Published in final edited form as:

Biol Psychol. 2008 February ; 77(2): 197–204. doi:10.1016/j.biopsycho.2007.10.007.

Anticipation of Affect in Dysthymia: Behavioral and Neurophysiological Indicators

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Abstract

Anticipation for future affective events and prediction uncertainty were examined in healthy controls and individuals with dysthymia (DYS) using behavioral responses and the contingent negative variation (CNV) and post-imperative negative variation (PINV) event related potential (ERP) components. Warning stimuli forecasted the valence of subsequently presented adjectives (“+”, positive; “=”, neutral; “-”, negative), and participants indicated whether each adjective would describe them over the next two weeks. Controls expected fewer negative, and individuals with DYS expected fewer positive, adjectives to apply to them. CNV amplitudes were enhanced in controls prior to positive versus other adjectives. Response times and PINV amplitudes were greater following neutral compared to other adjectives, and PINV was larger overall in dysthymics compared to controls. In sum, healthy controls and individuals with DYS exhibit different behavioral and neurophysiological biases in anticipation for future affective events. These results are discussed in the context of cognitive theories of depression.

Keywords

dysthymia; affective bias; anticipation; event-related potentials

Cognitive theories posit that individuals with unipolar mood disorders have biased processing of affective events (Abramson et al., 1978, 1989; Beck, 1967, 1987). In particular, individuals with depressive disorders may expect to experience more negative outcomes and fewer positive outcomes than psychologically healthy individuals. Mood-congruent processing of past or current affective events has been demonstrated using measures of both behavior (for meta-analyses see Casement et al., 2007; Matt et al., 1992) and brain activity (for review see Shestyuk & Deldin, in press). However, there is less empirical evidence that expectations for *future* affective events are biased in mood disorders. The present research evaluates future-oriented

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affective biases in individuals with dysthymia (DYS) and healthy controls using both behavioral and neurophysiological indices. Cognitive biases are particularly pronounced in individuals with chronic mood disorders such as DYS (McCullough et al., 1988, 1994; Riso et al., 2003), and the continuation of depressive symptoms over a period of years may be especially likely to change expectations for future affective experience.

Participants in this study completed a two-stimulus imperative response task. A symbol forecasted the affective valence of a subsequently presented adjective (“+”, positive; “=”, neutral; “-”, negative), and participants indicated whether each adjective would likely describe their general feeling about themselves over the next two weeks. The percent of positive, neutral, and negative adjectives anticipated to be self-referent provided a behavioral measure of future-oriented affective bias, and the time taken to make these judgments provided a behavioral measure of response uncertainty. Existing research using a similar procedure indicates that individuals with major depression expect more negative and fewer positive adjectives to apply to them than healthy controls, but the amount of time taken to make self-reference judgments didn't vary significantly as a function of depressive state or adjective valence (Serfaty et al., 2002).

Event related potential (ERP) components elicited during the response task were examined to determine the extent of neurophysiological biases in affect anticipation and response uncertainty. In particular, potential biases in affective stimulus anticipation and response preparation were examined using the contingent negative variation (CNV) component preceding an imperative stimulus (for a review, see Fabiani et al., 2007; McCallum, 1988; Rockstroh et al., 1989). Potential differences in uncertainty during indications of adjective future self-reference were examined using the post-imperative negative variation (PINV) component following an imperative stimulus (for a review see McCallum, 1988; Rockstroh et al., 1989). Very few studies have used CNV or PINV to index affective processing biases in mood disorders, and existing research fails to find an effect of affective valence on these ERP components (Serfaty et al., 2002; Yee & Miller, 1988). Rather, individuals with major depression generally demonstrate non-valence-specific decreases in CNV amplitudes (less anticipation and response preparation; Ashton et al., 1988; Giedke & Bolz, 1980; Timsit-Berthier, 1993), and increases in PINV amplitudes (more response uncertainty; Kessler et al., 1992; Knott et al., 1991; Serfaty et al., 2002; Thier et al., 1986), compared to healthy controls.

