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# Affective Modulation Of Startle In Fearful And Schizotypal College Students.

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# AFFECTIVE MODULATION OF STARTLE IN FEARFUL AND SCHIZOTYPAL COLLEGE STUDENTS

by

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Previous research has demonstrated enhanced affective modulation of startle in persons reporting high trait negative affectivity, fearfulness, and related characteristics. Altered startle response (impaired inhibition) has also been reported in individuals with schizophrenia and persons selected for schizotypal characteristics. The present study addressed the relationship between these effects in a paradigm, including both affective imagery and pictures, and permitting simultaneous assessment of both affective modulation of startle and habituation. Subjects ($n$ = 103) were selected to vary along independent fearfulness and schizotypy dimensions, using the Fear Survey Schedule and Chapmans' Perceptual Aberration and Magical Ideation Scales. As expected, both high fear and high schizotypy subjects showed reliable potentiation of startle by aversive imagery. In addition, perceptual aberration and magical ideation were associated with impaired habituation, particularly during aversive imagery. These findings indicate that the relationship between enhanced startle modulation and negative emotionality may not be as specific to fearfulness as

previously thought and suggest that sensory gating deficits previously observed in schizotypals and persons with schizophrenia may be related to or exacerbated by negative emotion.

**Abstract Approved by:** **Committee Chairman** Edwin W. Cook III

**Program Director**

**Date** 8/31/95 **Dean of Graduate School**

DEDICATION

To my nieces, nephews,

and black youth.

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## Introduction

Recent research indicates that the startle reflex is disinhibited among individuals with schizophrenia and schizotypal characteristics. Laboratory studies have associated both schizophrenia and related cognitive processes (e.g., perceptual aberration and magical ideation) with deficits in startle habituation and prepulse inhibition. These specific deficits in startle processing may index a more general sensory gating deficit in schizophrenia. Emotional variables also affect startle, as demonstrated by recent research from our laboratory and elsewhere. For example, Cook, Hawk, Davis, and Stevenson (1991) demonstrated that individual differences in affective variables are associated with potentiation of the startle response, particularly during processing of aversive information. That is, subjects reporting fearful, depressive, and anger-prone symptoms show greater potentiation of startle magnitude during negative compared to positive affective conditions.

The present investigation sought to integrate within a single study previous findings for schizophrenia-related and affective characteristics as they relate to startle modulation. Subjects were selected to vary independently on both schizotypal thought processes (perceptual aberration and magical ideation) and fearfulness. The experimental paradigm allowed simultaneous investigation of both the sensory gating hypothesis (delayed habituation of startle among

schizotypal subjects) and the affective modulation hypothesis (enhanced potentiation of startle by negative affect among fearful and anxious subjects). The goal was to advance knowledge of the role that anxiety plays in modulating the sensory gating deficit previously observed in schizotypy, as well as the relationship between schizotypy and affective modulation of startle.

Literature Review

The startle reflex is a transient somatomuscular response elicited by intense stimuli with rapid onset. The reflex can be elicited by auditory, visual, or tactile stimuli, although auditory stimuli are most frequently used in laboratory studies. The response complex consists of an array of apparently protective components, including eyeblink, forward and downward head movements, raising and drawing forward of the shoulders, contraction of the abdomen, and flexion of the limbs. The short latency of the response (less than 50 ms) in humans as well as neuroanatomical studies in rodents suggest that the primary startle circuit involves few synapses. However, substantial data indicate that the reflex is modulated by a variety of cognitive and emotional experimental variables. In addition, the startle reflex has been shown to be disinhibited or potentiated among persons with schizophrenia and anxiety disorders, as well as among nonclinical populations with related characteristics.

The existing research on startle and psychopathology consists of two separate literatures, one dealing with schizophrenia and schizotypy, and the other dealing with fearfulness and anxiety disorders. The literature in these two research areas is briefly reviewed below.

Schizophrenia, sensory gating, and startle. Schizophrenia is often characterized by deficits in processing and modulating responses to irrelevant stimuli. Chapman and Chapman (1973, pp. 253-285) reviewed data and theories of schizophrenia that are related to this characteristic. For example, the widely-cited interview study of McGhie and Chapman (1961) demonstrated that persons with schizophrenia experience marked loss of control over environmental stimuli, distractibility, and the subjective impression that incoming sights and sounds are unusually intense and intrusive. Theoretical explanations of this characteristic of schizophrenia have posited deficits in filtering and selective attention.

A series of laboratory studies by Geyer, Braff, and their colleagues (Geyer & Braff, 1987; Geyer, Swerdlow, Mansbach, & Braff, 1990) have used the startle response to investigate stimulus processing among persons with schizophrenia. Results obtained with two paradigms--habituation and prepulse inhibition--suggest that startle processing deficits in schizophrenia involve difficulties in attenuating or inhibiting responses to stimuli. For example, in a study of startle habituation in normals and patients with schizophrenia, Geyer and Braff (1982) demonstrated that while normal and patient controls exhibited about a 70% decrement in response amplitudes across a 121-trial session, patients with schizophrenia habituated by less than 50%. In a more recent study, Braff, Grillon, and Geyer (1992) also demonstrated this effect for medicated persons with schizophrenia during a shorter experimental session of 73 trials. In addition, using a prepulse inhibition paradigm, Braff et al. (1978) examined inhibition of startle blink amplitude among persons with schizophrenia and normal controls.

Subjects were presented a weak tone prior to an acoustic startle probe during a 60 ms prestimulus condition. As predicted, among normal controls the weak prestimulus effectively inhibited the startle reflex. However, significantly less prepulse inhibition was observed among the subjects with schizophrenia. Grillon, Ameli, Charney, Krystal, and Braff (1992) found that this deficient prepulse inhibition among individuals with schizophrenia was independent of the intensity of the prepulse across a fairly broad range of values. Impaired habituation and prepulse inhibition have also been shown in animal models of schizophrenia (e.g., Geyer et al., 1978; Geyer, Segal, & Greenberg, 1984).

Although much of the research on startle processing deficits has been conducted with individuals diagnosed with schizophrenia, these deficits have also been investigated among persons with schizotypal personality disorder and related schizotypal characteristics in the general population. Cadenhead, Geyer, and Braff (1993) investigated both startle habituation and prepulse inhibition among individuals who met the diagnostic criteria for schizotypal personality disorder according to the Diagnostic and Statistical Manual of Mental Disorders-3rd Edition, Revised (DSM-III-R; American Psychiatric Association, 1986). The individuals with schizotypal personality disorder compared to controls had deficits in both habituation and prepulse inhibition similar to the deficits observed in patients with schizophrenia. In addition, such schizotypal characteristics as perceptual aberration, magical ideation, and physical anhedonia have been linked to startle processing deficits. Paul Meehl coined the term schizotypy, a phenotypic indication of an underlying genetic predisposition toward

schizophrenia (Meehl, 1990). Brief questionnaires have been developed by Loren Chapman and his colleagues (see Chapman & Chapman, 1987, for a review) for identifying individuals with these characteristics in college student populations. Simons and his colleagues (Losito & Simons, 1988; Perlstein, Fiorito, Simons, & Graham, 1989; Simons, 1990) investigated prepulse inhibition among individuals selected with these scales. Similar to persons with schizophrenia, individuals with schizophrenia-related symptoms (especially perceptual aberration) show diminished prepulse inhibition. Evidence for delayed habituation among students selected for perceptual aberration and magical ideation was presented by Ladner, Filion, and Dawson (1991).

In summary, schizophrenia, schizotypal personality disorder, and schizophrenia-related symptoms have been associated with impaired inhibition of startle, as evidenced by delayed habituation and reduced prepulse inhibition. These deficits are reflected in exaggerated or potentiated responses to startle probe stimuli. Thus, Geyer and Braff (1987) suggest that individuals with schizophrenia "have a unique problem in overcoming the disruptive or distracting effects that occur when stimuli that require information processing are presented in fairly rapid succession" (p. 643). In this "complex and stimulus-laden world" (p. 644), persons with schizophrenia are hypothesized to experience serious psychological and physiological problems as a result of the inefficient sensory processing that is indexed by excessive startle responses. Recent research from outside the area of schizophrenia supports the hypothesis that startle reactivity is related to affect, and this literature is reviewed next.

