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Pers Soc Psychol Bull 2010 36: 1101
DOI: 10.1177/0146167210375618

Personality and Social
Psychology Bulletin
36(8) 1101–1114

DOI: 10.1177/0146167210375618
http://pspb.sagepub.com

The Cost of Self-Protection: Threat Response and Performance as a Function of Autonomous and Controlled Motivations

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Abstract

Seventy-seven undergraduates, primed for autonomous or controlled motivation, were videotaped and physiologically monitored during a stressful interview and subsequent speech. Interview videotapes were coded for behavioral measures of threat response; speech videotapes were coded for performance. It was hypothesized that relative to controlled motivation, autonomous motivation would decrease interview threat response and enhance speech performance, and that threat response would mediate the effect of motivation on performance. Results support the prediction across measures of verbal, paralinguistic, smiling, vocal fundamental frequency, and cardiovascular response. Autonomously primed participants continued to show less cardiovascular threat throughout the later speech and gave better speeches. Finally, speech performance was mediated by interview threat response. Results demonstrate that relative to controlled motivation, autonomous motivation lowers threat response, which enhances performance.

Keywords

defensive processes, motivation, performance, self-determination theory, physiological processes

Received August 12, 2009; revision accepted February 23, 2010

According to process models of self, individuals continually take in information and use it to construct, elaborate, and maintain a sense of identity. Thus, the self is like a running story line with working assumptions from which individuals interpret and respond to the social world (McLean, Pasupathi, & Pals, 2007). Information that is discrepant from the self interrupts the story line. If new information is integrated, it allows more optimal responding (Showers & Zeigler-Hill, 2007); however, discrepant information often is perceived as threatening rather than as potentially helpful information, in which case it is responded to defensively.

Perceiving and responding to threat is so compelling an experience that it is a core explanatory mechanism in many psychological theories. For example, threat is central to protection motivation (Forster, Higgins, & Werth, 2004), terror management (Greenberg, Solomon, & Arndt, 2008), theories of interpersonal rejection (Richman & Leary, 2009), attachment (Mikulincer & Shaver, 2001), self and identity (Ellemers, Spears, & Doosje, 2002), and executive decision making (Chattopadhyay, Glick, & Huber, 2001). Some theorists recognize that threat response is multifaceted and postulate connections between different response systems. For example, cognitive appraisals of events influence both physiological responses (Blascovich & Tomaka, 1996) and vocal acoustic patterns (Scherer, 1986). Thus, threat responses include multifaceted effects that are linked across response systems.

Negative arousal underlies some threat responses, including nonverbal behavior (e.g., Burgoon, Le Poire, Beutler, Bergan, & Engle, 1992), vocal changes (Russell, Bachorowski, & Fernández-Dols, 2003), and physiological responses (Blascovich & Tomaka, 1996). Some threat behaviors are at least partly consciously controllable (e.g., verbal content, smiling),

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whereas others are more automatic and less controllable (e.g., paralinguistic cues, vocal acoustics, cardiovascular [CV] responses). However, in highly threatening situations, negative arousal can be so intense that behavioral regulation becomes challenging and increases the likelihood that threat responses "leak" into behavior. We refer to the critical point at which individuals perceive and respond to threat as "threshold for threat."

Factors Influencing Threshold for Threat

Although everyone perceives and responds to threat when it reaches a critical level, many factors determine that level, or threshold for threat. Situations can exacerbate or mitigate threat response; for example, threatening just-world beliefs causes participants to derogate victims (Hafer, 2000), activating thoughts of parents after mortality salience decreases worldview defense (Cox et al., 2008), and spousal hand-holding attenuates neural system activation of threat response (Coan, Schaefer, & Davidson, 2006). Threat response is also predicted by individual differences including attachment (Hart, Shaver, & Goldenberg, 2005), defensive self-esteem (Jordan, Spencer, Zanna, Hoshino-Browne, & Correll, 2003), authenticity and mindfulness (Lakey, Kernis, Heppner, & Lance, 2008), and repression (Weinberger, 1990). Thus, situational and individual factors together determine readiness to perceive and respond to threat.

Motivation and Threat Response

Hodgins and colleagues (Hodgins, 2008; Hodgins & Knee, 2002) proposed that autonomous and controlled motivation orientations, as described by self-determination theory (SDT; Deci & Ryan, 2000; Ryan & Deci, 2000), are an important predictor of threat and defense. In SDT, autonomous motivation refers to the tendency to initiate behavior based on choices consistent with integrated feelings and values; it is accompanied by a sense of choicefulness, endorsement, and ownership of behavior. In contrast, controlled motivation refers to the tendency to organize behavior on the basis of external contingencies, such as rewards and recognition, and internally controlling contingencies, such as "I should" and "I ought." Controlled motivation is thus experienced as external and internal coercion and pressure.

Autonomous motivation (i.e., choiceful responding) and controlled motivation (i.e., pressured responding) are postulated by SDT to be differentially associated with self-structures and self-esteem. Specifically, autonomous motivation is accompanied by integrated and secure self-processes, whereas controlled motivation involves ego-involved self-structures and fragile self-esteem (Deci & Ryan, 1995; Kernis , Paradise, Whitaker, Wheatman, & Goldman, 2000; Ryan, 1991). According to Hodgins and Knee (2002; Hodgins, 2008), self-structures influence threshold for threat, in the direction of autonomous motivation causing a higher threshold relative to controlled motivation. The secure self underlying autonomous motivation equips individuals to encounter information with lower defense and allows integration of, rather than defense against, new and discrepant information. In contrast, under controlled motivation, fragile self-worth is at stake, causing hypervigilant readiness to perceive and respond to social threat.

Past empirical evidence supports the Hodgins and Knee (2002) model; for example, dispositional autonomy relates to interpersonal openness whereas controlled motivation relates to defense with romantic partners (Knee, Lonsbary, Canevello, & Patrick, 2005) and across relationship (Hodgins, Koestner, & Duncan, 1996). Similarly, autonomy predicts apology after wrongdoing whereas control predicts defense and deception (Hodgins & Liebeskind, 2003; Hodgins, Liebeskind, & Schwartz, 1996). Consistent with threat, controlled motivation predicts self-serving attributions (Knee & Zuckerman, 1996), defensive coping (Knee & Zuckerman, 1998), aggressive driving (Neighbors, Vietor, & Knee, 2002), and an easily threatened identity (Soenens, Berzonsky, Vansteenkiste, Beyers, & Goossens, 2005). Together, results support that dispositional autonomy is associated with less defense than controlled motivation. Experimental findings are consistent with individual difference findings: Relative to those primed with controlled and impersonal (i.e., noneffectance) motivation, autonomously primed individuals report lower desire to escape, use less self-serving attributions, and make fewer excuses for athletic performance (Hodgins, Yacko, & Gottlieb, 2006). Hence, across methods and behaviors, studies show that autonomous motivation is associated with lower defense.

