Psicothema
2001. Vol. 13, nº 1, pp. 57-62

ISSN 0214 - 9915 CODEN PSOTEG

Subjective and autonomic stress responses in alexithymia

Francisco Martínez-Sánchez, Beatriz Ortiz-Soria and Manuel Ato-García
University of Murcia

Alexithymia refers to a specific disturbance in emotional processing that is manifested through difficulties in identifying and verbalizing feelings. The main objective of this investigation has been the study about the relationship between subjective and autonomic physiological reactivity pattern to stressful laboratory situation, related with alexithymia level, assessed by the Toronto Alexithymia Scale, TAS-20. The experiment involved six phases: I-adaptation, II-relaxation, III-stress (mental arithmetic), IV-relaxation, V-stress (watching a distressing film), and VI-relaxation. During all periods, the subjective self-perception of physiological activation and autonomic reactivity (using the Palmar Sweat Index), was assessed. Results showed a significantly dissociation by group between subjective self-perception of physiological arousal and self-perception of affective arousal in questionnaire scores, during adaptation period exclusively. The results don't show significant correlations among groups between the subjective self-perception of activation and the autonomous reactivity. These results are discussed in terms of their alexithymic characteristics they are associated with autonomic arousal.

Respuestas subjetivas y autonómicas al estrés en la alexitimia. La alexitimia describe una alteración en el procesamiento emocional, manifestada mediante dificultades en la identificación y expresión emocional. Este trabajo examina la relación entre los patrones fisiológicos autónomos y subjetivos de activación en respuesta a una situación de estrés inducido experimentalmente, y el nivel de alexitimia, evaluado mediante la Escala de Alexitimia de Toronto, TAS-20. El experimento consta de seis fases: I-adaptación, II-relajación, III-estrés (aritmético), IV- relajación, V-estrés (visual), y VI-relajación. Durante el procedimiento experimental se registró tanto la percepción subjetiva de activación como la reactividad autónoma, empleando el Índice de Sudoración Palmar. Los resultados muestran diferencias significativas entre la percepción subjetiva de activación fisiológica y afectiva en función del nivel de alexitimia, exclusivamente durante el periodo de adaptación. Asimismo, no aparecen diferencias significativas entre la percepción subjetiva de activación y la reactividad autónoma. Los resultados se discuten en términos de la vinculación de la alexitimia con la activación autonómica.

The term Alexithymia (literally from Greek: lack of words for emotions), coined by Sifneos (1973) twenty years ago, refers to a specific disturbance in affective-emotional processing that is manifested through the following salient features: 1) difficulty in identifying and describing feelings and emotions verbally, 2) difficulty in distinguishing between feelings and somatic sensations that accompany emotional arousal, and 3) externally-oriented thinking and impaired symbolic activity (Taylor, 2000; Taylor, Bagby, & Parker, 1997). The most recent research has stressed the point that in alexithymia there is not only a difficulty in expressing emotions verbally but also a deficit in cognitive processing of emotions (Berenbaum & Prince, 1994; Jessimer & Markham, 1997; Martínez-Sánchez & Marín, 1997; Parker, Taylor, & Bagby, 1993; Roedema & Simons, 1999; Suslow, 1998); as a consequence, emotions remain undifferentiated and poorly regulated (Taylor, Bagby, & Parker, 1991).

Correspondencia: Francisco Martínez-Sánchez
Facultad de Psicología
Universidad de Murcia
30080 Murcia (Spain)
E-mail: franms@fcu.um.es

These characteristics are conceptualized both as an affect-deficit disorder and a continuous personality trait that correlates positively with neuroticism (Pandey & Mandal, 1996), depression (Hendryx, Haviland, & Shaw, 1991) and anxiety (Bagby, Taylor, & Atkinson, 1988). Some authors (Horton, Gewirtz, & Kreutter, 1992) argue that alexithymia could be considered also as a state consequent to depression and/or anxiety (Hendryx, Haviland, Shaw, & Henry, 1994), as well as the effect of some chronic psychopathologic and somatic disorders.

