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Big Tales and Cool Heads: Academic Exaggeration Is Related to Cardiac Vagal Reactivity

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Students who exaggerate their current grade point averages (GPAs) report positive emotional and motivational orientations toward academics (Gramzow & Willard, 2006; Willard & Gramzow, 2007). It is conceivable, however, that these self-reports mask underlying anxieties. The current study examined cardiovascular reactivity during an academic interview in order to determine whether exaggerators respond with a pattern suggestive of anxiety or, alternatively, equanimity. Sixty-two undergraduates were interviewed about their academic performance. Participants evidenced increased sympathetic activation (indexed with preejection period) during the interview, suggesting active task engagement. Academic exaggeration predicted parasympathetic coactivation (increased respiratory sinus arrhythmia). Observer ratings indicated that academic exaggeration was coordinated with a composed demeanor during the interview. Together, these patterns suggest that academic exaggeration is associated with emotional equanimity, rather than anxiety. The capacity for adaptive emotion regulation—to keep a cool head when focusing on academic performance—offers one explanation for why exaggerators also tend to improve academically. These findings have implications for the broader literature on self-evaluation, emotion, and cardiovascular reactivity.

Keywords: Self-evaluation, self-positivity bias, respiratory sinus arrhythmia, cardiac vagal tone, academic performance

Persons in Western societies tend to cast themselves in an overly positive light (Taylor & Brown, 1988). This self-positivity bias holds across a wide variety of characteristics, such as physical attractiveness, personal virtue, sense of humor, and academic performance. One issue of contention is whether overly positive self-reports are emotionally and motivationally adaptive. An absolute statement supporting either side in this debate is likely untenable, largely because conceptual and, therefore, operational definitions of self-positivity bias vary considerably (Kwan, John, Kenny, Bond, & Robins, 2004). In addition, the same objective level of bias may result from several distinct emotional and motivational processes (Gramzow, Elliot, Asher, & McGregor, 2003; Gramzow & Willard, 2006; Willard & Gramzow, 2007; Willard & Gramzow, in press). It may be more theoretically generative to examine the emotional and motivational underpinnings of specific forms of self-positivity bias—particularly if these are highly prevalent biases that have real-world significance. One example of a self-positivity bias that meets these criteria is the tendency for students to exaggerate current grade point average (GPA).

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Academic Exaggeration

Our previous research demonstrates that academic performance is motivationally and emotionally charged for most students, and that the tendency to exaggerate GPA reflects these motivations and emotions. GPA exaggeration is associated with stable individual-difference measures such as achievement motivation (Gramzow et al., 2003) and dispositional self-enhancement (Gramzow & Willard, 2006). GPA exaggeration also is correlated with positive self-reported emotions and appraisals, as well as an approach orientation toward academics, while exaggeration is not typically associated with negative emotions or appraisals, avoidance orientation, narcissism, self-deception, or impression management (Willard & Gramzow, 2007). Finally, GPA exaggeration predicts both short-term and long-term improvements in academic performance (Gramzow et al., 2003; Willard & Gramzow, 2007). Thus, GPA exaggeration appears to reflect a positive motivational and emotional orientation toward academics.

This previous research has relied exclusively on self-reports of motivation and emotion. It is conceivable that persons who exaggerate their GPAs actually experience negative emotions when thinking about their academic performance, but deny or mask these emotions. That is, GPA exaggeration may reflect repressive coping (Weinberger, 1990) or defensive denial (Shedler, Mayman, & Manis, 1993), which are patterns characterized by subjective reports of low negative emotionality despite physiological measures consistent with high negative emotionality. If so, the apparent emotional, motivational, and performance benefits of GPA exag-

geration would come at a physical cost. The only relevant empirical evidence of which we are aware, however, points away from this conclusion. Specifically, a global measure of self-positivity bias predicted less cardiovascular reactivity in response to a stress induction and more rapid recovery (Taylor, Lerner, Sherman, Sage, & McDowell, 2003). This previous research did not differentiate parasympathetic from sympathetic activation, however, which is critical when interpreting patterns of cardiovascular reactivity.

