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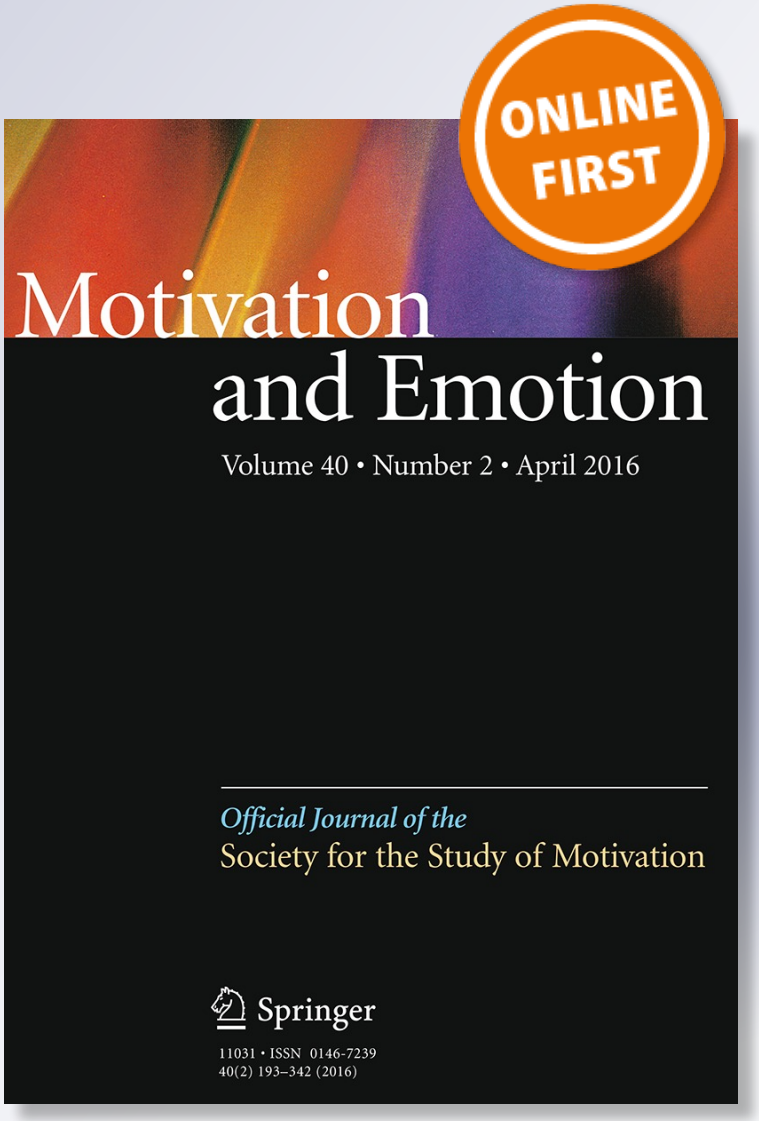

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When context *matters*: Negative emotions predict psychological health and adjustment

Karin G. Coifman[1] · Jessica J. Flynn[1] · Lavinia A. Pinto[1]

Abstract Functional theories of emotion argue for the adaptive function of negative emotions in response to specific contextual or environmental demands. However, data supporting these theories in community samples is limited and much research has suggested the opposite: negative emotions predict poor adjustment. To begin to address this discrepancy, we tested the functional association between negative emotion and psychological health and adjustment across three diverse samples: adults in intimate-partnerships, patients with chronic illness, and first-year college students. In each study we employed lab-based methods to elicit and index emotion as a multi-dimensional response system and considered contextual factors and the theorized or demonstrated function of negative emotions in that context and in relation to specific outcomes. Data analysis revealed that contextually sensitive negative emotion *was* adaptive, and associated with better relationship adjustment and related behaviors (Study 1), higher treatment adherence (Study 2), and adaptive responses to peer rejection (Study 3). Across samples, circumstances, and outcomes, negative emotions were positively associated with psychological health and adjustment.

Keywords Negative emotion · Adjustment · Stress · Context · Health

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Introduction

Functional models of emotion strongly emphasize the link between emotions and adaptation, such that *adaptive* emotional responses are those that meet the particular demands of a given "incentive context" (Goldsmith and Davidson 2004, p. 363). This seems particularly true for certain negative emotions (e.g., anger, fear, sadness, disgust) most tightly linked to contextual factors in order to serve clear survival functions (Ekman 1992). For example, fear is highly adaptive in the presence of a real threat (c.f. Ohman and Mineka 2001). Fear evokes physiological changes that augment threat responses (e.g., enhanced attention and perception: Phelps et al. 2006) as well as corresponding behavioral signals that are adaptive for the larger group (e.g., recognition of facial expressions of fear across cultures and species: Russell 1991; Bloom and Friedman 2013). However, patterns of contextually insensitive or over-generalized fear responses are maladaptive, and characteristic of certain psychiatric populations (e.g., in anxiety disorders: Graham and Milad 2011). Indeed, the assumption that negative emotional responses are adaptive in certain contexts and not in others underlies dominant theories of emotion, emotion regulation (Cole et al. 1994; John and Gross 2004), and current models of psychiatric disease (Nolen-Hoeksema and Watkins 2011).

Testing the link between negative emotion, context, and indicators of psychological health has proven complicated. *First*, the rapid production and resolution of emotional responding demands in vivo measurement (c.f. Rosenberg 1998). *Second*, emotions are multi-dimensional with emotion-related behavior, autonomic activity, and reported experience only "loosely coupled" (Bonanno and Keltner 2004). Indeed, emotion response modes may serve differing functions, operate on very different time scales (Bulteel

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et al. 2014), and be under varying influences often not accessible to the individual. For example, self-reported emotion is particularly vulnerable to influences that have been well-documented (e.g., demand characteristics: Dubitsky et al. 1993; dispositional differences: Coifman et al. 2007; environmental circumstances: Messner and Wanke 2011; perceived stress: Zautra 2006; attachment: Zimmerman et al. 2001). *Third*, many factors influence the tie between emotional responses, context, *and* a given outcome (e.g., some responses may have short-term benefit but may be functionally maladaptive in relation to longer-term indicators: Bonanno and Burton 2013). *Finally,* individuals differ considerably in their *appraisal* of emotional contexts (c.f., Lerner and Keltner 2001) including in particular negative emotional contexts. This can translate to different negative emotional responses, such as the benefit of challenge rather than threat (or optimism versus pessimism) appraisals resulting in anger versus fear responses during aversive lab contexts (Lerner et al. 2007).

Given these complexities, identifying a clear association between a given negative emotional response and adjustment requires careful tailoring of outcome indicators to the emotions in question and their presumed population- and context-specific functions. Consequently, the evidence supporting functional theories of negative emotion has been largely limited to highly controlled experimental designs, demonstrating the functionality of a negative emotion to proximal outcomes (e.g., performance on goal-oriented tasks). In fact, there is scant evidence of the adaptive function of negative emotions in real-world or community samples (for key exceptions: Lerner et al. 2003; McNulty and Russell 2010).

What constitutes an adaptive negative emotion?

Negative emotional responses are complex integrations of biological signals that, when considered together, support the hypothesis that negative emotions are largely adaptive. For example, there is convincing evidence demonstrating the critical role of somatic manifestations of negative emotion in effective decision making and risk management (e.g., Bechara and Damasio 2005). Indeed, there is clear evidence of discrete functions for emotions such as fear (Ohman and Mineka 2001), sadness (Bonanno et al. 2008), anger (Lerner and Keltner 2001), and disgust (Tybur et al. 2013) to facilitate survival as well as social living. Moreover, low levels of negative emotion awareness or inability to discriminate emotion from bodily sensations (e.g., alexithymia: Bagby et al. 1994) are particularly prevalent in groups with psychiatric disorders (c.f., Kashdan et al. 2015). These findings support the concept that higher negative emotion awareness could be psychologically beneficial and associated with health (see also Schwarz and Clore 1983; Salovey et al. 1995).

Despite the broader evidence, there remains the challenge that in most samples, negative emotions are largely associated with poor outcomes. For example, those same psychiatric populations that are consistently low on indices of emotion awareness often, in fact typically, report high levels of negative emotion (c.f., Barlow et al. 2014). This could be simply a measurement-related issue. For example, patients may confound different levels of affective phenomena, reporting on enduring negative mood rather than moment-level negative emotion. Affective phenomena are highly complex, involving multiple levels and hierarchical systems, and emotion episodes are but the briefest of these phenomena, frequently passing outside of awareness (LeDoux 2012). Indeed, there is growing evidence of important variability in the capacity to attend to emotional experiences (Kashdan et al. 2015). As such, negative emotions are often poorly differentiated and other enduring, and likely more obvious phenomena, such as mood, is readily available.

An additional, and perhaps more pressing, issue relates to the functional matching of negative emotions to their eliciting context, or the question of emotion context sensitivity. Functional theories have been interpreted to posit that negative emotions are functionally adaptive in their associated contexts (e.g., fear in the presence of a real threat; Ekman 1992). Obviously, when the context is narrow and discrete it may be easier to identify the functionally optimal emotional response. Less discrete contexts are more likely to elicit a range of emotional responses, modified by prior experiences and/or individual differences (e.g. Lerner et al. 2003, 2007). Accordingly, there is an increasing demand for research to focus on emotion and emotion-related processing in relation to specific contextual factors (Aldao 2013; McNulty and Fincham 2012). Indeed, there is a small but developing literature examining *emotion context sensitivity*: the ability to generate emotion responses that are adaptive within a given context as well as flexibly shift responses across contexts (c.f., Coifman and Bonanno 2009). These studies have demonstrated that negative emotions expressed in positive or neutral contexts (contextually-insensitive negative emotion) predict poor long-term outcomes (e.g., Coifman and Bonanno 2010; Buss et al. 2004). More importantly, there is also evidence that weak contextually-sensitive negative emotional responses may be equally problematic and predict the development and persistence of psychopathology (Rottenberg et al. 2002). Together, this evidence suggests that more contextually sensitive negative emotion is better than less.

Indeed, recent research has demonstrated that contextually sensitive negative emotion (or greater negative

emotion in explicit negative contexts) is associated with adaptive health behavior, including higher treatment adherence (Harvey et al. 2014) and greater physical activity or exercise (Shields et al. 2015). However, largely, the ECS literature has not tested these associations for *specific* negative emotions. Indeed, evidence for the functional connection between specific negative emotion, an eliciting context, and broader psychological functioning in humans has been largely absent.

Here, we sought to narrow the gap between theories of negative emotion and existing evidence in community samples by testing the functional benefit of negative emotions to psychological health and adjustment across three samples in distinct circumstances: intimate relationships, chronic illness, and adjustment to college. Our overarching hypothesis was that negative contextually-sensitive emotion would be functionally adaptive in relation to *particular* indicators of outcome. Specifically, that negative emotions can be functionally adaptive if they are contextually sensitive *and* they are adaptive with respect to a particular outcome that they can influence. As such, we strove to elicit and measure emotions linked to the unique sample circumstances, the context, *and* the particular index of psychological adjustment.

In all studies we assessed emotional responses in real-time, across response dimensions, and in relation to multiple outcome indicators. Finally, we examined predicted emotion responses in concert with other possible emotions to provide a more rigorous test of our hypotheses. For example, our assessments always included positive emotion due to evidence demonstrating that positive emotions are both frequently evident and highly adaptive in negative emotional contexts. In particular, positive emotions have been shown to both regulate negative emotional responses as well as facilitate longer term goals (e.g., Papa and Bonanno 2008; c.f., Fredrickson 1998). Given the measurement and elicitation paradigms used (i.e. indexing real-time emotion for several minutes) we thought it likely that positive emotions would emerge and that mixed emotional responses could be adaptive (e.g., Larsen et al. 2001).

In the first two studies we focused on eliciting emotional responses in discrete, unambiguous contexts defined using standardized film stimuli. Given the large literature demonstrating how individual differences in appraisal influence emotion responses (c.f., Smith and Ellsworth 1985), we strove to limit individual variability in appraisal by using well-validated emotion eliciting film clips. Thus, in both Study 1 and 2, contextually sensitive negative emotion would be, by definition, the established target responses to each clip (e.g., sadness, in response to *The Champ* in Study 2). In order to evaluate if these were functionally adaptive negative emotions, we examined clip target responses (as well as non-target responses) with respect to their prediction of psychological health for that population.

