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Emotional reactivity and activity in the regulative theory of temperament and positive mood regulation in bipolar disorder – a pilot study

Reaktywność emocjonalna i aktywność w ujęciu regulacyjnej teorii temperamentu i regulacja pozytywnego nastroju w chorobie afektywnej dwubiegunowej

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Abstract

Introduction: Despite an enormous amount of evidence that supports the connection between temperament and susceptibility to bipolar disorder as well as the intensively evolving knowledge regarding patients' positive affect regulation, there is no evidence of a relationship between emotional reactivity and activity in the regulative theory of temperament conceptualization, affective regulation, and aggravation of hypomanic symptoms associated with bipolar disorder. The present study builds on the relationship between emotional reactivity and neuroticism connected with negative affect and between activity and extraversion connected with positive affect. There is also a widely proven relationship between activity, understood as a state, and positive affect.

Aim of the study: To examine the connection between temperament, the frequency of using positive mood regulation strategies and aggravation of hypomanic symptoms.

Material and methods: This study surveyed 22 bipolar disorder patients with a battery of questionnaires: Formal Characteristics of Behaviour – Temperament Inventory, Mood Regulation Practices, HCL-32, and BDI-I. Formal Characteristics of Behaviour – Temperament Inventory diagnoses biologically conditioned dimensions of temperament in 6 scales: Briskness, Perseverance, Sensory sensitivity, Endurance, Emotional reactivity and Activity. Mood Regulation Practices measures frequency of using mood regulation strategies in scales as follows: positive/negative mood and up-/down-regulation. The HCL-32 contains 32 yes/no questions focusing on hypomanic symptoms appearing in emotions, behaviors and thoughts. The intensity of depression symptoms was assessed with BDI-I.

Results: Quadratic regression analysis showed a linear relationship between activity and the frequency of

Streszczenie

Wstęp: Efektywność przetwarzania stymulacji jest jednym z kluczowych czynników determinujących adaptacyjne lub nieadaptacyjne funkcjonowanie jednostki w otaczającym ją środowisku. Pomimo licznych badań oceniających związek cech temperamentu z wystąpieniem i przebiegiem choroby afektywnej dwubiegunowej oraz rozwoju wiedzy z obszaru regulacji pozytywnego afektu pacjentów brakuje doniesień empirycznych odpowiadających na pytanie o związek między efektywnością przetwarzania stymulacji, regulacją afektywną a nasileniem objawów choroby afektywnej dwubiegunowej.

Cel pracy: Ocena związku między cechami temperamentu, częstością stosowania zabiegów regulacji pozytywnego nastroju a nasileniem objawów choroby afektywnej dwubiegunowej.

Materiał i metody: 22 osoby z diagnozą choroby afektywnej dwubiegunowej przebadano z użyciem kwestionariuszy: Formalna Charakterystyka Zachowania – Kwestionariusz Temperamentu, Zabiegi Regulacji Nastroju, Hipomania Check List-32, Inwentarz Depresji Becka-I. Formalna Charakterystyka Zachowania – Kwestionariusz Temperamentu służy do pomiaru biologicznie uwarunkowanych wymiarów temperamentu na 6 skalach: żwawość, perseweratywność, wrażliwość sensoryczna, wytrzymałość, reaktywność emocjonalna, aktywność. Kwestionariusz Zabiegi Regulacji Nastroju mierzy częstość stosowania strategii regulacji nastroju na wymiarach: pozytywny/negatywny nastrój, zabiegi obniżania/podwyższania nastroju. Kwestionariusz HCL-32 składa się z 32 pytań „tak/nie" obejmujących objawy hipomanii dotyczące emocji, zachowań i myśli. Do pomiaru nasilenia objawów depresji zastosowano kwestionariusz BDI-I.

