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INDIVIDUAL DIFFERENCES ASSOCIATED WITH CARDIAC DEFENCE RESPONSE: PSYCHOPHYSIOLOGICAL AND PERSONALITY VARIABLES

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Individual differences associated with cardiac defence response: psychophysiological and personality variables. The aim of this work was to analyse individual differences associated with the cardiac components of the defence reflex. 144 subjects underwent a psychophysiological reactivity test. During the test some psychophysiological measures (heart rate, finger pulse amplitude, respiratory period and amplitude and respiratory sinus arrhythmia amplitude) and self-report measures (subjective reactivity to sounds, anxiety, anger and Type-A behaviour pattern) were simultaneously recorded. We found that: (a) a cluster analysis applied to changes in heart rate differentiated two groups of subjects, one that presented the typical cardiac defence response pattern and another that did not; (b) a discriminant analysis indicated that the variable that best discriminates the two groups is sinus arrhythmia amplitude.

El objetivo del trabajo fue analizar las diferencias individuales asociadas a los componentes cardíacos del reflejo de defensa. 144 sujetos realizaron una prueba de reactividad psicofisiológica. Durante la prueba se recogieron diversas medidas psicofisiológicas (tasa cardíaca, amplitud del pulso digital, amplitud y período respiratorio, y amplitud de la arritmia sinusal respiratoria) y de autoinforme (reactividad subjetiva a los sonidos, ansiedad, ira y patrón tipo-A). Encontramos que: (a) un análisis de cluster, aplicado a los cambios en la tasa cardíaca, diferenció dos grupos de sujetos, uno que presentaba el patrón típico de la respuesta cardíaca de defensa y otro que no; (b) un análisis discriminante indicó que la variable que mejor discrimina a los dos grupos es la amplitud de la arritmia sinusal.

Cardiovascular reactivity to physical or psychological stressors is not uniform for all individuals. It has been demonstrated that there are important individual differences in the form in which the cardiovascular system reacts to challenging conditions, be they of an aversive nature or an appetitive one (Lawler, 1980; Light, 1981; Manuck and Garland, 1979; Obrist, 1981; Turner, 1989; Turner and Carroll, 1985). On the other hand, these response trends are relatively stable over time and consistent in the face of different types of stimuli and situation (Allen, Boquet and Shelley, 1991; Pollak, 1984). The data from research has served as the basis for postulating that those people who are most reactive at a cardiac level have the greatest risk of developing cardiovascular disorders, such as hypertension (Armario, Hernández del Rey and Pardell, 1995; Armario, Torres, Hernández del Rey and Pardell, 1996; Lovallo, Pincomb and Wilson, 1986; Sherwood, Davis, Dolan and Light, 1992) or isquemic cardiopathy (Booth-Kewley and Friedman, 1987; Krantz and Manuck, 1984; Matthews, 1988; Smith, Baldwin and Christensen, 1990), and that, therefore, cardiac hyperreactivity may constitute an important physiological mechanism in the etiology of cardiovascular illness.

The objective of research in this field has been twofold: on the one hand, to study the physiological mechanisms involved in cardiac hyperreactivity and, on the other, to discover the psychological variables associated with an increase or decrease in the level of physiological activation. As far as the first aspect is concerned, early studies on the physiological significance of changes in heart rate –influenced by the ideas of Cannon (1929)– analyzed exclusively the influence of the Sympathetic Nervous System (SNS), ignoring the contribution of parasympathetic control and its role in the field of cardiovascular health. Later psychophysiological results (which indeed support the findings of some of the pupils of Cannon himself, e.g., Bond, 1943) show the need to consider the effects of both systems, and especially to take into account sympathetic-parasympathetic interactions as

