Psychological Topics 16 (2007), 2, 311-328

Original Scientific article – UDC 159.942.072

Relations Between Dispositional Expressivity and Physiological Changes During Acute Positive and Negative Affect

Asmir Gračanin, Igor Kardum & Jasna Hudek-Knežević
University of Rijeka, Faculty of Arts and Sciences
Department of Psychology

Abstract

The aim of the present study is to examine the relations between emotional expressivity measured by Berkeley Expressivity Questionnaire and physiological response in situations where positive and negative affects were induced. On 65 participants four physiological parameters, including finger pulse amplitude, heart rate, skin conductance level and amplitude of skin conductance response were measured.

In situations in which negative affect was induced, individuals higher in negative expressivity showed higher skin conductance level, higher amplitude of skin conductance response and higher heart rate compared to individuals low on negative expressivity, whereas finger pulse amplitude did not differ between these two groups. The same results were obtained even when controlling for five factor personality traits and recorded participants' facial expression. In situation where a positive affect was induced, no differences in sympathetic responses between participants high and low in positive expressivity have been found. The results are explained in the context of *Coactivation theory* and possible consequences of the results on health outcomes are discussed.

Keywords: emotional expressivity, physiological changes, affect

Introduction

Existing theories assuming specific relations between expression of emotions and physiological measures indicating emotional (sympathetic) arousal are contradictory in their predictions. Two basic explanations are grounded in

---

✉ Asmir Gračanin, University of Rijeka, Faculty of Philosophy, Department of Psychology, Omladinska 14, 51000 Rijeka, Croatia. E-mail: *asmirg@net.hr*

This paper is a part of research project *Personality traits, emotional and social processes as determinants of health* (009-0092660-2658), supported by Croatian Ministry of Science, Education, and Sport

Emotional discharge theory and *Theory of psychophysiological arousal*, also named *Coactivation theory*. *Emotional discharge theory*, which can be traced to Freud's dynamic theory (e.g., Bonaparte, Freud & Kris, 1954), posits an inverse relationship between the outward expression of emotion and the inward autonomic response. In the context of this theory, emotion is seen as a form of energy which must follow the basic dynamics of energy conservation. Therefore, if a person gets emotionally aroused, this arousal must be discharged either through expression (e.g., facial movements), or through internal pathways (e.g., sympathetic activity) (Notarius, Wemple, Ingraham, Burns & Kollar, 1982).

Gross and his colleagues have designed numerous experiments aimed at investigating the acute effects of emotional suppression on physiological measures (Gross, 1998; Gross & Levenson, 1993, 1997; Richards & Gross, 1999). These studies have shown that suppression of sadness, amusement and disgust leads to greater sympathetic and cardiovascular activation, with the exception of heart rate deceleration, which is, as authors suggest, the consequence of fewer bodily movements when expression is being inhibited. Similar findings for other emotions also exist (e.g. Butler *et al*., 2003; Demaree *et al*., 2006; Harris, 2001; Kunzmann, Kupperbusch & Levenson 2005). The results of these studies can, in the most parsimonious way, be explained by the *Effort model* (Kunzmann, Kupperbusch & Levenson, 2005), which says that work needed for the regulation of emotional behaviour leads to an increase in activation of those physiological measures which are effort sensitive. In other words, effort directed to suppress emotional behaviour should lead to higher sympathetic activity.

On the other hand, *Theory of psychophysiological arousal*, which can be traced back to seminal work of Cannon (1927) and Duffy (1957), is based on the idea that general physiological arousal is observable in internalized responses (e.g., skin conductance) as well as in external responses (e.g., muscle tension and expressivity). Sympathetic activation and expressive tendency are expected to covary closely within individuals because of the common underlying excitatory mechanism, so the theory is also referred to as *Coactivation theory* (Cacioppo *et al*., 1992). Most important in the context of emotion regulation is that inhibitory actions are not thought to modulate the operation of arousal mechanism (Duffy, 1957). This means that attempts to inhibit facial expression are not expected to alter sympathetic activation or subjective emotional experience. Most empirical data supporting this theory are based on intraindividual (within-subjects) differences. Some earlier studies have shown that while waiting for a painful shock, inhibited expressive behaviour leads to lesser reactivity of electrodermal responses (Colby, Lanzetta & Kleck, 1977; Lanzeta, Cartwright-Smith & Kleck, 1976). Other studies have found that voluntary suppression leads to attenuation of general arousal (Zuckerman, Klorman, Larrance & Spiegel, 1981). Obviously, these results are contrary to the studies done by Gross and his colleagues.

Cacioppo *et al*., (1992) have concluded that contemporary empirical data better support *Coactivation theory* regarding intraindividual functioning, while *Emotional discharge theory* better explains interindividual differences.

There are numerous studies supporting *Emotional discharge theory* on the between-subject level, but they have two important caveats. Few earlier studies (Buck, 1977; Buck, Miller & Caul, 1974; Lanzetta & Kleck, 1970; Notarius & Levenson, 1979) supporting *Emotional discharge theory* have shown that the level of expressed emotions correlates negatively with sympathetic arousal. However, these studies did not address an inclination to suppress emotion and, therefore, incongruence between activated emotion and expressive behaviour was not taken into account. In a more recent study, Egloff, Schmukle, Burns and Schwerdtfeger (2006) found that individuals who had spontaneously suppressed their emotional behaviour were also higher in sympathetic activity. As in previously mentioned studies, there is a high possibility that this behaviour was situation specific and did not reflect stable traits. To the best of our knowledge, there are no studies where dispositional suppression measured by a questionnaire has been related to physiological activity in emotional situations.