It has been hypothesized that the limited emotional awareness and cognitive processing of affects lead to prolonged and amplifies the physiological arousal and neurovegetative reactivity to stress (Infrasca, 1997; Martin & Pihl, 1986; Martínez-Sánchez, 1999; Papciak, Feurstein, & Spiegel, 1985) potentially disturbing the autonomic, pituitary-adrenal, and immune system. Dysregulation or heightened activation of the autonomic nervous system might explain the proneness to «functional» somatic disorder of individuals described as alexithymic. In addition, alexithymia is regarded as one of several possible risk factors that seem to increase the susceptibility to organic disease, certain types of unhealthy behavior, and a biased perception and reporting of somatic sensations and symptoms (Lumley, Stettner, & Wehmer, 1996; Lumley, Tomakowsky, & Torosian, 1997).

Several reports reveal a higher prevalence of alexithymic characteristics among patients with stress-related disorders in comparison with other patients and normal controls (Krystal, Giller & Cicchetti, 1986; Kohn et al., 1994; Shipko, 1982; Zeitlin, McNally & Cassiday, 1993); however, the relationship between alexithymia and stress-related illness is more complex than a simple co-occurrence (Martin & Pihl, 1985).

The stress-alexithymia hypothesis (Martin & Pihl, 1985, 1986a, 1986b; Martin et al., 1986) proposes that «the presence of alexithymic characteristics influences an individual's response to a stressful situation in such a way so as to create conditions favourable to the development of a stress-related disorder. Perhaps the most important result of the influence of alexithymic characteristics is an aggravated physiological response to stress» (Martin & Pihl, 1986b; p. 108). Several empirical reports, carried out for Martin and Pihl and their colleagues, confirm empirically the influence of alexithymic characteristics on the stress responses.

Several studies they have examined autonomic activity associated with alexithymia, both at rest and in response to stressors. There is some evidence that tonic physiological hyperarousal in association with alexithymia (Papciack, Feurestein & Spiegel, 1985; Rabavilas, 1987; Newton & Contrada, 1994). In contrast, the hypoarousal theory of alexithymia predicts that, under conditions of comparable emotional provocation, there is less physiological activation in individuals with alexithymic tendencies; these is no evidence that alexithymia leads to excessive reactivity to stressor; indeed, most studies found either no alexithymia effect, or that alexithymia was related to less reactivity (Hyer, Woods & Boudewyns, 1990; Linden, Lenz & Stossel, 1996; Nemiah, Sifneos & Apfel-Savitz, 1977; Wehmer, Brejnak, Lumley & Stettner, 1995).

Because the studies using the SSPS and MMPI-based alexithymia scales are now considered to possess insufficient reliability and validity it was considered possible that the opposite results might be a function of different alexithymia measures.

Martin & Pihl (1986a) argued that alexithymic are not necessarily more physiologically reactive to stress per se, but their subjective stress responses tend to be «decoupled» from their autonomic responses. Experimental evidence for a decoupling of HR and the subjective report of tension was found in alexithymics (Martin & Pihl, 1986a; Näring & van der Staak, 1995; Papciack, Feurestein & Spiegel, 1985).

On the basis of this fact, the purpose of the present study was to evaluate the relations to subjective and physiological stress responses related with alexithymia; besides the possible dissociation between the subjective awareness of autonomic arousal and physiological stress responses, in college student with high versus low alexithymia scores. Alexithymia was assessed utilizing the Toronto Alexithymia Scale -TAS-20-. To produce emotional arousal in our subjects, we designed a laboratory stress tasks with four different experimental conditions: baseline (adaptation), relaxation and two conditions of stress, cognitive and visual stimuli.

