Appl Psychophysiol Biofeedback (2012) 37:109–120
DOI 10.1007/s10484-012-9184-3

Getting Used to Academic Public Speaking: Global Self-Esteem Predicts Habituation in Blood Pressure Response to Repeated Thesis Presentations

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Published online: 6 March 2012

Abstract Global self-esteem was tested to predict quicker cardiovascular adaptation during stressful oral thesis presentation and faster habituation from the first to the second and third thesis presentations. Nineteen graduate students initially rated their global self-esteem and afterwards orally presented their theses proposals in 20-min presentations to their thesis supervisor and peers. A second and third presentation of the revised thesis concepts took place at 4-weeks intervals. Ambulatory blood pressure and heart rate were assessed repeatedly during the presentations. Post-talk self ratings of stressfulness indicated presentations to be a strong public speaking stressor. One hundred and thirty-eight measurements of systolic (SBP), diastolic blood pressure (DBP), and heart rate (HR) showed a significant adaptation (decrease) during presentations. There was an overall mean level decrease from the first to the second, and the second to the third presentations in HR, but not in SBP and DBP. However, habituation in SBP and DBP across three presentations was significantly faster ($p < .05$) in those participants who initially reported higher levels of global self-esteem. Higher global self-esteem did not foster adaptation within the presentations. Self-esteem is discussed as an important individual resource that allows successful coping with recurring evaluative threats.

Keywords Habituation · Self-esteem · Public speaking

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Introduction

Public speaking to an audience of academic scholars and peers is a strong and universal stressor to most individuals (Furmark et al. 1999). Public speaking to academic experts includes ego-involvement, defined as "situations when important ego factors, for example social prestige, self-esteem, fear of academic standing, are closely bound up in the task and where, because of this, performance is of more vital consequence to the subjects" (Klein and Schoenfeld 1941, p. 249). Many standardized laboratory stress tests therefore include anticipation of public speaking and/or actual public speaking (e.g. Boucsein and Wendt-Suhl 1981; Kirschbaum et al. 1993). In academic settings, presentations to audiences are stressful to teachers (Filaire et al. 2011) and students (Gilkinson 1942). Students consistently report high levels of activation (e.g. increased heart rate) and perceived stressfulness before and during an oral presentation in classes and tutorials (e.g. Croft et al. 2004.

Self-Esteem as a Stress Buffer in Public Speaking

Self-esteem was recognized early as an important individual resource to buffer stress reactivity in public speaking (Henderhan and Fotheringham 1962). Subsequent research has shown that a positive sense of self is related to lower reactivity to stressful events (Creswell et al. 2005; Jex and Elaqua 1999; Taylor et al. 2003) and a quicker physiological recovery after public speaking (Elfering and Grebner 2011). Explanations frequently refer to the influence of self-esteem on the appraisal of task demands as less threatening within the transactional model of stress (Lazarus and Folkman 1984). The transactional model postulates that the meaning of a stressor and related

psychophysiological reactions primarily depend on the person's appraisal of the situational characteristics and their perceived own coping skills (Park 1998). Self-esteem is likely to ameliorate both processes involved. With regard to threat evaluation, recent evidence shows psychosocial resources, including self-esteem, to inhibit threat responses during appraisal by stronger activation of the amygdale (Taylor et al. 2008). Lower threat appraisal permits attention to be kept focused on the task characteristics instead of being focused on the self (Jex and Elaqua 1999; Kallus 1992). Therefore, individuals who report high self-esteem tend to engage less in task-irrelevant cognitions (e.g. internal monologues about performing insufficiently) and focus more on task-relevant aspects (e.g. giving an adequate answer to a posed question). Furthermore, individuals high in threat appraisal and low in self-esteem are more easily distracted because they attribute mistakes and errors to themselves rather than to external or transient causes (Brockner 1988). Moreover, individuals with low self-esteem tend to over-generalize such attributions (e.g. Kernis et al. 1989).

With respect to the second important appraisal process within the transactional stress model, that is, perception of one's own coping skills, global self-esteem includes the belief of having competencies to solve problems successfully (Judge et al. 2000). As a result of both appraisal processes, stress reactions to public speaking should be lower in individuals high in self-esteem compared to individuals low in self-esteem.

Cardiovascular Activation During Public Speaking

Public speaking requires intense cognitive action and is, therefore, an active situation according to Obrist (1981). In situations that call for active coping and include evaluation through others, large increases in systolic blood pressure (SBP) can be expected (Obrist 1981). Indeed, during public speaking increases in SBP from baseline values are considerable in most individuals (Gramer 2006).

Blascovich and Tomaka (1996) mark public speaking as a demanding goal-relevant situation and add that, in public speaking, cognitive action can be evaluated by the individual and by others. Thus, following Blascovich and Tomaka (1996), public speaking is a *motivated performance situation*. Individuals are motivated to remain in the situation, to perform well, and to adapt to the situation as well as they can (Blascovich and Tomaka 1996).