Cardiovascular Reactivity

The purpose of the present research was to examine links between GPA exaggeration and patterns of cardiovascular reactivity (suggestive of motivational and emotional states) during an interview about academic performance. During the interview, we monitored participants' autonomic nervous system (ANS) reactivity, using measures that independently assess activation of the parasympathetic nervous system (PNS) and sympathetic nervous system (SNS). To assess parasympathetic activation, we used *respiratory sinus arrhythmia* (RSA), which is an index of cardiac vagal control. RSA reflects the degree to which heart rate accelerates and decelerates during the respiratory cycle, and is one of the purest measures of parasympathetic activation (Berntson et al., 1997). To assess sympathetic activation, we used *preejection period* (PEP). PEP reflects the time between the left ventricle contracting and the aortic valve opening, and is one of the purest measures of sympathetic activation (Brownley, Hurwitz, & Schneiderman, 2000).

Inferring emotional states from physiological responses should be done cautiously to avoid overstating the phenomenology associated with a concomitant physiological response (Cacioppo, Tassinary, & Berntson, 2000). However, mounting evidence suggests emotional and possible health benefits associated with greater *cardiac vagal tone*. The polyvagal theory (Porges, 2007) argues that vagal tone is associated with superior emotion regulatory capacity, positive social emotions, and awareness of the social environment. Clearly, low levels of vagal tone (assessed by RSA at baseline) are associated with dispositional measures of negative emotionality, including hostility (Demaree & Everhart, 2004), anxiety (Thayer, Friedman, & Borkovec, 1996), and certain symptoms of depression (Rottenberg, Wilhelm, Gross, & Gotlib, 2002). From a physical health perspective, vagal tone has been associated with reduced risk of heart disease (Thayer & Lane, 2007), less susceptibility to relapse after myocardial infarction (Bigger, Fleiss, Rolnitzky, & Steinman, 1993), and reduced cellular aging (Epel et al., 2006).

Cardiac vagal tone refers to tonic vagal control (dispositional, resting, or basal levels), whereas *cardiac vagal reactivity* refers to phasic vagal control (situational changes) as a result of (a) exposure to a stressor that requires attentional demands or (b) shifts in affective states. Cardiac vagal tone is generally thought to reflect temperament, whereas cardiac vagal reactivity is thought to reflect emotion and attention (Porges, 2007). Though strong evidence exists for positive physical and psychological benefits of cardiac vagal tone, comparatively less studied is vagal reactivity upon exposure to stressors, challenges, and emotional states. Withdrawal of the vagal brake (suppression of the vagus nerve resulting in decreased RSA) is argued to be adaptive in certain situations in which strong environmental demands or stressors require attentional focus to be shifted outward. For example, high cognitive demands tend to suppress vagal activity, resulting in decreased RSA (Scerbo et al., 2001). Decreases in RSA are also associated with the inducement of negative emotional states, such as worry (Hofmann et al., 2005). However, the polyvagal theory (Porges, 2007) predicts increased vagal control (increased RSA) during positive emotional experiences, such as those associated with social engagement. In support of this, Bazhenova, Plonskaia, and Porges (2001) found that infants' RSA levels increased during engaging social interactions and decreased during still-face paradigms compared to a baseline period. Furthermore, those infants who showed increases in RSA from still-face to social interactions showed emotionally concordant and appropriate responses (e.g., less negative signaling and more positive engagement during social interactions). In adult samples, relaxation (Houtveen, Rietveld, & De Geus, 2002) and positive mood (Ingjaldsson, Ladberg, & Thayer, 2003) have been shown to increase RSA.

With regard to the SNS, both benign and malignant interpretations of SNS activation can be found. One interpretation of increased SNS is that phasic activation of this system indexes task engagement, whereas a lack of activation suggests disengagement (Mendes, Reis, Seery, & Blascovich, 2003). This interpretation is consistent with the active versus passive coping perspective, which argues that stressors during which opportunities exist for active responding are more likely to increase SNS responding compared to situations that evoke passive coping, or nonaction oriented strategies (Obrist, 1981).

Overview and Hypotheses

If GPA exaggeration truly reflects a positive emotional and motivational orientation toward academics, then exaggerators interviewed about their academic performance should show positive vagal reactivity (increases in RSA),[1] which would suggest emotional *equanimity* (i.e., a calm and composed state). By contrast, if GPA exaggeration reflects repressive coping in response to visceral anxiety, exaggerators should experience more negative affect and distress during the interview, which would manifest itself as vagal withdrawal (decreases in RSA). Finally, GPA exaggeration also could reflect disengagement from the academic domain, which would be reflected by little to no changes in sympathetic activation (as indexed by PEP). Previous research (which relied on self-reported motivation and emotion) is most consistent with the first possibility—that GPA exaggeration will be related to a cardiovascular reactivity profile during the interview that is consistent with equanimity, rather than anxiety or disengagement.