At interindividual level, positive relations between different components of an emotion can be expected if we consider the possibility that highly emotionally expressive individuals are somehow less able to suppress their emotional reactions because they are more intense from the beginning. Rothbart and Sheese (2007) have recently noticed that the efficiency of controlling one's expression will depend on the strength of the emotional processes against which effort is exerted. A person with a stronger disposition to become emotionally aroused will require greater effort to control it and, keeping all other factors equal (e.g. skill to control one's behaviour), should appear more expressive. Accordingly, individuals who are, for example, high on negative expressivity would show more physiological arousal (sympathetic activation) in negative emotional situations.

Several scales such as Berkeley Expressivity Questionnaire (BEQ; Gross & John, 1997), Emotional Expressivity Scale (EES; Kring, Smith & Neale, 1994), and Emotional inhibition subscale from Emotional Control Questionnaire (ECQ; Roger & Najarian, 1989), have been constructed to measure the level of individual propensity to suppress emotions which are already under way. This means that individuals high on positive or negative expressivity or low on emotional inhibition should, in fact, be more prone to show emotion when they experience it, while individuals low on negative expressivity or high on emotional inhibition should be less prone to show experienced emotion.

The present study directly relates expressivity measured by a questionnaire and physiological responding in emotional situations. The main prediction is that different indexes of sympathetic arousal are positively related to emotional expressivity measured by a questionnaire.

METHOD

Participants

Sixty-five undergraduate students from the University of Rijeka participated in this study (51 women and 14 men, ranging from 18 to 35 years, M = 21.48; SD = 2.99). One participant was excluded from analyses because she closed her eyes during the presentation inducing negative affect. Also, because of lack of data from the analyses of some physiological parameters, a certain number of participants were also excluded. Therefore, the total number of participants in various analyses ranged from 58 (heart rate during the presentation of the clip inducing positive affect) to 64 (skin conductance level during the presentation of the clip inducing negative affect).

Procedure

Each participant was treated individually. As stimulus materials, we used one standardized movie clip intended to induce negative affect and one for positive affect together with one movie clip intended to gather data about behavioural, physiological and emotional indicators during the period without expected emotional reactions. Also, one movie clip for participants' familiarisation with experimental conditions was used. A clip, inducing negative affect, depicts an arm amputation (64 seconds duration) (Ekman, Friesen & O'Sullivan, 1988). Previous research showed this clip as inducing significant changes in behavioural and subjective measures of negative affect (Gross & Levenson, 1993; Kunzmann, Kupperbusch & Levenson, 2005). The clip inducing positive affect (134 seconds duration) was taken from the list of standardized emotional clips (Schaefer, Nils, Sanchez & Philippot, in press), and presents a scene from the movie "Les Visiteurs" (Poire, 1993). In the scene, two warriors from the Middle-Ages who were "transported" to the 20th century are attacking a black postman because they think he is a Saracen. This clip successfully induced a positive affect in previous studies (Schaefer, Nils, Sanchez & Philippot, in press). A neutral clip (30 seconds duration) shows birds on the beach and the clip for familiarising participants to experimental conditions (91 seconds duration) shows coloured vertical lines and various patterns of white lines and dots on a black background. The last two clips were taken from the study by Gross and Levenson (1995). Although the neutral clip was intended to produce a relatively low degree of all emotions, we expected that it would induce or maintain a low to moderate level of positive affect which is in accord with a positive hedonic tone of interest and can be explained in the context of positivity offset (Caccioppo & Berntson, 1999).

After they had completed several inventories, the participants were seated at a 60 cm distance from the 19-inch screen. They were told that several movie clips were to be presented to them and then given an explanation of the purpose of the instruments they were to be connected to. The following instruction was given to the participants: ”The first movie clip is now to be presented to you. Before and after its presentation, the screen will be empty for a couple of minutes. Please, try to relax and clear your thoughts trying not to think about anything but just focusing your attention on the screen. After the end of the presentation, please stay still until you hear the instruction “stop”. Please, do not talk to the experimenter during the presentation and do not move the parts of your body connected to the instruments. It is of the utmost importance that you watch the clip carefully, but if you feel it to be too upsetting, you just say «stop» and the presentation will be discontinued”. Next, the movie clip intended to familiarise the participants to the experimental conditions was presented. After the presentation, the participants again received the above-mentioned instruction adding that: ”Although it is necessary that you follow the instruction and not move the parts of your body that are connected to the instruments, it is of utmost importance that you behave naturally, as you would do in everyday life”.

