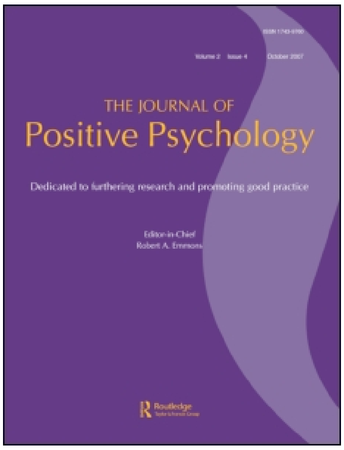

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Mood over matter: can happiness be your undoing?

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Mood over matter: can happiness be your undoing?

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Research in the field of positive psychology has revealed many advantages of positive emotions. According to the undoing hypothesis of Fredrickson and Levenson, positive affect can undo the physiological effects of negative emotion. The present study examined whether positive emotions could undo the cognitive effects of negative emotion. A letter identification task was used to measure changes in the cognitive processing of 86 college students who were induced into a positive, negative, or neutral affective state by viewing various film clips. The results of this study provided preliminary support for the hypothesis that positive emotions undo the cognitive effects of negative emotions.

Keywords: positive emotion; broaden-and-build; negative emotion; positive psychology; cognition; undoing hypothesis; emotion induction

The field of psychology has traditionally focused on the diagnosis and treatment of mental illnesses as well as other factors that prevent individuals from fulfilling necessary social roles (Seligman, Steen, Park, & Peterson, 2005). Recently, positive psychology has emerged to increase attention on the factors that promote happiness and allow individuals to flourish. Researchers in positive psychology have sought to understand the role that positive emotions play in human functioning in order to improve individuals' well-being (Fredrickson, 2001).

Negative emotion

Negative emotions such as fear, anger, and disgust have been shown to have physiological, behavioral, and cognitive effects that are beneficial for survival. Negative emotions are associated with the fight-or-flight response, a narrowed set of specific action tendencies that are accompanied by physiological changes that prepare the body either to attack in anger or flee in fear (Bradley, Codispoti, Cuthbert, & Lang, 2001). Fredrickson and Levenson (1998) observed notable physiological changes associated with negative affect on several cardiovascular measures. Compared to their baseline, individuals had a significantly higher heart rate and blood pressure after being induced into a negative emotional state by a fear-inducing film clip. In addition, negative affect has been found to result in a narrowed visual field and inattention to peripheral visual input (Brandt, Derryberry, & Reed, 1992; Fredrickson & Branigan, 2005). These physiological changes and narrowed action tendencies are initiated by negative emotions when a person is facing a stressful event.

Similar to these narrowed action tendencies, negative affect has been associated with cognitive narrowing. Negative emotions have been shown to narrow an individual's scope of attention, and this can prepare the body to act quickly in life-threatening situations (Fredrickson & Branigan, 2005). Fredrickson and Branigan (2005) found that individuals experimentally induced into a negative emotional state focused on details rather than the larger picture in a global versus local visual processing task. In addition, Lyubomirsky, Kasri, Zehm, and Dickerhoof (2007) found that individuals induced into a negative affective state performed more poorly at several simple (i.e., solving anagrams) and complex (i.e., GRE questions) cognitive tasks. This type of cognitive narrowing is also demonstrated by depressed individuals who tend to focus on their negative emotions. The internal focus and rumination that accompany depression have been found to impede problem solving (Lyubomirsky, Tucker, Caldwell, & Berg, 1999).

Positive emotion

Previous models of emotion have adequately addressed the adaptive role of negative emotions. However, positive emotions have not fit well within these models because they do not display the unique

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physiological changes or narrowing of behavior and cognition associated with negative emotions. Fredrickson (1998) proposed the broaden-and-build theory to address this gap and explain the evolutionary importance of positive emotions. In this theory, positive emotions are said to *broaden* an individual's repertoire of action tendencies and thoughts as well as *build* physical, cognitive, social, and psychological resources that can be drawn on in future times of need (Fredrickson, 1998, 2001, 2003; Fredrickson & Joiner, 2002).