Defensiveness and Performance

We suggest that the lower defense under autonomy should have the consequence of enhancing performance. This should occur, first, because defenses literally limit perception (Balcetis & Dunning, 2006) and therefore exclude potentially helpful information. Second, the negative arousal that accompanies threat response reduces coping (Blascovich & Tomaka, 1996) and depletes cognitive resources. Empirical research supports the costs of defense; for example, thought suppression causes obsession (Wenzlaff & Wegner, 2000), impaired incidental memory (Richards & Gross, 1999), and negative emotion and arousal (Mendolia & Kleck, 1993); avoidance of somatic sensation impairs pain coping (Cioffi & Holloway, 1993); and self-enhancement longitudinally predicts poor social skills and maladjustment (Colvin, Block, & Funder, 1995). Given the broad negative consequences of avoidance for capacities, defensive threat responses should interfere with performance on subsequent tasks, even tasks unrelated to the initial threat. Essentially, a broad-based shutting out of reality should undermine functioning in broad-based ways.

The predicted cost of defense seems inconsistent with the perspective that positive illusions predict well-being (Taylor & Brown, 1988) and that defenses are necessary (Greenberg, et al., 2008) or helpful (Cramer, 2006). Two factors might help account for the seeming contradiction. First, it is possible that self-enhancement benefits (e.g., Taylor & Brown, 1988) occur mostly in self-report, which are influenced heavily by social desirability concerns (see Shedler, Karliner, & Katz, 2003). Second, defenses might facilitate responding in immediate contexts according to some criteria that have been used in past research; however, over longer periods and on complex performance-based criteria, functioning should be undermined because of the loss of reality-based information and reduction of energy, coping, and cognitive capacities.

In summary, past research shows that autonomous motivation, relative to controlled motivation, leads to lower defensiveness. We propose that the lower defense under autonomy enhances performance on subsequent tasks, even those unrelated to the initial threat (see Figure 1). The current study was designed to test this model. Past evidence for the effect of motivation on defense relies primarily on individual differences, with the exception of Hodgins et al. (2006), which used primed motivations. Priming procedures are said to globally activate entire stances on the world (Bargh, 2006) and shift self-concepts in prime-consistent directions (Wheeler, DeMarree, & Petty, 2007) analogous to the activation of conceptual structures by unattended environmental cues. In the case of motivation, priming causes tendencies for autonomous and controlled motivation and their underlying self-structures to become temporarily salient and operative. The assumption is that individuals have both autonomous and controlled motivations, which can be situationally activated, making them more or less accessible (Deci & Ryan, 2000). The current study used motivation priming to examine the hypothesis that motivation influences defense and performance.

Another limit of previous research on motivation and defense is that it did not involve high social threat, possibly limiting the range of threat responses. Moreover, previous defense measures have been largely self-report rather than behavioral, which is problematic because humans lack direct introspective awareness (Nisbett & Wilson, 1977), particularly with respect to the experience of threat and defense. In line with calls for behavioral research (Baumeister, Vohs, & Funder, 2007), the current study included multiple objective outcomes to assess threat response across diverse systems, providing a unique opportunity to examine relations among diverse outcomes. Participants were exposed to moderately high social threat, allowing for a wider range of threat responses than under low threat.

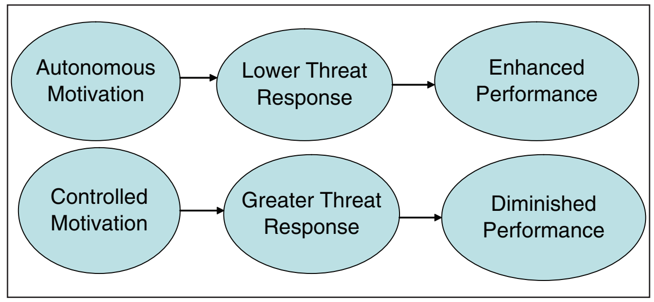

Figure 1. Model of motivation, defense, and performance

Manifestations of Threat Response

When individuals perceive threat, self-protective responses occur across diverse systems, including verbal, paralinguistic, and smiling behaviors, and vocal acoustic and physiological responses. In the verbal channel, threat undermines verbal effectiveness in psychotherapists (Paar & Seeman, 1973) and verbal initiative in college students (Peters, 1978). Self-protection also causes increased verbal defense from baseline during threatening interviews, especially when inconsistencies are openly acknowledged, and among highly self-deceptive participants (Barrett, Williams, & Fong, 2002).

Threat response also emerges in nonverbal behavior. Self-protection influences paralinguistic behavior by increasing response latencies (DePaulo, 1994; Vrij, Edward, & Bull, 2001) and decreasing response length (e.g., DePaulo, 1994), both cues to uneasy, "cautious thinking" (Ekman, Friesen, & O'Sullivan, 2005). Defense also increases nonverbal fake smiling, which is used in defensive communications by liars (Ekman et al., 2005), defensive repressors (Newton, Haviland, & Contrada, 1996), and nondisclosing survivors of sexual abuse (Bonanno et al., 2002). Threat responses are further revealed nonverbally in vocal acoustics, often assessed with fundamental frequency (F_o), or pitch. Interestingly, threat responses are variously reported as increased vocal F_o (e.g., Fairbanks, 1940) or frequent F_o changes (Vrij, 1995), or as showing individual differences, including decreased F_o among some participants (Hecker, Stevens, von Bismarck, & Williams, 1968; Utsuki & Exline, 1991). The variability of vocal F_o under threat is best explained by Scherer's (1986) vocal affect model, which postulates that affect-related vocal changes depend on two factors: the time course of affect-relevant events and perceptions of coping potential. According to Scherer, a series of appraisals is performed as events unfold over time, and initial appraisals influence vocal acoustics differently from later stage appraisals. When events that last longer than several minutes are perceived as controllable, individuals mobilize to act, and therefore vocal F_o increases. In contrast, when events that continue several minutes or longer are uncontrollable or threatening, individuals display "lax voice," reflected in unchanged or decreased F_o. Hence, for events that continue beyond 5 min, threat responses cause lower or unchanged F_o.