Wyniki: Analiza regresji wykazała liniowy związek między aktywnością a częstością stosowania zabiegów

using positive mood up-regulation strategies as well as a non-linear relationship between activity and the frequency of using negative mood up-regulation strategies. Emotional reactivity and an interaction effect between emotional reactivity and activity explained the variation in active/elated hypomanic symptoms. Irritable/risk taking hypomanic symptoms exhibited a linear relationship with emotional reactivity.
Conclusions: This study sheds light on the relationship between temperament in the regulative theory of temperament conceptualization and positive mood regulation in bipolar disorder.

Key words: regulative theory of temperament, emotional reactivity, activity, positive mood regulation, bipolar disorder.

podwyższania pozytywnego nastroju oraz nieliniowy związek między aktywnością a częstością stosowania zabiegów osłabiania nastroju negatywnego. Reaktywność emocjonalna oraz interakcja między reaktywnością emocjonalną i aktywnością wyjaśniła nasilenie objawów hipomanii związanych z aktywnością lub wzmożonym nastrojem. Objawy hipomanii związane z drażliwością lub wzmożonym nastrojem miały liniowy związek z reaktywnością emocjonalną.
Wnioski: Badanie wskazuje na możliwość istnienia związku między cechami temperamentu w rozumieniu regulacyjnej teorii temperamentu, częstością stosowania zabiegów regulacji pozytywnego nastroju i nasileniem występujących objawów w chorobie afektywnej dwubiegunowej.

Słowa kluczowe: regulacyjna teoria temperamentu, reaktywność emocjonalna, aktywność, regulacja pozytywnego nastroju, choroba afektywna dwubiegunowa.

Introduction

Temperament, by its strong biological base, may establish a connection between biomedical and psychological conceptions of functioning bipolar patients in the environment (Pragłowska 2011). Most of the best proven present temperament theories utilize the Pavlovian idea of strength of excitation, strength of inhibition and mobility of nervous processes (Grimsley and Windholz 2000). Eysenck's psychoticism, extraversion and neuroticism model (Eysenck 2016) assumes that high extraversion is linked to low excitation of nervous processes and results in seeking arousal from external stimuli and that high neuroticism is connected with a low level of resistance to stress and susceptibility to developing mental illness. According to Gray's reinforcement sensitivity theory (Corr 2002; Bijttebier *et al*. 2009; Hundt *et al*. 2013), the behavioral inhibition system (BIS), the behavioral activation system (BAS) and the fight/flight system (FFS) control a person's interactions with their environment. The BIS is responsive to punishment and non-rewarding stimuli, the BAS is referred to as the reward system and the FFS mediates reaction to the threat. Cloninger's psychobiological model of temperament and character (Cloninger *et al*. 1993) identifies 4 dimensions of temperament (Novelty seeking, Harm avoidance, Reward dependence, Persistence) and 3 dimensions (Self-directedness, Cooperativeness, Self-transcendence) of character and describes the neurobiological foundation for personality.

Similarly, the regulative theory of temperament (RTT) appeals to the theory of higher nervous activity (Strelau 1974; Strelau & Zawadzki 1995; Strelau 2008; Fajkowska *et al*. 2012). The structure of temperament is described in the RTT by the six following traits: briskness, perseverance, sensory sensitivity, emotional reactivity, endurance and activity. High emotional reactivity, which is understood as the "tendency to react intensively to emotion-generating stimuli" (Strelau 1974; Strelau 2008), is connected with high excitatory and low inhibitory neural processes and activity that is described as the "tendency to undertake behavior of high stimulative value or to supply by means of behavior strong stimulation from the surroundings" (Strelau 1974; Strelau 2008). The effectiveness of stimulation processing as a result of the harmonious or disharmonious structure of temperament is a crucial factor that regulates the relationship between humans and their environment.