Unlike negative emotions that narrow behavioral action tendencies, positive emotions broaden action potentials. Fredrickson and Branigan (2005) found that participants who were induced into a positive emotional state generated more activities that they would like to participate in than those induced into a negative mood. Additionally, research has demonstrated that individuals experiencing positive emotions engaged in more social interactions and spent more time with other individuals than participants in a negative or neutral state (Berry & Hansen, 1996; Lyubormirsky, King, & Diener, 2005).

Similar to the effects on behavior, positive emotions have also been found to broaden cognition. Individuals in whom positive emotions have been experimentally induced were more likely to focus on the big picture in a global versus local visual processing task compared to participants experiencing a negative emotion, who narrowed their scope of attention (Brandt et al., 1992; Fredrickson & Branigan, 2005). In addition, cognitive broadening during times of positive affect has been consistently demonstrated by research on creativity (Hirt, Melton, McDonald, & Harackiewicz, 1996; Isen, Daubman, & Nowicki, 1987; Rowe, Hirsh, & Anderson, 2007). Individuals induced into a positive affective state have shown more creative problem solving than those in a negative affective state (Isen et al., 1987). Finally, persons experiencing a positive emotion were able to generate more correct responses than those induced into a negative mood when asked to generate the remote associations among a group of words indicating greater breadth of cognition (Rowe et al., 2007).

Although positive emotions have not been found to display the distinct physiological changes associated with negative emotions, some physiological benefits of positive emotions have been found. For example, positive affect has been associated with a better immune response and a decrease in stress hormones, both of which contribute to better health (Pressman & Cohen, 2005). In addition, Fredrickson and Levenson (1998) proposed that the physiological effects of positive emotions may only be detectable in the presence of negative emotions. They have suggested that positive emotions undo the harmful physiological effects of negative emotions, such as increased heart rate and blood pressure. In tests of the undoing hypothesis, participants who were induced into a positive affective state after experiencing negative affect (e.g., fear or anger) returned to their physiological baseline faster than those who were induced into a negative or neutral state (Fredrickson & Levenson, 1998; Fredrickson, Mancuso, Branigan, & Tugade, 2000). The undoing effects of positive emotions have been suggested as a potential mechanism to explain an individual's resilience to stressful events (Folkman & Moskowitz, 2000; Tugade & Fredrickson, 2004).

The current study

Negative emotions have been associated with both distinct physiological and cognitive effects. Tests of the undoing hypothesis have demonstrated that positive emotions can undo the physiological effects of negative emotions. The goal of the current study was to extend the undoing hypothesis to the cognitive domain to determine whether positive emotion can undo the cognitive effects of negative emotion.

Although it has not been previously examined within the field of positive psychology, a letter-identification task was selected because it is a standard cognitive task that is amenable to repeated administration. Letter-recognition tasks were central to the development of early cognitive theories of pattern recognition (Kahneman, 1973; Lindsay & Norman, 1977). One prominent explanation, feature-detection theory, suggests that people recognize patterns by examining the presence or absence of individual features (e.g., vertical and horizontal lines of varying lengths). According to this theory, pattern recognition requires feature extraction, feature analysis, and integration of information prior to pattern recognition. Thus, pattern recognition occurs in stages requiring highly specialized cognitive processes. Latency in pattern recognition is affected by factors such as the similarity of features among stimuli as well as context (Best, 1999). Therefore, we hypothesized that the effects of negative affect on cognitive processing (as measured by the speed of letter identification) will be reversed by the subsequent induction of a positive emotion, but not by induction of another negative or neutral emotional state.

Method

Participants

The sample consisted of 86 undergraduate students from a small, public liberal arts college in the mid-Atlantic region who received credit in a general psychology course for their participation. Participants included 41 females and 21 males between the ages of 18 and 22 with a mean age of 19 ($SD = 1.11$).

Approximately 83.9% of the participants were Caucasian, 1.6% African-American, 6.5% Hispanic, and 8.1% Asian or Pacific Islander, while 6.5% defined themselves as 'Other.' These demographics are representative of the student population at this university.

