Published in final edited form as:

J Posit Psychol. 2009 March ; 4(2): 182–192. doi:10.1080/17439760802650600.

The Time Course of Positive and Negative Emotion in Dysphoria

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Abstract

Prior research has demonstrated attenuated reactivity to positive stimuli among depressed and dysphoric individuals, and inconsistent evidence regarding attenuated reactivity to negative stimuli. However, such research has measured experiential reactivity to emotion stimuli in one static moment, which may obscure important information regarding the time course and dynamics of emotion. The current study employed continuous measurement of experiential emotion during and following the presentation of emotion eliciting film clips. Results revealed that dysphoric individuals ($n=16$), as compared to nondysphoric controls ($n=31$), were equally responsive to positive and negative film clips in terms of peak reactivity during and following the clip. The most striking difference between groups was that dysphoric individuals showed a shortened time course of positive emotion. These emotion dynamics suggest that perhaps the most important aspect of positive emotion regulation in the context of depressed mood is not the inability to initially react to a positive experience, but rather the inability to maintain positive emotion. Possible underlying mechanisms of positive emotion regulation are discussed, and implications for intervention are highlighted.

Keywords

dysphoria; positive emotion; emotion reactivity; emotion regulation; depression

Introduction

Positive emotion has been shown to play an important role in healthy socio-emotional (1998), cognitive (e.g., Isen, 1999) and physical (e.g., Salovey, Detweiler, Steward, & Bedell, 2001) functioning. Studies have shown that the attenuation of positive emotion is a core feature of depression (Clark & Watson, 1991) and possibly dysphoric mood states (Sloan, Bradley, Dimoulas, & Lang, 2002). Given that dysphoric mood is a prominent risk factor for the development of depression (Lewinsohn, Rohde, Klein, & Seeley, 1999), understanding positive emotion in the context of dysphoria is indicated.

In the depression literature, attenuated positive emotion reactivity has been demonstrated with notable consistency across response systems, methodologies, and measurement modalities (Bylsma, Morris, & Rottenberg, 2008). Individuals with depression show attenuated reactivity to positive stimuli (e.g. positive picture slides, pleasant film clips) as measured by experiential self reports (Berenbaum & Oltmanns, 1992; Rottenberg, Gross, & Gotlib, 2005; Rottenberg, Kasch, Gross, & Gotlib, 2002; Sloan, Strauss, & Wisner, 2001), behavioral responses (Allen, Trinder, & Brennen, 1999; Sloan, Strauss, Quirk, & Sajatovic, 1997), and neurobiological activation patterns (Davidson, 1998; Davidson, Abercrombie, Nitschke, & Putnam, 1999).

Physiological indices of positive emotion attenuation in depression historically have been less consistent (Dichter & Tomarken, 2008; Rottenberg et al., 2005), but a recent meta-analysis demonstrated an overall effect (Bylsma et al., 2008).

Somewhat less is known about positive emotion among dysphoric or sub-clinically depressed individuals, though Sloan's et al.'s (2002) evaluation of behavioral and experiential emotion among dysphoric and nondysphoric individuals indicated a similar pattern of attenuated positive emotion. Given the demonstrated role of positive emotion in adaptive coping (e.g., Burns et al., 2008; Folkman & Moskowitz, 2000) and in the regulation of negative emotion or mood among healthy populations (Fredrickson, 2000b; Fredrickson & Levenson, 1998; Tugade & Fredrickson, 2004), the regulation of positive emotion could be an important target for prevention and intervention programs. Several researchers have already recommended the development of treatments to increase positive emotion in depression (Forbes & Dahl, 2005; Fredrickson, 2000a; Karwoski, Garratt, & Ilardi, 2006), and initial trials are ongoing (Seligman, Rashid, & Parks, 2006). Likewise, targeting positive emotion in dysphoria—a population subject to functional impairment and vulnerability to depression (Gotlib, Lewinsohn, & Seeley, 1995; Sheeber, Davis, Leve, Hops, & Tildesley, 2007)—may mitigate negative trajectories associated with mood dysregulation. As both prevention and treatment development move forward, however, it is important to continue to gain a more complete understanding of the regulation of positive emotion in the context of depressed mood. In this way, intervention development and advances in basic science can continue to be mutually informative.