Despite the distinct correspondence between the effectiveness of stimulation processing in the regulative theory of temperament as well as the model of susceptibility to stress, only a few studies have examined temperament in the regulative theory of temperament conceptualization in bipolar disorder (Koszewska 2007; Pragłowska 2011; Oniszczenko 2014); also, in the case of emotional reactivity, it corresponds with a large amount of evidence regarding emotional reactivity, which is defined differently by other theories and examined in diverse contexts (Cuellar *et al*. 2009; M'Bailara *et al*. 2009; Stratta *et al*. 2014). These studies conclude that bipolar disorder patients, because of their high emotional reactivity, do not need much stimulation from their surrounding environment.

On the other hand, the mechanisms of the symptomatic characteristics of hypomanic and manic episodes (DSM-V, APA 2013) can be investigated with research on positive affect

as a specific factor linked to bipolar disorder (Meyer and Baur 2009), the Positive Emotion Persistence model (Gruber 2011; Reeves *et al*. 2014) and temperamental positive affect related constructs such as Behavioral Activation System dysregulation theory (Depue and Iacono 1989; Urošević *et al*. 2008; Nusslock *et al*. 2009; Alloy *et al*. 2012; Stange *et al*. 2013) and reward responsiveness (Gruber *et al*. 2014), impulsivity (Muhtadie *et al*. 2014) and novelty seeking (Lin *et al*. 2010; Zaninotto *et al*. 2016). These studies may suggest that bipolar disorder is strongly linked with a biologically conditioned supply of strong stimulation to an organism. High extraversion in a bipolar disorder group may lead to this same finding, especially when considered as a predictor for manic episodes (Meyer 2002; Kirkland *et al*. 2015; Stanton *et al*. 2017).

In view of the importance of affective regulation not only for maintaining inter-episode periods in bipolar disorder and onset prevention but also for increasing patients' well-being, it is necessary to gain a broad understanding of positive affect regulation in bipolar disorder in light of its temperamental base (Gross *et al*. 1998; Larsen 2000; Watson 2000). Unfortunately, there is no evidence that takes into consideration the relationship between positive affect regulation and the level of patients' stimulation needs. Also, there is a large amount of evidence that demonstrates the link between the abovementioned temperamental theories and positive/negative affect (Larsen and Ketelaar 1991; Gross *et al*. 1998). In addition, a connection between the regulative theory of temperament and mood in the healthy population has been proven (Jankowski and Zajenkowski 2012). Furthermore, owing to Pavlov's pedigree, correlations between the regulative theory of temperament traits and the theories discussed above are well known. The present study builds on the relationship between emotional reactivity and neuroticism connected with negative affect and between activity and extraversion connected with positive affect (Strelau and Zawadzki 1995). There is also a widely proven relationship between activity, understood as a state, and positive affect (Watson 2000).

The current study investigates the relationship between emotional reactivity (as a trait appointing stimulation needs) and activity (as a trait responsible for supply stimulation), positive mood regulation strategies and the level of hypomanic/manic symptoms. The main purpose of this study is to examine the connection between temperament, the frequency of using positive mood regulation strategies and aggravation of the disease. Thoroughly understanding the dependence between the aforementioned constructs may help to improve therapeutic interventions for bipolar disorder. This is especially important due to the recurrent character of the disease, the high suicidal risk associated with bipolar disorder (Tondo *et al*. 2016) and the wide social, psychological and material consequences of hypomanic/manic onsets with which patients must cope.

The hypotheses of this study include the following:

H1. There is a positive correlation between emotional reactivity and the frequency of using positive mood up-regulation strategies, and there is a positive correlation between activity and the frequency of using positive mood up-regulation strategies in bipolar disorder.

H2. There is a positive correlation between emotional reactivity and hypomanic symptoms and a positive correlation between activity and hypomanic symptoms in bipolar disorder.

