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Seeing the World Through Rose-Colored Glasses: People Who Are Happy and Satisfied With Life Preferentially Attend to Positive Stimuli

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Given the many benefits conferred by trait happiness and life satisfaction, a primary goal is to determine how these traits relate to underlying cognitive processes. For example, visual attention acts as a gateway to awareness, raising the question of whether happy and satisfied people attend to (and therefore see) the world differently. Previous work suggests that biases in selective attention are associated with both trait negativity and with positive affect states, but to our knowledge, no previous work has explored whether trait-happy individuals attend to the world differently. Here, we employed eye tracking as a continuous measure of sustained overt attention during passive viewing of displays containing positive and neutral photographs to determine whether selective attention to positive scenes is associated with measures of trait happiness and life satisfaction. Both trait measures were significantly correlated with selective attention for positive (vs. neutral) scenes, and this general pattern was robust across several types of positive stimuli (achievement, social, and primary reward), and not because of positive or negative state affect. Such effects were especially prominent during the later phases of sustained viewing. This suggests that people who are happy and satisfied with life may literally see the world in a more positive light, as if through rose-colored glasses. Future work should investigate the causal relationship between such attention biases and one's happiness and life satisfaction.

Keywords: attention, happiness, eye tracking

People value and seek out happiness, and it is not hard to understand why. Trait happiness confers many benefits: Happy people have better coping skills, improved job performance, bolstered immune systems, and greater sociability and likability (Gruber, Mauss, & Tamir, 2011; Lyubomirsky, King, & Diener, 2005). As a result, we all seek to optimize our levels of happiness, and as psychologists we can contribute to this effort by exploring how happiness is linked to underlying cognitive and perceptual mechanisms. Better understanding of such mechanisms may ultimately help us to harness them—both to counter emotional processes that have gone awry and to create lasting trait happiness.

Happiness has been regarded as a global subjective evaluation composed of three parts: (a) the frequency and intensity of pleasant moods, (b) the infrequency of unpleasant moods, and (c) a cognitive component, which is the evaluation of the degree to which the conditions of one's life are ideal (Diener, 2000; Lyubomirsky, 2001; Veenhoven, 1994). In the present study, we measure the cognitive component via the Satisfaction With Life Scale (SWLS; Diener, Emmons, Larsen, & Griffin, 1985), and we measure the global assessment of all three components together via the Subjective Happiness Scale (SHS; Lyubomirsky & Lepper, 1999). Previous studies have found the SWLS and SHS to be highly correlated (Lyubomirsky & Lepper, 1999), and while we analyze them separately, we use the term "trait happiness" here to encompass both.

Cognitive processes—such as attention, memory, and decision-making—are widely recognized as both contributing to and being affected by positive emotion processes (e.g., Josephson, 1996; Mather & Carstensen, 2005; Schwarz, 2000). In the present article, we focus on possible links between happiness and underlying mechanisms of one particular cognitive process: visual attention. Happy individuals have been colloquially described as "seeing the world through rose-colored glasses," and the present study seeks to empirically examine whether they are in fact taking in more positive visual information from their environment.

Links Between Attention and Emotion

During nearly every waking moment, the visual system is confronted by far more information than it can hope to process, and so vision is (and must be) intrinsically *selective*, via the operation of attention. We can attend to many different kinds of stimulation (including our thoughts, emotions, bodily sensations, etc.), but in the visual domain, attention serves to select only some information in the visual field for in-depth processing. This process is capacity-limited and may often involve a sense of overt effort—though attention may also be automatically captured by certain types of

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transient stimuli (for a review, see Pashler, 1998). The importance of attention is made especially clear by phenomena such as inattentional blindness, wherein we may completely fail to consciously perceive unattended information at all (for reviews, see Mack & Rock, 1998; Most, Scholl, Clifford, & Simons, 2005)—with attention essentially serving as a gateway to conscious awareness.

Attentional biases to sensory information have long been recognized as a critical component of emotion (LeDoux, 1986; MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002), and indeed, attentional deployment seems to be a fundamental way in which people shape their emotional experience (John & Gross, 2004; Sheppes & Gross, 2011). Patterns of attention may predispose people to experience emotions with greater intensity and greater frequency and may even predispose them to negative emotional disorders, such as depression (Gotlib, Krasnoperova, Yue, & Joormann, 2004; Gotlib & Neubauer, 2000).

Connections between attention and trait *negative* emotion in both healthy and clinical populations have been firmly established. In subclinical levels of trait negative emotion, high trait-anxious people tend to immediately orient their attention toward threat-related images such as fearful faces (for a review, see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007), while high-dysphoric people preferentially attend to dysphoric stimuli and away from positive stimuli—a bias particularly evident when examining sustained attention over relatively long stimulus durations (i.e., 1 s or more; Koster, De Raedt, Goeleven, Franck, & Crombez, 2005; Leyman, De Raedt, Vaeyens, & Philippaerts, 2011; for a review, see Peckham, McHugh, & Otto, 2010). Such attention biases are also found in clinical populations characterized by high trait anxiety (e.g., generalized anxiety disorder; Mogg, Millar, & Bradley, 2000) and high dysphoria (e.g., depression; Gotlib, McLachlan, & Katz, 1988). Indeed, attentional biases are conceptualized as a central means by which such negative emotions are maintained: Increased awareness of threat may lead to higher estimates of vulnerability to it (Weierich, Treat, & Hollingworth, 2008), and failing to attend to positive events may cause dysphoric people to view the world as containing fewer rewards (Armstrong & Olatunji, 2012).

Less is known about possible links between attention and positive emotion, though a handful of studies now suggest a link between attention and positive mood states (and below we discuss in detail how the present investigation expands on these). For example, manipulations that put people in positive moods result in several varieties of enhanced attention to positive stimuli: speeded transient attention to high-arousal rewarding words in a dot probe task (Tamir & Robinson, 2007); greater fixation duration on high-arousal rewarding images compared with both neutral and threatening images (Ford et al., 2010), and heightened awareness of perceptual details for positive stimuli during an attention-demanding task (Becker & Leinenger, 2011). In addition, some characteristics that are indirectly associated with trait happiness—including optimism, older age, and extraversion—have been linked to attentional biases away from negative (and/or toward positive) stimuli, suggesting that trait happiness itself may also be associated with similar biases (Isaacowitz, 2005; Isaacowitz, Wadlinger, Goren, & Wilson, 2006; Segerstrom, 2001).

The Present Study: Trait Happiness and Sustained Attention to Images

To examine the question of whether happy people do in fact take in more positive information from their environment, the present study aims to determine how trait happiness is associated with biases in selective attention to positive images, with a special focus on the timecourse of such associations during sustained attentional engagement. Healthy adults passively viewed multiple positive and neutral photographs (Figure 1) during 15-s trials, while their eye movements were tracked as a continuous measure of sustained overt attention. The degree to which they attended preferentially to positive images (relating to achievement, social interactions, and primary reward) versus neutral images was then computed and correlated with trait happiness—as measured by the SHS and SWLS—after removing variance associated with current positive and negative state affect.

