Psychological and physiological responses to stress
Houtveen, J.H.

Citation for published version (APA):

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A repressive coping style cannot be related to affective, facial, or physiological responses to looking at emotional pictures

Jan H. Houtveen, Simon Rietveld, Mirjam Schoutrop, Mark Spiering, & Jos F. Brosschot

Abstract

Previous studies have demonstrated increased physiological emotional responses despite relatively low self-reported affect for individuals with a repressive coping style as compared to control groups. The main question in the current study was whether such group differences could also be demonstrated by using the picture perception methodology of Lang. A second question was whether differences between these groups could be found in the habituation of physiological emotional responses. Repressors \( n=14 \), ‘truly’ low anxious participants \( n=14 \), and moderately high anxious participants \( n=13 \) were selected with the Marlowe-Crowne Social Desirability Scale and the Taylor Manifest Anxiety Scale. Two sets of 27 pictures with alternating neutral, threatening, and sexual content were presented whilst valence and arousal ratings, skin conductance, heart rate, and facial muscle responses were measured. No straightforward group differences were found. The data only supported the view that differential habituation, and not a repressive coping style, may contribute to differential self-reported, facial, and physiological emotional responses.
Introduction

Differential self-reported emotional ratings, emotion-related facial expression, and emotion-related physiological responses have often been observed in the field of psychophysiological research on stress and emotions (e.g., Laan, Everaerd, van Bellen, & Hanewald, 1994; Lang, Levin, Miller, & Kozak, 1983; Skelton & Pennebaker, 1990). The combination of a relatively low self-reported emotional rating and a relatively high physiological response is of special relevance in this field. This type of differential response is considered typical for individuals with a repressive style of coping with emotions (Weinberger, Schwartz, & Davidson, 1979; Weinberger, 1990). Repression of emotions is considered to have potential negative clinical consequences, for example, it has been related to cardiovascular disease and immune function (Gross, 1989; Pennebaker, Hughes, & O’Heeran, 1987; Scheier & Bridges, 1995). Moreover, the concept of repression and/or non-expression of emotions may be particularly relevant in explaining slow physiological recovery, which has been suggested as a direct cause of stress-related diseases (Brosschot & Thayer, 1998).

Weinberger and co-workers (1979) used a combination of the Marlowe-Crowne Social Desirability Scale (MCSDS; Crowne & Marlowe, 1964) and the Taylor Manifest Anxiety Scale (TMAS; Taylor, 1953; see Bendig, 1956 for a short form) to differentiate repressors, ‘truly’ low anxious, and high anxious individuals. In their classic conceptualisation, individuals with high scores on the MCSDS and low scores on the TMAS were defined as repressors, while individuals with low scores on both the MCSDS and the TMAS were defined as truly low anxious. Individuals with high scores on the TMAS were defined as high anxious. Weinberger and co-workers (1979) used a phrase association task to validate their classification of repression. This test consisted of phrases regarding neutral, sexual, and aggressive topics. Their results demonstrated that repressors had slower responses to sexual and aggressive phrases as compared to truly low anxious participants, and they had higher levels of verbal disturbances and avoidance regarding emotional topics. Importantly, physiological measures (heart rate, skin conductance, and forehead electromyogram) indicated that repressors were actually more stressed as compared to truly low anxious participants, despite the fact that repressors scored low on trait anxiety. A moderately high anxious control group, which scored above the normative median on the TMAS, exhibited an intermediate level of stressful physiological response. Ever since, several studies have demonstrated increased physiological responses (despite low self-reported affect) for repressors as compared to truly low anxious and/or high anxious participants, as classified by a combination of the MCSDS and TMAS (Asendorpf & Scherer, 1983; Baumeister & Cairns, 1992; Brosschot & Janssen, 1998; Brown et al., 1996; Newton & Contrada, 1992).

