Personality Disorders: Theory, Research, and Treatment
2016, Vol. 7, No. 1, 50–60

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1949-2715/16/$12.00 http://dx.doi.org/10.1037/per0000126

Emotional Switching in Borderline Personality Disorder: A Daily Life Study

Marlies Houben
KU Leuven

Kristof Vansteelandt
University Psychiatric Center KU Leuven

Laurence Claes
KU Leuven and University of Antwerp

Pascal Sienaert
University Psychiatric Center KU Leuven

Ann Berens and Ellen Sleuwaegen
Psychiatrisch Ziekenhuis Duffel, Duffel, Antwerp, Belgium, and University of Antwerp

Peter Kuppens
KU Leuven

Despite large efforts to understand emotional instability in borderline personality disorder (BPD), it is still unclear exactly how this is manifested in the daily lives of people suffering from the disorder. Building on theoretical and clinical observations of BPD, we propose that the emotional instability in BPD particularly consists of the occurrence of strong changes between positive and negative emotional states from 1 moment to the next, labeled emotional switching. We tested this proposal by means of an experience sampling study in which 30 BPD patients and 28 healthy controls reported in their daily lives the level of pleasantness/unpleasantness of their emotional states 10 times a day for 8 consecutive days using handheld palmtops. Results showed that although BPD patients did not differ from healthy controls regarding their overall tendency to switch from a positive to a negative emotional state or vice versa, the size of such changes between positive and negative states was found to be significantly larger in BPD patients. In contrast, the magnitude of emotional changes that remained within the negative emotional range or positive emotional range was not particularly larger for BPD patients compared with healthy participants. These findings imply that the emotional instability in BPD is particularly characterized by larger changes from positive to negative states and vice versa, rather than overall larger changes in intensity, providing insight into possible processes underlying emotion dysfunction in BPD.

Keywords: borderline personality disorder, changes between positive and negative emotional states, daily life study, emotional instability, emotional switching

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Emotion dysregulation has consistently been presented as a core symptom of borderline personality disorder (BPD; Lieb, Zanarini, Schmahl, Linehan, & Bohus, 2004; Linehan, 1993), a serious and pervasive mental disorder that affects 1% to 3% of the general population (Trull, Jahng, Tomko, Wood, & Sher, 2010), that is associated with a suicide rate of 10% (Lieb et al., 2004) and high societal costs (van Asselt, Dirksen, Arntz, & Severens, 2007). The nature of emotional dysfunction in BPD has been the subject of intense investigation in an attempt to better understand the disorder. In the present study we introduce a specific type of emotional instability that may be characteristic of individuals with BPD, termed emotional switching, defined as the occurrence of sudden emotional changes from a positive to a negative emotional state, or vice versa. We provide theoretical and clinical arguments for why emotional switching may be particularly characteristic of BPD, and present empirical evidence of its occurrence in BPD.

Emotion Dynamics in Borderline Personality Disorder

According to Linehan's theory (1993), several processes of emotional vulnerability are assumed to contribute to emotional dysregulation characteristic of BPD. BPD patients experience (a) high emotional sensitivity to emotional stimuli, which translates into a lower threshold to respond to or recognize emotional stimuli, (b) intense reactivity to emotional stimuli, which is reflected by emotional responses with greater amplitudes, and (c) a slow return to emotional baseline, which translates in longer duration of emotional responses (Crowell, Beauchaine, & Linehan, 2009; Linehan, 1993).

This article was published Online First June 22, 2015.

Marlies Houben, Faculty of Psychology and Educational Sciences, KU Leuven; Kristof Vansteelandt, University Psychiatric Center KU Leuven; Laurence Claes, Faculty of Psychology and Educational Sciences, KU Leuven, and Collaborative Antwerp Psychiatric Research Institute (CAPRI), University of Antwerp; Pascal Sienaert, University Psychiatric Center KU Leuven; Ann Berens and Ellen Sleuwaegen, Psychiatrisch Ziekenhuis Duffel, Duffel, Antwerp, Belgium, and Collaborative Antwerp Psychiatric Research Institute (CAPRI), University of Antwerp; Peter Kuppens, Faculty of Psychology and Educational Sciences, KU Leuven.

Correspondence concerning this article should be addressed to Marlies Houben, KU Leuven, Tiensestraat 102 - Box 3713, 3000 Leuven, Belgium. E-mail: marlies.houben@ppw.kuleuven.be

Although many studies have investigated different emotional components contributing to this dysregulation in the lab (e.g., Carpenter, & Trull, 2013; Domes et al., 2008; Gratz, Dixon-Gordon, Breetz, & Tull, 2013) or used questionnaires to assess emotional instability (e.g., Koenigsberg et al., 2001), more and more studies have started to examine the patterns of emotional changes and fluctuations of persons with BPD throughout daily life as recorded using experience sampling methods (relying on electronic devices such as smartphones or palmtops to collect multiple self-reports of affect and symptoms in everyday life) to obtain a precise picture of the emotional functioning in the daily lives of individuals with BPD.

Results from experience sampling studies focusing on patterns of emotional change in BPD indicate that the characteristic that is most successful in distinguishing between the emotional lives of persons with BPD and healthy individuals is the presence of large changes in emotional intensity that occur relatively frequent over time in BPD patients (Ebner-Priemer et al., 2015). Indeed, in a recent meta-analysis (Houben, Van Den Noortgate, & Kuppens, 2015) synthesizing studies linking different patterns of emotional change to different forms of psychological well-being and psychopathology, we concluded that BPD is particularly characterized by higher variability and instability of emotional intensity across time. Emotional variability refers to emotions that deviate more from their mean level, thus reaching more extreme values (typically measured using the within-person standard deviation or variance of repeated emotion ratings over time). Emotional instability reflects larger changes in the intensity of emotions from one time point to the next (typically measured with the mean square successive difference of repeated emotion ratings over time). Although these studies provide important first insight into the emotional life of BPD patients, the used indicators of emotional variability and instability remain relatively broad and do not provide much insight into the exact nature of emotional changes involved in the emotion dysfunction characterizing BPD. Specifically, although these findings indicate that BPD is characterized by quantitatively larger emotional changes, it gives no insight into the exact quality of these changes. To fill this gap, we introduce a qualitative form of emotional instability that is directly based on theoretical and clinical descriptions of BPD, termed emotional switching.