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regulators of physiological responses in conditions of behavioural stress (Allen and Crowell, 1989; Grossman, Stemmler and Meinhardt, 1990; Grossman and Svebak, 1987; Myers, 1991; Reyes, Godoy and Vila, 1993; Reyes and Vila, 1993; Sloan, Korten and Reyes, 1992). The study of the second aspect, that is, the relationships between psychophysiological reactivity and self-report and/or dimensions of personality measures, offers more contradictory information (Blondin and Waked, 1991; Sherwood et al., 1992). Some evidence has been found relating psychophysiological reactivity to hostility levels (Light and Obrist, 1983) and to states of anger (Hodapp, Heiligtag and Störmer, 1990) and of anxiety (Chesney and Rosenman, 1985); however, these results have not always been corroborated (Blondin and Waked, 1991). On the other hand, gender differences in cardiovascular reactivity constitute one of the most well-demonstrated facts within this research approach. In general, it has been found that men present greater secretions of adrenaline and increases in systolic blood pressure in response to stressful stimulation, in comparison to women. Although data related to heart rate is more difficult to interpret, some studies defend the idea that gender differences in cardiovascular reactivity may provide an explanation for the different rates of coronary mortality and morbidity found in men and in women (Stoney, Davis and Matthews, 1987). Nevertheless, this is still a somewhat controversial topic.

An important part of this line of research has dealt with the analysis of individual differences in relation to different types of reflex, such as those of being startled and of defence (Cloete, 1979; Eves and Gruzelier, 1984; 1985; Fernández and Vila, 1989a; 1989b; Turpin and Siddle, 1978; 1981; Vila and Beech, 1978; Vila and Fernández, 1989). The cardiac components of the defence reflex –Cardiac Defence Response (CDR)– constitute a pattern of cardiac reactivity observed after the presentation of intense or aversive stimulation, such as electric shocks or very loud noises lasting for half a second. This pattern includes two accelerative cardiac components and two decelerative ones (relative to the pre-stimulation baseline), presented sequentially, that last for 80 seconds after stimulus presentation and which, moreover, are sensitive to changes in stimulus conditions. This response pattern can be used as a working model, both for studying the significance of changes in heart rate and for analysing the cardiac reactivity that appears in stressful situations (Cook and Turpin 1997; Fernández and Vila, 1989a).

Individual differences have been found in the facility with which the pattern typical of this response is manifested. Vila and Beech (1978) found inter-individual differences: the pattern of CDR was more frequent in phobic women examined in the pre-menstrual period than in phobic women examined in the inter-menstrual phase. It is also possible to classify subjects according to the typical pattern of CDR that they present on receiving stimulation. Eves and Gruzelier (1984), after administering intense auditory stimulation, differentiated three groups of subjects, "Accelerators", "Decelerators" and "Atypical". "Accelerators" were characterized by presenting a clear cardiac acceleration with long latency; "Decelerators" presented a marked deceleration; "Atypical" subjects, meanwhile, presented no characteristic response to the sound. In the same line, Fernández and Vila (1989c) established two groups of subjects, one that presented the complete response pattern, with the four accelerative and decelerative components, and the other characterized by not presenting the second cardiac acceleration. They also found significant differences between men and women in the second acceleration, with men presenting higher values. Finally, Robles (1988) replicated the results on gender differences, and also found an interaction between Type-A behaviour pattern and sex, with Type-A men and Type-B women being the subjects that most frequently presented the second cardiac acceleration.

There is as yet scarce research data on the psychological significance of individual differences in CDR. Richards and Eves (1991) studied whether the presence or absence of the long latency acceleration could be predicted from personality characteristics. That is, they tried to establish whether "Accelerators" and "Decelerators" presented differences in any personality features. In order to do so, they selected some personality characteristics that fulfilled two requirements: to present behavioural profiles that were stable over time and consistent across different situations, and to bear some relation to physiological reactivity parameters. Specifically, they chose measures of the dimensions of Extraversion (E) and Neuroticism (N), as described by Eysenck, and the properties of Excitatory Force (EF), Inhibitory Force (IF) and Mobility (M) of the Nervous System, following the criteria of Pavlov. In the first place, they found that introverted subjects (with low scores in E), subjects with high scores in N, and those with low scores in EF and IF maintained, throughout the experiment, higher heart rate levels than extraverted subjects, stable subjects and those that presented high scores in EF and IF. Secondly, they found no relationship between presentation of the first cardiac acceleration in response to the sound and any of the personality scores. However, a relationship was found in the case of the long latency acceleration: those subjects with low scores in EF and M presented a more pronounced second cardiac acceleration than subjects with high scores in these variables.