However, further research may provide new insight into the complex relationships between the concomitants of an emotional state, and into the original
conceptualisation of repression. Lang (1995) proposed a motivational theory of emotions on the basis of a combination of affective valence and arousal. He argued that there are two motivational systems in the brain, an apetitive system and an aversive system, which determine the primacy of the valence dimension. The arousal dimension reflects variations in the metabolic and neural activation of both motivational systems. Lang, Greenwald, Bradley, and Hamm (1993) presented pictures to their participants that varied widely across the valence dimension (pleasant-unpleasant) and arousal dimension (excited-calm), during which facial muscle activity (zygomatic and corrugator electromyogram) and autonomic responses (heart rate and skin conductance) were measured. After each picture, the participants reported their experienced valence and arousal. A factor analysis revealed two factors: self-reported pleasure (valence), changes in heart rate, and changes in facial muscles on one factor, and self-reported arousal and changes in skin conductance on a second factor. Lang and co-workers (1993) used the same combination of the MCSDS and the short version of the TMAS. With their picture perception methodology, they did not find any differences between repressors and control groups neither on self-reported emotional ratings, nor on facial and physiological responses. However, the study of Lang and co-workers (1993) was not comparable to the study of Weinberger and co-workers (1979). For example, the selection criteria were not similar. Based on these differences in selection criteria, Lang and co-workers (1993) suggested that larger group differences could have been found when actual repressors were selected (i.e., selected from a larger population). The main question of the current study is whether these group differences may be found for actual repressors selected from a larger population.

Whether increased physiological responses (e.g., as found for repressors) are the result of increased reactivity or prolonged activation is not always clear. The picture perception methodology of Lang has the advantage that it creates the possibility of studying group differences in self-reported, facial, and physiological responses regarding both the valence and arousal dimensions. Moreover, this methodology may also be used to study group differences in generalization of habituation of the emotional responses. Generalization of habituation is defined as response extinction to repeated presentation of different stimuli (based on the classical definition of habituation as response extinction after repeated identical stimulus presentation; see Öhman, Hamm, & Hugdahl, 2000). One could speculate that physiological habituation patterns are particularly relevant for the development of stress-related disease. Reduced generalization of habituation during repeated (novel but to some extent similar) emotional stimulation might be related to slow physiological recovery (i.e., prolonged activation) after or during a stress situation. Some authors have suggested that slow recovery of the physiological response after an emotional situation may be more important for the development of stress-related disease than physiological reactivity (Brosschot & Thayer, 1998; Dienstbier, 1989; Linden, Earle, Gerin, & Christenfeld, 1997). It seems logical and adaptive that the emotional system habituates after repeated
exposure to identical or slightly different emotional stimulation, as the result of a reduction in novelty and unpredictability (Öhman et al., 2000). However, the different components of the emotional state (i.e., self-reported emotional ratings, facial responses, and physiological responses) may habituate differently over time. Hence, an important additional question of the current study is whether repressors have reduced generalization of physiological response habituation to emotional pictures.

The picture perception methodology of Lang was used in the current study to estimate group differences between repressors, a truly low anxious control group, and an additional moderately high anxious control group. Self-reported affective responses, physiological response patterns, and generalization of response habituation were measured regarding both the valence and the arousal dimensions. Neutral, threatening, and sexual conditions were selected (i.e., three types of stimulus contents), based on the study of Weinberger and co-workers (1979). Two sets of pictures were successively presented to study generalization of response habituation (based on the most-simple estimation of response habituation: by computing the difference in mean response amplitude between early and late trials; see Öhman et al., 2000).

By using this methodology, responses to looking at emotional pictures (i.e., threatening and sexual) may be compared to responses to looking at neutral pictures. It was hypothesized that repressors would show similar differences between their responses to emotional and neutral pictures as compared to the truly low anxious control group on their self-reported valence and arousal ratings. It was also hypothesized that repressors, as compared to the truly low anxious control group, would show larger differences between their responses to emotional and neutral pictures on the physiological measures of the valence factor (i.e., heart rate and facial muscles) and on the physiological measure of the arousal factor (i.e., skin conductance). It was further hypothesized that the additional, moderately high anxious control group, as compared to repressors and the truly low anxious control group, would show the largest differences between their responses to emotional and neutral pictures on self-reported valence and arousal ratings, while showing an intermediate level on the physiological measures. Regarding group differences in generalization of habituation, it was hypothesized that repressors, as compared to both control groups, would show the smallest reduction between the second set and the first set in the differences between their responses to emotional and neutral pictures on the physiological measures.
Method

Participants

General. Repressors, truly low anxious, and moderately high anxious participants were all recruited from a sample of 420 undergraduate students. The participants were invited for a study entitled ‘looking at pictures’ without informing them of the reason of their selection. They signed an informed consent and received course credits or Dfl 15 ($8) for participation.