Switching in Borderline Personality Disorder

Emotional switching refers to sudden changes from positive to negative emotional states or vice versa, in which an individual rapidly switches from being in a good to a bad mood or the other way around. We distinguish between two aspects of emotional switching. First, one can consider the mere probability for a switch to occur in a person, independent of the magnitude of the emotional change. We refer to this as *switching propensity*. Second, one can look at the magnitude of the emotional change when a switch has occurred, which we refer to as *switch distance*. Switch distance reflects the amount of change (in terms of for instance self-reported ratings of valence) from one time point to the next if a person changed from a positive to a negative state, or vice versa. The higher a switch distance, the larger the emotional change toward the opposite valence. As such, switch distances reflect a particular part of emotional instability, an important characteristic and diagnostic criterion for BPD, namely a type of emotional fluctuations that go from positive to negative valence or vice versa.

The notion that switching may be particularly characteristic of BPD resonates with the concept of dichotomous thinking that has been introduced in scientific and clinical literature on BPD. According to cognitive models of BPD (Beck, Freeman, & Associates, 1990), BPD is characterized by a cognitive distortion referred to as dichotomous thinking, defined as the tendency to evaluate or observe the world, people, and feelings in terms of extreme, dichotomous categories which are mutually exclusive, rather than evaluating in a more gradual manner. For example, people, objects, or feelings are labeled as all good or all bad, reflecting the so-called black–white thinking. However, because intermediate evaluation categories are lacking, persons with BPD will tend to shift from one view to the opposite view, leading to emotional responses that can change from one extreme to the other. In line with this idea is also the concept of splitting, which is defined as a common defense mechanism in BPD according to Kernberg's psychoanalytic theory of object relations (Kernberg, 1976). It reflects the presence of good and bad representations of self and others as isolated states, which means that all feelings about and evaluations of an object are either all good or all bad, with the possibility of complete abrupt shifts from one extreme to the other. Both concepts capture similar clinical manifestations, which are thought to underlie cognitive, affective, and interpersonal instability in BPD (Beck et al., 1990).

One recent study has empirically investigated the occurrence of dichotomous thinking in emotional experiences specifically, by exploring the polarity of affective experiences (meaning feeling all good or all bad) over time in the daily lives of persons with BPD. Coifman, Berenson, Rafaeli, and Downey (2012) conducted an experience sampling study in which they showed that BPD patients tend to evaluate their affective experiences in a more polarized manner, that is, as either good or bad, which was shown by a stronger negative association between momentary positive and negative affect over time. Focusing on momentary covariation between positive and negative affect, this study showed that a person with BPD will feel positive or negative at each point in time. However, from a dynamic perspective on emotions in BPD, it is not clear how the phenomenon of polarized affective experiences unfolds over time. More specifically, it is not clear whether individuals with BPD more frequently alternate or switch between such good or bad emotional experiences over time, or what the nature of such switches is.

Indeed, no empirical work has directly examined the occurrence of such switches between positive and negative emotional states, although a few exceptions have touched on this indirectly. First, Ebner-Priemer et al. (2007) showed that persons with BPD who are in a current positive-neutral emotional state tend to show larger decreases in affect to the next time point than healthy individuals, and in the case of very positive states these decreases were also more likely to result in a negative affective state. However, this reflects only indirect and partial evidence for the occurrence of switching in BPD. Second, Reisch, Ebner-Priemer, Tschacher, Bohus, and Linehan (2008) examined the occurrence of abrupt transitions between different discrete emotional states from one moment to the next. They concluded that BPD patients more frequently switched from anxiety to sadness, from anxiety to anger, and from sadness to anxiety. However, they only report

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switches between discrete negative emotions, and it is not clear whether they also investigated switches between discrete positive and negative states. Moreover, their analyses did not take into account the possible size of such switches. For example, no distinction is made between a change from a slightly anxious state to a slightly angry/annoyed state and a transition from extreme anxiety to a state of total rage.

The Present Study

The aim of the present study is to investigate the notion of emotional switching between positive and negative emotional states in BPD directly, using experience sampling data collected from individuals with BPD and healthy controls in daily life. Specifically, we will examine whether BPD patients, compared with healthy participants, switch more frequently between positive and negative emotional states from one moment to the next across time, reflecting difference in the mere occurrence or propensity to make such switches. In addition, we will investigate whether such switches involve larger emotional changes in BPD, compared with healthy controls, as reflected by a larger magnitude of such switches, that is, switch distances. Finally, we will study in an exploratory way the role of the direction of switching by examining to what extent findings are specific for switches going from negative to positive states, and from positive to negative states.

Based on previous research and theoretical notions central to BPD, we hypothesize that individuals with BPD are more likely to switch between positive and negative emotional states from one time point to the next, compared with healthy controls, as reflected in greater switching propensity. Moreover, we expect individuals with BPD to display larger emotional changes toward the opposite valence, reflecting larger switch distances, but not necessarily larger changes within the positive or negative realm. Confirming these hypotheses would identify switching as the specific type of emotional instability involved in BPD. Regarding switching to different directions, no specific hypotheses were formulated in advance.

Method

Sample

BPD participants were 34 volunteering inpatients with a diagnosis of a borderline personality disorder who were currently staying in psychiatric hospitals while completing the study. Twenty-five patients were recruited at the University Psychiatric Center KU Leuven–Campus Kortenberg in Belgium, and nine patients were recruited at the psychiatric hospital in Duffel, Belgium. Participants were recruited after the intake process, where new incoming patients who met BPD diagnosis were informed about the study and invited to participate. Patients received diagnoses based on a clinical interview by an experienced senior psychiatrist. In addition, clinical diagnosis of BPD was confirmed using the Assessment of *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (*DSM–IV*) Personality Disorders–Borderline scale (ADP-IV-Borderline scale; Schotte, De Doncker, Vankerckhoven, Vertommen, & Cosyns, 1998). All patients met criteria for BPD based on ADP-IV self-report ratings on the presence of at least 5 diagnostic criteria according to the *DSM–IV* (American Psychiatric Association, 2000)[1] that are causing significant distress (more information below). Four participants were excluded based on poor compliance with the experience sampling data collection protocol (<25% compliance in terms of responded beeps in daily life), resulting in a final sample of 30 BPD patients. Of all included BPD patients, 93% was taking psychotropic medication, with antidepressants being taken by most patients (73%), followed by atypical antipsychotics (50%), and typical antipsychotics (37%) and benzodiazepine (37%). Available data on comorbid axis-I and axis-II disorders of patients are shown in Table 1. Note that diagnoses are based on clinical interviews, and therefore, not all diagnoses were systematically checked using structured and standardized interviews.

