Basic Emotions Elicited by Korean Affective Picture System Can be Differentiated by Autonomic Responses

Jin-Hun Sohn, Estate Sokhadze, Kyug-Hwa Lee and Imgap Yi
Department of Psychology, Institute for Brain Research,
Chungnam National University,
#220 Kung-dong, Yusong-gu, 305-764, Taejon, Korea
jhsohn@hanbat.chungnam.ac.kr

Abstract

Autonomic responses were analyzed in 32 college students exposed to visual stimulation with Korean Affective Picture System (KAPS). Cardiac, vascular and electrodermal variables were recorded during 30 sec of viewing affective pictures. The same slides intended to elicit basic emotions (fear, anger, surprise, disgust, sadness, happiness) were presented to subjects in 2 trials with different experimental context. The first time slides were shown without any instructions (passive viewing), while during the second with instruction to exert efforts to magnify experienced emotion induced by pictures (active viewing). The aim of the study was to differentiate autonomic manifestations of emotions elicited by KAPS stimulation and to identify the role of instructed emotional engagement on physiological response profiles. The obtained results demonstrated reproducibility of responses in both trials with different contexts. Pairwise comparison of physiological responses in emotion conditions revealed the most pronounced differentiation for "fear-anger" and "fear-sadness" pairs (in electrodermal and HR variability parameters). "Fear-surprise" pair was also well differentiable. The typical response profile for all emotions included HR acceleration (except happiness and surprise), an increase of electrodermal activity, and a decrease of pulse volume. Higher cardiovascular and electrodermal reactivity to fear observed in this study, e.g., as compared to data with IAPS as stimuli, can be explained by cultural relevance and higher effectiveness of KAPS in producing certain emotions such as fear in Koreans.

(This project was supported by KRF research grant to J.-H.Sohn.)

Introduction

Affective pictures, e.g., slides specially selected to induce emotional response in laboratory became popular in pyschophysiology after introduction of International Affective Picture System (IAPS) by Lang *et al.* [4, 15-18, 34]. Primarily developed for dimensional scaling of emotions, IAPS happened to be effective enough to evoke discrete emotions and even differentiate them by physiological manifestation [29]. In previous studies [29-30, 35] we reported on patterns of responses evoked by IAPS stimulation and on differentiation among several emotions. Namely we showed that disgust and sadness could be distinguished by ANS responses and disgust and happiness by EEG measures .

However, we outlined as well difficulties in eliciting certain emotions, such as fear and anger [30]. Among the reason why we failed to induce fear and anger there might be attributed cultural differences, namely responses to the slides from IAPS "fear" categories demonstrated response pattern more typical for attention and orienting [11, 14, 15, 22, 24, 30, 33]. Responses did not showed signs of cognitive evaluation of slides as "fearful" enough (i.e., intensively aversive) leading to defensive response of "fight-or-flight" type [5, 9, 17, 26, 33]. KAPS project was in part proposed to fulfill these shortcomings and to have available affective pictures invariantly evoking intended emotional states in Korean viewers. Some preliminary results on KAPS have been already presented [20].

Reproducibility of significant effects in autonomic nervous system (ANS) responses, including reproduction of the differentiation of response profiles in different emotions, is another important topic in studies with affective visual stimulation. Analysis should take into account both compatibility of results from different laboratories and reproducibility of emotion-specific ANS activity within one laboratory (in a case of application of different experimental contexts, with repeated exposure to the same stimulus, or different slides from similar category). Cross-cultural differences in psychophysiological manifestation during basic emotions continue to be an interesting material for research and encourages worldwide studies in this area.