Interestingly, Scherer's (1986) vocal prediction parallels the CV prediction in the biopsychosocial model (for review, see Blascovich & Tomaka, 1996), and although both view cognition as central to threat response, the two have not been examined together. The inclusion of vocal acoustic and CV measures in the current study provides the unique opportunity to examine the relation between the two responses. The biopsychosocial model maintains that cognitive appraisals of challenge versus threat cause distinguishable patterns of physiological arousal that are best differentiated by myocardial and vascular responses. Challenge appraisals cause benign arousal that functionally represents energy mobilization; it is characterized by increased cardiac reactivity (measured by cardiac output [CO]) and decreased vascular resistance (measured by total peripheral resistance [TPR]). In contrast, threat appraisals cause malignant arousal, associated with negative affective intensity and characterized by stable or moderately increased CO and stable or increased TPR. Hence, the biopsychosocial model views threat perceptions as critical in malignant CV arousal (Blascovich & Tomaka, 1996) whereas Scherer views threat perceptions as critical for "lax voice" acoustics.

In summary, past research indicates that threat causes multifaceted effects across diverse response systems. Moreover, threat responses can be reliably assessed with objective behavioral, acoustic, and CV measures. The primary purpose of the study was to examine the relation of motivation, threat response, and performance; the inclusion of rich objective measures also allowed us to examine the relation between the Blascovich and Tomaka (1996) and Scherer (1986) models.

The Current Study

We examined threat-related responding during a structured stressful interview with moderately high social threat (Barrett et al., 2002) as a function of manipulated autonomous and controlled motivation. The interview includes neutral baseline questions as a comparison to threatening questions. After the interview, participants gave speeches, a challenging performance task that requires attention and poise. Participants were physiologically monitored, providing CV arousal measures, and videotaped, allowing coding of behavioral measures from interviews and speeches. Measures expected to relate to threat were included as covariates to test precisely the effect of motivation on threat response; covariates included dispositional autonomous and controlled motivations, biased responding, and interview cognitive appraisals. The design allowed us to examine the effect of primed motivation on threat response across many objective measures, and the relation of threat response to performance.

We hypothesized that, first, relative to primed controlled motivation, primed autonomous motivation would cause a higher threshold for threat, as evidenced by less pronounced interview threat response. Measures reflecting interview threat response included high verbal defense, long response latency, short response length, increased fake smiling, less increased vocal F_o, less increased CO, and more increased TPR. Second, we hypothesized that relative to controlled motivation, autonomous motivation would improve speech performance. Finally, we expected that interview threat responses would mediate the effect of primed motivation on speech performance, such that the better speech performance among autonomously primed participants would be due at least in part to a lower threat response.

Method

Participants

Seventy-seven undergraduates (47 women, 30 men) participated for a course requirement. Eighty-four percent were first-year students (age, $M = 18.6$, $SD = .93$).

Materials

General Causality Orientation Scale (GCOS; Deci & Ryan, 1985a). GCOS subscales measure individual differences in autonomous and controlled motivation orientations; the impersonal subscale was excluded. Autonomy involves choicefulness and endorsement of behavior whereas control involves external and internal pressure. We used the 34-item version (Ryan, 1989). Subscales were unrelated, $r = .06$; men were higher on control, $r = .30$, $p < .01$, a difference noted before (Deci & Ryan, 1985b). Subscales show good past internal (αs = .75 to .90) and test–retest reliability (*r*s = .75 to .85; Deci & Ryan, 1985b); current αs were .88 (autonomy) and .70 (control).

Balanced Inventory of Desirable Responding (BIDR; Paulhus, 2002). The 20-item (1 = *not at all,* 7 = *very true*) Self-Deceptive Denial subscale was covaried; it measures defensiveness associated with moralistic denial of unsavory traits (Paulhus & John, 1999; $M = 5.27$, $SD = 2.43$, range = 1-11, $\alpha = .76$).

Motivation manipulation. We combined two supraliminal, unattended tasks previously used to induce goals and motives, namely, sentence scramble priming (Bargh, Chen, & Burrows, 1996) and motivation-relevant instructions (e.g., Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004), without theoretical interest in their relative contributions. Two 30-item versions (15 targets, 15 fillers) primed autonomous and controlled motivations (see Hodgins, Brown, & Carver, 2007). Participants construct four-word sentences; examples include "I usually have choice" (autonomous) and "We must do this" (controlled). Manipulation checks are not included because effects depend on participant unawareness of priming (Bargh et al.,1996); in follow-up probing, no participant identified the theme.

Written instructions were similar to those previously used to create autonomous and controlled contexts. Controlled instructions intentionally introduced pressure (Ryan, 1982) with "the measure correlates with verbal intelligence" and "most college students should be able to complete it."

In contrast, autonomous instructions emphasized interest without pressure with "many people find the task enjoyable and interesting" and "we need to obtain norms."

Defensive Verbal Behavior Assessment, Version 3.0 (DVBA; Barrett et al., 2002). DVBA detects self-protective speech in nonclinical samples. A structured interview includes 15 threatening questions about value-laden experiences conflicting with self-concept (e.g., "Describe a time when you've felt less attractive than a friend") and 10 neutral questions (e.g., "How are you enjoying Skidmore so far?"). In validation studies, neutral questions were rated on 5-point scales as less likely to make others uncomfortable ($M = 2.11$) than threatening questions ($M = 3.60$; Barrett, Cleveland, Conner, & Williams, 2000). Responses are coded for two dimensions (awareness level/degree of distortion) into four categories: 0 = *no defense* (high/none), 1 = *mild defense* (moderate/low), 2 = *moderate defense* (low/moderate), or 3 = *high defense* (none/high). Codes are summed separately for neutral (DVBA-N) and threatening (DVBA-T) questions. In the past, DVBA-T related to self-deception and denial of threat in conscious appraisals (Barrett et al., 2002, Study 1), suggesting that DVBA assesses verbal defense. Additionally, scores were higher among high self-deceivers and in confrontational interviews (Barrett et al., 2002, Study 2).

We used Barrett et al.'s (2000) questions in a slightly different order (6 neutral, 15 threatening, 4 neutral) and included 1-min breaks to assess physiology without bodily movement (see Figure 2). Three women experimenters trained extensively in nonconfrontational techniques and neutral queries (e.g., "Can you tell me more about that?") ran 14 practice pilot participants. Two coders, unaware of condition, trained with manual examples and pilot data. DVBA scores in past use were: DVBA-N, $M = .36$, $SD = .28$, range = 0-1.30, and DVBA-T, $M = .76$, $SD = .32$, range = .19-1.71 (Barrett et al., 2002, Study 2); in current use, scores were DVBA-N, $M = .24$, $SD = .23$, range = 0-1.10, and DVBA-T, $M = .73$, $SD = .46$, range = 0-2.07. Interrater reliability (intraclass r) was $M = .84$ in Barrett et al. (2002; range not reported) and $M = .93$, range = .71-1.0 in the current study. Thus, our coding appears consistent with the original procedure.

Cognitive appraisals. Participants appraised the upcoming interview on 7-point scales: "How threatening do you expect the interview to be?" (primary) and "How able are you to cope with the interview?" (secondary). Appraisal ratios were calculated, with higher numbers indicating greater threat than coping (Tomaka, Blascovich, Kelsey, & Leitten, 1993).