The present study addresses a need for further research on chronic forms of depression such as DYS, and is unique in its combined use behavioral measures and the CNV and PINV ERP components to examine future-oriented, self-referent affective biases. Consistent with evidence for a positive bias in non-depressed individuals (Abramson et al., 1978; Abramson et al., 1989), healthy controls were hypothesized to have increased anticipation and response certainty for positive events (i.e., more indications of adjective future self-reference, larger CNV, shorter response times, smaller PINV), and decreased anticipation and response certainty for negative events (i.e., fewer indications of adjective future self-reference, smaller CNV, longer response times, larger PINV), compared to neutral events. Consistent with evidence for a negative bias in depressed individuals (Abramson et al., 1978, 1989; Beck, 1967, 1987), participants with DYS were expected to have increased anticipation and response certainty for negative events, and decreased anticipation and response certainty for positive events, compared to neutral events. Furthermore, these mood-congruent anticipation biases were expected to differentiate individuals with DYS from healthy controls.

Method

Participants

Participants included 15 healthy controls and 12 individuals with current DYS between 18 and 65 years of age. Participants were recruited through newspaper advertisements and fliers placed in outpatient psychiatric clinics within the greater Boston area. Diagnoses were determined using the Structured Clinical Interview for the DSM-IV (SCID; First et al., 1995) administered by a doctoral level clinician (PJD) or research assistants trained in SCID administration. Twenty-five percent of the SCID interview tapes were reviewed by a second rater to confirm diagnoses. Five DYS participants had comorbid major depressive disorder. Groups were balanced for sex, handedness (Edinburgh Handedness Questionnaire; Oldfield, 1971), age, and education, and differed predictably on measures of depression (Beck Depression Inventory; BDI; Beck et al., 1961; Beck Hopelessness Scale; BHS; Beck et al., 1974) and anxiety (State/Trait Anxiety Inventory; STAIS/STAIT; Spielberger et al., 1970; see Table 1). Individuals taking psychiatric medications and those with a history of cognitive impairment, major medical illness, substance abuse or dependence, head injury with loss of consciousness over 10 min, or seizure disorder were excluded from the study. All participants provided written informed consent and were paid \$10/hr.

Materials

Emotional adjectives were selected from a list of 310 adjectives rated by 146 undergraduates for valence and arousal using two 5-point Likert scales ranging from very positive (1) to very negative (5), and very arousing (1) to very calm (5), respectively. Adjectives were then ranked according to mean valence ratings, and the 40 most positive (e.g., “vivacious”, “thrilled”, “creative”, “loved”), neutral (e.g., “acceptable”, “silent”, “tolerable”, “unchanging”), and negative (e.g., “miserable”, “humiliated”, “wretched”, “guilty”) adjectives were selected for use in the present study. Adjectives in each valence condition were balanced for word length, $F(2, 117) = .34, p > .1$, and frequency of use, $F(2, 117) = .12, p > .01$, and varied in valence, $F(2, 117) = 1601.45, p < .001$, and arousal, $F(2, 117) = 66.53, p < .001$. Average valence ratings were 1.67 for positive words, 2.92 for neutral words, and 4.29 for negative words, and all paired comparisons were significant ($p < .001$ for all). Average arousal ratings were 2.16 for positive words, 3.41 for neutral words, and 2.52 for negative words, and all paired comparisons were significant ($p < .01$ for all).

Procedure

Participants toured the lab, provided informed consent, and completed the diagnostic assessment at least one day prior to completing the self-report questionnaires and physiological recording. Participants were seated in a comfortable chair approximately 115 cm from a computer monitor within a darkened experimental room during physiological recording. Participants were presented with one of four visual symbols (“+”, “=”, “-”, “?”; S1) for 250 ms, followed 3 s later by the presentation of an emotionally-valenced adjective (positive, neutral, or negative; S2) for 500 ms. Plus signs signaled positive adjectives, equal signs signaled neutral adjectives, minus signs signaled negative adjectives, and question marks signaled the pseudorandom presentation of either a positive, neutral, or negative adjective.¹ Symbols were 3.8 cm in height, adjectives were 1.3 cm in height, and all stimuli were white with black