[1] We did not predict baseline differences in PEP or RSA as a function of GPA exaggeration because the relevant domain (academic performance) must be made salient in order to evoke the motivational and emotional orientation related to that domain.

Method

Participants

Sixty-two Northeastern University undergraduates (35 male, 27 female; ages 18 to 34) participated as part of a course option.[2] They were prescreened for pregnancy, pacemakers, and diagnosed heart murmurs.

Procedure

Participants arrived individually at the lab for a two-phase study. The first phase consisted of a computerized survey. The survey included a request for the cumulative GPA (through the previously completed academic term). Participants also completed a grade sheet on which they wrote each course taken in the previous semester and the grade received.

Cardiovascular measures. After the survey, the experimenter applied sensors to the participant for noninvasive recording of cardiovascular responses. All physiological procedures adhered to guidelines established by the Society for Psychophysiological Research (Sherwood, et al., 1990). Responses were recorded at a rate of 1,000 samples per second using an integrated system (Biopac MP150, Biopac Systems, Goleta, CA) with amplifiers for impedance cardiography (ZKG; NICO100C amplifier) and electrocardiograph (ECG; ECG100C amplifier).

Four strips of disposable tetrapolar aluminum/mylar electrode tape were attached to each participant for ZKG recording, the first pair encircling the neck and the second pair encircling the torso. The inner electrode strips were placed at the base of the neck and at the thoracic xiphisternal junction. The outer two electrodes were separated from their respective inner electrodes by approximately 3 cm. A small electrical current (4 mA) was sent through the two outer electrodes and Z_0 (and its first derivative $\Delta Z/\Delta t$) was obtained from the inner electrodes. Pregelled snap electrodes were placed on each participant in a Standard Lead II configuration (right arm, left leg) for ECG recording. After attaching the sensors, the experimenter left the room, and began recording physiological signals for a 5-min baseline period.

Upon completion of the study, physiological data were scored in 1-min intervals using commercially available software (Mindware HRV 2.0 and IMP 2.0 modules, Westerville, OH). The impedance (IMP) module integrated the ECG and ZKG waves to identify PEP: time between the initiation of left ventricle contraction (the Q-point on the ECG wave) and the opening of the aortic valve (the B-point on the $\Delta Z/\Delta t$ wave). We scored these data using the max slope option, which required manual adjustment of the B-point. PEP is an index of left ventricular contractile force, which is almost exclusively influenced by the SNS (Brownley et al., 2000). The heart rate variability (HRV) module incorporated the ECG signal in order to determine interbeat intervals (IBIs) and the Z_0 component of the ZKG in order to index respiration. The program identified the R-point of each heartbeat on the ECG waveform, and improbable IBIs were detected based on the overall distribution, using a validated algorithm (Berntson, Quigley, Jang, & Boysen, 1990). We also manually inspected the data for any recording artifacts. The HRV module detrended the data using a first order polynomial to remove the mean and any linear trends, cosine tapered the data, submitted it to Fast Fourier Transformation, and took the natural log integral of the high frequency power (.15-.40 Hz) as an index of RSA. This method is generally accepted as an optimal noninvasive measure of cardiac vagal control (Bernston et al., 1997).

Academic interview. An interviewer, who had no previous contact with the participant, entered the room following the baseline period. Immediately after introductory remarks and instructions, the interviewer began a scripted interview covering the participant's academic history, with an emphasis on current performance. Participants were asked to rate their performance relative to other students at each stage of their academic careers (from elementary school to the present), and to indicate how well they did on standardized tests. Participants also reported their current GPA, their satisfaction with that GPA, and their ideal GPA upon graduation.[3] The interviewer reviewed the grade sheet completed during the earlier survey, asking participants to confirm each course and grade reported. Finally, participants were asked about their goals and plans upon graduation. The interview was videotaped (with participant consent), and physiological signals were recorded during a standardized 6-min portion of the interview. Following the interview, participants were left alone for a 5-min recovery period.

Actual GPAs. After the recovery period, participants were debriefed and consent was obtained to access their academic records from the university registrar. Each participant's official GPA was recorded once at the time of the study to index exaggeration, and again after the completion of the semester in order to assess changes in performance.