Physiological measures. Student Lab software and MP-30 hardware from Biopac Systems, Inc., Goleta, CA, USA, recorded and digitized cardiac and hemodynamic signals to assess CO and TPR, which most reliably distinguish challenge and threat (Blascovich, Mendes, Hunter, Lickel, & Kowai-Bell, 2001). Cardiac performance was measured noninvasively with ECG spot electrodes on the shoulder and torso. A Biopac Model SS31L transducer assessed basal

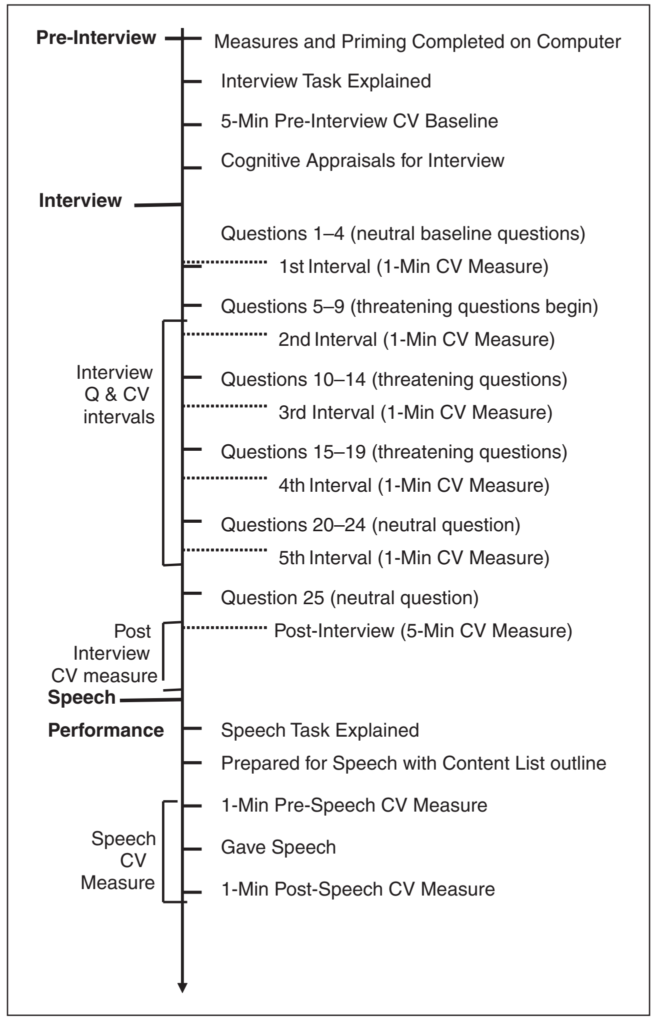

Figure 2. Diagram of task order and cardiovascular (CV) period measures

transthoracic impedance (Z_O), time-varying thoracic impedance (ΔZ), and the first derivative of basal impedance with respect to time (dZ/dt) with four 25-cm Ag-AgCl strip electrodes placed at the neck base and low back. A NIBP100A noninvasive cuff collected continuous blood pressure (BP). Heart rate (HR), mean arterial pressure (MAP), and stroke volume (SV) were quantified to calculate CO and TPR.

HR, SV, and MAP data plots were inspected for artifacts and outliers more than 2 *SD* from the mean. On this basis, 3 participants were eliminated, and others were dropped for specific measures (i.e., 4 for HR, 4 for SV, 6 for MAP). Additionally, approximately 1% of outlier values were replaced by extrapolating from adjacent values. CO was calculated as HR × SV; TPR in resistance units (Sherwood et al. 1990) was calculated as (MAP/CO) × 80. Mean values were computed for each preinterview baseline minute, 1-min interview period, postinterview baseline, and pre- and postspeech task periods.

MANCOVA showed no effect of prime on preinterview baselines, all Fs < 1, allowing calculation of CO and TPR reactivity difference scores. Llabre, Spitzer, Saab, Ironson, and Schneiderman (1991) compared the use of difference and residualized change scores to assess CV reactivity in two samples; they concluded that the measures are equally reliable, but difference scores are conceptually simpler, independent of sample characteristics, and suitable for absolute level comparisons. Thus, following typical practice (e.g., Tomaka et al., 1993), CO and TPR scores were calculated for three task periods (interview, postinterview, speech) by subtracting the preinterview baseline from mean task period measures. The first preinterview baseline minute was omitted because of frequent measurement error; the first interview CV measure was omitted because it occurred before threatening questions began.

Speech. Participants gave speeches to persuade a hypothetical prospective student to attend Skidmore College. They received a list of dimensions to consider (academic challenge, available majors, college/class size, location, social life), had unlimited time to plan speeches, had an opportunity to ask questions, and were videotaped speaking.

Procedure

Participants were randomly assigned to primed motivation and were run individually in a study described as a one-on-one interview. They signed a consent form and completed computer-based GCOS, BIDR, and priming measures, leaving experimenters unaware of condition. Participants donned loose t-shirts and received electrodes, allowing 13 min for adhesion. The BP cuff was placed on the nondominant wrist, supported at heart level; preinterview baselines were collected; and participants completed cognitive appraisals. One-minute CV measures were collected every four or five questions during the videotaped interview (see Figure 2), and a 5-min postinterview measure was taken. The speech was explained, participants were prepared, and 1-min pre- and postspeech CV measures were taken. Participants were debriefed and received contact information for the first author, Institutional Review Board chair, and counseling center.

Extraction of Interview Threat Measures

Paralinguistic cues. To assess response latency, we timed from the end of experimenters' questions until participants' first vocalization ($M = 3.69$, $SD = 1.98$, range = .39-46.28). Response length was measured as the number of words ($M = 40.4$, $SD = 19.6$, range = 1.0-392.0).

Smiles. Smiles can be reliably coded as real or fake with the Facial Affective Coding System (FACS; Ekman, Friesen, & Hager, 2002), which assesses visible facial action with 44 action units (AUs), that is, anatomically separate units of muscle activity. Relevant for smiling are AU12, the "lip corner puller" or zygomatic major; AU6, the "cheek raiser" or Duchenne's marker, that is, outer part of the orbicularis oculi without lateralis; and AU7, the "lid tightener" or outer orbicularis oculi without medialis. Fake smiles lack AU6 and AU7, and sometimes include other AUs (Newton et al., 1996). We categorized smiles as real if AU12 was present, symmetrical, and at least .66 s long; AU6 or AU7 was present; and no AU related to fear, disgust, contempt, sadness, or anger was present (Ekman et al., 2005; Ruch, 2005). Validation studies show that cerebral activity reflecting enjoyment occurs in real but not fake smiles (Ekman, Davidson, & Friesen, 1990), and that compared to fake smiles, real smiles contain more smoothness of action markers and less variability in overall duration, onset, and apex duration (Frank, Ekman, & Friesen, 2005).

