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6.21), scoring extremely on both alexithymia dimensions (either in the top or bottom 30% of the population) on both the cognitive and the affective component of alexithymia, were shown neutral and emotional pictures, while their Galvanic Skin Response (GSR) was measured. Results: The affective alexithymia component, not the cognitive component, turned out to be an important factor in the regulation of GSR peak amplitude. The results further indicate a significant interaction of type of emotional deficit (cognitive by affective) on GSR latency times in reaction to fear stimuli, demonstrating significant longer latencies in the mixed groups (high scores on one dimension and low scores on the other dimension) compared to those in the non-mixed groups (either high or low on both dimensions). Finally suggestive evidence indicated that baseline values (measured during the short rest periods between stimuli), defined by the levels during the second preceding the stimulus, are related to the cognitive component of alexithymia, in the sense that higher emotion cognitive capacities result in higher baseline values. Conclusions: We cautiously conclude that the classification of alexithymics on the basis of both the affective and a cognitive components, rather than on the basis of only the cognitive component might provide more consistent research results, and thus give rise to a better understanding of emotional physiological responses in alexithymic subjects.

THE COGNITIVE AND AFFECTIVE ALEXITHYMIA DIMENSIONS IN THE
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and a cognitive components, rather than on the basis of only the cognitive component might provide more consistent research results, and thus give rise to a better understanding of emotional physiological responses in alexithymic subjects.

Running head: Cognitive and Affective Alexithymia Dimensions and Sympathetic Responses

Introduction

As early as the late forties of the last century, MacLean (1949) observed that, in a large proportion of patients with psychosomatic complaints, the emotional experience does not reach the stage of full conscious symbolic and verbal elaboration, resulting in problems during psychoanalysis based psychotherapy (Ruesch, 1948; Groen, van der Horst, & Bastiaans, 1951; Sifneos, 1975). Nemiah and Sifneos (1970) gave the following description of the psychological features of these patients: “These patients manifested either a total unawareness of feelings or an almost complete incapacity to put into words what they were experiencing. The associations of the majority of the patients were characterized by a) a nearly total absence of fantasy or other material related to their inner, private mental life of thoughts, attitudes and feelings, and b) a recounting, often in almost infinite detail, of circumstances and events in their environment, including their own actions. Their thoughts, that is, were stimulus-bound rather than drive-directed.” Sifneos (1973) coined the term alexithymia (a = lack, lexis = word, thymos = mood or emotion (Sifneos, Apfel-Savitz, & Frankel, 1977)) for this complex of features. Thus, alexithymia has been defined by deficits in as well the cognitive (reduced capacity to put emotions into words) as of affective aspects of the mental emotional responses (reduced capacity to experience or feel emotions). Alexithymia measuring devices should therefore cover both types of deficits. This is all the more important since it has been argued that these two aspects of the mental emotional responses are regulated by different neural modules (Bermond, Vorst, & Moormann, 2006; Bermond, 2008).

Although it has been demonstrated that stress induces or enhances alexithymia (Kristal, & Krystal, 1988), recent results suggest strongly that alexithymia is a relative stable personality trait (Picardi, & Caroppo, 2005; Luminet, et al., 2007).

It has been proposed that alexithymia enhances the probability of (psycho)-somatic complaints, and many publications support this notion (see Taylor, Bagby, & Parker, 1997 for review). It has, furthermore, been proposed that alexithymia results in greater emotional physiological responses, or greater autonomic baseline levels, which may explain the relationship between alexithymia and psychosomatic complaints (Gross, 2002; Thayer, & Brosschot, 2005). However, the relevant literature presents conflicting results. Several studies indicated that alexithymia is related to higher baseline or relaxation-levels (Papciak, Feuerstein, & Spiegel, 1985; Henry, et al., 1992; Wehmer et al., 1995; Infrasca, 1997; Fukunishi, et al., 1999; Stone, & Nielson, 2001; Gündel, et al., 2004). However other, though fewer, studies found lower values (Hyer et al., 1991; Newton & Cotrada, 1994) or failed to find effects (Roedema & Simons 1999; Neumann et al., 2004).

The literature regarding alexithymia and autonomic responses to stress or negative affect is clearly equivocal. Some studies suggest that alexithymia is related to attenuated autonomic responses to stress (Wehmer, et al., 1995; Linden, Lenz, & Stossel, 1996; Friedlander, et al., 1997; Fukunishi, et al., 1999; Roedema, & Simons, 1999; Neumann, et al., 2004), while others suggest the opposite (Papciak, Feuerstein, & Spiegel, 1985, Martin, & Pihl, 1986; Infrasca, 1997; Waldstein, et al., 2002; Gündel, et al., 2004) or found no effect (Rabavilas, 1987; Franz, Olbrich, Croissant, & Kirsch, 1999; Stone, & Nielson, 2001; Connelly, & Denny, 2007). Whereas regarding the study Franz et al. (1999) it should be noted that although the results demonstrated no difference in mean GSR response, they also demonstrated that the fluctuations in GSR responses were significantly greater in *low* alexithymics compared to *high* alexithymic subjects. Arguably, the literature is even more confusing, as various studies used several measures of autonomic response, of which

only one or a few were associated with the expected effect, or with just one of the alexithymia subscales (Nyklicek, 2004; Spitzer, et al., 2005) for instance.

Three hypotheses have been proposed to explain the enhanced emotional physiological responses in alexithymics: the decoupling hypothesis (Papciak, et al., 1985), the discharge theory (Cacioppo, et al., 1992), and the stress hypothesis (Martin, & Pihl, 1985). One theory, denoted the hypo-arousal model of alexithymia, has been proposed to explain lower autonomic responses in alexithymics (Linden, et al., 1996). For the following reasons we believe that the hypo-arousal theory fits the classical alexithymic subject as described by Nemiah & Sifneos (1970). The severe reduction in affective feeling (see above) is an important element in their description of the alexithymic features. Damasio and co-workers have underlined the importance of the orbitofrontal cortex (O-FC) in the regulation of the emotional feeling and emotional decision-making (Damasio, & Anderson, 1993; Damasio, 1994; 1999; Bechara, Damasio, & Damasio, 2000; Tranel, Bechara, & Denburg, 2002; Bechara, 2004), and specific O-PFC activations in reaction to emotion inducing stimuli have been described (Taylor, et al., 2002). The O-FC projects to the hypothalamus, where the orbitofrontal neurons connect with neurons projecting to the brainstem- and spinal-autonomic centers. It is by these connections that the O-FC has control over emotional autonomic responses (Simpson, et al., 2001; Barbas, et al., 2003). Finally, electrical stimulation of the O-FC produces many autonomic responses (Iversen, Kupfermann, & Kandel, 2000).

Based on these neuropsychological data, it is feasible that subjects that show no or very low affective responses, also show low activation in their O-FC, and thus low activations in the brainstem- and spinal-autonomic centers, which would result in

lower autonomic responses in the classical alexithymic subjects (Bermond et al., 2006; Bermond, 2008).