Material and methods

Participants

The study surveyed 22 adult bipolar disorder patients (13 women, 9 men) aged 20 to 66 years. Participants were recruited by advertisements in the university and outpatient psychiatric clinics. The diagnosis of the disorder was established by a psychiatrist, and was made according to the ICD-10 classification. Moreover, the basic inclusion criterion was a Hypomania Check List (HCL-32; Angst *et al*. 2005) score of 14 or above. The average HCL-32 score was $M = 21.18$ ($SD = 4.95$). The median score of the group was 21.5, which corresponded with the level of the criterion for differentiating bipolar disorder type I and bipolar disorder type II (Łojko *et al*. 2010). Current psychological condition during the examination was as follows: 40.9% of patients stated that they felt *neither worse nor better than usual*, 18.2% *a bit worse than usual*, 27.3% *a bit better than usual*. The average Beck Depression Inventory I (BDI I; Beck *et al*. 1961; Parnowski and Jernajczyk 1977) score was $M = 18$ ($SD = 11.94$), which may be interpreted as mild depression. Taken together, both HCL-32 and BDI I results can be interpreted as most of the group presented symptoms of a mixed state.

Measures

The HCL-32 (Angst *et al*. 2005) was used to measure hypomanic symptoms, understood as

an actual state. The HCL-32 contains 32 yes/no questions focusing on hypomanic symptoms appearing in emotions, behaviors and thoughts. The total score is the number of items with a "yes" response. The optimal criterion to distinguish bipolar disorder and major depressive disorder is a result equal to 14 points or more. The HCL-32 distinguishes between bipolar disorder and major depressive disorder with a sensitivity of 80% and a specificity of 51%. Two subdomains of hypomanic symptoms have been identified in previous studies: active/elated and irritable/risk-taking factors. The Polish adaptation HCL-32 (Łojko *et al*. 2010) was used.

To assess the frequency of using mood regulation strategies, the Mood Regulation Practices was used (Nowicka 2009). According to Larsen (2000), the Mood Regulation Practices (Nowicka 2009) comprises 42 questions dealing with the frequency of using positive/negative mood up-/down-regulation strategies. Participants are requested to rate their frequency of using mood regulation strategies from 1 (*almost*) *never* to 5 (*almost*) *always*. The questionnaire has good psychometric quality. Internal consistency for each subscale is high; Cronbach's alphas for up and down mood regulation subscales range from 0.87 to 0.94.

Emotional reactivity and activity were measured using the Formal Characteristics of Behaviour – Temperament Inventory (FCB-TI) (Zawadzki and Strelau 1997). The psychometric quality of the FCB-TI has been widely confirmed in numerous studies (Strelau 2008). The inventory comprises 120 yes/no questions divided into six dimensions (Emotional Reactivity, Activity, Briskness, Perseverance, Sensory Sensitivity and Endurance). Each scale has 20 items with an average reliability coefficient of 0.86.

Aggravation of depression symptoms was assessed with the Polish adaptation (Parnowski and Jernajczyk 1977) of the Beck Depression Inventory I (Beck *et al*. 1961; Beck and Steer 1993). The BDI comprises 21 items that present each depressive symptom. Each item is scored from 0 to 3 to reflect the intensity of that symptom over the past week, and the total score ranges from 0 to 63. Total scores of 10 to 20 points may indicate mild depression, 20-30 moderate depression and ≥ 30 severe depression. The psychometric properties of the BDI have been broadly documented. The average internal consistency (i.e., Cronbach's alphas) is 0.86 among psychiatric patients (Beck *et al*. 1988).

Results

Descriptives

Mood regulation strategies

A paired-samples t-test indicated that the frequency of using positive mood up-regulation strategies ($M = 48.30$, $SD = 7.00$) was greater than the frequency of using positive mood down-regulation strategies [$M = 32.80$, $SD = 9.00$, $t(19) = 6.13$, $p < 0.001$, $d = 1.36$]. Also, the frequency of using negative mood down-regulation strategies ($M = 32.64$, $SD = 7.64$) was greater than the frequency of using negative mood up-regulation strategies [$M = 16.91$, $SD = 5.55$, $t(21) = 7.2$, $p < 0.001$, $d = 1.53$]. These results may suggest that when a person with bipolar disorder is in a positive mood, the person more often regulates their mood to feel more positive than to feel less positive; when a person is in a negative mood, the person more often regulates their mood to feel more negative than to feel less negative.