Decrease of Blood Pressure During the Talk (Adaptation to Stressor During Public Speech)

The more pronounced is the elevation in SBD and DBP in public speaking, the more beneficial is an early decrease from peak activation. In terms of partial adaptation to public speaking, an adequate response requires not a decrease to baseline levels, but to more moderate levels (Lazarus 1991; McEwen 1998; Southwick et al. 2008). At the beginning of public speaking high activation reflects effort that is spent on self-regulation. This means that, in the beginning, attention is often focused more on the self and less on task regulation. The focus of attention changes after a while, and with increasing feedback from the secondary appraisal that the situation can be coped with successfully, the focus of attention shifts from the self to the task and activation decreases to levels that are suited to successful task regulation (Semmer et al. 2005). Not surprisingly, self-esteem is positively associated with the likelihood of challenge appraisals in general (Blascovich and Tomaka 1996). During public speaking, self-esteem can facilitate the change from initial threat appraisal towards challenge appraisal in the course of iterative reappraisal. The change in appraisal then corresponds to a change in attention focus. Individuals high in self-esteem can focus earlier on the task compared to individuals low in self-esteem who rather focus on the self-regulation of emotions. Lower self-esteem facilitates primary appraisal of social threats and relates to a "prolonged physiological response" during the presentation, that is, a sustained or even increasing activation, especially in DBP.

Self-Esteem as Catalyst of Habituation to Repeated Public Speech

The potential of individuals to habituate to the same repeated stressor reflects an adaptive performance of the organism, protecting it from overshooting physiological stress responses (McEwen 1998). When graduate students present their master's theses proposals, they are expected to have increased blood pressure levels in terms of a response to the public speaking situation. Brockner's plasticity hypothesis assumes that people with low self-esteem are more susceptible to stressors than those with high self-esteem (Brockner 1988). People with low self-esteem are not only likely to react more strongly than people high in self-esteem, they are also less likely to habituate to repeated public speaking. If individuals high in self-esteem cope more actively with public speaking at the first encounter with a stressor and thus cope successfully, they are also more confident about again coping successfully with public speaking (Judge et al. 2000). Individuals high in self-esteem, therefore, should experience successful coping after their first public presentation of their master's thesis concept because they also think less about their own possible shortcomings, flaws and imperfections. We therefore expect higher self-esteem to be associated with faster habituation to public speaking.

So far, empirical evidence on habituation with public speaking merely stems from studies that investigated habituation to repeated exposure of the trier social stress test (TSST) that includes a *speaking task* and mental arithmetic in front of an expert audience (Kirschbaum et al. 1993; Kirschbaum 2010). Consistent evidence shows habituation of the hypothalamic–pituitary–adrenal (HPA) axis activity: ACTH or cortisol responses, decline upon the second exposure to the TSST, i.e. doing the speech and mental arithmetic in front of an expert audience (Kirschbaum et al. 1995). HPA axis habituation can be circumvented by changing the test setting (novel rooms/labs, panel members of the expert audience, and experimenters) for each TSST (Kirschbaum 2010). Kirschbaum et al. (1995) assessed the self-concept of own competence and the cortisol response to a sequence of five TSST on consecutive days. Strong habituation even to the second TSST was observed in thirteen participants, nearly no habituation in seven participants. The Spearman rank correlation between the mean cortisol response and the self-concept of own competence was $-.65$ ($p < .01$). Evidence for habituation to TSST, however, was consistently observed in the HPA system but not in cardiovascular activation (Gerra et al. 2001; Jönsson et al. 2010; von Känel et al. 2006). Schommer et al. (2003) concluded that "habituation to psychosocial stress seems to be specific for a given response system. Although HPA responses quickly habituate, the sympathetic nervous system shows rather uniform activation patterns with repeated exposure to psychosocial challenge". The data basis, however, for this conclusion is small. Previous research has been equivocal as to the impact of the self-esteem status on cardiovascular reactivity to challenge. In addition, little is known about patterns of cardiovascular response, habituation–sensitization to repeated challenge, in participants who differ in global self-esteem.

The Present Study

This study is based on a graduate seminar where students have to repeatedly present their master's theses concepts to an audience of other students and the supervisor. One month after their first presentations students had to present again to demonstrate the progress made. Again, after 4 weeks they had to present for a third and last time to that particular audience. The goals of the seminar were to train oral presentation, to develop good presenting skills, and to develop a sound master's thesis concept. We expect self-esteem to buffer the impact of public speaking (the stressor) on ambulatory blood pressure during speaking (hypothesis 1). Moreover, we expect higher self-esteem to be associated with more decreasing blood pressure after the start of public speaking (hypothesis 2). Third, we expect self-esteem to facilitate habituation, that is, we expect the decrease in activation from the first to the second and third presentations to be more pronounced in individuals reporting higher self-esteem compared to those reporting lower levels of self-esteem (hypothesis 3). Global self-esteem measured before the students start their oral thesis defence should predict *faster habituation to repeated public speaking stressors* (*i.e. habituation*), whereas lower self-esteem should correspond to a *lack of habituation*.

Method

Sample

Nineteen graduate students of a Swiss University volunteered to participate in the study. The students were enrolled in a graduate seminar on research methods in work and organizational psychology. All participants gave their informed consent prior to inclusion in the study (eight female and eleven male psychology majors, mean age = 27.4 years, SD = 4.1 years). The study was performed in accordance with all the ethical requirements defined by the Swiss Society of Psychology.