Above mentioned issues implicate necessity to use autonomic variables sensitive enough for differentiation of emotions [1, 2, 6-7, 21, 23, 25, 27, 28]. Research data indicated possibility that two or more emotions do differ not only on a single ANS measure, but they do differ in the profile of pattern of produced physiological responses [2, 31]. In a comprehensive meta-analysis of physiological differentiation in emotions Cacioppo *et al.* (1993) stated that ".. there is little evidence for replicable autonomic differences in pairwise comparisons of the emotions on the measures of EMG, systolic blood pressure (BP), facial temperature, respiration, SCL and cardiac stroke volume..... too few data exist on several other measures (SCR, finger pulse volume, pulse transit time etc.) to permit to draw a strong conclusions" . Ekman *et al.* (1983) demonstrated SCL increase more in sadness than in fear, anger and disgust during imagery. Heart rate (HR), skin temperature (TEMP) and diastolic BP yielded more differentiation. TEMP increased more in anger than fear, and HR showed differentiation for sadness-disgust, disgust-anger, and fear-surprise pairs [2, 7, 21], being thus one of the best discriminators. But, on another hand there had been reported results indicating rather low reproducibility of HR to differentiate happiness-surprise, sadness-anger, sadness-fear, anger-fear, or surprise-disgust pairs [2, 27].

This problem could be explained partially by an inadequate scoring of responses, because potential patterns may not be described by gross output measures of an end-organ responses (e.g., HR) particularly for dually and antagonistically innervated organs (i.e., heart) [2, 5, 8, 19, 25, 26, 33]. Emotional stimuli do not invariantly evoke reciprocal activation of sympathetic (SNS) and parasympathetic (PNS) branches [5]. The resulting response of such measure as cardiac chronotropy could be determined by several combinations of ANS influences [5, 19, 25]. It is possible that emotions (e.g., anger vs. sadness) could be differentiated if the focus had been done on indices of SNS and PNS influences on heart rather than HR as such. Deciphering of the entire autonomic nervous system mechanisms mediating physiological responses during affective stimulation becomes possible if we use parameters specifically sensitive to activation of branches of autonomic nervous system (ANS). For instance, such parameters as respiratory sinus arrhythmia (RSA), high frequency (HF) component of heart period variability (HPV) could be as indices of parasympathetic activity [6, 8, 25, 26], while cardiac low frequency component of HPV (LF), vascular parameters (pulse volume, pulse transit time, skin temperature), and electrodermal variables as indices of sympathetic activity [1, 5, 19].

Stemmler (1992) introduced another crucial aspect in peripheral physiological emotion-specificity related to context-deviation. He outlined dependence of physiological responses on emotional stimuli and situational context (specific instructions which affect setting during particular experimental situation). This conceptual study emphasizes as well importance of the choice of experimental design to test autonomic emotion-specificity [31].

The aim of the study was to differentiate autonomic responses associated with emotions elicited by KAPS stimulation and to identify the role of instructions of emotional involvement during viewing slides on physiological response profiles.

Methods

Subjects and procedure.

Thirty two college students (19-24 years old females) participated in the study.. Participants after passing psychometric tests, brief introduction to experimental situation and attachment of electrodes were placed in recliner-chair in sound-proof room with dim lights, and further were instructed to sit quietly with eyes open and watch the screen where pictures had to be presented by Kodak slide-projector. Next, initial baseline measurements of physiological signals were taken. Six slides for 6 discrete emotions (Set A) were selected from KAPS. In the first trial subject were not given any specific instructions (passive viewing), while in the second trial the same slides were presented with specific instruction to "view slides and exert effort to experience relevant emotion" (active viewing). Baseline values were recorded during 30 sec periods, each picture was presented during 30 sec. Two trials with the slides from the same set of slides were presented to each subject. Order of slides was counterbalanced in each trial.

Equipment

Physiological signals were acquired by BIOPAC MP100WS hardware and AcqKnowledge III (v.3.5) software with sampling rate 512 Hz. Three Ag/AgCl electrodes were mounted for measurement of Lead I Electrocardiogram. Electrodermal activity was recorded with Ag/AgCl electrodes filled with isotonic Unibase gel (0.5 V DC technique was employed to measure skin conductance). Recorded were also finger photoplethysmogram (PPG) and skin temperature (TEMP).

Following physiological variables were recorded: Electrodermal activity, e.g., skin conductance level (SCL), specific skin conductance response amplitude (SCR, i.e., amplitude of SCR within 0.2-4.0 s from slide onset), non-specific SCR number (N-SCR); Cardiovascular activity: heart rate (HR), high (HF) and low (LF) frequency components and LF/HF ratio of heart rate period variability (HPV), respiratory sinus arrhythmia index (RSA) measured by peak-to-valley method as the mean difference between highest and lowest HR within each respiration cycle [8], pulse transit time (PTT), calculated as interval from R-wave to PPG ascending slope peak, finger pulse volume (PV), and finger skin temperature (TEMP).

