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Psychophysiological Reactivity to Affective Visual Stimulation of Negative Emotional Valence: Comparative Analysis of Autonomic and Frontal EEG Responses to the IAPS and the KAPS *

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Abstract. Autonomic and EEG responses were analyzed in 32 college students exposed to visual stimulation with Korean Affective Picture System (KAPS) and 36 students exposed to the International Affective Picture System (IAPS). Cardiac, electrodermal, and electrocortical measures were recorded during 30 sec of viewing affective pictures. The slides intended to elicit basic emotions (fear, anger, surprise, disgust, and sadness) were presented to subjects via Kodak slide-projector. The aim of the study was to differentiate autonomic and EEG responses associated with the same negative valence emotions elicited by KAPS and IAPS stimulation and to identify the influence of cultural relevance on physiological reactivity. The analysis of obtained results revealed significant differences in physiological responsiveness to emotionally negative valence slides from KAPS and IAPS. The typical response profile for all emotions elicited by the KAPS included HR acceleration (except surprise), an increase of electrodermal activity, slow and fast alpha blocking and fast beta power increase in EEG, which was not associated with significant asymmetry (except fast alpha in sadness). Stimulation with the IAPS evoked HR deceleration, specific electrodermal responses with relatively high tonic electrodermal activation , alpha-blocking and fast beta increase, and was accompanied also by theta power increase and marked frontal asymmetry (e.g., fast beta, theta asymmetries in sadness, fast alpha in fear). Physiological responses to fear and anger-eliciting slides from the IAPS were significantly less profound and were accompanied by autonomic and EEG changes more typical for attention rather than negative affect. Higher cardiovascular and electrodermal reactivity to fear emotion observed in the KAPS, e.g., as compared to data with the IAPS as stimuli, can be explained by cultural relevance and higher effectiveness of the KAPS in producing certain emotions such as fear in Koreans.

Introduction

Affective pictures, e.g., slides specially

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selected to induce emotional response in laboratory conditions became popular in psychophysiological research after the introduction of the International Affective Picture System (IAPS) by Lang et al. (Lang, 1997). Primarily developed for dimensional scaling of emotions and mapping in affective space, the IAPS was turned out to be effective enough to evoke discrete emotions and even differentiate them by physiological manifestation (Cuthbert et al., 1996; Lang, 1995). In the previous papers (Sohn et al., 1998a,b; Yi et al., 1998) we reported on patterns of physiological responses evoked by the IAPS stimulation and findings about possibility to differentiate several emotions, for example disgust and sadness by autonomic responses, and excitement-fear by EEG alpha power and frontal alpha asymmetry.

However, we outlined in the article (Sohn et al., 1998b) as well the difficulties in eliciting certain negative emotions, such as, for instance, fear and anger. Among the reasons why we failed to induce fear and anger might be attributed cultural differences. Responses to the slides from the IAPS "fear" category demonstrated response pattern more typical for an attention and orienting (Jennings, 1986; Sohn et al., 1998a,b, Yi et al., 1998), and did not show the signs of cognitive evaluation of the IAPS slides as "fearful" enough to induce defensive response of "fight-or-flight" type. The KAPS project was in part proposed to fulfill these shortcomings and to have available the affective pictures invariantly evoking intended emotional states in Korean viewers. Some preliminary results on psychometry tests (Lee et al., 1998), ANS (Sohn et al., 2000) and EEG reactivity in the KAPS and have been already presented elsewhere (Sohn et al., 2000b).

Reproducibility of the autonomic nervous system (ANS) and the central nervous system (CNS) responses is another important topic in studies with affective visual stimulation, both in terms of: 1) compatibility of results from different laboratories, and 2) reproducability of emotion-specific physiological reactivity within one laboratory (in a case of application of different experimental materials, for example, the slides from the similar category from different picture systems, i.e., the IAPS and the KAPS). Cross-cultural differences in psychophysiological response manifestation during basic emotions continue to be an interesting venue for research and encourage further studies in this area.