Prevailing definitions of emotion regulation include not only the regulation of initial negative or positive affective arousal, but also the enhancement or dampening of such arousal over time (Thompson, 1994). To date, however, research has measured experiential emotion in the context of depressed mood at a single time point: a participant is exposed to a stimulus, and then asked for a one-time rating of the emotional experience. Physiological data and EEG studies also primarily have relied on one-time probes or data aggregated across a time period. Recently, data from physiological measures (startle eye blink and cardiovascular recovery) and fMRI have provided preliminary support for the notion that the time course of emotion reactivity may be an important consideration among depressed individuals (Dichter & Tomarken, 2008; Rottenberg, Wilhelm, Gross, & Gotlib, 2003; Siegle, Thompson, Carter, Steinhauer, & Thase, 2007). However, even these data have been limited in their sensitivity to moment-to-moment change. For example, startle eye blink methods require several individual probes to assess emotion reactivity at different points in time (thus limiting information about what is occurring between such probes), while cardiovascular recovery has been assessed by aggregating data points and comparing mean levels across various conditions. The current study seeks to gather continuous experiential data that may offer insight into the moment-to-moment emotion dynamics that dysphoric individuals experience in response to emotion stimuli. These emotion dynamics could offer greater insight into underlying emotion (dys) regulation.

Tugade and Fredrickson (2007) have noted that healthy individuals show an important regulatory capacity to maintain or enhance positive emotion over time. Comparatively, Forbes and Dahl (2005) have suggested that depressed individuals may be unable to regulate positive emotion through initial activation, as well as through subsequent maintenance and enhancement. This pattern of emotion regulation among depressed individuals could be reflected by emotion dynamics such as a shortened time course of positive emotion, for which recent physiological data offer preliminary support. Specifically, Dichter and Tomarken (2008) demonstrated that immediately preceding (0.75 s) and immediately following positive slide presentation (0.3 s), depressed and nondepressed participants responded similarly to a startle eyeblink probe, while more distal probes (2.0 s before slide presentation, 3.5-4.0 s following the onset of slide presentation) demonstrated a response consistent with positive

emotion attenuation among the depressed group. The failure to find differences in initial reactivity of positive emotion was somewhat surprising, as this is inconsistent with prior data (Bylsma et al., 2008). Although the current study seeks to understand emotion reactivity in the context of dysphoric mood, rather than Major Depressive Disorder (MDD), the continuous data approach may help to disentangle findings like these by providing a moment-to-moment time course of experiential emotion reactivity. Also, the current study may offer insights into the time course of emotion reactivity in MDD for future investigation.

The experience and regulation of negative emotion in the context of depressed mood is also important to understand. Despite numerous studies of experiential negative emotion in depression (Bylsma et al., 2008; Sloan et al., 2001) and at least one in dysphoria (Sloan et al., 2002), none have reported on its immediate time course following an event. Although there has been some inconsistency in findings, a recent meta-analysis (Rottenberg, 2008) suggests a small effect of attenuated negative emotion reactivity across studies among depressed individuals. At least one report of experiential negative emotion reactivity among dysphoric participants demonstrated no difference in reactivity relative to nondysphoric participants (Sloan et al., 2002), but this null finding has not been replicated and requires further investigation.

The finding that negative emotion reactivity is either typical or attenuated among individuals with depressed mood is somewhat unexpected. In fact, in their tripartite model, Clark and Watson (1991) suggest that increased negative emotion characterizes both anxiety and depression; and several theoretical perspectives stress negative cognition and negative mood as core features of depressed mood (Abramson, Garber, Edwards, & Seligman, 1978; Beck, 1967; Nolen-Hoeksema, 1991). This discord in the literature may be addressed by elucidating the distinction between emotion and mood. Rottenberg et al. (2005) suggests that despite an increased negative mood and a diminished positive mood, individuals with Major Depressive Disorder are disengaged from immediate emotional contexts (Emotion Context Insensitivity--ECI) and show poor modulation of emotion in reactivity to emotion stimuli. In the case of dysphoric mood, it also seems possible that although mood states are negative, emotion reactivity is somewhat attenuated as dysphoric individuals experience behavioral lethargy and reduced engagement in the world around them.

However, it may also be that understanding the time course of experiential emotion reactivity in the context of dysphoric mood could provide additional insights into findings related to negative emotion reactivity. That is, individuals experiencing depressed mood may show attenuated initial responses to emotion contexts (consistent with an ECI model of emotion reactivity in depression) but also subsequently fail to offset and recover from these initial responses over time. Such a pattern of emotion dynamics may reflect potentially maladaptive regulatory strategies (e.g. rumination rather than distraction or positive reconstruction) that are pervasive in dysphoria and depressive disorders, and contribute to a chronic negative mood state. In fact, if this were true, it would reconcile experiential data with fMRI time course data that suggests that individuals with MDD experience a sustained amygdala response to negative stimuli (Siegle et al., 2007), and physiological data among children at risk for depression (Forbes, Fox, Cohn, Galles, & Kovacs, 2006) and adults with depression (Rottenberg et al., 2003) that suggest slower cardiovascular recovery following negative emotion reactivity.