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 ms^2) in baseline and experimental conditions. HF/LF ratio was calculated to measure ANS balance index. Normalized HF/LF reactivity index was calculated as $(HF/LF)n = (HF/LF_{condition} - HF/LF_{baseline}) / HF/LF_{baseline}$.

Statistical analysis was performed by SPSS package using one-way ANOVA, t-test for paired samples and correlation analysis for data with normal distribution of variables (Pearson's coefficients of correlation).

Results

Response profiles. Profiles of autonomic responses demonstrated similarity of patterns of responses for emotions induced by KAPS stimulation. Most typical responses in observed pattern included vascular responses (PV decrease and TEMP increase), electrodermal responses (N-SCR increase) and HR acceleration. However, happiness and surprise did not demonstrated HR changes, while sadness and surprise did not show N-SCR increase. The same time, fear was featured by significant RSA decrease, whereas happiness by decreased LF of HPV. Profiles of autonomic responses are displayed on Table 1. Most responses were reproducible in both trials, nevertheless there were observed certain exceptions, which are shown as *a* and *b* letters and express significance of particular response in only one of the trials.

Correlation analysis. We performed bivariate Pearson correlation analysis to find specific autonomic correlates of subjective rating of emotional experience during viewing KAPS slides. Table 2. displays correlation of subjective rating and ANS variables in both experimental trials and correlation of ratings between trials. Surprise and fear emotions demonstrated high subjective reproducibility ($r=0.60$ and 0.46 respectively, $p<0.01$). Disgust had highest number of autonomic correlates (RSA, HF, TEMP and SCR), followed by anger (PTT, LF and SCR). Sad and surprise showed less correlation with ANS parameters (PTT, RSA and SCR), whereas fear did not correlate with any autonomic measure at all. It should be noted that surprise rating showed positive correlation with PTT and RSA.

Correlation between autonomic balance index (normalized HF/LF ration of HPV) and LF and HF components was performed

Table 1. Summary of ANS response profiles in 2 trials with the same KAPS slides.

	HR	RSA	LF	TEMP	PV	N-SCR	SCL
ANGER	increase			increase^{b}	decrease	increase	
DISGUST	increase				decrease	increase	decrease^{b}
FEAR	increase	decrease			decrease^{a}	increase	
HAPPINESS			decrease^{b}	increase	decrease	increase	decrease
SADNESS	increase			increase^{a}	decrease		decrease
SURPRISE					decrease		decrease

Responses are shown as changes to baselines. Only changes significant by t-test are presented ($p<0.05$).
a - responses significant only in trial without instruction.
b - responses significant only in trial with instruction.

Table 2. Correlation of subjective emotion ratings and ANS responses elicited by the same KAPS slides in 2 trials.

	ANS variables						Subjective rating (1 vs. 2 trial)
Emotion	PTT	RSA	HF	LF	TEMP	SCR-A	
ANGER	-0.35^{*b}			0.38^{*a}	-0.41^{*a}		
DISGUST		-0.48^{**a}	-0.48^{**b}		-0.35^{*a}	-0.55^{**a}	
FEAR							0.46^{**}
SADNESS	-0.49^{**b}					0.52^{**b}	
SURPRISE	0.40^{*a}	0.39^{*a}					0.60^{**}

Only significant Pearson correlation coefficients are presented (N=32).
a - significant only in trial 1 (no instructions) , b - significant only in trial 2 (instructions).
* $p<0.05$, ** $p<0.01$.

Table 3. Correlation matrix between normalized HF/LF ratio of HPV(autonomic balance index) and HF and LF changes during KAPS stimulation in 2 trials with the same slides.