Above mentioned issues implicate necessity to use autonomic parameters sensitive enough for the detection of occurrence and subsequent differentiation of emotions (Boucsein, 1999; Cacioppo et al., 1993; Christianson, 1987; Klorman et al., 1975; Lang, 1995; Schwartz et al., 1981; Sinha et al., 1992, Sohn et al, 1998). Ekman et al. (1983) demonstrated skin conductance level increase more in sadness than in fear, anger and disgust during imagery. Heart rate (HR) showed differentiation for sadness-disgust, disgust-anger, and fear-surprise pairs (Ekman et al., 1983), being thus one of the best discriminators. But, on the other hand, there had been reported results indicating rather low reproducibility of HR response to differentiate sadness-anger,sadness-fear, angerfear, or surprise-disgust pairs (Cacioppo et al., 1993).

This problem could be explained partially by an inadequate scoring of cardiac responses, because potential patterns may not be described by gross output measures of an end-organ responses (e.g., HR) particularly for antagonistically innervated organs (i.e., heart) (Bernston et al., 1997; Cacioppo et al., 1993). Emotional stimulus does not invariably evoke reciprocal activation of the sympathetic (SNS) and the parasympathetic (PNS) branches, and thus resulting response of such measure as HR could be determined by several combinations of ANS influences (Cacioppo et al., 1993). It is possible that emotions could be differentiated if the focus had been done on indices of the SNS and the PNS influences on HR rather than HR as such. Autonomic nervous system mechanisms mediating physiological responses during affective stimulation are easier to identify if we use parameters specifically sensitive to activation of branches of the ANS, such as high frequency (HF) component of heart period variability (HPV) as index of the PNS activity (Bernston et al. 1997), cardiac low frequency component of HPV (LF) and electrodermal activation as indices of the SNS activity (Boucsein, 1999).

Emotion-specificity of electrocortical responses has been explored only in few studies (Davidson et al., 1990; Davidson, 1995). These EEG studies of discrete emotions have found that the EEG power from right frontal areas is higher in negative than in positive emotions. Davidson et al. (1990) presented emotionally charged film clips to subject and demonstrated that disgust indicates greater right-sided frontal activation than during the happiness condition. However, frontal alpha asymmetry has not been found for emotions comparable in terms of "withdrawal" (e.g., disgust and fear) or "approach" tendencies. The most important in the studies of emotions by Davidson's group (Davidson et al., 1990; Davidson, 1995, 1998) is that they were looking and found a reliable EEG marker for affect. Namely, they showed that the EEG index of activation (i.e., reduced alpha activity) when recorded from left (F3) and right (F4) frontal areas respectively predicted affective reactions to emotional stimuli and also correlated with affective condition. Davidson et al. (1990) recorded the difference in alpha power between right (F4) and left (F3) frontal areas, and on the basis of these results, hypothesized that in the left frontal lobe is a positive affect or "approach" system, whereas a negative affect or "withdrawal" system is located in the right frontal lobe (Davidson, 1995, 1998; Spence et al., 1996). Thus, frontal asymmetry approach for differentiation of emotions seems to be useful one, especially when the other EEG bands' asymmetries are also analyzed along with traditionally established frontal alpha asymmetry.

The aim of the study was to analyze and compare cardiac, electrodermal, and electrocortical reactivity in the emotions subjectively evaluated as belonged to the same category but elicited by the KAPS and the IAPS stimulation in two different experiments and to identify the influence of cultural relevance on physiological response profiles.

Methods

Experiment #1 (KAPS). Thirty two college students (19-24 years old females) participated in the study. After passing psychometric tests, brief introduction to experimental situation and attachment of electrodes, they were sitted in recliner-chair in sound-proof room with dim lights, and further were instructed to watch the screen where pictures were presented by Kodak slide-projector. Initial baselines of physiological signals were measured. Five slides for 5 discrete emotions (Set A: disgust, fear, anger, sadness, and surprise) were selected from the KAPS. Subjects were not given any specific instructions and the procedure constituted a passive viewing paradigm. Baseline values were recorded during 30 sec periods, each picture was presented during 30 sec. Order of the slides was counterbalanced.