Overall, this study aims to extend past research in four particular ways: First, this is the first study to our knowledge that directly explores links between attention and *trait* happiness, rather than state positive affect. Trait happiness (encompassing both its affective and cognitive components) seems particularly important to explore, given its consistent association with desirable life outcomes and favorable mental health (Lyubomirsky, King, & Diener, 2005). Should trait happiness, independent of state affect, be associated with looking patterns of the sort measured here, this would provide support for the possibility that attentional biases are linked to long-term happiness—perhaps even as part of a mechanism that could subsequently be harnessed to lead to lasting improvements in daily functioning and relief from clinical disorders characterized by low trait positive emotion. Should such an association not exist, in contrast, this would suggest that attention may be linked only to moment-to-moment fluctuations in state positive affect, without any more lasting connections to sustained happiness at the trait level.

Second, whereas previous studies of attention and state positive mood have typically assessed transient attentional shifts in response to briefly presented stimuli, the present experiments as-

Figure 1. A sample screenshot of the display with intact images from an experimental trial. See the online article for the color version of this figure.

sessed sustained attention across long-duration 15-s intervals, using a continuous eye tracking measure. This allows us to measure not only brief attentional shifts, but also attentional biases that develop and grow in strength over time. Exploring happiness' association with attention over a longer time period may be particularly helpful when examining its associations with emotion, because mood-congruent attentional biases in depression are evident over relatively long stimulus durations rather than early stage orienting of attention, and it may be important to establish whether attention in happiness unfolds with a similar time course (Gotlib, McLachlan, & Katz, 1988; Leyman, De Raedt, Vaeyens, & Philippaerts, 2011; Peckham, McHugh, & Otto, 2010).

Examining the time-course of attention in this way also allows us to distinguish two potential mechanisms that have been shown to be importantly distinct (e.g., Nakayama & Mackeben, 1989): *transient* attention (involving individual momentary attentional shifts) versus *sustained* attention (involving selective allocation of resources that persists beyond a single discrete shift of attention from one object or location to another). Whereas many previous studies (e.g., those using the dot-probe task) have explored transient attention, our study allows us to measure sustained attentional allocation, where such an effect might (as explored in the Discussion section) have different implications for the roles that attention might play in the maintenance of happiness over time.

Third, the use of several categories of positive photographs (rather than words, as in some past studies; e.g., Tamir & Robinson, 2007) allows us to explore attentional biases to novel stimuli (i.e., photographs that observers have not previously seen) and the degree to which any effects generalize across multiple varieties of positive stimuli. It is interesting that affective science has differentiated between discrete types of positive emotions, such as those related to achievement (Tracy & Robins, 2004), those that promote social bonding (Oveis, Horberg, & Keltner, 2010), and those that motivate the appetitive system (Berridge, 1996). We know that these discrete contexts in which positive emotion may arise facilitate differentiated responses (Shiota, Keltner, & John, 2006), suggesting that research must separately test these different categories before drawing general conclusions about "positive emotion" more broadly. As such, the present study explores whether attentional biases of trait happiness generalize across three distinct kinds of positive stimuli (compared with neutral stimuli), all of which have been distinguished in past research (e.g., Johnson, 2005; Spreckelmeyer et al., 2009; Wise, 2002): photographs relating to achievement, social interactions, and primary reward.

Fourth, while using these different categories of photographs, we aimed to control for lower-level stimulus properties to a greater extent than has been done in most previous research. Patterns of attention may be influenced by high-level semantic content of images, but it is also influenced by low-level stimulus properties—for example, with greater attention to regions that are brighter, more complex, or have greater contrast (e.g., Itti, Koch, & Niebur, 1998). As such, we could never be sure if we used only the experimental images, whether any differences in looking patterns were driven by the positivity-related content of the images, or by confounded differences in the lower-level visual characteristics of the images (e.g., different average distributions of brightness, or different spatial frequency profiles). To allow us to analyze our data in a way that removes the contribution of such low-level visual features, we also included trials in which the experimental images were phase-scrambled—a manipulation that eliminates the categorical semantic content from the images while preserving contrast, color, and luminance profiles (Figure 2). To foreshadow, and as we anticipated, we observed several differences in fixation patterns across stimulus categories based only on these low-level factors. However, inclusion of these images allowed us to remove the variance that they contributed from our primary analyses—a control that we argue should be adopted in any research of this sort with photographic stimuli to ensure that effects are not driven by their low-level visual features.

Method

Participants

Seventy young adults (53 from Yale University and 17 from the surrounding New Haven community) participated in exchange for financial compensation. Eight participants from this original sample were excluded—1 for equipment failure, 2 for failing more than one attention check on the self-report questionnaires (e.g., "If you are reading this, mark 'not at all' as your answer"), and 5 for having an unreliable eye tracking signal (defined as less than 80% of eye data being successfully recorded in the viewing area on more than one third of the trials; e.g., Fehd & Seiffert, 2008). This resulted in a final sample of 62 participants, aged 18–37 (M = 22.79; SD = 4.00), 40 (64.5%) of whom were women. Self-reported ethnicities were as follows: 31 (50.0%) Caucasian/White, 5 (8.1%) African American/Black, 9 (14.5%) Asian American/Asian, 9 (14.5%) Latino/Hispanic, and 8 (12.9%) multiracial. All participants had normal or corrected-to-normal acuity as tested with a Snellen eye chart (Hetherington, 1954).

Apparatus

Eye gaze was tracked as participants viewed stimuli on a 22", 32 bit, AMD Radeon HD 6630M computer monitor. Participants viewed the display without restraint from a distance of approxi-

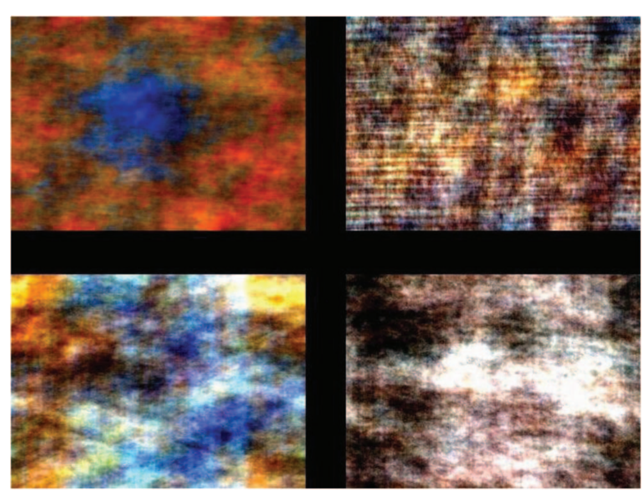


Figure 2. A sample screenshot of the display from a control trial with phase-scrambled control images (matched to those in Figure 1). See the online article for the color version of this figure.

mately 24" (with all angular extents below calculated based on this distance), so that the display subtended 42.16° (width) by 27.64° (height). Stimuli were presented using Experiment Center software (Version 2.1, 2010, SensoMotoric Instruments, 2010). Binocular gaze was recorded using a SensoMotoric Instruments (SMI) RED250 eye tracker with a dark pupil tracking system, 250-Hz sampling rate, 0.03° spatial resolution, and gaze position accuracy sharper than 0.4°. All analyses examine data recorded from the left eye. The eye tracker compensated for head movements of up to 25 cm/s, and in the case of more robust head movements, it had a 115-ms recovery time back to full tracking ability after an offset or after the pupil was lost. Tracking was recovered after an eyeblink within 6 ms. Continuous eye movement data were collected using iView X software (Version 2.4.19, 2009).