The objective of the present work was to make progress in the study of the significance of individual differences in the production of the CDR. Our intention is to study, on the one hand, the extent of the relationship between individual differences in the manifestation of the CDR and individual differences in other psychophysiological variables and self-report measures and, on the other, to examine which measures (psychophysiological and self-report) allow discrimination between groups of subjects with differences in the display of CDR.

METHOD

Subjects

144 Psychology students (48 men and 96 women) from the University of Granada participated in the research, with ages ranging from 19 to 39 years (Mean=23, Standard deviation=3.31). None of them were receiving psychiatric or pharmacological treatment, nor had any vision or hearing problems. Subjects were divided in two groups according to whether or not they presented the second cardiac acceleration in a test of psychophysiological reactivity.

Individual differences in the production of the CDR (first presentation of auditory stimulation) were established in accordance with the profile of changes in heart rate presented by subjects. To this end, a cluster analysis was applied, using the program KM of the BMDP/386, to the second-by-second heart rate data during the 20 to 45 seconds following the presentation of the first auditory stimulus. This period was selected as it is that which best picks up the second accelerative component of the CDR which, in turn, and following previous studies (Fernández and Vila, 1989c), is that which allows the clearest differentiation of subjects presenting the typical pattern of CDR, as opposed to those that do not present it. Also, a three-category cluster analysis was selected on the grounds of being that which produced the best agreement with an external criterion of classifications based on the maximum points of acceleration and deceleration (Vila and Fernández, 1989). In this way, we hoped to guarantee that the division of the two groups would be made according to whether or not subjects produced the typical pattern –external criterion– and that the main differences would be concentrated in the second acceleration –cluster analysis. Cluster 1 (n=31) produced an agreement of 100% with the subjects classified as producing CDR in accordance with the external criterion. Cluster 2 (n=54) produced an agreement of 90.74% with the same group of subjects, while Cluster 3 (n=59) produced an agreement of 81.36% with the subjects classified as non-producers of CDR according to the external criterion. Thus, two groups of subjects were established: a first group (n=85) of CDR producers (Cluster 1-2) and a second group (n=59) of non-CDR producers (Cluster 3). Figure 1 represents graphically the response pattern for the two groups (Cluster 1-2 and Cluster 3). It can be seen that the subjects of Cluster 1-2 produce the typical pattern of CDR (acceleration and deceleration with short and long latency), while Cluster 3 presents only an initial acceleration followed by a prolonged deceleration

Apparatus

- POLYGRAPH: For the recording of the psychophysiological variables a GRASS polygraph (model Rps 7c 8b) was used. Heart rate was recorded by means of a GRASS pre-amplifier, model 7P4, through which the Electrocardiogram –derivation II– was produced. This served as an input to a cardiotachometer, from which the beat-by-beat heart rate recording was obtained. The biological signal was registered by means of two active plate electrodes, 5 cm by 3 cm (LETICA), with a hypertonic electrolytic gel (Beckman) being applied between skin and electrode. Electrodes were fastened with elastic bands. The earth electrode was adapted to the leg using an adjustable strap. Breathing activity was recorded using a pre-amplifier 7P1 G, by means of a GRASS pneumatic transducer (model PRT), situated in the middle of the thorax. Finally, recording of finger pulse amplitude was made using a pre-amplifier 7P1 J, by means of a GRASS photoelectric plethysmograph located on the index finger of the right hand.
- AUDITORY STIMULATOR: For generating the sounds a Letica LE100 was used. This device allows the presentation of stimuli between 100 and 10,000 Hz, 0 and 120 dB and with adjustable duration. Subjects heard the sounds through a headset, model SUN-SE. Sound intensity was calibrated with a sound spectrograph (Brüel & Kjaer, model 2235) using an artificial ear (Brüel & Kjaer model 4153).
- STIMULUS PROGRAMMER: a Letica LE 2000 bank timer, with 10 channels independently adjustable from 1 to 999 tenths of a second, was used for controlling the presentation sequence of the stimuli and the duration parameters.