The primary aim of the present study is to examine the temporal dynamics of positive and negative emotion reactivity in the context of dysphoric mood. Specifically, we expect to replicate previous research indicating attenuated initial experiential responses to positive and negative emotion stimuli in dysphoria (Sloan et al., 2002). That is, the dysphoric group, relative to the nondysphoric comparison group, will show diminished positive emotion reactivity following the offset of the positive stimulus (hypothesis 1), and diminished negative reactivity

following the offset of the engative stimulus (hypothesis 2). Although one prior study in dysphoria demonstrated no effect for initial negative reactivity (Sloan et al., 2002), the weight of the evidence as indicated by a recent meta-analysis of negative emotion reactivity in clinical depression supports a small effect for the attenuation of negative emotion reactivity in the context of depressed mood. Thus, we propose that this effect will replicate among the dysphoric sample.

In addition, we expect to extend this line of research by demonstrating that the time course of positive emotion is curtailed, whereas the time course of negative emotion is extended, among dysphoric individuals. Specifically, the dysphoric group, relative to the nondysphoric comparison group, will show a steeper slope, or more rapid return to their own emotion baseline, following initial positive emotion reactivity (hypothesis 3), and a shallower slope, or slower return to baseline, following initial negative emotion reactivity (hypothesis 4).

Finally, previous research on experiential emotion in depression has generally investigated emotion following the offset of slides or film clips. Therefore, in the current study we are also interested in evaluating experiential emotion across a temporal course during the film clip--at the point when each individual reported their strongest emotional reaction, or peak reactivity. It is important to test hypotheses of emotion reactivity both within and outside of the context of the emotion eliciting stimulus. Otherwise, resting state versus engagement in a stimulus could be contributing to findings in an important way. With regard to the positive film clip, we anticipate that the dysphoric group, relative to the nondysphoric comparison group, will show attenuated peak reactivity of both positive emotion (hypothesis 5) and negative emotion (hypothesis 6). In addition, the duration of emotion reactivity following these peaks for the dysphoric group, relative to the nondysphoric group, will be shorter for positive emotion (hypothesis 7), and longer for negative emotion (hypothesis 8).

Method

Participants

Participants were 47 undergraduates between the ages of 18 and 23 who were recruited from undergraduate psychology classes (see Table 1 for descriptive data). Sixteen of the participants made up the dysphoric group based on scores on the Beck Depression Inventory (BDI-I) of 16 or greater (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). These scores were required at two time points: during initial screening as part of recruitment, and during attendance at the experimental session. These visits were an average of 15.7 days apart ($SD=7.85$), suggesting some stability in reported depressive symptoms. On the BDI-I, cut off scores have been established such that scores between 10 and 15 represent the dysphoric range, whereas scores of 16 and above represent the dysphoric/depressed range (Kendall, Hollon, Beck, Hammen, & et al., 1987). Non-depressed participants, per Kendall et al. (1987) scored at or below the normative mean of 9 on the BDI-I. Four participants were excluded from the sample at screening because they were receiving pharmacotherapy ($n=3$) or psychotherapy ($n=1$) for psychiatric symptoms. These exclusion criteria were included to maintain a sample free from ongoing intervention-related effects on emotion reactivity.

Stimuli

The selected film clips have been shown to elicit emotions reliably (Gross & Levenson, 1995). The negative film clip was 170 seconds in duration and depicted a young boy who is upset about the death of his father. The positive film clip (168 s) depicted a humorous interaction between a male and a female friend¹. The three neutral film clips (180 s) were created for the current study and depicted various shapes, balls and pinwheels moving around the screen. The mean for the neutral film clips across participants was 5.47 ($SD=1.06$) on a 9

point scale and did not differ significantly between groups ($Z=-1.57$, $p=.12$). No participants reported having a strong emotion response to the neutral clips in post-hoc questionnaires.

Measures

Continuous affect ratings—Continuous experiential ratings of emotion were obtained using an affect meter which was a variant of a previously validated meter (Levenson & Gottman, 1983). The affect meter is a slide lever that allows participants to move a pointer from left (“1” Very Negative) to right (“9” Very Positive). Participants were asked to move the lever as often as necessary so that it always reflected their current emotional experience. The lever was attached to a potentiometer in a voltage-dividing circuit that was monitored by a computer that sampled at a rate of 200 Hz. Data from this equipment was maintained at the level of seconds.

Beck Depression Inventory (BDI-I)—The BDI-I (Beck et al., 1961) is a commonly used self report questionnaire. The 21 items assessed various symptoms of depression including sadness, disturbances in eating and sleeping, anhedonia and suicidal ideation. For each item, participants endorsed one of four statements graded in severity from 0 to 3 that reflected the degree to which they have experienced particular depressive symptoms in the last two weeks.