	Trial 1 (no instructions)		Trial 2 (instructions)	
Emotion	(HF/LF)n-LF	(HF/LF)n-HF	(HF/LF)n-LF	(HF/LF)n-HF
ANGER	-0.64^{**}		-0.49^{**}	
DISGUST	-0.63^{**}	0.42^{*}	-0.41^{*}	0.49^{*}
FEAR		0.54^{**}		0.48^{**}
HAPPINESS	-0.60^{**}		-0.49^{*}	
SADNESS	-0.48^{**}		-0.53^{**}	
SURPRISE		0.44^{*}	-0.43^{*}	

Only significant correlation coefficients are shown. *$p<0.05$, ** $p<0.01$

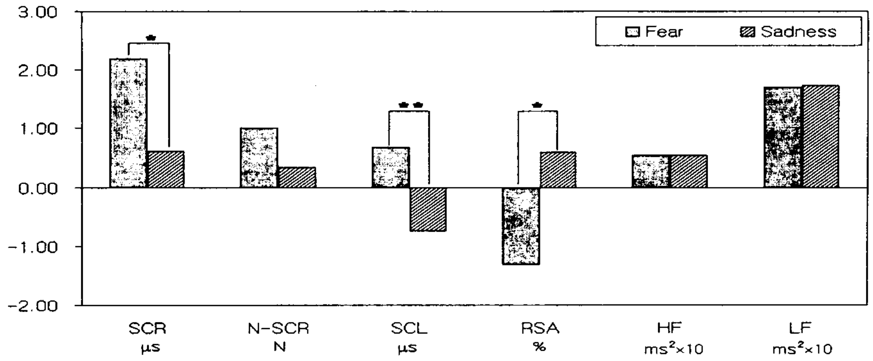

Figure 1. Pairwise comparison of fear-sadness profiles during KAPS stimulation. The second trial with instructions. SCR, SCL change and RSA change demonstrated differentiation. Asterisks denotes significant differences of particular ANS responses by paired-sample t-test. * $p<0.05$,** $p<0.01$.

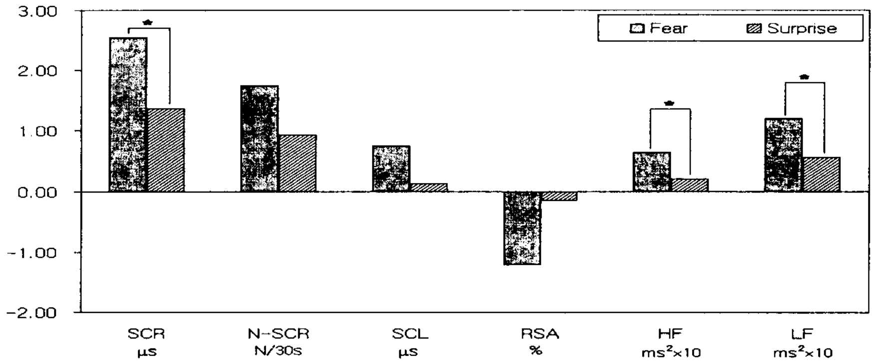

Figure 2. Pairwise comparison of fear-surprise profiles during KAPS stimulation. The first trial without instructions. SCR, HF and LF components of HPV demonstrated differentiation. Asterisks denotes significant differences of particular ANS responses by paired-sample t-test. * $p<0.05$,** $p<0.01$.

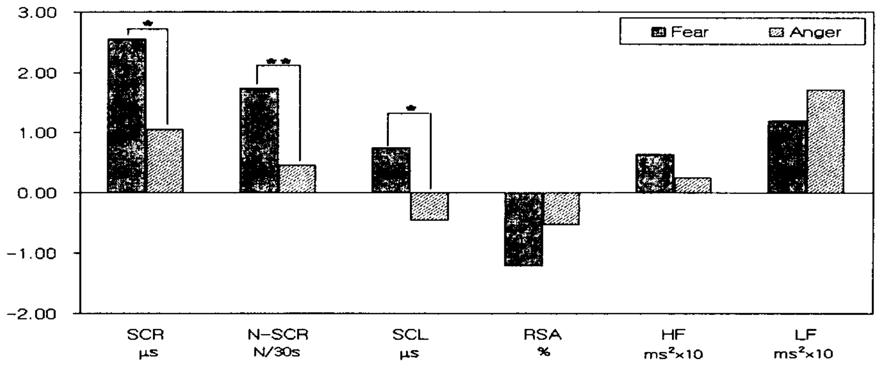

Figure 3. Pairwise comparison of fear-anger profiles during KAPS stimulation. The first trial without instructions. SCR, N-SCR frequency change and SCL change demonstrated differentiation. Asterisks denotes significant differences of particular ANS responses by paired-sample t-test. * $p<0.05$,** $p<0.01$.