Stimuli

On each of 12 experimental trials, participants viewed four images (each subtending 20.66° × 11.90°): one neutral image and three positive images drawn from different categories (one each from achievement, social, and primary categories). Different images were used on each trial, for a total of 48 experimental images. These novel images were compiled for the purposes of this study to assess whether attentional biases generalized across several categories of positive stimuli. The images were presented in the four quadrants of the display on a black background (Figure 1), with their nearest borders separated by 4.78° (vertically) and 4.80° (horizontally). For half of the participants, the specific quadrants in which the four images on each trial were presented were randomized and counterbalanced, such that images from each category occurred in each of the four positions equally often. The second half of participants viewed the identical quartets of images, but with the specific quadrant assignments on each trial reversed (such that the particular image that had been in the upper-left quadrant for the first half of the participants was now in the lower-right quadrant).[1]

We included four distinct categories of photo stimuli in the present study. The 12 photos in the achievement category depicted the attainment of goals or rewards—including academic contexts (e.g., graduation ceremonies) and athletic contexts (e.g., winning a race), as well as more generalized depictions of achievement (e.g., podiums, medals). The 12 photos in the social category depicted positive social interactions, such as people laughing together at a coffee shop or friends hugging. The 12 photos in the primary category were drawn from a standardized set of high-calorie foods (e.g., pizza, pasta, cupcakes) that have been used as primary reward stimuli in previous studies (Giuliani, Calcott, & Berkman, 2013). Finally, the 12 neutral photo stimuli were drawn from the International Affective Picture Set (IAPS; Lang, Bradley, & Cuthbert, 2005) and depicted a variety of nonemotional scenes, such as shoes on the ground or a mug on a counter.

To validate these four categories of images on valence and arousal ratings prior to their experimental administration, 150 participants (ages 18–75, $M = 37.51$, $SD = 13.16$) were recruited online via Amazon Mechanical-Turk (MTurk; Buhrmester, Kwang, & Gosling, 2011). Participants scored images using the 9-point Self-Assessment Manikin rating scales (from 1= *very unpleasant/very calm* to 9 = *very pleasant/very excited*) that have previously been used to validate the IAPS images (Hodes, Cook, & Lang, 1985; Lang, Bradley, & Cuthbert, 2005). For valence ratings, in paired *t* test comparisons, each of the three categories of positive images was rated as significantly more positive than the neutral pictures ($ps < .01$; $ds > 1.74$), but the categories of positive images did not differ from each other ($ps > .45$; $ds < .07$). For arousal ratings, as is standard with emotional images (e.g., Caseras, Garner, Bradley, & Mogg, 2007; Kellough, Beevers, Ellis, & Wells, 2008), each of the three categories of positive images had significantly higher arousal ratings than the neutral images ($ps < .01$; $ds > .99$). Photos from the achievement and primary categories did not differ from each in terms of arousal ratings, $t(149) = .87$, $p = .38$, $d = .06$, but both were rated higher than images from the Social category, $t(149) = 5.40$, $p < .01$, $d = .32$; $t(149) = 3.47$, $p < .001$, $d = .26$.

We also validated the content of the images, by having a separate sample of 120 MTurk participants (ages 18–68, $M = 34.25$, $SD = 12.87$) rate the extent to which the positive photos from all three categories portrayed the categories of interest (achievement, social, and primary), using a 1 (*not at all*) to 9 (*extremely*) scale. Specifically, to obtain an achievement score, participants were asked: "To what extent does this picture portray themes of achievement (e.g., pursuit or attainment of a goal/reward)?"; to obtain a social score, participants were asked: "To what extent does this picture portray a positive social interaction?"; and to obtain a primary score, participants were asked: "How appetizing do you find this photo?" Each image was validated as portraying its category of interest to a significantly greater degree when compared with each of the other three image categories ($ps < .02$; $ds > 2.65$), thereby validating that the images successfully portrayed the categories of interest (see Table 1 for means and *SD*s).

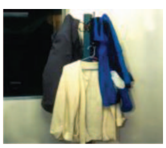
A phase-scrambled control image was generated for each experimental image using a 2D Fast Fourier Transform manipulation in MATLAB to randomize its phrase spectrum while maintaining its amplitude spectrum (thus preserving mean contrast, luminance, and color distribution, while eliminating semantic content). When presented during the experiment, each phase-scrambled image was always presented in the same position as its experimental counterpart, resulting in a full set of matched control trials. In addition, we included eight filler trials composed of four neutral pictures (mean valence = 4.78, $SD = 0.46$; mean arousal = 2.69, $SD = 0.35$).

Self-Report Measures

Subjective happiness was assessed using the 4-item SHS, which assesses happiness on a global level (Lyubomirsky & Lepper, 1999). Participants responded to statements such as "In general, I consider myself . . ." on a 7-point scale—for example, from 1 (*not a very happy person*) to 7 (*a very happy person*). The SHS was created in response to the idea that previous scales separate happiness into disparate components (i.e., positive affect, low negative affect, and life satisfaction), whereas

[1] These reversed layouts yielded no significant differences on any measure of interest, and so all reported analyses collapse over this variable.

Table 1
Valence and Arousal Ratings for Positive and Neutral Image Categories

				Category ratings		
Example	Category	Valence	Arousal	Achievement	Social	Primary
	Achievement	6.68 (1.16)	4.61 (2.19)	7.84 (0.60)	4.05 (1.39)	1.89 (1.63)
	Social	6.64 (0.91)	4.00 (1.54)	2.65 (1.38)	7.18 (0.93)	2.01 (1.47)
	Primary	6.60 (1.29)	4.49 (2.16)	1.61 (1.20)	1.76 (1.23)	6.69 (1.34)
	Neutral	4.66 (0.90)	2.53 (1.44)	1.29 (0.58)	1.22 (0.52)	1.37 (0.74)

Note. Values represent mean ratings for valence and arousal, with *SD*s in parentheses. See the online article for the color version of this table.

people seem capable of assessing their overall trait happiness (Lyubomirsky & Lepper, 1999). SHS scores are correlated with higher self-esteem, optimism, a predominance of positive moods, and with peer informant reports of subjective happiness (Lyubomirsky & Lepper, 1999). A single composite score for subjective happiness is computed by averaging responses to the four items, with final scores ranging from 1 to 7, with higher scores indicating greater levels of dispositional happiness. Internal consistency of the SHS in the present study was $\alpha = .90$.