In Study 1, we examined responses to films depicting either discretely negative or positive (e.g., conflict or reunion) relational themes in individuals engaged in long-term, intimate-partnerships. Emotion responses were examined in relation to established indicators of relationship adjustment and behavior. In Study 2, we narrowed our focus on to the specific emotion sadness in chronically-ill adults, elicited during a film depicting loss which followed an interview about their illness. Sadness was selected because of its relevance to this particular sample and its association with factors that influence treatment adherence (e.g., increased problem solving).

In contrast, in Study 3 we employed a more naturalistic emotion elicitation by simulating peer-rejection in first-year college students via a within-subjects adaptation of the Cyberball paradigm (Williams et al. 2000). In this case, there were still pre-defined target emotions (e.g., fear, anger, sadness, happiness) established in prior research but the potential for individual variation in emotional responses due to differences in appraisal was substantially greater. As such, the target emotions would not necessarily all be functionally adaptive. Indeed, in Study 3, we not only broadened our elicitation paradigm but also our test in relation to outcomes, considering both short-term or proximal functions as well as long-term or distal functions. This final test constitutes a more ecologically valid and perhaps rigorous next step, as a wider range of emotion responses *could* be elicited that might be functionally adaptive in a variety of ways. Indeed, given the importance of peer-relationships when adjusting to college, we anticipated that some negative emotion responses would be quite important and would have differing functionality or benefits depending on the indicator of outcome.

Study 1: Negative emotion and intimate-partner-relationships

Emotions arise between romantic partners and serve critical functions by communicating internal states and intentions (Keltner et al. 2006). Indeed, there are many that argue that intimate partnerships are both strongly influenced *by* as well as *do* strongly influence emotional processing (Shaver and Mikulincer 2008; Zaki and Williams 2013). There has been considerable research attention focused on emotions in relationships, documenting the sometimes detrimental effect of negative emotions, including hostility, distress, and contempt (e.g., Gottman et al. 1998; c.f. Gottman 1994). More recently, however, literature has begun to demonstrate not only the functional relevance of negative emotions within relationships but

also the importance of considering contextual factors (e.g., McNulty and Russell 2010). In particular, there is evidence suggesting that contextually sensitive negative emotional responses can be adaptive and highly relevant to relationship functioning. For example, Waldinger et al. (2004) demonstrated that male expressions of distress during couple conflict discussions predicted better marital adjustment. Whereas, Graber et al. (2011) found that expressions of contempt during "love" interactions predicted the opposite.

Our goal here was to build upon this developing literature by examining negative emotion generated during discrete negative contexts created by films depicting core relational themes (e.g., conflict, loss; Mikulincer et al. 2002). This was specifically investigated in individuals in long-term, intimate-partnerships in relation to patterns of relational behavior and ratings of relationship adjustment. Indeed, there is considerable theory suggesting the importance of negative emotional expression and related responsiveness in intimate relationships, beginning in early childhood and throughout life (Magai 1999). This includes both expressions of negative emotions that elicit responses, as well as responsiveness to those expressions (Keltner et al. 2006; Magai and MacFadden 1995).

Broadly, we expected that negative emotions elicited in negative contexts (here films depicting negative relational themes) would be positively associated with relationship adjustment indicators. Our study builds upon recent evidence suggesting the relevance of emotion-context matching in adult relationships (e.g., Waldinger et al. 2004). We deliberately included positive films that might also activate attachment-related emotion through representation of reunion-related themes (e.g., Mikulincer et al. 2001) so as to test the importance of contextually-matched negative emotion. Moreover, we considered other contextual factors known to influence relationship adjustment, including the length and type of relationship (e.g., long-distance) as well as the presence of psychopathology which can influence not only relationship adjustment but also negative emotional responses (e.g., depression: Davila et al. 2003). Accordingly, our hypothesis was that negative emotional responses generated discretely in response to negative films depicting conflict and loss would be positively associated with relationship adjustment and related behaviors.

Methods

Participants and procedure

Participants were 79 adult individuals (71 % female, age M = 22, SD = 6 years, 82 % Caucasian, 94 % non-Hispanic), recruited from a Midwestern university community in an intimate heterosexual or homosexual relationship for at least six months. Informed consent was obtained for all participants and all research activity was approved by the Institutional Review Board overseeing human subjects research. One participant was excluded because he was older than the age mean by seven standard deviations. The mean relationship length was 29 months ($SD = 38$). Forty-one percent of the sample were in a long distance relationship, defined as greater than 30-min drive for in-person contact.

Participation included completion of questionnaires followed by an emotion-modulation task in which participants were asked to engage emotionally with a series of brief film clips. Participants were video-taped to obtain facial behavior and provided reports of emotional experience following each film. Following the lab-task, 52 participants[1] (66 %) also completed a relationship interview in which they reported on the frequency of relationship-related behaviors in the past 7 days. Upon completion of the study, 60 participants received course credit and 19 received $25. Paid participants were older, in longer relationships, and reported greater negative affect. As such, compensation type was examined in all analyses.

Measures

Relationship adjustment Participants completed the *Dyadic Adjustment Scale,* a well-validated 32-item self-report measure of relationship adjustment among couples (DAS; Spanier 1976). An overall relationship adjustment score was calculated according to Spanier (1976) and the mean for this sample was $M = 2.30$; $SD = .90$ ($\alpha = .92$).

Positive relationship behaviors Following the lab task, participants were seated across from a research assistant and asked to think over their interactions and experiences with their partner over the past 7 days. They were handed a calendar, and asked to report on the frequency of each in-person contact with their partner as well as three specific behaviors for each day, beginning with the previous day and working back in time by day, to seven days prior. Participants reported the number of times they scheduled activities with their partner, the number of times they engaged in an activity with their partner, and the number of times they laughed with their partner. Frequencies for each behavior were summed by day and then averaged across the 7 days, yielding one score reflecting mean positive relationship behavior per day, $M = 3.11$, $SD = 2.51$. The frequency of in-person contact was left as a control

[1] This interview was added to the study after data collection had already commenced, as such it was not available to the first 27 participants. Analysis of the individuals who had and had not participated in the interview revealed no demographic, relationship or emotion-related differences.

variable for these analyses given that some partnerships were long-distance.

Depression symptoms Participants completed the Center for Epidemiologic Studies Depression Scale (CES-D) a commonly used, well-validated assessment of depressive symptomatology ($\alpha = 0.80$; Radloff 1977). Mean CES-D was: 10.19 ($SD = 7.43$).

Emotion assessment

Participants were asked to engage emotionally with a series of brief film clips: one initial neutral film ("Big Cat Diaries"; 2010, BBC Earth) to adjust to the viewing paradigm and camera and four well-validated films for inducing specific negative and positive emotions (Gross and Levenson 1995; Gilman et al. 2016). We employed a sequence of video stimuli that alternated negative with positive film clips in order to maximize the discreteness of each negative context and place greater demands on participants to shift emotion responses accordingly. In addition, the clips were selected for their explicit interpersonal content and depiction of themes, including conflict and loss, central in relationships (i.e., conflict between inmates and guards: "The Road to Guantanamo Bay" 2006 Revolution Films; joy at being rescued by friends: "Alive" 1993, Paramount Pictures; sadness at the loss of a parent: "The Champ" 1979, Metro-Goldwyn Mayer; and shared humor between peers: "Between Two Ferns" 2010, www.funnyordie.com). Participants were videotaped and following the viewing of each film, completed affect ratings during a 2 min break. Film stimuli were displayed on a 23-inch monitor at a viewing distance of 2 feet. The task was programmed in *E-prime 2.0*.

Affect Participants rated negative (fear, sadness, distress, guilt, anger, disgust) and positive (interest, relief, enjoyment, happiness, amusement, affection) emotion words on a scale from 1 (*none*) to 7 (*strong*) after each film. Self-ratings were averaged by film to derive overall negative affect (negative films $\alpha = .85$; positive films $\alpha = .76$) and positive affect scores (negative films $\alpha = .75$; positive films $\alpha = .83$).

Facial behavior Negative and positive emotional facial behaviors were coded by five research assistants blind to hypotheses and all study details. Coders received limited training[2] and each coded videos independently on a 23-inch monitor without sound, rating participant facial expressions for every film on 7-point Likert scales for degree of negative emotional expressiveness and degree of positive emotional expressiveness. Overall coder agreement was satisfactory (average ICC = .84) and scores were averaged across coders by participant to increase reliability further. There was an equipment malfunction for one participant, so facial behavior was only available for 78 participants. Negative and positive affect and facial responses were combined across the two negative films and two positive films to create a more robust indicator of responses to negative or positive relational themes. This yielded 4 indices of emotion to negative films and the same 4 indices to positive films: negative affect, positive affect, negative facial behavior, positive facial behavior.

Results

Preliminary analyses

Emotion data were examined to ensure that participants responded to each film context. As expected, participants reported significantly greater negative affect, M = 2.81 SD = 1.04, relative to positive affect, M = 1.65 SD = .58, $t(78) = 8.43$ $p < .000$, and showed greater negative facial behavior, M = 3.13 SD = 1.00, relative to positive facial behavior, M = 1.08 SD = .17, $t(77) = 17.87$, $p < .000$, in the negative films and greater positive affect, M = 3.57 SD = .94, relative to negative affect, M = 1.25 SD = .35, $t(78) = -23.32$, $p < .000$, and showed greater positive facial behavior, M = 3.02 SD = .76, relative to negative facial behavior, M = 1.91 SD = .60, $t(77) = -8.92$, $p < .000$, in the positive films. We examined concordance across dimensions of emotion using bivariate correlations. Negative affect was associated with negative facial behavior during the negative films ($r = .31$, $p = .003$), and positive affect was associated with positive facial behavior during the positive films ($r = .40$, $p < .000$). See Table 1 for bi-variate correlations between all key variables.

Primary analyses: Negative emotions and relationship adjustment

We conducted two OLS regression analyses with relationship adjustment (DAS) as the dependent variable. In Step 1 we entered factors likely to influence either emotion and/or relationship functioning. These included age, gender, depression, as well as length and type (long distance v. not) of relationship, and amount of in-person contact in the previous week. We did also initially control for compensation type, race and ethnicity but these variables did not meaningfully impact the results, so they were excluded. In Step 2, we entered expressed negative and positive facial behavior (Table 2: Regression A) *or* reported negative and positive affect (Table 2: Regression B) from *both* negative

[2] Increasing evidence suggests that facial coding by relatively naïve coders may be as valid as highly trained coders (e.g., Dondi et al. 2007; Waldinger et al. 2004).

Table 1 Study 1 bi-variate correlations between key study variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Length of Relationship	–											
2. In-Person Contact	.03	–										
3. Depression Symptoms	−.02	−.29	–									
4. Neg. Expression—Neg. Films	−.18	.01	**.27**	–								
5. Pos. Expression—neg. Films	.11	−.16	−.11	−.06	–							
6. Neg. Expression—pos. Films	−.09	.15	.15	**−.50**	−.13	–						
7. Pos. Expression—pos. Films	.02	**−.44**	.10	**.28**	**.27**	**−.32**	–					
8. Neg. Reported Emotion—neg. Films	−.00	.03	.13	**.33**	−.01	.03	.11	–				
9. Pos. Reported Emotion—neg. Films	.02	.08	−.09	−.21	.16	−.03	−.15	−.05	–			
10. Neg. Reported Emotion—pos. Films	.11	**.36**	−.07	.14	.20	.08	.16	**.51**	**.23**	–		
11. Pos. Reported Emotion—pos. Films	−.11	.14	−.12	.20	.10	−.16	**.40**	**.51**	**.25**	**.44**	–	
12. Dyadic Adjustment Scale Score	**−.56**	−.07	**−.35**	.16	−.05	.08	.05	−.07	.08	−.07	.15	
13. Positive Relationship Behaviors	−.28	−.01	−.16	.17	−.07	.22	−.03	.14	−.03	−.07	.14	**.47**

Significant associations are indicated in bold

and positive film contexts. We entered negative and positive indicators of each dimension of emotion together in order to control for their shared variance. Moreover, we entered together responses from both emotional contexts (negative and positive films) in order to provide a rigorous test of our hypothesis and to test if negative emotions uniquely in negative contexts are adaptive. The results of these analyses supported our hypothesis. Indeed, *higher* negative emotion facial behavior, exhibited only in the negative film context, was significantly associated with *higher* relationship functioning $\beta = .37, t = 2.40, p = .02, sr^2 = 0.06$; $F(10, 63) = 2.86$, $p = .01$, $R^2 = .31$, even when controlling for all other emotional responding, relationship variables, and depression (which did also significantly predict DAS scores $\beta = -.47, t = -4.19, p = .00, sr^2 = 0.19$). Moreover, we also found that *higher* positive emotion facial behavior exhibited only in the negative film context (a contextually in-sensitive response) was significantly associated with *lower* relationship functioning $\beta = -.27$, $t = -2.45$, $p = .02$, $sr^2 = 0.07$. We did not find any effects for reported emotion.