Design

The field study took place in a graduate teaching seminar for master's students, who were starting their master's theses in work and organizational psychology. The seminar takes place on a periodic basis serving the supervised development of the master's thesis concept. In the seminar, students had to develop their research questions and/or hypotheses and present their master's theses concepts three times to the audience of other master's course participants and their supervising teaching staff. Courses took place on Saturday mornings and afternoons. There were five to eight students participating in each course, and six courses were followed over 2 years.

Procedure

Starting at 9 a.m. on a Saturday participants presented their master's theses concepts by giving a PowerPoint presentation in front of an audience of other participants and two of the department's supervisors (the first and second author). During the presentation, supervisors asked questions, gave feedback and made suggestions for improvement of the thesis concept. Students were also instructed to ask supervisors for advice and were free to take notes during their presentations. Presentations on average took 20 min. The students had no prior experience of presenting their master's theses to an audience of colleagues and

supervisors when the course started, and within the course students did their first, second, and third presentations.

Students were also instructed to ask supervisors for advice with regard to unclear aspects. The focus of the thesis proposal defence was on the study hypotheses and their rationale.

Self-Report Questionnaire Data

Before presenting for the first time, participants completed a short questionnaire asking for their experience in giving presentations, their general level of self-esteem, their self-efficacy before the thesis presentation, neuroticism, and how well they had slept the night before. Because many students worked part-time beside their studies we asked for their employments. The item "Work" asked for the degree of part-time they work (e.g. 40% means 40% of 42 h full time/week = 16.8 h/week). Global self-esteem was assessed with a validated single-item measure (Robins et al. 2001). The item says "I have high self-esteem" with a five-point Likert-scale response format (1 = strongly disagree to 5 = strongly agree).

Experience in giving presentations was assessed by asking "How many times have you presented on your own to a greater audience (more than three persons)?" Participation in group presentations was not counted. Self-efficacy in giving presentations was assessed by asking "How do you manage generally in giving presentations?" The item had a six-point Likert-scale response format ranging from (1) "very poorly" to (6) "very well". Neuroticism was assessed by the use of a validated bipolar single item that includes various adjectives at the poles (Rammstedt et al. 2004) saying "I am balanced" (i.e. calm, relaxed, self-contented, robust) versus "I am emotional" (i.e. nervous, anxious, get upset, tense, sensitive). Response options included seven points with seven indicating full agreement with emotional. Another item addressed sleep during the previous night asking the number of hours of sleep in the night before the presentation "How many hours of sleep did you get last night?"

Self-reported stress during the presentation was assessed directly after the presentation had finished. Post hoc stress assessment asked stress during presentation was very low (1) to very high (6). After having finished their presentation participants also graded their performance using Swiss school grades (1 = poorest grade, 6 = best grade).

Ambulatory Blood Pressure Measurement

Ambulatory blood pressure was automatically recorded throughout the presentation and before (blood pressure monitor Spacelabs© model 90207; readings taken by the Korotkoff method). In ambulatory blood pressure monitoring, the Spacelabs 90207 often is referred to as the "gold standard" (e.g. Magometschnigg et al. 2001). All participants got used to ambulatory blood pressure measurement 1 h before their presentations started. The blood pressure cuff was installed at the beginning of the session at 9 a.m. Presentations by students wearing the blood pressure device started after 1 h. The blood pressure device was programmed to measure every 6 min. To assess baseline estimates in blood pressure and heart rate we averaged three repeated measures that were assessed 30–10 min before the presentation started. The baseline measures however cannot be interpreted as resting values because of the anticipation of the presentation.

Thus, within the first 20 min of the talk three blood pressure measurements at 6 min intervals were collected. Baseline measurements were taken in sitting position; blood pressure levels measured during the presentations are based on data recorded in standing position.

Statistical Analyses

Data contain information at the individual level and at the situation level of the presentations, with presentations nested within individuals. To deal with this data structure, a multilevel linear growth model approach was employed (Hox 2002) that allows for the testing of the influence of situation-related variables and person-related measures, as well as the cross-level interactions of the situation and person-related variables; for example, the different impacts of global self-esteem on habituation. The dependent variables in the multilevel regression analysis were systolic and diastolic blood pressure and heart rate. The baseline values of the dependent variables entered the model as predictors together with other predictor variables. This way of analysing longitudinal data means predicting changes net of baseline association of predictor variables and outcome (Kasl and Jones 2003).

Each of the nineteen study participants presented three times, giving a maximum of 57 presentation results. With three measures of blood pressure and heart rate each, the achievable sample size in multilevel regression analysis was 171. There was, however, a loss of 5 presentations as the students missed the sessions and could not present because of illness. From the remaining 52 presentations, a further eighteen blood pressures and heart rate measurements had to be excluded from the analysis, because they were outside the time window of the presentation, that is, they were recorded before the presentation started or after the presentation had finished. Thus, the final sample size was 138 measurements from 52 presentations of nineteen participants. Multilevel regression analyses were conducted with MLwiN software version 2.20 (Rasbash et al. 2000). Alpha was set to .05 and one-tailed in test of

self-esteem to negatively associated with cardiovascular activation and stressfulness during oral presentation (hypothesis 1) and alpha was two-tailed in tests of hypothesis 2 and hypothesis 3 that include test of interaction effects.