Two undergraduates, trained with FACS examples and pilot data, viewed videos in slow motion, identified smiles by the presence of AU12, and coded independently. Mean agreement was .90 (range = .50-1.00). We calculated smiles per minute to control for response length by dividing number of smiles by response length, obtained from audiotapes edited to remove experimenter speech. Edited response lengths ranged from .55 to 134.31 s ($M = 17.20$ s, $SD = 7.12$). Smile rates were: real, $M = 1.58$, $SD = 1.27$, range = 0-6.42; fake, $M = 3.73$, $SD = 2.43$, range = .54-10.96; total, $M = 5.31$, $SD = 3.24$, range = .81-16.05.

Vocal fundamental frequency (F_o). Interview audios were digitized with Sound Studio for Macintosh (Freeverse.com, Brooklyn, NY, USA) and edited to remove all sound except participant voice (e.g., room noise, sneezes, coughs, experimenter voice). Mean acoustic F_o was extracted for each response with Amadeus Software (HairerSoft.com, Kenilworth, UK). When signal quality was unclear, the portion yielding a clear F_o reading was used. Mean extracted F_o response length was 14.88 s ($SD = 6.16$, range = .15-131.82). One man's F_o ranged from 75.4 to 184.4 Hz ($Mdn = 75.8$), which falls below typical values (women: 122-619 Hz, men: 79-619 Hz; Shute & Wheldall, 1999). However, his voice was just very low, so his data were included. F_o ranges were: women: 133.95 to 301.28 Hz ($M = 194.88$, $SD = 14.24$); men: 75.43 to 214.81 Hz ($M = 119.25$, $SD = 8.71$).

Speech Coding

Speech structure and content. Successful speeches include clear structure and many arguments. Two undergraduates independently coded speeches for *structure*, defined as presence of clear opening, summary, and ending statements, and *content*, defined as inclusion of the five planning dimensions. Interrater reliabilities were $r_i = .94$ (structure) and .92 (content). Numbers of dimensions were: structure, $M = 2.05$, $SD = 1.01$, range = 0-3, and content, $M = 3.81$, $SD = 1.17$, range = 0-5.

Inappropriate behavior. Although participants asked questions earlier, some nonetheless interrupted their own speeches with questions, reflecting poor planning or lack of poise. In this persuasive speech context, laughter was nervous and

Table 1. Partial Correlations of Interview Measures

	1	2	3	4	5	6	7	8	9	10
1. DVBA-N										
2. DVBA-T	.63***									
3. Latency-N	.10	.03								
4. Latency-T	.09	.11	.65***							
5. Length-N	.11	.12	–.31*	–.27*						
6. Length-T	.11	.04	–.31*	–.28*	.92***					
7. Real smile	.11	.13	–.01	.01	.07	.05				
8. Fake smile	.41**	.41**	.17	.25†	.03	–.13	.12			
9. F_o change	–.09	–.12	.15	.02	–.12	–.09	.00	–.07		
10. CO	–.12	.14	–.24†	–.11	.20	.14	.03	.00	–.17	
11. TPR	.26†	–.10	.19	–.08	–.05	.01	.07	–.03	.24†	–.68***

DVBA = Defensive Verbal Behavior Assessment; N = neutral question; T = threat question; F_o = change in fundamental frequency calculated by subtracting threatening from neutral question F_o, so that higher scores indicate threat; CO = cardiac output; TPR = total peripheral resistance. CO and TPR are reactivity scores (i.e., change from preinterview baseline).
†$p < .08$. *$p < .05$. **$p < .01$. ***$p < .001$.

inappropriate. We counted questions and laughs; 30% asked questions ($M = .39$, $SD = .70$, range = 0-3) and 59.5% laughed ($M = 1.14$, $SD = 1.30$, range = 0-6).

Speech length. For this brief task, longer speeches reflect greater effort and performance. Length was defined as number of words ($M = 341.5$ words, $SD = 190.7$, range = 16-876) assessed with text analysis software (Pennebaker & Francis, 1996).

Speech performance scores. We calculated speech performance by subtracting z-scored inappropriate behavior from z-scored structure, content, and length ($M = .02$, $SD = 1.08$, range = –3.32-1.79). Hence, higher scores reflect longer, clearly structured speeches, with more content and fewer inappropriate behaviors.

Results

Data Analytic Approach

Perhaps unsurprisingly, given the one-on-one interview, preliminary analyses showed experimenter effects, which were not theoretically interesting but were controlled for by including experimenter as a variable. The design included between-subjects factors of primed motivation (autonomous or controlled), sex, and experimenter. A question type repeated measure (neutral/threatening) assessed threat-related change from neutral to threatening questions for all variables except CV measures, which could not be separated by question. A repeated measure of smile type (real/fake) was included for smile analyses. Dependent variables included DVBA scores, response latency, response length, smile rate, vocal F_o, CO and TPR, and speech performance. Covariates included GCOS autonomy and control, BIDR scores, and cognitive appraisal ratios.[1] Following accepted practice for CV data (e.g., Blascovich et al., 2001), MANOVAs were performed on CO and TPR and checked for overall effects before interpreting individual effects. Effect size estimates were computed as Pearson r (Rosenthal & Rosnow, 1984); rs of .10, .30, and .50 correspond to small, medium, and large effects (Cohen & Cohen, 1983). Threat response variables showed modest correlations in expected directions; fake smiling and response latency were the strongest predictors (see Table 1).

DVBA Verbal Defense

As expected, verbal defense was higher for threat ($M = .77$, $SE = .07$) than neutral ($M = .20$, $SE = .04$) responses, $F(1, 62) = 8.35$, $p < .01$, $r = .34$.[2] Importantly, the increased defense on threat questions was more pronounced among controlled-primed participants, Question × Prime interaction $F(1, 62) = 3.95$, $p < .05$, $r = .24$ (see Table 2). Simple effects tests were not significant, Fs < 1.2; hence, the moderate effect size interaction shows only that the increased verbal defense on threatening questions was relatively larger for controlled-primed participants.

Nonverbal Threat Response

Latency. There was a trend for longer response latencies after threat ($M = 4.86$, $SE = .34$) than neutral ($M = 3.08$, $SE = .27$) questions, $F(1, 60) = 2.49$, $p < .12$, $r = .20$. This tendency to pause after threat was more pronounced among controlled-primed participants, Question × Prime interaction, $F(1, 60) = 4.60$, $p < .04$, $r = .27$ (see Table 2). Simple effects tests were not significant, Fs < 1; hence, it can only be said that the tendency to hesitate after threat was relatively larger among controlled-primed participants.

