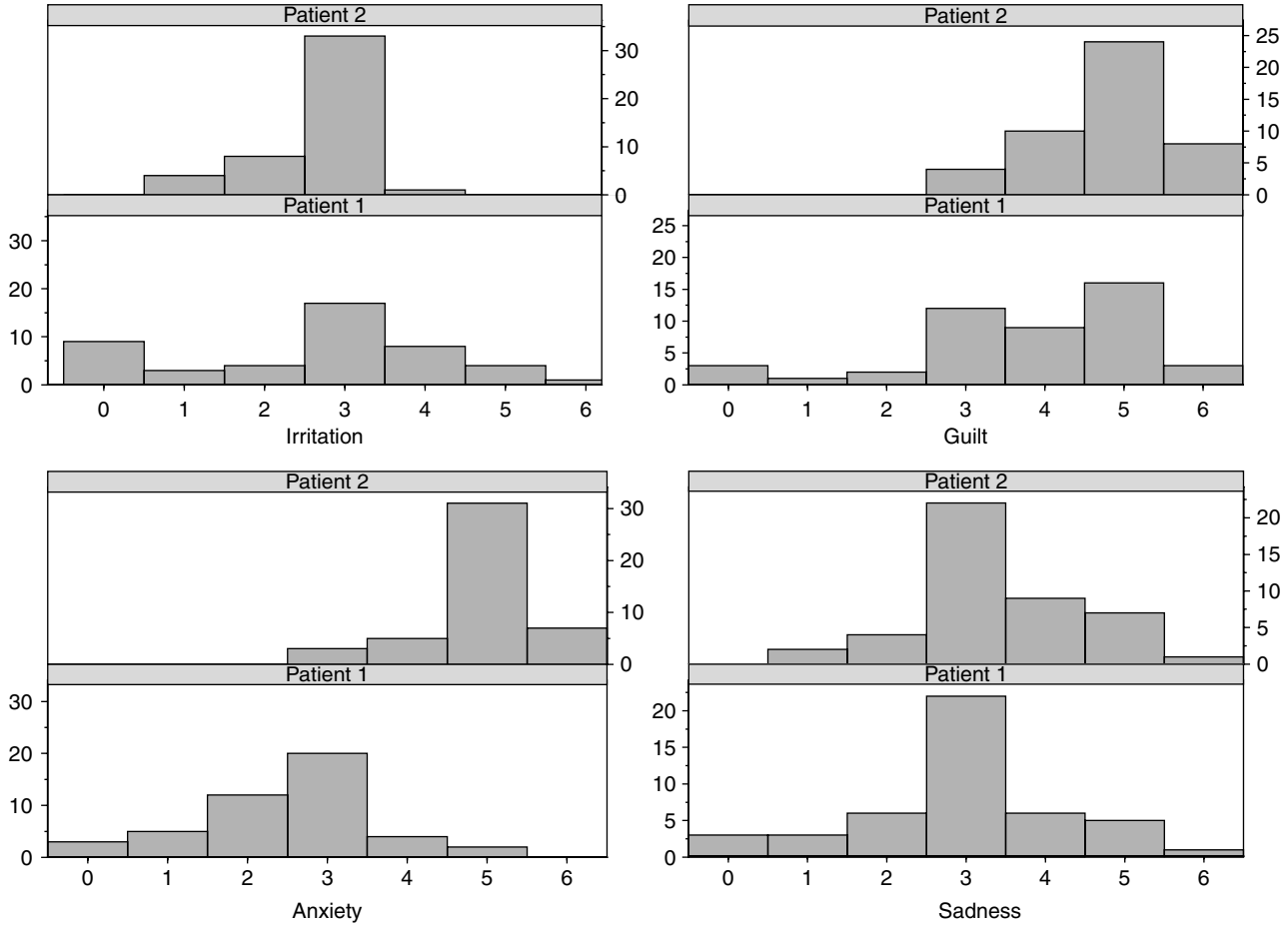


Fig. 3. Frequency distribution of negative emotions: 'Irritation' (above left), 'guilt' (above right), anxiety (below left) and sadness (below right) in patient 1 (below) and patient 2 (above).