Procedure

All participants provided written informed consent prior to the experimental session and received course credit for their participation. All procedures were approved by a university based IRB. Participants were first screened with a BDI-I, and within 2 weeks were contacted with an invitation to participate in the study if their screening measure was either above 16 (dysphoric group), or between 1 and 9 (nondysphoric group). Upon arrival at the lab, participants again completed the BDI-I at a computer. Participants who *again* scored between 1 and 9, or above 16 on the BDI-I, and who were not currently enrolled in psychotherapy or pharmacotherapy, were entered in the study. Participants who did not qualify were offered course credit, thanked for their time, and offered referrals as appropriate. Qualified participants were moved to a different chair in a viewing room surrounded by curtains. Videos were projected on a white wall (approximately 6 feet in front of the participant) at a size of 4×3 feet. Participants received practice with the affect meter by viewing picture slides, and were then instructed that they would be viewing a series of short film clips and black screens with instructions. They were instructed to move the lever as much as needed to reflect their current emotion experience. Next, participants viewed the neutral film clip #1, negative film clip, neutral film clip #2, positive film clip, and neutral film clip #3 (the order of the negative and positive film clips was randomly counterbalanced across participants). Each film clip was followed by a 60-second rest period during which the black screen read, “Please continue rating your emotion.” At the conclusion of viewing, participants were debriefed and asked 1) if they had seen the video before and 2) what emotion (s), if any, was elicited by each film clip.

A 60 second interval was chosen as the rest period for several reasons. First, we were interested in measuring emotion, rather than mood, which has been described as occurring on the order of seconds or minutes (e.g., Oatley, Keltner, & Jenkins, 2006). Second, prior research investigating emotion reactivity or emotion regulation over time using physiological, neurobiological or expressive measures has used time frames following stimulus offset of 6-14 seconds with good success (e.g., Dichter & Tomarken, 2008; Forbes, Miller, Cohn, Fox, &

¹In previous research (Gross & Levenson, 1995), the positive emotion film clip has been shown to most often elicit amusement, while the negative film clip has been shown to most often elicit sadness. However, in the current study, participants used a nonspecific emotion rating dial (1-9; negative to positive). Also, post hoc questionnaires indicated appropriate elicitation of positive and negative valence, but some variation in the specific positive or negative emotion elicited (e.g. amusement vs. happiness). Therefore, the emotions elicited by the films in the current study are described as “positive” and “negative” rather than “amusement” and “sadness.”

Kovacs, 2005). Finally, in one prior study that used films and an affective meter to evaluate experiential emotion (Fredrickson & Levenson, 1998), the period of rest following the film clips was 150 seconds. However the experiential data were not reported for the rest period (rather, data points during film clip viewing were aggregated into mean values) making it difficult to ascertain the period of recovery for experiential emotion. Cardiovascular measures which were analyzed during the 150 second rest period revealed a mean of 33.59 (SD=27.29) seconds to recovery. Based on all of this information, we felt that a 60 second time frame should be a sufficient time period to evaluate recovery, while minimizing the risk of participants becoming bored or tired during rest periods.

Results

Preliminary tests

Descriptive statistics are reported in Table 1. Tests and plots of normality indicated that skewness and kurtosis were within acceptable limits, and there were no extreme outliers. A chi square analysis of group by gender revealed no differences in group membership, $X^2 = 3.19$, $p = .07$. However, given the trend towards an effect whereby more females were included in the dysphoric group, subsequent analyses were conducted with gender included in the HLM models at level 2, and as a covariate in the univariate models. Results did not change with the inclusion of gender. For ease of interpretation and to maximize power, the results reported here do not include gender as a level 2 variable, or a covariate.

Hierarchical linear models

Two hierarchical models (positive condition, negative condition) are proposed to examine emotion response both in terms of initial reactivity and subsequent slope of reactivity following the positive and negative film clips. For both hierarchical linear models (positive and negative), emotion rating difference scores are the outcome variable (see specific model descriptions below for calculations of difference scores). Time was entered as a level 1 predictor (60 seconds following the positive/negative film clip). Dysphoric Category (nondysphoric vs. dysphoric, dummy coded 0 and 1, respectively) was entered as a Level 2 predictor. Thus, each person at Level 2 has 60 data points at Level 1 (time) predicting emotion rating difference scores, necessitating an analytic strategy that handles hierarchical data. The random effect terms are included to allow for random variation due to variables not included in the model. This approach allows us to utilize multiple data points across time, controlling for the hierarchical nature of the data, and ultimately analyzing trajectories of emotion across a sixty-second time interval.

$$\text{Level 1: } (\text{Positive/Negative Emotion})_{ij} = \beta_{0j} + \beta_{1j}(\text{Time})_{ij} + r_{ij}$$

$$\begin{aligned} \text{Level 2: } \beta_{0j} &= \gamma_{00} + \gamma_{01}(\text{Dysphoric Category})_j + \mu_{0j} \\ \beta_{1j} &= \gamma_{10} + \gamma_{11}(\text{Dysphoric Category})_j + \mu_{1j} \end{aligned}$$

Positive emotion

A hierarchical linear model is proposed to examine the research question that dysphoric individuals, compared to control, will show a weaker initial response to a positive stimulus (hypothesis 1) and a steeper slope back towards baseline from the initial positive emotion response (hypothesis 3). The positive emotion model was run using random effects hierarchical regression. Dysphoric category was entered at level 2 as a group-level variable. At level 1, time

was entered as an individual predictor of positive emotion rating difference score (outcome variable)².