Most studies have used the Toronto alexithymia questionnaires, i.e., the TAS-26, TAS-R, or TAS-20 (Taylor, Ryan, & Bagby, 1985; Taylor, Bagby, & Parker, 1992; Bagby, Parker, & Taylor, 1994). None of these scales, however, measures emotionalizing (reduced ability to experience emotional feelings). In addition, the TAS-R and TAS-20 do not measure fantasizing. Thus, although, the originators of the alexithymia concept included the affective components (reduced emotionalizing and fantasizing) of alexithymia explicitly (Nemiah, & Sifneos, 1970; Nemiah, 1996; Sifneos, 1991 & 2000) the TAS scales focuses on the emotion-cognitive aspects of alexithymia.

For the reasons presented above, a failure to classify subjects on the affective alexithymia features may have introduced uncontrolled variance into the data produced in the experiments reviewed above. In the present study, therefore, the distinction between the cognitive and the affective dimensions is retained in the selection of subjects, i.e., we study the relationship between the affective and cognitive components of alexithymia, and emotion-induced sympathetic activation.

Our hypothesis is that adding the affective component, as a separate measure for alexithymia will explain a significant part of the variance. Apart from measuring the amplitude of the physiological responses which allows for direct comparison with previous studies we also will *explore* baseline levels preceding the stimuli and latency times.

Methods

Alexithymia measurement

Alexithymia was measured the by aid of the Bermond Vorst Alexithymia Questionnaire (BVAQ) (Vorst, & Bermond, 2001). The BVAQ has five separate subscales, (8 items per sub-scale, four indicative and four contra-indicative) for all alexithymia features as discussed by others (Nemiah, & Sifneos, 1970; Sifneos, et al., 1977; Taylor, Ryan, & Bagby, 1985; Nemiah, 1996; Sifneos, 1991, 2000; Hendryx, Haviland, & Shaw, 1991); reduced capacities concerning (1) ‘emotionalizing’ [When friends around me argue violently, I become emotional.], (2) ‘fantasizing’ [I have few daydreams and fantasies.], (3) ‘identifying’ emotions, [When I am upset, I know whether I am afraid or sad or angry.], (4) ‘verbalizing’ emotions [I like to tell others about how I feel.], and (5) ‘analyzing’ emotions, i.e., the opposite of Marty and M’Uzan’s (1963) ‘pensé opératoire’ [I hardly ever consider my feelings.].

In previous research, exploratory and confirmative factor analyses of BVAQ subscale scores in various populations consistently produced two orthogonal factors. These factors reflect the emotion-affective¹ dimension of alexithymia (emotionalism and fantasizing) and the emotion-cognitive dimension (verbalizing- and identifying-emotions). The subscale ‘analyzing-emotions’ invariably loads on both factors, albeit with differing loadings in the various populations or languages (Vorst, & Bermond, 2001; Bermond et al., 2007). Thus the BVAQ allows an analysis on the basis of the two alexithymia dimensions mentioned, hence called the cognitive alexithymia dimension (COG) and the affective alexithymia dimension (AFF). The original 40-item Dutch BVAQ has very good psychometric properties. Three of the BVAQ subscales (Identifying-, Analyzing- and Verbalizing-emotions) cover the same domain as the TAS-20, and the sum-score on these subscales correlates highly (.80)

¹ ‘Emotion affective’ may seem redundant, however this label has been chosen to differentiate this dimension clearly from the ‘emotion cognitive dimension’ (‘identifying’, ‘verbalizing’ and ‘analyzing’ emotions).

with the TAS-20 (Vorst, & Bermond, 2001). Since the subscale ‘analyzing-emotions’ loads, in the Dutch population, clearly on the cognitive factor (.77) and much less on the affective factor (.22) (Vorst, & Bermond, 2001; Bermond et al., 2007), we included ‘analyzing-emotions’ in the cognitive factor.

Subjects

At the department of psychology of the university of Amsterdam all freshman psychology students are invited to fill out various questionnaires (among which the BVAQ), for which they get study credit points, those who do not want to do this have to earn these credit points by taking a small examination about literature concerning psychological questionnaires. Those freshman psychology students who had filled out the questionnaires, and fulfilled the selection criteria (see below), were asked by letter, whether or not they wanted to participate in an experiment. In the same letter they were asked whether or not they had any objection, that some of their previous scores would be connected to other scores gathered during the experiment.

Sixty-six female psychology students (mean age = 21.2, Sd= 6.21), scoring extremely on both alexithymia dimensions (either in the top or bottom 30% of the population) selected out of the population of freshman psychology students (N= 516, ± 70% female), had no objections, and were willing to participate in this study.

This enabled us to create four extreme groups: (1) Low capacities on both dimensions (AFF-,COG-) (affective dimension [emotionalizing & fantasizing] & cognitive dimension [verbalizing-, identifying- & analyzing-emotions] (N=15)); (2) low on the cognitive dimension & high on the affective dimension (AFF+,COG-; N=20); (3) high cognitive & low on the affective (AFF-,COG+; N=16); and (4) high on both dimensions (AFF+,COG+; N=15) (*For reasons of convenience we applied a reversed*

scoring, thus a plus (+) indicates that the capacities are high, whereas a minus (-) corresponds to low capacities (alexithymia is related to low capacities)).

Although the first two groups mentioned (AFF-, COG- & AFF+, COG-) are now clearly recognized as two different types of alexithymia, one could question whether the other two groups are also types of alexithymia. It is for instance clear that the last groups (AFF+, COG+) is just the opposite of the classical alexithymics as described by Sifneos and Nemiah, and it is for this reason that it has been labeled 'Lexithymic' in the past. Further, although the AFF-, COG+ group has been labeled alexithymia type 3, this is still open for debate. However, all this is of no importance for the research presented here. It is a well-established fact that there are two dimensions in alexithymia, and this research was meant to study the effects of these two alexithymia dimensions on the autonomic responses. We therefore selected the four groups mentioned, since only then can the effects of these two dimensions on this autonomic response be studied well (Nemiah & Sifneos, 1970; Vorst & Bermond, 2001; Bermond et al. 2007).

Since gender differences in psychophysiological responses in alexithymic subjects have been described (Spitzer, et al., 2005; Bermond, et al., 2008), and further since including males into the study would result in low numbers of males in the various cells ($\pm 30\%$ males in the population of freshman psychology students) it was decided to limit this study to females only.

A coworker, who was not otherwise involved in the study, carried out the actual selection. The experimenters knew subjects only by name and had no knowledge of their alexithymia scores. The subjects were informed that they had been selected on the basis of scores on a test. Only after the experiment were they informed of the nature of the selection.

Subjects were asked to abstain from smoking, coffee and alcohol consumption at the day they participated in the experiment, till the end of the experiment. All subjects provided informed consent, and received 7 euros for their cooperation. The study was approved by the ethical comity of the department of psychology of the university of Amsterdam.