¹The random valence condition was included to determine whether uncertainty about the affective valence of the to-be-presented adjective would alter neurophysiological anticipation. This condition was ultimately excluded from CNV analyses because data for the random and neutral conditions were comparable. The random condition was excluded from PINV analyses *a priori* because there were not enough trials to compare responses to positive, neutral, and negative adjectives within the random valence condition, and a composite measure of these responses was not relevant to the project aims. Responses to adjectives in the random valence condition were also excluded from behavioral analyses.

background. After adjective presentation, participants had 4 s to indicate whether or not each adjective would likely describe their general feeling about themselves over the next two weeks by pressing one of two buttons on a response box. Response hand was counterbalanced across participants. Participants completed two blocks of 60 trials, with an optional break between blocks, for a total of 120 7 s trials (30 in each valence condition).

Behavioral Analysis

Mean adjective future self-reference, reaction time, and non-response rate were calculated for each participant and valence condition. Adjective future self-reference and reaction time were based on the total number of completed responses, rather than the number of trials. Adjective future self-reference, reaction time, and non-response rate were then analyzed using three separate Valence (positive, neutral, negative) $\times$ Group (CTL, DYS) ANOVAs. As a conservative test of interaction effects, higher order effects were required to be significant at each stage of post-hoc testing (e.g., if a 2-way interaction of Valence $\times$ Group was obtained, a main effect of valence within each group was required before paired valence comparisons were interpreted). Huynh-Feldt corrections were applied when data failed to meet the sphericity assumption. Pearson correlations were computed within each diagnostic group to assess associations between self-report measures of symptom severity and behavioral responses. Due to equipment malfunctions, behavioral data were not available for two participants with DYS.

Physiological Recording, Data Reduction, and Analysis

EEG was collected, filtered, and amplified using an S.A. Instruments Company (Encinitas, CA) polygraph. Signals were recorded from 32 sites using a conductive electrogel and tin electrodes mounted in an electrode cap (Electro Cap International, Inc., Easton, OH) according to the International 10-20 System. Electrooculography (EOG) was recorded for both horizontal and vertical eye movements using tin electrodes placed on the outer canthi, left suborbital, and right supraorbital positions. EEG was referenced to the left earlobe and then re-referenced offline to the average of both earlobes (Miller et al., 1991). Impedances for all electrodes were kept below 10 K Ω . Data were digitally sampled at 512 Hz and filtered online with a high pass analog filter set to .01 Hz and a low pass filter set to 30 Hz. A 7 Hz low-pass digital filter was applied to the data offline.

Eye movement artifact was corrected by applying linear transformation based on computed regression weights for the propagation factors of vertical and horizontal EOG in each EEG channel (James Long Company, Caroga Lake, New York). Eye movement correction was then visually confirmed, and trials containing residual eye and muscle movement artifacts were excluded from analysis. Data from leads with remaining artifact (< 4%) were substituted with averages from all surrounding leads that did not require substitutions for each participant and valence condition.

Of the original 32 scalp sites, only midline sites Fz, Cz, and Pz were included in the analyses. This allowed the inclusion of left handed participants and participants with uncorrectable artifact at other sites. ERPs were averaged separately for each participant, valence condition, and site using a 500 ms pre-S1 baseline for CNV, and a 500 ms pre-S2 baseline for PINV. Principle component analysis, grand average inspection, and literature review (e.g., Ashton et al., 1988; Bolz & Giedke, 1981; Klein et al., 1998; Knott et al., 1991; Serfaty et al., 2002; Thier et al., 1986) were used to define time windows for CNV (800-3000 ms post-S1) and PINV (4000-5000 ms post-S1), and mean amplitudes for each component time window were calculated for analysis. Both CNV and PINV are negative components, where more negative amplitudes indicate greater component-related processing.

CNV and PINV were analyzed using two separate Valence (positive, neutral, negative) $\times$ Group (CTL, DYS) $\times$ Lead (Fz, Cz, Pz) repeated measures ANOVAs. Data for one participant with DYS were excluded from PINV analyses due to unresolvable artifact in the physiology data following S2. The inclusion of ERP data in the analyses was not contingent on behavioral responses, as per standard practice. Higher order effects were required to be significant at each stage of post-hoc testing, and Huynh-Feldt corrections were applied when data failed to meet the sphericity assumption. Pearson correlations were computed within each diagnostic group to assess associations between self-report measures of symptom severity and ERP components, averaging across leads.