Results

Figure 1 shows the frequency distributions of the hyperactivity items ('feel urge to move' and 'feel agitated') in both patients: compared with patient 1, patient 2 reported higher scores on agitation and lower scores on the urge to move. Figure 2 shows the frequency distributions of cognitions about 'drive for thinness' and 'attractiveness' for both

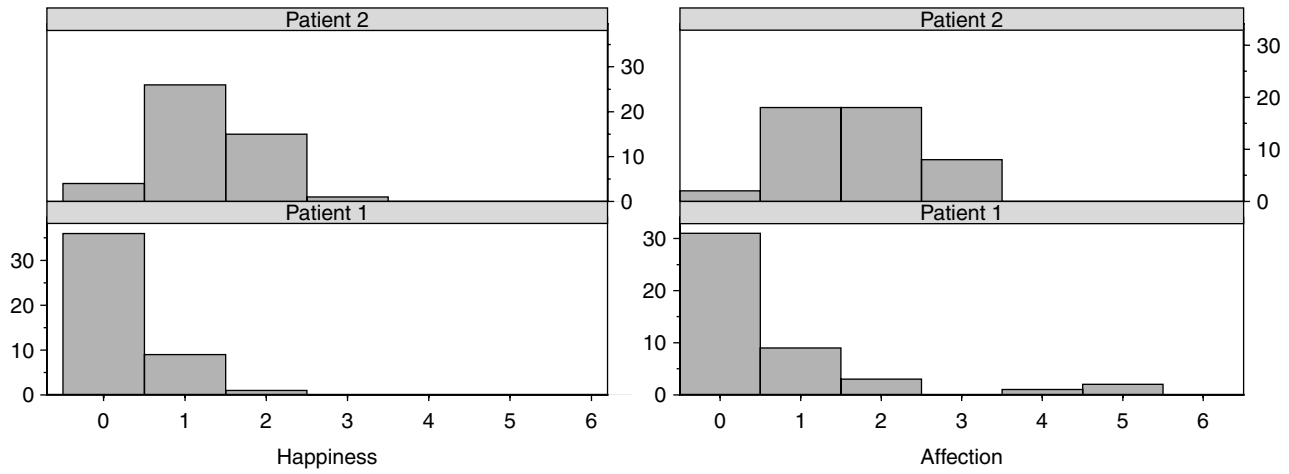


Fig. 4. Frequency distribution of positive emotions: happiness (left) and affection (right) in patient 1 (below) and patient 2 (above).

patients during the week of observation. Patient 2 indicated more often to feel unattractive, while patient 1 more often wanted to 'burn calories'. Figures 3 and 4 show the frequency of appearance of (some) negative and positive emotions during the study week. Patient 2 indicated to experience more often negative emotions than patient 1. While both patients seemed to experience less positive than negative emotions, patient 2 mentioned positive emotions more often than patient 1.

For each of the two patients separately, a principal component analysis with VARIMAX rotation was performed on the eliciting conditions across time moments (Table 1). For patient 1, on the basis of a scree test and the interpretability of the results, two principal components were retained explaining 51% of the total variance. The first component can be labeled *weight preoccupation/negative emotions*, as burning calories, drive for thinness, physical attractiveness, and several negative emotions have high positive loadings on this component. The second component can be called *positive emotions and absence of tension/irritation*, as all positive emotions have high positive loadings on this component while the items tension and irritation have high negative loadings on this component.

For patient 2, on the basis of Kaiser's criterion (Eigen values above one) and on the interpretability of the results, four principal components were retained explaining 73% of the total variance. Here, the first component can be labeled *weight preoccupation and absence of love*: the burning calories, drive for thinness, and physical attractiveness items having high positive loadings on this component, while the two 'love' items have high negative loadings on this component. The second component can be called *negative emotions*, because all items related to negative emotions, except for anger-disgust, have high positive loadings on this component. As both 'joy' items have high positive loadings on the third component, it could be called *joy*. Finally, the fourth component could be named *anger/disgust*, as these two items load highly positive on this component.

Subsequently, for each patient separately, the obtained component scores were used as predictors in a multiple regression analysis with 'feeling the urge to move' and 'agitation' as criterion variables. For 'agitation', the multiple regression analysis yielded no significant results in patient 1: $F_{(2,42)} = 0.90$, $P = 0.4149$. In patient 2, the null model was rejected when 'agitation' was introduced as a criterion variable: $F_{(2,42)} = 4.35$, $P = 0.0055$, the regression explaining only 32% of the variance (R^2 adjusted for the number of predictors = 0.24). Table 2 describes the results of the multiple regression analyses with 'urge to move' as criterion variable for both patients.