Thirty volunteering healthy control participants from the community who were individually matched on age and gender with the participants of the BPD group were recruited. The control sample consisted of participants who were recruited by research assistants on a volunteering basis using word of mouth. Healthy control participants were unfamiliar with the research (questions), with psychology in general, and with the main researchers. Because they were one-on-one matched on age and gender with BPD participants, the healthy control group represents a general community sample, with varying ages, varying education levels, different professions, and varying gender. One participant from this control group met criteria for BPD, based on the ADP-IV self-report ratings, and a second participant was currently taking psychotropic medication. Therefore, these two participants were excluded from further analyses, resulting in a final group of 28 healthy control participants.[2] Of the remaining included healthy control participants, none reported mental health problems or current use of psychotropic medication using a screening questionnaire with open-ended questions about (history) of mental problems, hospitalizations and medication use.

Both samples did not differ in mean age ($M = 29.03$, $SE = 1.60$ for BPD; $M = 29.29$, $SE = 1.64$ for healthy controls; $t(56) = -0.11$, $p = .91$), and the majority of participants were females (87% of BPD sample, and 86% of healthy sample). According to the dimensional scores on the ADP-IV-Borderline scale, BPD patients scored significantly higher on BPD symptoms ($M = 56.83$, $SE = 1.42$) compared to healthy controls ($M = 19.52$, $SE = 1.58$; $t(55) = 17.64$, $p < .01$).

Ethical approval for this study was given by the ethical review board of the Faculty of Psychology and Educational Sciences of KU Leuven (s54563) and by the medical ethics committee of university hospital KU Leuven (ML8517/ML5967).

Procedure

All participants were individually tested. First, participants were fully informed about the study, and signed the informed consent. Next, participants completed self-report questionnaires, including the ADP-IV-Borderline scale, and a collection of additional ques-

[1] Note that diagnostic criteria for BPD remained unchanged in *DSM–5* (American Psychiatric Association, 2013).

[2] An additional two participants from the healthy control group obtained ADP-IV dimensional scores similar to the dimensional score of the lowest scoring BPD patient ($M = 38$). Repeating all reported analyses excluding these two participants yielded similar results.

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Table 1
Comorbid Diagnostic Status of Borderline Personality Disorder Patients

Disorder	*N*
Axis-I disorders	
Adjustment disorder	11
Depressive disorder	6
Post traumatic stress disorder	2
Dissociative identity disorder	1
Alcohol dependency	1
Axis-II disorders	
Personality disorder-NOS	4
Narcissistic personality disorder	1

Note. This table is based on data that were available in patients files. Note that patients were not systematically assessed for all possible disorders.

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tionnaires that are not relevant for the current study. All questionnaires were returned in sealed envelopes. Next, participants received a Tungsten E palmtop and instructions on how to complete questionnaires on the palmtop. Next, they participated in eight days of experience sampling (ESM; Csikszentmihalyi & Larson, 1987; Ebner-Priemer & Trull, 2009) throughout their everyday lives. During these eight days, participants carried these palmtops with them and were prompted 10 times a day during waking hours (standard between 8.30 a.m. and 9.30 p.m., which was divided into 10 equal intervals and a beep was programmed randomly within each interval) by a beeping signal to complete a short questionnaire on the palmtop inquiring about among others the emotions they were currently experiencing. The mean time interval (in hours) between consecutive beeps did not differ between BPD patients and healthy controls ($M = 1.33$, $SE = 0.01$ for BPD; $M = 1.33$, $SE = 0.01$ for healthy controls; $t(56) = 0.10$, $p = .92$). This time based design was chosen, as it represents a good balance between duration of sampling (capturing emotions over multiple days) and the frequency of sampling within each day, and conforms to findings by Ebner-Priemer and Sawitzki (2007) that suggest to use time intervals under 2 hours when examining emotional instability in BPD. After eight days, the palmtops were handed in, and the data were downloaded from the palmtops.

Measures

The Assessment of *DSM–IV* Personality Disorders (ADP-IV)-Borderline personality disorder scale. The ADP-IV is a 94-item questionnaire that allows for a categorical and dimensional assessment of the *DSM–IV* personality disorders (Schotte et al., 1998). In this study we only used the borderline personality disorder scale, which consists of 10 trait items that assess the *DSM–IV–TR* (which is identical to *DSM–5*) diagnostic criteria for BPD. Each item is first scored on a seven point scale to indicate to what degree the trait applies to oneself (ranging from 1 to 7). If the score is five or higher, an additional distress rating is required on a three point scale (ranging from 1 to 3). A dimensional score can be computed by summing the trait scores for all 10 items. A categorical rating can be obtained by first counting the number of items (i.e., criteria) that are scored at least 5 on the trait scale and at least 2 on the distress scale for each participant. A total of at least 5 items that meet this criterion is considered indicative of BPD diagnosis. Internal consistency is shown to be good in our sample ($\alpha = .96$). A previous study by Schotte et al. (2004) indicated that the ADP-IV-Borderline scale showed acceptable concordance with the Structured Clinical Interview for *DSM–IV*-Axis II borderline personality disorder section (SCID-II - Borderline section) for the categorical diagnosis ($\kappa = 0.54$; Schotte et al., 2004), and for dimensional scores (Pearson correlation = 0.57; Schotte et al., 2004).