Results

Behavioral Data

Mean self-reference ratings are presented in Table 2 and Figure 1. Analyses of adjective future self-reference revealed a significant Valence $\times$ Group interaction, $F(2, 46) = 52.92, p < .001$. Valence comparisons indicated that fewer negative than positive ($p < .001$) or neutral ($p < .001$) adjectives were expected to be self-referent by healthy controls. In contrast, fewer positive than neutral ($p < .01$) or negative ($p < .001$) adjectives were expected to be self-referent by individuals with DYS. Group comparisons indicated that more positive and fewer negative adjectives were expected by healthy controls than individuals with DYS ($p < .001$ for both). There was also a trend for healthy controls to expect more neutral adjectives than individuals with DYS ($p < .10$). No further significant effects were observed for adjective self-reference.

Mean response times (RT) are presented in Table 2. RT analyses revealed a significant main effects of Valence, $F(2, 46) = 32.72, p < .001$, where participants took longer to respond to neutral adjectives than to either positive ($p < .001$) or negative ($p < .001$) adjectives. No further significant effects were observed for RT.

The mean (and standard deviation) non-response rate was 4.61% (6.19) for healthy controls and 8.33% (11.97) for individuals with DYS. Analyses of non-response rate revealed a significant main effect of Valence, $F(2, 46) = 8.85, p < .01$, where participants failed to respond more often to neutral than positive ($p < .01$) or negative ($p < .01$) adjectives. No further significant effects were observed for non-response rate.

Correlational analyses indicated a negative relationship between the self-reference of positive adjectives and BDI score in healthy controls, $r(13) = -.62, p < .05$, and BHS score in individuals with DYS, $r(8) = -.86, p < .01$. Furthermore, the self-reference of negative adjectives was positively correlated with scores on the BDI, $r(13) = .57, p < .05$, STAIT, $r(13) = .78, p < .001$, and STAIS, $r(13) = .74, p < .01$, in healthy controls, and with scores on the STAIT, $r(8) = .67, p < .05$, and STAIS, $r(8) = .68, p < .05$, in individuals with DYS. There were no other significant correlations between behavioral responses and self-report measures of symptom severity.

ERP Data

Grand average ERP waveforms following S1 are presented in Figure 2, and average CNV amplitudes for each group at each valence condition are presented in Table 2 and Figure 3.² CNV analyses revealed a significant Valence $\times$ Group interaction, $F(2, 50) = 4.93, p < .05$. Valence comparisons indicated that healthy controls had larger CNV amplitudes when positive adjectives were forecasted than when either neutral ($p < .05$) or negative ($p < .05$) adjectives

²CNV subcomponents thought to represent orienting (early CNV, 800-1300 ms), sustained attention (late CNV, 1300-2500 ms), and motor response preparation (2500-3000 ms) for expected stimuli were examined individually. As data for each subcomponent were essentially identical, only the composite CNV index (800-3000 ms) was analyzed.

were forecasted. The effect of valence was marginally significant for individuals with DYS ($p < .10$), where pairwise comparisons indicated larger CNV amplitudes when negative compared to neutral adjectives were forecasted ($p < .05$). Group comparisons of CNV amplitudes indicated that healthy controls had larger CNV amplitudes than individuals with DYS when neutral adjectives were forecasted ($p < .05$), and CNV prior to positive and negative adjectives did not vary by group ($p > .10$). Finally, across groups there was a main effect for lead, $F(2, 50) = 5.55$, $p < .01$, where CNV amplitudes at Fz were smaller than those at Cz ($p < .01$), and marginally smaller than those at Pz ($p < .10$). No further significant effects were observed for CNV.