Materials

Emotion induction

Brief segments of video were used to induce emotion because film clips have been found to be a reliable form of emotion induction (Fredrickson & Branigan, 2005; Gross & Levenson, 1995; Martin, 1990). The clips were selected because previous research had found these films to be an effective method to induce the desired emotional states (Hewig et al., 2005). The negative emotion of sadness was induced in all participants by a 171-second clip from the film, *The Champ*, in which a son sees his father die after a boxing match. Sadness was chosen for this particular study because of the lack of general physiological arousal that accompanies it. Physiological arousal may cause a difference in reaction time that could confound the effects of the cognitive narrowing on which the current study is focusing (Fredrickson & Levenson, 1998; Fredrickson et al., 2000).

Participants were then randomly assigned to see one of three additional film clips intended to induce a subsequent positive, negative, or neutral affective state. To induce the positive emotion of amusement, a humorous 149-second clip of a man and woman talking in a restaurant from the movie *When Harry Met Sally* was used. The negative emotion of sadness was induced by showing a scene from *An Officer and a Gentleman* (101 seconds) in which a friend is found dead by a couple. Finally, a 65-second segment of two men talking in a courtroom from the film *All the President's Men* was used to induce a neutral mood.

Cognitive processing task

A letter-identification task was created by the computer program PEAK (St. James, Schneider, & Eschman, 2005). Participants were asked to press the letter on the keyboard that corresponded to the letter that appeared on the screen (i.e., *X*, *Z*, *N*, or *M*). The dependent variable was response latency as measured by the time in milliseconds that the participant took to press the button after the letter appeared on the screen.

Manipulation check

To determine whether participants experienced the emotions intended by each film clip, they completed an Emotion Report Form (ERF) developed by Fredrickson et al. (2000). The ERF contained nine different emotions including amusement, anger, anxiety, contentment, disgust, fear, happiness, sadness, and serenity. Participants rated the amount of each emotion they felt in response to the films they watched on a 9-point scale ranging from 0 (*none*) to 8 (*a great deal*).

Trait optimism

Previous researchers have also found that it is important to distinguish between state and trait levels of emotion (Rosenberg, 1998). Affective traits refer to stable characteristics of individuals and how an individual typically behaves; however, state refers to temporary changes in emotions in response to different film clips. The Revised Life Orientation Task (LOT-R) was given to participants, as a control variable, to determine whether the dispositional tendency of an individual to have an optimistic personality would affect the ability of the film clips to induce different emotional states (Scheier, Carver, & Bridges, 1994).

The LOT-R measures individual differences in trait optimism (Scheier et al., 1994). The LOT-R consists of 10 questions (four are filler items) such as 'In uncertain times, I usually expect the best' and 'Overall, I expect more good things to happen to me than bad.' Participants were asked to rate their agreement to these statements on a 5-point scale (1 = *I disagree a lot* and 5 = *I agree a lot*). This scale has been used widely in research to measure trait optimism. The LOT-R has sufficient reliability ($\alpha = 0.82$) as well as predictive and discriminate validity (Scheier et al., 1994). Cronbach's alpha for this sample was 0.75.

Procedure

The experiment was conducted in small groups (~9 per group) with each person seated in a comfortable chair in front of a computer screen. All participants received informed consent, practiced the letter-identification task, and completed the first experimental trial to establish a baseline reaction time (trial 1). In the initial emotion induction phase, all participants viewed a clip from *The Champ* to induce negative affect and completed the letter-identification task a second time (trial 2). Then, participants viewed a second clip that was randomly assigned to their group to induce either positive ($n = 32$), negative ($n = 27$), or neutral ($n = 27$) affect. Following this second emotion-induction procedure, all participants completed the letter-identification task a third time (trial 3). Finally, all participants completed the ERF for each film viewed as well as the LOT-R. The LOT-R was given at the end of the experiment to avoid priming people's emotions with the content of the measure (e.g., 'expect the best' and 'enjoy my friends'). It is more likely that a transient emotional state, as reported on the ERF, would be subject to these priming effects than that a current emotional state would influence respondents' report of trait optimism (Pavot & Diener, 1993). All participants were treated according to the ethical guidelines of the American Psychological Association (2001).