The additional instructions were repeated before each movie clip until the end of the experiment. Before presenting the movie clip intended to induce negative affect, participants additionally received the following instruction: ”Because of the brevity of this movie clip, it is necessary that you are given additional information, so that you are able to recognize what the clip is about as early as possible. The content of this clip depicts an arm amputation and may or may not be upsetting to the observer. Nevertheless, it is important that you do not move your eyes from the screen. If you can not bear it, close your eyes, but only after you have seen the scene. We ask you not to close your eyes before you have seen the scene because it may not be too stressful for you.”

This instruction was intended to intensify the targeted emotions and simultaneously maintain ethical standards. The participants who closed their eyes during presentation were excluded from all further analyses.

Each participant was first exposed to the neutral clip, then to the clip inducing positive affect, and lastly to the clip inducing negative affect. After the presentation of each movie clip, they were asked to evaluate their emotional states during viewing, and to indicate whether they had ever seen the presented movie clips before.

After the last evaluation of their affect, participants were shown one humorous scene from the movie “There’s something about Mary” (Farrelly & Farrelly, 1998) in order to mitigate possible negative affects of the previous emotional clips. After the end of this part of the procedure, participants completed NEO-PI-R inventory in the other room.

Measures

Subjective emotional experience

In order to test the effects of the movie clips on targeted emotions, participants were requested to indicate the degree of experienced anger, sadness, joy, rage, contentment, despair, pleasure, repulsion, fear, delight, disgust and anxiety on a scale from 1 to 5. The items were chosen on the basis of the participants' subjective emotional experience in the previous studies (e.g. Gross & Levenson, 1993; Kunzmann, Kupperbusch & Levenson, 2005).

Eight out of the 12 items measure negative affect (NA), and four items measure positive affect (PA). Coefficients of internal reliability (Cronbach-alpha) of PA scale for different movie clips range from .92 to .95, and of NA scale from .73 to .83. Correlations between PA and NA for different movie clips were from -.22 to .03.

Emotional expressivity

Emotional expressivity was measured using Berkeley Expressivity Questionnaire – BEQ (Gross & John, 1997). It contains 16 items in the form of short sentences and measures three expressivity factors – positive and negative expressivity and impulse strength. In the present study only the positive and negative expressivity scales were used because for impulse strength we did not have any specific hypotheses. Positive expressivity subscale consists of four items indicating the degree to which a person tends to express positive emotions (e.g. "Whenever I feel positive emotions, people can easily see exactly what I am feeling"). Negative expressivity, measured with six items, refers to the degree to which a person tends to express negative emotions (e.g. "I've learned it is better to suppress my anger than to show it"). Eight-point Likert type scale was used with 1 indicating "it does not apply to me at all" and 7 "it applies to me completely". Coefficients of internal consistency (Cronbach-alpha) for each subscale are .70 on the American sample (Gross & John, 1997), and on the sample of participants of the present study .70 for positive and .66 for negative expressivity. Correlation between these two scales is .54 ($p < .001$).

Dimensions of positive and negative expressivity are related to the broader five-factor personality traits in the present study. Positive expressivity proves to be related most to extraversion (.47; $p < .01$) and openness (.51; $p < .01$), and negative expressivity to extraversion (.28; $p < .05$). Therefore, when testing the effects of positive and negative expressivity on physiological reactions, the dimensions of the five-factor personality model were controlled for.

Five factor personality traits

The Croatian version of NEO-PI-R questionnaire (Costa & McCrae, 2005), measuring five basic personality traits and 30 facets (six facets defining each of the five domains) was used. However, for the purpose of the present study, only scores for the five basic personality traits were used. The questionnaire contains 240 items, with responses given on a 5-point Likert type scale. On American samples, coefficients of internal consistency (Cronbach alpha) ranged from .86 to .91, with an average of .88 (Costa, McCrae & Dye, 1991). Test-retest reliability coefficients over 5 years ranged from .68 to .83, with an average of .85 for neuroticism, extraversion and openness scales, and during three years .63 for agreeableness and .79 for conscientiousness scale (Costa & McCrae, 1988). Internal reliability coefficients (Cronbach-alpha) on the sample of participants of the present study are .79 for extraversion, .72 for agreeableness, .85 for conscientiousness, .84 for neuroticism, and .73 for openness to experience. Correlations between dimensions range from -.36 ($p < .01$) to .43 ($p < .001$).

Expressive behaviour

Facial expressions were recorded by a camera located above the screen on which movie clips were presented. Two trained raters, not informed about the situation of the participants or the purpose of the study, independently analysed behaviour recorded during the selected parts of the movie clips and estimated participants behaviour using the coding system designed for this study.

In comparison with previous studies dealing with the effects of suppression on physiological processes, in which expressive behaviour and data on physiological reactions were collected during the whole duration of the movie clip, in the present study only data from those parts of the movie clips that were saturated with targeted emotional states were analysed, which is a method rarely used (e.g. Davidson, Ekman, Saron, Senulis & Friesen, 1990). Except for economic reasons, gathering data in this way has also an advantage over the previous studies, because expressive behaviour and physiological reactions which are not the result of induced emotional processes are, therefore, not taken into account. Estimated time periods for facial expressions were 25 second for the neutral clip, 67 seconds for the clip intended to induce negative affect and 100 seconds for the clip intended to induce positive affect. The facial expression analysis system used in this study was adapted on the basis of data showing the adequacy of different systems in similar studies (e.g. Gross & Levenson, 1993, Kunzmann, Kupperbusch & Levenson, 2005). The system used in the present study contains 10 categories, four of which refer to primary emotions (fear, sadness, disgust and anger), five categories to specific behaviour related to different primary emotions (smiling, frowning, eyebrows and mouth moving and redirecting gaze from the screen), and one to general distress. Frequency and intensity of each category of expressive emotional behaviour were rated on a scale ranging from 1 to 5. Agreement between the two raters through all the clips was calculated using Pearson correlation coefficient, and for further analyses only estimates of those behaviours for which agreement between raters was over .60 (.70 for smiling, .81 for frowning, .73 for disgust and .63 for distress) were taken into account. Average value across raters as a measure of each behaviour was used.