Individual differences in affective modulation of startle. Recent research has demonstrated that the startle reflex varies with the emotional state of the subject. Vrana, Spence, and Lang (1988) presented acoustic startle probes during three sets of photographic slides varying in emotional content: negative/interesting slides (e.g., fearful or phobic objects), positive/interesting slides (e.g., opposite sex models and smiling children), and neutral/dull slides (e.g., common household objects). Aversive stimuli produced startle reflex facilitation (i.e., larger startles) relative to the neutral and positive slides. This effect was independent of measures of attention, interest, orienting, and arousal. Numerous studies have replicated the potentiation of the startle reflex by negative affect. These studies have used a variety of procedures to manipulate affect, including affective imagery (e.g., Cook et al., 1991; Cuthbert, Bradley, York, & Lang, 1990), aversive photographic slides (e.g., Bradley, Cuthbert, & Lang, 1990, 1991; Cook, Davis, Hawk, Spence, & Gautier, 1992), shock exposure (e.g., Greenwald, Hamm, Bradley, & Lang, 1988), and shock threat (e.g., Foot, Grillon, Merikangas, Woods, & Davis, 1991).

The effect of emotional valence on startle has recently been shown to be sensitive to affective individual differences. Cook et al. (1991) used an emotional imagery paradigm to assess the relationship between affective modulation of startle and individual differences in fearfulness. Subjects were selected for high and low scores on the Fear Survey Schedule (FSS). Acoustic startle probes were presented while subjects imagined scripts judged a priori to elicit a variety of emotional states (i.e., sadness, fear, pleasant relaxation, joy, anger and neutral imagery). Subjects selected two scripts from each of the

six affect categories that elicited the strongest and most vivid affective images. The high fear subjects (i.e., high FSS) showed reliable potentiation of startle magnitude during negative as compared to positive affective imagery, whereas the low fear (i.e., low FSS) subjects did not. Follow-up testing of these subjects suggested that other affective individual differences (i.e., anger and depression) were also correlated with affective modulation of startle. Cook et al. (1992) again selected subjects for high and low scores on the FSS. Acoustic startle probes were presented while subjects viewed aversive and neutral slides. High fear but not low fear subjects showed startle magnitude potentiation during aversive compared to neutral slides, effectively replicating the earlier imagery findings.

Other laboratories employing different startle paradigms have also found greater potentiation of startle during negative affect among fearful subjects. Greenwald, Bradley, Cuthbert, and Lang (1990) presented startle probes while subjects viewed photographic slides varying in pleasantness and arousal. The startle response increased linearly with the unpleasantness of the slides, and, consistent with the two previous startle studies from our laboratory, this valence effect was larger among fearful as compared to low fear subjects. Foot et al. (1991) elicited startle responses during various intervals of both shock-threat and nonthreat conditions. Subjects with high state anxiety had larger startles overall and showed larger fear-potentiated startles during the last interval of the shock threat condition, compared to low anxiety subjects. Finally, in a paradigm in which subjects were actually exposed to an electric shock either at the beginning of the experimental session or midway through an eight-trial habituation series

of two photographic slide stimuli, Greenwald, Bradley, Cuthbert, and Lang (1991) demonstrated that fearful/inhibited as compared to nonfearful/impulsive subjects showed greater startle magnitude potentiation to the shock. In summary, studies from our laboratory and elsewhere indicate that subject fearfulness or anxiety is associated with enhanced facilitation of startle magnitude during negative affective conditions.

Combined influences of schizotypy and affective variables on startle. Two recent studies suggest that schizotypy and affective variables (e.g., fearfulness) might jointly affect startle response or startle modulation. Stevenson, Cook, and Hawk (1991) used an imagery startle paradigm similar to that of Cook et al. (1991) to investigate the specificity of individual differences in affective modulation of startle. Three groups of subjects (i.e., high fear/low schizotypy, high schizotypy/low fear, and low fear/low schizotypy) were presented with acoustic startle probes while they imagined scripts judged a priori to elicit various emotions (i.e., fear, anger, sadness, pleasant relaxation, and joy). As in Cook et al. (1991), the Fear Survey Scale (FSS) was used to assess fearfulness. In addition, the Perceptual Aberration (Per; Chapman, Chapman, & Raulin, 1978) and Magical Ideation (Mag; Eckblad & Chapman, 1983) Scales were used to assess schizotypy. Schizotypal subjects were included in this study because, unlike high fear subjects, they are primarily identified on the basis of cognitive and perceptual distortions.

Results were inconsistent with the numerous previous studies of fearfulness and startle described above, in that the high fear subjects (who were also selected for low schizotypy scores) did not show enhanced

affective modulation of startle. In contrast, high schizotypy subjects (who were also selected for low fearfulness scores) showed reliable potentiation of startle magnitude for negative as compared to positive imagery. It is noteworthy that, as in the prepulse and habituation studies described above, schizotypal subjects in this affective modulation study showed increased startle magnitude. However, in this study, enhancement of startle was specific to aversive imagery.

Butler et al. (1990) investigated exaggerated startle responding among Vietnam veterans with combat-related posttraumatic stress disorder (PTSD). PTSD is an anxiety disorder characterized by intense affective features (e.g., anger, irritability, depression), perceptual abnormalities, and physiological reactivity upon exposure to events or thoughts resembling the precipitating traumatic experience. Exaggerated startle has been included among the diagnostic criteria for PTSD in the Diagnostic and Statistical Manual of Mental Disorders-4th Edition (DSM-IV; American Psychiatric Association, 1994), although with little empirical basis. Subjects in the Butler et al. (1990) study were administered the Schedule for Affective Disorders and Schizophrenia (SADS), as well as the Schedules for Assessment of Negative and Positive Symptoms. Veterans diagnosed with PTSD had enhanced startle reactivity compared to non-PTSD controls. Additionally, among veterans diagnosed with PTSD, those who also presented with symptoms of schizophrenia (e.g., perceptual aberration and atypical thought) showed the greatest startle reactivity.

In summary, two studies have investigated both schizophrenia-related and affective symptoms in relation to startle. Taken together and in the context of previous research, the studies of Butler et al.

(1990) and Stevenson et al. (1991) suggest that schizophrenia-related characteristics and anxiety or related affective disturbance may combine to enhance startle or startle modulation.

Experimental Approach

The present study sought to replicate and extend the study of Stevenson et al. (1991). The independent and interacting effects of fearfulness and schizotypy as they relate to both habituation and affective modulation of startle were assessed.[1] Subjects were selected based on questionnaire measures of schizotypy and fearfulness that had been used in previous studies of startle modulation. Bilateral eyeblinks, heart rate, and skin conductance were measured while subjects engaged in affective imagery (imagery phase) and then viewed affective pictures (picture phase) within a single experimental session. The imagery phase closely followed the procedures of Stevenson et al. (1991). The picture phase was added to this study in order to provide adequate startle trials to assess the sensory gating deficit--indexed here by startle habituation--hypothesized to characterize schizotypy. Finally, the Minnesota Multiphasic Personality Inventory (MMPI; Dahlstrom, Welsh, & Dahlstrom, 1972) was administered to assess its prediction of affective modulation of startle. The following predictions were made for affective modulation of startle:

1. Startle responses would be modulated by affect; that is, there would be larger startles during negative imagery and during viewing of aversive pictures, relative to neutral and positive control conditions.

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[1]This subject selection plan was consistent with the relative independence of schizotypy and fearfulness in the population from which subjects were selected. That is, within Gender X Race groups, correlations of Perceptual Aberration and Magical Ideation scores with FSS ranged from .152 to .317 (median $r$ = .208).

2. Affective modulation of startle would be enhanced among high fear subjects, replicating previous research in our laboratory and elsewhere.