Primary analyses: Negative emotions and positive relationship behaviors

Again, we used 2 OLS regressions, employing the identical step-wise approach and control variables with positive relationship behaviors as the dependent variable.[3] The results also supported our hypothesis. Higher negative emotion facial behavior, exhibited only in the negative film context, was significantly associated with higher mean frequency of daily positive relationship behaviors $\beta = .39$, $t = 2.23, p = .03, sr^2 = 0.08$; $F(10, 40) = 2.58$, $p = .016$, $R^2 = .39$, when controlling for other emotional responding, relationship variables, and depression (which did marginally predict fewer positive behaviors $\beta = -.25, t = -1.78$, $p = .08$, $sr^2 = 0.05$) (see Table 3: Regression A). Moreover, we found that higher reports of negative emotion in the negative film contexts also appeared to predict higher daily positive relationship behaviors. However when we corrected the threshold alpha for multiple tests, employing a False Discovery Rate Calculation (Benjamini and Hochberg 1995, 2000) the results did not reach significance, $\beta = .36$, $t = 1.77$, $p = .08$, $sr^2 = 0.05$; $F(10, 41) = 2.37$, $p = .03$, $R^2 = .37$ (see Table 3: Regression B). There were no effects for reported positive emotions or coded facial positive emotion.

Discussion

Here we examined the functional utility of negative emotion generated in response to negative relational themes depicted in films, in relation to adjustment and behavior in intimate-partnerships. Our findings suggest that greater negative emotion generated *discretely* in response to films depicting conflict and loss was associated with higher relationship adjustment (DAS) and greater daily positive relational behavior. Additionally we found that positive facial emotion in response to negative films was maladaptive, predicting lower scores on the DAS. Together, these data demonstrate the importance of context sensitive emotion and in particular, suggest a

[3] We tested all assumptions of regression in each analysis in all three studies, including the assumption of normality in the dependent variable. Although behavioral indices including relationship behaviors indexed here and treatment adherence indexed in Study 2 can be skewed, the distributions in our samples were within normal parameters (Tibachnik and Fidell 2006).

Table 2 Study 1—OLS regression examining emotional responses during relational contexts and relationship adjustment

Dependent variable: relationship adjustment—Dyadic Adjustment Scale		*B*	*SE*	*β*	sr^2	R^2	ΔR^2
Regression A							
Step 1	Age	−.22	.43	−.08	.00	.13	–
	Sex	.28	4.30	.01	.00		
	Length of Relationship	−.02	.06	−.06	.00		
	Relationship Type[a]	−.02	3.80	−.00	.00		
	In-Person Contact[b]	−.05	.11	−.06	.00		
	Depression Symptoms	−.77**	.26	−.36	.12		
$F(6, 67) = 1.69$, $p = .14$							
Step 2	Age	−.29	.40	−.11	.01	.31	.18***
	Sex	−4.44	4.34	−.13	.01		
	Length of Relationship	−.02	.06	−.04	.00		
	Relationship Type	−.11	3.90	−.00	.00		
	In-Person Contact	−.04	.01	−.05	.00		
	Depression Symptoms	−1.02**	.24	−.47	.19		
	Neg. Expression—Neg. Films	5.90*	2.46	.37	.06		
	Pos. Expression—Neg. Films	−30.61*	12.51	−.27	.07		
	Neg. Expression—Pos. Films	−.49	3.91	−.02	.00		
	Pos. Expression—Pos. Films	1.66	2.99	.08	.00		
$F(10, 63) = 2.86$, $p = .005$							
Regression B							
Step 1	Age	−.22	.42	−.08	.00	.14	–
	Sex	.35	4.26	.01	.00		
	Length of Relationship	−.02	.06	−.06	.00		
	Relationship Type	.05	3.95	.00	.00		
	In-Person Contact	−.05	.11	−.06	.00		
	Depression Symptoms	−.75**	.24	−.37	.12		
$F(6, 68) = 1.77$, $p = .12$							
Step 2	Age	−.08	.44	−.03	.00	.16	.02
	Sex	.61	4.79	.02	.00		
	Length of Relationship	−.04	.06	−.09	.00		
	Relationship Type	−1.12	4.22	−.04	.00		
	In-Person Contact	−.05	.11	−.06	.00		
	Depression Symptoms	−.69*	.27	−.34	.09		
	Neg. Reported Emotion—Neg. Films	−.55	2.63	−.04	.00		
	Pos. Reported Emotion—Neg. Films	−.11	3.63	−.00	.00		
	Neg. Reported Emotion—Pos. Films	−5.82	6.74	−.13	.01		
	Pos. Reported Emotion—Pos. Films	3.1	2.61	.19	.02		
$F(10, 64) = 1.24$, $p = .29$							

Neg. negative, *Pos.* positive

* $p < .05$; ** $p < .001$

[a] Relationship Type describes if the relationships was long distance

[b] In-Person Contact was the frequency of in-person contact in the prior week

functional benefit to contextually matched negative emotion to intimate partnerships. This finding is consistent with emerging research on inter-personal emotion processes in relationships.

In particular, there has been recent work demonstrating the role of inter-personal emotion regulation and empathic accuracy in relationships (c.f., Zaki and Williams 2013). Broadly, the literature has suggested a critical role for

Table 3 Study 1—OLS Regression examining emotional responses during relational contexts and positive relationship behaviors

Dependent variable: relationship adjustment —positive relationship behaviors		B	SE	β	sr^2	R^2	ΔR^2
Regression A							
Step 1	Age	−.05	.07	−.13	.01	.27	–
	Sex	.01	.75	.00	.00		
	Length of Relationship	−.00	.01	−.05	.00		
	Relationship Type[a]	.88	.77	.17	.02		
	In-Person Contact[b]	.06**	.02	.49	.21		
	Depression Symptoms	−.04	.05	−.12	.01		
$F(6, 44) = 2.75$, $p = .02$							
Step 2	Age	−.10	.07	−.24	.03	.39	.12*
	Sex	−.75	.79	−.14	.01		
	Length of Relationship	−.00	.01	−.07	.00		
	Relationship Type	.88	.83	.17	.02		
	In-Person Contact	.06**	.02	.44	.14		
	Depression Symptoms	−.09	.05	−.25	.05		
	Neg. Expression—Neg. Films	1.06*	.48	.39	.08		
	Pos. Expression—Neg. Films	−2.17	2.53	−.13	.01		
	Neg. Expression—Pos. Films	−.12	.99	−.02	.00		
	Pos. Expression—Pos. Films	−.55	.57	−.16	.01		
$F(10, 40) = 2.28$, $p = .02$							
Regression B							
Step 1	Age	−.05	.07	−.13	.01	.28	–
	Sex	−.01	.74	−.00	.00		
	Length of Relationship	−.00	.01	−.05	.00		
	Relationship Type	.86	.76	.17	.02		
	In-Person Contact	−.06****	.02	.49	.21		
	Depression Symptoms	−.05	.04	−.14	.02		
$F(6, 45) = 2.85$, $p = .02$							
Step 2	Age	−.06	.07	−.15	.01	.37	.09
	Sex	−.59	.81	−.11	.01		
	Length of Relationship	−.00	.01	−.03	.00		
	Relationship Type	1.14	.78	.22	.03		
	In-Person Contact	.06**	.02	.47	.18		
	Depression Symptoms	−.07	.05	−.21	.03		
	Neg. Reported Emotion—Neg. Films	.83	.47	.36	.05		
	Pos. Reported Emotion—Neg. Films	−.05	.63	−.01	.00		
	Neg. Reported Emotion—Pos. Films	−1.55	1.28	−.22	.02		
	Pos. Reported Emotion—Pos. Films	.18	.45	.07	.00		
$F(10, 41) = 2.37$, $p = .03$							

* $p < .05$; ** $p < .001$

emotion attunement in relationships. As such, our data demonstrating the importance of context-sensitive emotion is well in line. Moreover, these data are largely consistent with recent evidence suggesting that in socially salient situations, positive emotional expressions can be maladaptive (e.g., Bonanno et al. 2007). However, although our results speak to the functional benefit of context-sensitive negative emotion, they do not attend to the likelihood that specific negative emotions (e.g., contempt) may be more or less functionally adaptive in intimate-partnerships (c.f., Gottman 1994). Finally, our results suggested that facial expressions of emotion were most predictive of outcome indices of relationship functioning. This finding is consistent with the longstanding emphasis in relationship

research on behavioral indicators of emotion, as well as the clear role that facial emotion can play in social communication (Keltner et al. 2006).

There were several limitations. First, the sample was young and the nature of relationships varied. Also, we examined broader affective and facial responses, rather than specific emotions which may be particularly important in the context of intimate-partnerships. Finally, given the cross-sectional design, we cannot point to a causal association between negative emotion and relationship functioning (e.g., we cannot rule-out that individuals in higher functioning relationships are then more emotionally responsive to negative relational themes). Indeed, though we could not test explicitly that it was the attachment system at work, our results are consistent with social-functional and discrete emotion theories, as well as dominant attachment theories and new relationship-specific emotion research.

Our results in Study 1 suggest that context sensitive negative emotional responses to relational themes of conflict and loss were functionally beneficial in intimate-partnerships. These benefits were restricted to negative emotions in response to negative contexts. Further, we found that context in-sensitive positive emotions could be problematic in relation to these particular outcomes. In our next study, we strove to move beyond general valence-based context sensitivity by increasing the precision of our elicitation, targeting one specific negative emotion that would have bearing on one functional outcome for a specific population.

Study 2: Sadness and treatment adherence during chronic illness

Theories of coping with illness suggest that emotion-related processes are highly relevant to health behaviors, influencing assessments of risk, decision-making, and related coping responses (e.g., Leventhal et al. 1998). However, much research on chronic illness has implicated negative emotions in poor adherence (e.g., Leombruni et al. 2009) and even increased mortality (e.g., Moussavi et al. 2007). In contrast, recent evidence suggests that specific negative emotions can be functionally adaptive when the source of the emotions are factors relating to the disease itself. For instance, a recent review of the literature suggests that the functional benefit of fear and worry in relation to disease screening is constrained by contextual factors. For example, if the fear is in response to the probability of developing the disease, or fear of regret for *not* screening, then greater fear and worry appears to motivate greater screening (e.g., Sanberg and Conner 2008). However, if the fear is in response to the screening itself (i.e., fear of a mammography experience) then increased fear predicts less screening (Consedine et al. 2004).

Much of the research examining emotions and health-related behaviors has focused on negative emotions typically associated with avoidance, including the above work on fear. In contrast, there has been relatively little research on other negative emotions that are well-demonstrated to facilitate other, perhaps more adaptive responses. For example, sadness has been shown to increase deliberation, problem-solving, and reflection (e.g., Bodenhausen et al. 2000; c.f., Bonanno et al. 2008). Typically, researchers have examined *enduring* sad-related emotion, such as grief or depression in relation to health or illness in community samples. However, there has been no prior research examining sad emotion (brief in duration) in response to coping with real-life circumstances such as chronic illness. Indeed, although evidence for benefits in sadness have been well-demonstrated in laboratory paradigms there have been few attempts to examine sadness in contexts where adaptive problem-solving and decision making are important, such as chronic illness.

We built upon this developing literature by examining sadness and treatment adherence in adults with transfusion-dependent forms of the congenital blood-disorder Thalassemia (TDT). TDTs are diagnosed in infancy and associated with considerable life-long treatment demands, given the high risk of life-threatening comorbidities due to iron toxicity (e.g., cardiovascular disease). These include regular blood transfusions, frequent medical screenings, and daily iron chelation treatment. Indeed, this disorder is associated with shortened lifespan and deterioration in major organ systems due to complications associated with poor disease management (Rund and Rachmilewitz 2005). Patients with TDT experience substantial losses over their lifespan, including frequent loss of peers and/or siblings from complications relating to the same disorder, as well as potential losses of independence and normative developmental progression (e.g., decreased fertility).