Pre-selection. The pre-selection was based on the trait version of the Spielberger State-Trait Anxiety Inventory (STAI), completed by all undergraduate students two months before the experiment started (i.e., for another study). Individuals who scored below the normative median value of the STAI (n=203) received the MCSDS and TMAS by mail. These two questionnaires were used to select repressors and truly low anxious participants. Both groups were selected on a score in the lowest quartile of the TMAS (equal to or below value 4). The repressors (n=18) were selected on a score in the highest quartile of the MCSDS (equal to or above value 19), while the truly low anxious participants (n=18) were selected on a score in the lowest quartile (equal to or below value 17). Adopted from Weinberger and co-workers (1979), an additional control group of moderately high anxious participants was selected. These participants (n=18) were randomly selected from the subgroup of undergraduate students (n=217) that scored above the normative median value of the STAI. They scored above the normative median on the TMAS (above value 6) and below the normative median of the MCSDS (equal to or below value 17).

Final selection. All participants completed the MCSDS and TMAS (for a second time) immediately following the experimental procedure. Again adopted from Weinberger and co-workers (1979), final groupings were based on these scores rather than on the scores obtained from previous testing. Selection scores were similar to those used during the pre-selection. The final sample consisted of 14 repressors (7 men, 7 women), 14 truly low anxious participants (7 men, 7 women), and 13 moderately high anxious participants that, unintended, consisted of women only. Ages ranged between 18 and 40. Table 1 shows the mean and standard deviation values of age, the MCSDS, and the TMAS of the final groups.

Questionnaires

A Dutch translation of the Spielberger State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lustene, 1970; van der Ploeg, 1981) was used for the initial selection of low trait anxious participants. This questionnaire has 20 items, and the total score ranges from 20 to 80 points.

A Dutch translation of the short form of the Taylor Manifest Anxiety Scale (TMAS) was used to measure trait anxiety (Taylor, 1953; Bendig, 1956), and used
for Weinberger’s repressive coping style classification (Weinberger et al., 1979). This questionnaire has 20 items, and the total score ranges from 0 to 20 points. The TMAS correlates highly with other trait anxiety scales (Watson & Clark, 1984).

A Dutch translation of the Marlowe-Crowe Social Desirability Scale (MCSDS; Crowne & Marlowe, 1964) was used for Weinberger’s repressive coping style classification (Weinberger et al., 1979). This questionnaire has 33 items, and the total score ranges from 0 to 33 points.

Table 1. Means (and SD) of age, MCSDS, and TMAS scores.

<table>
<thead>
<tr>
<th></th>
<th>Repressors (n=14)</th>
<th>Truly low anxious (n=14)</th>
<th>Moderately high anxious (n=13)</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
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<tr>
<td>Age</td>
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<tr>
<td>MCSDS</td>
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<tr>
<td>TMAS</td>
<td>1.22</td>
<td>1.19</td>
<td>2.36</td>
</tr>
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Stimulus selection

Three types of digitized colour pictures were used: 27 neutral, 18 threatening, and 18 sexual. The neutral and threatening pictures were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1995). The sexual pictures were digitized from slides used in earlier sex-research experiments (Janssen, Everaerd, Spiering, & Janssen, 2000). The neutral pictures showed various kinds of emotionally neutral objects, e.g., plants, bushes, and household utensils. The threatening pictures showed angry, mutilated, or dead people. The sexual pictures showed nude female models and heterosexual couples engaged in oral or genital sexual activity. All pictures were carefully selected and digitally adjusted to match on stimulus dimensions as complexity, contrast, and luminance. Nine neutral pictures were randomly selected for the practice session. The remaining pictures were (for each category) randomly assigned to one of two (parallel) sets of 27 pictures each: nine neutral, nine threatening, and nine sexual pictures. There was one (randomized) order of picture presentation for each set.