ESM items. To obtain information on the occurrence of emotional switches, consecutive ratings on the positive or negative valence of subsequent emotional states are needed, preferably on a bipolar rating scale ranging from very positive over neutral to very negative. To this end, at each experience sampling assessment moment (or beep), participants rated their current emotional state using an affect grid, next to a couple of other items not relevant for the present study. This grid consists of a 100 × 100 two-dimensional space with valence on the *x* axis, and activation on the *y* axis (Russell, 2003), and assesses current affect as a function of how pleasant or unpleasant one is feeling at the moment (ranging between 0 and 100), and how activated or passive one is feeling at the moment (ranging between 0 and 100). As switching pertains to changes in valence, we only considered the valence ratings obtained from the affect grid. These valence ratings were recoded into a scale ranging from −50 (*very unpleasant*) to +50 (*very pleasant*). Considering the absence of remuneration for participation in the study, compliance to the experience sampling was fair for BPD patients, with an average compliance of 65.80% ($SE = 3.52$), yielding an average of 53.40 repeated assessments per person ($SE = 2.77$, range = 19–76), and good for healthy controls with an average of 84.24% compliance ($SE = 2.29$), yielding an average of 67.86 repeated assessments per person ($SE = 2.03$, range = 38–91).

Statistical Analysis

The experience sampling design resulted in repeated measurements per person over time that are not independent of each other, but can be considered nested within participants. To deal with this nested data structure, we relied on multilevel regression modeling to analyze the data (Nezlek, 2001). In this approach, different aspects of emotional change (such as occurrence of a switch, switch distance, etc.) were modeled at the moment-to-moment level (Level 1 of the models), and were modeled as a function of BPD diagnosis and symptom severity at the person level (Level 2 of the models). Note that for all analyses, only changes between successive valence scores that were sampled at consecutive time points were used. Additionally, emotional changes between the last time point of a day and the first time point on the next day were not taken into account to remove overnight changes. For detailed information about our analytical approach and estimated models, we refer to the Appendix.

Results

Replication of Previous Research

To replicate previous findings on variability and instability of emotional intensity in BPD, we examined differences between BPD patients and healthy controls in within-person variance as a

measure of emotional variability (assessing average deviations around the mean level, e.g., Cowdry et al., 1991) and in mean squared successive difference (MSSD) or mean absolute successive differences (MASD) as measures of emotional instability (assessing average emotional changes from one point to the next, e.g., Ebner-Priemer et al., 2007). In line with previous findings, results showed that persons with BPD showed significantly larger within-person variance compared to healthy controls (mean variance for healthy controls $\alpha_0 = 5.78$, $SE = 0.03$, $p < .01$; difference in variance between two groups $\alpha_1 = 0.52$, $SE = 0.05$, $p < .01$), and a higher mean MSSD ($M_{BPDgroup} = 4.38$, $SD_{BPDgroup} = 0.14$), and mean MASD ($M_{BPDgroup} = 2.32$, $SE_{BPDgroup} = 0.06$) than healthy controls ($M_{HCgroup} = 3.86$, $SD_{HCgroup} = 0.18$ for MSSD; $M_{HCgroup} = 2.07$, $SE_{HCgroup} = 0.08$ for MASD; Difference between two groups = 0.52, $SE = 0.22$, $t(56) = 2.33$, $p = .02$ for MSSD; Difference between two groups = 0.25, $SE = 0.10$, $t(56) = 2.37$, $p = .02$ for MASD).

Switching Propensity

As a first aspect of switching, we estimated the difference in switching propensity between BPD patients and healthy controls and examined the relation between switching propensity and BPD symptoms. Next, this was repeated for the propensity to switch to positive or negative specifically. Two-level logistic regression models were used in which the probability to switch (in general or to a specific direction) was modeled at level 1, which was subsequently modeled as a function of BPD diagnosis (dummy) or symptoms (standardized) at level 2 (see Appendix for detailed information on the statistical modeling approach). Regarding the propensity to switch, no significant differences between BPD patients and healthy controls were found (see γ_{01} reflecting the difference between groups in log-odds to switch, Table 2, upper panel) for the log-odds to switch in general, as well as for the log-odds to switch to positive, or to negative specifically. Similarly, no significant relation was found between BPD symptoms and the log-odds to switch, the log-odds to switch to positive, and the log-odds to switch to negative (see γ_{01} reflecting the increase in log-odds to switch for every increase of one standard deviation in BPD symptoms, Table 2, lower panel). This showed that the propensity to switch is not specifically characteristic of BPD.

Switching Distance

As a second aspect of switching, we examined group differences between BPD patients and healthy controls in average switch distance and average nonswitch distance, that is, the magnitude of changes if respectively a switch or no switch occurred, and similarly examined whether BPD symptoms predicted the magnitude of switch distances and nonswitch distances. Two-level linear regression models were estimated in which absolute consecutive changes in valence were estimated as a function of a switch and a nonswitch dummy (leaving out the intercept) at level 1, of which the slopes were again modeled as a function of BPD diagnosis (dummy) or BPD symptoms (standardized) at level 2 (see Appendix for detailed information on the models used). Table 3 shows the estimated average distance for both switches and nonswitches (at level 1), and the differences between BPD patients and healthy controls for these switch and nonswitch distances (at level 2). Results showed that only in case a switch was made, the magnitude of emotional changes was larger for BPD patients than for healthy controls (see γ_{11} reflecting the difference between groups for switch distances, Table 3). For nonswitch distances, this difference between BPD patients and healthy controls was nonsignificant (see γ_{21} reflecting the difference between the two groups for nonswitch distances, Table 3). This means that only when BPD patients switch, the resulting emotional change is larger compared with healthy controls, whereas BPD patients do not differ from healthy control participants in the magnitude of emotional changes that are not switches. Results for the effect of BPD symptoms on switch distance and nonswitch distance were in line with these results (Table 3, lower panel). They showed that the more BPD symptoms, as measured by higher ADP-IV dimensional scores, the larger the switch distances (see γ_{11} reflecting the increase in switch distance for every increase of one standard deviation in symptoms, Table 3), while BPD symptoms were not related to nonswitch distances (see γ_{21} reflecting the increase in nonswitch

Table 2
Results From Binary Logistic Multilevel Analyses Predicting Switches, Switches to Positive, and Switches to Negative by BPD Diagnosis (Upper Panel), and BPD Symptoms (Lower Panel)