to identify determinants of autonomic balance changes (and relevant HR responses) for each emotion in both trials. Most important findings of this analysis were in demonstration that anger, happiness and sadness ("approach" tendency) showed negative correlation with LF in both trials (SNS mediation of response), while fear showed positive correlation with HF ("avoidance" , PNS mediated). Autonomic balance in disgust showed correlation both with HF and LF, whereas surprise-mixed response. These data are presented on Table 3.

Autonomic differentiation of emotions. One-way ANOVA analysis was performed to differentiate ANS responses accompanying emotions elicited by KAPS in both trials. Results are summarized on Table 4. Most reliable discrimination was observed for fear-sadness pairs, namely fear had higher specific SCR amplitude in both trials (2.41 μS and 2.21 μS compared to 0.87 μS and 0.60 μS in sadness respectively, ps<0.05), and bigger magnitude of RSA response in the second trial (-1.30 bpm in fear, 0.63 bpm in sadness, p<0.05). Fear-anger pair showed differentiation only in the first trial by electrodermal variables : SCR (2.41 μS in fear vs. 1.05 μS in anger, p< 0.01) and non-specific SCR frequency change (1.75 N/30s in fear vs. 0.45 N/30s in anger, p< 0.01). Fear-surprise pair was distinguished by LF in the first trial (p< 0.01). ANOVA did not show differences in any ANS variables between trials with instruction or without instruction. All differences were not significant. Thus instructions in our study could not be considered as a factor influencing physiological outcome during viewing affective pictures.

Table 4. Differentiation of emotions by ANS parameters during KAPS stimulation.

Pairs/ANS variables	SCR-A	RSA	N-SCR	LF
Fear-Sad	$>^{ab}$	$<^{b}$		
Fear-Anger	$>^{a}$		$>^{a}$	
Fear-Surprise				$>^{a}$

< magnitude of ANS variable is more in the first emotion in pair. > - more in the second emotion.
a - significant in trial 1 only, b - significant in trial 2 only, a,b - significant in both trials.

More detailed analysis with paired sample t-test using both phasic (responses calculated as changes from baseline) and tonic measures (absolute values of parameter) enabled to identify more variables which differentiate KAPS elicited emotions. However, some parameters were demonstrating only marginal significance of differentiation. Fear-surprise and fear-sadness conditions were differentiable by tonic levels of LF and HF in the first trial (ps< 0.05) and SCL changes (p<0.05). Best autonomic differentiation by paired t-test was found for fear-anger and fear-surprise pairs in the first trial and fear-sadness in the second. Some of results of profiles comparison are shown on Figure 1-3.

Discussion

The analysis of obtained results demonstrated reproducibility of responses to KAPS slides in both sessions with different contexts (passive vs. instructed viewing). Pairwise comparison of mean data of physiological responses and tonic levels in emotion conditions revealed the most pronounced differentiation for "fear-anger" and "fear-sadness" pairs (by N-SCR, SCR amplitude, RSA index change and tonic HPV variables). "Fear-surprise" pair was also well differentiable (HF and LF of HPV). It should be mentioned that the typical response profile for all emotions included HR acceleration (except happiness and surprise), an increase of N-SCR, and a decrease of PV. References on HR responses in experiments aimed to evoke emotions in different design are quite ambiguous [2-7, 10, 12, 15, 22, 25-27, 28-30, 35]. It has been reported HR acceleration in studies manipulating facial expressions [7, 21], and imagery [27, 28], visual traumatic stimuli [3], or for phobic subjects [9, 12-13]. In passive viewing (e.g., IAPS stimulation) HR response showed phasic deceleration with greater decrease for slides of negative valence [4, 10, 11, 15, 18] and also in our own data [29, 30, 35]. 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 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 capable to evoke imprinted fear in Koreans with strong ancient folk beliefs in mystical spirits and shaman symbols. On other hand, 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 incongruity of such behavior.