Results

Preliminary analyses

Initial emotion induction

A series of dependent *t*-tests were performed as a manipulation check to determine whether participants reported feeling more sadness than any other emotion after viewing *The Champ*. Participants reported significantly more sadness ($M = 4.90$, $SD = 2.50$) compared to each of the other eight emotions on the ERF ($p < 0.001$). Means, standard deviations, and *t*-scores can be found in Table 1.

Second emotion induction

A second manipulation check was conducted to determine whether the emotions reported by participants differed by emotion-induction condition (i.e., positive, negative, and neutral) on each of the nine emotions reported on the ERF. ANOVAs were conducted at the 0.006 level to control inflation of the type I error rate due to multiple analyses. There were no differences among the induced emotion conditions on anxiety. However, the ANOVAs were significant for the remaining eight emotions, so post hoc Tukey tests were conducted. Individuals in the positive-emotion condition reported significantly higher levels of amusement and happiness than in both the neutral and negative-emotion conditions; they also experienced more contentment and serenity than individuals in the negative emotion condition. Participants in the negative-affect group felt significantly more disgust, fear, and sadness than both the positive and neutral groups, and more anger than the positive group. The means can be found in Table 2.

Table 1. Means, standard deviations, and *t* values of Emotion Report Form for initial mood induction.

Emotion	Mean (*SD*)	*t* (*df*)
Amusement	0.95 (1.45)	12.04 (81)
Anger	0.99 (1.55)	14.88 (80)
Anxiety	2.21 (2.08)	8.45 (81)
Contentment	0.74 (1.36)	12.21 (80)
Disgust	1.51 (1.90)	11.77 (81)
Fear	1.43 (2.09)	12.84 (80)
Happiness	1.07 (6.68)	4.89 (80)
Serenity	1.18 (1.80)	10.41 (81)
Sadness	4.89 (2.50)	

Note: All emotions were significantly different from sadness at the $p < 0.001$ level.

Trait optimism

An ANOVA was performed to determine whether there were differences in trait optimism among the three groups that needed to be controlled for in the analyses. There were no significant differences on participants' total score on the LOT-R for the positive, negative, and neutral groups, $F(2, 82) = 1.32$, $p = 0.27$, $R^2 = 0.03$. Therefore, this variable was excluded from subsequent analyses.

Main analyses

A log transformation was performed on reaction time data prior to analyses to correct for a violation of the assumption of sphericity. A 3 (trial) $\times$ 3 (emotion) mixed ANOVA was performed to determine whether there were differences in reaction time across trial and emotion induction condition. There was a statistically significant interaction of emotion and trial, $F(4, 158) = 5.49$, $p < 0.001$, $R^2 = 0.11$, and a significant

Table 2. Means, standard deviations, and *p* values of Emotion Report Form by affect condition.

	Mood condition				
Emotion	Positive ($n = 32$)	Neutral ($n = 27$)	Negative ($n = 27$)	$F(2, 83)$	*p*
Amusement	5.81 (1.69)	1.15 (1.69)[a]	0.48 (0.92)[a]	100.85	<0.001*
Anger	0.00 (0.00)[b]	0.35 (1.02)	1.00 (1.55)	5.95	0.004*
Anxiety	0.70 (1.41)	0.96 (2.31)	2.36 (2.41)	4.90	0.012
Contentment	2.96 (2.33)	1.62 (2.14)	0.48 (0.92)[a]	10.96	<0.001*
Disgust	0.52 (0.94)[b]	0.38 (1.13)[b]	2.48 (2.45)	13.19	<0.001*
Fear	0.11 (0.42)[b]	0.62 (1.58)[b]	1.980 (2.33)	7.37	0.001*
Happiness	4.37 (2.86)	0.73 (1.51)[a]	0.08 (0.28)[a]	38.99	<0.001*
Sadness	0.04 (0.19)[b]	0.38 (1.10)[b]	3.92 (2.78)	40.74	<0.001*
Serenity	2.81 (2.59)	1.50 (2.25)	0.72 (1.54)[a]	6.15	0.003*

Notes: [a]This emotion was reported significantly less than in the positive film condition.
[b]This emotion was reported significantly less than in the negative film condition.
*$p = 0.006$

main effect of trial, $F(2, 158) = 106.54$, $p < 0.001$, $R^2 = 0.47$. The main effect of emotion condition was not significant, $F(2, 79) = 2.00$, $p > 0.01$, $R^2 = 0.07$. See Figure 1 for a graph of the interaction.