Results

The mean levels of SBP (140.2 mmHg), DBP (90.1 mmHg) and HR (85 beats/min) during the presentations indicate a state of increased cardiovascular activation when compared to baseline values (SBP: 126.3, DBP 77.7, HR: 76.1, Table 1). All correlations between indicators of cardiovascular activation at baseline and during presentation were significant (SBP: $r = .63$, DBP: $r = .33$, HR: $r = .39$, all $p < .001$). Levels of SBP at baseline ($r = .33, p < .001$) and during presentations baseline ($r = .45$, $p < .001$) were positively related to sex, i.e. values were lower in women compared to men. Levels of DBP during presentation were also positively related to sex, i.e. lower in women than in men ($r = .35, p < .001$), but there was no association of sex with DBP at baseline ($r = -.01$, ns). Heart rate during presentations was not related to sex ($r = .14$, ns), but heart rate at baseline was negatively related to sex ($r = -.32, p < .001$), i.e. heart rate at baseline was lower in men compared to women. Neuroticism was positively related to SBP with significant correlations with SBP at baseline ($r = .44$, $p < .001$) and during presentation ($r = .21$, $p < .05$). Neuroticism was also positively related with DBP at baseline ($r = .28$, $p < .001$) but showed no significant association with DBP during presentations ($r = .16$, ns). Neuroticism corresponded with lower HR at baseline ($r = -.25$, $p < .001$ but showed no association with heart rate during presentations ($r = -.15$, ns). BMI was positively related to SBP at baseline ($r = .23$, $p < .05$), to HR at baseline ($r = .22, p < .05$) and to SBP during presentations ($r = .23$, $p < .01$). The number of cups of coffee before the presentation started was significantly related with SBP during presentation ($r = .27$, $p < .01$) and SBP at baseline ($r = .32, p < .001$). Hours of sleep in the night before presentation was positively related to SBP at baseline ($r = .20$, $p < .05$) and DBP at baseline ($r = .27$, $p < .01$). Overall experience in giving presentations was negatively associated with SBP during presentations ($r = -.17, p < .05$) and DBP during presentations ($r = -.21$, $p < .05$). Self-efficacy before the presentation started was positively related with SBP during presentation ($r = .22, p < .05$).

Self-Esteem as a Buffer of Public Speaking Stressor (Hypothesis 1)

Individual responses to the single item "I have high self-esteem" (Robins et al. 2001) were restricted to two out of five response options. Six participants marked Option 3 labelled "moderately agree" and thirteen participants marked Option 4 labelled "fairly agree". Zero-order correlations between global self-esteem and SBP, DBP, and HR at baseline or during presentation were not significant. In multilevel analysis, with control of other significant personal variables including sex, BMI, and degree of employment outside university, higher global self-esteem was significantly negatively related with SBP during presentation ($B = -16.05$, $SE = 7.46$, $p < .05$, Table 2). Table 2 shows that global self-esteem did not predict DBP, HR, and self-reported stress during presentation.

Self-Esteem as a Catalyst of Adaptation During Presentations (Hypothesis 2)

Figure 1 shows the mean levels of SBP, DBP, and HR during presentations at first, second, and third measurement within presentations. During the talk—from first measurement within a presentation to the third measurement—cardiovascular activation rather remained on high levels but also showed a tendency to decrease with time during presentation. The first measurement of cardiovascular activation in the first 6 min of the talk showed higher levels than the second and third measurements that capture the intervals between minutes 7–12, and minutes 13–18 of the presentation (Fig. 1). Zero-order correlations between the times within the presentations (adaptation: 1st, 2nd or 3rd measurement within the presentation) for SBP, DBP, and HR were all significantly negative (Table 1), showing decreasing activation during speech. In multilevel regression analyses, adaptation showed unique significant associations with SBP ($B = -5.38$, $SE = 1.05$, $p < .001$), DBP ($B = -2.74$, $SE = 0.92$, $p < .001$) and HR ($B = -3.83$, $SE = 0.96$, $p < .001$).

Hypothesis 2 postulated quicker adaptation in those with higher self-esteem. Thus, hypothesis 2 was tested with introduction of the interaction between self-esteem and adaptation into the multilevel regression model. The interaction between global self-esteem and consecutive blood pressure measures during the presentation (1st, 2nd or 3rd measurements within the presentation) did not reach significance levels in SBP, DBP, or HR.

Self-Esteem as a Catalyst of Habituation to Repeated Presentations (Hypothesis 3)

Habituation to oral presentation stressor included higher mean levels of activation in the first compared to the second and third presentations. Zero-order correlations between the sequence of presentations (1st, 2nd or 3rd theses' presentations) and SBP, DBP, HR during presentation and self-reported levels of stress after the

Table 1 Mean values, standard deviations and correlations between study variables