Apparatus

The pictures were displayed on a 15-inch colour monitor connected to an MS-DOS computer system. This computer also controlled the experimental events, the presentation of the rating scales, and the synchronization with the measurement devices. Participants sat at a close distance (i.e., 40 cm) to the monitor. This
stimulus computer was placed in a (normally lit) sound-attenuated room. The apparatus for the physiological registrations was placed in an adjacent (dimly lit) room. A one-way screen and an intercom connected the two rooms.

Each trial started with a fixation point that was presented for 15 seconds on the middle of the screen. During this period, physiological base-rate values were measured. Then a picture was presented for 10 seconds, during which the physiological responses were measured (see below), and after which the emotional rating scales were presented on the screen. The average rating time was 5 seconds. After a picture was rated, a short waiting period was created in order to obtain a minimum duration of 30 seconds between the presentation of pictures, to allow values to return to base-rate.

The emotional experience of a picture could be rated on five-point scales for valence and arousal, based on the Self-Assessment Manikin (SAM; Bradley & Lang, 1994; Lang, 1980). Valence and arousal was graphically represented on these scales by changes in a cartoon figure (see Bradley & Lang, 1994). The SAM figures were digitized and displayed on the computer screen. A figure could be selected by entering the corresponding number on the keyboard: for valence from 1 (pleasant) to 5 (unpleasant), and for arousal from 1 (excited) to 5 (calm).

Facial electromyogram (EMG) activity was recorded with miniature Ag/AgCl surface electrodes filled with electrolyte gel and placed in pairs over the corrugator supercilii (frown muscle) and the zygomatic major (smile muscle) on the left side of the face. The electrode placement was in accordance with the guidelines of Fridlund and Cacioppo (1986), except that a separate reference electrode was used for each muscle. The EMG signals were pre-amplified (2000x), band-pass filtered (80-1000 Hz), rectified, processed through an integrator with a time constant of 25 ms, and further amplified (5-50x).

The electrocardiogram (ECG) was recorded with two Ag/AgCl surface electrodes filled with electrolyte gel and placed on the lateral sides of the chest (at the ninth rib). The ECG signal was pre-amplified and band-pass filtered (1.0-1000 Hz).

Skin conductance was recorded with two Ag/AgCl electrodes (1 cm² contact area). The electrodes were filled with 0.05 mol NaCl Unibase electrode paste (Fowles et al., 1981), and attached to the medial phalanges of the middle and index finger of the non-dominant hand. A minimal time period of 20 minutes was used as a stabilization period. An alternating current (AC) voltage source (30 Hz; ± 0.75 V) was used to measure the skin resistance, which was converted to a voltage (0.2 V/µS; linear within a skin resistance range of 5-200 kΩ). The output of the resistance-to-voltage converter was integrated with a time constant of 300 ms.

All physiological signals were sampled at 100 samples per second, by using a Keithly System 570 analogue to digital converter, and recorded by an MS-DOS computer system. A synchronization signal from the stimulus computer was also recorded by this computer system.
Procedure
After general instruction, informed consent, and electrode placement, participants were seated at the computer and were asked to relax and to refrain from talking during the task. At this point, the physiological measurement devices were tested and adjusted. Participants were told that pictures differing in emotional content would be displayed on the computer screen, and that they should pay close attention to each picture during the entire time it was displayed. After a picture was presented, the participants had to rate it on both SAM dimensions by selecting the corresponding figures from the SAM pictures that appeared on the computer screen. Specific information was given to explain the SAM rating scales.

The experiment began with a practice session to familiarize the participants with the SAM rating system and the experimental procedure. Then the first experimental set was presented, which consisted of 27 pictures with neutral, threatening, and sexual content. The second experimental set was presented after a break of five minutes. This second experimental set also consisted of 27 pictures with neutral, threatening, and sexual content. The pictures were presented to all participants in the same order. After the second experimental set, the equipment was disconnected and questionnaires were completed. Finally, participants were debriefed, asked some evaluative questions, paid, and sent home.