Two additional checks were conducted before following up the interaction. First, the main effect of trial was examined to ensure that participants' reaction times changed significantly from trial 1 (baseline) to trial 2 (after sadness was induced). The post hoc Tukey tests indicated that participants had significantly faster reaction times at trial 2 ($M = 2.80$, $SD = 0.07$) than trial 1 ($M = 2.83$, $SD = 0.06$). Therefore, it was deemed appropriate to examine whether or not the second emotion induction was able to 'undo' the effects of the negative affective state induced initially in all participants. Second, participants' reaction times were compared across emotion conditions at trial 1, $F(2, 79) = 2.93$, $p = 0.06$, $R^2 = 0.05$, and trial 2, $F(2, 79) = 1.07$, $p = 0.35$, $R^2 = 0.06$ to determine whether there were differences among the groups prior to random assignment to emotion-induction condition that needed to be controlled for in subsequent analyses. The groups were not significantly different prior to randomization; therefore, the significant interaction was examined.

To follow up the significant interaction between emotion and trial, simple main effects were performed by conducting repeated-measures ANOVAs at each level of the affect condition. All three ANOVAs were significant at the $p < 0.001$ level. For the negative ($F(2, 50) = 24.54$, $p < 0.001$, $R^2 = 0.50$) and neutral affect ($F(2, 52) = 57.33$, $p < 0.001$, $R^2 = 0.69$) groups, post hoc analyses indicated that participants' reaction times were significantly faster each time they completed the letter identification task (i.e., trial 1 > trial 2 > trial 3). However, the pattern of results was different for the positive affect condition ($F(2, 56) = 31.73$, $p < 0.001$, $R^2 = 0.53$). Although participants in this group had a significantly faster reaction time at trial 2 than trial 1, their reaction time at trial 3 did not differ significantly from trial 2 (i.e., trial 1 > trial 2 and trial 3). The power to detect this difference was almost 100% (Faul, Erdfelder, Lang, & Buchner, 2007).

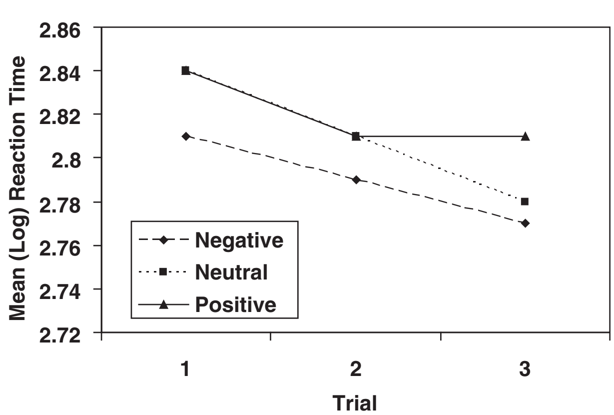

Figure 1. Mean ($\log_{10}$) reaction times of mood conditions at each trial.

Discussion

The current study provides preliminary support for the application of the undoing hypothesis (Fredrickson & Levenson, 1998) to the cognitive domain. As would be expected from previous research on the narrowed scope of attention associated with negative affect, all participants responded faster on the letter-identification task when induced into a negative affective state by a clip from *The Champ*. After the second emotion-induction procedure, in which participants viewed film clips intended to induce three different emotional states, a different pattern of reaction times to the letter-identification task emerged across the groups. The negative and neutral affect conditions continued to demonstrate significantly faster reaction times, while the positive group's reaction time did not change. Although induction into a positive emotional state did not return the participants to their baseline reaction time, it was the only group for whom reaction times were not significantly faster from trial 2 to trial 3 (i.e., after the experimental manipulation). The interesting finding here is that there is a different pattern of results for the positive emotion condition compared to the negative and neutral emotion conditions.