	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) SBD	140.16	15.43										
(2) DBD	90.85	11.48	.62***									
(3) HR	85.00	13.35	.26**	.27**								
(4) Baseline SBD	126.34	9.68	.63***	.38***	.06							
(5) Baseline DBD	77.68	5.96	.29**	.33***	.09	.61***						
(6) Baseline HR	76.11	7.99	−.01	−.01	.39***	.05	.33***					
(7) Stress during presentation	2.96	0.82	.04	−.10	.02	.17	.10	.11				
(8) Age	27.44	4.12	−.10	−.11	−.13	.01	−.08	.07	.08			
(9) Sex (1 = f, 2 = m)	0.53	0.50	.45***	.35***	−.14	.33***	−.01	−.32***	−.14	−.08		
(10) BMI	21.84	1.65	.21*	.16	.07	.23**	.15	.22*	.09	−.13	.18*	
(11) Work (%)	32.26	17.84	.04	−.04	−.25**	.13	.05	−.02	.08	.16	.15	.40***
(12) Neuroticism	3.01	1.15	.21*	.16	−.15	.44***	.28**	−.25**	.13	−.04	.16	−.09
(13) Global self-esteem	3.72	0.45	−.16	−.09	.08	−.09	−.07	.14	−.07	.08	−.04	.30***
(14) Smoking (# cigarettes before presentation)	0.69	1.43	.13	.10	.06	−.18*	−.13	−.09	−.07	−.06	.39***	.01
(15) Coffee (# cups before presentation)	1.35	1.27	.27**	.04	−.02	.32***	.08	−.21*	.11	−.13	.23**	.04
(16) Habituation (1st, 2nd, 3rd thesis presentation)	2.02	0.81	−.23**	−.23**	−.30***	−.28**	−.30***	−.11	−.25**	−.03	−.01	.01
(17) Adaptation (1st, 2nd, 3rd measurement during presentation)	1.90	0.80	−.27**	−.21*	−.24*	−.01	−.04	−.04	−.02	.01	−.03	−.05
(18) Hours of sleep in night before presentation	5.52	1.61	−.12	.06	−.16	.20*	.27**	.04	−.06	−.18*	−.09	.13
(19) Self-efficacy before thesis presentation	4.43	1.02	.22*	.13	.19*	.21*	−.04	−.18*	−.03	−.31***	.29**	−.01
(20) Experience in giving presentations	14.07	13.56	−.17*	−.21*	−.02	−.12	−.12	.15	.13	.69***	−.35***	−.04
(21) Subj. performance	4.75	0.39	.11	.01	−.06	.21*	.01	−.18*	−.02	−.07	.09	−.06

	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(12) Neuroticism	−.28**									
(13) Global self-esteem	.02	−.09								
(14) Smoking (# cigarettes before presentation)	.41***	−.39***	−.07							
(15) Coffee (# cups before presentation)	.22**	.39***	−.07	.41***						
(16) Habituation (1st, 2nd, 3rd thesis presentation)	.05	−.02	.02	.01	.05					
(17) Adaptation (1st, 2nd, 3rd measurement during presentation)	−.01	.01	.02	.04	.06	.04				
(18) Hours of sleep in night before presentation	−.24**	.57***	.12	−.55***	.10	.11	−.06			
(19) Self-efficacy before thesis presentation	−.17*	.18*	.34***	.04	.22**	−.13	.01	−.08		
(20) Experience in giving presentations	−.21*	.04	.09	−.37***	−.23**	.06	−.02	.15	−.34***	
(21) Subj. performance	.08	.23**	.30***	−.06	.35***	−.04	.01	.27**	.14	−.06

$N = 138$ measurements of from 19 participants. * <.05, ** <.01, *** <.001, two-tailed

Table 2 Linear multilevel models predicting blood pressure, heart rate, and self-reported stress during thesis presentations

	Systolic BP		Diastolic BP		HR		Self-reported stress[a]	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
Level 2 (individual)								
Age	0.18	0.33	−0.13	0.27	−0.12	0.38	0.03	0.03
Sex (1 = f, 2 = m)	14.10***	3.00	6.19**	2.49	−1.69	3.45	−0.36	0.31
BMI	2.39**	0.92	1.45	0.76	1.69	1.08	0.10	0.10
Work (%)	−0.22*	0.10	−0.07	0.08	−0.35**	0.12	−0.01	0.01
Neuroticism	−2.28	1.72	2.26	1.46	−4.57*	1.90	0.08	0.18
Global self-esteem	−16.05*	7.46	−9.64	6.35	−8.78	7.07	−0.37	0.56
Level 1 (presentation)								
Baseline value in BP or HR	0.25*	0.13	0.64**	0.22	0.28*	0.14	n.a.	n.a.
Smoking (# cigarettes before thesis presentation)	−1.73	1.34	1.77	1.34	0.25	1.45	0.01	0.14
Coffee (# cups before thesis presentation)	4.17**	1.37	−1.93	1.19	1.86	1.41	0.13	0.14
Habituation (1st, 2nd, 3rd thesis presentation)	−1.64	1.33	−1.25	1.13	−3.19**	1.18	0.26*	0.13
Adaptation (1st, 2nd, 3rd Measurement during presentation)	−5.38***	1.05	−2.74**	0.92	−3.83***	0.96	n.a.	n.a.
Hours of sleep in night before thesis presentation	−6.55***	1.71	−0.54	1.46	−2.46	1.52	−0.14	0.16
Overall experience in giving presentations	−0.80*	0.37	−0.20	0.38	0.10	0.34	0.02	0.04
Self-efficacy before thesis presentation	−1.43	2.01	−0.11	1.65	6.50**	1.73	0.08	0.18
Self-rated performance	−1.69	3.98	4.80	3.13	6.58*	3.31	−0.23	0.35
Cross-level interactions								
Self-esteem × habituation	5.52*	2.60	6.25**	2.19	5.05*	2.38	0.10	0.24
Self-esteem × adaptation	−0.53	2.37	−3.03	2.06	0.19	2.16	n.a.	n.a.
Random effects								
Intercept	135.31	6.10	93.10	5.13	111.17	6.63	3.96	0.59
Var level 2	13.44	8.81	8.17	6.03	25.68	12.05	0.16	0.10
Var level 1	95.01	12.30	72.11	9.33	78.52	10.17	0.35	0.09
IGLS	1,033.35		993.31		1,016.56		107.72	