Measurement of autonomic responses

The autonomic responses are regulated by both the parasympathetic and sympathetic arms of the autonomic nervous system. However, *crosso modo*, it is the activation sympathetic arm that results in enhancements of autonomic responses, whereas the activation of the parasympathetic arm results in lower autonomic responses. For this reason we directed our attention to the sympathetic arm. Further the Galvanic Skin Response (GSR) was chosen as the estimate of the sympathetic response, since, in contradistinction to most autonomic responses, this response is innervated by the sympathetic nervous system only. It is easy to measure, sensitive, and, given proper instructions to the subjects, relatively free of artifacts (Dawson, Schell, & Filton, 1990).

Skin conductance was registered by applying a constant one volt peak to peak alternating voltage (50 Hz), and measuring the current. These values were converted to an analog voltage of 0.2 volt / microSiemens, and digitalized using a BioSemi 24 bit analog-to-digital converter (BioSemi, Netherlands). Analyses were done using the Brain Vision Analyzer package (Brain Products GmbH, Germany). The following skin-conductance parameters were analyzed: (1) Conductance *baselinevalues*, defined by the mean value during the second preceding the stimulus onset; (2) *latency*,

defined by time between the appearance stimulus and the moment the conductance departed from baseline (defined by the peak in the second derivative of the conductance, between 1500 and 3000 msec after stimulus onset (Boucsein, 1992); and (3) *amplitude* defined by the mean value in the conductance curve between 3 and 4 seconds after stimulus onset.

Procedure

Subjects were asked to sit in front of a computer screen, on which the stimuli (emotion-inducing pictures) were to be presented. Subjects were told that their galvanic skin responses would be measured. To this end, Ag-AgCl electrodes with isotonic electrode paste were connected to the medial phalanges of the index and middle finger, according to the method as described by (Dawson, et al., 1990). Subjects were asked to relax, to move as little as possible, and to passively watch the pictures.

Materials

The pictures presented were selected out of the International Affective Picture System (IAPS), and contained fear-inducing, erotic or emotionally neutral information². In previous research, this picture set was found to elicit reliable electrodermic responses (Tranel, & Damasio, 1994; Lane, Chua, & Dolan, 1999). Twenty pictures with erotic content, which are often used in sex-studies in our laboratory (Laan, Everaerd, & Evers, 1995), were added to the IAPS stimuli. Stimuli were presented on a 75 Hz color (16 bit) display with a 1024*786 resolution starting with a fixation point for 6.5 seconds, followed by picture presentation time for 0.5 seconds, followed by a blank screen for 11 seconds, after which a new trial started. The presentation of the various

²IAPS numbers:

1201,1205,1220,1301,1460,1525,1750,2080,2260,2278,2299,2304,2383,2395,2399,2490,2516,2590,2650,2715,2840,3000,3053,3060,3063,3064,3068,3069,3080,3100,3102,3120,3150,3170,3400,4460,4470,4651,4652,4653,4656,4659,4666,4670,4677,4681,4810,5500,5530,5760,5831,6260,6510,6550,6560,7009,7010,7090,7207,7830,7950,9000,9040,9050,9070,9220,9330,9341,9342,9570,9611,9910,9911.

pictures was randomized with replacement for each subject separately, with equal probabilities for fear-inducing, erotic, and neutral pictures. Forty-eight pictures were presented to each subject.

Results

The skin conductance in some subjects did not noticeably vary with the stimulus presentation; there could be a slow drift from the baseline, but no recognizable peaks. We call these subjects ‘non-responders’. An objective criterion to identify non-responders is the mean RMS (root mean squared value) in their skin conductance records after removing the drift (Dawson, 1990). Using the criterion that the mean RMS be larger than 0.002 microSiemens²/sec, we found that ~17% of the subjects were classified as non-responders. Table I gives the distribution of these subjects over the 4 groups.

---Insert Table 1 about here---

Non-responders are randomly distributed over the 4 categories of subjects ($\text{Chi}^2 = 3.960$, $\text{df} = 3$, $p = 0.27$).

GSR measurement

The mean skin conductance is shown in figure 1 for each stimulus condition as a function of time with respect to stimulus onset for all subjects (responders & non-responders). In figure 2 the data are shown for the 4 groups of subjects separately. The baselines in these figures are corrected with the mean value of the skin conductance from -1 seconds to stimulus onset.

---Insert Figure 1 about here---

---Insert Figure 2 about here---

Peak amplitude

Results for peak amplitudes are given in table 2.

---Insert Table 2 about here---

As is clear from figure 1 there is an expected main effect of stimulus valence giving a larger peak value for emotional than for neutral pictures [$F_{\text{Valence}} = 7.18$, $df = 2$, $p = 0.001$, $N = 66$]. More interestingly this effect showed an interaction with the type of alexithymia dimension, and most notably with the AFF factor [$F_{\text{Valence} \times \text{AFF}} = 3.462$, $df = 2$, $p = 0.034$, $N = 66$], while there is no effect of the COG factor [$F_{\text{Valence} \times \text{COG}} = 0.662$, $df = 2$, $p = 0.52$, $N = 66$].

Removing the neutral condition from the analysis revealed the interaction effect of the AFF factor on peak values more clearly [$F_{\text{Valence} \times \text{AFF}} = 5.996$, $df = 1$, $p = 0.017$, $N = 66$], while the effect of the COG factor remained negligible [$F_{\text{Valence} \times \text{COG}} = 0.88$, $df = 1$, $p = 0.35$, $N = 66$].

It should be noted that all subjects were entered in these analyses, because the definition of peak value allows us to include ‘non-responders’. Removing the non-responders from the analysis did not change the overall result. Most notably the interaction between the valence of the stimulus and the AFF factor remains the same [$F_{\text{Valence} \times \text{AFF}} = 3.467$, $df = 2$, $p = 0.035$, $N = 55$], while there are no COG effects [$F_{\text{Valence} \times \text{COG}} = 0.39$, $df = 2$, $p = 0.68$, $N = 55$].

Post hoc two contrasts were calculated: (‘Cog high, Aff high’ + ‘Cog low, Aff high’ versus ‘Cog high, Aff low’ + ‘Cog low, Aff low’) for both (1) the fear stimuli, and (2) the erotic stimuli. Only for fear stimuli was there a suggestive difference [mean difference .173, $df = 64$, $t = 1.80$, $p = 0.076$ two-tailed, $N = 66$], whereas the same analysis for erotic stimuli provided a clear insignificant result [mean difference .088, $df = 64$, $t = -0.764$, $p = 0.764$ two-tailed, $N = 66$]. Removing the ‘non-responders’ from the analyses, provide the same results more clearly: fear stimuli [mean difference

.228, $df = 53$, $t = 2.054$, $p = 0.045$ two-tailed, $N = 55$], erotic stimuli [mean difference .087, $df = 53$, $t = -.633$, $p = 0.529$ two-tailed, $N = 55$]. This indicates that the significance of the interaction factor (stimulus valence x affective alexithymia dimensions) is mainly due to the higher GSR peak-values in subjects with high affective capabilities, in response to fear stimuli, compared to subjects with low affective capabilities in their response to fear stimuli.