3. Affective modulation of startle would also be enhanced among schizotypal subject, replicating Stevenson et al. (1991). In addition, based on the findings of Butler et al. (1990), the largest startle responses (and perhaps greatest startle modulation) would be observed in those subjects with both high fear and high schizotypy scores.

For startle habituation, the following predictions were made:

1. Startle responses would habituate across trials.

2. Deficits in startle habituation among the high schizotypy subjects would replicate prior findings suggesting that schizophrenia-related symptoms are associated with deficits in sensory gating.

## Methods

### Subjects

During questionnaire screening, introductory psychology undergraduates (N = 2307) completed the Fear Survey Schedule (FSS; Arrindell, Emmelkamp, & van der Ende, 1984) and the Perceptual Aberration and Magical Ideation Scales (Per-Mag; Chapman et al., 1978; Eckblad & Chapman, 1983). One hundred and ten subjects from this population were selected for low, moderate, and high scores on the FSS and Per-Mag scales (see Measures). Table 1 presents subject demographics and questionnaire scores for the low, moderate, and high fearfulness and schizotypy groups. These individuals were contacted by telephone and invited to participate in a study of physiological responses during an emotional task.

The FSS and the Per-Mag scales were readministered at the end of the laboratory session to verify separation of groups.

### Measures

Perceptual Aberration and Magical Ideation Scales. The 35-item Per scale was constructed to measure aberration in perception of one's own body-image and other objects. Illustrative items are: "Occasionally I have felt as though my body did not exist" (true), and "Sometimes I have had the feeling I am united with an object near me" (true). Chapman, Chapman, and Miller (1982) found coefficient alphas to be .88

Table 1

Subject Demographics and Questionnaire Scores for Fearfulness and Schizotypy Groups

| | Low fearfulness | | | Moderate fearfulness | | | High fearfulness | | |
|---|---|---|---|---|---|---|---|---|---|
| | Schizotypy | | | Schizotypy | | | Schizotypy | | |
| | Low | Moderate | High | Low | Moderate | High | Low | Moderate | High |
| Age | 21.5(4.1) | 22.0(5.9) | 21.4(4.2) | 20.6(3.3) | 19.5(2.1) | 21.5(4.9) | 21.2(3.3) | 20.5(4.7) | 19.7(2.3) |
| Gender | 6M / 6F | 5M / 5F | 4M / 5F | 6M / 9F | 5M / 6F | 5M / 7F | 5M / 6F | 6M / 6F | 6M / 5F |
| Race | 2B / 10W | 2B / 8W | 4B / 5W | 4B / 11W | 4B / 7W | 2B / 10W | 4B / 7W | 3B / 9W | 3B / 8W |
| Screening Questionnaire Scores | | | | | | | | | |
| Fear Survey Schedule | | | | | | | | | |
| Males | 83.2(11.0) | 91.0(14.2) | 86.5(12.0) | 124.3(9.5) | 136.2(8.4) | 115.4(10.6) | 152.2(11.1) | 143.3(13.6) | 153.5(19.2) |
| Females | 109.2(10.1) | 99.6(11.5) | 102.2(6.4) | 137.6(11.2) | 136.2(8.4) | 138.7(10.9) | 163.3(4.2) | 168.7(9.5) | 172.4(7.5) |
| Perceptual Aberration | | | | | | | | | |
| Males | 2.5(1.5) | 7.0(3.9) | 20.5(6.6) | 3.2(1.8) | 8.4(3.4) | 15.6(4.8) | 2.2(1.3) | 6.3(1.4) | 16.3(5.6) |
| Females | 3.3(1.4) | 6.8(5.4) | 18.8(4.5) | 2.3(1.5) | 9.0(5.5) | 23.9(7.5) | 1.3(1.2) | 7.3(4.2) | 18.8(7.0) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Magical Ideation | | | | | | | | | |
| Males | 5.5(1.6) | 10.8(5.2) | 18.5(6.6) | 7.0(1.3) | 11.6(2.5) | 19.6(5.9) | 5.4(2.6) | 9.7(4.2) | 21.0(4.1) |
| Females | 6.2(2.1) | 13.0(3.4) | 22.0(2.9) | 6.1(1.6) | 14.0(4.3) | 22.1(4.1) | 5.0(2.4) | 14.5(3.8) | 19.4(5.0) |
| Laboratory Questionnaire Scores | | | | | | | | | |
| Fear Survey Schedule | | | | | | | | | |
| Males | 83.3(8.9) | 96.8(19.7) | 94.8(22.8) | 115.3(6.9) | 112.6(11.3) | 122.7(17.7) | 117.0(37.9) | 133.5(25.1) | 153.2(11.4) |
| Females | 99.5(22.5) | 108.0(24.2) | 106.0(7.2) | 135.2(16.7) | 119.0(25.4) | 120.4(13.3) | 157.7(8.9) | 162.2(10.7) | 153.8(20.3) |
| Perceptual Aberration | | | | | | | | | |
| Males | 1.3(1.4) | 9.6(5.5) | 14.5(13.5) | 2.8(2.6) | 3.8(4.3) | 9.8(4.9) | 2.6(3.3) | 6.3(2.9) | 16.5(10.0) |
| Females | 2.2(2.6) | 7.6(4.9) | 17.8(8.3) | 2.7(2.4) | 6.7(4.9) | 20.0(12.4) | .83(.41) | 9.3(6.9) | 14.0(5.7) |
| Magical Ideation | | | | | | | | | |
| Males | 6.3(3.1) | 11.6(5.7) | 16.0(6.6) | 6.2(3.1) | 9.2(5.2) | 18.5(4.4) | 5.8(3.8) | 11.8(4.2) | 19.2(4.5) |
| Females | 5.8(3.4) | 10.4(5.4) | 21.8(2.3) | 6.9(3.7) | 11.7(4.0) | 17.7(7.6) | 4.3(2.3) | 14.7(4.3) | 18.0(8.2) |

Note. Entries for age and questionnaire scores are means, with standard deviations in parentheses. For Fear Survey Schedule, range = 52-270; for Perceptual Aberration, range = 0-35; for Magical Ideation, range = 0-30. For race, B=Black and W=White.

be .88 for male college students (N = 631) and .90 for female college students (N = 718).

The 30-item Mag scale was constructed to measure belief in forms of causality that are considered invalid in our culture. Illustrative items are: "I have sometimes felt that strangers were reading my mind" (true), and "Numbers like 13 and 7 have no special powers" (false). Chapman et al. (1982) found coefficient alpha to be .82 for males (N = 682) and .85 for females (N = 830).

Chapman and Chapman (1987) examined psychotic-like and schizotypal symptoms in college students selected for high Per or Mag scores. Approximately 55% of these high scorers reported more than three psychotic-like symptoms during blind interviews (e.g., visual and auditory hallucinations, aberrant beliefs, and passivity experiences); less than 20% of low- to moderate-scoring control subjects reported this level of symptomatology. Similar findings have been observed for subjects selected only on the Per scale (Allen, Chapman, Chapman, Vuchetich, & Frost, 1987). Chapman and Chapman (1987) assessed the degree to which these hypothetically psychosis-prone subjects manifest symptoms of psychosis warranting clinical attention within a 25-month follow-up study. Three of 162 high Per-Mag subjects reported having received their first clinical attention for psychosis (i.e., schizophrenia, paranoia, and bipolar disorder) over this relatively brief follow-up period. Finally, at 10-year follow-up which included 94% of the original high Per-Mag subjects (total N = 182), Chapman, Chapman, Kwapil, Eckblad, and Zinser (1994) found that 10 high Per-Mag subjects reported DSM III-R psychoses (i.e., 3--schizophrenia; 3--psychosis NOS; 3--bipolar, psychotic; 1--delusional disorder). Thus,

these findings offer strong support for the validity of Per and Mag scales as indicators of psychosis proneness.