Life satisfaction, the cognitive component of happiness, was assessed using the 5-item SWLS (Diener, Emmons, Larsen, & Griffin, 1985). Participants respond to statements such as "In most ways my life is close to ideal" on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale. SWLS scores are correlated with frequency of positive mood, diminished symptoms of psychopathology, and interviewer estimates of life satisfaction (Diener et al., 1985). Scores range from 5 to 35, with higher scores indicating higher global life satisfaction. Internal consistency of the SWLS in the present study was $\alpha = .88$.

To focus on trait happiness, we also collected two baseline measures of state affect (whose contribution to looking patterns could later be partialed out): the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and the modified Discrete Emotion Scale (mDES; Fredrickson, Tugade, Waugh, & Larkin, 2003).[2] Internal consistency of the PANAS (positive affect $\alpha = .85$; negative affect $\alpha = .84$) and the mDES (positive affect $\alpha = .91$; negative affect $\alpha = .84$) in the present study was good.

Procedure

Participants first completed the measures of baseline positive and negative state affect, followed by the picture-viewing task. Participants completed the picture-viewing task in a darkened and sound-attenuated private testing room. They first completed a standard eye tracker calibration task (making sequential eye-movements to several calibration points, until the eye position was recorded within 2° of each point). Participants were told to view the images "as if [they] were at home watching TV" (e.g., Isaacowitz, 2005; Kellough et al., 2008). They then proceeded to view 32 trials (12 experimental, 12 scrambled, and 8 filler) for 15 s each, in a different randomized order for each participant, each separated by a 2-s display containing only a fixation cross. The picture-viewing task took approximately 10 min to complete, and gaze tracking was revalidated (and recalibrated, as necessary) halfway through. After completing the picture-viewing task, participants rated the valence and arousal of the images they had just viewed, and then they completed the session by filling out the self-report (SHS and SWLS) questionnaires on a computer.

[2] After the eye-tracking task, but before completing our self-report measures of trait happiness, subjects also completed a series of questionnaires related to symptoms of bipolar disorder and depression, which were for a different study aimed toward a separate theoretical question. These scales were the Hypomanic Personality Scale (Eckblad & Chapman, 1986), Altman Self-Rating Mania Scale (Altman, Hedeker, Peterson, & Davis, 1997), and Beck Depression Inventory Short Form (Beck, Rial, & Rickels, 1974). These scales were not included in our analyses.

Data Reduction and Analyses

For eye tracking analyses, the viewing area was defined as the entire display, and the four areas of interest (AOIs) on each trial were defined by the boundaries of the four images. Thirty-six trials (4.84% of trials) from the 62 participants included in the analyses were discarded for unreliable eye tracking signals (defined as having less than 80% of eye tracking data during that trial being successfully recorded in the viewing area). Dwell Time was defined as the total time spent fixating and making saccades within a given AOI (computed and reported as a percentage of the total trial duration). A fixation was defined as any period for which gaze was still (varying less than 1°) for more than 100 ms. Total Fixation Time was defined as the sum of the time spent fixating within a given AOI across a given trial (again, computed and reported as a percentage of the total trial duration). Fixation Count was defined as the total number of fixations made within a given AOI across the trial. In using these variables as measure of sustained attention, we follow previous attention and emotion researchers (e.g., Kellough et al., 2008; Rösler et al., 2005). First Fixation, a measure of transient attention, was defined in terms of the location to which a subject first moved their eyes on any given trial (measured in terms of the number of First Fixations made to each AOI type and calculated as a percentage of a subject's total usable trials).

Looking preferences were assessed in terms of four variables: Dwell Time, Total Fixation Time, Fixation Count, and First Fixation—each measured separately for each of the four AOIs per trial. Most reported analyses of looking behavior were then based on difference scores, measuring the relative looking preference to one type of image versus another. To compute these difference scores for Dwell Time for each participant, we first we averaged Dwell Time for each AOI across all 12 trials. This resulted in separate average Dwell Times for achievement images, social images, primary images, and neutral images. The positivity bias for each participant was then computed as their average Dwell Time for neutral images, subtracted from their mean Dwell Time across the three categories of positive images. (Thus, a positive positivity Bias Score indicates that a participant had longer Dwell Time for positive images than for neutral images.) An Achievement Bias for each participant was computed as their average Dwell Time for achievement images, minus their mean Dwell Time across the other two categories of positive images. Social and Primary biases were calculated in this same manner.

Each of these four Bias Scores (positivity, achievement, social, and primary) was computed for each participant for each of the four gaze variables (Dwell Time, Total Fixation Time, Fixation Count, and First Fixation), for a total of 16 key measurements per participant. (Thus, e.g., a positivity bias for the Fixation Count variable of 8% would indicate that the average number of a participant's fixations to the three positive images categories was 8% greater than the number of their fixations to the neutral images.)

Results

Preliminary Analyses: Age, Gender, and Ethnicity

SHS and SWLS scores did not differ on the basis of either gender ($ps > .73$; $\eta_p^2s < .01$) or ethnicity ($ps > .62$; $\eta_p^2s < .03$), and were not correlated with age ($ps > .19$; $rs < .17$). Gender was also not associated with differences in the magnitude of any of the 16 key measurements (the four bias measures combined with the four gaze variables; $ps > .13$; $\eta_p^2s < .04$). As a result, this variable is not considered further. Ethnicity, however, was associated with differences in the magnitude of Primary bias on the three gaze variables that measured sustained biases (i.e., all except for First Fixation: $ps < .02$; $\eta_p^2s > .19$). We do not report any pairwise comparisons across ethnicities, however, because some of the groups had especially small sample sizes. Age was not significantly associated with achievement, social, or Primary bias on any of the four gaze variables ($ps > .35$; $rs < .12$), but older age was associated with weaker positivity bias on the three gaze variables that measure sustained biases (i.e., all except for First Fixation; $ps < .01$; $rs > .38$). (This correlation is in the opposite direction from that usually found—wherein older people tend to look longer at positive images; e.g., Isaacowitz, Toner, Goren, & Wilson, 2008. This may be because our participants were much younger than those in previous studies, which were designed to look at the influence of aging on happiness: in our study, the mean age was relatively young [$M = 22.79$; $SD = 4.00$], and our oldest participant was 37.) Because of the significant associations with age and ethnicity, all subsequent correlations between bias measures and measures of trait happiness were computed both with and without using age and ethnicity as covariates. However, including these as covariates never changed the resulting pattern of significant results, thus the analyses below all report the correlations without including either age or ethnicity as a covariate.