Length. Participants used fewer words to answer threat ($M = 38.1$, $SE = 2.88$) than neutral ($M = 40.9$, $SE = 3.01$) questions, $F(1, 62) = 4.96$, $p < .03$, $r = .27$, indicating

Table 2. Adjusted Mean Dependent Variables as a Function of Primed Motivation

Outcome variable		Autonomous		Controlled	
DVBA verbal defense	Neutral	0.19	(0.05)	0.21	(0.05)
	Threat	0.76	(0.09)	0.77	(0.10)
Response latency (sec.)	Neutral	2.78	(0.35)	3.29	(0.41)
	Threat	4.51	(0.44)	5.09	(0.51)
Length (*N* words)	Neutral	45.22	(3.82)	37.94	(4.45)
	Threat	43.66	(3.66)	34.39	(4.26)
Vocal F_o (Hz)	Neutral	176.66	(2.38)	154.95	(2.77)
	Threat	180.76	(2.34)	155.58	(2.72)
Speech performance		0.39	(0.21)	–0.35	(0.24)
Threat composite		–0.11	(0.13)	0.17	(0.15)

Standard errors are in parentheses. For threat composite, higher numbers indicate higher threat. DVBA = Defensive Verbal Behavior Assessment; F_o = fundamental frequency.

withdrawal under threat. Additionally, across question type, controlled-primed participants used fewer words ($M = 36.2$, $SE = 4.26$) than autonomously primed participants ($M = 44.4$, $SE = 3.66$), $F(1, 62) = 5.29$, $p < .03$, $r = .28$. The main effects did not interact, $F < 1$; hence, although autonomously primed participants had longer responses overall, they similarly withdraw after threat.

Fake and real smiling. To simplify presentation, we calculated change in smiling rate from neutral to threat questions separately for real and fake smiles. Negative scores indicate decreased smiling from neutral to threatening questions, the pattern expected under threat-related emotion. In contrast, positive scores indicate increased smiling from neutral to threatening questions, a pattern inconsistent with emotion under threat and therefore suggestive of defense. Analysis showed a Smile Type × Prime interaction, $F(1, 62) = 4.35$, $p < .04$, $r = .26$ (see Figure 3). Simple effects showed no effect of prime on real smiles, $F < 1$, but an effect on fake smiling, $F(1, 75) = 4.22$, $p < .04$, $r = .23$. Thus, the increased smiling among controlled-primed participants from neutral to threatening questions, *specifically for fake smiles*, suggests that salient controlled motivation causes less authentic facial displays.

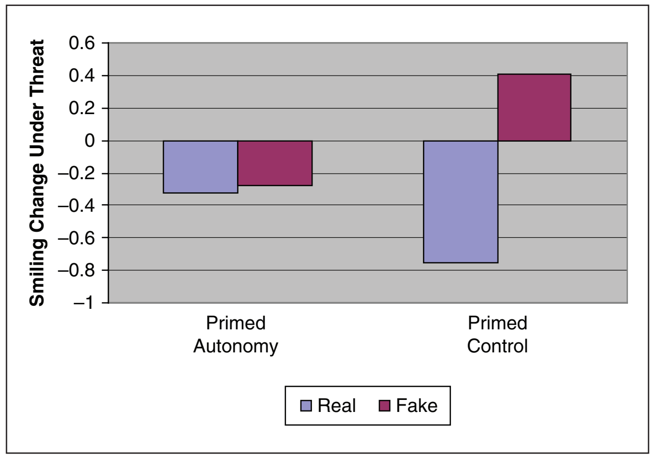

Figure 3. Change in smiles per minute from neutral to threatening questions as a function of primed motivation and smile type

Vocal F_o Threat Response

According to Scherer (1986), perception of controllability cause increased vocal F_o, whereas threat perception leads to smaller increases. As hypothesized, F_o increased more from neutral to threat questions among autonomous ($M = 4.10$) than controlled-primed ($M = 0.62$) participants, indicating lower threat response among autonomously primed, Question × Prime interaction, $F(1, 62) = 5.69$, $p < .02$, $r = .29$ (see Table 2). Simple effects tests showed no effect of prime on neutral questions, $F < 1$, but a significant effect on threat questions, $F(1, 75) = 3.96$, $p < .05$, $r = .22$. Although mean F_o appears higher under autonomy, the effect of prime was not significant, $F(1, 62) = 2.08$, $p < .16$, $r = .18$.

CV Threat Response

According to past findings, CV challenge arousal involves increased CO and decreased TPR, whereas CV threat arousal can involve unchanged or small CO increases and unchanged or increased TPR (see Blascovich & Tomaka, 1996). MANCOVA showed greater threat arousal among controlled than autonomously primed participants during the interview, main effect of prime (Wilks's Lambda = .85), $F(1, 61) = 4.17$, $p < .02$, $r = .25$; univariate analyses for CO, $F(1, 61) = 8.33$, $p < .01$, $r = .35$, and TPR, $F(1, 61) = 4.43$, $p < .04$, $r = .26$ (see Figures 4 and 5). The same pattern emerged in the post-interview period, prime main effect (Wilks's Lambda = .81), $F(1, 59) = 5.51$, $p < .01$, $r = .29$; univariate analyses for CO,

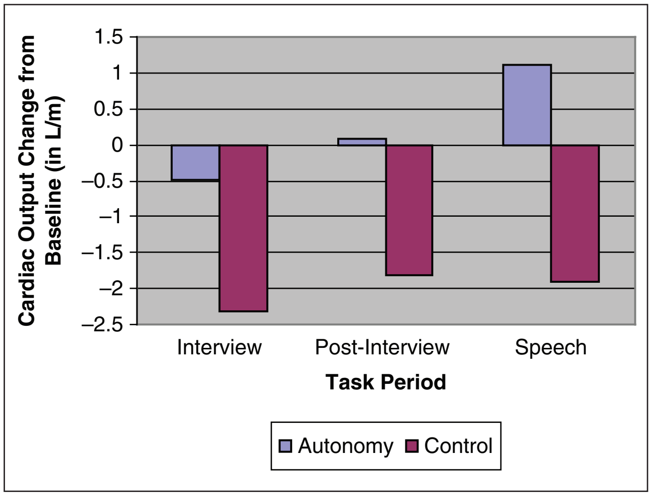

Figure 4. Cardiac output reactivity scores (change from preinterview baseline) as a function of primed motivation and task period