- COMPUTERISED SYSTEM: Recording of the psychophysiological variables was processed by means of a computerised system using a 12-bit analogue-digital converter made by Med (model ANL-947), connected to an IBM PC/XT computer that registered 25 samples per second. An input-output card (Data Translation, model DT-2817), connected to the computer and the stimulus programmer, controlled the presentation sequence of the stimuli. Each subject's bioelectric values were digitised, represented graphically on the computer screen through 3 channels and stored on the hard disk, for their subsequent analysis.

Procedure

The research was carried out in individual laboratory sessions with an approximate duration of 90 minutes, divided in three phases:

(1) Pre-experimental phase. Subjects filled out a form, giving details of their age, past and current illnesses, pharmacological or psychiatric treatment and vision or hearing problems; they were also administered Spielberger, Gorsuch and Lushene's anxiety inventory (STAI, Spanish version by TEA, 1982) in its two scales (A/R –trait– and A/E –state) and Spielberger's anger inventory (STAXI, 1988) in its three scales (Trait, State and Expression). Next, the instructions were read relating to the experimental session and the placing of the electrodes and sensors. First, the respiration transducer was positioned, followed by the electrodes of the EKG, and finally by the plethysmograph that picked up the pulse signal. At the end of this process the headset was fitted and adjusted.

(2) Experimental phase. During this phase, the psychophysiological reactivity test was carried out. This consisted in the presentation of 4 intense auditory stimuli (109 dB, 400 Hz, 0.5 seconds and virtually instantaneous onset time) according to the following sequence: a) a 10-minute initial adaptation period; b) the presentation of three sounds with 100 seconds between stimuli interval, and c) the presentation of a fourth sound, 5 minutes after the third. During this phase, the experimenter left the room where the subject was and reduced the lighting to a pre-established level of dimness.

(3) Post-experimental phase. Once the test had finished, the headphones, sensors and electrodes were removed, and the subject completed the Subjective Reactivity to Sounds Questionnaire, Scale E of the STAI, the State Scale of the STAXI and the JASE Questionnaire on Type-A Behaviour Pattern by Bermúdez, Sánchez Elvira and Pérez García (1988). After this, the experimental session was deemed to have been completed.