Predicted event	Level 1	Level 2	Coefficient	*SE*	*t* (*df*)	*p* value	Odds ratio	Confidence interval
Switch	Intercept, β_{0j}	Intercept, γ_{00}	−1.75	0.21	−8.49 (56)	<.01	0.17	(0.12, 0.26)
		BPD diagnosis, γ_{01}	0.28	0.28	1.00 (56)	.32	1.32	(0.76, 2.30)
Switch to Positive	Intercept, β_{0j}	Intercept, γ_{00}	−2.36	0.16	−14.41 (56)	<.01	0.09	(0.07, 0.13)
		BPD diagnosis, γ_{01}	0.22	0.22	1.03 (56)	.31	1.25	(0.81, 1.92)
Switch To Negative	Intercept, β_{0j}	Intercept, γ_{00}	−2.49	0.17	−14.48 (56)	<.01	0.08	(0.06, 0.12)
		BPD diagnosis, γ_{01}	0.22	0.23	0.93 (56)	.36	1.24	(0.78, 1.97)
Switch	Intercept, β_{0j}	Intercept, γ_{00}	−1.58	0.14	−11.54 (55)	<.01	0.21	(0.16, 0.27)
		BPD symptoms,[a] γ_{01}	0.19	0.14	1.41 (55)	.17	1.21	(0.92, 1.59)
Switch to Positive	Intercept, β_{0j}	Intercept, γ_{00}	−2.22	0.11	−20.87 (55)	<.01	0.11	(0.09, 0.13)
		BPD symptoms,[a] γ_{01}	0.13	0.10	1.28 (55)	.21	1.14	(0.93, 1.41)
Switch To Negative	Intercept, β_{0j}	Intercept, γ_{00}	−2.35	0.11	−20.97 (55)	<.01	0.10	(0.08, 0.12)
		BPD symptoms,[a] γ_{01}	0.17	0.11	1.52 (55)	.13	1.19	(0.95, 1.49)

[a] Standardized.

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Table 3
Results From Multilevel Regression Models Estimating Switch Distances and Non-Switch Distances as a Function of BPD Diagnosis (Upper Panel) and BPD Symptoms (Lower Panel)

Level 1	Level 2	Estimate	*SE*	*t* (*df*)	*p* value
Switches slope, β_{1j}	Intercept, γ_{10}	3.42	0.09	38.13 (56)	<.01
	BPD diagnosis, γ_{11}	0.27	0.11	2.36 (56)	.02
Non-switches slope, β_{2j}	Intercept, γ_{20}	1.79	0.07	26.98 (56)	<.01
	BPD diagnosis, γ_{21}	0.14	0.09	1.57 (56)	.12
Switches slope, β_{1j}	Intercept, γ_{10}	3.55	0.06	63.32 (55)	<.01
	BPD symptoms,[a] γ_{11}	0.16	0.06	2.52 (55)	.02
Non-switches slope, β_{2j}	Intercept, γ_{20}	1.88	0.04	42.14 (55)	<.01
	BPD symptoms,[a] γ_{21}	0.08	0.05	1.58 (55)	.12

[a] Standardized.

distance for every increase of one standard deviation in symptoms, Table 3).[3,4,5]

Switch Distance With Correction for Starting Point of a Switch

To examine the robustness of our findings, we examined whether or not the found results for switch distance were driven by possible differences in starting points of switches. When a person is in a more extreme emotional state, a larger emotional change has to occur to result in a switch. As BPD and healthy controls differ in the extremity of emotional states they experience, we wanted to verify that differences in switch distance still hold when correcting for the extremity of their starting points. We reran the multilevel analyses used to estimate (non-)switch distances (as reported in the previous section), however this time also including the valence rating at $t - 1$ (which was grand mean centered across all participants), which corresponds to the starting point of each calculated distance, modeled at level 1 of the equation (see Appendix for more detailed information). Results showed that when controlling for the start point of each calculated distance (by keeping it constant at the average level across all participants), the findings were in line with previous analyses, showing that BPD patients are characterized by larger switch distances than healthy controls (see γ_{11} reflecting the difference in switch distance between the two groups, Table 4, upper panel), but not by larger nonswitch distances (see γ_{21} reflecting the difference in nonswitch distances between the two groups; Table 4, upper panel). Similarly, BPD symptoms remained related to switch distances (see γ_{11} reflecting the increase in switch distance for every increase of one standard deviation in BPD symptoms; Table 4, lower panel) but not to nonswitch distances when controlling for starting points.[6]

Switch Distance to Different Directions

Last, we examined whether the difference between BPD patients and healthy controls in switch distance occurs both for switches from negative to positive states and vice versa, or whether it is limited to switching in one specific direction. Two-level regression models were used in which absolute differences between consecutive emotion ratings were modeled as a function of a switch to positive, a switch to negative, and a no-switch dummy (leaving out the intercept) at level 1. Each slope was again modeled at level 2 as a function of BPD diagnosis (dummy), or BPD symptoms (standardized). Table 5 shows the relation between BPD diagnosis and symptoms on the one hand, and on the other hand the estimated average distances for switches to positive, switches to negative, and for moments where no switch occurred. On average, BPD patients displayed larger switch distances both to positive states (see γ_{11} reflecting the difference in switch distance between the two groups, Table 5, upper panel) and to negative states (see γ_{21} reflecting the difference in switch distance between the two groups, Table 5, upper panel), although again not differing from

[3] To investigate the unique predictive value of switch distance for BPD diagnosis and symptoms when switch distances and non-switch distances are considered simultaneously, we repeated the above analyses, however without including predictors at level 2. The random slopes at level 1, β_{1j} and β_{2j}, yielding an estimate for the average switch distance and non-switch distance per person, were extracted and simultaneously used as predictors (thereby controlling for possible overlap between the two) in a logistic regression model to predict BPD diagnosis and in a linear regression model to predict BPD symptoms. Results indicated that when considered simultaneously, switch distance and not non-switch distance is a significant predictor of both BPD diagnosis and symptoms. Importantly, these results held when mean level of valence was additionally entered as a covariate, indicating that the differences in switching we observed between BPD and healthy controls were not merely the reflection of differences in average positions on the valence dimension.

[4] To investigate the correlation between MSSD and (non-)switch distances, we first ran separate two-level analyses to estimate the MSSD or switch and non-switch distances at level 1, as explained earlier (without including a predictor at level 2). The random intercept and random slopes at level 1 yielded estimates for MSSD, and switch and non-switch distances per person respectively, and were extracted. The correlation between MSSD and switch distance was $r = .14$, whereas the correlation between MSSD and non-switch distance was $r = .82$.