The Per and Mag scales were combined, as recommended by Chapman and Chapman (1987), to form the 65-item Per-Mag scale. Chapman and his colleagues have generally used a criterion of two standard deviations above the mean on either the Per or Mag scale to select schizotypal subjects (Chapman & Chapman, 1987) and scores below the mean on both measures to select low subjects. These conventions were used in the present study. The inclusion of the middle group permitted a more general assessment of the relationship between startle reactivity and the schizotypy dimension. In addition, five infrequency items were included in the Per-Mag scale to identify careless responding. Illustrative items are: "On some mornings, I didn't get out of bed immediately when I first woke up" (false), and "I believe that most light bulbs are powered by electricity" (false). Students who endorsed two or more infrequency items during questionnaire screening were not considered for the study.

Fear Survey Schedule. As in three prior startle studies from our laboratory (Cook et al., 1991; Cook et al., 1992; Stevenson et al., 1991), the 52-item version of the FSS was used in this study (Arrindell et al., 1984). This version of the FSS indexes phobic fear in response to a variety of objects and situations. Arrindell et al. (1984) observed five factors (i.e., Social, Agoraphobia, Blood Injury/Illness/Death, Sex/Aggression, and Harmless Animals) to be consistent across 10 diverse patient and nonpatient samples ($N$ = 3,143). Cook, Melamed, Cuthbert, McNeil, and Lang (1988) found that agoraphobics had higher FSS scores than simple phobics, suggesting that this measure

may be more sensitive to generalized rather than circumscribed fears. The internal consistency of this 52-item FSS has been found to be .937 based on a sample of 264 subjects drawn from the same population as the subjects in the present experiment (Stevenson et al., 1991).

Cutoff scores on the FSS were derived to identify high, moderate, and low fear groups that are similar in their proportions in the population to the high, moderate, and low schizotypy subjects. Thus, high fearfulness subjects scored at least 1.33 SD above the mean for their age and race group, whereas low fearfulness subjects scored below the mean.

Copies of all questionnaires may be found in Appendix A.

## Materials

Imagery materials. Both scripts and pictures were used to elicit various emotions in this study. Scripts representing each of five affective conditions (i.e., sadness, fear, anger, pleasant relaxation, and joy) served as prompts for emotional imagery. These scripts comprised the imagery materials during trials 1-45 (i.e., imagery phase). All scripts were two sentences (26-41 words, or 10-12 s when read aloud) in length.

The construction and validation of these scripts are described in Cook et al. (1991) and Stevenson et al. (1991). Most of the scripts in this study were generated from an affective situation questionnaire previously administered to undergraduates enrolled in introductory psychology. These students described situations that produced joy, fear, sadness, anger, and pleasant relaxation, and the physiological responses that accompanied them. Additional script themes for these affects were obtained from prior research on emotional imagery (e.g.,

Cook, Melamed, Cuthbert, McNeil, & Lang, 1988; Miller et al., 1987). The final set of scripts included six scripts of each affective category.

The affective characteristics of the scripts have previously been validated with ratings obtained from three independent samples of unselected subjects (Cook et al., 1991; N = 250) and from the mixed fearfulness/schizotypy sample of Stevenson et al. (1991). Nominally negative scripts (i.e., fear, anger, sadness) were rated more unpleasant than nominally positive scripts (i.e., joy, pleasant relaxation). In addition, nominally high arousal scripts (i.e., joy, fear, anger) were rated more arousing than nominally low arousal (sadness, pleasant relaxation) scripts. Valence and arousal ratings were again obtained for all selected scripts in the present study, during a second (recall) session. The scripts are reproduced in Appendix B.

Picture materials. Pictures comprised the affective material during trials 46-105 (i.e., picture phase). Sixty pictures were selected for either aversive, pleasant, or neutral affective content. Most of the 20 aversive pictures were photographs of wounds or mutilated bodies. The 20 pleasant pictures included such stimuli as smiling babies and opposite sex models (including nudes). The 20 neutral pictures were photographs of plants, animals, neutral faces, and common household objects. As in Vrana et al. (1988), the pleasant and aversive pictures were selected for high arousal content, and the neutral pictures were selected for low arousal content. Most of the pictures comprising the three affective categories were obtained from the International Affective Picture System (Lang, Öhman, & Vaitl, 1988; see

also Greenwald, Cook, & Lang, 1989); some of the slides were obtained locally (e.g., the university medical library's slide collection).

Affective content of the pictures has previously been validated by introductory psychology undergraduates at The University of Alabama at Birmingham and University of Florida (Cook et al., 1992; Greenwald, 1987). Aversive pictures were rated as both more negative in affective valence and higher in affective arousal than the neutral pictures. In addition, pleasant pictures (e.g., opposite-sex nudes) were rated as more positive than neutral pictures, which in turn were rated as more positive than aversive pictures. Like the selected scripts, the pictures were rated for affective valence and arousal during the recall session, described below.

Procedures

The experimenter was blind to subjects' group membership. All laboratory procedures were conducted in a 3m X 3m electrically and acoustically isolated chamber. Subjects were shown all candidate scripts for each affect and asked to select the three that produced the "strongest and most vivid image" of the corresponding emotional state. After script selection, subjects were seated in a comfortable recliner chair and prepared for physiological recording. Electrodes for bilateral measurement of eyeblink startle were attached to the skin approximately 0.8 cm below the pupil and outer canthus of each eye. Heart rate electrodes were attached to the lower anterolateral chest, and skin conductance electrodes were applied to the thenar and hypothenar eminences of the nondominant hand. A ground electrode was centered on the forehead. Two preliminary startle probes were presented, and physiological signals were checked.

Imagery trials. The imagery trial (i.e., trials 1-45) procedures were identical to those in Stevenson et al. (1991). Subjects were instructed to form a vivid image of each scene as it was described and to continue imagining the scene after the end of the description. When they heard a soft tone they were to stop imagining and relax until the next script was presented. In addition, they were informed that at various times during the procedure they would hear loud noises that they should try to ignore.

All 15 scripts were presented in each of three randomized blocks of trials, yielding a total of 45 trials during the imagery phase. Each trial consisted of a 10-12 s script presentation period and a 15 s imagery period. At an irregular time within seconds 8-13 of 30 of the imagery periods, a binaural 50 ms burst of 110 dB (A) white noise was presented with less than 3 ms rise and fall times to elicit startles. Timing of probes was equated across affective conditions. The remaining 15 startle probes were presented 8 or 11 s before script presentation, during the intertrial interval (ITI). The purpose of these startles was to reduce temporal conditioning to the startle probe. Trial order was randomized with the following constraints: in each block of five trials, each affect was presented once; no individual script was presented in more than two consecutive blocks of five trials; and no more than three imagery or two ITI startle trials was presented contiguously. ITIs ranged from 17-35 s. In order to maintain adequate alertness, subjects performed vigorous arm and leg exercises (40 arm circles and 20 leg lifts) during 3-min breaks following trials 15 and 30.

Picture trials After trial 45, subjects took their third 3-min break and were given instructions for the picture trials (i.e., trials 46-105). Subjects were instructed that they would view pictures varying in affective content and that, although some pictures might be difficult to look at, it is important to attend to them during the entire viewing period. Subjects were also told that they would again hear occasional noises that they should try to ignore and to attend instead to the pictures.

Subjects viewed the 60 pictures for 6 s each with an ITI varying from 10 to 18 s. The pictures were grouped into five randomized blocks of 12 pictures each. Each block consisted of four negative, positive, and neutral content pictures. For each content, an acoustic startle probe (of the same intensity, duration, and rise time as in the imagery phase) was presented .5 s after onset of one picture, 2.5 s after onset of another picture, and 4.5 s after onset of a third picture (Vrana et al., 1988). In addition, on the remaining picture of each content within each block, the startle was presented 5.0-7.7 s after picture offset, during the ITI. As in the imagery phase, the ITI startles served primarily to reduce the temporal predictability of the startle probe. Trial order was randomized with the following constraints: in each block of three trials, each affect was presented once; in addition, no more than four picture or two ITI startle trials was presented contiguously. Midway through presentation of the 60 pictures subjects received a final 3-min break.