Contrary to prediction, a main effect for Dysphoria was not found, coefficient = $-.5011$, $p > .05$, suggesting that dysphoric and nondysphoric individuals had similar initial ratings of positive emotion³ (hypothesis 1). A main effect was found for time, coefficient = $-.0286$, $p < .05$, indicating that positive emotion significantly declined across time. Consistent with prediction, a significant cross-level interaction was found, coefficient = $-.0291$, $p < .05$, suggesting that dysphoric individuals showed steeper declines than the nondysphoric individuals in positive emotion across time (hypothesis 3 see Table 2, see Figure 1). Thus, dysphoric and nondysphoric individuals had similar initial positive emotion, but the dysphoric individuals were not able to maintain this emotion across time relative to the nondysphoric individuals.

A between subjects one-way Analysis of Variance (ANOVA) was conducted to examine differences in levels of peak positive emotion during the film clip (hypothesis 5). To create a difference score to reflect peak positive emotion reactivity, each participant's neutral film clip mean (mean across 180 emotion ratings during the first neutral film clip) was subtracted from their maximum emotion rating during the positive film clip. This peak positive emotion reactivity difference score was entered as the dependent variable. Dysphoric status was the between factor independent variable. Contrary to prediction, results revealed no significant group differences between dysphoric ($M = 2.61$; $SD = 1.01$) and nondysphoric ($M = 2.75$, $SD = 1.16$) groups, $F(1, 45) = .17$, $p > .05$. These results suggest no differences between groups in their peak positive emotion reactivity (after controlling for baseline emotion) in response to the positive film clip.

A between subjects ANOVA was conducted to examine group differences in duration of peak positive emotion. Time (seconds) that participants stayed at their maximum emotion rating was entered as the dependent variable, and dysphoric status was the between factor independent variable. Consistent with prediction (hypothesis 7), results revealed a significant difference between dysphoric ($M = 24.00$, $SD = 25.13$) and nondysphoric ($M = 70.94$, $SD = 68.71$) groups, $F(1, 45) = 6.92$, $p < .05$, suggesting that nondysphoric individuals maintained their peak rating of positive emotion longer than dysphoric individuals.

Negative emotion

A second hierarchical linear model is proposed to examine the research question that dysphoric individuals, relative to control, would show no difference in their initial response to a negative stimulus (hypothesis 2) and a shallower slope back towards baseline following this initial response (hypothesis 4). The negative emotion model was run using random effects hierarchical regression. Dysphoric category was entered at level 2 as group-level variable. At level 1, time was entered as an individual predictor of negative emotion rating difference scores.⁴ Contrary to prediction, a main effect for dysphoria was not found, coefficient = $-.1780$, $p > .05$, suggesting that dysphoric and nondysphoric individuals had similar initial ratings of negative emotion (hypothesis 2).⁵ A main effect was found for time, coefficient = $-.0182$, $p < .05$, indicating that negative emotion significantly declined across time. Contrary to

²Positive emotion rating difference scores for HLM analyses were calculated by subtracting each participant's baseline rest mean (mean score of the 60 emotion ratings acquired during the rest period following the first neutral clip) from each of the 60 emotion ratings acquired during the rest period following the positive film clip. Difference scores were used to account for baseline emotion (Sloan, 2001).

³Significance of results for HLM analyses did not change when raw data, rather than difference scores, were used. Analyses available upon request from the corresponding author.

⁴Negative emotion rating difference scores for HLM analyses were calculated by subtracting each of the 60 emotion ratings acquired during the rest period following the negative film clip from each participant's baseline rest mean (mean score of the 60 emotion ratings acquired during the rest period following the first neutral clip).

prediction, the cross-level interaction was not significant, coefficient = .0091, $p > .05$, suggesting that dysphoric and nondysphoric individuals showed similar declines in negative emotion across time (hypothesis 4, see Table 2). Thus, negative emotions declined at similar rates across time for both dysphoric and nondysphoric individuals.

A between subjects Analysis of Variance (ANOVA) was conducted to examine differences in levels of peak negative emotion during the film clip. To create a difference score to reflect peak negative emotion reactivity while controlling for baseline emotion ratings (e.g., Sloan et al., 2001), each participant's maximum negative emotion rating (or lowest rating on the 1-9 scale) during the negative film clip was subtracted from their neutral film clip mean (mean across 180 emotion ratings during the first neutral film clip). This peak negative emotion reactivity difference score was entered as the dependent variable. Dysphoric status was the between factor independent variable. Results revealed no significant group differences between dysphoric ($M = 4.41$, $SD = 1.49$) and nondysphoric ($M = 4.26$, $SD = 1.79$) groups, $F(1, 45) = .09$, $p > .05$ while controlling for baseline emotion. These findings suggest that dysphoric and nondysphoric groups did not differ in their peak negative emotion reactivity during the negative film clip (after controlling for baseline).