Experiment#2 (IAPS). Thirty six college students (20-26 years old) of both genders (men, N=16) participated in the study. After psychometric tests, brief introduction to experimental situation and attachment of electrodes, subjects were placed in the same experimental situation. Initial baseline measurements of physiological signals were taken. Then presented were slides for 5 discrete negative valence emotions pre-selected from the IAPS (Lang, 1997). The affective pictures were: sadness #2800, disgust #3140, surprise #3170, anger #6540, fear #3110. Baseline values were recorded during 30 sec periods, each picture was presented during 60 sec long trial. Slides were presented in the counterbalanced order for each subject. Data were calculated for the first 30 sec of exposure to stimulus and 30 sec long inter-trial resting baselines.

Equipment. Physiological signals in both experiments were acquired by BIOPAC MP100WS hardware and AcqKnowledge III (v.3.5) software with the sampling rate 512 Hz. Three Ag/AgCl electrodes were mounted for measurement of Lead I Electrocardiogram(ECG). Electrodermal activity was recorded with Ag/AgCl electrodes filled with isotonic Unibase gel (0.5 V DC technique to measure skin conductance). The EEG was recorded from frontal areas (F3, F4).

Following autonomic parameters were recorded: electrodermal activity, e.g., non-specific SCR frequency (NS.SCR); cardiac activity, namely, heart rate (HR), high (HF) and low (LF) frequency components and HF/LF ratio of heart period variability (HPV). Inter-beat intervals of ECG were resampled at 10 Hz basis and analyzed with Fast Fourier Transformation (FFT) to assess HPV using Hanning window. Integrals of spectrum in 0.04- 0.14 Hz (LF component of HPV) and 0.14-0.40 Hz (HF of HPV) band were measured (in ms2) in baseline and experimental conditions.

EEG spectral power (FFT, Hanning window) was analyzed for frontal sites (F3 and F4 monopolarly referred to ipsilateral earlobe) and power was calculated for following frequency bands: delta (0.5-3.99 Hz), theta (4.0-7.99 Hz), slow alpha (8.0-9.99 Hz), fast alpha (10.0-12.99 Hz), slow beta (13.0-19.99 Hz), fast beta (20.0-30.0 Hz). Relative power (RP) of each band was calculated and converted to percents: e.g., theta relative power = theta power / total power. Frontal slow alpha asymmetry index (A-score) was calculated as following: Frontal A-score = (SAF4 - SAF3)/ (SAF4 + SAF3), where SA is relative power of slow alpha.

Other asymmetry scores were calculated in a similar way for theta, fast alpha, slow beta and fast beta. Statistical analysis was performed by SPSS package using one-way ANOVA, t-test for paired samples and Pearson correlation analysis.

Results

Response profiles in the KAPS. Profiles of autonomic responses demonstrated the similarity of patterns of responses for emotions induced by the KAPS stimulation. Most typical responses in observed pattern included electrodermal responses (NS.SCR increase) and HR acceleration. However, surprise did not demonstrated HR changes, while sadness and surprise did not show significant NS.SCR increase. Theta power tended to decrease, especially in surprise, but theta change did not reach significance level, while slow beta did not change in any emotion. Slow alpha decreased in all emotions ($p<0.01$). Fast alpha decreased bilaterally in all emotions ($p<0.05$), except fear. Fast beta increased at both frontal sites in disgust and fear ($ps<0.05$), only at F3 in sadness and surprise ($p<0.05$), but did not show significance of change in anger. Frontal fast alpha asymmetry index was significantly negative in sadness ($p<0.05$), while slow alpha asymmetry index only tended to be negative in disgust ($p=0.057$). Fast alpha asymmetry was significantly lower in sadness than in disgust and fear ($ps<0.05$).

Response profiles in the IAPS. HR deceleration response was typical for all IAPS pictures, however HR decreased from baseline in fear ($p<0.05$) and especially in surprise ($p<0.001$). Comparison of surprise with the other emotions showed significant differences, except for fear, which on its turn yielded higher HR response than anger. LF decreased in surprise more than in fear ($p<0.05$). Level of LF in HPV in sadness was lower than in fear and anger ($p<0.05$). The HF/LF index of HPV was lower in anger than in sadness ($p<0.05$). SCR amplitude was higher in sadness than in disgust ($p<0.05$), but disgust demonstrated more electrodermal activation in a form of increased frequency of NS.SCR, which was higher than in fear ($p<0.05$).