Trait Happiness Measures

Although SHS and SWLS scores were highly correlated, $r = .76$, $p < .001$, we explore them separately in the analyses below. SHS scores ranged from 1 to 7 ($M = 4.76$, $SD = 1.49$) with good internal consistency ($\alpha = .90$). SWLS scores ranged from 5 to 35 ($M = 22.95$; $SD = 7.73$), with good internal consistency ($\alpha = .88$).

Overall Gaze Preferences and the Utility of Phase Scrambled Control Images

The first step in our primary analyses was to compute the 16 key measurements across all participants: the four Bias Scores (positivity, achievement, social, and primary) computed for each of the four gaze variables (Dwell Time, Total Fixation Time, Fixation Count, and First Fixation). These measures are included in Table 2, along with the relevant statistics that highlight significant biases, for both the experimental (i.e., intact) images and the phase-scrambled images. Inspection of these data reveals a common pattern. For the experimental images, several of the Bias Scores were significant (as measured with one-sample *t* tests) for several of the gaze variables. However, many of these effects were also significant for the phase-scrambled images. As an example, note that the analysis of Dwell Time for experimental images yielded a 4.43% positivity bias, a 3.40% Achievement Bias, and a *negative* 4.69% Primary bias—all statistically significant. However, the analysis of Dwell Time for phase-scrambled images also yielded a significant 3.37% Achievement Bias and a significant negative 2.63% Primary bias.

These patterns suggest that several of the significant bias effects are attributable not to the images' semantic content, but instead to their confounded lower-level visual properties. As a result, to

Table 2
Overall Looking Behavior for Experimental/Intact and Scrambled Images Across Four Measures of Attention

	Experimental/Intact							
	Dwell Time				Total Fixation Time			
	Positivity	Achievement	Social	Primary	Positivity	Achievement	Social	Primary
Bias (%)	**4.43***	**3.40***	1.29	**−4.69***	**3.92***	**3.16***	1.01	**−4.18***
p	**<.01**	**<.01**	.19	**<.01**	**<.01**	**<.01**	.23	**<.01**
t	4.66	3.19	1.33	−4.17	4.69	3.43	1.19	−4.25
Cohen's *d*	.84	.58	.24	−.75	.85	.62	.22	−.77
	Fixation Count				First Fixation			
	Positivity	Achievement	Social	Primary	Positivity	Achievement	Social	Primary
Bias (%)	**2.20***	**1.78***	0.40	**−2.18***	**9.92***	**−14.88***	**28.16***	**−13.27***
p	**<.01**	**.01**	.36	**<.01**	**<.01**	**<.01**	**<.01**	**<.01**
t	4.85	3.67	0.92	−4.43	5.94	−6.03	8.26	−5.55
Cohen's *d*	.88	.66	.17	−.80	1.08	−1.09	1.50	−1.01
	Scrambled							
	Dwell Time				Total Fixation Time			
	Positivity	Achievement	Social	Primary	Positivity	Achievement	Social	Primary
Bias (%)	−1.23	**3.37***	−0.74	**−2.63***	−1.17	**2.97***	−0.60	**−2.36***
p	.11	**<.01**	.29	**<.01**	.01	**<.01**	.34	**<.01**
t	−1.62	4.18	−1.06	−3.97	−1.66	4.00	−0.95	−3.89
Cohen's *d*	−.29	.76	−.19	−.72	−.30	.73	−.17	−.70
	Fixation Count				First Fixation			
	Positivity	Achievement	Social	Primary	Positivity	Achievement	Social	Primary
Bias (%)	−0.37	**1.48***	−0.31	**−1.17***	**−3.87***	3.92	−1.13	−2.79
p	.21	**<.01**	.29	**<.01**	**.04**	.09	.54	.16
t	−1.27	4.58	−1.07	−4.45	−2.06	1.73	−0.62	−1.41
Cohen's *d*	−.23	.83	−.19	−.81	−.37	.31	−.11	−.26

Note. Degrees of freedom for all one-sample *t* tests shown is 61. Boldface entries highlight statistically significant results.
* $p < .05$.

characterize the overall gaze measures of interest, we must compute the difference scores between the experimental and phase-scrambled images for each bias measure, for each participant. Doing so enables us to remove the variance contributed by the low-level visual features so that we can examine baseline gaze preferences of our sample that are driven by semantic content *alone*. For example, the positivity bias for a participant is computed by subtracting their positivity bias for phase-scrambled images (itself a difference score, as explained above) from their positivity bias for experimental images (another difference score). Such an analysis is the most direct way to subtract out effects because of the low-level visual properties of the images, so that the calculation of these "difference-of-differences" scores describe the amount of baseline gaze bias driven only by semantic content. For example, if subjects on average looked at experimental (i.e., intact) positive images 8% longer than experimental neutral images, but they also looked at phase-scrambled positive images 8% longer than phase-scrambled neutral images, then a "difference-of-differences" calculation would yield no difference at all—suggesting (in this hypothetical example) that looking was not influenced by the semantic categories of the images.

These difference-of-differences measures—presented in Table 3, along with the relevant statistics—effectively summarize the impact of the semantic categories, per se, on looking behavior for our sample as a whole. As summarized Table 3, the only significant biases were a positivity bias for both the sustained attention measures (5.66% for Dwell Time, 5.09% for Total Fixation Time, 2.56% for Fixation Count) and for the immediate attention measure (13.79% for First Fixation), along with several other First Fixation biases (a 29.28% social bias, a *negative* 18.81% Achievement Bias, and a *negative* 10.48% Primary bias). Note that these difference-of-difference scores are utilized only to assess these baseline gaze preferences. All of the primary analyses reported below, in contrast, employ difference scores (as described in the Method section), then statistically partial out the variance contributed by the low-level visual features (i.e., as measured in the trials with phase-scrambled images).