Despite the fact that HR did not differentiate emotions in our study, other cardiac responses still proved to be sensitive enough. Namely parasympathetic index such as RSA was found to decrease more in fear than in sadness, and autonomic cardiac balance in fear more dependent on HF changes (i.e., parasympathetic withdrawal) than in anger (Table 3). HF/LF ratio changes in the latter emotion showed more dependence on LF changes and subjective rating scores of anger correlated with LF measures (SNS activity increase). Electrodermal variables (SCL, SCR, and N-SCR) also demonstrated efficiency in differentiation of emotions in our study and these results are compatible with assumption that phasic and tonic skin conductance measures could be used as markers of emotional states, especially in arousal dimension [1, 4, 15, 18, 24 34, 35]. Manipulations with situational context with instructions to exert efforts to experience more vivid emotion (active viewing) did not affected physiological profiles and only slightly modulated ability to differentiate emotions by ANS variables. Higher cardiovascular and electrodermal reactivity to fear emotion observed in this study, e.g., as compared to data with IAPS as stimuli [30], can be explained by closer cultural relevance and higher effectiveness of KAPS in producing certain such as fear in Koreans.

References

[1] Boucsein, W. (1999). Electrodermal activity as an indicator of emotional processes. *Korean Journal Science of Emotion Sensibility,* 2, 1-25.

[2] Cacioppo J.T., Klein, D.J., Bernston, G.G., & Hatfield, E. (1993). The psychophysiology of emotion. In : M.Lewis, & G.Haviland (Eds.). *Handbook of emotions.(* pp. 119-142). New York: Guilford.

[3] Christianson, S.A. (1987). Emotional and autonomic responses to visual traumatic stimuli. *Scandinavian Journal of Psychology,* 28, 83-87.

[4] Cuthbert, B., Bradley, M., & Lang. P.J. (1996). Probing picture perception: Activation and emotion. *Psychophysiology,*

33, 103-11.
[5] Fernandez, M.C., & Vila, J. (1989) Sympathetic-parasympathetic mediation of the cardiac defense response in humans. *Biological Psychology*, 28, 123-133.
[6] Fredrickson, B. (1997). Vagal tone moderates the undoing effects of positive emotions. *Psychophysiology,* 34, S36.
[7] Ekman, P., Levenson, R.W., & Friesen W.V. (1983). Autonomic nervous system distinguishes among emotions. *Science,* 221, 1208-1210.
[8]Grossman, P., & Wientjes, C. (1986). RSA and parasympathetic cardiac control. In Grossman et al. (Eds) *Cardiorespiratory and cardiosomatic psychophysiology* (p. 117-138) N.Y.Plenum.
[9] Hare, R.D. (1973). Orienting and defensive responses to visual stimuli. *Psychophysiology*, 27, 559-567.
[10] Hubert, W., & de Jong-Meyer, R. (1990). Psychophysiological response patterns to positive and negative film stimuli. *Biological Psychology*, 31, 73-93.
[11] Jennings, J.R. (1986) Bodily changes during attending. In M.G.H.Coles, E.Donchin, & S.W.Porges (Eds.), *Psychophysiology: Syste강도 함수, Processes and Applications* (pp. 268-289), New York: Guilford.
[12] Klorman, R., Weisberg, R.P., & Austin, M.L. (1975). Autonomic responses to affective visual stimuli. *Psychophysiology,* 12, 553-560.
[13] Klorman, R., Weissberg, R.P., & Weisenfeld, A.R. (1977). Individual differences in fear and autonomic reactions to affective stimulation. Psychophysiology, 14, 45-51.
[14] Lacey, J.L., & Lacey, B.C. (1970). Some autonomic-central nervous system interrelationships. In: P.Black (Ed.), *Physiological correlates of emotion* (pp. 205-227), New York: Academic Press.
[15] Lang, P.J. (1995). The emotion probe: Studies of motivation and attention. *American Psychologist*, 50, 372-385.
[16] Lang, P.J. (1997) *International Affective Picture System (IAPS): Technical manual and affective rating*. NIMH Center for study of emotion and attention, Gainsville.
[17] Lang, P.J., & Bradley, M.M. (1999) The defense cascade. *Psychophysiology,* 36, S3.
[18] Lang, P.J., Bradley, M.M., & Cuthbert, B.N. (1997). Motivated attention: Affect, activation, and action. In P.J.Lang, R.F. Simons, & M.T.Balaban (Eds.) *Attention and orienting* (pp. 97-135). Hillsdale, NJ: Erlbraum.
[19] Larsen, P.B., Schnerderson, N. & Pasin R.D.C. (1986). Physiological bases of cardiovascular psychophysiology. In M.G.H.Coles, E.Donchin & S.W.Porges (Eds.), *Psychophysiology: Systems, Processes and Applications*. (pp. 122-165). New York: Appleton-Century-Crofts.
[20] Lee K.-H., Yi, I., Park, K.-J., Choi, S., & Sohn J.-H. (1998). Development of a standardized Korean Affective Picture System (KAPS): A preliminary study. *Proceedings Korean Society for Emotion and Sensibility Fall' 99 Conference, November 20-21*, 74-79.
[21] Levenson R. W. (1994) The search for autonomic specificity. In : P.Ekman & R.J.Davidson (Eds.) *The Nature of Emotion* (pp. 252-257).New York: Oxford University Press.
[22] Libby, W.L., Lacey, B.C., & Lacey, J.I. (1973). Pupillary and cardiac activity during visual attention. *Psychophysiology,* 10, 270-294.
[23] Nyklicek I., Thayer J., Van Doornen J. (1997) Cardiorespiratory differentiation of musically-induced emotions. *J. Psychophysiology*, 11, 304-321.
[24] Ohman, A., Esteves, F., Flykt, A. & Soares J.J. (1993). Gateways to consciousness: Emotion, attention and electrodermal activity. In: J.-C.Roy, W.Boucsein, D.C.Fowles, & Gruzelier J.H.