Behavioral coding. A research assistant (blind to hypotheses and to participants' exaggeration levels) viewed the video recordings and rated on 5-point scales how "confident" and "happy" each participant appeared during the academic interview. These ratings were combined into an overall measure of behavioral composure (Cronbach's alpha = .65).

Results

GPA Exaggeration

Self-reported GPAs ($M = 3.01$, $SD = 0.59$) were significantly higher than the actual GPAs recorded by the registrar ($M = 2.92$, $SD = 0.71$), $t(61) = 3.14$, $p = .003$. Thus, as in previous research, students tended to exaggerate their GPAs. We created a GPA exaggeration index by regressing self-reported GPAs onto actual GPAs and saving the standardized residuals. Higher scores on this index indicate greater exaggeration, controlling for individual differences in actual GPA (Gramzow et al., 2003; Gramzow & Willard, 2006; Willard & Gramzow, 2007). GPA exaggeration was not associated with participant age, gender, or ethnicity.

The prevalence of exaggeration can also be characterized in terms of percentages. In the present sample, 44% were accurate within rounding error (we requested GPA to 2 decimal places, whereas the registrar records to 3 decimal places). The pattern of

[2] The equipment and software did not record sufficient data at key time points for the omitted participants. The effective sample sizes for analyses involving physiological measures are 53 for PEP and 54 for RSA.

[3] The GPA values that participants reported during the interview ($M = 3.00$, $SD = .60$) did not differ from those reported earlier during the computerized survey ($M = 3.01$, $SD = .59$), $t(61) = 0.61$, $p = .546$.

inaccurate respondents, however, was highly asymmetrical: less than 10% of the total sample underreported, whereas 46% exaggerated. Therefore, GPA exaggeration was a fairly normative response.

Exaggeration and improvement. We created a GPA improvement index by regressing actual GPAs at the time of the study onto actual GPAs at the end of the semester and saving the standardized residuals. Higher scores on this index indicate greater improvement in academic performance over the course of the semester. Consistent with previous research (Gramzow et al., 2003; Willard & Gramzow, 2007), the GPA exaggeration index was correlated positively with the improvement index, $r(60) = .48$, $p < .001$, indicating that students who exaggerated actually improved their performance over time (controlling for initial level of performance.)

Exaggeration and behavioral coding. GPA exaggeration was correlated positively with observer ratings of how composed (confident and happy) participants appeared during the interview, $r(60) = .26$, $p < .05$.

Cardiovascular Reactivity

The primary purpose of this research was to examine whether the tendency to exaggerate GPA is associated with ANS reactivity during an academic interview. To address this question, we examined patterns of SNS reactivity (indexed by PEP) and PNS reactivity (indexed by RSA) over time and whether these patterns were qualified by GPA exaggeration. GPA exaggeration is a residualized variable and therefore is mean centered (i.e., has a mean of zero). Mean centering aids interpretation of lower-order terms (e.g., the time effect) when testing interactions involving continuous predictors.

Exaggeration and PEP activation. The pattern of PEP values as a function of time period and level of GPA exaggeration is displayed in Figure 1. Using a general linear model (GLM) procedure, we examined the main effects of time period (baseline, interview, and recovery) and exaggeration, and the Time × Exaggeration interaction on PEP. We treated time as a within-participants variable and exaggeration as a continuous between-participants variable.[5] The time effect was significant, $F(2, 51) = 4.76$, $p = .013$, indicating that PEP values differed across the three time periods (at the mean level of exaggeration). Follow-up tests indicated that PEP decreased significantly from baseline to interview, $t(53) = 2.09$, $p = .041$, and then increased significantly from interview to recovery, $t(53) = 3.18$, $p = .002$. Baseline and recovery values did not differ significantly, $t(53) = 1.26$, $p = .213$.

The exaggeration effect was not significant, $F(1, 52) < 1$, indicating that GPA exaggeration was not associated with an overall difference in PEP across the three time periods. In addition, the Time × Exaggeration effect was not significant, $F(2, 51) < 1$. Thus, the pattern of PEP reactivity over time (decrease during the interview, followed by return to baseline during recovery) did not differ significantly as a function of the tendency to exaggerate.