For patient 1, results from the multiple regression for 'urge to move' indicated that the null model was clearly rejected, $F_{(2,42)} = 31.78$, $P < 0.0001$, with the regression explaining 60% of the variance (R^2 adjusted for the number of predictors = 0.58). Similarly, for patient 2, the null model was rejected, $F_{(4,37)} = 11.91$, $P < 0.0001$, with the regression explaining 56% of the variance (R^2 adjusted for the number of predictors = 0.52). In Table 2, the raw and standardized regression weights for the components (2 for patient 1, 4 for patient 2) together with *t*-test results are presented. Patient 1 felt a significant increase in her momentary urge to move when she was preoccupied with her weight or experiencing negative emotions (C1). Her momentary tendency to move was not related to positive emotions and absence of tension/irritation (C2). As for patient 2, her momentary urge to move increased significantly when she was preoccupied with her weight in the absence of feelings of 'love' (C1) and when she experienced negative emotions (C2). In contrast, the experience of emotions of 'joy' (C3) predicted a significant decrease in her urge to move (negative regression weight), while her momentary tendency to move was not related to feelings of anger and disgust (C4). Inspection of the standardized regression coefficients in Table 2 indicates that absence of joy (C3) is most strongly related to the urge to move in patient 2, followed by weight preoccupation and absence of love (C1).

Table 2. Multiple regression with urge to move as criterion and principal component scores of eliciting conditions as predictors: regression weights, standardized regression weights and *t*-tests for two patients

	Regres. weight	Stand. regres. weight	Standard error	*t*-Value	df	$P > \|t\|$
Patient 1						
Intercept	4.46667	0	0.09968	44.81	1	<0.0001
C1	0.79414	0.76674	0.10081	7.88	1	<0.0001
C2	0.12358	0.11932	0.10081	1.23	1	0.2271
Patient 2						
Intercept	3.09524	0	0.10009	30.92	1	<0.0001
C1	0.39156	0.42009	0.10130	0.87	1	0.0004
C2	0.24489	0.26273	0.10130	2.42	1	0.0207
C3	−0.49791	−0.53419	0.10130	−4.92	1	<0.0001
C4	0.16692	0.17908	0.10130	1.65	1	0.1079

Stand., standardized; regres., regression; df, degrees of freedom; $n = 46$ for patient 1; $n = 46$ for patient 2.

Discussion

Two inpatient anorexics were willing and able to use ESM and completed an acceptable part of the

questionnaires following prompts during 1 week. Before discussing the results, we should mention some weaknesses of our approach. The ESM study took place in the artificial environment of the hospital ward where both patients were treated. This possibly influences (i.e. limits) the variability of the social interactions of these patients. Furthermore, the treatment program limits the amount of exercising allowed, especially during the first weeks of admission, when the studies took place. Another possibility is that patients do not report honestly the amount of activity they display, as they often seem reluctant to admit it in interviews or are not even aware of it. The combination of ESM with the use of accelerometry as an objective measure of activity might be useful to explore this problem. We also learned from this research the importance of a 'debriefing interview', in which it is possible to elaborate on the meaning attributed to some items of the questionnaires, and to inquire about the reasons for missing beeps.

In clinical practice, ESM may be used as an assessment tool because it allows to probe the dynamic relations between target symptoms (e.g. hyperactivity/urge to move) and different, potentially relevant eliciting conditions (e.g. emotions) in a particular patient. In this way, it may be tested to what extent general theories of pathology apply to a particular patient. Moreover, on the basis of an interview with a particular patient, it is possible to include a number of idiosyncratic (or idiographic) eliciting conditions in the diagnostic assessment and to test the relation between these specific conditions and the target symptoms in an empiric way. The results of such an ESM study can be discussed with the patient, helping her to gain insight and/or become aware of the relationships between target symptoms and their eliciting conditions. Although the (dynamic) relations between variables that interact over time can be studied by means of ESM, it is impossible to make conclusions about the causal relations between the different variables. The multiple regression analysis conducted in these studies may wrongfully suggest that the experience of weight preoccupation or of negative emotions will result in, or even stronger, cause hyperactivity (or the tendency to move). However, it is not our intention to claim causal relations – but only covariation – between the included variables.

From a therapeutic point of view, it could be hypothesized that for both patients in this study, an approach geared at coping with negative emotions could be beneficial when treating their urge to move. While concentrating on dealing with anger-disgust (i.e. by assertiveness training) could clearly benefit patient 1, it might be less indicated in patient 2, who also seemed more able to differentiate between emotions, both positive and negative. Positive emotions related to interpersonal relations ('love') are discriminated from achievement-related emotions ('joy'). Learning to discriminate between emotions might be a worthwhile focus of therapeutic intervention in patient 1. Furthermore, in patient 2, an approach focusing on the enhancement of positive emotions might be considered worthwhile. Clearly, ESM allows for an individually tailored approach to self-monitoring and can thus make a significant contribution to research and treatment of specific problems, including hyperactivity.

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