EEG profiles during exposure to the IAPS exhibited theta increase, alpha-blocking and increased fast beta activity. However, particular emotions demonstrated variations of the response profiles, enabling to differentiate some pairs of emotions by several EEG parameters. Significant differences (all $ps<0.05$) were found within negative emotions, such as in theta for fear-anger, disgust-anger (F3, F4), for sadness-anger only at F4, and in slow alpha sadness-surprise (F3), fear-surprise(F3), sadness- disgust (F4) pairs. Slow and fast beta reactivity differentiated only at F3 in fear-disgust pair. Fast beta increased in surprise bilaterally more than in sadness ($p<0.05$). Sadness was characterized by positive frontal theta asymmetry ($p<0.01$), but negative fast beta symmetry ($p<0.05$). Fear resulted in positive slow alpha A-score ($p<0.001$), and negative slow beta asymmetry index ($p<0.01$). Anger had negative frontal fast beta score ($p<0.05$). Differentiation of slow alpha asymmetry was significant in fear-surprise ($p<0.05$), while slow beta asymmetry in fear-disgust pairs ($p<0.01$). Theta asymmetry was positive and significantly higher in sadness than in anger, disgust, and fear ($p<0.05$).

Comparison of autonomic reactivity in the KAPS and the IAPS. In KAPS stimulation most emotions were associated with HR acceleration, while in the IAPS with HR deceleration. On Table 1 presented are results of ANOVA test showing significance of HR response differences between the KAPS and IAPS for all negative emotions. The HF/LF ratio of HPV was lower in all emotions in the KAPS as compared to the IAPS, but difference for fear was not significant statistically. Electrodermal reactivity (NS.SCR frequency) in fear was higher in KAPS than in IAPS. However, anger evoked higher NS.SCR in the IAPS than in KAPS. To assess the role of LF and HF components in HPV, we analyzed correlation of normalized HF/LF ratio with its compon ents in both experiments in each emotion. In the KAPS experiment anger, disgust and sadness showed negative correlation between HPV ratio and LF component, while positive correlation of HPV ratio with HF in disgust, fear, and surprise. In experiment with the IAPS all emotions were featured by positive correlation of HF/LF ratio of HPV with HF component (which may explain more profound HR deceleration during emotions in the IAPS).

Comparison of EEG reactivity in the KAPS and the IAPS. Most significant differences in reactivity between the KAPS and IAPS were found for theta power for all emotions except sadness. These data are summarized in Table 2. Theta power in KAPS decreased, while in the IAPS experiment increased. Differences in slow alpha decrease in the KAPS and IAPS were revealed only in sadness (F3, F1.55=5.72, p<0.05: F4, F1.55=12.86, p<0.01). Slow beta power decreased in the KAPS, whereas increased in the IAPS (F4 only, F1.55=5.16, p<0.05). These data are presented on Fig. 1. Frontal slow beta asymmetry in fear was marginally more negative in the IAPS than in the KAPS (F1.54=4.32, p<0.05). There were not found any other differences in the frontal asymmetries in negative emotions between the KAPS and the IAPS.

<**Table 1**> Cardiac and electrodermal reactivity in KAPS and IAPS stimulation.