Given the frequency of experienced and anticipated losses in TDT patients (Vardaki et al. 2004), we predicted that sad emotion could be functionally important in patient management of their disease. Compelling evidence has demonstrated that sadness can promote deliberation, problem-solving, and other factors underlying adherence with treatment and self-management of care (Hill-Briggs 2003). Moreover, sadness is associated with reflection and acceptance (c.f. Bonanno et al. 2008), both important given the challenging circumstances of this particular population. As such, we predicted that sad responses within the context of their illness could facilitate better adherence in this population. Specifically, we predicted that following an interview about their illness, expressions of sadness elicited

during a film about loss would be predictive of better adherence to treatment.

Methods

Participants and procedure

Adult patients diagnosed with transfusion-dependent Thalassemias (TDTs: e.g., Thalassemia Major, Intermedia, Blackfan Diamond Anemia) were offered the opportunity to participate in the study by their physician. Those expressing interest were approached directly by researchers and informed consent was obtained. Participants were not offered compensation and all research activity was approved by the Institutional Review Board overseeing research involving human subjects.

Of fifty-four possible patients, 36 adult individuals were recruited, however, one individual did not provide sufficient treatment diaries for inclusion, so the final study sample was n = 35. The mean age of participants was 32.33 years, SD = 8.50. The majority were female (70 %), Caucasian (83 %), and college educated (66 %). The mean number of comorbid physical disorders, or disease burden, was 3.53, SD = 1.64 (range 1–7), these most commonly were osteoporosis, HIV, hyper/hypogonadism, heart failure, and diabetes.

Participation occurred exclusively in the hospital setting (as part of a larger project examining emotional processes in health, see Harvey et al. 2014) where patients regularly attended blood transfusion appointments and included a packet of initial questionnaires assessing disease–related and demographic factors. This was followed by a ten minute interview about their experiences with Thalassemia which was concluded with the presentation of a film clip, evoking sadness and loss, during which emotional facial behavior was recorded and affective responses were assessed. Following the interview, participants completed treatment diaries at the next six consecutive blood transfusion appointments (approximately every 2–3 weeks; the total period ranged from 15 to 18 weeks for all participants) in the hospital. In each diary, participants reported adherence in the previous 14 days with iron chelation (prescribed 2–7 times weekly to all patients in the study to address iron toxicity associated with frequent blood transfusions).

Interview and emotion assessment

Following completion of the initial packet, participants were brought to a 4′X 6′ room, instructed to sit comfortably in a chair facing a tripod-mounted video camera and told they would be asked to speak about their illness and then would watch a brief video. Participants responded to two open-ended prompts regarding the nature of their illness experience (i.e., tell me about what it means to have Thalassemia; tell me how you are coping). Each question was open-ended, the interviewer rarely commented, and participants were allowed to speak broadly about each topic as they saw fit. At the conclusion of the interview (approximately 10 min), participants were told they would next watch a brief film clip and were asked to engage with it as best they could. They were informed that the camera would be recording their responses during the film and the interviewer left the room. Participants viewed the final scenes of the film "The Champ" 1979, Metro-Goldwyn Mayer, on a 17″ screen. This brief clip has been very well-validated as an elicitor of sadness (Gross and Levenson 1995) and depicts a son watching his father die, a theme highly relevant to patients who have both experienced considerable losses, and anticipate more, including their own early death and its impact on their family. Immediately following the clip, participants were instructed to make ratings of their emotional experience. Four participants elected not to be video-taped during the film and therefore do not have scores for emotional expression.

Emotional expression We employed two coders, certified in the Facial Action Coding System (FACS: Ekman et al. 2002 and blind to the hypotheses and all study details to code specific muscle actions related to happiness and sadness (smiling and frowning). Unlike in Study 1, we employed FACS (rather than naïve coders) and focused on these particular muscle actions given recent evidence suggesting that they may most clearly differentiate these emotional signatures as compared to muscle action that is common to both expressions (e.g., AU 6: Messinger 2002). Each coder coded one minute of each participant's video, corresponding to the peak minute in the film clip for muscle changes or Action Units (AUs) associated with frowns (AUs: 15, 17) and smiles (AU: 12). Intercoder-reliability (0.84) was the mean ratio of agreement across 5 randomly selected videos including onset/offset, duration and intensity (e.g., Keltner et al. 1995). Participant scores reflect the AU (15 and/or 17 for sadness; 12 for happiness) frequency by duration (in seconds) and are weighted by intensity. Mean expressed sadness was $M = 5.53$, $SD = 11.66$, range 0–48.50, and mean expressed happiness was $M = 14.46$, $SD = 53.40$, range 0–300.00. There was one extreme score for expressed happiness, greater than 5 SDs above the mean. As such, we performed a truncation procedure (Winsor method, Guttman 1973) reducing the one outlier to the next highest value and adjusted happiness was $M = 5.72$, $SD = 15.38$, range 0–54.01.

Emotional experience Participants rated six emotion words (fear, sadness, guilt, interest, happiness, amusement)

on a scale from 1 (*none*) to 7 (*strong*) after the film. Ratings of sadness and happiness were used to comprise self-reported emotional experience that corresponded to the specific emotions in question. Mean reported sadness was $M = 3.31$, $SD = 1.94$, range 1–7, and mean reported happiness was $M = 2.14$, $SD = 1.42$, range 1–6.

Treatment diary

Participants reported adherence with physician prescribed iron chelation six times at each consecutive blood-transfusion appointment following the interview. Daily iron chelation is an essential component of treatment in TDT and is one of the most commonly used indicators of adherence in this population (e.g., Trachtenberg et al. 2011). Prior to commencing the study, participants reported the prescribed frequency of iron chelation (prescribed $M = 5.69$ times per week, $SD = 1.60$, range: 2–7) as well as the technique used. Fifty percent of participants employed subcutaneous/intravenous methods and the rest reported oral methods. These data were later confirmed by reviewing the medical record.

Treatment adherence During each diary, participants indicated which days, over the past fourteen, they had completed iron chelation so that together, the six diaries allowed for reporting over 12 weeks. Percentage of adherence was calculated by dividing the total patient reported chelation days by the total prescribed by their physician. Mean reported chelation adherence was high $M = 84.45$, $SD = 21.11$ (range: 23.64–119.05). Some participants did choose to chelate more frequently than prescribed; as such we used scores truncated to 100 % in the primary analysis.[4] There was a marginal difference in adherence based on the method employed (i.e., oral chelators appeared to have higher adherence, $t(33) = -1.71$, $p = .10$).

Results

Preliminary analyses

Emotion data were examined to ensure that participants responded as anticipated to the film. Participants reported significantly greater sadness than happiness, $t(34) = -2.82$, $p = .008$, but the difference between sadness expression versus adjusted happiness expression was not significant $t(30) = 0.054$, $p = .96$. We examined concordance across dimensions of emotion and there was a significant correlation between sadness report and expression $r = .47$, $p = .007$, but not between happiness report and expression $r = -.15$, $p = .42$. A review of all correlations between key study variables was consistent with our predictions (e.g., both sadness expressions and reported sadness were significantly positively correlated with adherence). See Table 4 for all correlations between key study variables.

Primary analyses

We conducted two OLS regression models with adherence as the dependent variable. In the first step, we controlled for variables that would likely influence adherence because of increased treatment-related demands, these included the disease burden (i.e., number of comorbid physical conditions), chelation method, and prescribed rate of chelation (i.e., times per week). We did test to see if other variables were meaningful, including age and gender, but found that they did not impact the model. In the second step we included coded sadness and happiness expressions (Table 5: Regression A) *or* reported sadness and happiness (Table 5: Regression B). As in Study 1, we included sadness and happiness together in the analysis to control for shared variance as well as to provide a more rigorous test of our hypothesis. The results of these analyses supported our hypothesis that greater sadness expression, $\beta = .32$, $p = .049$, $sr^2 = 0.09$; $F(5, 25) = 4.45$, $p = .01$, $R^2 = .47$ was associated with higher treatment adherence. Greater reported sadness $\beta = .24$, $p = .087$, $sr^2 = 0.06$; $F(5, 29) = 5.25$, $p = .001$, $R^2 = .48$, did not reach significance. There were no effects for happiness.

Discussion

Here we examined the adaptive utility of sadness generated in a loss-evoking context and treatment adherence in patients with chronic illness. Prior research has broadly implicated negative emotions in poor adherence. However, recent evidence has suggested that contextual factors are quite important when evaluating these associations for specific negative emotions (Consedine et al. 2004). Consistent with this, our data suggest that sadness in response to a loss context predicted higher rates of treatment adherence (daily iron chelation) in patients with TDT. In prior research, sadness has been associated with factors that could translate into greater patient self-management, including improving problem solving, reflection, and deliberation. We believe that of particular importance was the disease-focused interview which may have primed

[4] Although we are not aware of data suggesting that over-chelation in patients with TDT is problematic or beneficial, we did not want to assume that chelating more than prescribed was is indicative of "better" adherence. However, to be sure that we we did not artificially influence results by truncating scores to 100 %, we conducted analyses again using un-truncated scores and the results were unchanged.

Table 4 Study 2 bi-variate correlations between key variables

	1.	2.	3.	4.	5.	6.
1. Disease Burden	–					
2. Prescribed Rate of Chelation	.21	–				
3. Sadness Expression	**−.36**	−.28	–			
4. Happiness Expression	−.06	−.33	**.48**	–		
5. Sadness Report	−.14	−.09	−.05	−.25	–	
6. Happiness Report	−.11	−.06	.09	−.07	−.04	–
7. Treatment Adherence (Chelation)	**−.40**	−.15	**.40**	**.30**	**.36**	−.27

Significant associations are indicated in bold

Table 5 Study 2—OLS Regression examining sad and happy responses and treatment adherence during chronic illness

Dependent variable: treatment adherence		B	SE	β	sr^2	R^2	ΔR^2
Regression A							
Step 1	Disease Burden	−4.37*	2.06	−.33	.11	.35	–
	Chelation Method	22.05**	6.79	.56	.25		
	Prescribed Rate of Chelation	−3.26	2.20	−.26	.05		
$F(3, 27) = 4.84$, $p = .008$							
Step 2	Disease Burden	−4.04	1.98	−.31	.09	.47	.12†
	Chelation Method	19.59**	6.66	.50	.18		
	Prescribed Rate of Chelation	−.98	2.35	−.08	.00		
	Sadness Expression	.55*	.27	.32	.09		
	Happiness Expression	.26	.21	.20	.03		
$F(5, 25) = 4.48$, $p = .005$							
Regression B							
Step 1	Disease Burden	−5.01**	1.75	−.41	.16	.39	–
	Chelation Method	21.97**	6.23	.57	.24		
	Prescribed Rate of Chelation	−3.33	1.97	−.27	.06		
$F(3, 31) = 6.64$, $p = .001$							
Step 2	Disease Burden	−4.54*	1.72	−.37	.13	.48	.09
	Chelation Method	19.36**	6.24	.50	.17		
	Prescribed Rate of Chelation	−2.92	1.91	−.24	.04		
	Sadness Report	2.48	1.40	.24	.06		
	Happiness Report	−2.22	1.96	−.16	.02		
$F(5, 29) = 5.25$, $p = .001$							

* $p < .05$; ** $p < .001$

participant's beliefs and feelings about their illness, prior to investigating sadness in response to loss. Patients with TDT experience and anticipate tremendous losses throughout their lifetime. As such, sadness when elicited in this context, for these patients, was functionally adaptive and predicted better adherence with iron chelation over a period of 4–6 months.

Like Study 1, we found that the strongest association with outcome was for coded negative emotional *expressions*, here sadness, rather than reported emotional experience. Prior research examining in vivo emotion broadly in relation to psychological adjustment has similar findings (e.g., Bonanno and Keltner 1997). As we describe earlier, there are many reasons why this may be the case, including the vulnerability of self-report to well-documented influences. Limitations in this study included the small sample size. TDTs are rare in the US. As such it will be important to examine these kinds of relationships in larger patient groups. Also, in this investigation we relied only on single-ratings of sadness and happiness from participants. Finally, although we believe the method of employing the disease-focused interview was important in eliciting relevant sadness responses, we cannot confirm this as we were unable to include a control condition.