Physiological activation

Periods during which physiological measures were analysed were exactly the same as the ones used for the facial expression estimates. Data of the resting states before and after each emotional clip were used as baseline measures of physiological parameters. Mean values of each parameter during resting states before and after the movie clip were calculated (50 seconds before and 50 seconds after the clip presentation) (Rottenberg, Ray & Gross, 2007).

Physiological parameters used in this study were selected because they indicate emotional activation (Bradley, 2004; Mendes, Reis, Seery & Blascovich, 2003) and are related to health outcomes (e.g. Gross, 1998). All four parameters were measured using the polygraph system Contact Precision Instruments and analysed by compatible computer system Psylab.

Finger pulse amplitude (PPA)

Finger pulse amplitude was measured by photoplethysmograf. Finger blood volume amplitude, measured in milivolts (mV), was recorded using a photocell PT1 attached to the distal phalanx of the first finger of the nondominant hand. Decreases in finger pulse amplitude are the consequence of vasoconstriction, which reflects an increase in sympathetic activity (Bradley, 2004), although there is some proof that vasoconstriction is connected to aversiveness of situation (Blascovich & Tomaka, 1996).

Heart rate

Heart rate was measured by ECG with disposable EL4 electrodes and EL2 conductors placed in the bipolar configuration on the opposite sides of the participant's chest. Cardiac interbeat interval (IBI) was calculated as the time between successive R waves (in milliseconds). Decreases in IBI (or increases in heart rate) reflect increased sympathetic and decreased parasympathetic activity and thus they are related to increases in metabolic demands (Bradley, 2004).

Skin conductance level and amplitude of skin conductance response

Skin conductance level (SCL) and amplitude of skin conductance response (SCR) were measured by electrodes EL1 – TDE 22, located on the medial phalanx on the second and the third finger of the nondominant hand. A signal was conducted through SC5 - 24 bit digital amplifier of electrical conductance, with a sensitivity of .01 micro-Siemens (μS), and a potential range from 0 to 100 μS. The SCL was calculated as an average value of skin conductance during selected time periods, while SCR was calculated as a composite of all the amplitudes of electrodermal responses during the same time periods. In order to get normal distribution, both parameters were logarithmized.

Higher SCL and SCR indicate a higher sympathetic activation and are positively related to intensity of emotions (Bradley, 2004). Because of numerous factors influencing the relationship between SCR amplitudes, latency and rise time, as well as SCR frequency, correlations between SCL and SCR are lower than .50 (Dawson, Schell & Filion, 2004). Therefore, in the present study both measures of electrodermal activity were used.

RESULTS

The efficacy of movie clips

Previous studies have shown that movie clips used in the present study induce high degrees of positive (Schaefer, Nils, Sanchez & Philippot, in press) and negative affect (Gross & Levenson, 1995; Kunzmann, Kupperbusch & Levenson, 2005) in people of different ages. In order to test the degree to which movie clips induced various emotional states, subjective experience, facial expressions and physiological activity, movie clips inducing positive and negative affect were compared with neutral movie clip.

Subjective experience

Self-reported emotions induced by the emotional movie clips were compared with self-reported emotions induced by the neutral movie clip. Two MANOVAs with repeated measures (neutral clip and one of the two emotional movie clips) were conducted with subjective experience of positive and negative affect as dependant variables. Both multivariate effects are significant and high; with $F(6,57) = 19.51$, $p < .001$; $\eta^2 = .67$ for the clip inducing positive affect and $F(6,57) = 42.97$, $p < .001$; $\eta^2 = .82$ for the clip inducing negative affect. Table 1 presents the effects of both emotional clips on subjective experience of positive and negative affect.

Table 1. Effects of emotional clips on subjective emotional experience

Subjective experience	Targeted state							
	Positive affect			Negative affect			Neutral state	
	η^2	M	SD	η^2	M	SD	M	SD
Positive	.43***	12.86	4.03	.53***	4.22	1.10	8.43	4.01
Negative	.00	9.08	2.52	.70***	17.70	5.76	9.00	2.04

η^2 – effect size estimate, ***p < .001, N = 63

As can be seen from Table 1, during viewing of the positive emotional clip, participants experienced a significantly more positive affect than during viewing of the neutral clip, whereas during viewing of the negative emotional clip, they experienced a significantly more negative affect compared to the neutral clip.