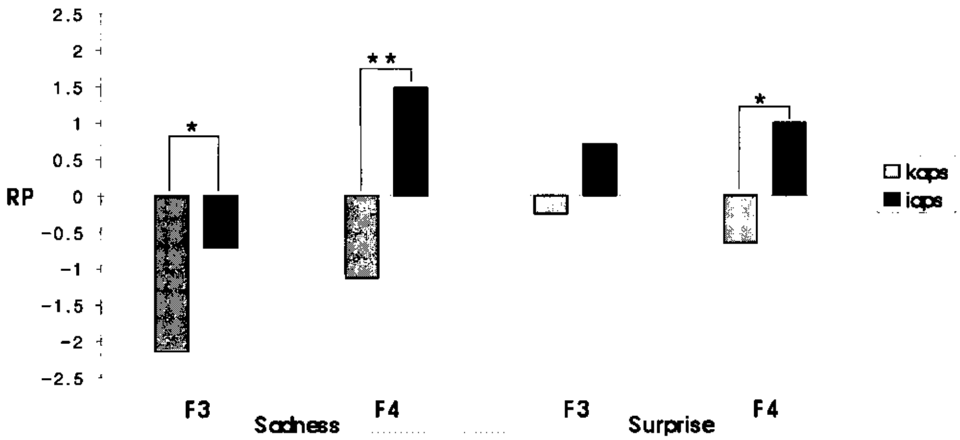
	HR change (bpm)			**HF/LF index of HPV**			**NS.SCR frequency (per min)**		
	KAPS	**IAPS**	*F, df, p*	**KAPS**	**IAPS**	*F, df, p*	**KAPS**	**IAPS**	*F, df, p*
ANGER	2.79	-0.10	F1,68=10.68**	0.51	0.67	F1,67=10.46**	0.81	1.38	F1,74=4.45*
DISGUST	2.55	-0.79	F1,65=11.07**	0.52	0.75	F1,67=13.63**	1.59	1.79	n.s.
FEAR	2.81	-0.03	F1,63=6.83*	0.54	0.68	n.s.	2.18	1.22	F1,74=5.13*
SADNESS	2.09	-0.15	F1,63=6.37 *	0.50	0.75	F1,67=20.28**	1.03	1.41	n.s.
SURPRISE	1.44	-2.06	F1,64=12.22**	0.57	0.72	F1,67=9.59**	1.30	1.44	n.s

Note: Significance exposed by one-way ANOVA test : * p<0.05, ** p<0.01, n.s. not significant.

<**Table 2**> Frontal EEG theta reactivity in KAPS and IAPS stimulation (One-way ANOVA test). Relative power values changes from baseline are compared.

	Theta F3			**Theta F4**		
	KAPS	**IAPS**	*F, df, p*	**KAPS**	**IAPS**	*F, df, p*
ANGER	-0.96	0.63	F1,54=4.29*	-0.33	-0.64	F1,54= 0.11 n.s.
DISGUST	-0.87	1.41	F1,55=8.01**	-0.42	1.52	F1,55= 5.18*
FEAR	-0.06	1.69	F1,55=6.71*	-0.16	1.30	F1,55=3.25 n.s.
SADNESS	-0.09	1.01	F1,55=1.75 n.s.	-1.44	0.24	F1,55=1.74 n.s.
SURPRISE	-1.17	1.15	F1,55 =7.40**	-1.32	1.26	F1,55=6.43**

Note: * p<0.05, ** p<0.01, n.s. not significant.



⟨Fig. 1⟩ Differentiation of frontal slow alpha in sadness and slow beta responses in surprise (KAPS vs. IAPS). Significance of differences: * $p<0.05$, ** $p<0.01$.

Discussion

The analysis of obtained results demonstrated that the typical response profile in the KAPS for all negative valence emotions includes HR acceleration (except surprise), moderate HPV changes, an increase of NS.SCR frequency, slow and fast alpha RP decrease, fast beta increase, but no significant changes in theta and slow beta RP in the EEG. Frontal asymmetry is significant only for fast alpha in sadness. Most typical responses in the IAPS in all emotion conditions are HR deceleration (higher in surprise and fear), decrease of LF and HF components of HPV, and electrodermal activity in a form of increased frequency of nonspecific SCR (NS.SCR), which was highest in disgust. The EEG pattern in the IAPS shows theta increase, alpha blocking and beta enhancement. Sadness shows positive theta asymmetry and negative fast beta asymmetry, while fear positive slow alpha, but negative slow beta asymmetries. Anger is accompanied by negative fast beta asymmetry.

Frontal theta changes are characteristic of vigilance and other tasks involving attention (Masitani et al., 1985). The theta band also have to be taken into consideration in emotion research, because while in some tasks and conditions, theta activity appears to be dissociated from slow alpha, for example, in disgust and sadness emotions in the IAPS. Also like alpha asymmetry, theta asymmetry appears to reflect hemispheric task demands. Our results demonstrate positive frontal theta asymmetry in sadness in the IAPS. Overall theta reactivity (e.g., theta RP decrease) in the IAPS experiment therefore demonstrates significant difference from theta responses in the KAPS (i.e., tendency to theta RP decrease). Assuming that frontal theta is more related to attention process (Masitani et al., 1985), we have to conclude that the IAPS evoked more obvious attention to the pictures than the KAPS.