Measures

- HEART RATE. Tonic levels: Average second-by-second heart rate in the 15 seconds prior to auditory stimulation onset. Specific responses: second-by-second heart rate, expressed in terms of differential scores with respect to tonic level, during the 80 seconds following auditory stimulus onset. The form of the response was analyzed, reducing the 80 heart rate values to 10 values corresponding to the medians of 10 progressively longer intervals, in accordance with the descriptive characteristics of the CDR, thus facilitating the subsequent statistical analysis (Vila and Fernández, 1989).
- FINGER PULSE AMPLITUDE. Tonic levels: Average second-by-second finger pulse amplitude in the 15 seconds prior to stimulus onset. Specific responses: the recorded parameter was second-by-second pulse amplitude during the 80 seconds following stimulus onset, expressed in terms of percentage change with respect to average pulse amplitude during the 15 seconds prior to stimulus onset. The 80 pulse amplitude values were reduced to 10 values, corresponding to the medians of the same periods as those for heart rate, also expressed in terms of percentage change with respect to the mean of the 15 seconds prior to stimulus presentation.
- BREATHING ACTIVITY. Two parameters of breathing activity were obtained, respiratory amplitude and respiratory period. Tonic levels: For each parameter, tonic levels were recorded for the same periods as for heart rate and finger pulse amplitude. Specific responses: both for respiratory amplitude and respiratory period we obtained, in the trials with stimulation, the cycle-by-cycle values during the 80 seconds following the presentation of each auditory stimulus, which were reduced to 10 values corresponding to the medians of the same intervals as for heart rate and pulse amplitude, expressed in terms of percentage change (respiratory amplitude) or differential scores (respiratory period) with respect to the average values of the 15 seconds prior to the presentation of each stimulus.
- RESPIRATORY SINUS ARRHYTHMIA AMPLITUDE. Respiratory sinus arrhythmia amplitude was obtained as the mean (sum of the individual respiratory sinus arrhythmia amplitudes) divided by the number of respiratory cycles for the 15 seconds before and 80 seconds after stimulus onset and for the individual respiratory cycle in which the stimuli were presented and the cycle immediately afterwards. As with the other variables, during the trials

with stimulation, the cycle-by-cycle values of sinus arrhythmia during the 80 seconds following stimulus presentation were reduced to 10 medians that corresponded to the periods already referred to, expressed once more as differential scores with respect to the mean of the 15 seconds prior to stimulus presentation.

- STATE-TRAIT ANXIETY INVENTORY (STAI): We used the Spanish adaptation of the State-Trait Anxiety Inventory (STAI) of Spielberger et al. (1982), published by TEA. The questionnaire includes two scales, Anxiety/State (A/E) and Anxiety/Trait (A/R).
- SUBJECTIVE REACTIVITY TO SOUNDS QUESTIONNAIRE: This includes two types of information, intensity and unpleasantness of the sounds, and emotional reactions to them, assessed using a list with 8 adjectives referring to 8 different emotional reactions (surprised, annoyed, frightened, sad, startled, nervous, depressed and happy), scored on a 1 to 7 scale (1 medians “not at all” and 7 “a lot”), with respect to the subject’s experience of the emotion or feeling described.
- ANGER INVENTORY (STAXI): We used a Spanish adaptation of Spielberger’s STAXI (State-Trait Anger Expression Inventory) (1988), which assesses the construct of anger. The questionnaire contains three scales, referring to Trait, Expression and State of Anger.
- QUESTIONNAIRE ON TYPE-A BEHAVIOUR PATTERN (JASE): We used a version of Jenkins’ Activity Questionnaire for students, developed by Bermúdez et al. (1988) for assessing Type-A behaviour pattern. It contains 4 scales: General (A), Competitiveness (H), Overwork (J) and Impatience (S).

RESULTS

We shall now present the analysis of the differences between the two reactivity groups by applying the techniques of, first, analysis of variance (ANOVA), and second, discriminant analysis.

ANOVA: Figures 1 and 2 show the response patterns for each group on initial presentation of stimulus in each of the psychophysiological variables. The first presentation of the sound produces differences between the groups in the measures of respiratory amplitude (main effect of the factor Group: F(1,142)=5.39, p(0.0216) and respiratory period (main effect of the factor Group: F(1,142)=4.06, p(0.0457), and in the response pattern of respiratory sinus arrhythmia amplitude (effect of Group x Medians interaction: F(9,1278) = 3.71, p(0.0001), these differences being located in the medians 5 (F(1,143) = 12.90, p(0.0005), 6 (F(1,143) = 11.93, p(0.0010) and 7 (F(1,143) = 7.06, p(0.0088). As regards the self-report measures, differences between groups were only found in the “startled” reaction to the sounds (F(1,143) = 4.55, p(0.0347). In all the cases the group of Cluster 1-2 shows greater respiratory amplitude, longer respiratory period and smaller respiratory sinus arrhythmia amplitude in the medians 5, 6 and 7. Likewise, it is the group that presents the greatest “startled” reaction.