Recall session. During the recall session, subjects rated the scripts and pictures for both affective valence and arousal using 11-point paper-and-pencil Likert scales (Appendix B). In addition,

subjects completed the 399-item version of the MMPI, which has been described as the most widely used and researched objective personality inventory (Dahlstrom, Welsh, & Dahlstrom, 1972). MMPI profiles of the individual groups provided an assessment of the degree to which fearfulness (FSS) and schizotypy (Per-Mag) model anxiety and schizophrenic disorders.

Protocols for the initial telephone contact and the laboratory session are given in Appendix C. The recall session protocol is reproduced in Appendix D.

Apparatus

Electrodes were Ag/AgCl, provided by Med Associates. Electrolytes were Med Associates electrode gel for EMG and EKG, and Unibase for skin conductance (Fowles et al., 1981). Blink EMG was amplified and filtered for 90-250 Hz activity by Coulbourn S75-01 Bioamplifiers. Amplifier outputs were fed to a Scientific Solutions Labmaster analog-to-digital converter installed in a PC Designs PC/AT clone. The amplified EMG was sampled by a computer program (VPM; Cook, Atkinson, & Lang, 1987) at 1000 Hz for 300 ms following startle probe onset. EKG was amplified and filtered for 8-13 Hz activity by an additional S75-01 bioamplifier and fed to a digital input on the computer, which recorded interbeat intervals with a resolution of 1 ms. A Coulbourn S71-22 Skin Conductance Coupler applied a constant .5 V across the skin conductance electrodes, and its output was sampled at 10 Hz.

A Coulbourn S-81 Noise Generator was used to generate the startle probe. The probe was gated by an electronic relay, amplified by a DH-120 stereo amplifier, and fed to Telephonics TDH-49 headphones, which the subject wore throughout the session. Imagery scripts were recorded

on a videocassette tape and presented by a computer-controlled videocassette recorder (PC-VCR). The recorded script material was amplified by the Hafler DH-120 stereo amplifier and presented through a loudspeaker placed approximately 1.5 m in front of the subject. Loudness was adjusted so that subjects could readily hear the scripts while wearing the headphones. Affective pictures were also recorded on a videocassette tape, presented by the same VCR as the imagery scripts, and displayed on a Sony KX-2501A Trinitron television located approximately 1.5 m in front of the subject.

Data Reduction

Questionnaires. In the present study Per and Mag scores were highly correlated in the same population from which the experimental subjects in this study were drawn: for males ($n$ = 884), $r$ = .651 to .717; for females ($n$ = 1,262), $r$ = .711 to .750; $ps$ < 0.00001. In order to reduce the correlation among predictor variables in data analyses, a single schizotypy (SZP) score was generated for each experimental subject. These scores were computed with principal components analyses (PCAs) conducted separately on the screening data for each level of gender and race (i.e., black and white), and factor score coefficients were obtained. These gender- and race-appropriate factor coefficients were then applied separately to the Per and Mag scores obtained at the screening and laboratory sessions, yielding one schizotypy factor score for each administration. Then, the screening and laboratory factor scores were averaged to obtain a single schizotypy score. Similarly, FSS scores were computed and averaged across screening and laboratory administrations for each subject.

Startle response. Digitized raw EMG data were integrated (i.e., full-wave rectified and low-pass filtered with a time constant of 80 ms) offline, separately for left and right eye sites. The computer program of Balaban, Losito, Simons, and Graham (1986) was used to score these integrated blink responses for startle magnitude. A magnitude score of 0.0 was assigned when the EMG response waveform for neither eye included a scoreable blink. Where two blink responses in an EMG waveform were identified, the response with the peak latency closest to the subject's median peak latency was selected. A blink response was considered missing if the EMG waveform showed excessive baseline shift, identified by a) baseline range > 2 $\mu$V, regardless of the scored blink magnitude, or b) baseline range of 1-2 $\mu$V and greater than 20% of the scored blink magnitude. These criteria represented an attempt to include only those responses clearly distinguishable from excessive background activity. Blink latencies were considered missing if a scorable blink was not detected, or if baseline shift was excessive. The entire blink trial (i.e., both eyes) was defined as missing when the blink magnitude at either eye was rejected. These criteria resulted in exclusion of 8.1% of imagery blink trials and 7.3% of picture blink trials.

During the imagery phase, within-subject averages for magnitude were computed for the five affects and ITI for each of the trial blocks of 15 trials. Subjects were excluded from subsequent analyses for insufficient startle responsivity, defined as unscorable blink magnitudes (0.0 or missing) on more than 50% of all imagery startle trials at either eye, or more than one Trial block X Affect average blink magnitude of 0.0. These criteria resulted in exclusion of 7

subjects from the imagery blink analyses, leaving a final sample of 103 subjects.

Separate within-subject averages were computed for the affects and ITI for each of the trial blocks of 12 trials during the picture phase. Criteria similar to those used in the imagery phase were used to exclude subjects for insufficient startle responsivity. Thirteen subjects were excluded from the picture blink analyses based on these criteria, including 6 of the 7 subjects excluded from the imagery analyses. The final sample for picture phase analyses was therefore 97 subjects.

Finally, because few laterality effects have been observed for startle in prior studies, blink magnitudes were averaged across left and right electrode sites prior to all statistical analyses.

Autonomic response. Cardiac interbeat intervals were converted offline to a rate-per-minute format, with each interval weighted proportionally to the period of time that it occupied. During the imagery phase, heart rate (HR) and skin conductance level (SCL) difference scores were computed by subtracting the mean for the 2-s period prior to script presentation from the mean for the first 5 s of the imagery period. These autonomic difference scores were then averaged for the five affects for each of the trial blocks of 15 trials. During the picture phase, HR and SCL difference scores were computed by subtracting the 2 s prior to picture onset from the mean for each of the 6 s of picture presentation. Separate averages were computed for the affects for each of the trial blocks of ITI startle trials. For consistency of the sample across measures, subjects excluded from the blink analyses were also excluded from the analyses of autonomic response within each phase.

Affective rating and MMPI. Valence and arousal ratings of the affective scripts were averaged separately for each affective condition. Subject MMPI raw scores for the 3 validity scales and 10 clinical scales were converted to T-Scores, using K-corrected Minnesota adults norms (MMPI; Dahlstrom et al., 1972). Methodological error warranted proration of the K Validity Scale score and exclusion of the Social Introversion (0) scale from all statistical analyses. Individual validity scale profiles did not warrant exclusion of any subjects.[2]

Data Analysis

Startle response during imagery. Startle magnitude for the imagery phase was analyzed with repeated measures regression to accommodate the continuous schizotypy (Per-Mag) and Fear Survey Schedule (FSS) scores. The main analysis used gender, FSS score, and Per-Mag score as the between-subject factors. Two-way interactions were tested using the hierarchical strategy recommended by Cohen and Cohen (1983).

Consistent with Cook et al. (1991) and Stevenson et al. (1991), within-subject contrasts related to affective valence and arousal were tested. The valence contrast involved a comparison of positive (pleasant relaxation and joy imagery) and negative (sadness, anger, and fear imagery) affective conditions, whereas the arousal contrast compared high-arousal (joy, anger, and fear) and low-arousal (pleasant relaxation and sadness) conditions. As described in Cook et al. (1991), noninteger contrast weights were used to compensate for the presence of two high-arousal, negative valent contents (i.e., fear and anger), the

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[2]Five subjects had an F-K index greater than 11, and of those subjects three had an F-K index greater than 21. However, the exclusion of those subjects from the analyses had no effect on the pattern of significant relationships among the MMPI variables, the selection questionnaires, and affective modulation of startle.

differentiation of which was tested with an additional contrast. In addition, linear and quadratic trends across trial blocks were tested for assessment of startle habituation. Trial number within block was used as a covariate because of the reliable habituation of startle found in prior studies.[3]

Startle response during pictures. Startle magnitude for the picture phase was analyzed with repeated measures MANOVA. The main analysis again used gender, FSS score, and Per-Mag score as the between-subject factors. Affective picture content (i.e., pleasant, neutral, unpleasant) served as a repeated measures factor. As with the imagery phase, planned orthogonal valence and arousal contrasts were used to assess the relationship between startle responsivity and affective conditions during the picture phase. Because prior research has suggested a relationship between schizophrenia-related symptoms and startle habituation, trial block was included as an additional within-subjects factor. Tests were conducted of linear and quadratic trend across blocks and the interaction of these trends with affective modulation.