How Trait Happiness Relates to Attentional Biases

To test whether looking patterns to positive images differed as a function of trait happiness, we computed correlations between the attentional bias measures and the self-report measures of subjective happiness and satisfaction with life (as assessed by the SHS and SWLS). Because we were interested only in the influence of the positivity-related semantic content of the different images

Table 3
Overall Looking Behavior in Our sample, Using Difference-of-Differences to Show Impact of Semantic Categories (Beyond Low-Level Visual Features), Across Four Measures of Attention

	Dwell Time				Total Fixation Time			
	Positivity	Achievement	Social	Primary	Positivity	Achievement	Social	Primary
Bias (%)	**5.66***	0.03	2.03	−2.06	**5.09***	0.20	1.61	−1.81
p	**<.01**	0.98	0.07	0.11	**<.01**	.85	.10	.11
t	4.99	0.02	1.80	−1.63	5.29	0.19	1.68	−1.64
Cohen's *d*	.90	.00	.33	−.29	.96	.03	.30	−.30
	Fixation Count				**First Fixation**			
Bias (%)	**2.56***	0.30	0.71	−1.01	**13.79***	**−18.81***	**29.28***	**−10.48***
p	**<.01**	.57	.14	.05	**<.01**	**<.01**	**<.01**	**<.01**
t	4.88	0.57	1.50	−1.96	5.67	−5.81	6.91	−3.50
Cohen's *d*	.88	.10	.27	−.35	1.03	−1.05	1.25	−.63

Note. Degrees of freedom for all *t* tests shown is 61. Boldface entries highlight statistically significant results.
* $p < .05$.

categories—and because these turned out to be confounded in various ways with the images' low-level visual properties (as described in the previous section)—all of the analyses in this section were computed as partial correlations that tested the looking behavior on the experimental trials while partialing out looking behavior on the matched control trials with phase-scrambled images. In addition, because we were interested in the influence of trait happiness—rather than state positive or negative affect—the reported correlations always partialed out the participants' PANAS and mDES scores (both positive affect and negative affect for both measures).

Table 4 presents the resulting correlations (and their associated statistics) between the two trait happiness measures (SHS, SWLS) and the four Bias Scores (positivity, achievement, social, primary), for each of the four gaze variables (Dwell Time, Total Fixation Time, Fixation Count, First Fixation). Dwell Time, Total Fixation Time, and Fixation Count can all be considered as measures of sustained attention, and accordingly, they all exhibited similar patterns of results—Dwell Time and Total Fixation Time yielded sizable and significant correlations (rs $> .28$, ps $< .04$), while Fixation Count yielded a nonsignificant correlation (in the same direction but not reaching significance; $r = .23$, $p = .09$) between happiness (for both SHS and SWLS) and the overall positivity bias. No significant correlations occur for any of the individual category biases. This demonstrates that people who are happier and more satisfied with life spend longer looking at positive images—and that this effect generalizes across several varieties of positive images.

Dwell Time, Total Fixation Time, and Fixation Count all assessed sustained looking behavior throughout each 15-s trial. In

Table 4
Correlations Between Trait Happiness Measures and Attentional Bias Scores, Across Four Measures of Attention

	Dwell Time				Total Fixation Time			
	Positivity	Achievement	Social	Primary	Positivity	Achievement	Social	Primary
SHS								
r	**.28**	.21	−.01	−.19	**.28**	0.22	−.02	−.19
p	**.04***	.11	.94	.16	**.03***	.10	.85	.16
SWLS								
r	**.45**	.015	.06	−.06	**.43**	.02	.07	−.07
p	**<.01***	.91	.64	.68	**<.01***	.88	.61	.59
	Fixation Count				**First Fixation**			
	Positivity	Achievement	Social	Primary	Positivity	Achievement	Social	Primary
SHS								
r	.23	.25	−.08	−.19	−.04	−.18	.16	−.04
p	.09	.06	.55	.17	.75	.17	.24	.75
SWLS								
r	**.39**	.04	−.01	−.03	−.07	−.09	.10	−.04
p	**<.01***	.75	.96	.79	.60	.52	.45	.74

Note. SHS = Subjective Happiness Scale; SWLS = Satisfaction With Life Scale. All correlations partial out variance contributed by the matched scrambled images, as well as by state affect (both the Positive and Negative Affect Schedule [PANAS] and the modified Discrete Emotion Scale [mDES] positive affect and negative affect). Boldface entries highlight statistically significant results.
* $p < .05$.

contrast, the First Fixation measure can be considered as a measure of immediate attentional orienting—assessing looking behavior only in the instant after the images appear. There was no hint of any correlation between First Fixations and our measures of trait happiness, for either the overall positivity bias (SHS: $r = -.04$, $p = .75$; SWLS: $r = -.07$, $p = .60$), or for any of the individual category biases (rs $< .18$, ps $> .17$). Thus, people who score high on trait happiness are no more likely to immediately orient to positive images, even though they do look longer at such images during sustained viewing.

Trait Happiness Influences Sustained Attention, Not Transient Attention

To further explore the influence of sustained versus transient attentional biases with regard to the link between trait happiness and the positivity bias, we also separated our three measures of sustained attention (Dwell Time, Total Fixation Time, Fixation Count) into early, middle, and late phases of each trial. In particular, for both the SHS and SWLS, we conducted a 3 (Time: 0–5 s, 5–10 s, 10–15 s) × 2 (Trait Happiness Score: High vs. Low) repeated measures analysis of variance for each of the three sustained gaze variables. (A median split was used to divide SHS and SWLS scores into high and low levels, and the variance contributed by the matched phase-scrambled images was controlled for as a covariate.) The results are presented in Table 5 for all sustained gaze variables, and in Figure 2 for Dwell Time. Inspection of these results reveals that all of the associations between happiness and positivity bias are driven by the final phases of each trial, as evidenced by significant Time × SHS interactions across all three of our sustained gaze variables (Fs $>$ 3.45, ps $< .04$, dfs $= (2, 118)$, η_p^2s $> .05$). In particular, positivity biases of high versus low SHS participants do not differ at either the 0–5-s or 5–10-s bins (all ps $> .15$), but high SHS participants have stronger positivity biases for the 10–15-s bin (all ps $< .02$). (This same pattern held numerically for Time × SWLS interactions, but did not reach significance.) This pattern emphasizes that the connection between trait happiness and longer looking to positive images is not a transient phenomenon, but grows stronger over the course of sustained viewing.

Discussion

The present results demonstrate that trait-happy people show attentional biases in which they preferentially attend to positive stimuli, such that they may literally observe the world differently—"seeing the world through rose-colored glasses." Participants' eyes were tracked as they viewed three types of positive photographs (achievement, social, and primary), as well as neutral photographs. Higher trait happiness—as indicated by higher scores on the trait happiness and satisfaction with life scales—was associated with an attentional bias toward positive (vs. neutral) images, a bias that was particularly salient during the last third of our 15-s trials.