Exaggeration and RSA activation. The pattern of changes in RSA as a function of time period and level of GPA exaggeration is displayed in Figure 2. We used the same GLM procedure to examine the main effects of time period and exaggeration, and the Time x Exaggeration interaction on RSA. Because RSA is potentially influenced by rate and depth of respiration, we controlled for these parameters (Berntson et al., 1997).[6] The time effect was not significant, $F(2, 52) < 1$, indicating that the interview did not lead to changes in RSA levels at the mean level of exaggeration. The exaggeration effect also was not significant, $F(1, 53) < 1$, indicating that GPA exaggeration was not associated with an overall difference in RSA across the three time periods. Finally, the Time × Exaggeration effect was significant, $F(2, 52) = 3.48$, $p = .039$, indicating that the pattern of RSA across time varied as a function of the tendency to exaggerate.

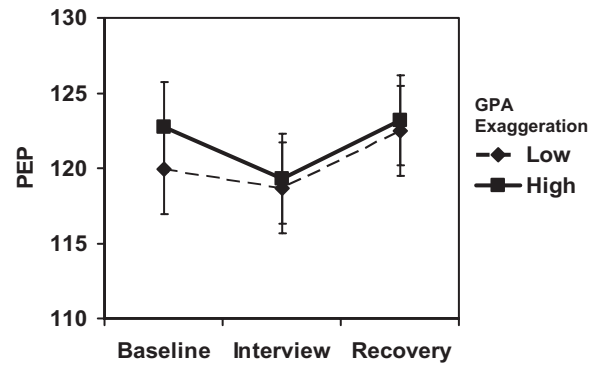

Figure 1. Preejection period (PEP) as a function of time (baseline, during the interview, and recovery) and level of GPA exaggeration. Note: Data points are predicted PEP values and *SE*s plotted at 1 *SD* above and below the mean of exaggeration.

To help interpret the pattern contributing to this interaction, we examined the predicted values of RSA at high (+1 *SD*) and low (-1 *SD*) levels of GPA. At the high level of exaggeration, there was a significant time effect, $F(2, 52) = 3.19$, $p = .050$. As shown in Figure 2, RSA values for students relatively high in GPA exaggeration increased significantly during the interview from baseline, $F(1, 53) = 4.67$, $p = .036$, and did not decrease significantly during recovery, $F(1, 53) < 1$. Indeed, at the high level of GPA exaggeration, RSA values during recovery remained marginally higher than baseline, $F(1, 53) = 3.68$, $p = .060$. At the low level of exaggeration, the time effect was not significant, $F(2, 52) = 1.26$, $p = .293$. In addition, the decrease from baseline during the interview was not significant at the low level of exaggeration, $F(1, 53) = 1.58$, $p = .214$, and values at recovery did not differ from baseline, $F(1, 53) < 1$.

[5] A word of caution regarding interpretation of the error bars plotted in Figures 1 and 2. The depicted error bars represent the standard error around the predicted values at low and high levels of exaggeration. They are useful for examining the between-participants exaggeration effect within each time period, but bear no relevance to significance tests for comparisons across time. The effects across time are within-participants effects, for which different (and much smaller) error terms are applied.

[6] We controlled for respiration rate and amplitude within each time period. For example, the RSA values at baseline controlled for respiration at baseline, while the RSA values during the interview controlled for respiration during the interview. We also controlled for average respiration values across the entire recording period, and this did not alter the pattern of results. In addition, because there is debate about the merits of controlling for respiration when examining RSA, we repeated the analysis without this control and the results were unchanged.

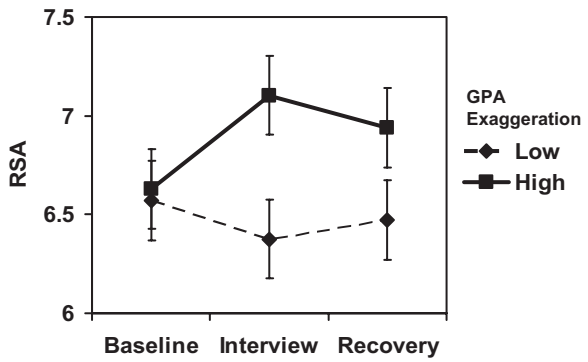

Figure 2. Respiratory sinus arrhythmia (RSA) as a function of time (baseline, during the interview, and recovery) and level of GPA exaggeration. Note: Data points are predicted RSA values plotted and *SE*s plotted at 1 *SD* above and below the mean of exaggeration.