Left frontal activation is considered to be related more to behavioral activation system (Davidson et al., 1990; Spence et al., 1996). The "approach/withdrawal" motivational model of emotion and frontal brain asymmetries suggests that "approach" emotions such anger are associated with relatively greater left frontal brain activity (i.e., positive alpha asymmetry, negative beta asymmetry), whereas "withdrawal" emotions such as sadness, fear, and disgust are associated with relatively lower left frontal brain activity, and should be expressed in negative alpha asymmetry and/or positive beta asymmetry (Davidson, 1995, 1998). Our data shows that in the KAPS experiment frontal fast alpha asymmetry index was negative in sadness and slow alpha asymmetry index tended to be negative in disgust, and anger had negative fast beta asymmetry. Thus, all these results on frontal asymmetry in the KAPS are closer to the "approach-withdrawal" related anterior asymmetry model of Davidson (1995, 1998). On the other hand, in the IAPS experiment fear showed negative slow beta and positive slow alpha indices, and these findings do not match above model. We may suggest conversely that negative affect in classical form for fear was not taking place in EEG responses to the IAPS fear-eliciting stimulus.

Comparison of the EEG rhythm responses also showed more profound alpha-blocking response in the KAPS than in the IAPS in sadness. The same time the right slow beta and bilateral fast beta in surprise increased more in the IAPS than in the KAPS (Fig. 1), and this says that more typical orienting response occurred in the IAPS. Practically most of EEG parameters show signs of typical emotion-specific responses in the KAPS, whereas more attention-specific reactivity in the IAPS.

References on HR responses in experiments aimed to evoke emotions in different design are quite ambiguous (Cacioppo et al., 1993; Christianson, 1987; Cuthbert et al., 1993; Klorman et al., 1977; Schwartz et al., 1981; Sinha et al., 1992; Sohn et al., 1998). It has been reported HR acceleration in studies manipulating facial expressions (Ekman et al., 1983), and imagery (Schwartz et al., 1981), visual traumatic stimuli (Christianson, 1987; Hubert, de Jong-Meyer, 1990; Sinha et al., 1992), or for phobic subjects (Hare, 1973, Klorman et al., 1975, 1977). In passive viewing HR response showed phasic deceleration with greater decrease for slides of negative valence (Cuthbert et al., 1996; Hubert, de Jong-Meyer, 1990; Lang, 1995). We also have found similar cardiac response pattern in our own data with the IAPS as visual stimuli (Sohn et al., 1998; Yi et al., 1998).

Increase of HR in negative emotions (fear, anger, and disgust) could be explained taking into consideration data of Hare (1973) and Klorman et al. (1975,1977) who reported HR deceleration in normal subjects, while HR acceleration in subjects with phobias. Pictures employed in the KAPS seemed to be more relevant to provoke phobic response, especially in fear eliciting situation, since used slides (e.g., "woman with ghost-like white face") are seemed to be capable to evoke imprinted fear in Koreans with strong ancient folk beliefs in mystical spirits and shaman symbols. On the other hand, the slides with negative emotion-eliciting contents (e.g., "vomiting woman" "man beating woman" etc.) might happen to be specifically more aversive to young Korean female students due to traditional social incongruity of such behaviors.

Cardiac responses (HR, HPV) still proved to be sensitive enough as markers of emotions. Namely parasympathetic index such as HF of HPV was found to decrease more in fear than in sadness, and autonomic cardiac balance in fear more dependent on HF changes (i.e., the parasympathetic withdrawal) than in anger in the KAPS. The HF/LF ratio changes in anger show more dependence on LF changes (mediated the SNS activity increase). In the IAPS HPV ratio is more dependent on HF component. NS.SCR frequency also demonstrated efficiency in the differentiation of reactivity to emotions in our studies and these results are compatible with assumption that tonic skin conductance measures (e.g., NS.SCR) could be used as markers of emotional states, especially in the arousal dimension and in an intensity labeling (Boucsein, 1999; Cuthbert et al., 1996; Lang, 1995). There exists many arguments for utility of the simultaneous use of HR (as emotional valence sensitive)(Lang, 1995) and NS.SCR (arousal sensitive) (Boucsein, 1999, Sohn et al., 1998b) as parameters in assessment of the ANS mediated responses in affective visual stimulation mode. However HR discrimination is not always sufficiently reproducible, since heart is an example of an end-organ innervated dually by sympathetic and parasympathetic system and output HR is influenced by both autonomic inputs (Bernston et al., 1997). For further differentiation of the concrete mechanisms of cardiac reactivity to emotional stimulation heart period variability analysis seems more feasible.