Physiological data analysis
A baseline period of 10 seconds before picture onset (during which the fixation point was visible) was defined for all physiological signals. A viewing period of 10 seconds was defined for the presentation of each picture. Reactivity scores were computed for the two facial EMG signals by subtracting the mean EMG signal during the baseline period from the mean EMG signal during the viewing period. These reactivity scores were log\(^10\) transformed to normalize the distribution. Inter Beat Interval times (IBI's; used as measure for heart rate) were computed off-line from the ECG signals by detecting the time intervals between R-tops. The R-top detection level was visually adjusted and inspected for each specific segment. The reactivity scores were calculated by subtracting the mean IBI value during the baseline period from the mean IBI value during the viewing period. This measure (unfortunately) differs from the more refined heart rate reactivity reported in Lang and co-workers (1993); it includes both the heart rate acceleration and final deceleration in response to a picture. The skin resistance signal was calibrated and converted to a skin conductance value (in \(\mu S\)). The skin conductance response magnitudes were scored as the largest value (compared to the mean baseline value) from one to five seconds after picture onset (based on Lang et al., 1993). The obtained skin conductance responses were also log\(^10\) transformed to normalize the distribution.
AA repressive coping style and looking at emotional pictures

Statistical data analysis
The data for the nine pictures with neutral, nine pictures with threatening, and nine pictures with sexual content were pooled separately for each stimulus-set. Statistical analyses were performed using group (repressors, truly low anxious, moderately high anxious) as a between-subject factor, and picture content (neutral, threatening, sexual) and stimulus-set (first picture set, second picture set) as within-subject factors. Group differences were tested separately for the valence factor (i.e., self-reported valence, IBI, corrugator, and zygomaticus responses) and the arousal factor (i.e., self-reported arousal and skin conductance responses). Overall group differences for differential responses between neutral and emotional pictures, and overall group differences for the extinction of responses between the first and second set were tested with repeated-measures multivariate analysis of variance (MANOVA) procedures, using Wilks' Lambda and a Bonferroni adjusted significance level of .05/2=.025. Follow-up univariate tests and univariate contrast tests were performed to test for specific picture content and stimulus-set effects, using a Bonferroni adjusted significance level of .01.

Results

Group effects
The mean self-reported and physiological responses for each group and within-subject condition are shown in Table 2. The overall repeated-measures MANOVA test for the valence factor (i.e., self-reported valence, IBI, corrugator, and zygomaticus responses) yielded no main effect for group ($F(8,72)=1.10, p=.38$), no interaction effect between group and picture content ($F(16,62)=0.80, p=.68$), no interaction effect between group and stimulus-set ($F(8,70)=0.62, p=.76$), and no interaction effect between group, picture content, and stimulus-set ($F(16,62)=1.54, p=.12$). Additionally, including gender as a covariate or performing multiple univariate tests for each of the valence factor measures yielded no main effects for group and no interaction effects with group.

A trend, however, was found for an interaction effect between group, picture content, and stimulus-set for corrugator responses ($F(4,76)=3.13, p=.019$). Post-hoc tests indicated that this trend (for a group difference) was limited to the threatening pictures during the first stimulus set ($F(2,38)=3.14, p<.05$) A Tukey HSD procedure yielded that the corrugator responses were smaller for the repressor group as compared to the moderately high anxious group ($p<.05$). However, this trend disappeared completely when gender was included as a covariate.
Table 2. Means (and SD) of self-reported valence and arousal ratings, Skin Conductance Level (SCL) responses \(\log^{10}(\text{SCL}+1)\mu\text{S}\), Inter Beat Interval (IBI) responses [ms], corrugator \(\log^{10}(\text{cor}+1)\) and zygomaticus \(\log^{10}(\text{zyg}+1)\) responses.