Baseline scores

Mean values and standard deviations of the baseline values preceding the stimuli are presented in table 3.

---Insert Table 3 about here---

Analysis of variance provided suggestive evidence for higher GSR baseline levels in subjects with higher cognitive emotional capacities [$F_{\text{COG}} = 3.43$, $df = 1$, $p = .069$, $N = 66$], [$F_{\text{AFF}} = .22$, $df = 1$, $p = .64$, $N = 66$], [$F_{\text{COG} \times \text{AFF}} = .95$, $df = 1$, $p = .33$, $N = 66$].

Note that all subjects, including ‘non-responders’, were entered in this analysis, because baseline can be assessed in the absence of clear peaks. Excluding the non-responders from the analysis yields comparable results [$F_{\text{COG}} = 3.17$, $df = 1$, $p = .081$, $N = 55$] [$F_{\text{AFF}} = 0.353$, $df = 1$, $p = .552$, $N = 55$] [$F_{\text{COG} \times \text{AFF}} = .378$, $df = 1$, $p = .542$, $N = 55$].

Latencies

In this analysis only subjects were included who showed a definite response on the mean of all trials, regardless of the nature of the stimulus picture. This excludes the ‘non-responders’, and also subjects who did not show one single clear peak in the second derivative of the conductance. Many subjects did not show a clear latency in response to neutral stimuli. This is understandable since these neutral pictures hardly

induce any change in skin conductance. For this reason, the responses to the neutral pictures were excluded from the statistical analyses of the skin conductance latency times. The excluded subjects are randomly distributed over the 4 experimental groups ($\text{Chi}^2 = 4.33$, $\text{df} = 3$, $p = 0.23$).

---Insert Table 4 about here---

Repeated Measurement Analysis of Variance shows a three-way interaction between the two alexithymia dimensions (cognitive and affective), and valence (the type of emotion inducing picture; erotic or fear). ($F_{\text{Valence*COG*AFF}} = 7.954$, $\text{df} = 1$, $p = 0.0097$, $N = 42$). Analyses of variance of the responses to two emotional stimulus types separately produced non-significant results for the erotic stimuli, but a clear significant interaction result for fear stimuli: Fear stimuli [$F_{\text{COG}} = .833$, $\text{df} = 1$, $p = .367$, $N = 42$]; [$F_{\text{AFF}} = .339$, $\text{df} = 1$, $p = .564$, $N = 42$]; [$F_{\text{COG} \times \text{AFF}} = 17.062$, $\text{df} = 1$, $p = .0002$, $N = 42$]; Erotic stimuli [$F_{\text{COG}} = .00003$, $\text{df} = 1$, $p = .995$, $N = 42$]; [$F_{\text{AFF}} = .446$, $\text{df} = 1$, $p = .508$, $N = 42$]; [$F_{\text{COG} \times \text{AFF}} = 2.132$, $\text{df} = 1$, $p = .152$, $N = 42$]. The significant interaction factor for fear stimuli is due to the long latency of the mixed groups on fear stimuli. Especially the group with high cognitive emotional capacities, but low affective emotional capacities (COG+ AFF-) has a ~ 20 % higher mean latency, whereas the COG- AFF+ has a ~ 10 % higher latency, compared to the COG+ AFF+ and COG- AFF- groups.

Discussion

Results provided suggestive evidence that the cognitive alexithymia dimension (verbalizing-, identifying- & analyzing-emotions) could be a factor in GSR baseline levels. Specifically, higher emotional cognitive capacities result in higher baseline

GSR levels. However, it should be realized that our baseline levels refer to second preceding the stimulus onset. It is likely that subjects with high emotional cognitive capacities ruminate longer than those with strongly reduced emotional cognitive capacities. This prolonged emotional engagement could spill over to the next trial, and thus explain the higher baseline levels. If this conjecture is correct, then our results are consistent with Brosschot et al. (2006). These authors, in a review of the relevant literature, concluded that rumination results in enhanced activation of numerous physiological responses.

The present results demonstrated that the emotion-induced GSR latencies to fear stimuli were significant longer in the mixed groups (AFF high, COG low & AFF low, COG high) than those in the non-mixed groups (AFF low, COG low & AFF high COG high). This suggests that subjects, with discordant scores on the two components in the mental emotional responses (affective component & cognitive component), need more time to appraise emotional stimuli as emotional.

The results regarding, the main aim of this study, peak values, demonstrated that the affective alexithymia dimension (emotionalizing & fantasizing) is an important factor in the regulation of the intensity of sympathetic responses in response to fear stimuli. Specifically, higher emotional affective capacities result in higher GSR peak values in response to fear inducing stimuli. The influence of the cognitive alexithymia dimension (verbalizing-, identifying- & analyzing-emotions) turned out to be negligible. This is in line with our expectations, the hypo-arousal model of alexithymia (Linden, et al., 1996), and neuropsychological data (see introduction). This result could also explain why the literature regarding the relationship between alexithymia and autonomic responses has produced equivocal results, since alexithymia has been assessed in these studies by aid of a version of the TAS, which

does not explicitly measure the affective dimension of alexithymia. It seems therefore advisable to use for clinical purposes alexithymia scales that measure both alexithymia dimensions. The results of the recent study of Bailey and Henry (2007), indicating that alexithymia type 2 (AFF+,COG-) is related with the report of more somatic symptoms than either type 1 alexithymia (AFF-,COG-) or alexithymia (AFF+,COG+), also stress the importance of separate measurements of the two alexithymia dimensions for clinical purposes.

There is, however, room for a slightly different explanation. Most studies used rather complicated negative affect inductions, like 'anger recall tasks' or 'stress quizzes', while in our study subjects were required only to passively watch emotion inducing pictures. Therefore, the task in the present study was undemanding in cognitive information processing, thus the cognitive dimension was less important factor in the affect-induction, while the affective dimension was relatively more important. Support for this notion is provided by Wehmer et al. (1995). These authors also used slides to induce affect, and their results indicated less reactive heart rate increases and fewer GSR responses in alexithymics compared to non-alexithymic subjects. Wehmer et al. (1995) used two alexithymia measurements; (1) the TAS and (2) the percentage of emotion words in descriptions of a modified Thematic Apperception Test (TAT). The results concerning the above mentioned physiological responses were statistically significant only when alexithymia was assessed by TAT descriptions. It is possible that this TAT based assessment (percentage of emotion words used) is more strongly related to the affective alexithymia dimension than the assessment based on the TAS. In conclusion, we cautiously interpret the current results in support of the contention that the equivocal results, which characterize part of the literature concerning

alexithymia and autonomic responses, might be due to the uncontrolled variance arising from the, not measured, affective alexithymia dimension.