MMPI prediction of affective modulation of startle. MMPI scale scores were also assessed as predictors of affective modulation of startle, to describe the relationship between startle modulation and more clinically-based measures of psychopathology and related symptoms. During the imagery phase, correlations of valence modulation (i.e., the value of the valence contrast, computed for each subject) with the MMPI

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[3]As suggested by Hawk, Stevenson, and Cook (1992), startle baseline was also tested as a potential covariate. However, startle baseline did not explain a significant amount of variance in startle magnitude in this study and thus was not included in the analyses.

clinical scales were first tested. Reliable correlates of valence modulation were then added to the main regression analyses, to assess their unique contributions in combination with fearfulness, schizotypy, and gender. MMPI scale scores were also assessed for their relationship to startle modulation by emotional arousal and fear-anger differentiation. Similarly, MMPI prediction of affective startle modulation was assessed during the picture phase.

Autonomic response. Pretrial and imagery period heart rate and skin conductance means were analyzed in parallel with the startle data. Imagery period autonomic means were statistically adjusted for pretrial levels. Again, contrasts related to affective valence, arousal, fear-anger differentiation, and trial block were tested. In addition, differences among subjects related to gender and the questionnaire scores were tested. It was predicted that heart rate and skin conductance would be primarily responsive to emotional arousal. That is, higher heart rates and skin conductance levels were predicted for high- compared to low-arousal imagery.

During the picture phase, difference scores representing the heart rate and skin conductance waveforms were analyzed similarly to the startle data. Planned contrasts related to affective valence and arousal were again tested, as were differences among subjects related to gender and the questionnaires' scores. Trend analyses were used to test changes over time. It was predicted that heart rate would be primarily sensitive to affective valence; that is, greater deceleration of heart rate was expected for unpleasant relative to pleasant pictures. In addition, it was predicted that skin conductance would be primarily sensitive to arousal; that is, greater skin conductance increase was

predicted for emotional arousing (pleasant and unpleasant) compared to neutral pictures.

Affective ratings. Valence and arousal ratings obtained for all affective conditions during the imagery and picture phases were analyzed in parallel with their respective blink and autonomic measures. Based on previous data, it was predicted that a priori positive scripts (relaxation and joy) and negative scripts (sadness, anger, and fear) would differ primarily along the valence rating dimension. Similarly, it was predicted that a priori high-arousal scripts (joy, anger, and fear) and low-arousal scripts (relaxation and sadness) would differ primarily along the arousal rating dimension. A contrast differentiating fear and anger scripts on valence and arousal ratings was also tested, and it was predicted that scripts representing both of these affects would be rated similarly as unpleasant and highly arousing. Similarly, a priori pleasant and aversive pictures were expected to differ primarily along the valence ratings dimension; intermediate ratings along this dimension were predicted for a priori neutral pictures. In addition, the affective pictures compared to neutral pictures were predicted to be more arousing. Finally, because individual differences in affective response were a primary focus of this study, interactions of all contrasts with gender and the questionnaire variables were also tested.

Relationships between selection questionnaires and MMPI. These relationships were assessed with multivariate regression analyses. The main analysis paralleled those conducted on the physiological and rating variables in that gender, FSS score, and Per-Mag score served as between-subject factors. The multiple MMPI clinical scales served as

variates in this multivariate analysis, and univariate regression analyses were used to follow up significant multivariate effects.[4]

[4]Scale 5 (Mf; Masculinity-Femininity) was excluded from all statistical analyses because of large but theoretically uninteresting gender differences on this scale. In addition, the interactions of gender and the MMPI scales are not discussed, as there were no specific hypotheses about these relationships.

## Results

### Imagery Phase

Startle magnitude. Figure 1 presents mean startle magnitudes for all affective imagery conditions across all subjects. As predicted, startle magnitudes averaged across unpleasant imagery conditions (sadness, fear, and anger) were larger than those averaged across pleasant imagery conditions (relaxation and joy), $F$ (1,98) = 5.55, $p$ < .03. Consistent with Stevenson et al. (1991) and Hawk, Stevenson, and Cook (1992), startles averaged across high-arousal imagery (joy, fear,and anger) were substantially larger than those averaged across low-arousal imagery (relaxation and sadness), $F$ (1,98) = 22.02, $p$ < .0002. This overall potentiation of startle magnitude by high-arousal imagery was reliable in Trial Block 1, $F$ (1,98) = 21.82, $p$ < .0002, but not in Blocks 2 and 3; in the combined analysis, Block linear X Arousal $F$ (1,98) = 6.11, $p$ < .02. Finally, in contrast to prior findings from our laboratory, in the present study startle magnitudes were potentiated during fear relative to anger imagery, $F$ (1,98) = 15.86, $p$ < .0002.

Figures 2 and 3 present mean startle magnitudes for unpleasant and pleasant imagery for the low, moderate, and high fearfulness and schizotypy groups, respectively. Potentiation of startle by unpleasant imagery increased with scores on both questionnaires; for Valence X FSS, $F$ (1,98) = 3.90, $p$ = .051; for Valence X Per-Mag, $F$ (1,98) = 4.21, $p$ < .05. Follow-up tests in the individual groups demonstrated that