Method

Subjects

Eighty five female undergraduates psychology students, aged between 18 and 22 years (19.38; Sx = 1.94) participated in this experiment. They all were randomly selected from students enrolled in the «Psychology of Emotion» course at the University of Murcia who scored in the upper o lower quartile of the distribution of scores on the TAS-20. Subjects were divided into two groups according to their alexithymia scores which were bases on quartile criteria, 20 in the lower 25 percentile, 23 in the upper 25 percentile.

All reported being in good health, and none were taking medication at the time of the study that might have influenced either physiological responses or the perception of bodily sensations. Subjects were asked not to ingest alcohol, caffeine, or nicotine 2 hours prior to the experimental study. They all got an academic credit in return for their cooperation.

Materials and measures

The experiment was conducted in a light and temperature controlled laboratory. Electrodermal activity was assessed using the Palmar Sweat Index (PSI); palmar sweat gland activity is a very sensitive indicator of autonomic reactivity (Freedman et al., 1994; Köhler, Weber & Vögele, 1990; Martínez-Sánchez, Fernández & Ortiz, 1998; Turpin & Clements, 1993). PSI was assessed using the plastic impression technique, with fingerprints being obtained at 2,5-min intervals form the left index finger. PSI provides a direct measure of the number of sweat glands using a solution of 3% polyvinyl formal, 1% butylphthalate as a plasticizer, and the remainder ethylene dichloride.

Subjective self-perception of arousal experience during the experiment was assessed using a 10-point scale. Five ratings concerned bodily sensations liked to physiological arousal (racing heart, respiration rate, sweaty hands, muscular tension, and dry mouth). The remaining five scales were included in order to asses affective-subjective responses referred to psychological state, rating were colleted for agited, angry, anxious, nervous and tense. Subjects were asked to rate each symptom on a 10-point scale with a score of 1 representing «not at all» and a score of 10 representing «very much or extremely so»; higher scores indicated heightened perception of arousal.

Toronto Alexithymia Scale (TAS-20; Bagby, Parker & Taylor, 1994), Spanish version (Martínez-Sánchez, 1996). The TAS-20 is a 20-item self-report measure of the alexithymic construct with demonstrated good internal consistency and test-retest reliability (Bagby, Taylor & Parker, 1994), and to three-factor structure theoretically congruent with the alexithymia construct: (F. I.) difficulty to identify feelings and to distinguish between feelings and somatic sensations of emotional arousal; (F. II.) difficulty in describing feelings to others; and (F. III.) externally-oriented thinking. A Spanish version of TAS-20 was accomplished by Spanish psychologists fluent in both English and Spanish, using back-translation methodology; This version showed good internal consistency (Cronbach´s alpha = .78) and test-retest reliability ($r = .71$, $p<.001$) over a 19-week interval. These results are comparable to those obtained with the English version of the scale.

Of the various techniques used to measure alexithymia, the Toronto Alexithymia Scale has been most widely used, since multiple studies of its validity and reliability have shown the TAS-20 to have internal consistency, high test-retest reliability, construct validity, and criterion validity (Bagby, Taylor, & Parker 1994; Martínez-Sánchez & Ortiz, 2000). The stability and replicability of this factor structure were demonstrated with both clinical and nonclinical populations by the use of confirmatory factor analysis (Bagby, Parker, & Taylor, 1994; Páez et al., 1999; Parker, Bagby, Taylor, Endler, & Schmitz, 1993).

Experimental tasks and procedure

The experiment protocol (i.e. baseline definition, data reduction recovery periods, etc.) follows the standard designs used in several studies (Köhler, Weber & Vögele, 1990; Köhler & Troester, 1991; Köhler & Schuschel, 1994).