The results of Study 1 and 2 suggest the adaptive utility of negative emotions generated during discrete and explicit

negative contexts. Both studies benefited from increased internal validity (e.g., use of standardized stimuli to elicit targeted emotion in well-defined contexts). However, typical encounters with emotional contexts in daily life elicit a range of emotions with differing functional utility (i.e., depending on the individual's appraisal, circumstances, and short-term versus long-term needs). As such, in Study 3, we broadened the emotion-elicitation context by employing a highly salient and more naturalistic emotion induction to elicit multiple negative emotions, to further test our broader hypothesis regarding negative emotions and adjustment.

Study 3: Anger, sadness, fear and on-line peer-rejection during adjustment to college

Adjustment to college is marked by considerable variability in responses and outcomes (e.g., completion rates: National Center for Educational Statistics 2013). A key factor may be the development of peer-support networks (Fass and Tubman 2002) making peer rejection particularly salient during this transition (Williams 2007). Here, we broadened our emotion elicitation context to test the functional benefit of negative emotions using a more naturalistic provocation. Given the association between psychological adjustment and success in college with peer-relations, we investigated emotional responses to simulated online peer-rejection during the first year of college in relation to multiple outcome indicators. We employed a well-validated paradigm, Cyberball (Williams et al. 2000) to simulate rejection naturalistically, thereby allowing for the elicitation of multiple emotions at once. Indeed, prior research with *this* paradigm has demonstrated that peer-rejection typically elicits anger, sadness, fear (Williams 2007), *as well as* positive emotions (DeWall et al. 2011). The variability in emotion responses is understood to be driven by individual differences in appraisals of the situational context (Lerner and Keltner 2001) resulting in varying emotions that may have different consequences or functionality. For example, some emotions may have functional utility in the short term but not in the long term. The deliberate inclusion of this more naturalistic paradigm to further answer our overall hypothesis provided a broader context in which to more rigorously test the function of negative emotions in relation to adjustment.

Given the range of possible emotions elicited in this context, we considered the functional utility of each emotion both in relation to the specific elicitation of peer-rejection and the broader framework of adjustment to college. In general, we hypothesized that emotions that have been demonstrated to facilitate *approach* responses (versus withdrawal or avoidance) would likely be most adaptive. Positive emotions have almost uniformly been associated with approach-related behavior as well as broad benefits in social contexts (c.f., Fredrickson 1998). However, prior research and theory has suggested that of the *negative* emotions, anger is the only emotion clearly associated with "approach-related" behavior (c.f., Carver and Harmon-Jones 2009) including adaptive responses to goal-blockage (Lerner and Keltner 2001). Though fear and sadness have functional benefits in responses to survival threats and losses, they are largely associated with avoidance (Ohman and Mineka 2001) and withdrawal (Bonanno et al. 2008). Given the importance of peer-relations during adjustment to college, avoidance and withdrawal responses could be problematic as they would be least likely to fulfill the broader goal.

Prior research on negative emotions during peer-rejection has had mixed findings. The conflicting evidence may be due in part to the likelihood that functional benefits of negative emotion vary depending on whether immediate versus long-term needs or outcomes are in question. For example, as compared to sadness or fear, anger could activate resources most effectively *in the moment* because anger is associated with appraisals of certainty, control, and predicts optimism and greater decisiveness (Lerner and Keltner 2001; Lerner et al. 2003). Moreover, there is clear behavioral evidence that anger is predictive of less sympathetic arousal and less HPA axis reactivity (e.g., Stemmler et al. 2001; Lerner et al. 2007) *relative to fear*. Indeed, there is some evidence suggesting that anger may be relatively adaptive (Miller and Olson 2000) and that fear is particularly problematic during social rejection (Sethi et al. 2013). Finally, there is very convincing evidence in prior use of this paradigm that positive emotions are functionally important responses during peer-rejection. However, they appear to occur largely outside of the awareness and impact secondary or broader goals (DeWall et al. 2011).

In this study, we tested the functional relevance of the negative emotions anger, sadness, and fear, as well as positive emotion elicited during simulated-peer rejection in first year college students. To do so, we examined them in relation to an immediate functional indicator of outcome (sympathetic nervous system activity) *and* a distal indicator of adjustment (reports of psychological distress). We hypothesized that relative to fear or sadness, anger would be most adaptive in the moment. Anger is associated with optimistic appraisals, more adaptive coping, and, in particular, reduced sympathetic arousal. Increased sympathetic arousal (in this case skin conductance) can be highly adaptive in response to survival threats, but in a social context would be incongruent with approach-related behaviors and flexible responding. However, in relation to distal outcome, we considered that anger and positive

emotions *could potentially both* be adaptive given their associations with approach-related responses and goal achievement. Indeed, prior work has demonstrated that positive emotions are critical to relationship development, and are therefore likely adaptive in the broader framework of adjustment to college (Fredrickson 1998), though not necessarily during the task. Given the clear association of sadness to social withdrawal and fear to avoidance, we predicted that neither would provide functional benefit. Indeed, we anticipated that as in prior work, fear might be most problematic, predictive of high sympathetic arousal during rejection and higher reported psychological distress.

Methods

Participants and procedure

Seventy participants who identified as first-year students at a Midwest public university were recruited for a study on emotion and attention and compensated with course credit. Informed consent was obtained for all participants and all research activity was approved by the Institutional Review Board overseeing research involving human subjects. After consenting, participants were photographed and completed an "online profile" to aid in the deception during the simulated rejection task. Next, participants completed questionnaires indexing demographics and psychological distress. Finally, participants were seated in front of a desktop computer and played two "online" ball games during which rejection was simulated (Cyberball: Williams et al. 2000). Emotion was indexed via self-reported emotion responses as well as coded facial behavior (high-definition video of facial expressions was captured during each game). Sympathetic arousal (skin conductance) was indexed throughout.

Participant mean age was $M = 19.27$ years, $SD = 3.71$. Four participants were older than traditional college age (i.e., greater than 22 years) and there was variability in age that predicted some marginal differences in emotional responses, as such, we routinely controlled for age in all analysis. Participants were primarily female (60 %), Caucasian (84 %), and non-Hispanic (93 %).

Questionnaire measures

Psychological distress The Global Symptom Index is a 29-item self-report measure of psychological distress measured using a combination of Depression, Anxiety, and Hostility sub-scales from the Symptom Check List (SCL-90-R; Derogatis 1983). Items were averaged to form a psychological distress score. Mean distress reported was $M = .67$; $SD = .57$ ($\alpha = .94$).

Rejection task and emotion assessment and autonomic activity

Participants engaged in an adapted version of the Cyberball paradigm, a well-established computer simulation of rejection or ostracism (Williams et al. 2000). In this within-subjects version, participants were told they would be playing a series of "online" ball games with three other students who were in other rooms around the university and that they would be evaluated on their performance. Several features were integrated into the protocol to aid the deception (e.g., online "profile" creation; the experimenter made several "checks" on the status of other online players prior to each game, etc.). Participants played two games, in the first they experienced no rejection and were tossed the ball 25 % of the time. In the second game, participants were rejected and were tossed the ball only 7 % of the time, and only in the first 30 s of the game. Participant reported emotional experience after each game, facial behavior and autonomic activity were recorded in real time, throughout.

Reported emotional experience

Participants rated their experience of Anger, Sadness, Fear, and Happiness, each on a 1–7 Likert scale immediately after each game. The pattern of means conformed to expectations from Game 1 (no rejection) to Game 2 (rejection) such that there was an increase in Anger and Sadness and a decrease in Happiness: Game 1—Anger $M = 1.10$, $SD = 1.04$, Game 2—Anger $M = 1.59$, $SD = 1.25$, $t(69) = -3.49$, $p = .001$; Game 1—Sadness $M = 1.14$, $SD = 57$, Game 2—Sadness $M = 1.40$, $SD = 1.04$ $t(69) = -2.21$, $p = .03$; Game 1—Happiness $M = 3.57$, $SD = 1.57$, Game 2—Happiness $M = 2.80$, $SD = 1.54$, $t(69) = 7.02$, $p = .000$. However, there was no significant difference in reported Fear across the two games: Game 1 Fear $M = 1.20$, $SD = 0.63$, Game 2 Fear $M = 1.\ 14$, $SD = 0.52$, $t(69) = 1.00$, $p = .32$.

Coded emotional expression Participant facial behavior was recorded using a customized high-definition web-cam. Nine participants did not have usable video data because of camera malfunction (n = 5) and experimenter error (n = 4), so facial scores are available for n = 61 participants only. Four coders, blind to the hypotheses and all study details, viewed each participants videos from each game without sound on a 23-inch computer monitor. Coders coded facial behavior indicative of Anger, Sadness, Fear or Happiness, each on 1–7 Likert scales for each participant for each of the two games. Coders received limited training (as in Study 1) and relied on global indicators of each emotion in a manner consistent with prior

research (e.g., Waldinger et al. 2004). Coder reliability was assessed (average ICC = .67, range: .41–.86) and scores was averaged across all four coders by participant to increase reliability. The result was each participant had one score for each coded emotion for each game.

The pattern of means across games conformed to expectations for Sadness and Happiness: Game 1—Sadness $M = 1.15$, $SD = 0.27$, Game 2–Sadness $M = 1.28$, $SD = 0.34$ $t(60) = -2.91$, $p = .005$ Game 1—Happiness $M = 2.06$, $SD = 1.16$, Game 2—Happiness $M = 1.49$, $SD = 0.92$, $t(60) = 4.86$, $p = .000$. However, there was no significant difference in coded expressions of Fear or Anger across the two games: Game 1 Fear $M = 1.13$, $SD = 0.20$, Game 2 Fear $M = 1.\ 12$, $SD = 0.22$, $t(60) = .44$, $p = .67$; Game 1—Anger $M = 1.14$, $SD = 0.29$, Game 2—Anger $M = 1.15$ $SD = 0.29$, $t(60) = -.55$, $p = .59$.

Sympathetic Arousal—skin conductance response After completing the player "profile" participants were fitted with an *Affectiva Q-Sensor*™ to monitor skin conductance (SC) on the inner wrist or ventral forearm, of their non-dominant arm, one inch below the wrist bone. The Q-Sensor uses two, 1-cm diameter Ag–AgCl dry electrodes and samples skin conductance at a rate of 32 Hz. Data were cleaned and artifacts removed using customized software (*Affectiva*) and visual inspection. One SC value for each game, in *u*Siemens, was calculated by averaging SC across that game period. Mean SC for game 1 $M = .18$, $SD = .35$ was not significantly different from mean SC for game 2 (rejection) $M = .19$, $SD = .40$, $t(61) = -1.33$, $p = .19$. Eight individuals lacked usable SC data because of equipment malfunction (n = 4) and experimenter error (n = 4).

Results

Preliminary analysis

We examined bi-variate correlations between key study variables (see Table 6). The results were largely consistent with our hypotheses. For example, fear expressions were associated with increased psychological distress and generally reported emotions during the rejection game were associate reported psychological distress (i.e., happy reports had an inverse association, whereas sad, anger, and fear reports had a positive association). However, notably there was relatively little concordance across response modes by emotion. This may be due to differences in the differentiation of reported emotional experience as compared to facial behavior. For example, ratings of negative emotions (anger, fear, sadness) were all correlated significantly whereas facial expressions of those same emotions were largely not. This suggests that participants rated emotional experiences less distinctly than their faces displayed emotions, consistent with recent evidence on individual differences in emotion differentiation and/or clarity (Kashdan et al. 2015).

Emotion responses and proximal outcome—sympathetic arousal

In this analysis we focused on proximal responses within the rejection game. We conducted two OLS regressions (one for each index of emotion). In each analysis, mean skin conductance during rejection was the dependent variable. In the first step we controlled for mean skin conductance from the prior neutral game, age and gender. In the second step we entered either expressed (Table 7—Regression A) *or* reported (Table 7—Regression B) fear, sadness, anger, and happiness during game 2. The results of these analyses were consistent with our hypothesis and revealed that greater expressed anger was significantly predictive of lower skin conductance during rejection, although the effect was quite small, $\beta = -.10$, $p = .03$, $sr^2 = .01$; $F(7,\ 48) = 65.23$, $p < .000$, $R^2 = .91$. However, we did not find effects consistent with our predictions for fear (expressed or reported) and found no other associations.