Speaking. Levels of PEP and RSA are potentially influenced by motor activity such as speaking (Berntson et al., 1997). Obviously, the amount of speaking engaged in by participants increased during the interview (relative to when seated alone during baseline and recovery). On average, participants spoke for approximately 20% of the time (78 s during the 6-min interview). Therefore, we repeated the two GLM analyses predicting PEP and RSA while controlling for the length of time that participants spoke during the interview (which we determined from the video recordings). For PEP, the time period effect remained significant, $F(2, 49) = 4.52$, $p = .016$, and the exaggeration and Time × Exaggeration effects remained nonsignificant (Fs < 1). For RSA, the time and exaggeration effects remained nonsignificant (Fs < 1), and the Time × Exaggeration effect remained significant, $F(2, 50) = 3.64$, $p = .033$.

Physiological Reactivity and Academic Improvement

The final question we addressed was whether ANS reactivity during the academic interview was associated with subsequent changes in academic performance. To simplify presentation of the analysis, we created deviation scores from baseline to the interview and from baseline to recovery for both PEP and RSA. PEP changes from baseline during the interview and during recovery were not correlated significantly with GPA improvement (rs $<$ .033, ps $>$. 814). Increases in RSA from baseline during the interview were correlated positively with GPA improvement ($r = .31$, $p = .022$). Changes in RSA from baseline during recovery were not correlated significantly with improvement ($r = -.01$, $p = .957$). Thus, increases in RSA during the academic interview predicted subsequent improvement in actual academic performance.

Discussion

Students tend to exaggerate their current academic performance. Previous researchers generally have regarded such exaggeration as a nuisance—an unwanted source of variance or a methodological stumbling block. By contrast, our previous research demonstrated that academic exaggeration is a psychologically meaningful self-positivity bias that reflects important emotional, motivational, and self-regulatory processes (Gramzow et al., 2003; Gramzow & Willard, 2006; Willard & Gramzow, 2007). One shortcoming of our previous research was a reliance on self-report measures. It is possible that participants misreported both their grades and their motivations and emotions. If so, the association between exaggeration and positive emotions and approach motivations in the academic domain would be misleading, and exaggeration may actually reflect an unacknowledged or repressed anxiety about academics. The present study addressed this shortcoming by measuring physiological correlates of GPA exaggeration in a context in which academics (and academic performance) was highly salient.

In general, students showed a decrease in PEP during the academic interview, indicating an increase in SNS activation, and possibly suggesting active task engagement (Mendes et al., 2003). GPA exaggeration was not associated with baseline PEP levels or with PEP reactivity during the interview or recovery. The increase in SNS activation (decreased PEP) implies that students in general were not disengaged during the interview. Additional analyses demonstrated that changes in PEP were not attributable to the fact that participants were speaking during the interview.

Although GPA exaggeration was not related to PEP levels, it was coordinated with increases in RSA during the interview (even after controlling for respiration and speaking). Increases in RSA imply increases in vagal influence and, therefore, increased PNS activation in response to the academic interview. According to the polyvagal theory, the elicitation of a negative emotion typically results in systematic withdrawal of vagal influence via the nucleus ambiguous in order to promote fight-flight behaviors (Porges, 2007). Therefore, negative emotionality in response to the academic interview presumably would correspond with decreases in RSA from baseline. The tendency for GPA exaggeration to be associated with increases in RSA, then, suggests that exaggerators experienced little if any anxiety and instead responded to the interview with equanimity (i.e., a composed emotional state). Indeed, there is evidence that increases in RSA are associated with shifts to more pleasant affective states (Porges, 2007). Therefore, the present findings are consistent with previous self-report evidence indicating that exaggerators experience positive rather than negative emotions when thinking about their academic performance (Willard & Gramzow, 2007).

Behavioral coding provided converging evidence that exaggeration was coordinated with greater composure (confidence and happiness) during the interview. Moreover, students who exaggerated actually tended to improve their academic performance over time (controlling for initial performance). This overall profile of the academic exaggerator (increased RSA during the academic interview, behavioral composure, and subsequent academic improvement) builds upon our previous self-report evidence linking exaggeration with a positive emotional and motivational orientation toward academics (Gramzow et al., 2003; Gramzow & Willard, 2006; Willard & Gramzow, 2007).