A between subjects ANOVA was conducted to examine group differences in duration of peak negative emotion. Time that participants stayed at their highest rating of negative emotion was entered as the dependent variable and dysphoric status was the between factor independent variable. Results revealed no significant difference between dysphoric ($M = 64.06$, $SD = 63.90$) and nondysphoric ($M = 58.16$, $SD = 54.75$) groups, $F(1, 45) = .11$, $p > .05$. These results suggest that dysphoric and nondysphoric groups did not differ in the duration of their negative emotion reactivity.

Additional analyses

Given the null finding for between group differences in negative emotion slope, we evaluated what percentage of each group recovered during the rest period. This analysis was conducted in order to ensure that 60 seconds was sufficient time for recovery from the negative film clip. To define recovery, we first created a baseline range by calculating a mean across the 60 second neutral rest period for each participant, and then added and subtracted one standard deviation from this mean to create the baseline range. Next, we categorically ("0" = failed to recover, "1" = recovered) determined whether or not each participant's emotion ratings returned to their own baseline range (and remained there for 5 out of 6 seconds) during the 60 second time period following the positive and negative film clips. This approach to evaluating recovery by creating a baseline range has not been used with experiential data, to our knowledge, but it has been described and used to evaluate cardiovascular recovery from film clips among healthy adults (Fredrickson & Levenson, 1998). We were interested in this approach as a definition of "recovery" that considered the dynamic nature of the continuous data in the current study, and the individual variability of the magnitude of this change.

For the negative film clip, the majority of participants in both groups failed to return to baseline, 65% of the nondysphoric group and 75% of the dysphoric group. A group (dysphoric, nondysphoric) by recovery (recovered, not recovered) chi square analysis revealed no between group differences in recovery category membership, $X^2 = .53$, $p > .05$, suggesting that both dysphoric and nondysphoric groups had similar rates of participants who recovered from emotion elicitation.

⁵Significance of results for HLM analyses did not change when raw data, rather than difference scores, were used. Analyses available upon request from the corresponding author.

For the positive film clip, participants who failed to return to baseline (and, that is, rated emotion *above* their baseline range throughout the 60 second rest period), were disproportionately part of the nondysphoric group (78%) as compared to the dysphoric group (50%). A group (dysphoric, nondysphoric) by recovery (recovered, not recovered) chi square analysis revealed a trend toward a significant difference between groups in recovery category, $X^2 = 3.65$, $p = .06$, suggesting a trend for individuals in the nondysphoric group to maintain positive emotion above their baseline for the entire 60 second rest period, relative to the dysphoric group.

Discussion

The aim of this study was to investigate the time course of positive and negative emotion reactivity in the context of depressed mood. Results showed an important difference in the time course positive emotion between individuals who reported depressed mood and those who did not. Although both groups showed similar initial reactivity to positive stimuli, dysphoric individuals showed a pattern of reactivity indicative of more rapid fading compared to nondysphoric comparisons. These emotion dynamics suggest that perhaps the most important aspect of positive emotion regulation in the context of depressed mood is not the inability to *initially react* to a positive experience, but rather the subsequent inability to *maintain positive emotion*. Consistent with our hypothesis, dysphoric individuals showed a relatively steep degradation of positive emotion following the end of a positive experience as compared to controls. However, contrary to our prediction and previous research, the dysphoric individuals did not show attenuation in initial positive emotion reactivity.

This pattern of results was also replicated in the analyses of peak positive emotion which occurred during the film clip. That is, no support was found for a group difference in peak positive emotion response, but there was evidence indicating a shorter duration of this peak positive emotion response among the dysphoric group compared to the nondysphoric comparison group. These results are consistent with findings reported by Dichter and Tomarken (2008) indicating that startle eye blink responses to positive stimuli were not consistent with positive attenuation among a depressed group at first probe, but did support positive attenuation at a later probe, relative to a nondepressed comparison group.

A rapid fading of positive emotion over time following a positive experience fits well with previous research in depression and dysphoria. There is preliminary evidence that individuals with depressive symptoms or low self esteem are less likely to savor positive events (Bryant, 2003; Bryant & Veroff, 2007; Wood, Heimpel, & Michela, 2003) while dysphoric or depressed individuals have poor memory for pleasant events (e.g., Bergouignan et al., 2008; Lyubomirsky, Caldwell, & Nolen-Hoeksema, 1998), and tend to recall or experience less positive emotion in response to positive events (Joormann, Siemer, & Gotlib, 2007; Walker, Skowronski, Gibbons, Vogl, & Thompson, 2003). It may be that the short-lived experience of positive emotion demonstrated here interferes with adequate encoding of positive events, thus leading to poor memory for positive events. Alternatively, the inability to cognitively encode and savor positive events could lead to a short lived emotion experience. Regardless of direction, there is likely a dynamic relation here between emotion and cognitive processes that occurs over the time following a positive event.