$N = 138$ measurements from 19 participants; [a] Self-reported stress during thesis presentation, reported immediately after end of thesis presentation; n.a. = not applicable. Estimate = fixed unstandardized regression parameter estimate; *SE* standard error; *IGLS* iterative generalized least squares. After the standard errors, the significance level of the Wald test (Estimate/standard error) is indicated: * <.05, ** < .01, *** <.001, two-tailed, in test of self-esteem as a predictor * <.05, ** <.01, *** <.001, one-tailed. Random Effects = variance and covariance estimates of parameters that are allowed to vary on Level 1

presentations are all significantly negative (SBP: $r = -.23$, $p < 01$, DBP: $r = -.30$, $p < .001$, HR: $r = -.28$, $p < .01$, Self reported stressfulness: $r = -.25$, $p < .01$, cf. Table 1). The third hypothesis postulated more rapid habituation to oral presentation in those participants with higher self-esteem.

The test of the interaction between global self-esteem and consecutive presentations (1st, 2nd or 3rd presentation) in multilevel regression revealed significant findings in prediction of SBP (B = 5.52, SE = 2.60, $p < .05$), DBP (B = 6.25, SE = 2.19, $p < .01$), and HR (B = 5.05, SE = 2.38, $p < .05$). There was no such significant interaction effect in prediction of self-reported stressfulness. The graphical illustrations of the interaction effects in Figs. 2, 3, 4, 5 showed in SBP (Fig. 2) and DBP (Fig. 3) the largest differences in activation between high and lower self-esteem groups in the first presentation with the differences becoming smaller in the second presentation, while differences are absent in the third presentation. Thus, the pattern showed individuals who report moderate self-esteem to habituate less quickly than participants reporting higher levels of self-esteem, while the latter showed lower activation even during the first thesis presentation. Although the interaction between self-esteem and habituation was significant, the pattern was partly unexpected: heart rate during first presentation did not differ (Fig. 4). Those who were lower in self-esteem tended to show higher values in second presentation compared to those who reported higher self-esteem. However, at the third presentation they were lower than those with higher self-esteem. Thus with respect to the first and second presentation the results confirmed the hypothesis but at third presentation results failed to confirm. Finally, there were no differences in habituation between higher and lower

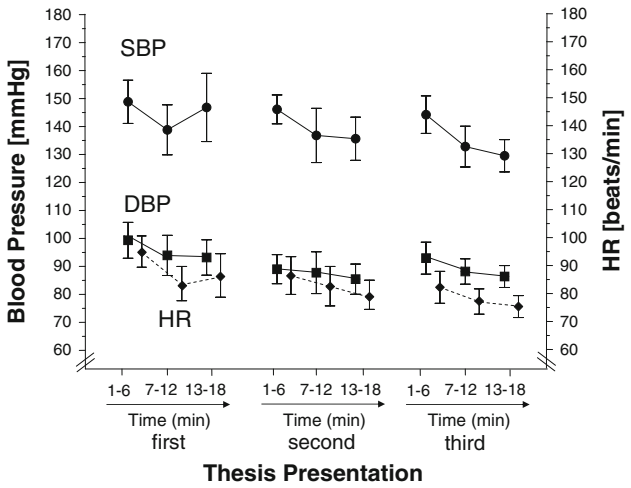

Fig. 1 Course of SBP, DBP, and HR levels form ambulatory consecutive measurements during first, second, and third thesis presentations (mean values and 95% CI)

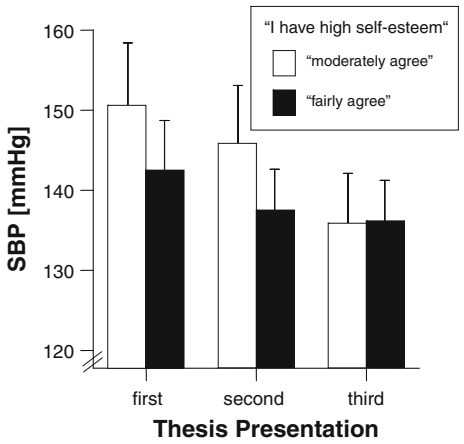

Fig. 2 SBP by global self-esteem (mean values ±2 SEM)

self-esteem groups concerning self-reported stressfulness (Fig. 5).