Emotion responses and distal outcome—psychological distress

In this analysis we focused broadly on responses to both Cyberball games, and were particularly interested in emotions generated during the rejection game. Again we conducted two OLS regressions. In each analysis, psychological distress was the dependent variable. In the first step of each model we controlled for age and gender, and included emotion responses (either reported *or* expressed) during Game 1 (no rejection). In the second step, entered either expressed (Table 8: Regression A) or reported (Table 8: Regression B) anger, fear, sadness and happiness from Game 2.[5] In the final model examining facial behavior, expressed fear during rejection was significantly associated with higher distress $\beta = .28$, $p = .05$, $sr^2 = .06$, and expressed happiness during rejection was significantly associated with lower distress, Game 2 happiness: $\beta = -.43$, $p = .01$, $sr^2 = .10$ $F(10,\ 50) = 2.09$,

[5] Given the correlations among emotion variables we did rerun these analyses in various combinations (e.g., without all emotions included; without baseline emotion) to test the possibility that the effects reported were dependent on the presence of the covariates. Across analyses the nature of the relationships between IVs and distress were relatively consistent and there were not meaningful differences when covariates were or were not included.

Table 6 Study 3 bi-variate correlations between key variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1. Game 1 Fear Expression	–																	
2. Game 1 Sad Expression	**.43**	–																
3. Game 1 Anger Expression	−.15	.06	–															
4. Game 1 Happy Expression	−.06	**−.35**	−.20	–														
5. Game 1 Fear Report	−.08	−.12	−.11	.13	–													
6. Game 1 Sad Report	.05	−.07	−.11	.24	**.58**	–												
7. Game 1 Anger Report	−.12	−.05	−.09	**.32**	**.74**	**.56**	–											
8. Game 1 Happy Report	**.27**	.10	−.03	.08	.10	.11	.09	–										
9. Game 2 Fear Expression	**.48**	.14	−.08	−.02	−.07	−.04	−.06	.06	–									
10. Game 2 Sad Expression	−.00	**.35**	.05	−.04	−.17	−.13	−.08	−.01	.09	–								
11. Game 2 Anger Expression	.07	.17	**.68**	**−.26**	−.13	−.13	−.11	.09	−.03	.11	–							
12. Game 2 Happy Expression	−.08	**−.27**	−.20	**.64**	.03	**.33**	.16	.06	−.04	−.07	−.25	–						
13. Game 2 Fear Report	−.10	−.13	−.07	**.30**	**.67**	**.48**	**.66**	.07	−.04	−.08	−.09	.17						
14. Game 2 Sad Report	.05	−.17	−.15	.18	**.48**	**.38**	**.31**	.15	−.01	−.15	−.09	.09	**.81**	–				
15. Game 2 Anger Report	.07	−.04	−.08	−.04	**.54**	.24	**.37**	.07	.08	.07	−.08	−.12	**.59**	**.67**	–			
16. Game 2 Happy Report	**.26**	−.12	−.03	.08	−.04	.13	.07	**.83**	.02	−.01	.07	.15	.03	.01	−.14	–		
17. Game 1 (neutral) SC	−.12	−.07	−.02	−.02	−.02	−.07	−.04	.06	−.08	−.13	−.02	.04	−.09	−.09	−.12	.17	–	
18. Game 2 SC	−.10	−.04	−.07	.07	.04	−.04	.02	.13	−.05	−.16	−.11	−.03	−.04	−.02	−.05	.17	**.94**	–
19. Psychological Distress	.02	−.01	−.10	.22	.19	−.04	.05	−.10	**.27**	.16	−.13	−.13	**.36**	**.40**	**.32**	**−.25**	−.12	−.09

Significant associations are indicated in bold

Table 7 Study 3—OLS regression examining emotional responses to simulated rejection during adjustment to college—proximal outcome: sympathetic arousal

Dependent variable: mean skin conductance during rejection (Game 2)		B	SE	β	sr^2	R^2	ΔR^2
Regression A							
Step 1	Age	.01	.01	.05	.00	.89	–
	Gender	.01	.04	.02	.00		
	Game 1 (neutral) SC	1.14***	.06	.94	.85		
$F(3, 52) = 146.64$, $p < .000$							
Step 2	Age	.01	.01	.04	.00	.91	.02
	Gender	.01	.04	.01	.00		
	Game 1 (neutral) SC	1.15***	.06	.95	.84		
	Game 2 Fear Expression	.00	.09	.00	.00		
	Game 2 Sad Expression	.02	.06	.01	.00		
	Game 2 Anger Expression	−.15*	.07	−.10	.01		
	Game 2 Happy Expression	−.00	.02	−.00	.00		
$F(7, 48) = 65.23$, $p < .000$							
Regression B							
Step 1	Age	.01	.01	.05	.00	.88	–
	Gender	.03	.04	.03	.00		
	Game 1 (neutral) SC	1.14***	.06	.94	.84		
$F(3, 58) = 146.86$, $p < .000$							
Step 2	Age	.01	.01	.07	.00	.89	.01
	Gender	.04	.04	.04	.00		
	Game 1 (neutral) SC	1.14***	.06	.95	.81		
	Game 2 Fear Report	−.00	.06	−.01	.00		
	Game 2 Sad Report	.01	.03	.02	.00		
	Game 2 Anger Report	.02	.02	.06	.00		
	Game 2 Happy Report	.01	.01	.03	.00		
$F(7, 54) = 61.48$, $p < .000$							

* $p < .05$; ** $p < .001$

$p = .04$, $R^2 = .30$. Neither expressed anger nor sadness was significantly associated with distress. Interestingly, expressed happiness during Game 1 (no rejection) was associated with greater distress $\beta = .46$, $p = .01$, $sr^2 = .12$. In the final model, neither reported fear during rejection, $\beta = .48$, $p = .10$, $sr^2 = .03$, nor reported happiness, $\beta = -.41$, $p = .07$, $sr^2 = .04$; $F(10, 59) = 2.85$, $p = .006$, $R^2 = .33$ reached significance. Again, neither reported anger nor reported sadness was significantly associated with distress.

Discussion

The goal of this study was to examine the utility of negative emotion responses in relation to proximal and distal outcomes when generated during simulated peer-rejection in first-year college students. Our approach in this final study was to broaden our elicitation paradigm, so as to approach the question of negative emotion context sensitivity more naturalistically. Accordingly, we tested the functional importance of multiple negative emotions (i.e., fear, anger, sadness) and positive emotion in relation to proximal and distal outcomes.

As predicted, our results largely depended on the outcome indicator. For example, anger expressed during peer-rejection was adaptive *in the moment*, predicting lower sympathetic arousal during the task itself. Prior research has clearly linked anger responses with optimism and challenge (versus threat) appraisals (Lerner and Keltner 2001). Both are predictive of *parasympathetic* nervous system enhancement during lab stressors (e.g., higher, high-frequency heart rate variability: Laborde et al. 2015) an indicator of regulatory resources and psychological health (c.f., Beauchaine and Thayer 2015), although not measured here. In contrast, although anger responses had proximal benefit, we found that only positive emotional

Table 8 Study 3—OLS regression examining emotional responses to simulated rejection during adjustment to college—distal outcome: psychological distress

Dependent variable: psychological distress		B	SE	β	sr^2	R^2	ΔR^2
Regression A							
Step 1	Age	−.02	.01	−.21	.04	.11	–
	Gender	.08	.12	.09	.01		
	Game 1 Fear Expression	−.05	.32	−.02	.00		
	Game 1 Sadness Expression	.06	.24	.04	.00		
	Game 1 Happy Expression	.09	.05	.24	.05		
	Game 1 Anger Expression	−.10	.19	−.07	.00		
$F(6, 54) = 1.06$, $p = .40$							
Step 2	Age	−.02	.01	−.17	.03	.30	19*
	Gender	−.01	.11	−.01	.00		
	Game 1 Fear Expression	−.29	.34	−.14	.01		
	Game 1 Sadness Expression	.00	.24	.00	.00		
	Game 1 Happy Expression	.17**	.06	.46	.12		
	Game 1 Anger Expression	−.08	.25	−.06	.00		
	Game 2 Fear Expression	.53*	.26	.28	.06		
	Game 2 Sadness Expression	.18	.17	.14	.02		
	Game 2 Happy Expression	−.20**	.07	−.43	.10		
	Game 2 Anger Expression	−.13	.25	−.09	.00		
$F(10, 50) = 2.10$, $p = .04$							
Regression B							
Step 1	Age	−.03	.02	−.19	.03	.12	–
	Gender	.03	.14	.03	.00		
	Game 1 Fear Report	.36*	.17	.40	.07		
	Game 1 Sadness Report	−.18	.15	−.18	.02		
	Game 1 Happy Report	−.05	.04	−.14	.02		
	Game 1 Anger Report	−.19	.25	−.14	.01		
$F(6, 63) = 1.45$, $p = .21$							
Step 2	Age	−.02	.02	−.16	.02	.33	21**
	Gender	−.09	.14	−.08	.01		
	Game 1 Fear Report	.05	.18	.06	.00		
	Game 1 Sadness Report	−.22	.15	−.21	.02		
	Game 1 Happy Report	.07	.08	.19	.01		
	Game 1 Anger Report	−.29	.29	−.22	.01		
	Game 2 Fear Report	.53	.32	.48	.03		
	Game 2 Sadness Report	.07	.15	.12	.00		
	Game 2 Happy Report	−.15	.08	−.41	.04		
	Game 2 Anger Report	−.02	.08	−.04	.00		
$F(10, 59) = 2.84$, $p = .01$							

* $p < .05$; ** $p < .001$

responses during peer-rejection were functionally adaptive in the broader framework of adjustment to college. This is largely consistent with prior research demonstrating the relevance of positive emotions elicited during peer-rejection (that are largely out of awareness) on broader perhaps secondary outcomes (e.g. DeWall et al. 2011).

Also consistent with prior work and our prediction, we found that fear during rejection was predictive of *more* reported distress. We did not, despite our prediction, find any association between fear and sympathetic arousal. This may be due to the restricted range in fear responses and the limited change in skin conductance, perhaps because the threat was social and not survival-related. Sadness was unrelated to our indices of outcome. Together these findings suggest short-term functional benefits for anger but no long term benefit. As with the prior two studies, we saw the

strongest associations for coded facial expressions of emotion in our regression analyses. We address this pattern in detail in the general discussion below.

Limitations included reliance on single-item ratings of emotional experience which, particularly in a more ambiguous emotional context, may have made participant reports less reliable and contributed in part to the lack of concordance across response dimensions. Indeed, there were relatively high correlations among negative emotion ratings, or evidence of poor emotion differentiation. This phenomenon is increasingly demonstrated to be less an indicator of emotion responding and more an indicator of differences in the conceptualization of emotional experience (c.f., Kashdan et al. 2015). Moreover, because of equipment and other malfunctions we lost data and the sample was smaller than intended. Finally, the overall change in skin conductance was quite small. Although we are confident in our findings, and they are consistent with the extant literature, it will be important to replicate this particular effect in order to better understand the degree of benefit that anger provides during social threat in relation to decreases in sympathetic arousal. Despite these limitations, we still provided evidence of a relatively adaptive (i.e., anger) negative emotion within the naturalistic context of peer-rejection during adjustment to college.

General discussion

In this investigation we examined associations between specific negative emotions and psychological health and adjustment across a range of samples, methods, and outcomes. Although each of the studies varied in terms of population, emotions in question, emotion elicitation paradigm, and indicator of adjustment, overall the data were consistently supportive of our broader hypothesis that negative emotions can be functionally adaptive. Taken together, these data broadly support functional theories of negative emotions in a range of community samples. Moreover, these three studies take an important step beyond largely basic experimental research examining the functions of discrete negative emotions, to demonstrating their broader role in psychological health and adjustment in real-world samples and circumstances.

A key strength of this investigation was use of lab paradigms with well-defined contexts in which emotions were elicited and measured in real-time, across response dimensions. Although there is considerable evidence demonstrating a link between negative emotions and poor adjustment in community samples, much of this work has relied on participant reports of *typical* responding. Indeed, if one reviews the extant literature on negative emotion and adjustment, a considerable portion has relied on self-reported assessment of general tendencies. The strengths and weaknesses of self-report indices aside, our data demonstrate the importance of capturing in-the-moment emotion responses with explicit attention to in-lab contextual factors.