Expressive behaviour

In order to test to what degree each of the movie clips led to changes in facial expressions and behaviours, those facial expression and behaviours induced by emotional movie clips were compared to the behaviours manifested while watching the neutral movie clip. For this purpose two MANOVAs with repeated measures (neutral clip and one of the two emotional clips) were conducted, with average estimates of behaviours of the two raters as dependent variables. Both multivariate effects of emotional movie clips are significant and high; $F(4,59) = 46.00$, $p < .001$; $\eta^2 = .76$ for the clip inducing positive affect; and $F(4,59) = 13.04$, $p < .001$; $\eta^2 = .53$ for the clip inducing negative affect. In Table 2 the effects of both emotional clips on each estimated expressive behaviour are presented.

Table 2. Effects of emotional clips on expressive behaviours

Expressive behaviours	Targeted state							
	Positive affect			Negative affect			Neutral state	
	η^2	M	SD	η^2	M	SD	M	SD
Smiling	.69***	2.84	1.02	.00	1.29	.72	1.23	0.66
Frowning	.19***	1.42	.73	.37***	1.89	1.16	1.06	0.30
Disgust	.17***	1.14	.31	.34***	1.72	1.00	1.00	0.00
Distress	.14**	1.28	.72	.47***	1.95	1.02	1.00	0.00

η^2 – effect size estimate, **p < .01, *** p < .001, N = 63

As could be seen from Table 2, the clip inducing a positive affect provoked a significant increase in smiling, frowning, disgust and distress when compared to the neutral clip. On the basis of the effect size, it can be noticed that from the estimated changes, the dominant one refers to an increase in smiling, whereas other changes are much smaller, which is in accord with the facial expression of positive affect. The low increase in disgust and distress demonstrates the well-documented difficulty in inducing pure targeted emotions (e.g. Gross & Levenson, 1995). The clip inducing negative affect provoked a significant increase in frowning, disgust and distress, the most prominent effect being for distress, and somewhat less for frowning and disgust, which is in accord with the display of negative affect.

Physiological activity

The effects of each emotional clip were tested by comparing patterns of physiological activation during the selected time sequences of each emotional movie clip with patterns of activation during the neutral movie clip. Physiological parameters obtained for each emotional clip and neutral clip were compared using MANOVA. Because of differences in the duration of the neutral clip and specific parts of emotional clips during which data were collected, the amplitude of SCR during 100 seconds from each clip was analysed. The other measures do not require these transformations because they contain average values independent of time duration, while SCR includes the sum of all amplitudes which increase over time. Both multivariate effects obtained are statistically significant; $F(4,50) = 18.12$, $p < .001$; $\eta^2 = 0.59$ for the clip inducing negative affect and $F(4,53) = 11.46$, $p < .001$; $\eta^2 = 0.46$ for the clip inducing positive affect. Table 3 presents the average level of activation for all four physiological measures during viewing of the neutral and two emotional movie clips.

Table 3. Average activation level of all four physiological measures taken during viewing neutral and each of the emotional movie clips

Physiological parameters	MOVIE CLIP					
	Positive affect			Negative affect		
	η^2	Neutral clip	Emotional clip	η^2	Neutral clip	Emotional clip
PPA (mV)	.02			.22***		
M		2.29	2.15		2.25	1.74
SD		1.73	1.72		1.68	1.39
IBI (ms)	.02			.00		
M		806.01	811.49		808.37	809.96
SD		125.80	120.29		127.44	121.96
SCR (μS)	.38***			.51***		
M		.19	.39		.17	.49
SD		.25	.29		.22	.31
SCL (μS)	.31***			.26***		
M		.57	.61		.55	.62
SD		.23	.23		.23	.23

η^2–effect size estimate, *** $p < .001$

(negative affect N = 54, positive affect N = 57),

PPA-finger pulse amplitude, IBI-cardiac interbeat interval,

SCR-skin conductance response, SCL-skin conductance level

These results confirm that both movie clips led to expected changes, namely, to an increase in physiological activation. The movie clip inducing positive affect provoked a significant increase in SCR and SCL, while the movie clip inducing negative affect led to a significant increase in SCR, SCL and PPA.

Familiarity with the movies from which clips were used frequently leads to a more intense subjective experience (Gross & Levenson, 1995). Therefore, for a movie clip inducing positive affect in further analyses, the effect of familiarity was controlled for.

The effects of expressivity on physiological changes

In order to test the effects of the two aspects of emotional expressivity on physiological activation during each emotional movie clip, participants were first split into two categories on each dimension of emotional expressivity according to the median; higher and lower positively expressive as well as higher and lower negatively expressive participants. For each index of physiological activation one way ANOVA was calculated and therefore during the viewing of the movie clip inducing negative affect negative expressivity was used as an independent variable, while during viewing of the clip inducing positive affect positive expressivity was used as an independent variable. In all analyses, five-factor personality traits were controlled for and also the baseline measure of each physiological parameter was included as a covariate.