Revisiting Four Goals

The importance of these results can be emphasized by revisiting the four goals described in the introduction:

Trait happiness. To our knowledge, these are the first results to suggest a link between trait happiness and biased sustained attention to positive stimuli. And indeed, the associations discovered here were all independent of state positive and negative affect (which was independently measured and partialed out of the key

Table 5
Time × Subjective Happiness Scale (SHS) of 15-s Trials, Across Three Measures of Sustained Gaze

	High SHS M		Low SHS M	F	p	η_p^2
Dwell Time						
Positivity bias early (0–5)	6.89		4.48	2.07	.15	.03
Positivity bias middle (5–10)	3.21		2.56	0.06	.80	<.01
Positivity bias late (10–15)	**8.40***		**0.22***	**7.40**	**<.01**	**.11**
F (Time × SHS)		3.93				
p (Time × SHS)		.02				
η_p^2 (Time × SHS)		.06				
Total Fixation Time						
Positivity bias early (0–5)	6.12		4.08	1.84	.18	.03
Positivity bias middle (5–10)	2.99		2.24	0.10	.74	<.01
Positivity bias late (10–15)	**7.15***		**0.31***	**7.47**	**.01**	**.11**
F (Time × SHS)		3.45				
p (Time × SHS)		.03				
η_p^2 (Time × SHS)		.05				
Fixation Count						
Positivity bias early (0–5)	1.18		0.80	1.8	.18	.03
Positivity bias middle (5–10)	0.35		0.43	0.03	.85	<.01
Positivity bias late (10–15)	**1.37***		**0.15***	**6.18**	**.016**	**.09**
F (Time × SHS)		3.87				
p (Time × SHS)		.02				
η_p^2 (Time × SHS)		.06				

Note. All positivity bias means are estimated marginal means. Boldface entries highlight statistically significant results.
* $p < .05$.

analyses), suggesting that biased attention to positive stimuli is linked to higher global trait happiness independent of the extent to which participants felt positive in the moment. As such, these results are in line with previous studies in which characteristics *linked to* trait happiness (optimism and older age) are associated with sustained attention toward positive images or away from negative images (e.g., Isaacowitz, 2005; Isaacowitz et al., 2006).

This link between positive attentional biases and trait happiness has interesting parallels to related clinical findings. Though anxiety has typically been linked to an increased bias for threatening stimuli (Weierich, Treat, & Hollingworth, 2008), recent work has found that, compared with healthy controls, clinically anxious subjects also show a *lack* of positivity bias (e.g., Chen, Clarke, MacLeod, & Guastella, 2012; Schofield, Inhoff, & Coles, 2013)—which may also contribute to the maintenance of their high levels of anxiety and their negative outlook. In conjunction with our findings, a positivity bias may thus demonstrate a healthy cognitive tendency that underlies happiness and that, when it fails, can facilitate clinical levels of negative emotion.

Sustained attention. In previous work, positive emotion has also been linked to transient attention. For example, one aspect of trait happiness (positive affect) is associated with transient attentional biases toward positive words in a dot-probe task (Tamir & Robinson, 2007). In contrast, the positivity bias observed here was evident only when examining sustained attention across each 15-s trial—with effects on measures of sustained attention (Dwell Time, Total Fixation Time, and Fixation Count) but not on the measure of initial transient attention (First Fixation). More directly, an analysis of the time course of the positivity bias observed here yielded a clear and robust dissociation (as depicted in Figure 3): Happier individuals had stronger positivity biases than did less happy individuals only during the last third of our 15-s trials.

Together, these findings suggest the attentional biases in trait happiness are less similar to those that involve transient shifts at stimulus onset (e.g., Mogg et al., 2000), and more similar to those that involve increased engagement across long stimulus durations (e.g., Kellough et al., 2008; Peckham, McHugh, & Otto, 2010). Just as such sustained attentional biases in negative emotions (e.g., in depression or anxiety; see Armstrong & Olatunji, 2012) may indicate elaborative information processing that also takes the form of rumination (Kellough et al., 2008) and/or intrusive negative thoughts (Beevers, Wenzlaff, Hayes, & Scott, 1999), so too sustained attentional biases in trait happiness may indicate similar but opposite-valence elaborative processes. This finding also suggests that future research on sustained attention and trait happiness should take care to examine attentional processes over relatively long durations in addition to momentary orienting.

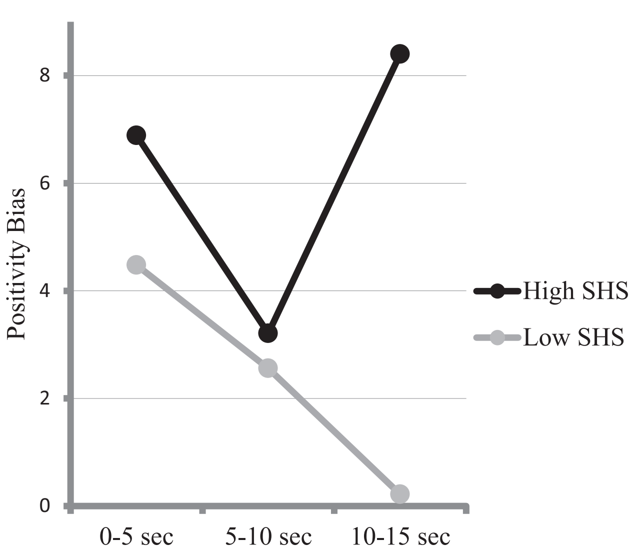


Figure 3. High and low Subjective Happiness Scale (SHS) subjects differ in the strength of their positivity biases only during the last 5-s block of each 15-s trial.

Naturalistic photographs of multiple positive categories. Whereas some previous studies have explored links between attention and positive mood using words, our participants viewed novel naturalistic photographs. Beyond being more similar to some sorts of real-world visual experience, such stimuli allowed us to test several varieties of positive stimuli. In particular, the positivity bias observed here replicated for images related to achievement, social interactions, and primary reward—with none of the biases being stronger for any one positive category compared with the other two positive categories. Although the positivity bias was not driven by attention to one specific type of positive category, examining attention to discrete types of negative stimuli has proved useful in the past (e.g., when contrasting threatening vs. dysphoric stimuli; Kellough et al., 2008), and so it may still be wise for future studies to assess attention using different discrete types of positive stimuli (e.g., amusement vs. pride) or on different dimensions (e.g., high vs. low arousal), because affective science increasingly draws such distinctions.

Positive semantic content versus low-level visual features. A final methodological contribution of these results pertains to the contrast between the raw images (as in Figure 1) and their phase-scrambled counterparts (as in Figure 2). Though the primary analyses all partialed out the contribution of biases to the phase scrambled images, it seems worth emphasizing that participants did have robust attentional biases based only on the preserved low-level features of those images, when their semantic content was eliminated. Future studies could potentially reveal just which features drive such looking patterns, but even a quick glance at the samples in Figure 2 suggest several possibilities. For example, participants may prefer to view some scrambled images because they are more complex, more colorful, or involve more phase-independent segmentation. Regardless, these results suggest that future experiments should always take care to test and quantify such effects, as was done here, since otherwise they could easily misattribute effects to semantic categories that really depend only on confounded low-level visual features.