Discussion

Public speaking is a stressor in many (occupational) settings. Nearly all individuals show enhanced cardiovascular activation in anticipation of and during public speaking. A higher level of activation may allow adequate coping with the demands of public speaking. Thereby, cardiovascular activation should not exceed a level that makes it difficult to meet the demands (over activation). In this field study, the focus is not on mere reactivity to the public speaking stressor in terms of the increase in cardiovascular activity from baseline values (e.g. Gendolla and Richter 2010), nor is it recovery after speaking in terms of return to baseline values (e.g. Waugh et al. 2010). Instead, this study is on

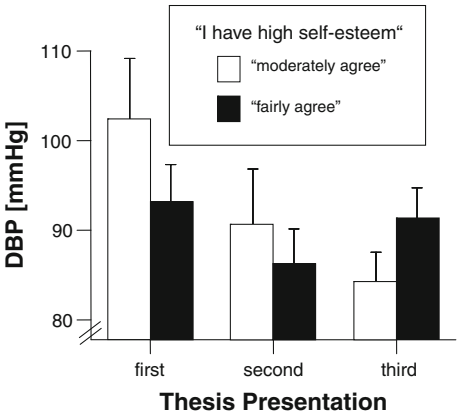

Fig. 3 DBP by global self-esteem (mean values ±2 SEM)

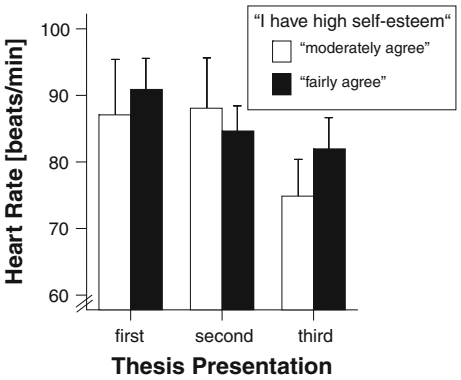

Fig. 4 HR by global self-esteem (mean values ±2 SEM)

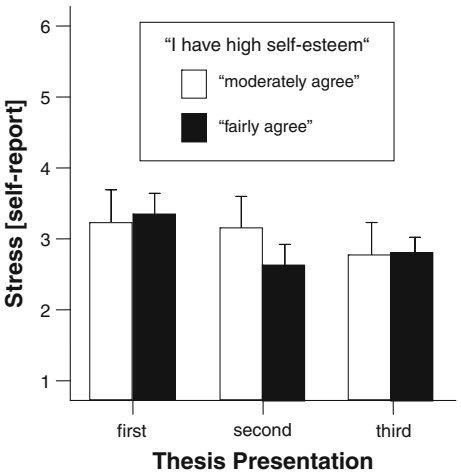

Fig. 5 Self-reported stressfulness during presentation by global self-esteem (mean values ±2 SEM)

adaptation during an academic presentation and habituation to repeated presentations. Baseline values were controlled in analyses to assure cardiovascular activation during presentations did not represent variation on different days of measurement. After the beginning of the presentation, initial very high levels of activation should decrease to

more moderate levels, and repeated presentations to a known audience should result in lower activation during the presentation. Thus, adaptation and habituation indicate progress in task regulation in this motivated performance situation, where behaviour is goal-directed, cognitive action is demanding and evaluation by the self and others important and inherent (Blascovich and Tomaka 1996). For the first time, global self-esteem was shown as a potential catalyst of habituation to the repeated exposure to the public speaking stressor in an evaluative academic setting. Unlike Schommer et al. (2003) suggested from repeated tests in their TSST, cardiovascular habituation to public speaking occurred in many individuals when tested in real life. The data basis, however, for this conclusion is small. Habituation was slower in individuals who reported moderate self-esteem compared to those who are fairly high in self-esteem. Individuals with lower levels of global self-esteem showed higher blood pressure levels to the first public speaking stressor, and they also did in their second presentations but they also successfully habituated to public speaking in their third presentations. In heart rate, habituation was found but no association with self-esteem. The expected pattern of moderated habituation was not found (Fig. 4). Unlike blood pressure heart rate was positively related to self-efficacy, experience in doing presentations, and self-reported performance. Thus, these associations in heart rate seem to reflect the challenging aspects of oral presentation (Blascovich and Tomaka 1996). Self-reports of stressfulness assessed after the end of the presentations also became smaller from first to third presentation (habituation), but were not related with self-esteem and no moderated habituation emerged (Fig. 5). Blood pressure, heart rate, and the subjective experience of stressfulness were not closely coupled in that motivated performance situation. One may expect that the subjective performance with the given talk may well vary with the expectation of the presenter about his level of achievement, and that may interact with self-esteem. Meanwhile, a post hoc analysis of the interaction between self-esteem and subjective performance showed no significant results.

While the main effect of adaptation was always significant, however, the interaction between the time since the start of the presentation and self-esteem failed to reach significance levels. The pattern of differences, however, was similar to habituation: After the presentation started individuals with moderate levels of global self-esteem needed more time to reach moderate levels of cardiovascular activation compared to individuals with fairly high self-esteem. Additional tests for higher-order interaction between adaptation, habituation, and self-esteem yielded no further significant moderation.