Participants attended individually for the laboratory session. After orientation, Ss was greeted by the experimenter and given a written explanation of the experiment and consent form. After completion of the consent form, the subject sat quietly for 20 minutes. The experiment itself started with a 10 min adaptation phase during which the subjects had to relax and get used to the measurement procedures, especially the taking of the fingerprints (adaptation phase). This was followed by another 7,5 min of relaxation (from min 10 to 17,5), after which there was an instruction phase I lasting 1,5 min; from min 19 to 26,5 (stress I, mental arithmetic), the subjects has to count backward by step of seven as quickly as possible, starting from 2007, which was followed by another resting phase of 7,5 min duration (relaxation II from 26,5 to 34 min). The second part of the experiment followed the same scheme: 34-35 instruction phase II; 35-42,5 (stress II) during this phase the subjects had to watch a distressing film about surgery. Thereafter the subjects were told to relax again (III-relaxation from 42,5-50 min). At the end of all six experimental phases, the set of subjective self-perception of arousal rating was completed immediately.

Data analysis

In order to evaluate the propioception patterns, both physiological and subjective, obtained by the uses of rating scale, regression analysis was carried out using an extension of quasilikelihood for generalized linear models (McCullagh and &Nelder, 1989) usually referred to as Generalized Estimating Equations approach or GEE (Zeger & Lyang, 1986; Zeger, Lyang & Qaqish, 1992; Diggle, Liang & Zeger, 1994; Stokes et al., 1995) with two correlation structures: independent and exchangeable.

With gaussian data, GEE approach is a simple extension of regression analysis for marginal models to take account of nonindependence emerging from the longitudinal pattern of observations within each individual. Zeger & Lyang (1986) proposed some common correlational structures to this end:

(1) independence, which represents an identity matrix and assume no correlation within repeated observations;

(2) exchangeable, which represents association as a matrix with a constant off-diagonal element (the intraclass correlation). It is equivalent to the compound symmetry structure required, but commonly not verified, in using the univariate approach for repeated measures ANOVA;

(3) auto-regressive, which considers association as a matrix with a decreasing correlation depending on the time lag between two longitudinal observations. It is a correlation structure very common in time series analysis;

(4) unstructured, which is a pattern obtained when no restriction are imposed on the structure of association. This is the same correlation pattern assumed in the multivariate approach for repeated measures ANOVA.

In general, GEE can obtain consistent estimates of marginal mean models, and robust standard errors and statistical tests, even if the assumed correlation structure within observations of same individual is mispecified, but statistical tests will be most powerful when the working correlation matrix closely approximates the true correlation matrix.

The estimation procedure may be summarized, from a computational point of view, in the following steps: (a) estimate model parameters for standard (naive) regression coefficient assuming independence of observations, (b) take the residuals from the model and use it for estimate the working correlation matrix within observations of the same individual, (c) Update the regression coefficients using the working correlation matrix obtained in step 2, (d) Iterate until convergence.

The main interest of GEE analysis was focused on the bivariate marginal relationship between the three different response measures used, labeled PHY for subjective self-perception of physiological arousal, AFF for subjective self-perception of affective arousal and PSI for Palmar Sweat Index. Each one of the bivariate relations (PHY-AFF, PHY-PSI and AFF-PSI) was analyzed for all the longitudinal phases of treatment (Adaptation - Relaxation - Stress - Relaxation - Stress - Relaxation, coded from 1 to 6) and experimental group (High Alexithymic - Low alexithymic, coded 1 and 0 respectively), each combination producing a different slope.

Results

Table 1 presents a summary of GEE estimation results for PHY-AFF bivariate relationship assuming independence.

Assuming independent correlational structure (Table 1), PHY-AFF correlation was evaluated in a set of slopes of regression analysis, for each phase and phase x group interaction effect. Significant slopes were obtained for all phases, but only appeared a significant (Z= -2.78; p= 0000) slope for group differences in phase I (adaptation) (Figure 1).

Assuming exchangeable correlational structure (Table 1), PHY-AFF correlation was again evaluated in a set of slopes of regression analysis, obtaining significant slopes for all phases, but only one marginal significant (Z= 1.99; p= 0465) slope was obtained for group differences in phase 6 (III-relaxation).