Limitations and Future Directions

The current study was also limited in a few notable ways. First, the use of complex images may yield increased ecological validity and perhaps generalizability, but they also introduce more possible variance in affective responses. For example, an image of a delicious cake might fuel positive thoughts and associations for one person (“Yum!”), but negative thoughts and associations for another person (“My diet is going so poorly!”). Of course, such variance apply to all stimuli to some degree (including words, e.g., "cake"), but they be especially salient for naturalistic photographs—which can differ from each other along more dimensions than can simpler stimuli such as words.

Second, First Fixation data was measured across a relatively small number of trials (12). Though similar studies have also used this same number of trials (Kellough et al., 2008), and minimizing the number of trials helps prevent participant fatigue during eye tracking, null results such as the lack of evidence of an association between immediate attentional orienting and trait happiness should be interpreted cautiously, and longer studies might still yield evidence for such effects.

Third, the predictable arrangement of our images (i.e., in 4 quadrants of the screen) may have led to intentional scanning patterns that could mask effects of positive emotional content. Indeed, several of our participants reported viewing the images in a clockwise manner (e.g., always looking first at the upper left image, followed by the upper right, lower right, and finally lower left images). Such a scanning pattern might be particularly likely to disrupt the First Fixation data, and to push off effects of emotional content into the later phases of the trial, as in Figure 3. Future studies could address this by jittering the positions of the images on the display.

Fourth, because this study focused on several varieties of positive images, we did not also test for effects of negative images at the same time. As a result, despite the novelty of these results, some of the positivity bias may be because of positivity per se, while some of the bias may simply reflect increased emotional salience relative to neutral images. A straightforward way of testing this, of course, would also contrast positive versus negative images, correlating the results with measures of trait happiness. At the same time, however, note that the present results do rule out other possibilities that would be apparent if we had contrasted only positive versus negative images. In that case, for example, it is always possible for any effects to reflect either increased attention to positive stimuli per se, or increased distraction away from negative information—where these are independent possibilities. Here, in contrast, there were no negative images, and so our results cannot reflect distraction away from negative information.

Underlying Causal Mechanisms

Having established a robust correlation between trait happiness and attentional biases toward positive stimuli, the question remains: How are these two properties causally related? Does trait happiness drive sustained attentional biases for positive stimuli, or do such biases enhance happiness, or both? The correlational design of this study cannot (by definition) resolve this question, but it is nevertheless interesting to speculate about the possible (nonexclusive) answers. First, attention to positive stimuli could help maintain trait happiness by enabling the processing of the attended information (Posner, 1978). In some circumstances, such a process could theoretically foster overly heightened and persistent positive affectivity characteristic of disorders of positive emotion, such as mania (Gruber, 2011). In particular, biased attention toward positive information could lead to a greater number and relative frequency of positive percepts, which could in turn lead to an impression of the world as a better place—just as attending to many smiling faces at a party (vs. attention to the furniture) could lead to the impression that the party is fun. Similarly, because our interactions with the world are so often based on our percepts, such viewing patterns could increase the likelihood of daily engagement with positive events and rewards—just as attending to a smiling face at a party (vs. a chair) could make it more likely that you will approach that friendly person.

This possibility is consistent with the finding that looking at something more *causes* one to be more likely to choose it in a preference task (Shimojo, Simion, Shimojo, & Scheier, 2003). Similarly, manipulations of attention toward positive information increase approach motivation and behavior (Goetz, Robinson, & Meier, 2008), which in the natural world could translate into more frequent pursuit of rewards, and thus more rewarding experiences. Manipulating attention toward positive information has also been found to lead to decreased stress about an upcoming stressful event (Dandeneau, Baldwin, Baccus, Sakellaropoulo, & Pruessner, 2007), decreased frustration during a difficult task (Taylor, Bomyea, & Amir, 2011), and higher self-esteem (Dandeneau, Baldwin, Baccus, Sakellaropoulo, & Pruessner, 2007). These are all cases in which attentional manipulations yield transient affective benefits, but the present results suggest that attentional factors could also yield and maintain happiness at the longer-term trait level, potentially supporting interventions that lead to lasting increases in wellbeing.

Selective attention may also help to generate or maintain trait happiness by regulating emotions. Attentional allocation appears to be a method of emotion regulation that can lead to positive affective outcomes (e.g., Isaacowitz et al., 2008). Older adults, who are better at regulating their moods (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000), appear to utilize attentional preferences for positive stimuli to regulate their mood (Isaacowitz, Toner, Goren, & Wilson, 2008), and such attentional deployment may contribute to their dispositional positive affect. Indeed, attentional deployment is an emotion regulatory process outlined by Gross (1998) in which attentional processes are recruited to shape affective experience early in the emotion generative process (see also Mauss, Bunge, & Gross, 2007, Mauss, Cook, & Gross, 2007). By directing attention to positive stimuli, attentional deployment may then serve as a relatively low-effort automatic regulatory strategy that underlies greater positive affect (e.g., Xing & Isaacowitz, 2006)—and perhaps eventually, sustained trait happiness.

If attentional biases toward positive stimuli facilitate trait happiness—just as biases toward threat seem to maintain trait high levels of anxiety (Weierich et al., 2008)—this opens the door to attentional retraining in which the goal is to enhance long-term well-being through steering attentional biases toward positive stimuli. Indeed, recent work has found that changing patterns of attention themselves can elicit a resulting change in emotion (for meta-analyses see Beard, Sawyer, & Hofmann, 2012; Hakamata et al., 2010; Hallion & Ruscio, 2011), including temporary increases in state positive mood (Grafton, Ang, & Macleod, 2012; Taylor, Bomyea, & Amir, 2011). Causal links between attention and *trait* happiness would suggest possibilities for attention bias modification interventions to lead to long-term increases in well-being.

A second possibility is that trait happiness causes mood-congruent or motivation-congruent attentional allocation. Regarding mood-congruency, we know that inducing a positive mood state causes attentional biases toward positive stimuli (Tamir & Robinson, 2007; Wadlinger & Isaacowitz, 2006). And to the extent that one component of happiness is the frequent experience of positive mood states (Diener & Seligman, 2002), it is therefore plausible that people high on trait happiness are frequently biased toward processing affect-congruent stimuli. Regarding motivation-congruency, increasing the expectation of reward has been found to increase attentional biases to rewarding stimuli (Jones et al., 2012); thus, happy people's optimism and general expectation that good things will come their way (Seligman, 1991) may cause them to be more vigilant for positive stimuli in the environment.

Beyond these two salient options for the causal directionality of the correlation observed in the present study, there are of course two other generic possibilities. First, both causal directions may be correct: Trait happiness may lead to "rose colored glasses," which in turn help to maintain trait happiness. Second, some unknown correlated third factor may be causing both effects without them directly interacting. Given the establishment here of a correlation between trait happiness and positive attentional biases, future studies in this domain may aim to directly ascertain the underlying causal mechanisms—for example, via attentional retraining. Such tests might help to determine whether this relationship can be experimentally and therapeutically harnessed as a way to create lasting increases in trait happiness.

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