However, more research is clearly necessary. First of all we did not control for height and weight of our subjects, and although subjects were asked to abstain from smoking, coffee and alcohol consumption during the hours before participating in the experiment, we had no way to control whether or not this was actually done. This may have contributed to the error variance and hence weakened our statistical conclusions. Further, this research should be replicated with male subjects, in order to see whether or not the results may be generalized to males also. Finally, future research should take into account both the cognitive and the affective alexithymia dimensions, and should utilize various negative emotion inductions, which require varying levels of cognitive reflection.

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Ms. Ref. No.: JA1377

Title: THE COGNITIVE AND AFFECTIVE ALEXITHYMIA DIMENSIONS
IN THE REGULATION OF SYMPATHETIC RESPONSES
International Journal of Psychophysiology

Dear dr. Bob Bermond,

I have now received two reviews on your manuscript from expert reviewers. Both reviewers see potential in this work but have identified deficiencies in the manuscript that require attention before it is acceptable for publication. As such my decision is the reject your manuscript but invite you to submit a revision that addresses the concerns raised by the reviewers. When resubmitting your manuscript please also submit a cover letter which states in detail the changes made and how you have addressed each of the reviewers' concerns.

For your guidance, reviewers' comments are appended below.

If you decide to revise the work, please submit a list of changes or a rebuttal against each point which is being raised when you resubmit the manuscript. You can then submit your manuscript as a new submission.

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Yours sincerely,

George D. Bishop, Ph.D.
Action Editor
International Journal of Psychophysiology

Reviewers' comments:

Reviewer #1: This paper presents the results of an interesting study on the electrodermal responses to affective slides for people who vary on alexithymia dimensions. In general, I feel that there is value in trying to understand EDA in response to stimuli related to these personality characteristics. I also think that there may be value in teasing apart different dimensions of alexithymia, and testing whether there are subtypes distinguished by the presence of emotionalizing. Thus, the conceptualization and the research methods are valuable. There are, however, three major concerns that I have.

First, the results are complex, and their interpretations are questionable. Also, the interpretations are post-hoc~no hypotheses were made, and it is not clear that any of the results would be expected.

Our hypothesis is now clearly presented at the end of the introduction: “.....In the present study, therefore, the distinction between the cognitive and the affective dimensions is retained in the selection of subjects, i.e., we study the relationship between the affective and cognitive components of alexithymia, and emotion-induced sympathetic activation.

Our hypothesis is that adding the affective component, as a separate measure for alexithymia will explain a significant part of the variance. A part from measuring the amplitude of the physiological responses which allows for direct comparison with previous studies we also will explore baseline levels preceding the stimuli and latency times....”

In the discussion section we refer to this hypothesis. We have further added some extra arguments for the direction of the expected effects dealing with the major dependent variable in the introduction:

“For the following reasons we believe that the hypo-arousal theory fits the classical alexithymic subject as described by Nemiah & Sifneos (1970). The severe reduction in affective feeling (see above) is an important element in their description of the alexithymic features. Damasio and co-workers have underlined the importance of the orbitofrontal cortex (O-FC) in the regulation of the emotional feeling and emotional decision-making (Damasio, & Anderson, 1993; Damasio, 1994; 1999; Bechara, Damasio, & Damasio, 2000; Tranel, Bechara, & Denburg, 2002; Bechara, 2004), and specific O-PFC activations in reaction to emotion inducing stimuli have been described (Taylor, et al., 2002). The O-FC projects to the hypothalamus, where the orbitofrontal neurons connect with neurons projecting to the brainstem- and spinal-autonomic centers. It is by these connections that the O-FC has control over emotional autonomic responses (Simpson, et al., 2001; Barbas, et

al., 2003). Finally, electrical stimulation of the O-FC produces many autonomic responses (Iversen, Kupfermann, & Kandel, 2000).

Based on these neuropsychological data, it is feasible that subjects that show no or very low affective responses, also show low activation in their O-FC, and thus low activations in the brainstem- and spinal-autonomic centers, which would result in lower autonomic responses in the classical alexithymic subjects (Bermond et al., 2006; Bermond, 2008). ”

Finally in the discussion section we discuss possible interpretations of our findings that by their nature are somewhat speculative and could result in new experimental questions.

Indeed, it appears that the three sets of analyses provide somewhat different results, and it is difficult to integrate them. The authors have not really integrated the three results~they have simply explained them separately~and this raises questions for me about the reliability of the findings.

By reorganizing the results section we hope that it is now clearer that we have an amplitude measure for which we have explicit expectations and two measures which are explorative in nature. For these latter two there is no a priori theoretical reason to assume that the relationships with the two alexithymia dimensions should be comparable with the amplitude variable.

Second, a major problem with the paper is the conceptualization and manner of describing the dimensions. I found myself repeatedly having to return to the definitions and struggled to understand the 4 groups. These authors have argued that alexithymia is not a unitary construct but that there are subtypes. Yet, in this paper, they argue that a 2 x 2 categorization scheme, based upon the structure of their scale, captures reality better. They may be correct~that alexithymia is not a unitary phenomenon. However, they deviate in this paper from their prior Type 1 and type 2 nomenclature and present an approach that is rather confusing to follow. I would hope that the authors could present their typology in a different format. I will highlight the parts that I find confusing, and that are likely to lose readers, and I encourage the authors to consider some modifications:

- 1) The labels "emotion-affective" and "emotion-cognitive" are problematic. The former sounds redundant, and the latter, almost oxymoronic. They are not good labels for these two constructs.

We understand the problem of the reviewer. To avoid further misunderstanding we have better explained the dimensions, especially the emotion-cognitive dimension that at first sight seems paradoxical, and have added the following text

“...Although the first two groups mentioned (AFF-, COG- & AFF+, COG-) are now clearly recognized as two different types of alexithymia, one could question whether the other two groups are also types of alexithymia. It is for instance clear that the last groups (AFF+, COG+) is just the opposite of the classical alexithymics as described by Sifneos and Nemiah, and it is for this reason that it has been labeled ‘Lexithymic’ in the past. Further, although the AFF-, COG+ group has been labeled alexithymia type 3, this is still open for debate. However, all this is of no importance for the research presented here. It is a well-established fact that there are two dimensions in alexithymia, and this research was meant to study the effects of these two alexithymia dimensions on the GSR-responses. We therefore selected the four groups mentioned, since only then can the effects of these two dimensions on this autonomic response been studied well (Nemiah & Sifneos, 1970; Vorst & Bermond, 2001; Bermond et al. 2007).... “

2) The subscales that go into these constructs and labels do not seem, on their face, to fit. Thus, "fantasizing" apparently correlates with "emotionalizing" (which is sometimes called "emotionalism" in this paper~this discrepancy should be fixed), although one would think of fantasy ability as much less emotional and much more cognitive. In addition, the "cognitive" subscales deal primarily with affect~identifying, and subscales are all "cognitive," which seems confusing and perhaps unwarranted to me, and differs from what the TAS-20 authors argue, which is that only EOT is "cognitive". The fact that fantasizing and external thought do not load together seems problematic.