(Eds.). *Progress in electrodermal research* (pp. 137-157), New York, Plenum .
[25] Porge S. (1991) Vagal tone: An autonomic mediator of affect. In J. Garber & K.A. Dodge (Eds.) *The development of emotion regulation and dysregulation* (p. 111-128) Cambridge: University Press.
[26] Reyes, G., Godoy, J., & Vila, J. (1993). Respiratory sinus arrhythmia as an index of parasympathetic cardiac control during the cardiac defense response. *Biological Psychology,* 35, 17-35.
[27] Schwartz, G.E., Weinberger, D.A., & Singer, J.A. (1981). Cardiovascular differentiation of happiness, sadness, anger and fear following imagery and exercise. *Psychosomatic Medicine*, 43, 343-364.
[28] Sinha, R., Lovallo, W.R., & Parsons, O.A. (1992). Cardiovascular differentiation of emotions. *Psychosomatic Medicine*, 54, 422-435.
[29] Sohn, J.-H., Yi, I., Lee, K.-H., & Sokhadze E. (1998) ANS and EEG differentiation of emotions induced by pictorial stimuli. *Psychophysiology*, 35, S75.
[30] Sohn, J.-H., Sokhadze, E., Yi, I., Choi, S., Lee, K.-H., & Sohn J.-H. (1998). Patterns of autonomic responses to affective visual stimulation: SCR, HR and respiration rate vary across discrete elitited emotions. *Korean J. Science of Emotion & Sensibility, 1*, 79-91..
[31] Stemmler, G. (1992). The vagueness of specificity: Models of peripheral physiological emotion specificity in emotion theories and their experimental discriminability. *J. of Psychophysiology,* 6, 17-28.
[32] Vila, J. (1999). Cardiac component of the defense response. *Psychophysiology,* 36, S3.
[33] Vila J., Perez, M.N., Fernandez, M.C., Pegalajar, J., & Sanchez M. (1997) Attentional modulation of the cardiac defense response in humans. *Psychophysiology*, 34, 482-487.
[34] Witvlet, C., & Vrana, S. (1995). Psychophysiological responses as indices of affective dimensions. *Psychophysiology*, 32, 436-443.
[35] Yi, I., Lee K.-H., Sokhadze, E., Choi S., & Sohn J.-H. (1998) . Physiological differentiation of emotional states by pictorial stimuli of positive and negative valence in passive viewing mode. *Proceedings Korean Society for Emotion and Sensibility Fall' 99 Conference, November 20-21*, 143-147.