Table 2 exhibits a GEE estimation results for PHY-PSI bivariate relationship assuming independence (left part) and exchangeable (right part) correlational structure. With independent structure, PHY-PSI correlation decomposition show significant slopes in all phases except phases 2 and 4 (relaxation phases), but no significant slopes for phases x group components. The same pattern of results was obtained with exchangeable structure (Figure 2).

Table 1
GEE estimation for PHY-AFF correlation, assuming independent and exchangeable structure

	Independent structure			Exchangeable structure		
	Estimates	Z-values	Probab.	Estimates	Z-values	Probab.
Phase 1	.9534	7.13	.0000	0.6655	5.5912	.0000
Phase 2	.6846	2.51	.0102	0.4523	2.5829	.0098
Phase 3	1.2353	4.96	.0000	1.0321	4.0481	.0001
Phase 4	.8549	3.40	.0007	0.6611	3.7424	.0002
Phase 5	1.2204	11.05	.0000	1.0951	10.5750	.0000
Phase 6	.8364	8.99	.0000	0.6796	6.2409	.0000
Ph*group 1	-.4424	-2.78	.0027	0.2391	1.5226	.1279
Ph*group 2	.0156	0.03	.9745	0.6310	1.5615	.1184
Ph*group 3	.0765	0.26	.7980	0.5584	1.7437	.0812
Ph*group 4	.0045	0.02	.9879	0.5224	1.8323	.0669
Ph*group 5	-.0877	-0.63	.5257	0.2186	1.6873	.0916
Ph*group 6	-.0422	-0.28	.7774	0.3892	1.9910	.0465

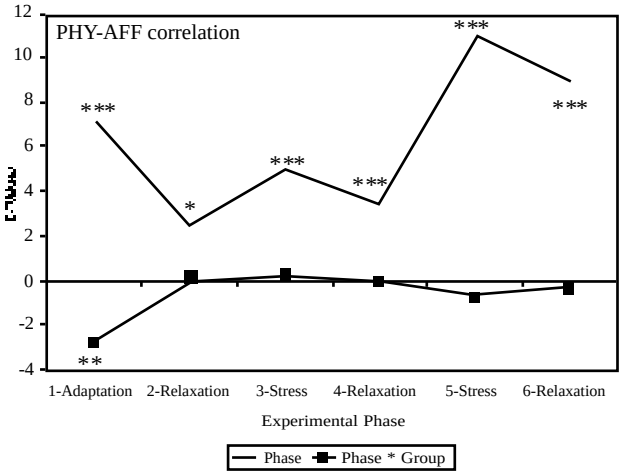

Figure 1. *GEE estimation results for PHY (subjective self-perception of physiological arousal) and AFF (subjective self-perception of affective arousal).*

Table 2
GEE estimation for PHY-PSI correlation, assuming independent and exchangeable structure

	Independent structure			Exchangeable structure		
	Estimates	**Z-values**	**Probab.**	**Estimates**	**Z-values**	**Probab.**
Phase 1	0.2087	1.8860	0.0593	0.1623	2.7936	0.0052
Phase 2	0.0805	0.5762	0.5645	0.0933	0.9530	0.3406
Phase 3	0.2560	2.9920	0.0028	0.2502	4.7086	0.0000
Phase 4	0.2083	1.2033	0.2289	0.0051	0.0353	0.9719
Phase 5	0.3925	2.5946	0.0095	0.3727	3.2798	0.0010
Phase 6	0.5141	3.6834	0.0002	0.3393	3.8598	0.0001
Ph*group 1	-0.1103	-.8764	0.3808	-0.1037	-0.9034	0.3663
Ph*group 2	-0.2157	-.8197	0.4124	-0.3711	-1.5610	0.1186
Ph*group 3	0.1047	0.6599	0.5093	0.1038	0.6975	0.4855
Ph*group 4	-0.2340	-.9284	0.3532	-0.1837	-0.7858	0.4320
Ph*group 5	0.0390	0.1916	0.8481	0.0316	0.1854	0.8529
Ph*group 6	-0.1480	-.5586	0.5764	-0.1651	-0.8190	0.4128