DISCRIMINANT ANALYSIS: The main objective of this section was to study which psychophysiological and self-report variables could allow differentiation of the groups established through the cluster analysis. Two step-by-step discriminant analyses were carried out using the programme 7M of the BMDP/386. The first included only variables of psychophysiological reactivity (medians), whilst the second combined psychophysiological measures scores (tonic levels), self-report scores and the variable sex.

In the upper part of Table 1 we present the data of the discriminant function corresponding to the first analysis, including the direct values of each variable in brackets. The classification matrix for each group according to the function indicates that 81.4% of cases have been correctly classified for the group of Cluster 3, and 78.8% for the group of Cluster 1-2. According to these results, the variables that best discriminate subjects who present

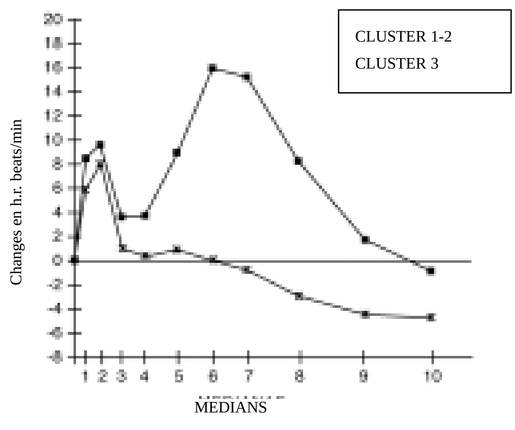

Figure 1. Pattern of heart rate response to the auditory stimulus produced by the two groups of subjects corresponding to Cluster 1-2 (n=85) and Cluster 3 (n=59). The mid-points of the 10 intervals represented on the *x*-axis correspond to seconds 2, 5, 9, 14, 20, 27, 34, 44, 57 and 70 post-stimulus.

greater reactivity in the second accelerative component when administered auditory stimulation are: higher value in the fifth median of the response pattern of respiratory amplitude; higher value in the fifth median of the response pattern of respiratory period; greater amplitude of respiratory sinus arrhythmia (greater parasympathetic control) in the first, eighth and tenth medians (first cardiac acceleration and second deceleration); and smaller amplitude of respiratory sinus arrhythmia (lower parasympathetic control) in the fifth and sixth medians (second accelerative cardiac component) (F (7,136) = 11.98, Wilks' Lambda = 0.62).

The lower part of Table 1 shows the discriminant function corresponding to the second analysis. In this case, the classification matrix shows that 70.4% of cases have been correctly classified for the group of Cluster 3, and 53.8% for the group of Cluster 1-2. The two variables included refer to the tonic levels of heart rate during the 15 seconds prior to presentation of the first and second auditory stimuli, which in both cases show higher values for the subjects that clearly present the second accelerative component (F(2,129) = 5.62, Wilks' Lambda=0.92).

DISCUSSION

There are important individual differences in the display of the cardiac defence response pattern. The cluster analysis allowed us to establish two groups of subjects: one that exhibited the typical pattern –acceleration and deceleration with short and long latency– and another that did not –absence of the second accelerative component. These results are coherent with those published previously by other authors (Fernández and Vila, 1989c; Richards and Eves, 1991). Also, subjects that present greater cardiac reactivity tend to exhibit greater reactivity in the form of response of the rest of the psychophysiological variables.