The findings from the present research must be considered in the context of the broader literature on self-positivity bias. The overall profile of the academic exaggerator appears to be largely consistent with research on unrealistic optimism and positive illusions about the self. Taylor and colleagues have demonstrated that overly positive self-views are generally adaptive from a motivational and performance standpoint—and may even promote phys-

ical health and successful recuperation from disease (Taylor & Brown, 1988; Taylor et al., 2003). We caution, however, that our results likely generalize primarily to self-positivity biases that reflect important aspects of the self or current goal pursuits. This is the case because exaggeration of performance on current and important goals is more likely to reflect a motivated self-enhancement process (Gramzow & Willard, 2006) that is coordinated with optimism and hope for the future (Taylor & Brown, 1988). Self-positivity biases also can result from motives that have maladaptive emotional and physiological profiles, such as narcissism, defensive denial, or poor self-presentational skills. Or, they may be relatively amotivated, reflecting more subtle biases in reconstructive memory (Willard & Gramzow, in press). It is critical, therefore, that researchers consider the motivational orientation underlying a given self-positivity bias.

The findings from the present research also contribute to the small, but growing literature on cardiac vagal reactivity in healthy adults (e.g., Hofmann et al., 2005). We are unaware of any previous research that links a person's self-evaluation in a given domain to his or her cardiac vagal reactivity when focusing on that domain. Further exploration of the link between self-evaluation (including positivity bias) and cardiovascular reactivity strikes us as an exciting avenue for future research. In addition to being predicted by GPA exaggeration, increases in RSA during the academic interview predicted subsequent academic outcomes. Again, we are unaware of any previous research demonstrating that cardiac vagal reactivity in a given domain predicts subsequent performance outcomes in that domain. Recent research on emotion regulation and RSA, however, may have some bearing on our findings. Butler, Wilhelm, and Gross (2006) demonstrated that active emotion regulation during a disturbing film (either suppressing or reappraising negative emotions) was associated with increases in RSA. It is conceivable that academic exaggerators spontaneously adopt emotion-regulation strategies when in an academic context. The ability to effectively regulate their emotions would likely serve them well in that context.

Conclusion

In the present study, the positive association between academic exaggeration and increased vagal control during an academic interview suggests that exaggerators may be less susceptible to anxiety about their academic performance. It may also be the case that exaggerators are less susceptible to performance-related anxiety in an actual academic setting. Future research should explore this possibility. In a highly evaluative context like academics, anxiety can be debilitating, even for students with high ability. Indeed, Martin and Marsh (2006) report that composure (defined as low anxiety on their measure of academic resilience) is a particularly strong predictor of academic success. The capacity to keep a cool head when thinking about academic performance (i.e., to maintain equanimity) may offer one explanation for why exaggerators tend to show actual improvement over time. What is clear from the results of the present study, in conjunction with previous research, is that evidence to date strongly suggests that the normative tendency to exaggerate current academic performance is coordinated with an emotionally adaptive and functional motivational process.

References

Bazhenova, O. V., Plonskaia, O., & Porges, S. W. (2001). Vagal reactivity and affective adjustment in infants during interaction challenges. *Child Development, 72,* 1314–1326.

Berntson, G. G., Bigger, J. T. Jr., Eckberg, D. L., Grossman, P., Kaufmann, P. G., Malik, M., et al. (1997). Heart rate variability: Origins, methods, and interpretive caveats. *Psychophysiology, 34,* 623–648.

Berntson, G. G., Quigley, K. S., Jang, J., & Boysen, S. T. (1990). An approach to artifact detection: Application to heart period data. *Psychophysiology, 27,* 586–598.

Bigger, J. T., Fleiss, J. L., Rolnitzky, L. M., & Steinman, R. C. (1993). The ability of several short-term measures of R-R variability to predict mortality after myocardial infarction. *Circulation, 88,* 927–934.

Brownley, K. A., Hurwitz, B. E., & Schneiderman, N. (2000). Cardiovascular psychophysiology. In: J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *Handbook of Psychophysiology, 2nd ed.,* pp. 224–264. New York: Cambridge University Press.

Butler, E. A., Wilhelm, F. H., & Gross, J. J. (2006). Respiratory sinus arrhythmia, emotion, and emotion regulation during social interaction. *Psychophysiology, 43,* 612–622.

Cacioppo, J. T., Tassinary, L. G., & Berntson, G. G. (2000). Psychophysiological Science. In: J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *Handbook of Psychophysiology, 2nd ed.,* pp. 3–23. New York: Cambridge University Press.

Demaree, H. A., & Everhart, D. E. (2004). Healthy high-hostiles: Reduced parasympathetic activity and decreased sympathovagal flexibility during negative emotional processing. *Personality and Individual Differences, 36,* 457–469.