Indeed, had we indexed negative emotions more generally, we may have only captured affective phenomena more consistent with enduring negative mood (see Rosenberg 1998) which has often been implicated in poor psychological functioning. However, here we employed a discrete or basic emotions framework, and sought to test the functional utility of discrete negative emotional responses on carefully selected indices of adjustment. Moreover, because we indexed responses across multiple dimensions, we were able to explore how particular response modes were more or less predictive of outcome. Overall, our findings suggested that behavioral indices of emotion were most predictive of outcome across samples and contexts (a point we return to later). Finally, matching of the outcome indicator to the sample's unique circumstances, contextual features, and emotion(s) in question was important. Prior investigations of emotions and adjustment in community samples have often relied on broad indicators of outcome (e.g., symptoms) that are unlikely to be functionally associated with specific emotions elicited. Indeed, there are few examples of research testing the influence of discrete negative emotions in real world samples (see Lerner et al. 2003 for a key exception).

Assessing the theorized tight association between emotion, context, and adaptive function is particularly challenging in community samples, given the potential for intervening factors not measured in the investigation. Here, we attempted to address this important challenge by employing established paradigms with demonstrated effectiveness in eliciting the target emotions in question, and we strove to include outcome indicators that would be likely influenced by factors or processes enhanced by the target emotion(s). For example, sadness, indexed in Study 2, increases deliberation, acceptance, and problem solving. These are all factors demonstrated to underlie treatment adherence in chronic illness, and sadness was indexed following an interview focused on experiences with their illness. Overall, these three studies present an important step forward in the broader application of discrete emotions theory to furthering the understanding of negative emotion and adjustment in community samples.

In this investigation we focused on examining context-sensitive negative emotion in relation to current adjustment broadly defined. As such, we focused specifically on context-emotion matching, basing our determination of a "match" on prior research, and testing the degree to which context-sensitive emotion predicted selected outcomes. Across all three studies, there was clear evidence that *more* matched or context-sensitive negative emotion predicted a

better outcome. Indeed, this has largely been the finding in the broader literature on emotion context sensitivity (e.g., Rottenberg et al. 2002). However, it is possible that it may not simply be that higher intensity, context-sensitive emotion is always adaptive. Indeed, there may be optimal levels, above or below which become problematic. Recent theorizing on emotion flexibility has argued that emotion context-sensitivity can not only be defined by the generation of matched emotion to contexts, but also the ability to disengage that emotion when the context shifts (Coifman and Almahmoud in press). Relatively few studies have investigated this idea (see Coifman and Bonanno 2010 and here, our Study 1) and have not fully explored the possibility that too much context-sensitive emotion could also be problematic. This is clearly an important area for future research.

Across the three studies, we consistently found evidence that greater context-sensitive negative emotional expressions were associated with specific outcomes as predicted. Surprisingly, we did not find similar effects for context-sensitive reports of negative emotion. We believe it important that although reports of emotion did not reach significance, the pattern of associations was largely consistent with those relating to facial expressions. Indeed, because this was so often the case, it may very well be that measurement limitations (reporting after each elicitation context) and individual difference factors relating to how individuals organize, conceptualize, and even value their emotional experiences, diluted the sensitivity of reports so that they only loosely matched behavioral indicators, in this case, facial expression of emotion.

Over the last several decades of emotion research the issue of concordance or coherence across emotion response modes (e.g., facial expressions, self-report, and/or autonomic activity) has largely shifted. In place of previous assumptions that coherence should be ever-present, more recent work characterizes response modes as "loosely coupled" (Bonanno and Keltner 2004) and demonstrations of concordance occur only under certain circumstances (e.g., high intensity: Mauss et al. 2005). Moreover, there is a burgeoning literature demonstrating the vulnerability of self-reports of emotion to internal influences. Indeed, recent work has de-emphasized the role of bias or demand characteristics (although these are likely still important) and instead has focused on individual differences in patterns of emotion conceptualization (Kashdan et al. 2015) and attention to emotional experience (e.g., Kashdan et al. 2006; Kross and Ayuduk 2011). These have been demonstrated to be highly influential on in-the-moment reporting. For example, considerable evidence suggests that even relatively simple associations between reported emotions of differing valence (negative versus positive) can shift *within* an individual, depending on their subjective perception of stress (c.f. Zautra 2006).

Taken together, this may mean that facial expressions of emotion are more objective indicators of responding than reports. Indeed emotion facial behavior is not only less likely to be influenced by dispositional or circumstantial biases, but may be most indicative of shifts in emotion that are outside of awareness, including seemingly divergent, conflicting, or mixed responses, as compared to *resolved* responses *reported* after the fact. However, there are some that would argue that internal conceptualizations of emotion define emotion responding and that facial expressions are only secondary (Barrett 2006). We would argue that both are important and would caution against approaches that only consider one response mode.

As described in each individual study discussion, there were limitations to these data relating to the specifics of each study. First, some might argue that the variability in methodology and independent/dependent variables across the three studies was a limitation. Indeed, it will be important to both replicate and further explicate these findings in similar samples. In particular, our method of coding facial expressions varied based on the research question and, in some cases, resources. Despite the consistency of our results, given the importance of facial behavior in our findings, the variability in coding methods is an important consideration and limitation. Moreover, we used highly controlled designs, yet differing paradigms for Studies 1 and 2 (i.e., using standardized stimuli), versus a broader, more naturalistic design in Study 3. In addition, in each study the hypotheses and at times methodology were tailored to the specific population, in order to test how a particular emotion would be associated with adjustment *in that context* (hence the variability in dependent variables). We would argue that in order to be sensitive to contextual and sample-specific factors that influence the role of negative emotions in relation to different outcomes, the methodology had to vary accordingly. Moreover, despite these differences, each study helped to address the question of the functional utility of negative emotion in adjustment and together the three studies are a convincing translation of functional and discrete emotion theories into diverse real-world circumstances.

Conclusion

Overall, these three studies are an important step in understanding the link between negative emotions and *better* psychological health and adjustment. Taken together, this research provides support for the theorized adaptive function of negative emotions and illustrates how negative emotions may have considerable utility across samples and circumstances when contextually sensitive. In particular, these studies illustrate the substantial relevance

of context as well as careful selection of outcome indicators and real-time assessment, when evaluating negative emotions in relation to psychological health and adjustment in community samples. Based on these findings, and the broader theoretical background, we would argue for increased attention to negative emotions in general and certainly in research specifically focused on emotion processes in relation to psychological and physical health.

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Compliance with ethical standards

Conflict of interest All authors have no conflicts of interest to disclose.

Human and animal rights All procedures performed in research involving human participants were in accordance with the ethical standards of the relevant institutional review boards governing research involving human subjects and with the 1964 Helsinki declaration and it later amendments or comparable ethical standards. Moreover, written informed consent was obtained from all individual participants included in this research.

References

Aldao, A. (2013). The future of emotion regulation research: Capturing context. *Perspectives on Psychological Science, 8*(2), 155–172.

Bagby, R. M., Parker, J. D. A., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia Scale-I. Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research*, *38*, 23–32.

Barlow, D. H., Ellard, K. K., Sauer-Zavala, S., Bullis, J. R., & Carl, J. R. (2014). The origins of neuroticism. *Perspectives on Psychological Science*, *9*(5), 481–496. doi:10.1177/1745691614544528.

Barrett, L. F. (2006). Emotions as natural kinds? *Perspectives on Psychological Science, 1*, 28–58.

Beauchaine, T. P., & Thayer, J. F. (2015). Heart rate variability as a transdiagnostic biomarker of psychopathology. *International Journal of Psychophysiology*. doi:10.1016/j.ijpsycho.2015.08.004.

Bechara, A., & Damasio, A. F. (2005). The somatic marker hypothesis: A neural theory of economic decision. *Games and Economic Behavior*, *52*, 336–372.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society, B, 57*, 289–300.

Benjamini, Y., & Hochberg, Y. (2000). On the adaptive control of the false discovery rate in multiple testing with independent statistics. *Journal of Educational and Behavioral Statistics, 25*, 60–83.

Bloom, T., & Friedman, H. (2013). Classifying dogs' (*Canis familiaris*) facial expressions from photographs. *Behavioural Processes*, *96*, 1–10.

Bodenhausen, G. V., Gabriel, S., & Lineberger, M. (2000). Sadness and susceptibility to judgmental bias: The case of anchoring. *Psychological Science, 11*, 320–323.

Bonanno, G. A., & Burton, C. L. (2013). Regulatory flexibility: An individual differences perspective on coping and emotion regulation. *Perspectives on Psychological Science, 8*(6), 591–612.

Bonanno, G. A., Colak, D. M., Keltner, D., Shiota, L., Papa, A., Noll, J. G., et al. (2007). Context matters: The benefits and costs of expressing positive emotion among survivors of childhood sexual abuse. *Emotion, 7*, 824–837.

Bonanno, G. A., Goorin, L., & Coifman, K. G. (2008). Sadness and grief. In M. Lewis, J. Haviland-Jones, & L. FeldmanBarrett (Eds.), *The handbook of emotion* (3rd ed.). New York: Guilford.

Bonanno, G. A., & Keltner, D. (1997). Facial expressions of emotion and the course of conjugal bereavement. *Journal of Abnormal Psychology, 106*(1), 126–137.

Bonanno, G. A., & Keltner, D. (2004). The coherence of emotion systems: Comparing "on-line" measures of appraisal and facial expression, and self-report. *Cognition and Emotion, 18*, 431–444.

Bulteel, K., Ceulemans, E., Thompsom, R. J., Waugh, C. E., Gotlib, I. E., Tuerlinckx, F., & Kuppens, P. (2014). DeCon: A tool to detect emotional concordance in multivariate time series data of emotional responding. *Biological Psychology, 98*, 29–42.

Buss, K. A., Davidson, R. J., Kalin, N. H., & Goldsmith, H. H. (2004). Context-specific freezing and associated physiological reactivity as a dysregulated fear response. *Developmental Psychology*, *40*(4), 583.

Carver, C. S., & Harmon-Jones, E. (2009). Anger is an approach-related affect: Evidence and implications. *Psychological Bulletin, 135*(2), 183–204.

Coifman, K. G., & Almahmoud, S. Y. (2016). Emotion flexibility in psychological risk and resilience. In U. Kumar (Ed.), *Handbook of resilience: A psychosocial perspective*. New York: Routledge.

Coifman, K. G., & Bonanno, G. A. (2009). Emotion context sensitivity in adaptation and recovery. In A. Kring Sloan (Ed.), *Emotion regulation and psychotherapy*. New York: Guilford.

Coifman, K. G., & Bonanno, G. A. (2010). When distress does *not* become depression; Emotion context sensitivity and adjustment to bereavement. *Journal of Abnormal Psychology, 119*(3), 479–490.

Coifman, K. G., Bonanno, G. A., Ray, R., & Gross, J. (2007). Does repression lead to recovery and resilience? Affective-autonomic response discrepancy in bereavement. *Journal of Personality and Social Psychology, 92*, 745–758.

Cole, P. M., Michel, M. K., & Teti, L. O. (1994). The development of emotion regulation: Biological and behavioral considerations. *Monographs of the Society for Research in Child Development, 59*, 73–100.

Consedine, N. S., Magai, C., Krivoshekova, Y. S., Ryzewicz, L., & Neugut, A. I. (2004). Fear, anxiety, worry, and breast cancer screening behavior: A critical review. *Cancer Epidemiology, Biomarkers and Prevention, 13*, 501–510.

Davila, J., Karney, B. R., Hall, T. W., & Bradbury, T. N. (2003). Depressive symptoms and marital satisfaction: Within-subject associations and the moderating effects of gender and neuroticism. *Journal of Family Psychology, 17*, 557–570.

Derogatis, L. R. (1983). *SCL-90-R administration, scoring and procedures manual-II for the R (revised) version*. Towson, MD: Clinical Psychometric Research.

DeWall, N. C., Twenge, J. M., Koole, S. L., Baumeister, R. F., et al. (2011). Automatic emotion regulation after social exclusion: Turning to positivity. *Emotion, 11*, 623–636.

Dondi, M., Messinger, D., Colle, M., Tabasso, A., Simion, F., Dalla Barba, B., & Fogel, A. (2007). A new perspective on neonatal smiling: Differences between the judgments of expert coders and naive observers. *Infancy, 12*, 235–255.