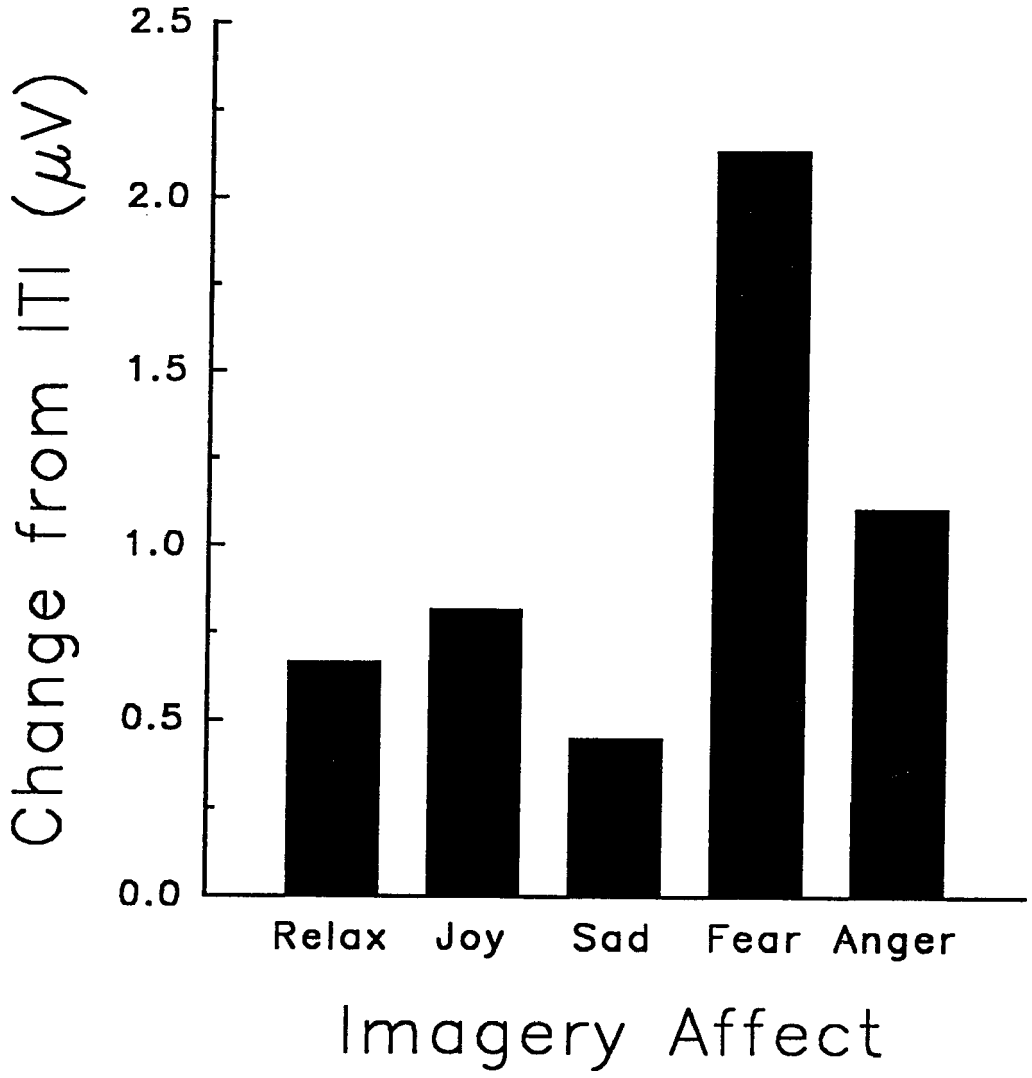


Figure 1. Mean startle magnitude potentiation during the imagery phase for all affective conditions across the entire sample. Values are deviated from subject averages during the intertrial interval.

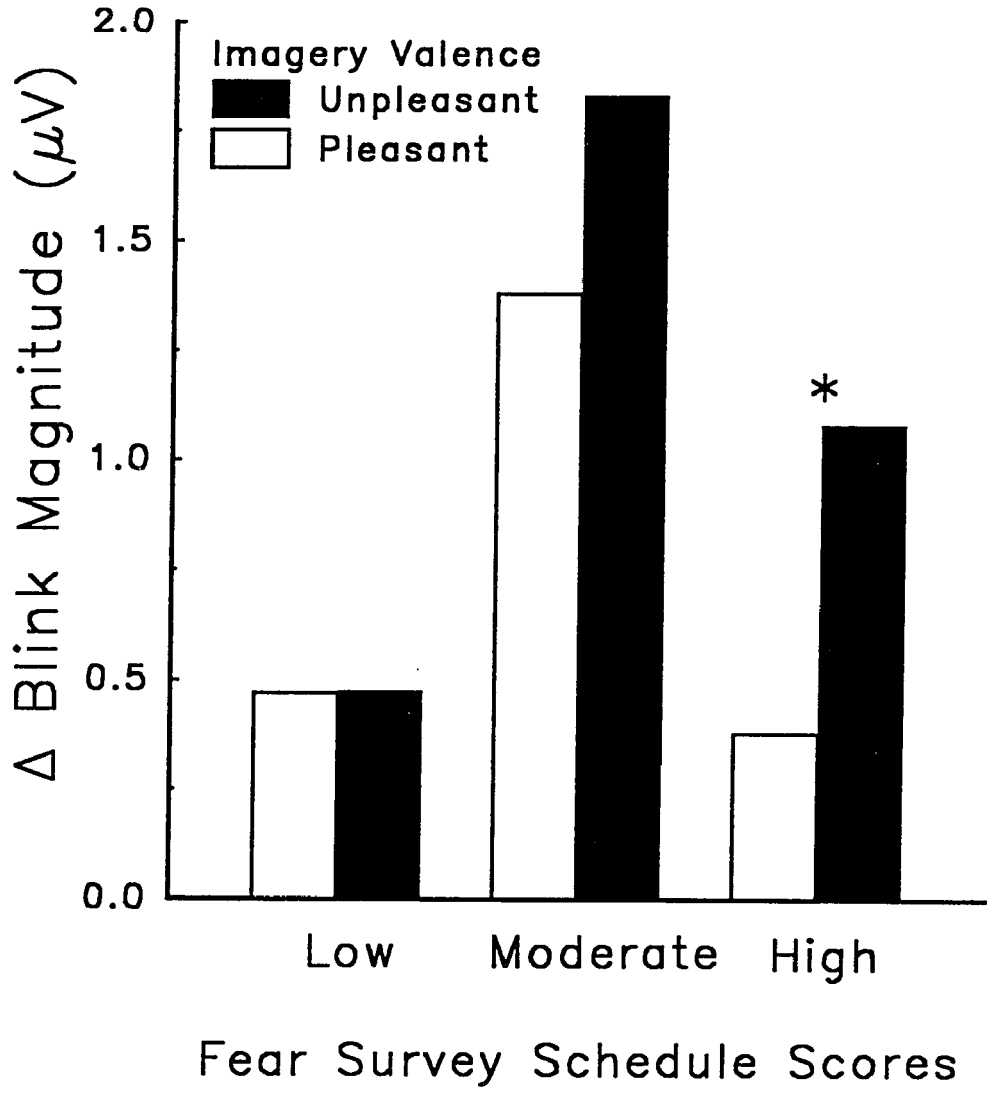


Figure 2. Mean startle magnitude potentiation (relative to intertrial interval) during the imagery phase as a function of affective valence and subject fear. The asterisk (*) denotes significance at $p < .02$.

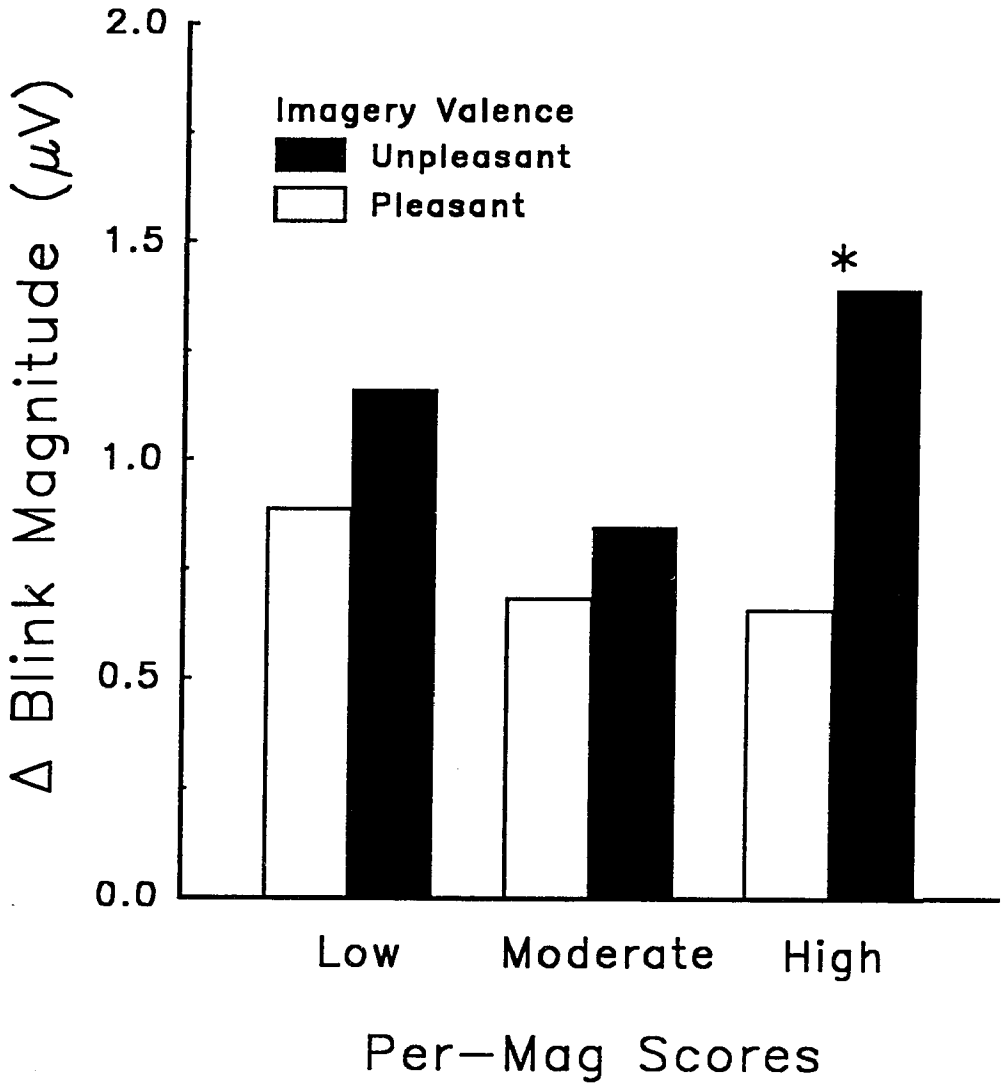


Figure 3. Mean startle magnitude potentiation (relative to intertrial interval) during the imagery phase as a function of affective valence and schizotypy. The asterisk (*) denotes significance at $p < .02$.