This dynamic process may serve as a prime target for prevention or intervention. As such, it is important that future research considers and measures these potential underlying mechanisms to fully understand the emotion dynamics demonstrated here. For example, if memory for positive events degrades as a function of diminished positive emotion one might expect few differences in event recall initially but emergent differences over time that are predicted by the temporal slope of positive emotion. Alternatively, initial differences in event recall in the

context of no differences in initial emotional response would suggest possible differences in encoding positive events.

Given previous results showing attenuation in initial positive reactivity among individuals with depressive symptoms, the lack of replication in this study was somewhat surprising. The most likely explanation is that methodological differences contributed to disparate results. Specifically, the current study used continuous measurement, while other research has administered a self report measure at one time point following stimulus offset. Therefore, it could be that single time point measures of emotion experience are not capturing important temporal differences. As noted previously, these data are consistent with Dichter and Tomarken's (2008) results in the depression literature, which also considered multiple time points of emotion reactivity. The current study's focus on dysphoria, rather than clinical depression, also could be a contributing factor in these results. With the exception of one previous study among dysphoric participants (Sloan et al., 2002), the majority of studies indicating attenuation of initial positive reactivity were conducted with depressed participants, suggesting the possibility that the attenuation of initial positive reactivity occurs only with more severe levels of depressive symptoms.

With regard to negative emotion reactivity, there was no support for our hypotheses. Contrary to our predictions of an attenuated response to a negative stimulus, the dysphoric group did not differ from the nondysphoric comparison group in initial negative reactivity following the offset of the clip, or peak response during the film clip. In addition, there was no support for the hypotheses that the dysphoric group would show a more shallow return towards baseline following the film clip, or that they would maintain their peak negative reactivity during the clip for a shorter duration of time.

Although these findings regarding emotion dynamics in dysphoria suggest that emotion regulation in response to negative events is typical in terms of initial reactivity and recovery, it will take further work to reconcile these findings with existing literature. With regard to initial reactivity, this is now the second study of negative emotion reactivity to suggest no differences between dysphoric and nondysphoric groups in initial emotion reactivity to negative stimuli (Sloan et al., 2002). It could be that both dysphoric and nondysphoric individuals react strongly to negative stimuli initially as they evaluate the potential for threat. With regard to the temporal course of recovery from negative experiences, one possible explanation is that methodological constraints of the current study obscured temporal findings. There is reasonable evidence in this data-set that 60 seconds may not have been long enough to capture recovery from the negative stimulus—65% and 75% of nondysphoric and dysphoric participants, respectively, never returned to their baseline range during the rest period.

There were several limitations to this study. First, a small sample of college students—the majority of whom were Caucasian—with and without dysphoric symptoms was evaluated. Given the small sample size, we may have been underpowered to detect small effects, and this may be particularly relevant to negative emotion reactivity given a recent meta-analysis suggesting a small effect for attenuation of initial negative emotion reactivity in depression (Bylsma et al., 2008). Also, this sample limits generalizability to a clinical sample or to a more ethnically diverse sample. Despite a lack of generalizability to a clinical sample, however, it is important to consider this work in the context of early prevention and intervention. The persistence of depressive symptoms in this sample (as demonstrated by the multiple assessments of depressive symptoms—see Participant section for description), and prior research indicating functional impairment among dysphoric populations (Gotlib et al., 1995; Sheeber et al., 2007), highlights the relevance of the current study to mental health and daily functioning.

Second, the continuous real-time experiential rating methodology offered a novel approach to understanding moment-to-moment fluctuations in emotion reactivity among a dysphoric sample and a comparison group. However, like any methodology, it carries its own set of costs and benefits. For example, this approach did not allow for the simultaneous evaluation of multiple emotions of positive or negative valence, or of multiple dimensions of emotion (e.g. arousal and valence). Although post-hoc questionnaires ensured that the primary reported emotion was consistent in terms of valence, it is possible that participants experienced more than one emotion—such as negative emotions in the positive condition, as demonstrated by Rottenberg et al., 2005—or differing levels of arousal. In the future, researchers could consider asking participants to view a film clip multiple times—rating valence and arousal separately during each viewing. Also, rating emotion continuously during and following emotion elicitation could interfere with emotion experience. However, it is not clear at this time that this would differentially affect dysphoric and nondysphoric participants. Regardless, it is feasible to imagine a complementary methodological approach in which an experimenter asks participants to view film clips two times—the first time passively viewing and experiencing their emotion, and the second time attempting to retrospectively report on the emotion they experienced while watching the clip the first time. Convergence across these approaches would offer more certainty regarding the time course of experiential emotion reactivity.