Dubitsky, S., Weber, R., & Rotton, J. (1993). Heat, hostility, and immune function: The moderating effects of gender and demand

characteristics. *Bulletin of the Psychonomic Society, 31*, 534–536.
Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion, 6*, 169–200.
Ekman, P., Friesen, W., & Hager, J. (2002). *Facial action coding system—Revised. Instructional manual and investigator guide*. San Francisco, CA: A Human Face.
Fass, M. E., & Tubman, J. G. (2002). The influence of parental and peer attachment of college students academic achievement. *Psychology in the Schools, 39*, 561–573.
Fredrickson, B. L. (1998). What good are positive emotions? *Review of General Psychology, 2*, 300–319.
Gilman, T. L., Shaheen, R., Nylocks, K. M., Halachoff, D., Chapman, J., Flynn, J. J., et al. (2016). A film set for the elicitation of emotion in research: A comprehensive catalog derived from four decades of investigation (under review).
Goldsmith, H. H., & Davidson, R. J. (2004). Disambiguating the components of emotion regulation. *Child Development, 75*(2), 361–365.
Gottman, J. M. (1994). *What predicts divorce? The relationship between marital process and marital outcomes*. Hillsdale, NJ: Erlbaum.
Gottman, J. M., Coan, J., Carrere, S., & Swanson, C. (1998). Predicting marital happiness and stability from newlywed interactions. *Journal of Marriage and the Family, 60*, 5–22.
Graber, E. C., Laurenceau, J. P., Miga, E., Chango, J., & Coan, J. (2011). Conflict and love: Predicting newlywed marital outcomes from two interaction contexts. *Journal of Family Psychology, 25*, 541–550.
Graham, B. M., & Milad, M. R. (2011). The study of fear extinction: Implications for anxiety disorders. *American Journal of Psychiatry, 168*(12), 1255–1264.
Gross, J. J., & Levenson, R. W. (1995). Emotion-elicitation using films. *Cognition and Emotion, 9*, 87–108.
Guttman, I. (1973). Premium and protection of several procedures for dealing with outliers when sample sizes are moderate to large. *Technometrics, 15*(2), 385–404.
Harvey, M. M., Coifman, K. G., Ross, G., Kleinert, D., & Giardina, P. (2014). Contextually appropriate emotion-word use predicts adaptive health behavior: Emotion context sensitivity and treatment adherence. *Journal of Health Psychology*. doi:10.1177/1359105314532152.
Hill-Briggs, F. (2003). Problem-solving in diabetes self-management: A model of chronic-illness self-management behavior. *Annals of Behavioral Medicine, 25*, 182–193.
John, O. P., & Gross, J. J. (2004). Healthy and unhealthy emotion regulation: Personality processes, individual differences, and life span development. *Journal of Personality, 72*(6), 1301–1333.
Kashdan, T. B., Barrett, L. F., & McKnight, P. E. (2015). Unpacking emotion differentiation; transforming unpleasant experience by perceiving distinctions in negativity. *Current Directions in Psychological Science, 24*(1), 10–16.
Kashdan, T. B., Barrios, V., Forsyth, J. P., & Steger, M. F. (2006). Experiential avoidance as a generalized psychological vulnerability: Comparisons with coping and emotion regulation strategies. *Behaviour Research and Therapy, 9*, 1301–1320.
Keltner, D., Haidt, J., & Shiota, M. N. (2006). Social functionalism and the evolution of emotions. In M. Schaller, J. A. Simpson, & D. T. Kenrick (Eds.), *Evolution and social psychology* (pp. 115–142). Madison, CT: Psychosocial Press.
Keltner, D., Moffitt, T. E., & Stouthamer-Loeber, M. (1995). Facial expressions of emotion and psychopathology in adolescent boys. *Journal of Abnormal Psychology, 104*(4), 644–652.
Kross, E., & Ayuduk, O. (2011). Making meaning out of negative experiences by self-distancing. *Current Directions in Psychological Science, 20*(3), 187–191.
Laborde, S., Lautenbach, F., & Allen, M. S. (2015). The contribution of coping-related variables and heart rate variability to visual search performance under pressure. *Physiology & Behavior*. doi:10.1016/j.physbeh.2014.12.003.
Larsen, J. T., McGraw, A. P., & Cacioppo, J. T. (2001). Can people feel happy and sad at the same time? *Journal of Personality and Social Psychology, 81*, 684–696.
LeDoux, J. (2012). A neuroscientist's perspective on debates about the nature of emotion. *Emotion Review, 4*, 375–379.
Leombruni, P., Fassino, S., Lavagnino, L., et al. (2009). The role of anger in adherence to highly active antiretroviral treatment in patients infected with HIV. *Psychotherapy and Psychosomatics, 78*(4), 254–257.
Lerner, J. S., Dahl, R. E., Hariri, A. R., & Taylor, S. E. (2007). Facial expressions of emotion reveal neuroendocrine and cardiovascular stress responses. *Biological Psychiatry, 61*, 253–260.
Lerner, J. S., Gonzalez, R. M., Small, D. A., & Fischhoff, B. (2003). Effects of fear and anger on perceived risks of terrorism: A national field experiment. *Psychological Science, 14*(2), 144–150.
Lerner, J. S., & Keltner, D. (2001). Fear, anger, and risk. *Journal of Personality and Social Psychology, 81*, 146–159.
Leventhal, H., Leventhal, E. A., & Contrada, R. J. (1998). Self-regulation, health, and behavior: A perceptual-cognitive approach. *Psychology and Health, 13*, 717–733.
Magai, C. (1999). Affect, imagery, and attachment; Working models of interpersonal affect and the socialization of emotion. In J. Cassidy & P. R. Shaver (Eds.), *Handbook of attachment: Theory, research, and clinical applications* (pp. 787–802). New York: Guilford.
Magai, C., & MacFadden, S. (1995). *The role of emotion in social and personality development*. New York: Plenum Press.
Mauss, I. B., Levenson, R. W., McCarter, L., Wilhelm, F. H., & Gross, J. J. (2005). The tie that binds? Coherence among emotion experience, behavior and physiology. *Emotion, 5*, 175–190.
McNulty, J. K., & Fincham, F. D. (2012). Beyond positive psychology? Toward a contextual view of psychological processes and well-being. *American Psychologist, 67*, 101–110.
McNulty, J. K., & Russell, V. M. (2010). When "negative" behaviors are positive: A contextual analysis of the long-term effects of problem-solving behaviors on changes in relationship satisfaction. *Journal of Personality and Social Psychology, 98*, 587–604.
Messinger, D. S. (2002). Positive and negative: Infant facial expressions and emotions. *Current Directions in Psychological Science, 11*(1), 1–6.
Messner, C., & Wanke, M. (2011). Good weather for Schwarz and Clore. *Emotion, 11*, 436–437.
Mikulincer, M., Gillath, O., & Shaver, P. R. (2002). Activation of the attachment system in adulthood: Threat-related primes increase the accessibility of mental representations of attachment figures. *Journal of Personality and Social Psychology, 83*, 881–895.
Mikulincer, M., Hirschberger, G., Nachmias, O., & Gillath, O. (2001). The affective component of the secure base schema: Affective priming with representations of attachment security. *Journal of Personality and Social Psychology, 81*, 305–321.
Miller, A. L., & Olson, S. L. (2000). Emotional expressiveness during peer conflicts: A predictor of social maladjustment among high-risk preschoolers. *Journal of Abnormal Child Psychology, 28*, 339–352.
Moussavi, S., Chatterji, S., Verdes, E., Tandon, A., Vikram, P., & Ustun, B. (2007). Depression, chronic diseases, and decrements in health: Results from the World Health Surveys. *Lancet, 370*, 851–858.
National Center for Education Statistics, U.S. Department of Education. (2013). *The condition of education 2013* (NCES 2013-037). Institutional Retention and Graduation Rates for Undergraduate Students.

Nolen-Hoeksema, S., & Watkins, E. R. (2011). A heuristic for developing transdiagnostic models of psychopathology: Explaining multifinality and divergent trajectories. *Perspectives on Psychological Science, 6*(6), 589–609.

Ohman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review, 108*, 483–522.

Papa, A., & Bonanno, G. A. (2008). Smiling in the face of adversity: The interpersonal and intrapersonal functions of smiling. *Emotion, 8*(1), 1–12.

Phelps, E. A., Ling, S., & Carrasco, M. (2006). Emotion facilitates perception and potentiates the perceptual benefits of attention. *Psychological Science*, *17*(4), 292–299.

Radloff, L. S. (1977). The CES-D scale a self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*(3), 385–401.

Rosenberg, E. (1998). Levels of analysis and the organization of affect. *Review of General Psychology, 2*(3), 247–270.

Rottenberg, J., Kasch, K. L., Gross, J. J., & Gotlib, I. H. (2002). Sadness and amusement reactivity differentially predict concurrent and prospective functioning in major depressive disorder. *Emotion, 2*(2), 135–146.

Rund, D. R., & Rachmilewitz, E. (2005). B-Thalassemia. *New England Journal of Medicine, 353*, 1135–1146.

Russell, J. A. (1991). Culture and the categorization of emotions. *Psychological Bulletin, 110*, 426–450.

Salovey, P., Mayer, J. D., Goldman, S. L., Turvey, C., & Palfai, T. P. (1995). Emotional attention, clarity, and repair: Exploring emotional intelligence using the trait meta-mood scale. In J. Pennebaker (Ed.), *Emotion, disclosure, and health* (pp. 125–154). Washington, DC: American Psychological Association.

Sanberg, T., & Conner, M. T. (2008). A mere measurement effect for anticipated regret: Impacts on cervical screening attendance. *British Journal of Social Psychology, 48*(2), 221–236.

Schwarz, N., & Clore, G. L. (1983). Mood, misattribution, and judgements of well-being: informative an directive functions of affective states. *Journal of Personality and Social Psychology, 45*(3), 513–523.

Sethi, N., Moulds, M. L., & Richardson, R. (2013). The role of focus of attention and reappraisal in prolonging the negative effects of ostracism. *Group Dynamics, Theory, Research, and Practice, 17*, 110–123.

Shaver, P. R., & Mikulincer, M. (2008). Adult attachment and cognitive and affective reactions to positive and negative events. *Social and Personality Psychology Compass, 2*(5), 1844–1865.

Shields, M. C., Matt, L. M., & Coifman, K. G. (2015). Physical activity and negative emotion during peer-rejection: Evidence for emotion context sensitivity. *Journal of Health Psychology*. doi:10.1177/1359105315587139.

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology*, *48*, 813–838.

Spanier, G. (1976). Measuring dyadic adjustment: New scales for assessing the quality of marriage and similar dyads. *Journal of Marriage and the Family, 38*, 15–28.

Stemmler, G., Heldmann, M., Pauls, C. A., & Scherer, T. (2001). Constraints for emotion specificity in fear and anger: the context counts. *Psychophysiology, 38*, 275–291.

Tibachnik, B. G., & Fidell, L. S. (2006). *Using multivariate statistics* (5th ed.). New York: Pearson.

Trachtenberg, F., Vichinsky, E., Haines, D., Pakbaz, Z., Mednick, L., et al. (2011). Iron chelation adherence to deferoxamine and deferasirox. *American Journal of Hematology, 11*, 433–436.

Tybur, J. M., Lieberman, D., Kurzban, R., & DeScioli, P. (2013). Disgust: Evolved function and structure. *Psychological Review*, *120*(1), 65.

Vardaki, M. A., Philalithis, A. E., & Vlachonikolis, I. (2004). Factors associated with attitudes and expectations of patients suffering from B-Thalassaemia: A cross-sectional study. *Scandinavian Journal of Caring Science, 18*, 177–187.

Waldinger, R. J., Hauser, S. T., Schulz, M. S., Allen, J. P., & Crowell, J. A. (2004). Reading other emotions: The role of intuitive judgements in predicting marital satisfaction, quality and stability. *Journal of Family Psychology, 18*(1), 58–71.

Williams, K. D. (2007). Ostracism: The kiss of social death. *Social and Personality Psychology Compass, 1*(1), 236–247.

Williams, K. D., Cheung, C., & Choi, W. (2000). Cyberostracism: Effects of being ignored over the internet. *Journal of Personality and Social Psychology, 79*, 748–762.

Zaki, J., & Williams, W. C. (2013). Interpersonal emotion regulation. *Emotion, 13*(5), 803–810.

Zautra, A. P. (2006). *Emotions, stress & health*. New York: Oxford University Press.

Zimmerman, P., Maier, M., Winter, M., & Grossman, K. (2001). Attachment and adolescents emotion regulation during a joint problem-solving task with a friend. *International Journal of Behavioral Development, 25*(4), 331–343.