We have removed the use of two words for the same construct. We only use 'emotionalizing' in the current manuscript.

It has been argued that there are two qualia involved in the emotional experience; one representing the cognitive affective aspects (Bermond, 2008). It has further been demonstrated that there are two more or less corresponding alexithymia dimensions, and these have to be named. One could of course argue about the names given. We think that these names are acceptable although it may some time to get used to them. The affective

dimension encompasses emotionalizing and fantasizing. It was not surprising that these two capacities turned out to load on the same factor, Freud (1916) and Bell (1919) already connected these two capacities. Since, further, emotionalizing is clearly affective it is acceptable to call the factor/dimension affective. The other factor encompasses 'identifying emotions' (knowing which emotions is at stake), 'verbalizing emotions', and analyzing emotions. These capacities all have a clear cognitive component (verbalizing), if not fully cognitive (identifying & analyzing). Thus the name cognitive dimension is acceptable. That the TAS authors argue differently might be caused by the fact that they do not measure all aspects of alexithymia (thus also fantasizing and emotionalizing). If that had been done they might have argued differently.

The fact that fantasizing and analyzing (external thought) do not load together is only problematic within a specific theoretical framework. The two alexithymia dimensions have been demonstrated in research covering 7 different populations, and more than 1500 subjects (Bermond et al, 2006) and thus results in a different framework with two more or less orthogonal dimensions.

Bell, C. (1919/1975). The artistic problem. (first published in 1919 by Athenaeum, pp. 496-497). In W.G. Bywater (Ed.), *Clive Bell's eye*. Detroit: Wayne State University Press.

Freud, S. (1916/17). *Vorlesungen zur Einführung in die Psychoanalyse* [Readings for an introduction to psychoanalysis]. London: Imago Publ. Co. (repr. 1950, XXIII. Vorlesungen).

3) Then there is the issue of labeling + vs. - on the AFF and COG dimensions. Whereas someone who scores high on these dimensions purportedly has alexithymic characteristics, the use of a minus sign to denote this seems backward and is confusing.

We extended the explanation for this convention. Please see our reaction under 5)

4) The authors also talk about the minus sign referring to the presence of "alexithymic features."

Unfortunately, the reader is not told what alexithymic features are ~what direction of scoring is "alexithymic." In particular, these authors argue that there are different types of alexithymia, so what is "alexithymic?" Is high emotionalizing alexithymic? Apparently so for Type 2, if I recall correctly, but not for Type 1. So, I don't think that you can simply say "alexithymic" features without being confusing.

Please see our reaction under 5)

5) My bottom line is that I strongly suggest that the authors consider alternative, or at least much clearer ways to present their typology. Minimally, they should spend much more time explaining what these subscales are, what they measure, what the larger factors are, and consider some alternative labels for AFF and COG.

We have considered alternatives but each alternative label results in another type of possible confusion. Therefore we focused on explaining the dimensions and labels in a clearer way. Since this is not a study about alexithymia but about the alexithymia dimensions, it is more straightforward to talk about capacities than about reductions in capacities. To avoid mis-understanding we added the following sentence in the article:

"...(For reasons of convenience we applied a reversed scoring, thus a plus (+) indicates that the capacities are high, whereas a minus (-) corresponds to low capacities (alexithymia is related to low capacities))..."

Another reason to stick to the labels is that the labels have already been used in other publications. Using new ones would possibly frustrate readers that are already informed about these labels.

Third, I have a concern with the "baseline" values used in this study, in that it probably is not comparable to the "resting" or "tonic" baseline used in other studies. The current "baseline" is really a "prestimulus" measure, but it occurs during the midst of a series of 48 trials, and is confounded by the experience of the trials. The authors' suggestion that rumination~or prolonged recovery~may be responsible for the elevated EDA levels is reasonable, but this measure is not a tonic or resting level, and so making conclusions along these lines is misleading. Perhaps the authors should drop these analyses, because the meaning is too confusing.

Do the authors have available a true resting baseline, such as might be obtained during an extended initial rest period, before any stimuli are presented? One could measure the SCL as well as frequency or SC responses.

The reviewer is right that our baseline values do not refer to pretest-rest-time values, but to values concerning short rest periods between stimuli. The remarks of the reviewer motivated us to add a sentence that makes clear to what these baseline data refer.

Abstract: *measured during the short rest periods between stimuli...*

Discussion: “...*However, it should be realized that our baseline levels refer to one second preceding the stimulus onset....*”

It could be that this is insufficient to remove the confusion between a rest-baseline and a baseline just before stimulus-onset. In that case we wouldn't mind to leave the results of this exploration out of the manuscript as the reviewer suggested.

Minor points:

While I agree that the literature on psychophysiological reactivity is problematic and seemingly contradictory, I encourage the authors to take a closer look at some of the specific studies they mention. I am not so sure that Hyer et al. found that alexithymia was associated with lower resting physiological arousal, and the same thing with Newton & Contrada. In addition, they should take a close look at Papciak and at Martin & Pihl. Although those abstracts imply higher arousal associated with alexithymia, I believe what they found is a discordance, with higher negative affect ratings relative to no differences in physiological arousal. These early studies appear to have tried to salvage the idea that alexithymia MUST lead to hyperreactivity~but a close look at the data questions this.

The reviewer is right regarding some of the publications mentioned. These inconsistencies between suggestive results and clear statements in the summaries, is always a problem. For this reason we have changed the text:

“...Some studies suggest that alexithymia is related to attenuated autonomic responses to stress while others suggest the opposite.....”

Please give some examples of the emotionalizing factor items, and the fantasizing items, since these are less familiar to readers who are otherwise aware of the TAS.

We have added examples of items concerning all BVAQ subscales in the Methods section.

The authors need to add details about how screening done. The authors have not listed any limitations of their study. They should. One that I would add is that the effects apply to women only, and it is possible that the effects are different for men.

The limitations of the study are now clearly listed at the end of the Discussion section

Reviewer #2: International Journal of Psychophysiology

Reviewer's comments to the author(s):

Ms. Ref. No.: JA1377

Title: THE COGNITIVE AND AFFECTIVE ALEXITHYMIA DIMENSIONS IN THE REGULATION OF SYMPATHETIC RESPONSES

This manuscript presents an investigation that examined the influence of the interaction of cognitive and affective dimensions of alexithymia on sympathetic responses (measured by galvanic skin responses or GSR) to pictures of fear, erotic and neutral content in young women. Results suggest the importance of measuring the affective dimension in addition to the cognitive dimension of alexithymia in measuring GSR. The study has several strengths and addressed an important clarifying research question. However, there were several major limitations with which detract from the overall scientific contribution. The comments provided below are listed in the order that they appear in the manuscript and will hopefully be helpful for the authors.