The Formal Characteristics of Behaviour – Temperament Inventory

This inventory gave results for emotional reactivity ($M = 13.45$, $SD = 3.16$), activity ($M = 7.00$, $SD = 4.13$), briskness ($M = 11.38$, $SD = 3.76$), perseverance ($M = 13.09$, $SD = 3.44$), sensory sensitivity ($M = 13.86$, $SD = 4.54$) and endurance ($M = 6.89$, $SD = 3.77$). The majority (95.5%) of participants presented medium and high emotional reactivity; also, the majority (90.9%) of participants presented low and medium activity. These results correspond with other research in which the Formal Characteristics of Behaviour – Temperament Inventory was used in a bipolar disorder group (Koszewska 2007; Pragłowska 2011; Oniszczenko 2014).

Temperament and mood regulation strategies

Emotional reactivity and mood regulation strategies

There was no significant correlation ($N = 22$) between emotional reactivity and the frequency of using positive mood up-regulation strategies (Pearson's $r = 0.17$, $p > 0.05$); there was also no significant correlation between emotional reactivity and any scales of mood regulation strategies. The correlations between emotional reactivity, activity and mood regulation strategies are shown in Table 1.

Table 1. Emotional reactivity and activity and the frequency of using mood regulation strategies

		Negative Mood down-regulation strategies	Positive Mood down-regulation strategies	Positive Mood up-regulation strategies	Negative Mood up-regulation strategies
Emotional Reactivity	*r*	0.382	0.099	0.171	–0.019
Activity	*r*	–0.062	0.029	0.486*	0.557**

*r – Pearson's r, *p < 0.05, **p < 0.01.*

Activity and mood regulation strategies

Table 1 shows that two significant positive correlations were obtained between activity and scales of mood regulation strategies. Activity was positively correlated with the frequency of using positive mood up-regulation strategies (Pearson's $r = 0.49, p < 0.05$) and strongly positively correlated with the frequency of using negative mood up-regulation strategies (Pearson's $r = 0.56$, $p < 0.01$).

Curve estimation and hierarchical regression were then used to check whether the linear or quadratic model of activity better described the frequency of using positive and negative mood up-regulation strategies. The results indicated that the linear activity explained 24% of the variation of the frequency of using positive mood up-regulation strategies ($F_{(1, 20)} = 6.17, p < 0.05, SEE = 6.79$). More variation was explained by quadratic activity (30%, $\Delta R^2 = 0.07$). However, the quadratic model did not significantly increase the explained variation in the frequency of using positive mood up-regulation strategies ($F_{change(1, 19)} = 1.85, p = 0.19$). Therefore, there was no basis to confirm that the quadratic model was better than the linear model.

In addition, the results showed that linear activity contributed significantly to the regression model ($F_{(1, 20)} = 9.01, p < 0.01, SEE = 4.72$) and accounted for 31% of the variation in the frequency of using negative mood up-regulation strategies. Introducing quadratic activity explained an additional 28% of variation in the frequency of using negative mood up-regulation strategies, and this change in R^2 was significant ($F_{change(1, 19)} = 12, p < 0.01$). Taken together, the quadratic model accounted for 59% ($SEE = 3.73$) of the variation in the frequency of using negative mood up-regulation strategies. Additionally a paired-samples *t*-test was used to compare the absolute values of the residuals of both (linear and quadratic) models; the results confirmed that the residuals of the linear model were significantly greater ($M = 3.90$, $SD = 2.30$) than the residuals of the quadratic model ($M = 2.71$, $SD = 2.21$): $t(21) = 2.35$, $p < 0.05$. Therefore, the quadratic model more precisely describes the relationship between activity and negative mood up-regulation strategies than the linear model (Fig. 1).