[5] To check whether the effect of BPD was different for non-switch distances within the positive and within the negative realm, a similar model was estimated, using dummies to code for a switch, a non-switch within positive realm, and a non-switch within negative realm. Results were the same as reported in the manuscript: only significant differences between BPD and HC were found for the switch distances (difference = .27, $t(56) = 2.41$, $p = .02$), and not for both types of non-switch distances (difference = .03, $t(56) = 0.32$, $p = .75$ for positive realm; difference = .23, $t(56) = 1.57$, $p = .12$ for negative realm).

[6] When investigating the unique predictive value of switch distance after controlling for non-switches (as mentioned in footnote 3) when also correcting for starting points of (non-) switches, results confirmed that switch distance, but not non-switch distance significantly predicted BPD diagnosis and symptoms. Again, these results also held when additionally controlling for mean valence.

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Table 4
Results From Multilevel Regression Models Estimating Switch Distances and Non-Switch Distances as a Function of BPD Diagnosis (Upper Panel) and BPD Symptoms (Lower Panel), Both With Correction for Valence at Previous Time Point (i.e., Start Point)

Level 1	Level 2	Estimate	*SE*	*t* (*df*)	*p* value
Switches slope, β_{1j}	Intercept, γ_{10}	3.36	0.09	38.42 (56)	<.01
	BPD diagnosis, γ_{11}	0.32	0.11	2.79 (56)	.01
Non-switches slope, β_{2j}	Intercept, γ_{20}	1.93	0.07	28.91 (56)	<.01
	BPD diagnosis, γ_{21}	0.03	0.09	0.35 (56)	.73
Valence rating at $t-1$,[a] β_{3j}	Intercept, γ_{30}	−0.01	0.00	−4.39 (56)	<.01
	BPD diagnosis, γ_{31}	0.01	0.00	2.95 (56)	.01
Switches slope, β_{1j}	Intercept, γ_{10}	3.53	0.06	62.70 (55)	<.01
	BPD symptoms,[b] γ_{11}	0.19	0.06	2.92 (55)	.01
Non-switches slope, β_{2j}	Intercept, γ_{20}	1.98	0.04	46.62 (55)	<.01
	BPD symptoms,[b] γ_{21}	0.02	0.04	0.46 (55)	.65
Valence rating at $t-1$,[a] β_{3j}	Intercept, γ_{30}	0.00	0.00	−3.85 (55)	<.01
	BPD symptoms,[b] γ_{31}	0.00	0.00	3.31 (55)	<.01

[a] Grand mean centered. [b] Standardized.

healthy controls for nonswitch distances. Results for BPD symptoms (Table 5, lower panel) were in line with these findings, and showed a significant relation between BPD symptoms and switch distance to positive and to negative states, but not with nonswitch distances. These results showed that larger switch distances are characteristic of BPD, regardless of whether the direction of the switch is from positive to negative or vice versa.

Discussion

In an attempt to better understand emotional dysfunction in BPD patients, this study is the first to propose and document the notion of emotional switching in BPD, defined as the abrupt changes between positive and negative emotional states from one time point to the next. Results showed that although BPD patients are not specifically characterized by a higher propensity to switch compared with healthy controls, BPD patients do show larger emotional changes from one time point to the next if they switch between emotional states of opposite valence. Importantly, the same does not hold when a nonswitch is observed. In other words, the higher emotional instability that is characteristic of BPD is driven by stronger emotional changes in which a positive state switches to a negative state or vice versa, whereas larger changes within the negative or positive realm do not seem to be particularly characteristic of BPD. This is still the case when correcting for the starting point of calculated distances, as BPD patients tend to show more extreme emotions in daily life which can influence possible switch distances. In sum, larger switch distances, but not larger nonswitch distances are specifically characteristic of BPD.

The finding that BPD was not characterized by a higher propensity to switch was surprising. Yet, it is in line with the results from Reisch et al. (2008), who only reported a greater occurrence of changes between discrete negative emotional states in BPD. Tentatively, this result could be explained by the fact that even small emotional changes from a slightly negative emotional state to a slightly positive mood are considered emotional switches, and

Table 5
Results From Multilevel Regression Models Estimating Distances for Switches to Positive, Switches to Negative, and Non-Switches, as a Function of BPD Diagnosis (Upper Panel) and BPD Symptoms (Lower Panel)

Level 1	Level 2	Estimate	*SE*	*t* (*df*)	*p* value
Switches to positive, β_{1j}	Intercept, γ_{10}	3.42	0.09	37.58 (56)	<.01
	BPD diagnosis, γ_{11}	0.26	0.12	2.18 (56)	.03
Switches to negative, β_{2j}	Intercept, γ_{20}	3.42	0.10	34.94 (56)	<.01
	BPD diagnosis, γ_{21}	0.28	0.12	2.27 (56)	.03
Non-switches, β_{3j}	Intercept, γ_{30}	1.79	0.07	26.98 (56)	<.01
	BPD diagnosis, γ_{31}	0.14	0.09	1.57 (56)	.12
Switches to positive, β_{1j}	Intercept, γ_{10}	3.55	0.06	60.64 (55)	<.01
	BPD symptoms,[a] γ_{11}	0.15	0.07	2.30 (55)	.03
Switches to negative, β_{2j}	Intercept, γ_{20}	3.55	0.06	58.65 (55)	<.01
	BPD symptoms,[a] γ_{21}	0.17	0.07	2.50 (55)	.02
Non-switches, β_{3j}	Intercept, γ_{30}	1.88	0.04	42.15 (55)	<.01
	BPD symptoms,[a] γ_{31}	0.08	0.05	1.59 (55)	.12

[a] Standardized.

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such changes are likely to also occur in everyday lives of healthy people. In contrast, the switch distance captures the extremity of such changes, and thus the finding that larger switch distances are specifically characteristic of BPD shows that BPD patients will on average make switches between a more extreme emotional state and the opposite state (even though, importantly the extremity of starting emotional states in itself does not explain the switches).