<table>
<thead>
<tr>
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<th>Moderately high anxious ((n=13))</th>
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The overall repeated-measures MANOVA test for the arousal factor (i.e., self-reported arousal and skin conductance responses) yielded no main effect for group \((F(4,74)=0.47, p=.76)\), no interaction effect between group and picture content \((F(8,70)=0.68, p=.71)\), no interaction effect between group and stimulus-set \((F(4,74)=1.04, p=.39)\), and no interaction effect between group, picture content, and stimulus-set \((F(8,70)=0.15, p=.98)\). Additionally, including gender as a covariate or performing univariate tests for each of the arousal factor measures yielded no main effects for group and no interaction effects with group.

Thus, the expected group differences were not found in the differences between responses to looking at neutral and emotional pictures. The expected group differences were also not found in the extinction of responses to looking at pictures between the first and the second stimulus-set presentation. The expected group differences were not found on the valence factor and they were not found on the arousal factor.

*Picture content and stimulus-set effects*

Graphs depicting the self-reported responses for each within-subject condition are shown in Figures 1 and 2. Graphs depicting the physiological responses for each within-subject condition are shown in Figures 3 to 6.

![Figure 1 and 2](image)

**Figures 1 and 2.** Self-reported mean (± SEM) valence and arousal ratings to the neutral, threatening, and sexual pictures, for both stimulus sets.

The overall repeated-measures MANOVA tests for the valence and arousal factors both yielded a significant effect of picture content \((F_{valence}(8,31)=46.79, p<.001; F_{arousal}(4,35)=60.72, p<.001)\), and a significant effect of stimulus-set \((F_{valence}(4,35)=6.21, p<.001; F_{arousal}(2,37)=21.47, p<.001)\). A significant interaction
effect between picture content and stimulus-set was only found for the arousal factor ($F(4,35)=6.45, p<.001$).

![Graphs showing SCR and IBI responses](image)

Figures 3 to 6. Mean ($\pm SEM$) Skin Conductance Level (SCL), Inter Beat Interval (IBI), corrugator, and zygomaticus responses to the neutral, threatening, and sexual pictures, for both stimulus sets.

Post-hoc univariate tests for picture content yielded significant effects for self-reported valence ($F(2,39)=128.66, p<.001$), self-reported arousal ($F(2,39)=59.27, p<.001$), skin conductance responses ($F(2,39)=33.29, p<.001$), IBI responses ($F(2,39)=128.66, p<.001$), corrugator responses ($F(2,39)=12.05, p<.001$), and zygomaticus responses ($F(2,39)=6.13, p<.01$). The threatening pictures were rated as more unpleasant than the neutral pictures ($F(1,40)=260.19, p<.001$), while both the threatening pictures ($F(1,40)=101.81, p<.001$) and the sexual pictures ($F(1,40)=291.25, p<.001$) were rated as more arousing than the neutral pictures. Additionally, the threatening pictures were rated as more unpleasant ($F(1,40)=167.32, p<.001$) and more arousing ($F(1,40)=7.68, p<.01$) than the sexual pictures. The skin conductance and IBI responses were larger for threatening pictures ($F_{\text{skin-con}}(1,40)=31.14, p<.001$; $F_{\text{IBI}}(1,40)=37.10, p<.001$) and sexual pictures ($F_{\text{skin-con}}(1,40)=61.33, p<.001$; $F_{\text{IBI}}(1,40)=35.96, p<.001$) than for neutral pictures, while skin conductance responses were larger for sexual pictures.
than for the threatening pictures ($F(1,40)=7.74, p<.01$). Finally, corrugator responses were larger only for threatening pictures than for neutral pictures ($F(1,40)=24.60, p<.001$) and sexual pictures ($F(1,40)=16.16, p<.001$), while zygomaticus responses were smaller for both threatening pictures ($F(1,40)=4.12, p<.05$) and sexual pictures ($F(1,40)=10.34, p<.001$) than for neutral pictures. Thus, differences between responses to looking at neutral and emotional pictures were found for all measures.