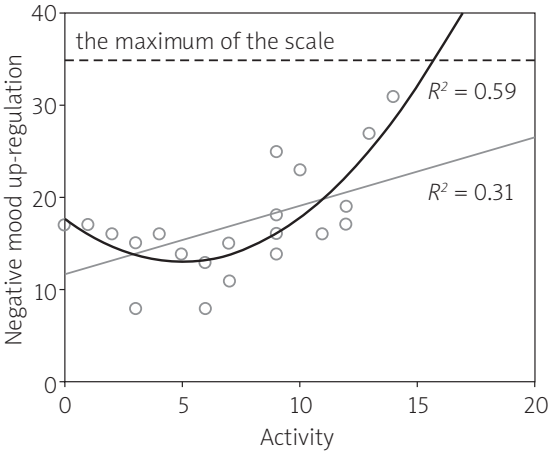

Fig. 1. Activity and negative mood up-regulation strategies

Temperament and hypomanic symptoms

There was a significant strong positive correlation ($N = 22$) between emotional reactivity and hypomanic symptoms (Pearson's $r = 0.62$, $p < 0.01$), and there was no significant correlation between activity and hypomanic symptoms (Pearson's $r = 0.07$, $p > 0.05$). Hierarchical regression analysis with an interaction effect was conducted to define the relationship between emotional reactivity and activity as well as (separately) active/elated hypomanic symptoms and irritable/risk taking hypomanic symptoms. Emotional reactivity and activity were centered by standardizing the variables.

The first hierarchical regression analysis with an interaction effect, in which the active/elated hypomanic symptoms was a dependent variable, confirmed a strong connection between emotional reactivity and active/elated hypomanic symptoms ($\beta = 0.45, p < 0.05$); also, there was no significant relationship between activity and active/elated hypomanic symptoms ($\beta = 0.19$, $p > 0.05$). A model with emotional reactivity, activity and an interaction effect was significant ($F_{(3, 18)} = 5.49, p < 0.01$); introducing an interaction effect of emotional reactivity and activity explained an additional 24% of the variation

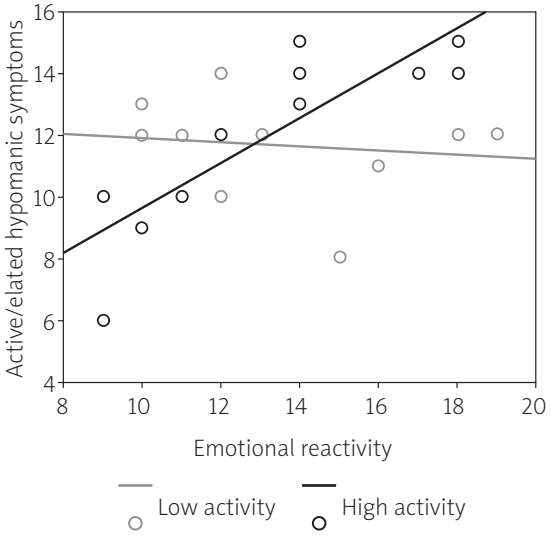

Fig. 2. Emotional reactivity and active/elated hypomanic symptoms

in active/elated symptoms. The relationship between emotional reactivity and active/elated symptoms was then analyzed in two groups (i.e., low and high activity). Emotional reactivity was not significantly connected with active/elated hypomanic symptoms in the low activity group ($\beta = -0.11$, $p > 0.05$, $F_{(1, 10)} = 0.12$, $p > 0.05$), and there was a very strong positive connection between emotional reactivity and active/elated hypomanic symptoms in the high activity group ($\beta = 0.85, p < 0.01$). In the group with high activity, the model was significant ($F_{(1, 8)} = 20.84, p < 0.01$) and accounted for 72% of the variation of the active/elated hypomanic symptoms (Fig. 2).