With regard to the form of the medians of pulse amplitude, we observed a non-significant tendency centred on a second vasoconstrictive component. The general pattern consists in a first vasoconstrictive component, similar in the two groups, followed by a vasodilation, or return to the baseline, and a second vasoconstrictive component that is only clearly appreciated in the high cardiac reactivity group (Cluster 1-2). As regards the pattern of respiratory amplitude, the significant differences are observed across all the medians, the highest

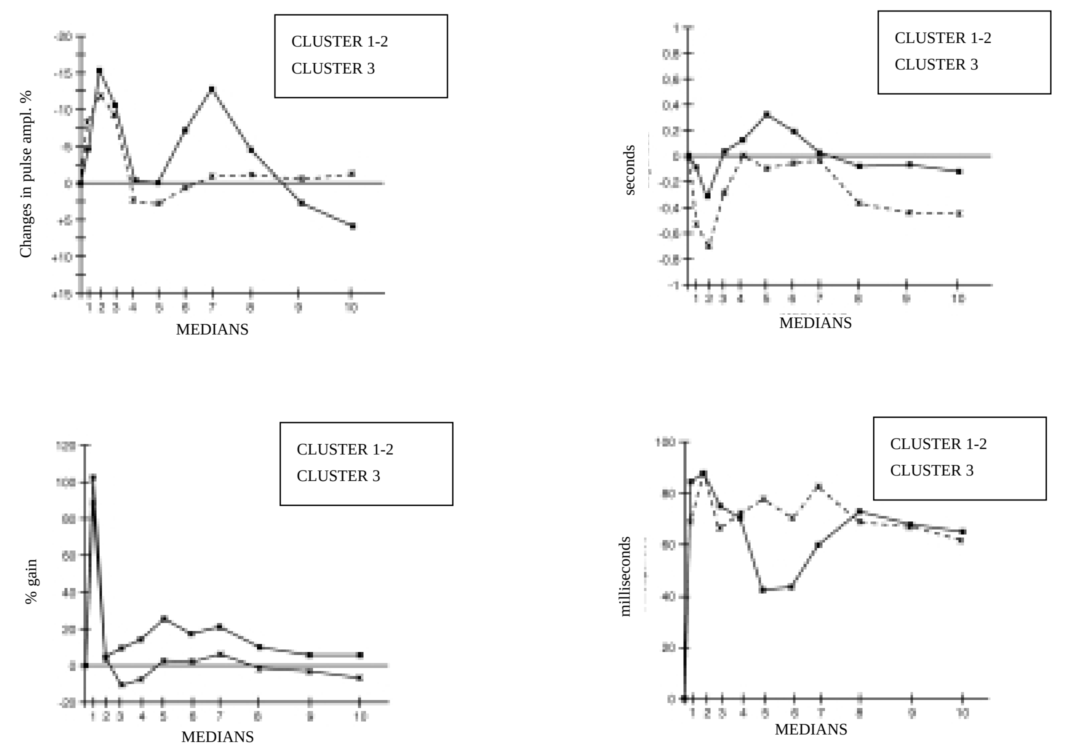

Figure 2. Response pattern of finger pulse amplitude (top left), of respiratory amplitude (bottom left), of respiratory period (top right) and of respiratory sinus arrhythmia (bottom right) on presentation of the auditory stimulus.

amplitude being for the group presenting the typical pattern of CDR. The results with respect to respiratory period also show significantly higher values in the high cardiac reactivity group. Lastly, significant differences are also found between the groups for the response pattern of respiratory sinus arrhythmia, centred on the medians 5, 6 and 7. These differences indicate lower vagal activation during the second cardiac acceleration in the group of subjects that present this component.

With regard to the results of the discriminant analysis, the most notable data concerns the absence of representation of the measures of self-report and of subjective reactivity to the sounds. In no case do these measures permit us to differentiate between the groups with different cardiac reactivity. They are results that reproduce, to a large extent, the data reported by Fernández and Vila (1989c) on the scarce representativeness of self-report variables in the discrimination of subjects exhibiting the cardiac defence response. The failure to find this relationship may be due to an inappropriate choice of self-report measures and/or to the research method employed. It should be borne in mind that, applying the methodology of Analysis of Variance, there does appear, at least, a significant difference in the self-report measures: that corresponding to the greater "startled" reaction in the high cardiac reactivity group (Cluster 1-2). With respect to the Type-A behaviour pattern, these results are consistent with those of Robles, Pérez and Reyes (1995). As in that study, in the present work no differences were observed between Type-A and Type-B subjects in the test of CDR. However, differences did appear between the two groups with low self-reported hostility. That is, there are relationships between cardiovascular reactivity and individual differences in personality dimensions, but such relationships may be masked if certain isolated variables are considered. Moreover, such differences can be observed not only in the initial reactivity to stimuli, but also in the habituation patterns –slow versus rapid– that appear when the original stimuli are repeated (Robles, 1988). Finally, we should point out the importance, in this context, of some dimensions, such as hostility, that should be taken into account in future research (García, 1997).