During viewing of the clip inducing negative affect, the main effect of negative expressivity on the amplitude of skin conductance response was obtained ($F(63,1) = 4.50$; $p < 0.05$, $\eta^2 = 0.07$), with the higher amplitude in higher negatively expressive ($M = 0.61$ μS, $SD = 0.33$ μS) than lower negatively expressive individuals ($M = 0.44$ μS, $SD = 0.30$ μS). Also, the main effect of negative expressivity on the skin conductance level was obtained ($F(63,1) = 5.93$ $p < 0.05$, $\eta^2 = 0.10$), with higher skin conductance level in higher negatively expressive ($M = 0.66$ μS, $SD = 0.17$ μS) than lower negatively expressive individuals ($M = 0.61$ μS, $SD = 0.27$ μS). The main effect of negative expressivity on the heart rate was also obtained ($F(58,1) = 6.26$, $p < 0.05$, $\eta^2 = 0.12$), with shorter time between heart beats in higher negatively expressive ($M = 782.11$ms, $SD = 82.02$ms) than lower negatively expressive individuals ($M = 822.57$ms, $SD = 143.11$ms). However, the main effect of negative expressivity on the amplitude of peripheral pulse was not obtained ($F(61,1) = 0.00$, $p > 0.05$).

During viewing of the clip inducing positive affect, there were no significant main effects of positive expressivity on the amplitude of skin conductance response ($F(63,1) = 0.08$; $p > 0.05$), on skin conductance level ($F(63,1) = 0.27$; $p > 0.05$), on amplitude of peripheral pulse ($F(63,1) = 1.29$; $p > 0.05$) as well as on heart rate ($F(58,1) = 0.00$; $p > 0.05$).

The effects of positive and negative expressivity on physiological parameters were analysed also by controlling expressive behaviours. For the clip inducing negative affect - frowning, expression of anger, disgust and distress were controlled for, while for the clip inducing positive affect smiling was controlled for. The results obtained were identical to those where expressive behaviours were not controlled for.

DISCUSSION

When encountering a negative emotional situation, individuals higher on negative expressivity showed higher amplitude of electrodermal response, higher skin conductance level and higher heart rate compared to individuals low on negative expressivity. Peripheral pulse amplitude did not differ between these two groups. These results were obtained even when controlling for five factor personality traits, which supports the conclusion that differences in emotional expressivity measured by Berkeley expressivity questionnaire account for differences in reactions of some sympathetic parameters in a negative emotional situation. The same results were obtained after controlling for the recorded participants' facial expressions, which means that differences in physiological reactions did not appear due to different behaviour. Although the participants were divided into high and low emotionally expressive groups, they showed relatively similar facial behaviour, which additionally support the notion that differences in sympathetic reactivity found between the two groups reflect different levels of ANS sensitivity or different gain of emotional response (see Cacioppo *et al.* 1992). However, estimated facial expressions are not the only important bodily movement accounting for eventual differences in peripheral physiological reactions. Further studies should resolve this, using more detailed facial coding systems (Ekman & Friesen, 1978) or movement detection device (Gross & Levenson, 1997).

Generally, these results are in accord with the hypothesis stemming from *Coactivation theory* or *Theory of psychophysiological arousal* which posits that higher expressivity is positively related to sympathetic arousal. The results obtained can also be explained bearing in mind the properties of the negative expressivity scales. Namely, it can be argued that scales such as BEQ, EES or ECQ, to a great extent, measure the intensity of emotional arousal and corresponding experience. The content of many items of these scales directly encompass proneness to show or not show emotion, without asking the question if the emotional program has actually been activated. It means that if emotion is expressed (e.g. facial behaviour), it is probably activated in other channels (e.g. experience, arousal), while if it is not expressed, it is highly possible that the intensity of arousal and corresponding experience have been low from the beginning of specific emotional event, and thus, process of suppression can not be under way. In short, it is highly possible that individuals higher on negative expressivity have a greater tendency to feel more negative emotion. Indeed, Kring, Smith and Neale (1994) have found a moderate positive correlation between emotional expressivity and the intensity of emotional experience.

In a positive emotional situation, no differences in sympathetic responses between individuals low and high in positive expressivity have been found. These results can be interpreted in several ways. Firstly, previous research suggests that negative emotions are manifested more intensely than positive ones, which could be attributed to the well known phenomena of negative bias (Cacioppo & Berntson, 1999), and specifically, in the context of this research, to the movie clips used. Thus, more intense emotional response makes it easier to find the effects of individual differences on physiological reactions. Accordingly, Table 1 shows that effect sizes are higher for NA than for PA. Furthermore, these two dimensions are marked with different physiological patterns (Cacioppo *et al*., 1992), and thus, regarding PA, the effects of expressivity may be found on some other physiological indicators.

In etiological models that relate psychosocial and emotional factors with disease onset, chronic autonomic activity is given a very important role (e.g. Krantz & Manuck, 1984). Because this study examines short-term changes in sympathetic activation as a consequence of expressivity trait and induced positive and negative affective states, we could not come to any conclusion about the effect of expressivity on long-term health outcomes, which should be the ultimate goal of all studies investigating the relation between emotional expression and suppression on physiological responses. It has been argued that autonomic response associated with emotion does not have any adverse health outcomes except when autonomic arousal is sustained and chronic and when it exceeds metabolic demand (Levenson, 1994). For example, theories of cardiovascular reactivity state that persons with more pronounced, more frequent and long-term cardiovascular responses to stressful stimuli have increased risk of essential hypertension, aterosclerosis (Manuck, 1994) and coronary heart disease (CHD) (Kop, 1999). This hypothesis was confirmed in numerous studies on animals, persons with high and low risk of coronary heart disease, retrospective case studies, as well as prospective studies on humans (Krantz & Manuck, 1984).