Grand average ERP waveforms following S2 are presented in Figure 4, and average PINV amplitudes for each group at each valence condition are presented in Table 2. PINV analyses revealed a main effect of Valence, $F(2, 48) = 3.32$, $p < .05$, where PINV amplitudes were larger in response to neutral compared to positive adjectives ($p < .05$). There was also a main effect of Group, $F(1, 24) = 6.66$, $p < .05$, where individuals with DYS had larger PINV amplitudes than healthy controls ($p < .05$). Finally, there was a marginally significant Valence $\times$ Lead interaction, $F(4, 96) = 3.84$, $p < .10$, where PINV at Pz was larger in response to neutral compared to positive adjectives ($p < .05$). No further significant effects were observed for PINV.

There were no significant correlations between CNV or PINV and self-report measures of symptom severity.

Discussion

The purpose of this study was to determine whether healthy controls and individuals with DYS demonstrate biased anticipation for future affective events at a behavioral and neurophysiological level. Behavioral data indicate that healthy controls expect fewer negative adjectives to apply to them in the future than either neutral or positive adjectives, and individuals with DYS expect fewer positive adjectives to apply to them in the future than either neutral or negative adjectives. Furthermore, these behavioral anticipation biases distinguished healthy controls from individuals with DYS, and they were correlated with measures of depression and anxiety. ERP data indicate that healthy controls have greater anticipation (larger CNV amplitudes) for positive compared to neutral or negative events, and more anticipation for neutral events than individuals with DYS. However, neurophysiological anticipation was not correlated with measures of depression or anxiety.

These results are generally consistent with cognitive models of depression (Abramson et al., 1978, 1989; Beck, 1967, 1987). In particular, Abramson et al. (1978, 1989) posit that depression is associated with frequent exposure to negative events and infrequent exposure to positive events, which result in more anticipation for negative compared to positive events in the future. The present study indicates that individuals with DYS expected more negative than positive adjectives to describe them in the future, and these data are consistent with earlier behavioral studies of cognitive bias in individuals with major depressive disorder (e.g., Andersen et al., 1992; Serfaty et al., 2002). Furthermore, because we used self-reference ratings for neutral adjectives as a comparison condition, this study demonstrates that behavioral anticipation of negative adjectives is reduced in healthy controls (rather than being enhanced for positive stimuli), while behavioral anticipation of positive adjectives is reduced in individuals with DYS (rather than being enhanced for negative stimuli).

The direction of behavioral anticipation biases differed from the direction of neurophysiological anticipation biases, indexed by CNV. While healthy controls showed reduced behavioral anticipation for negative affect, they demonstrated larger CNV amplitudes

prior to positive versus neutral or negative adjectives. Furthermore, while individuals with DYS had reduced behavioral anticipation of positive affect, there was a non-significant trend for them to have larger CNV amplitudes prior to negative versus neutral adjectives. Thus, healthy individuals exhibit reduced anticipation of naturalistic negative events, but enhanced anticipatory processing of immediately oncoming positive information in laboratory conditions. Individuals with DYS exhibit reduced anticipation of naturalistic positive events, but tend to have enhanced anticipatory processing of immediately oncoming negative information in laboratory conditions. Despite within-group differences, there were no differences between groups in CNV amplitude prior to positive or negative stimuli. However, controls demonstrated more anticipatory processing of neutral stimuli than individuals with DYS. These data are consistent with general reductions in CNV amplitude prior to non-affective, non-self-relevant, stimuli in individuals with major depression compared to healthy controls (Ashton et al., 1988; Giedke & Bolz, 1980; Timsit-Berthier, 1993), and may reflect a selective reduction in anticipation for stimuli without hedonic value.

Participants did not exhibit the predicted interaction between affective valence and group on measures of response uncertainty (response time, PINV). Rather, ratings of adjective self-reference took longer for neutral compared to positive or negative adjectives across groups, and PINV amplitudes were larger overall for individuals with DYS than healthy controls. Larger response times and non-response rates observed for neutral stimuli reflect difficulty anticipating the future self-reference of these adjectives. Furthermore, our PINV data indicate reduced response certainty in DYS, and these results are consistent with literature demonstrating larger PINV amplitudes in participants with major depression compared to healthy controls (Kessler et al., 1992; Knott et al., 1991; Thier et al., 1986). Enhanced PINV amplitudes in individuals with DYS compared to controls could reflect indecisiveness, which is a feature of both DYS and major depression. However, this neurophysiological index of decreased response certainty was not reflected by concurrent increases in response time.