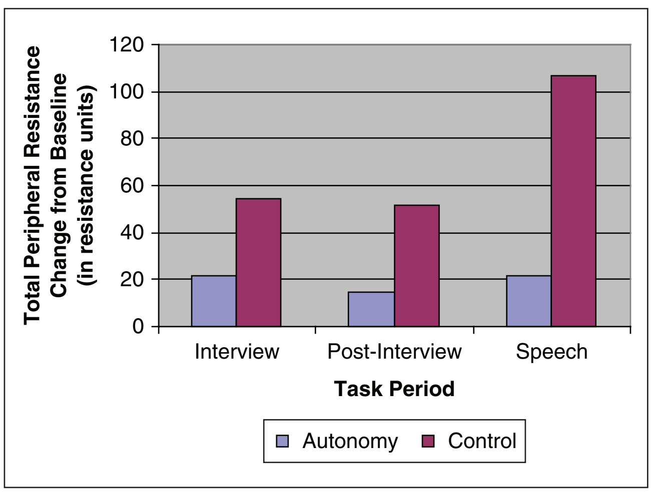

Figure 5. Total peripheral resistance reactivity scores (change from preinterview baseline) as a function of primed motivation and task period

$F(1, 59) = 9.93$, $p < .01$, $r = .38$, and TPR, $F(1, 59) = 5.80$, $p < .02$, $r = .30$. The pattern continued through the speech, prime main effect (Wilks's Lambda = .72) multivariate $F(1, 56) = 8.41$, $p < .001$, $r = .36$; univariate analyses for CO, $F(1, 56) = 8.91$, $p < .005$, $r = .37$, and TPR, $F(1, 56) = 16.76$, $p < .001$, $r = .47$. Hence, consistent with hypotheses, relative to autonomous priming, controlled priming caused more CV threat arousal throughout both the interview and speech tasks, lasting 60-90 min.

Relation of Vocal Acoustic and Physiological Responses

We compared the parallel and previously unexamined predictions made for threat on vocal (Scherer, 1986) and physiological CV responses (Blascovich & Tomaka, 1996). Results reported earlier showed that motivation influenced both vocal and physiological variables as predicted. A test of the relation between the models is their correlations; if both models are correct, vocal and CV interview measures should correlate. Table 1, which reports vocal F_o change and TPR and CO reactivity change scores across the entire interview, showed a marginal relation between TPR and F_o ($p < .08$) and a nonsignificant relation in the predicted direction between CO and F_o. However, a more precise test would be the relation between CV and F_o at specific times; hence, we calculated measures separately for each interview interval with threatening question (i.e., second through fifth intervals; see Figure 2). Specifically, we calculated F_o reactivity by subtracting mean interval F_o from mean neutral question baseline F_o (i.e., first interval). Thus, higher F_o reactivity scores indicate more vocal threat response during that interval. Likewise, CO and TPR reactivity scores were calculated for each interval by subtracting preinterview baselines from 1-min measures. Partial correlations showed associations between early interview CV arousal (second interval) and vocal threat throughout the interview; that is, lower second-interval CO reactivity (indicating threat) predicted marginally higher second-interval vocal threat ($r = –.21$, $p < .07$) and significantly higher third-interval vocal threat ($r = –.23$, $p < .05$). Likewise, higher second-interval TPR reactivity (indicating threat) predicted greater vocal threat in the second and third intervals ($r = .28$, $p < .02$; $r = .30$, $p < .01$, respectively). Thus, CV threat at the moment threatening questions began predicted vocal threat throughout the interview. The pattern provides the first evidence for a relation between vocal and CV threat responses, and it further supports both Scherer (1986) and Blascovich and Tomaka (1996). In addition, the relations provide another validation of the current measures as threat responses.

Speech Performance

Prime influenced performance as predicted, with autonomously primed participants giving better speeches, $F(1, 76) = 11.16$, $p < .001$, $r = .36$ (see Table 2). Although priming occurred at the beginning, it continued through the interview into the later speech.

Mediation

To test whether interview threat response mediated speech performance, we calculated an interview threat composite by combining standardized change scores for interview variables, scored with higher numbers indicating more threat ($M = .01$, $SD = .86$, range = –2.68-2.74). Consistent with earlier results, prime influenced the threat composite, $F(1, 76) = 6.75$, $p < .01$, $r = .29$ (see Table 2).

We used a bootstrap approach and obtained confidence intervals (CIs) to test mediation (Preacher & Hayes, 2004, 2008). Bootstrapping offers a better alternative to normal theory tests, such as Sobel (1982), which require larger samples, impose distributional assumptions, and are conservative (Preacher & Leonardelli, 2008). In contrast, bootstrap emphasizes the size and direction of indirect effects of mediators on outcomes. We utilized Preacher's (2008) SPSS syntax and computed bootstrap analysis with 5,000 samples and 95% CIs. The total effect of prime on performance showed a coefficient of .5588, $t = 2.26$, $p < .03$; the total direct effect showed a coefficient of .4756, $t = 1.90$, $p < .06$, which together show that motivation influenced performance and was reduced when threat was controlled. The difference between the total and direct effects is the total indirect effect of the mediator (interview threat) on the outcome (speech performance), and it is tested for significance. This showed a point estimate of .0832 and a 95% bootstrap CI of 0.0014 to 0.2406, which does not include zero. Hence, the difference between the total and direct effects of priming on performance is significantly different from zero, supporting that threat mediated the effect of motivation on performance.

Discussion

One purpose of the study was to examine the effect of manipulated motivation on multifaceted threat responses under social threat and to test the hypothesis that, relative to controlled motivation, autonomous motivation causes lower threat response. Support is especially compelling because motivation effects were largely consistent across very diverse systems: Relative to controlled-primed participants, autonomously primed participants showed less interview threat response on verbal, paralinguistic, and smiling behaviors, and on vocal and physiological responses. Specifically, autonomously primed participants showed (a) smaller increased verbal defense from neutral to threat questions, (b) smaller increased hesitation from neutral to threat questions, (c) longer interview responses, (d) less increased fake smiling from neutral to threatening questions, (e) less acoustic vocal F_o threat response, and (f) CV patterns of energy mobilization rather than threat arousal during the interview, postinterview, and subsequent speech tasks.

Behavioral change from neutral to threatening questions was a sensitive index of threat responses. The only variable that did not show the predicted Question Type × Prime interaction was response length. Curiously, response length was shown to be a valid threat measure in that, as expected, it decreased under threatening questions; furthermore, controlled-primed participants gave shorter responses compared to autonomously primed participants, giving evidence that primed motivation influenced response length. However, the pattern was inconsistent with other outcomes in that it was not moderated by question type.

An intriguing result is for smiling, a powerful social cue conveying positive emotion, either genuinely or falsely. Although Dickinson (1860/1960, p. 77) observed "Mirth is the mail of anguish," our results suggest that *fake* mirth hides anguish, especially in controlled individuals. In contrast, when responding to threatening questions, autonomously primed participants smiled less and displayed faces consistent with the challenging internal states they likely experienced. The result is the most persuasive behavioral evidence that autonomy promotes attunement to, and authentic expression of, internal states, whereas controlled motivation causes masking and communication discrepant with affect.