Finally, assessment of the time course of emotion across multiple response systems could enhance our understanding of emotion dynamics and the emotion regulation that they reflect. It will be important to continue to develop methodology to assess emotion reactivity across response systems in a more time sensitive manner, and to relate these time courses to each other. The frequently incongruent nature of emotion response systems (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005) suggests that each system provides unique information that will be important to gather. In the experiential domain, this is the first study to our knowledge to investigate the immediate and continuous temporal course of emotion reactivity in dysphoria and as such, it reveals important information about emotion dynamics and possible underlying regulatory processes that was not previously available.

Based on this research, there are several important directions for future work. First, the failure to find attenuated initial negative reactivity in the current study and at least one prior study in dysphoria (Sloan et al., 2002) suggests that attenuated initial negative reactivity (consistent with the ECI theory in Major Depressive Disorder) is likely specific to clinically elevated symptoms. In fact, Rottenberg et al. (2005) have reported that even within a sample of clinically depressed individuals, the attenuation of negative emotion reactivity was stronger for individuals with more clinically elevated symptoms. It seems feasible that recurring depression, or depression late in the clinical course, leads to attenuated negative emotion reactivity due to habituation or degradation of emotion or motivational response systems. When much of the environment appears threatening, emotion response systems may eventually stop responding, or subjective awareness of negative emotion responses may dissipate. Future research should evaluate initial negative reactivity across responses systems and across symptom levels, in order to clarify these findings. In addition, a longer recovery period following the emotion stimuli could further elucidate possible differences in recovery from negative reactivity.

Second, our failure to find initial attenuation of experiential positive emotion reactivity is inconsistent with previous experiential literature, which could be explained by the fact that prior work has only evaluated one time point of experiential emotion reactivity. These findings should be replicated using continuous emotion rating among a larger sample of participants who are dysphoric or depressed to rule out sample size and symptom severity as important factors in these results.

Finally, results indicating that individuals with dysphoric symptoms have difficulty maintaining positive emotion have substantial and exciting implications for prevention and intervention development. This laboratory study assessed emotion across a very short time period in controlled conditions, which limits generalizability to daily emotion experiences to some degree. However, it is reasonable to imagine that a series of emotion experiences such as those demonstrated in the current study could build up over the course of the day and actually amplify the effects found in this study. If dysphoric individuals are failing to maintain positive emotion following the positive events that they encounter throughout the day, they may be less equipped to deal with or rebound from stressors than nondysphoric individuals. And, in fact, Tugade and Fredrickson (2004, 2007) have suggested that individuals who maintain positive emotion are more resilient to future stress. In addition, in this laboratory condition participants were asked to experience a positive event. In real world conditions, dysphoric individuals may be less likely to attend to positive events, and may have more intervening stressful events with which to contend. These possibilities point to the need for additional research on positive emotion among both healthy and dysphoric individuals. Identification of mechanisms that sustain positive emotion could represent important targets for prevention and intervention.

Acknowledgments

Special thanks to Dr. Duan Zhang, Dr. Galena K. Rhoades and Dr. Greg J. Siegle for statistical consult. Also, thanks to the Adolescent Reading Group at the University of Denver for feedback on earlier drafts of this manuscript.

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Figure 1.

Experiential emotion ratings for dysphoric and nondysphoric groups after subtracting each participant's baseline (baseline = mean of emotion ratings across the 60 second baseline rest period which followed the first neutral clip) from each of their second by second emotion ratings. Data reflect baseline rest, positive clip and post-positive-clip rest epochs. Analyses concentrated primarily on the difference in slope during the rest period following the positive clip.

Table 1

Descriptive Statistics

	Mean Age	Percent Female	Mean BDI (SD)	Ethnicity
Dysphoric	20.13	81.3	24.11 (6.97)	African American, n=1; Asian, n=1; Caucasian, n=14
Nondysphoric	19.77	54.8	5.47 (2.14)	Caucasian, n=28; Latino, n=2; Other, n=1

Table 2

Hierarchical Linear Model Results

	Regression Coefficients and Statistical Tests		Variance Components and Statistical Tests	
	Coefficient	SE	t test	Chi-Square
<i>Positive Emotion Model</i>				
γ_{00} Intercept	2.9947	.2940	10.19*	6252.80*
γ_{01} Dysphoric Status	.5011	.5039	.99	
γ_{10} Time	-.0286	.0075	-3.83*	4734.20*
γ_{11} Dysphoric $\times$ Time	-.0291	.0128	-2.27*	
<i>Negative Emotion Model</i>				
γ_{00} Intercept	2.4878	.3199	7.77*	9266.26*
γ_{10} Dysphoric Status	-.1780	.5483	-.33	
γ_{10}	-.0182	.0055	-3.29*	3244.75*
γ_{11} Dysphoric $\times$ Time	.0091	.0095	.96	

*
p < .05