There are several possible explanations for why the positive group did not return to their baseline reaction time on the letter-identification task. First, a practice effect, as evidenced by the faster reaction times of the neutral group, may be counteracting the process of cognitive broadening that would slow down reaction times. The practice effect may have been pronounced by the relative simplicity of the letter-identification task as a measure of cognitive processing. However, even if there was a practice effect, the question remains as to why the pattern of effects is different for the positive emotion group compared to the neutral and negative emotion groups. Future research on this topic should examine more complex tasks with higher cognitive demand to avoid practice and ceiling effects that could limit detection of significant differences.

A second explanation for the inability to fully support the undoing hypothesis is related to limitations in the emotion induction procedure. Although the manipulation check confirmed that the intended emotions for each film were induced significantly more than any other emotion, the level of emotion reported by the participants was relatively low. On average, ratings of the intended emotions were only slightly above or at the midpoint on the response scale.

It is possible that although emotions were elevated to a level of statistical significance, the participants did not experience them as practically significant. Therefore, future research should examine additional methods of mood induction that will yield a more ecologically valid experience of emotion.

Another issue related to the emotion-induction procedure pertains to the ability to induce only the emotion of interest. In this study, the target negative affective state was sadness. Again, although the manipulation check indicated that sadness was felt more than any other emotion, the participants also reported significantly more anger, disgust, and fear than the positive affect condition. It is possible that the presence of anger, fear, or disgust individually, or in combination with sadness, is responsible for the faster reaction times associated with the negative affect condition. Future research should expand the choices of emotions studied and investigate methods of isolating the emotions induced.

Although the current study provides tentative support for the undoing hypothesis on cognitive processing, it utilized a homogeneous convenience sample of general psychology students at a small liberal arts college. Therefore, it is difficult to determine how the results of this study would generalize to different populations. Future research should examine the impact of mood on cognition in a variety of samples in order to determine the generalizability of the findings.

In summary, there has been considerable research demonstrating the benefits of positive emotions in all four domains of the broaden-and-build theory, including physical health (Fredrickson & Levenson, 1998; Fredrickson et al., 2000; Pressman & Cohen, 2005), social relationships (Berry & Hansen, 1996; Lyubormirsky et al., 2005), psychological resilience (Folkman & Moskowitz, 2000; Tugade & Fredrickson, 2004), and broadened cognition (Hirt et al., 1996; Isen et al., 1987; Rowe et al., 2007). In addition, prior research has found that positive emotions undo the adverse physiological impact of negative emotions (Fredrickson & Levenson, 1998; Fredrickson et al., 2000). The current study provides preliminary evidence that positive emotions may also undo the cognitive consequences of negative emotion, thus expanding the undoing hypothesis to the cognitive domain.

The question remains, however, whether the broadening effects of positive emotions on cognition are always advantageous. Some research has suggested that individuals experiencing positive emotions demonstrate cognitive processing deficits (Mackie & Worth, 1989) as well as an increased reliance on heuristics, resulting in recall errors (Bless et al., 1996). There may be times when the attention to detail associated with negative emotions (Brandt et al., 1992; Fredrickson & Branigan, 2005) may be beneficial, such as when completing income tax forms (Seligman, 2002). At other times, the increased creativity and broadened cognition associated with positive emotion (Hirt et al., 1996; Isen et al., 1987; Rowe et al., 2007) may be advantageous. Thus, the experience of positive emotions may be beneficial or detrimental depending on the task at hand. Future research should continue to examine in what cognitive contexts positive emotions are beneficial in order to best utilize the potential undoing of the cognitive effects of negative emotions.

Although these results are preliminary, we hope that they will encourage further research on the application of the undoing hypothesis to the other domains outlined in the broaden-and-build theory that have yet to be examined. Further research may contribute to understanding the ways that positive emotions can not only lead an individual to flourish under normal circumstances, but also aid an individual in recovering from the impact of negative emotions.

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