The greater threat response of controlled-motivated participants also emerged in automatic vocal acoustics: Relative to autonomously primed participants, controlled participants showed smaller vocal F_o increases from neutral to threatening questions, suggesting a failure to rise to challenge (Scherer, 1986). The same direction occurred in CV responses; controlled-primed participants showed negative emotional CV reactivity whereas autonomously primed participants showed benign CV arousal functionally associated with energy mobilization. Together, vocal and CV response patterns give powerful evidence that very physical threat responses during the interview were greater among controlled participants.

After surviving interviews, participants gave speeches, a challenging task under easier circumstances, requiring attention and poise. The effect of priming continued beyond the interview and into the speech, with autonomously primed participants performing better. Mediation analysis showed that the enhanced speech performance was due in part to autonomous participants' lower interview threat response. Interestingly, the interview and speech were unrelated; thus, experiencing threat "contaminated" functioning in the new context: Motivation changed threat responsiveness, which influenced subsequent unrelated behavior. This domino effect was advantageous for autonomous participants relative to unfortunate, randomly assigned controlled participants. Ironically, their poorer speeches gave them an objective basis for threat.

Interestingly, although both vocal and physiological responses have been linked theoretically to controllability versus threat (Blascovich & Tomaka, 1996; Scherer, 1986), the relation has not been previously examined. The separate effects of motivation on vocal and CV responses supported predictions; moreover, correlations reported above between the two effects give direct evidence of a shared underlying process. The correlations occurred at the critical moment when threatening questions began: As videotaped undergraduates described to a stranger how they had disappointed parents, vocal and CV threat responses corresponded. The result validates the Scherer (1986) and Blascovich and Tomaka (1996) models and provides new evidence for an integrated, broad-based threat response previously undocumented.

Additionally, this is the first evidence that autonomous motivation causes CV energy mobilization. Intriguingly, the pattern mirrors correlational findings between autonomy and the self-reported energy measure of subjective vitality (Reinboth & Duda, 2006; Ryan & Frederick, 1997). Hence, autonomy predicts energy mobilization, as assessed with physiology here and self-report in the past. The pattern lends support to the assertion that choice need not be ego depleting if made through autonomous self-regulation, but instead can be energizing (Moller, Deci, & Ryan, 2006; Ryan & Deci, 2008; cf. Vohs et al., 2008).

A strength of the study is the use of objective measures, free of self-report bias. Moreover, results document threat responses across more systems than previous studies, providing a rich demonstration of multifaceted social threat responses. It is perhaps not surprising that correlations among threat response measures were modest given the wide range of response systems measured (see Table 1). It is noteworthy, though, that priming effects were very similar across measures, supporting their validity.

The effects of the subtle motivation induction were astonishingly long-lasting, across two tasks, throughout 1-1½ hr, which is longer than typically shown (Bargh, 2006). It is possible that stressful contexts, such as this one, are experienced as controlling, which could make motivation cues more powerful. However, it also is possible that contextual cues are generally powerful and lasting, and were detectable with our sensitive measures over time.

CV responding, the only variable measured throughout the experiment, showed consistent priming effects throughout. Given that negative CV reactivity is linked to coronary heart disease (e.g., Hendrix & Hughes, 1997), our results suggest that autonomy support might reduce cardiac risk, an effect mirroring benefits for smoking cessation (Williams et al., 2006) and diabetic care (Williams, Lynch, & Glasgow, 2007). At the least, controlled motivation caused immediate negative CV arousal persisting an hour. We suspect that naturally occurring motivation cues in relationships are more powerful than our subtle manipulation; if so, real-life contexts can substantially influence physiological stress. A simple and effective way to reduce reactivity and improve performance would be increasing autonomy-supportive cues and minimizing controlling cues.

Threat responses were influenced by unknown experimenters' qualities, possibly extroversion, social skill, perspective taking, warmth, or motivation. Although dyadic effects were beyond the study's scope, joint contributions to threat could be investigated in the future. Importantly, controlling for experimenter effects and covariates allowed tests of hypotheses and supported that, relative to controlled motivation, autonomous motivation attenuates threat responses across very diverse responses and improves subsequent performance, and that threat response mediates performance effects.

The study lacks a neutral condition; thus, findings document relative differences and it is unknown whether autonomous mitigates or controlled exacerbates threat response compared to neutral. However, we believe the critical issue really is that threat responses decrease under salient autonomous *relative to* salient controlled motivation. After all, there is no objective "neutral"; neutral condition results are necessarily limited to widely differing operationalizations (e.g., in Levesque & Pelletier, 2003, neutral primes included *numbed, cold,* and *hungry*). The critical implication of the current design is that momentary activation of relatively more autonomous or controlled motivation influences threat susceptibility and task performance.

Threat response is a frequent occurrence that alters experience and functioning for the worse. We have demonstrated that threat response undermined performance, but real-life consequences are likely to be more wide ranging and profound. Our experimenters intentionally behaved neutrally. In naturally occurring situations, individuals do not necessarily attempt neutrality, especially when also experiencing threat. To the extent that both interaction partners are threatened, we expect threat responses would potentiate each other, increasing tension and conflict. According to Chodron (2006), defensiveness escalates aggression in all forms, perpetuating a warlike cycle in our lives and those around us. Autonomous motivation offers some hope that threat responses can be ameliorated and that the warlike cycle is not inevitable.

Acknowledgments

We thank Professor Jill Linz of the Skidmore College Physics Department for her valuable guidance in analyzing vocal acoustics. Thanks also to Kendra Kavanaugh for being an experimenter along with Kristin Weibust and Kathryn Adair, and to the many undergraduate coders, including Katherine Stevens, Hitomi Ikeda, Jennifer French, Chelsea Ring, Elin Ostvik-White, Diane Ventura, Kate Villanova, Anna States, Eleanor Cashmore, and Caroline Chen.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research and/or authorship of this article: National Science Foundation Grant 0338749 to the first author.

Notes

1. Exploratory analyses indicated that General Causality Orientation Scale (GCOS) scores and outcomes correlated modestly, but GCOS did not moderate effects of primed motivation, all Fs < 1.7. There were no main effects of cognitive appraisals on outcomes, but a nonsignificant Prime × Sex interaction emerged, $F < 2.1$. Hence, GCOS and cognitive appraisals were included as covariates as planned.
2. Degrees of freedom vary because of missing data. One participant refused the use of her video, one ended the experiment

before the speech, and one videotape was lost. Physiological measures were missing entirely for one participant, missing partially for others, or were unusable because of measurement artifact.

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