It seems that the results of this study suggest that, along with some personality traits (e.g. type A behaviour pattern, type C personality, hostility etc.) known to be detrimental to health, greater attention should be directed also to the trait of expressivity. Further studies should examine the conditions and mechanisms through which expressivity may lead to sustained and chronic autonomic reactions that could have adverse health consequences.

Finally, some of the most important limitations of the present study should be mentioned. The first refers to the external validity of the results because, as we know, laboratory induced emotional states are not always identical with naturally occurring states. The second relates to the possibility of comparing positive and negative affects because they differ not only according to the hedonic tone but also probably according to intensity. The third limitation relates to the content of the items from the questionnaires measuring suppression. Namely, even items high in facial validity (e.g. "No matter how nervous or upset I am, I tend to keep a calm exterior" – BEQ, negative expressivity) are problematic because they simultaneously mix up the intensity of two different psychological/behavioural processes, the intensity or frequency of emotional arousal and the intensity or frequency of the effort used to hide one's own feelings. This makes it difficult to tap the actual level of suppression and to separate it from the level of arousal or subjective experience as in the case when a person estimates that he/she often "tries to hide his/her feelings" although the emotional process (arousal) is not very intense. The fourth limitation lies in the sample of participants that were predominantly female and, therefore, gender differences in the relation between dispositional expressivity and physiological changes could not be examined. The aforementioned problems should be addressed in future studies dealing with this issue.

REFERENCES

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. *Advances in Experimental Social Psychology, 28,* 1–51.

Bradley, M.M. (2004). Emotion and motivation. In J.T. Cacioppo, L.G. Tassinary, & G.G. Berntson (Eds.), *Handbook of psychophysiology* (pp. 602-642). Cambridge: Cambridge University Press.

Bonaparte, M., Freud, A., & Kris, E. (1954). *The origins of psychoanalysis*. New York: Basic books.

Buck, R. (1977). Nonverbal communication of affect in preschool children: Relationship with personality and skin conductance. *Journal of Personality and Social Psychology, 35*, 225-236.

Buck, R., Miller, R.E., & Caul, W.F. (1974). Sex, personality and physiological variables in the communication of affect via facial expression. *Journal of Personality and Social Psychology, 30*, 587-596.

Butler, E.A., Egloff, B., Wilhelm, F.H., Smith, N.C., Erickson, E.A., & Gross, J.J. (2003). The social consequences of expressive suppression. *Emotion, 3*, 48-67.

Cacioppo, J.T., & Berntson, G.G. (1999). The affect system: Architecture and operating characteristics. *Current Directions in Psychological Science, 8*, 133-137.

Cacioppo, J.T., Uchino, B.N., Crites, S.L., Snydersmith, M.A., Smith, G., Berntson, G., & Lang, P.L. (1992). Relationship between facial expressiveness and sympathetic activation in emotion: a critical review, with emphasis on modeling underlying mechanisms and individual differences. *Journal of Personality and Social Psychology, 62*, 110-128.

Cannon, W.B. (1927). The James-Lange theory of emotion: A critical examination and an alternative theory. *American Journal of Psychology, 39*, 106-124.

Colby, C.Z., Lanzetta, J.T., & Kleck, R.E. (1977). Effects of the expression of pain on autonomic and pain tolerance responses to subject controlled pain. *Psychophysiology, 14*, 537-540.

Costa, P.T., & McCrae, R.R. (1988). Personality in adulthood: A six-year longitudinal study of self-reports and spouse ratings on the NEO personality inventory. *Journal of Personality and Social Psychology, 54*, 853-863.

Costa, P.T., & McCrae, R.R. (2005). *Priručnik: Revidirani NEO inventar ličnosti (NEO-PI-R) i NEO petofaktorski inventar (NEO-FFI).* Jastrebarsko: Naklada Slap.

Costa, P.T., McCrae, R.R., & Dye, D.A. (1991). Facet scales for agreeableness and conscientiousness: A revision of the NEO personality inventory. *Personality and Individual Differences, 12*, 887-898.

Davidson, R.J., Ekman, P., Saron, C.D., Senulis, J.A., & Friesen, W.V. (1990). Approach withdrawal and cerebral asymmetry: Emotional expression and brain physiology. *Journal of Personality and Social Psychology, 58*, 330-341.

Dawson, M.E., Schell, A.M., & Filion, D.L. (2004). The electrodermal system. In J.T. Cacioppo, L.G. Tassinary, & G.G. Berntson (Eds.), *Handbook of psychophysiology* (pp. 200-223). Cambridge: Cambridge University Press.

Demaree, H.A., Schmeichel, B.J., Robinson, J.L., Pu, J., Everhart, D.E., & Berntson, G.G. (2006). Up- and down-regulating facial disgust: Affective, vagal, sympathetic, and respiratory consequences. *Biological Psychology, 71*, 90-99.

Duffy, E. (1957). The psychological significance of the concept of „arousal“ or „activation“. *Psychological Review, 64*, 264-275.