The functional significance of CNV and PINV is not unanimously agreed upon. While CNV is probably most well-known as a measure of stimulus anticipation, it has also been interpreted as an index of motivation, excitability, and motor preparation independent of cognitive anticipation (for reviews see Fabiani et al., 2007; McCallum, 1988; Rockstroh et al., 1989). Likewise, PINV has been interpreted variously as an index of response uncertainty, stimulus ambiguity, and stimulus uncontrollability (for reviews see McCallum, 1988; Rockstroh et al., 1989). It is unclear whether alternate interpretations of CNV or PINV would change the significance of these ERP results: biased anticipation/motivation/excitement (larger CNV) for future positive adjectives characterized healthy controls, individuals with DYS had reduced anticipation/motivation/excitement (smaller CNV) for future neutral stimuli compared to controls, participants demonstrated less certainty/clarity/control (larger PINV) during decisions about neutral adjective future self-reference, and individuals with DYS had less certainty/clarity/control (larger PINV) overall than healthy controls.

Changes in the characteristics of CNV and PINV are observed in many forms of pathology, including major depression, schizophrenia, anxiety disorders, epilepsy, and Parkinson's disease (for review see McCallum, 1988). Rather than specifying particular forms of pathology, these components reflect synchronous activity in the frontal cortex, anterior cingulate, and thalamus during stimulus anticipation and response monitoring (Fan et al., 2007; Nagai et al., 2004; Zappoli, 2003). Though the timing, amplitude, and distribution of ERP components can vary widely across populations and experimental tasks (McCallum, 1988), the definitions and distributions reported here for CNV and PINV are within the usual ranges. The utility of this research is in the use of these ERP components as indices of cognitive processes that pertain to models of depression.

This study addresses a need for research on future-oriented biases in depressive disorders such as DYS, and it is unique in its combined use of behavior and the CNV and PINV ERP components as measures of affect anticipation and response uncertainty. Furthermore, because few differences have been found between individuals with DYS and those with other chronic forms of depression (McCullough et al., 2003), the implications of these data may extend to other populations of depressed patients. This study also has several limitations. Unfortunately, small sample size prevented us from analyzing ERP data across all leads, though graphs of CNV and PINV across all leads in right-handed participants with resolvable artifact produced remarkably similar results. Another limitation is that we did not control for stimulus arousal, and we used undergraduates rather than study participants to rate stimulus valence and arousal. A final limitation, and hopefully one that will stimulate further research, is that we did not employ a control task to distinguish the effects of future-orientation from mood-congruent biases observed in past- or present-oriented tasks. Participants' ratings of which adjectives will describe them over the next two weeks may reflect their current mood as much, if not more than, their anticipated mood.

In summary, anticipation biases characterized healthy controls and individuals with DYS. Affective biases are important to understand because mood disorders are a leading cause of worldwide disease burden (Murray & Lopez, 1996). Furthermore, characteristic symptoms of mood disorders (e.g., low mood, anhedonia, decision-making difficulties, suicidality) may result from unrealistic or unhelpful predictions about future affective events. Insights into the behavioral and neurophysiological mechanisms of affective anticipation biases may eventually improve the effectiveness of cognitive-behavioral therapy and similar mood-disorder treatments. Future research may benefit from explicit tests of illness severity and chronicity on affective anticipation biases in mood disorders as it is likely that illness chronicity is positively correlated with degree of anticipation for negative stimuli, and negatively correlated with degree of anticipation for positive stimuli. Furthermore, ERPs can be used to identify additional components of cognitive processing that underlie behavioral indications of adjective future self-reference. Finally, manipulations of stimulus self-reference and arousal may determine whether these constructs are important to the phenomenology of unipolar mood disorders.

Acknowledgments

This research was supported in part by NIMH B/START Grant 1R03MH57694-01 and Harvard College Research Program grants. We thank the study participants, Andrea S. Kim for assistance with data collection, James Long, Lufeng Liu and Nikhil R. Borkhetaria for assistance with physiological data reduction, and Theresa M. Lee for comments on the manuscript.