Previous studies have characterized emotional instability in BPD patients in terms of larger changes in the intensity of (composite) emotional states between consecutive moments (Cowdry et al., 1991; Ebner-Priemer et al., 2007; Russell et al., 2007; Santangelo et al., 2014; Trull et al., 2008). Our study, however, shows that not any large emotional changes are characteristic of BPD, but that specifically large emotional changes that go hand in hand with switches between emotional states with opposite valence describe the patterns of emotional change characteristic of BPD. This implies that differences between BPD patients and healthy controls in terms of larger average emotional changes in intensity, as found in previous studies, may be accounted for by larger switch distances specifically. By pinpointing the type of emotional change that is specifically characteristic of BPD, that is, large emotional changes toward the opposite valence, the findings can provide more insight into possible processes underlying emotion dysfunction in BPD, and reveal the true nature of emotional instability in BPD. They show that the polarity in emotional states in BPD (Beck et al., 1990; Coifman et al., 2012) goes hand in hand with making stronger and larger switches from one such state to the next, and that this results in unstable emotions over time. Dichotomous black–white emotional experiences may thus underlie the instability of emotions in BPD.

Noteworthy, differences in switch distance between BPD patients and healthy controls are not limited to one specific direction but hold for both switches from positive to negative or from negative to positive states. So on the one hand, BPD patients make larger emotional leaps from positive to negative states, which is in line with predominant clinical descriptions of sudden changes to states involving anxiety, dysphoria or other negative emotions (American Psychiatric Association, 2013), and the idea of heightened sensitivity to especially negative stimuli in BPD (e.g., Domes, Schulze, & Herpertz, 2009). However, BPD patients similarly showed larger emotional changes from negative to positive states in daily life. This is in line with the notion that next to devaluation of significant others or events, also idealization is a feature of persons with BPD in which others are truly admired and praised (American Psychiatric Association, 2013; Kernberg, 1976), with possible alternations between the two. In other words, next to thinking the worst of people and situations and despise others at some times, these findings illustrate that at other times, BPD also involves sudden uplifts and switching to positive states. Although intriguing, this does not necessarily imply that similar processes or mechanisms underlie switches from positive to negative or vice versa. More research is needed to understand differences and common processes underlying both types of switches.

Future studies are needed to identify possible triggers of switching between positive and negative states. Speculatively, interpersonal factors might be important triggers of switching. As shown by Coifman et al. (2012) interpersonal stress increased the polarity of affective experiences in BPD patients, thereby potentially also affecting the switch distances in BPD patients. Additionally, Sadikaj, Moskowitz, Russell, Zuroff and Paris (2013) found elevated affective reactivity to interpersonal perceptions in BPD, compared to healthy participants. More specifically, persons with BPD reported more negative affect in situations in which others were perceived as more cold-quarrelsome. This indicates that interpersonal stress might trigger the occurrence of larger switch distances. However, whether interpersonal or other factors are related to switching should be the focus of future research.

The current results are relevant for clinical practice. In effective treatments of BPD, such as for example dialectical behavioral therapy (DBT; Linehan, 1993), emotion regulation skills training is often an important component, and focuses on teaching patients how to handle emotions and emotional responses. However, next to skills that can help BPD patients to deal with the experience of intense emotions and intense emotional reactions, BPD patients might also benefit from specific attention to the occurrence of abrupt changes between different emotional states in such skills trainings. Providing BPD patients with tools to identify possible situations that can trigger such switches for an individual, and to deal with such situations can help BPD patients to better cope with this type of extreme emotional changes that are very dysfunctional and debilitating for the patients and his or her social environment.

Finally, some additional limitations should be noted. First, our sample size was relatively small, which might have affected the power of the study to detect effects with a smaller effect size, which is perhaps the case for switching propensity. Moreover, the sample consisted predominantly of women. Therefore, replication with larger samples that consist of more men is needed to test the generalizability of the findings. Second, all patients were institutionalized, which means that they were currently staying in a structured environment, with support of mental health workers. Although intensive treatment and daily interaction with staff and other patients can be challenging for patients, it is not clear to what degree emotional triggers encountered in daily life in a mental health institution are comparable with those in daily life outside an institution. Therefore, generalizability of these data to those gathered from BPD patients in their own daily environment outside hospitals is limited. Third, the compliance to the experience sampling design was good for healthy controls, but it was slightly lower for the BPD subsample. In this respect, it should be noted however that our measures of switching are in themselves not strongly affected by the amount of missing data. Fourth, next to self-report questionnaires and assessments from psychiatrists, we did not use standard screening tools, such as structured diagnostic interviews to assess the diagnostic status of both the BPD and healthy control group. For the healthy group, psychopathology was assessed using a borderline symptoms questionnaire, as well as a screening questionnaire asking them about history of mental problems, hospitalizations, and medication use. Similarly, the diagnostic status of patients was based on a clinical interview, but was not systematically assessed using standardized diagnostic interviews. Although there is no indication that control participants might not be healthy, and participants from the BPD sample might not have a BPD diagnosis, this approach is clearly suboptimal, and therefore should be considered a limitation of this study. Finally, establishing the occurrence of larger switches in BPD is a first step. As a next step, it is important to demonstrate specificity of these findings or the rather transdiagnostic nature of switching. Therefore,

comparisons between BPD patients and other patient groups are needed.

To conclude, we showed that BPD patients are characterized by larger emotional changes in which they switch between positive and negative emotional states in daily life, when compared with healthy controls. In contrast, they do not differ from healthy controls in the magnitude of changes within the positive or negative realm. These results give a more detailed description of emotional instability characteristic of BPD, and give clues to possible processes underlying emotional dysfunction in BPD.

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Appendix

Statistical Models

The experience sampling design resulted in repeated measurements over time that are nested within participants. To deal with the nested structure of the data, we applied multilevel regression models to analyze the data (Nezlek, 2001). For all analyses, the first emotion rating of every day was always set missing when computing consecutive changes, and (non-)switch variables, such that overnight changes were never taken into account. Additionally, to calculate consecutive change and (non-)switch variables, only successive valence scores that were sampled at consecutive time points within the experience sampling design were taken into account. If necessary, the dependent variables used in the models were first transformed using a logarithmic transformation (after adding the constant of 1), to resolve the non-normal distributions of error terms at level 1. All analyses were conducted in HLM7.

Replication of Previous Research

First, we aimed to replicate findings from previous studies on emotion dynamics in BPD by examining differences in diagnostic groups in terms of within-person variance, reflecting the average deviation of emotion ratings from the mean level of a person (e.g., Cowdry et al., 1991; Russell et al., 2007; Stein, 1996), as well as in mean squared successive difference (MSSD; von Neumann, Kent, Bellinson, & Hart, 1941) and mean absolute successive difference (MASD), reflecting the average magnitude of change from one point to the next (e.g., Cowdry et al., 1991; Ebner-Priemer et al., 2007; Trull et al., 2008).