Table 1
Discriminant function 1 and 2 for the groups found in the Cluster Analysis. In brackets, the direct values of each variable

FIRST ANALYSIS		
VARIABLE	CLUSTER 3	CLUSTER 1-2
RESPIRATORY AMPLITUDE		
Median 5	-0.01725 (3.06)	0.15033 (25.42)
RESPIRATORY PERIOD		
Median 5	-0.34918 (-0.08)	0.15082 (0.34)
SINUS ARRHYTHMIA AMPLITUDE		
Median 1	0.04193 (68.71)	0.11347 (84.61)
Median 5	0.24032 (77.65)	-0.06201 (42.74)
Median 6	0.27704 (70.61)	0.03160 (43.61)
Median 8	-0.01103 (68.89)	0.13394 (72.80)
Median 10	0.02821 (61.75)	0.17037 (64.55)
CONSTANT	-2.80956	-2.36363
SECOND ANALYSIS		
VARIABLE	CLUSTER 3	CLUSTER 1-2
TONIC LEVELS		
Prior to stimulus 1	0.70723 (81.91)	0.62356 (84.55)
Prior to stimulus 2	-0.01742 (77.62)	-0.07485 (83.42)
CONSTANT	-22.89507	-23.93225

As for the psychophysiological variables, the results of the discriminant analysis clearly confirm the existence of variables that discriminate subjects exhibiting the second accelerative component on intense auditory stimulation: higher tonic level of heart rate prior to stimulus presentation, higher values in the fifth median of the respiratory amplitude response pattern, higher values in the fifth median of the respiratory period response pattern, greater respiratory sinus arrhythmia amplitude in the first, eighth and tenth medians (first cardiac acceleration and second deceleration), and smaller respiratory sinus arrhythmia amplitude in the fifth and sixth medians (second accelerative cardiac component).

These results suggest the existence of lesser vagal mediation during the second cardiac acceleration and greater vagal mediation during the first cardiac acceleration and second deceleration, results that are consistent with those of the ANOVAs applied to each psychophysiological variable separately. Taken as a whole, they confirm the existence of complex sympathetic-parasympathetic interactions during the manifestation of the cardiac defence response: on the one hand, the presence of coactivation during the first acceleration and first deceleration and, on the other, the presence of reciprocal interactions during the second acceleration and second deceleration (Fernández and Vila, 1989b.; Reyes et al., 1993; Reyes, Langewitz, Robles and Pérez, 1996; Reyes and Vila, 1993; Turpin and Siddle, 1978; 1981). This data allows us to explain the presence of the second accelerative component of the cardiac defence response in terms of inhibition of parasympathetic control over heart rate, an effect that promotes reciprocally the simultaneous sympathetic activation demonstrated in previous studies (Fernández and Vila, 1989b; Reyes et al., 1993). These effects constitute, in themselves, cardiovascular risk factors, given the known negative influence on cardiac health of both reduced parasympathetic control and increased sympathetic control. Consequently, these results provide empirical support for the proposal of various authors (Fernández and Vila, 1989a; Richards and Eves, 1991) that differences in CDR constitute a good model for the study of individual features of reactivity to environmental stressors that, in the long term, may contribute to the development of specific cardiovascular disorders

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