Egloff, B., Schmukle, S.C., Burns, L.R., & Schwerdtfeger, A. (2006). Spontaneous emotion regulation during evaluated speaking tasks: associations with negative affect, anxiety expression, memory, and physiological responding. *Emotion, 6*, 356-366.

Ekman, P., & Friesen, W.V. (1978). *Facial action coding system: A technique for the measurement of facial movement*. Palo Alto, California: Consulting Psychologists Press.

Ekman, P., Friesen, V.W., & O'Sullivan, M. (1988). Smiles when lying. *Journal of Personality and Social Psychology, 54*, 414-420.

Farrelly, B., & Farrelly, P. (Director). (1998). There's something about Mary. [Film]. Zagreb: UCD.

Gross, J.J. (1998). Antecedent - and response - focused emotion regulation: Divergent consequences for experience, expression, and physiology. *Journal of Personality and Social Psychology, 74*, 224–237.

Gross, J.J., & John, O.P. (1997). Revealing feelings: Facets of emotional expressivity in self-reports, peer ratings, and behavior. *Journal of Personality and Social Psychology, 72*, 435-448.

Gross, J.J., & Levenson, R.W. (1993). Emotional suppression: Physiology, self-report, and expressive behavior. *Journal of Personality and Social Psychology, 64*, 970–986.

Gross, J.J., & Levenson, R.W. (1995). Emotion elicitation using films. *Cognition and Emotion*, 9, 87-108.

Gross, J.J., & Levenson, R.W. (1997). Hiding feelings: The acute effects of inhibiting negative and positive emotion. *Journal of Abnormal Psychology, 106*, 95-103.

Harris, C.R. (2001). Cardiovascular responses of embarrassment and effects of emotional suppression in a social setting. *Journal of Personality and Social Psychology, 81,* 886-897.

Kop, W.J. (1999). Chronic and acute psychological risk factors for clinical manifestations of coronary artery disease. *Psychosomatic Medicine*, *61,* 476-487.

Krantz, D.S., & Manuck, S.B. (1984). Acute psychophysiologic reactivity and risk of cardiovascular disease: A review of methodologic critique. *Psychological Bulletin, 96,* 435-464.

Kring, A., Smith, D., & Neale, J. (1994). Individual differences in dispositional expressiveness: Development and validation of the emotional expressivity scale. *Journal of Personality and Social Psychology, 66*, 934-949.

Kunzmann, U., Kupperbusch, C.S., & Levenson, R.W. (2005). Behavioral inhibition and amplification during emotional arousal: A comparison of two age groups. *Psychology and Aging 20,* 144–158.

Lanzetta, J.T., Cartwright-Smith, J., & Kleck, R.E. (1976). Effects of nonverbal dissimulation on emotional experience and autonomic arousal. *Journal of Personality and Social Psychology, 33*, 354-370.

Lanzetta, J.T., & Kleck, R.E. (1970). Encoding and decoding nonverbal affect in humans. *Journal of Personality and Social Psychology, 16*, 12-19.

Levenson, R.W. (1994). Emotional control: Variations and consequences. In P.Ekman, & R.J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 273-279). Oxford: Oxford University Press.

Manuck, S.B. (1994). Cardiovascular reactivity and cardiovascular disease: "Once more unto the breach". *International Journal of Behavioral Medicine, 1,* 4-31.

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

Notarius, C.I., & Levenson, R.W. (1979). Expressive tendencies and physiological response to stress. *Journal of Personality and Social Psychology, 37*, 1204-1210.

Notarius, C.I., Wemple, C., Ingraham, L.J., Burns, T.J., & Kollar, E., (1982). Multichannel responses to an interpersonal stressor: Interrelationships among facial display, heart rate, self report of emotion, and threat appraisal. *Journal of Personality and Social Psychology, 43*, 400-408.

Poire, J.M. (Director). (1993). *Les Visiteurs* [Film]. Zagreb: UCD.

Richards, J.M., & Gross, J.J. (1999). Composure at any cost? The cognitive consequences of emotion suppression. *Personality and Social Psychology Bulletin, 25,* 1033-1044.

Roger, D., & Najarian, B. (1998). The construction and validation of a new scale for measuring emotional control. *Personality and Individual Differences, 10*, 845-853.

Rottenberg, J., Ray, R.R., & Gross, J.J. (2007). Emotion elicitation using films. In J.A. Coan & J.J.B. Allen (Eds.), *The handbook of emotion elicitation and assessment* (pp. 9-28). New York: Oxford University Press.

Rothbart, M.K., & Sheese, B.E. (2007). Temperament and emotion regulation. In J. Gross (Ed.), *Handbook of emotion regulation* (pp. 331-350). New York: Guilford.

Schaefer, A., Nils, F., Sanchez, X., & Philippot., P. (in press). Multi-criteria assessment of emotional films. *Emotion.*

Zuckerman, M., Klorman, R., Larrance, D.T., & Spiegel, N.H. (1981). Facial, autonomic, and subjective components of emotion: The facial feedback hypothesis versus the externalizer-internalizer distinction. *Journal of Personality and Social Psychology, 41*, 929-944.

Received: 18. 10. 2007.