Regarding within-person variance over repeated emotion ratings over time, the following model was used in which the (log transformed) within-person variance at level 1 was estimated as a function of BPD dummy (1 for BPD, 0 for healthy controls).

$$Var(R) = \sigma^2 \; and \; \log(\sigma^2) = \alpha_0 + \alpha_1 \, BPD$$

The mean within-person variance for healthy controls is estimated by α_0 (when BPD = 0), and the mean within-person variance for BPD patients is estimated by $\alpha_0 + \alpha_1$ (when BPD = 1). Note that the difference between healthy controls and BPD patients is represented by α_1.

Regarding the MSSD and MASD, the following equations were used to estimate MSSD and MASD, as a function of group.

Level-1 model:

$$\ln(\textit{squared OR absolute consecutive difference})_{ij} = \beta_{0j} + r_{ij}$$

Level-2 model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} \, BPD_j + u_{0j}$$

Squared successive differences or absolute successive differences are modeled as a function of a random intercept, β_{0j} that is allowed to vary between persons and represents the mean squared/absolute successive difference for each person. At level 2, this random intercept is modeled as a function of a BPD dummy (1 for BPD patients, 0 for healthy controls), so that γ_{00} represents the mean estimate for healthy controls (when BPD = 0), $\gamma_{00} + \gamma_{01}$ represents the mean estimate for BPD patients (when BPD = 1), and γ_{01} reflects the difference between healthy controls and BPD patients.

(*Appendix continues*)

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Switching Propensity

Central to our research question, we investigated different aspects of emotional switching, of which the first is switching propensity. To investigate differences in switching propensity between BPD patients and healthy controls, for each person we coded for each pair of consecutive emotion ratings whether a switch occurred (SWITCH dummy = 1), or not (SWITCH dummy = 0). Next, we used multilevel logistic regression to estimate the probability to switch as a function of BPD diagnosis, using the following equation:

Level-1 model:

$$\text{Prob}(SWITCH_{ij} = 1|\beta_j) = \phi_{ij}$$
$$\log[\phi_{ij}/(1 - \phi_{ij})] = \eta_{ij}$$
$$\eta_{ij} = \beta_{0j}$$

Level-2 model:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} BPD_j + u_{0j}$$

The log-odds to switch is modeled by a random intercept, that represents the mean log-odds for each person, that is again modeled as a function of BPD dummy (coded 1 for BPD patients and 0 for healthy controls) at level 2, with γ_{00} reflecting the mean log-odds to switch for healthy controls (when BPD = 0), and $\gamma_{00} + \gamma_{01}$ reflecting the mean log-odds to switch for BPD patients (when BPD = 1). The difference between BPD patients and healthy controls is estimated by γ_{01}. Similar models were run to specifically estimate the odds of switching from positive to negative, and from negative to positive. Moreover, similar models were run to estimate the relation between switch propensity and BPD symptoms, by including standardized ADP-IV borderline dimensional scores instead of BPD diagnosis as level 2 predictor. Note that unit-specific models were used, although population-average models led to similar conclusions.

Switching Distance

Next to switching propensity, we examined group differences in average switch distance and average nonswitch distance, that is, the average absolute difference between consecutive emotional states in case an emotional switch or no emotional switch occurred. A two-level linear regression analysis was performed, with the following equation:

Level-1 model:

$$\ln(\textit{absolute consecutive difference})_{ij} = \beta_{1j} SWITCH_{ij} + \beta_{2j} NO_SWITCH_{ij} + r_{ij}$$

Level-2 model:

$$\beta_{1j} = \gamma_{10} + \gamma_{11} BPD_j + u_{1j}$$
$$\beta_{2j} = \gamma_{20} + \gamma_{21} BPD_j + u_{2j}$$

At level 1, the absolute difference[7] between consecutive ratings was modeled as a function of whether a switch occurred (SWITCH = 1) or not (NO_SWITCH = 1) at each beep, leaving out the intercept. At level two, subject-specific average absolute differences between consecutive emotion ratings for switches (β_{1j}) and nonswitches (β_{2j}) were modeled as a function of BPD diagnosis, estimating the mean absolute difference for switches for healthy controls (γ_{10}), and for BPD patients ($\gamma_{10} + \gamma_{11}$) on the one hand, and the mean absolute difference for nonswitches for healthy controls (γ_{20}), and BPD patients ($\gamma_{20} + \gamma_{21}$) on the other hand. Again, γ_{11} and γ_{21} estimate the differences between BPD patients and healthy controls in switch distances and nonswitch distance. A similar model was used to estimate the relation between BPD symptoms, and switch distances and nonswitch distances, by including standardized ADP-IV borderline dimensional scores as level 2 predictor.

Switch Distance With Correction for Starting Point of a Switch

To further examine the robustness of findings, we examined whether or not the found results for switch distance were driven by differences in starting points of switches, as for more extreme ratings, larger changes have to occur to result in a switch, and persons with BPD may tend to have more extreme ratings. To this end, we reran the multilevel analyses used to estimate (non-)switch distances (as reported in the previous section), however this time also including the valence rating at $t - 1$, which corresponds to the starting point of each calculated distance, at level 1 of the equation, after being grand mean centered across all participants. By using this type of centering, we estimated switch distances and nonswitch distances while holding the starting point for each distance constant at the average level for all participants, thus removing the effect of individual differences in starting positions.

Switch Distance in Different Directions

Last, we examined whether the difference between BPD patients and healthy controls in switch distance occurs both from negative to positive states and vice versa, or whether it is limited to switching in one specific direction. We estimated a model in which absolute differences between consecutive emotion ratings at level 1 were modeled as a function of whether a switch to positive, a switch to negative, or no switch occurred, using three dummy variables (leaving out the intercept), which were then modeled at level 2 as a function of BPD diagnosis, or standardized ADP-IV dimensional scores.

[7] All analyses reported in the article that pertain to switching distance were replicated using squared difference instead of absolute difference in valence as the dependent variable, and results from these analyses showed similar conclusions.

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