Challenges and Recommendations:

Abstract:

- * Include brief description of sample size and most important characteristics (e.g., age, sex).
- * Spell out GSR first before using the acronym.
- * Describe interaction on GSR latency times a bit more specifically.

Introduction:

- * Overall, the introduction was well organized, and reviewed the relevant literature adequately.
- * However, the introduction does not explain/justify why only the sympathetic nervous system arm was assessed?

We have added the following explication in the section Methods/ Measurement of autonomic responses:

:

*“...The autonomic responses are regulated by both the parasympathetic and sympathetic arms of the autonomic nervous system. However, *crosso modo*, it is the activation sympathetic arm that results in enhancements of autonomic responses, whereas the activation of the parasympathetic arm*

results in lower autonomic responses. For this reason we directed our attention to the sympathetic arm...”

Additionally, the rationale for choosing to study solely women was absent from the paper. This limits the generalizability of your findings and should be listed as a limitation in your discussion section.

We have added the following explication:

“...Since gender differences in psychophysiological responses in alexithymic subjects have been described (Spitzer, et al., 2005; Bermond, et al., 2008), and further since including males into the study would result in low numbers of males in the various cells ($\pm 30\%$ males in the population of freshman psychology students) it was decided to limit this study to females only....”

Methods:

Sample/Participants:

- There was a general lack of information regarding the sample and recruitment procedures. A table of the sample characteristics or some description would be appropriate here or under preliminary analyses including age range, height and weight or body mass index (M and SD), education (M and SD), and typical nicotine intake, caffeine intake, and alcohol intake if available. How were subjects recruited for the study and from where were they recruited? It is assumed that there was a larger pool of individuals from which you recruited?

* Were there any exclusionary criteria besides test scores? Were any medications or disease states that may affect physiology disallowed for the study? For instance, were any of these women taking anti-hypertensive or glucocorticoid medications or on hormone therapy?

Procedures:

Were subjects instructed to abstain from any substances (caffeine, nicotine, or alcohol) or physical activity prior to their session since these factors may influence or confound your physiological data? If not, were these activities recorded as part of the assessment?

Results:

* The inclusion of some preliminary analyses evaluating differences between groups on sample characteristics (e.g., education, age, body mass index,

nicotine consumption, alcohol consumption) and the baseline physiological measures is very important for interpretive reasons and are not presented in the manuscript.

* Accounting for potentially confounding factors on physiological measures was not adequately addressed. According to most researchers conducting experiments in the field of psychophysiological reactivity, accounting in some way for factors such as amount of typical smoking behavior (if including smokers in the sample), medication usage, body mass index or height and weight is standard, psychometrically sound research practice. Ignoring these issues can cause serious problems with reliability, validity, and generalizability of the results and should be acknowledged.

Age and recruitment, smoking, coffee and alcohol consumption have been taken care of by adding the following:

"...At the department of psychology of the university of Amsterdam all freshman psychology students are invited to fill out various questionnaires (among which the BVAQ), for which they get study credit points, those who do not want to do this have to urn these credit points by taking a small examination about literature concerning psychological questionnaires. Those freshman psychology students who had filled out the questionnaires, and fulfilled the selection criteria (see below), were asked by letter, whether or not they wanted to participate in an experiment. In the same letter they were asked whether or not they had any objection, that some of their previous scores would be connected to other scores gathered during the experiment.

Sixty-six female psychology students (mean age = 21.2, Sd= 6.21), scoring extremely on both alexithymia dimensions (either in the top or bottom 30% of the population) selected out of the population of freshman psychology students (N= 516, ± 70% female), had no objections, and were willing to participate in this study.

And:

"Subjects were asked to abstain from smoking, coffee and alcohol consumption at the day they participated in the experiment, till the end of the experiment."

Education was not measured, since all subjects were freshman psychology students. Height and weight and body mass and other variables were not measured. Firstly because there is not theoretical, nor empirical, evidence that the variance from these uncontrolled variables is systematically related to the relevant variables in this

study. They might of course add to the error variance and result in less significant p-values.

- Please state what the reasons are for individuals to be "nonresponsive" and more clearly justify reasons for removing these individuals measures from the main analyses.
-

It is not well studied why some subjects do not show clear GSR responses. Partly there are differences in thickness of the skin. Important of course is that non-responders were equally distributed over the four extreme groups.

- Results for the baseline GSR were MARGINAL or a TREND. This should be clearly stated in this section and in the discussion.

The reviewer is right and we have added clearly 'suggestive evidence'. Both in the section results as in the section discussion

What are the means and SD's for these marginal findings. These are presented in table 2

* Explain why baseline GSR is corrected with the mean value.

The correction of response values with a baseline just preceding stimulus onset is common in psychophysiology and is supposed to remove variance connected to slower processes unrelated with the stimuli.

* Were the significant interactions found on page 12 for GSR latencies tested with a post hoc analysis?

No. Firstly it refers to explorative data, secondly the resulting p-value was extremely low .0002. For both reasons we assumed it unnecessary and limited ourselves to mention that the effect was in the Cog+, AFF- group about twice as large as in the COG-, AFF+ group. However, if the reviewer finds further statistical testing concerning contrasts useful this could be done

* Were all analyses using a two-tailed test? Only some are specified as such.

Analyses of variance provide always one-tailed p-values, however, contrasts were expressed in two-tailed p-values

- Insert Figures and Tables to the end of the manuscript to enhance text readability.

Has been done

Discussion:

* The interpretation of the results is limited due to the problems presented with the data analyses and possible confounds mentioned above.

* 1st paragraph: Discussion about rumination is not within the scope of the research paper and was not tested in the study. This should be removed. In addition, these findings should be interpreted as cautionary as these were merely trends and not statistically significant findings.

Please see above by our reactions to reviewer 1

* A section discussing the limitations of the study needs to be added (e.g., limitation of generalizability due to the characteristics of the selected sample needs to be addressed).

Please see above by our reactions to reviewer 1

* Some discussion regarding the clinical significance of the findings in relation to health status is needed.

Has been dealt with in the following text

“...It seems therefore advisable to use for clinical purposes alexithymia scales that measure both alexithymia dimensions. The results of the recent study of Bailey and Henry (2007), indicating that alexithymia type 2 (high affective capacities together with low cognitive capacities) is related with the report of more somatic symptoms than either type 1 alexithymia (as well low affective as low cognitive capacities) or alexithymia (as well high affective as high cognitive capacities), also stress the importance of separate measurements of the two alexithymia dimensions for clinical purposes....”