The second hierarchical regression with an interaction effect, in which irritable/risk taking hypomanic symptoms was a dependent variable, confirmed that emotional reactivity is strongly connected with irritable/risk-taking hypomanic symptoms ($\beta = 0.67$, $p < 0.01$). Also, there is no significant relationship between activity and irritable/risk-taking hypomanic symptoms ($\beta = 0.52, p > 0.05$). A model with emotional reactivity, activity and an interaction effect was significant ($F_{(3, 18)} = 4.72$, $p < 0.05$), but introducing an interaction effect of emotional reactivity and activity did not significantly increase the percentage describing the variation of irritable/risk-taking hypomanic symptoms. A model with emotional reactivity and activity without an interaction effect was significant ($F_{(2, 19)} = 7.47$, $p < 0.01$) and accounted for 44% of the variation of the irritable/risk taking hypomanic symptoms.

Discussion

The current study contributed new knowledge regarding the relationship between temperamental traits in the regulative theory of temperament and mood regulation strategies in bipolar disorder. However, the results did not completely confirm the hypotheses. There was no connection between emotional reactivity and frequency of using any of the mood regulation strategies, and there was a relationship between activity and both positive and negative mood up-regulation strategies, which was linear in the case of positive mood up-regulation strategies and was quadratic in the case of negative mood up-regulation strategies.

These results are especially important in light of the dynamic changes of activity together with phase changes in bipolar disorder. According to the symptomatic characteristic (DSM-V, APA 2013) manic and depression phase, and also according to Pragłowska (2011), where the regulative theory of temperament traits was considered in the dynamic point of view, the intensity of activity may change with the change of the disease phase. Therefore, the activity may be lower in the depression phase and higher in the hypomania and mania phases. It is possible that when bipolar disorder patients become more active, they much more frequently use positive and negative mood up-regulation strategies, and this may be the basic mechanism that produces the hypomanic and manic symptoms.

The second part of this study focused on the relationship between temperament in the regulative theory of temperament conceptualization and aggravation of hypomanic symptoms. The results confirmed a positive relationship between emotional reactivity and hypomanic symptoms and both of its subdomains: active/elated and irritable/risk-taking factors. Essentially, more emotional reactivity corresponded with more hypomanic (both active/elated and irritable/risk-taking) symptoms. The results also showed that in the case of active/elated symptoms, there is an interaction effect of emotional reactivity and activity. This result may be interpreted with the basic foundation of the regulative theory of temperament (Strelau 2008). Participants that are characterized by high emotional reactivity do not need a large supply of stimulation from their surroundings. Therefore, when one is characterized by high activity, more emotional reactivity corresponds with more hypomanic symptoms. High emotional reactivity in participants characterized by high activity may be

interpreted as no effective stimulation processing (a large supply of stimulation when there is no need for a large amount of stimulation), which may underlie the occurrence of active/elated hypomanic symptoms.

This study had several limitations, including the small sample size, heterogeneity in both the presented depression symptoms and bipolar disorder type I and bipolar disorder type II diagnoses. Therefore, the current results should be confirmed in a larger sample size using experimental and longitudinal schemes while maintaining clinical research standards. Moreover, there may be alternatives to the interpretation in which temperament predicts the frequency of using mood regulation strategies and temperament and the frequency of using mood regulation strategies predict hypomanic symptoms. That is, the current study was only correlational, so temperament and mood regulation strategies may be predictors of hypomanic symptoms; also, hypomanic symptoms may predict temperament and changes in mood regulation strategies. However, the current study provides evidence for better understanding of the relationships between temperament, mood regulation strategies and hypomanic symptoms. Deliberation on hypomanic and manic symptoms in light of the regulative theory of temperament may lead toward understanding bipolar disorder specificity. In this conceptualization, the basic mechanism underlying hypomanic and manic onsets may be the supply of more stimulation from the surroundings than is needed. Future research is necessary, and a broad understanding of the psychological mechanism responsible for hypomanic and manic symptoms may help to improve therapeutic interventions for bipolar disorder.

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