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Figure 1.

Average (and standard deviation) self-reference ratings for positive (pos), neutral (neu), and negative (neg) adjectives, separated by group. Significant differences are indicated for within-group valence comparisons (V; $p < .01$) and between-group comparisons (G; $p < .001$); self-reference ratings for marked valence conditions (V) were significantly less than self-reference ratings for the two alternative valence conditions in both groups.

Figure 2. Grand average ERP waveforms following positive, neutral, and negative warning symbols, separated by group and lead. Data from 800-3000 ms were characterized as CNV.

Figure 3.

Average (and standard deviation) CNV amplitude for positive (pos), neutral (neu), and negative (neg) adjectives, separated by group. Significant differences are indicated for within-group valence comparisons (V; $p < .05$) and between-group comparisons (G; $p < .05$); CNV prior to positive adjectives was significantly larger than the two alternative valence conditions in control participants.

Figure 4.

Grand average ERP waveforms following positive, neutral, and negative adjectives, separated by group and lead. Data from 4000-5000 ms were characterized as PINV.

Table 1
Group Demographics and Self-Report Questionnaire Scores

	CTL (<i>n</i> = 15)	DYS (<i>n</i> = 12)	χ^2/F	<i>p</i>
Gender	10♀, 5♂	6♀, 6♂	$\chi^2 (1) = 0.8$	<i>p</i> > .10
Handedness	13 R, 2 L	9 R, 2 L, 1 A	$\chi^2 (2) = 1.4$	<i>p</i> > .10
Age	31.6 (11.7)	35.8 (15.2)	<i>F</i> (1, 25) = 0.9	<i>p</i> > .10
Education	16.3 (1.3)	15.3 (2.0)	<i>F</i> (1, 23) = 4.3	<i>p</i> > .10
BDI	2.6 (3.5)	22.6 (9.9)	<i>F</i> (1, 25) = 53.2	<i>p</i> < .001
BHS	1.6 (1.2)	12.4 (4.7)	<i>F</i> (1, 25) = 73.7	<i>p</i> < .001
STAI	26.3 (5.4)	38.1 (12.5)	<i>F</i> (1, 25) = 10.8	<i>p</i> < .01
STAIT	30.1 (5.4)	57.1 (10.0)	<i>F</i> (1, 25) = 80.1	<i>p</i> < .001

Note: Handedness was assessed using the Edinburgh Handedness Questionnaire (Oldfield, 1971; R = right handed, L = left handed, A = ambidextrous). Means (and standard deviations) are provided for age, number of years of education, and self-report questionnaire scores (Beck Depression Inventory; BDI; Beck et al., 1961; Beck Hopelessness Scale; BHS; Beck et al., 1974; State/Trait Anxiety Inventory; STAI/STAIT; Spielberger et al., 1970). Post-hoc testing for all self-report questionnaire scores indicates that healthy controls (CTL) differed significantly from individuals with DYS. Education was unavailable for two control participants and these data are therefore omitted from this select demographic analysis.

Table 2
Mean (and Standard Deviation) Self-reference Ratings, Response Times, CNV Amplitudes, and PINV Amplitudes

	CTL	DYS
Self-reference (%)		
Positive	80.2 (18.9)	22.6 (12.8)
Neutral	68.2 (16.3)	53.5 (25.0)
Negative	12.3 (16.1)	67.2 (19.6)
Response time (ms)		
Positive	426.2 (16.8)	439.6 (27.8)
Neutral	450.1 (18.0)	464.2 (27.9)
Negative	428.7 (24.7)	444.6 (22.9)
CNV (μV)		
Positive	-2.8 (5.0)	0.0 (3.63)
Neutral	-0.6 (3.0)	1.6 (2.3)
Negative	0.8 (4.1)	-0.9 (3.6)
PINV (μV)		
Positive	4.4 (4.5)	1.0 (4.2)
Neutral	3.1 (4.1)	-1.2 (3.7)
Negative	2.5 (4.3)	0.6 (4.3)