Presented comaparative meta- analysis of 2 experiments carried out in our laboratory aimed to emphasize the importance of cultural relevance of used visual affective materials to elicit negative emotions in laboratory settings. We understand that there exist certain methodological limitations that do not give us an opportunity to effectively compare results of these two studies. Among methodological shortcomings of this analysis should be mentioned following: there was used between group comparison design only, the time of exposure to affective pictures was different in 2 experiments, number of subjects in the groups was not equal, in the IAPS study subjects were of both genders, while in the KAPS subjects were females only, etc. All these methodological differences prevent us from drawing more extended conclusions about differential reactivity in the IAPS and the KAPS. Nevertheless, obtained results strongly support the important role of the cultural appropriateness in the selection of adequate affective sensory stimuli to induce intense emotions of negative valence.

The most important finding is the demonstration of autonomic and cortical responses typical for fear in the KAPS experiment. Physiological responses to fear and anger-eliciting slides from IAPS were significantly less profound and were accompanied by autonomic and cortical changes more characteristic for attention rather than negative affect. Namely, HR deceleration more dependent on HF HPV changes in most negative emotions and the same time NS.SCR increase were characteristics of autonomic reactivity along with increased theta in the EEG in the IAPS stimulation, whereas HR acceleration accompanied by high NS.SCR frequency, alpha-blocking and fast beta increase without significant theta power changes were more typical for the KAPS stimulation.

Higher cardiac and electrodermal reactivity to fear emotion observed in the KAPS, e.g., as compared to data with the IAPS as stimuli, can be explained by closer cultural relevance and higher effectiveness of the KAPS in producing certain emotions such as fear in Koreans.

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Psychophysiological Reactivity to Affective Visual Stimulation of Negative Emotional Valence: Comparative Analysis of Autonomic and Frontal EEG Responses to the IAPS and the KAPS *

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Abstract. Autonomic and EEG responses were analyzed in 32 college students exposed to visual stimulation with Korean Affective Picture System (KAPS) and 36 students exposed to the International Affective Picture System (IAPS). Cardiac, electrodermal, and electrocortical measures were recorded during 30 sec of viewing affective pictures. The slides intended to elicit basic emotions (fear, anger, surprise, disgust, and sadness) were presented to subjects via Kodak slide-projector. The aim of the study was to differentiate autonomic and EEG responses associated with the same negative valence emotions elicited by KAPS and IAPS stimulation and to identify the influence of cultural relevance on physiological reactivity. The analysis of obtained results revealed significant differences in physiological responsiveness to emotionally negative valence slides from KAPS and IAPS. The typical response profile for all emotions elicited by the KAPS included HR acceleration (except surprise), an increase of electrodermal activity, slow and fast alpha blocking and fast beta power increase in EEG, which was not associated with significant asymmetry (except fast alpha in sadness). Stimulation with the IAPS evoked HR deceleration, specific electrodermal responses with relatively high tonic electrodermal activation , alpha-blocking and fast beta increase, and was accompanied also by theta power increase and marked frontal asymmetry (e.g., fast beta, theta asymmetries in sadness, fast alpha in fear). Physiological responses to fear and anger-eliciting slides from the IAPS were significantly less profound and were accompanied by autonomic and EEG changes more typical for attention rather than negative affect. Higher cardiovascular and electrodermal reactivity to fear emotion observed in the KAPS, e.g., as compared to data with the IAPS as stimuli, can be explained by cultural relevance and higher effectiveness of the KAPS in producing certain emotions such as fear in Koreans.