Minor edits:

Correct spelling errors in manuscript to:

* artifacts

* baseline

Has been dealt with

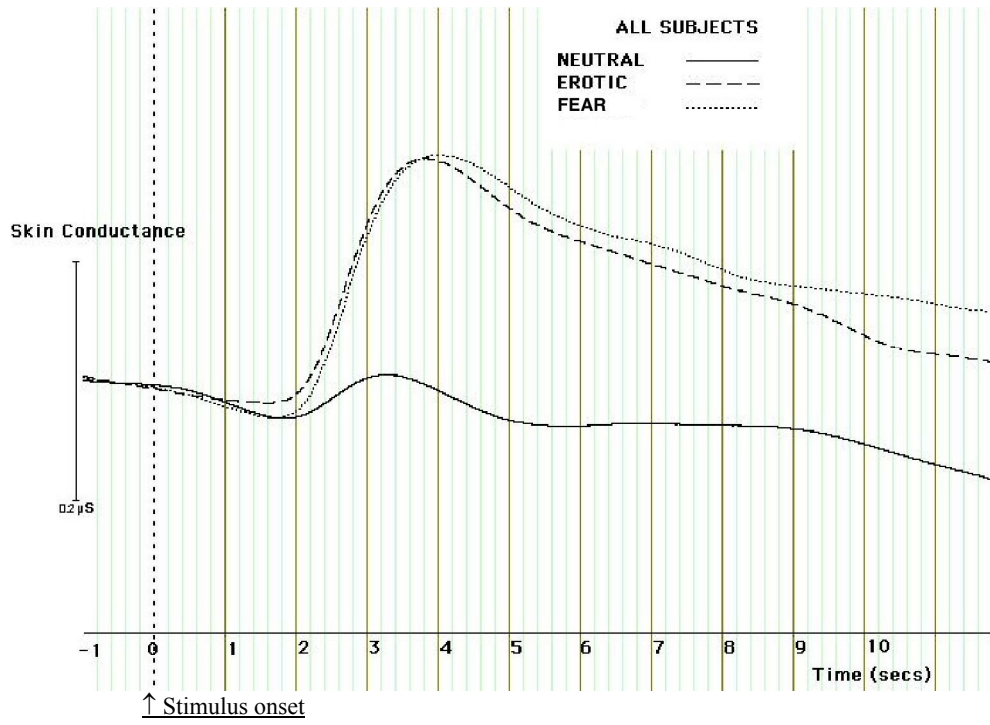


Figure 1. The average skin conductance response for all subjects split for three types of

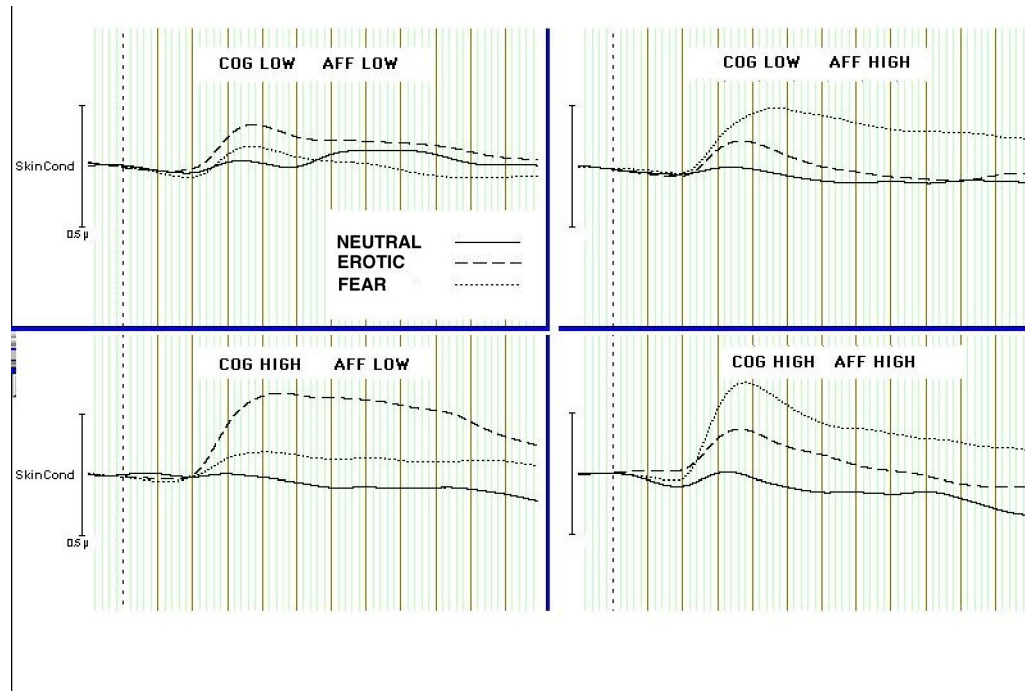


Figure 2: The average skin conductance response split for the 4 categories of subjects. High indicates high capacities.

Table 1. Counts of Responders and non-responders

| Group | Responders | Non-responders |
|------------|------------|----------------|
| COG- AFF-* | 13 | 2 |
| COG- AFF+ | 14 | 6 |
| COG+ AFF- | 14 | 2 |
| COG+ AFF+ | 14 | 1 |

* - Means that the capacities are low, referring to alexithymic features.

Table 2: mean values and standard deviations of peak-values in microSiemens

| <u>Group</u> | <u>N</u> | <u>Neutral</u> | <u>Erotic</u> | <u>Fear</u> |
|--------------|----------|-----------------|---------------|---------------|
| COG- AFF-* | 15 | 0.014 (0.086) | 0.154 (0.354) | 0.069 (0.242) |
| COG- AFF+ | 20 | -0.001 (0.123) | 0.069 (0.242) | 0.179 (0.452) |
| COG+ AFF- | 16 | 0.00001 (0.089) | 0.284 (0.813) | 0.088 (0.182) |
| COG+ AFF+ | 15 | -0.0001 (0.233) | 0.174 (0.230) | 0.348 (0.549) |

Standard deviations between parentheses.

* - Means that the capacities are low, referring to alexithymic features.

Table 3: Baseline values before baseline correction in microSiemens

| Group | Count | Mean | SD |
|------------|-------|--------|-------|
| COG- AFF-* | 15 | 15.056 | 5.438 |
| COG- AFF+ | 20 | 14.248 | 4.572 |
| COG+ AFF- | 16 | 16.451 | 8.231 |
| COG+ AFF+ | 15 | 18.751 | 7.242 |

* - Means that the capacities are low, referring to alexithymic features.

Table 4: overall (erotic & fear pictures) latencies in milliseconds

| Group | N | Mean (sd) | |
|------------|----|--------------|--------------|
| | | Erotic | Fear |
| COG- AFF-* | 11 | 1947 (236.2) | 1911 (170.0) |
| COG- AFF+ | 10 | 2142 (361.2) | 2270 (447.3) |
| COG+ AFF- | 9 | 2082 (221.9) | 2422 (379.9) |
| COG + AFF+ | 12 | 2009 (327.2) | 1944 (271.7) |

* - Means that the capacities are low, referring to alexithymic features.