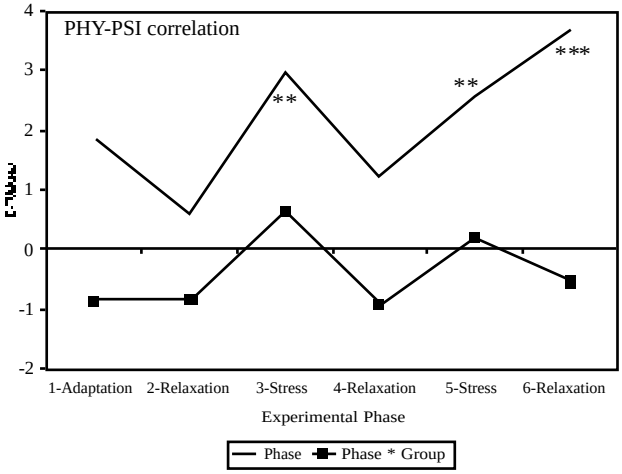

Figure 2. *GEE estimation results for PHY (subjective self-perception of physiological arousal) and PSI (Palmar Sweat Index).*

Table 3 exhibits a GEE estimation results for AFF-PSI bivariate relationship assuming independence (left part) and exchangeable (right part) correlational structure. No matter what correlational structure was pointed out, AFF-PSI correlation decomposition shows no significant slopes for all phases and phases x group components (Figure 3).

Table 3
GEE estimation for AFF-PSI correlation, assuming independent and exchangeable structure

	Independent structure			Exchangeable structure		
	Estimates	**Z-values**	**Probab.**	**Estimates**	**Z-values**	**Probab.**
Phase 1	0.0343	0.6223	0.5337	0.0174	0.5140	0.6073
Phase 2	-0.0112	-.1301	0.8964	0.0344	0.5040	0.6142
Phase 3	0.1242	1.3220	0.1862	0.1218	1.4347	0.1514
Phase 4	-0.0204	-.1927	0.8472	-0.1025	-1.3060	0.1914
Phase 5	0.2025	2.2306	0.0257	0.2040	2.5312	0.0114
Phase 6	0.0790	0.5027	0.6152	0.0350	0.2866	0.7745
Ph*group 1	0.0829	0.8306	0.4062	0.0556	0.5196	0.6033
Ph*group 2	0.0714	0.4362	0.6627	-0.1028	-0.8363	0.4030
Ph*group 3	-0.0029	-.0259	0.9794	-0.0042	-0.0393	0.9686
Ph*group 4	0.1441	0.9175	0.3589	0.0855	0.7512	0.4525
Ph*group 5	0.0335	0.2251	0.8219	-0.0108	-0.0876	0.9302
Ph*group 6	0.2020	0.7298	0.4655	0.1018	0.5389	0.5900

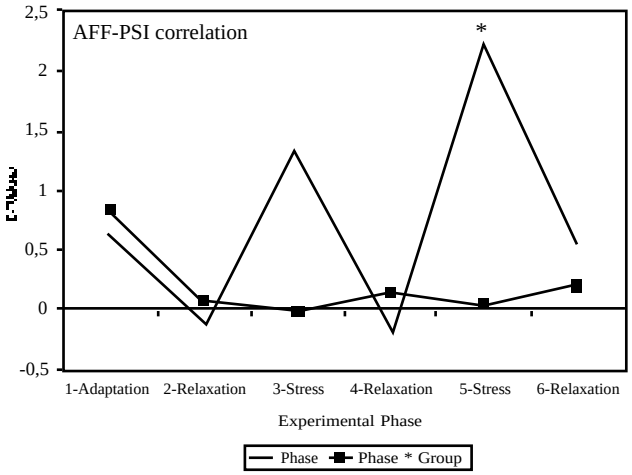

Figure 3. *GEE estimation results for AFF (subjective self-perception of affective arousal) and PSI (Palmar Sweat Index).*

Discussion

The objective of this study has been to test the relations to subjective and physiological stress responses related with alexithymia; besides the possible dissociation between the subjective awareness of autonomic arousal and physiological stress responses.