In sum, the results support the view that self-esteem corresponds to goal-oriented task regulation in repeated public speaking to the same audience (Frese and Zapf 1994). Noteworthy results emerged when important third variables were controlled in regression analyses. Self-esteem showed the potential catalytic effect on habituation when self-efficacy in giving the presentation, experience in giving presentations and neuroticism was controlled. All three control variables showed significant zero-order correlations with SBP. Control of task-specific self-efficacy and prior experience in the task helped to interpret the potential benefit of self-esteem, not in comparably more positive appraisals of own skills and coping resources but in the esteem-related experience of a "sense of security" in a highly evaluative social situation (Martens et al. 2010). Indeed, it seems to be especially social evaluation, including the real presence of others during the speech that elicits high cardiovascular responses to the public speaking stressor (Christian and Stoney 2006). Martens et al. (2010) reported four studies that examined the relationship between self-esteem that should provide a *sense of security* that facilitates the level of influence of the parasympathetic nervous system on the heart in daily life and in the face of social stressors. In two field studies, higher self-esteem measured daily over the course of 2 weeks also predicted higher resting cardiac vagal tone. Furthermore, two experiments showed that positive self-esteem relevant feedback increased cardiac vagal tone relative to negative feedback. O'Donnell et al. (2008) showed global self-esteem to specifically buffer cardiovascular and inflammatory responses to a speech task. Multiple linear regressions revealed that greater self-esteem was associated with a smaller reduction in heart rate variability during a speech task, but not during a colour-word task. The authors conclude that the pattern of responses could reflect processes through which self-esteem protects against the development of disease.

Self-esteem as a buffer in HPA activation during a driving simulation task was demonstrated by Seeman et al. (1995) in 70-years-olds and discussed as an important resource in successful aging. On the other hand, prolonged or chronic experiences of social self threat could have damaging mental and physical health consequences and lack of self-esteem may render some more vulnerable to these negative effects (Dickerson et al. 2009).

The view on adaptation and habituation response patterns as proposed, for instance, in the allostasis model (McEwen 1998) is rare. While there is some research on individual characteristics that moderate the prolonged response pattern, there is less research on the moderation of (the lack of) the adaptation and habituation allostasis patterns. Moreover, so far there is no research on the moderation of such allostasis patterns including real-life stressors (Pattyn et al. 2010).

Appraisal processes that depend on global self-esteem as a catalyst of habituation fit to the important role of the

central nervous system in the allostatic load model are consistent with a cognitive appraisal mechanism and naturally highlight its applicability to the understanding of psychosocial stressors (Ganster 2008, p. 267).

Limitations

There is need for replication of this study not only for the small sample size but for the small variation in global self-esteem. The restricted range in variation may have rendered some results spurious. On the other hand restricted variation often contributes to underestimation of associations and—from this view—increases likelihood to replicate the results in a larger sample.

The natural setting of the study accounts for the small sample size. On the other hand, the natural setting of the study is also an advantage. Blascovich and Tomaka (1996) make a claim against naïve measurement of arousal in arbitrary situations. Physiological assessment of arousal must be specified within an appropriate external (i.e. environmental) and internal (i.e. biological) context. Moreover, physiological responses must be studied over time (Blascovich and Tomaka 1996, p. 8).

Future field studies of cardiovascular adaptation and habituation in real-life motivated performance situations should differentiate between stable and unstable high self-esteem (Seery et al. 2004).

Outlook

Emotional tension can be adaptive or maladaptive in both nature and outcome (Rotenberg and Boucsein 1993). On the one hand, emotional tension serves to allocate resources to a complex task. On the other hand, it should not prevent the individual from continuing with his/her goal-directed behaviour by distracting attention and resources from the task to the self (Semmer et al. 2007). More occupational field research on individual and work-related resources that moderate time-bound cardiovascular stress response patterns seems promising in understanding the physiological cost of work and long-term decreased body resistance (Semmer et al. 2010). Recent findings emphasize the important involvement of brain function in the development of early hypertension (Gianaros and Sheu 2009; Jennings and Zanstra 2009). This study fills a gap in research on individual factors that predict resilience to cardiovascular disease (CVD). This view is shared by Gallo et al. (2004) who stated in their review that in contrast to research on risk factors on CVD, "research focused on the potential resilient contribution of positive emotions and cognitions has been notably absent from the literature" (p. 669). Further studies should include experience of subjective success in presentations as a further potential buffer (Grebner et al. 2010).

Continuous recording of physiological data in natural contexts is still a technological challenge. Ambulatory blood pressure measurement in this field study is exemplary for small, unobtrusive and helpful instrumentation that is fast becoming a valid tool in work and organizational psychology (Klumb et al. 2009).

Conclusion

The study shows important insight into self-esteem as an important catalyst of habituation to academic speech, relying on habituation to a strong ego-involvement stressor situation, a physiological process that is a marker in the near-term but is assumed to be indicative of underlying disease processes as well (Ganster 2008). Self-esteem has turned out to be a resource in public speaking among graduate students. Higher education should deliver adequate and, whenever possible, low-ego-threatening feedback, acknowledge good work, give support in difficult situations, teach skills, including presentation skills, assign goals that are challenging but reachable, and help students to organize work efficiently to enhance self-esteem.

A health risk might emerge in situations where public speaking is a common demand while habituation to the stressor is low. Lack of habituation to public speaking—for instance in school teachers—represents an allostatic load that is a risk to health deterioration (McEwen 1998). Early detection of those individuals at risk may reduce CVD in the long-term.

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