Post-hoc univariate tests for stimulus-set yielded a significant effect for self-reported valence ($F(1,40)=11.66, p<.001$). Pictures of the second stimulus-set were rated as more unpleasant than pictures of the first stimulus set. A trend was, however, found for reduced self-reported arousal ratings for pictures of the second stimulus-set ($F(1,40)=3.87, p=.06$). Further, significant stimulus-set effects were found for skin conductance ($F(1,40)=40.84, p<.001$) and IBI ($F(1,40)=8.34, p<.01$). Reduced skin conductance responses were found for pictures of the second stimulus-set, but the IBI responses (i.e., heart rate deceleration in response to a picture) were larger. Finally, a trend was found for reduced zygomaticus responses for pictures of the second stimulus-set ($F(1,40)=4.88, p=.033$). Thus, an extinction of responses during the second stimulus-set presentation was found for some of the measures. It is remarkable that although reduced arousal ratings, skin conductance, and zygomaticus responses were found for pictures of the second stimulus-set, these pictures were rated as more unpleasant.

Finally, post-hoc univariate tests for the picture content by stimulus-set interaction yielded a significant effect for skin conductance ($F(2,39)=13.71, p<.001$). The difference between skin conductance responses for both threatening and sexual pictures versus neutral pictures was larger for pictures of the first stimulus-set than for pictures of the second stimulus set ($F_{\text{threat}}(1,40)=8.16, p<.01$; $F_{\text{sexual}}(1,40)=828.13, p<.001$).

**Discussion**

No differences could be found (for both the valence and arousal factors) between participants classified as repressors, truly low anxious, and moderately high anxious, in their self-reported emotional ratings or physiological responses to emotional pictures. The hypotheses that repressors would show scores similar to those of the truly low anxious control group on self-reported emotional ratings but with larger physiological responses, while the additional moderately high anxious control group would show larger self-reported emotional ratings but with intermediate physiological responses were not confirmed. The hypothesis that repressors would show the smallest reduction of physiological responses to emotional pictures of the second set was also not confirmed. The hypothesized group differences were absent despite substantial (content specific) responses for
both the valence and arousal factors to the threatening and sexual pictures as compared to the neutral pictures. Furthermore, the hypothesized group differences in habituation were also absent despite substantial generalization of physiological response habituation to the threatening and sexual pictures as compared to the neutral pictures. Thus, whereas the manipulations of the current study were successful, the results do not support the classic concept of a repressive coping style (with repressors defined by using a combination of the MCSDS and TMAS).

Importantly, as Figures 1 to 6 show, a pronounced generalization of habituation was only selectively found for some measures. Regarding the arousal factor, a pronounced generalization of habituation was found for skin conductance response, while this was hardly found for self-reported arousal ratings. Regarding the valence factor, only the zygomaticus (smile muscle) response showed some generalization of habituation. The self-reported unpleasantness was even increased for the second stimulus-set. Although recovery of responses have been reported before when the stimulus is reintroduced after a resting interval (see Öhman et al., 2000), one could only speculate about the reason for this (selective) unexpected sensitization of self-reported valence ratings. It cannot be excluded that stimulus-set effects might have been the result of differences in the emotional content between the pictures of both sets. In that case, generalization of response habituation and differences in the emotional contents of the sets would have been confounded. However, this appears to be unlikely since: a) highly equivalent pictures (for each category) were randomly assigned to one of the two sets; and b) while generalization of response habituation was hardly found for self-reported emotional ratings, a pronounced generalization of response habituation was found for skin conductance.

Repressors appeared to have less corrugator (frowning) responses for the threatening pictures of the first stimulus-set as compared to the moderately high anxious group. However, because this difference disappeared after including gender as a covariate, combined with the fact that the moderately high anxious group consisted of women only, we must attribute this result to larger corrugator responses for women as compared to men (see also Lang et al., 1993). Thus, although deficits in spontaneous displays of negative affect have been reported in the literature for internalizers (Jones, 1935) and alexithymics (McDonald & Prkachin, 1990), the results of the current study only demonstrated differences between the sexes.

The repressors and truly low anxious participants of the current study consisted of men and women. Comparing balanced groups of men and women seems acceptable since the expected differences between repressors and truly low anxious participants have been demonstrated for men (Asendorf & Scherer, 1983; Weinberger et al., 1979), women (Newton & Contrada, 1992), and men and women (Brown et al., 1996). Thus, the inclusion of both men and women (in balanced groups) cannot explain why the expected differences between repressors and truly low anxious participants were not found in the current study.
Additionally, including gender as a covariate did not result in significant group differences.