Results showed a significantly dissociation by group between subjective self-perception of physiological arousal and self-perception of affective arousal in questionnaire scores, during adaptation period exclusively. The results don't show significant correlations among groups between the subjective self-perception of activation and the autonomous reactivity (evaluated with the Palmar Sweat Index), although, in general, they correlated poorly with skin parameters. We found that both alexithymic and nonalexithymic subjects showed significant increases in PSI during

stress phases. However, contrary to prediction, the groups were essentially the same in their reported affective and physiological states.

Our data confirm Papciak et al.'s (1985) findings. They predicted that alexithymic males college student would react autonomically to stress just as normal subjects do, but, would be less reactive in terms of the subjective report of their emotional state. They used a stress quiz to provoke autonomic responses and the Profile of Mood States rating scale to assess affects, and recorded blood pressure, HR, and frontal electromyogram results. They found that both alexithymic and nonalexithymic subjects showed significant increases in HR and blood pressure during the stress quiz. However the groups were essentially the same in their reported mood states. The only group difference in mood was a significantly higher level of tension reported during the baseline period by the high alexithymic subjects.

No correlations were found between PSI values and self-report of affective and somatic arousal scores. Näring & van der Staak (1995) has demonstrated that high alexithymic subjects perceived heart rate less accurately than low alexithymic subjects. This fact can explain our results partially, and supports the hypothesis that cognitive biases towards experiencing bodily sensations are associated with alexithymia, and that the selective attention to external stimuli does not lead to more accurate identification of autonomic changes.

As regards changes of the self-perception and PSI during stressful situations, our results replicate findings from previous studies (Köhler, Weber & Vögele, 1990; Köhler & Troester, 1991; Köhler & Schuschel, 1994; Martínez-Sánchez, Fernández & Ortiz, 1998; Turpin & Clements, 1993) and are in accordance with reactions in other psychophysiological variables observed in some studies: PSI increased significantly form baseline to stress and decreased after its cessation.

These results confirm partially the decoupling hypothesis (Martin & Pihl, 1986a; Näring & van der Staak, 1995; Papciack, Feurestein & Spiegel, 1985) that it proposes that alexithymia may lead to the inaccurate self-perception of stress states in stress-provoking situations, which may impede the appropriate self-regulation in these situations.

Luminet & Rimé (1998) obtain consistent results with the decoupling hypothesis, their results show that a higher degree of alexithymia was associated with fewer degree of cognitive-experiential level and greater physiological reactivity as indicated by increase heart rate. Recently Näätänen, Ryynänen & Keltikangas-Järvinen (1999) also obtain consistent results with the decoupling hypothesis. The authors conclude that high alexithymic characteristics seem to predispose to the delayed self-perception of physiological stress state so that the beginning of this state may remain subjectively unnoticed and the subjective recovery from it prolonged relative to the physical recovery.

There are some limitations in the present study concerning the generalization of the results. First, the subjects were women and the applicability of the results to the men populations remains to be shown. Second, there may be some limitations in the generalization of the results related with the PSI, further studies are need to replicate changes of PSI during stress, however diverse investigations have demonstrated that PSI displays essentially the same behaviour as electrodermal variables (Clements & Turpin, 1996); the physiologic basis of the electrodermic response has been identified as the activity of the sudoriferous glands, which are innervated by the sympathetic branch, thus making this neurovegetative parameter reliable for measuring arousal. Another problem is the method is intrusive, because the subject perceives clearly the application of the drop, its removal and the social interactions involved.

It must be concluded that our data provides little support with the decoupling hypothesis.

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Aceptado el 20 de octubre de 2000