Epel, E. S., Lin, J., Wilhelm, F., Wolkowitz, O. M., Cawthon, R., Adler, N., et al. (2006). Cell aging in relation to stress arousal and cardiovascular disease risk factors and genetic variation. *Psychoneuroendocrinology, 31,* 277–287.

Gramzow, R. H., Elliot, A. J., Asher, E., & McGregor, H. A. (2003). Self-evaluation bias and academic performance: Some ways and some reasons why. *Journal of Research in Personality, 37,* 41–61.

Gramzow, R. H., & Willard, G. (2006). Exaggerating current and past performance: Motivated self-enhancement versus reconstructive memory. *Personality and Social Psychology Bulletin, 32,* 1114–1125.

Hofmann, S. G., Moscovitch, D. A., Litz, B. T., Kim, H., Davis, L. L., & Pizzagalli, D. A. (2005). The worried mind: Autonomic and prefrontal activation during worrying. *Emotion, 5,* 464–475.

Houtveen, J. H., Rietveld, S., & De Geus, E. J. C. (2002). Contribution of tonic vagal modulation of heart rate, central respiratory drive, respiratory depth and respiratory frequency to respiratory sinus arrhythmia during mental stress and physical exercise. *Psychophysiology, 39,* 427–436.

Ingjaldsson, J. T., Laberg, J. C., & Thayer, J. F. (2003). Reduced heart rate variability in chronic alcohol abuse: Relationship with negative mood, chronic thought suppression, and compulsive drinking. *Biological Psychiatry, 54,* 1427–1436.

Kwan, V. S. Y., John, O. P., Kenny, D. A., Bond, M. H., & Robins, R. W. (2004). Reconceptualizing individual differences in self-enhancement bias: An interpersonal approach. *Psychological Review, 111,* 94–110.

Martin, A. J., & Marsh, H. W. (2006). Academic resilience and its psychological and educational correlates: A construct validity approach. *Psychology in the Schools, 43,* 267–281.

Mendes, W. B., Reis, H., Seery, M. D., & Blascovich, J. (2003). Cardiovascular correlates of emotional expression and suppression: Do content and gender context matter? *Journal of Personality and Social Psychology, 84,* 771–792.

Obrist, P. (1981). *Cardiovascular psychophysiology: A perspective.* New York: Plenum Press.

Porges, S. W. (2007). The Polyvagal perspective. *Biological Psychology, 74,* 116–143.

Rottenberg, J., Wilhelm, F. H., Gross, J. J., & Gotlib, I. H. (2002).

Respiratory sinus arrhythmia as a predictor of outcome in major depressive disorder. *Journal of Affective Disorders, 71,* 265–272.

Scerbo, M. W., Freeman, F. G., Mikulka, P. J., Parasuraman, R., Di Nocero, F., & Prinzel, L. J., III. (2001). *The efficacy of psychophysiological measures for implementing adaptive technology* (NASA/TP-2001–211018). Washington, DC: NASA.

Shedler, J., Mayman, M., & Manis, M. (1993). The illusion of mental health. *American Psychologist, 48,* 1117–1131.

Sherwood, A., Allen, M. T., Fahrenberg, J., Kelsey, R. M., Lovallo, W. R., & van Doornen, L. J. (1990). Methodological guidelines for impedance cardiography. *Psychophysiology, 27,* 1–23.

Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin, 103,* 193–210.

Taylor, S. E., Lerner, J. S., Sherman, D. K., Sage, R. M., & McDowell, N. K. (2003). Are self-enhancing cognitions associated with healthy or unhealthy biological profiles? *Journal of Personality and Social Psychology, 85,* 605–615.

Thayer, J. F., Friedman, B. H., & Borkovec, T. D. (1996). Autonomic characteristics of generalized anxiety disorder and worry. *Biological Psychiatry, 39,* 255–266.

Thayer, J. F., Lane, R. D. (2007). The role of vagal function in the risk for cardiovascular disease and mortality. *Biological Psychology, 74,* 224–242.

Weinberger, D. A. (1990). The construct validity of the repressive coping style. In J. L. Singer (Ed.), *Repression and dissociation: Implications for personality theory, psychopathology, and health* (pp. 337–385). Chicago: University of Chicago Press.

Willard, G., & Gramzow, R. H. (2007). *Academic exaggeration: Affective, motivational, and performance correlates.* Manuscript submitted for publication.

Willard, G., & Gramzow, R. H. (in press). Exaggeration in memory: Systematic distortion of self-evaluative information under reduced accessibility. *Journal of Experimental Social Psychology.*

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