We compared the absolute scores on the MCSDS and TMAS used for the selection of our groups (see Table 1) with the absolute scores used in other studies that have demonstrated differences between repressors and control groups. It was found that our criteria for the selection of repressors and control groups were not different from the criteria proposed and used by these other studies (cf., Brown et al., 1996; Newton & Contrada, 1992; Weinberger et al., 1979). This implies that our selection criteria cannot explain why repression effects were not found in the current study. Lang and co-workers (1993) suggested that including extreme repressor and control groups could possibly have resulted in more differences when they are compared with the picture perception methodology. The results of the current study do not support this view.

Weinberger and co-workers (1979) emphasized that individuals with a repressive coping style were particularly threatened by the phrase association task during phrases with negative emotional content. This conclusion was based on their study, as well as on literature regarding the relationship between verbal disturbance during phrase association and the appearance of affective imagery on the Rorschach test. However, the picture perception methodology of Lang (Lang et al., 1993, 1995) is not similar to the phrase association task, although the physiological responses were found to be similar. A phrase association task is an active task, while perception of pictures is passive. Thus, although it seems unlikely, we cannot exclude the possibility that relatively high physiological responses despite relatively low self-reported emotional ratings for repressors (as found by Weinberger et al., 1979) is task-specific, and cannot be generalized to looking at threatening and/or sexual pictures. Several authors argued that specifically threat to the self (or self-esteem) would trigger discordance responses in repressors (Brosschot & Janssen, 1998; Weinberger, 1990). With respect to the current data, this would imply that the expected group effects might not have been found because participants did not experience real threat to the self by looking at the emotional pictures.

Lang and co-workers (1993) averaged the heart rate responses to their pictures over the highest peaks found during the initial acceleration interval. They found that these peaks in heart rate acceleration were lower when self-reported pleasure ratings were lower. The heart rate analysis technique used in the current study was (unfortunately) less refined since the heart rate measurement interval during picture presentation was longer and included the acceleration and the deceleration responses. As a result of our longer intervals, we always found a heart rate deceleration in response to a picture. However, this deceleration was more pronounced for threatening and sexual pictures as compared to neutral pictures, and this deceleration was larger during the second picture-set. Heart rate deceleration versus acceleration in response to pictures is discussed in great details in Öhman and co-workers (2000). Such responses may be interpreted in terms of:
(a) Lang’s defense cascade model as a tendency towards freezing versus overt action; (b) Lacey’s hypothesis as an indicator of cortical processing; or (c) Obrist’s cardiac-somatic coupling hypothesis.

Highly unpleasant self-reported valence ratings and high arousal ratings combined with relatively high skin conductance responses corresponded with the threatening pictures in the first stimulus-set. However, relatively higher unpleasant self-reported valence ratings and only slightly reduced arousal ratings combined with relatively lower skin conductance responses corresponded with the threatening pictures in the second stimulus-set. Furthermore, the self-reported arousal ratings and unpleasant valence ratings were lower during the sexual pictures as compared to the threatening pictures, while the skin conductance responses were higher during the sexual pictures. Thus, a relatively low self-reported unpleasant valence and a relatively low self-reported arousal combined with a relatively high physiological activation is not a state that is specific for repressors.

The results of the current study indicate that a repressive coping style (as classified by a combination of the MCSDS and TMAS) cannot be related to reduced self-reported emotional ratings in combination with increased physiological responses to looking at emotional pictures. It can also not be related to a reduced generalization of physiological response habituation after repeated emotional picture presentation. The data only support the view that differential generalization of response habituation may contribute to differential self-reported, facial, and physiological emotional responses.

Acknowledgments

The authors gratefully acknowledge the aid of Monicque van Kemp, Jet Meijer, Nicole Oei, Luus Reijkem, and Richard Smit for their assistance in data collection and scoring.

References


Gainesville, FL. The Center for Research in Psychophysiology, University of Florida.