potentiation of startle magnitude during unpleasant compared to pleasant imagery was reliable among all high fear subjects (regardless of schizotypy score; see upper panel, right) and among all high schizotypy subjects (regardless of fear; see lower panel, right); Fs (1,84) = 6.65 and 5.94, respectively; ps < .02. Neither moderate nor low fearfulness or schizotypy groups showed reliable modulation of startle by affective valence, both Fs (1,84) < 2.55, n.s.

High scores on MMPI scale 6 (Pa) were also associated with greater affective modulation of startle by affective valence, p < .0002. Figure 4 presents affective modulation data as a function of Pa scores. In addition, when Pa was added to the regression model predicting valence modulation, it was the only variable that accounted for unique variance, F (1,84) = 8.50, p < .005; FSS and Per-Mag Fs (1,84) < 1, n.s. None of the other MMPI clinical scales were reliably correlated with valence modulation of startle.

The arousal effect noted above -- larger startles for high- compared to low-arousal imagery -- was less strongly related to the individual difference variables than was valence. There was a tendency for males with lower FSS scores to show greater potentiation of startle magnitude by emotional arousal, F (1,95) = 3.77, p = .055. In contrast, females' FSS scores were unrelated to arousal, leading to an overall interaction among arousal, fearfulness, and gender, F (1,95) = 4.34, p < .05. Potentiation of startle magnitude by arousal was unrelated to any of the MMPI clinical scales, all ps >.10.

As noted above, startle magnitude was potentiated during fear compared to anger imagery (see Figure 1); this effect did not covary reliably with fearfulness or gender, Fs (1,98) < 1. However, subjects

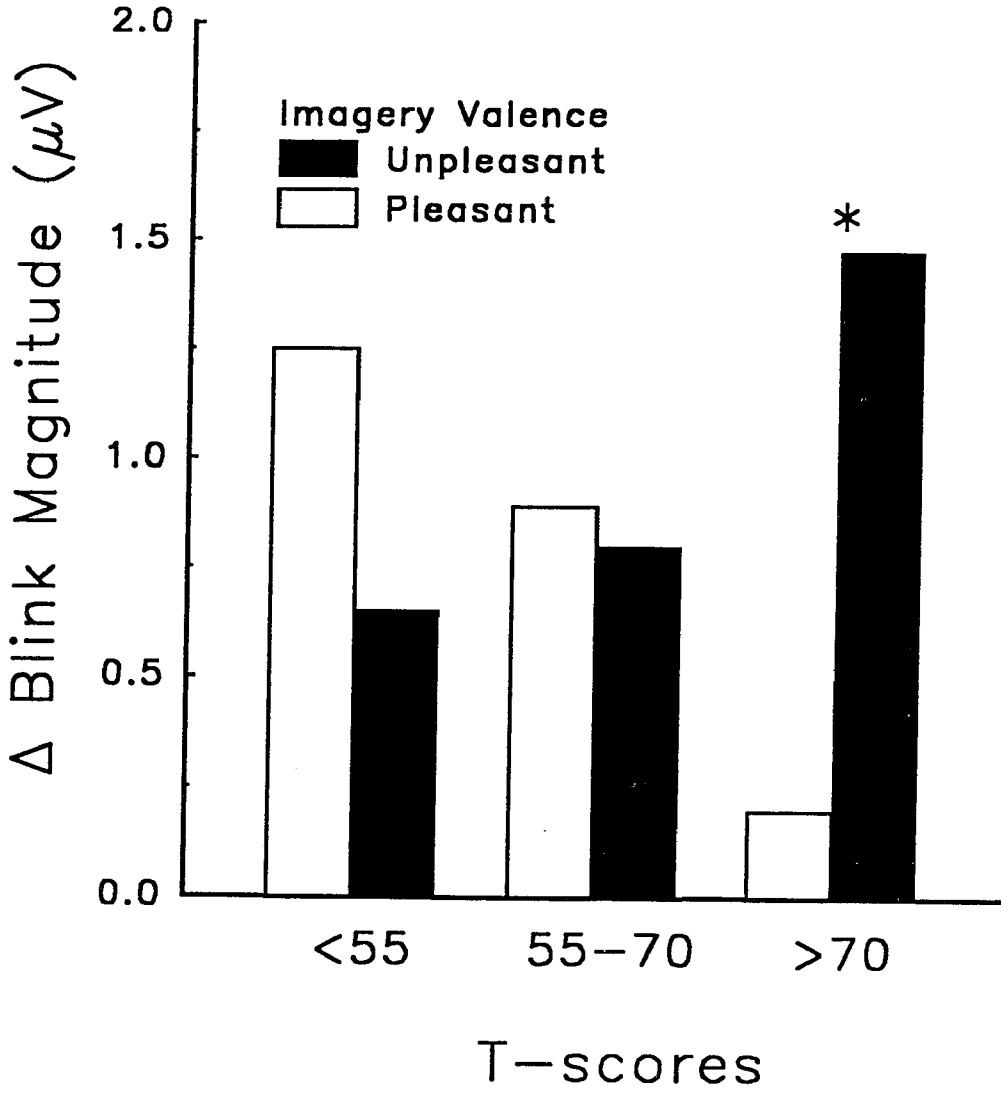


Figure 4. Mean startle magnitude potentiation (relative to intertrial interval) during the imagery phase as a function of affective valence and MMPI Pa (paranoia) scores.

with high Per-Mag scores tended to respond more equivalently during fear and anger imagery, $F$ (1,98) = 3.71, $p$ = .057; and those with high scores on MMPI Scale 7 (Pt; psychasthenia) showed a similar effect, $p$ < .03.

Startle magnitude habituated substantially across imagery trials, trial block linear and quadratic $F$s (1,98) = 152.32 and 7.12, $p$s < .01. However, neither habituation rate nor subjects' overall mean startle magnitudes were reliably associated with questionnaires' scores or gender, all $F$s (1,98) < 1.

Heart rate. Pretrial heart rate was reliably higher for females than for males; means were 73.96 and 70.09 bpm, respectively, $F$ (1,99) = 4.81, $p$ < .04.

Figure 5 presents pretrial-adjusted mean heart rates for all affective imagery conditions across all subjects. As predicted, heart rate was sensitive to both arousal and valence classifications of the scripts. Heart rates were higher during high-arousal imagery (joy, fear, and anger) than during low-arousal imagery (sadness and relaxation); for arousal, $F$ (1,98) = 30.39, $p$ < .0002. Heart rates were also generally higher during aversive imagery (sadness, fear, and anger) than during pleasant imagery (relaxation and joy); for valence, $F$ (1,98) = 12.53, $p$ < .0007. There were no overall relationships between valence modulation of heart rate and the questionnaires' scores, both $F$s (1,98) < 2.80, n.s. Across imagery trials, low fear subjects demonstrated a reliable increase in valence modulation of heart rate, whereas high fear subjects tended to show a decrease; for low fear subjects, Block linear X Valence $F$ (1,84) = 4.05, $p$ <.05; for high fear subjects, $F$ (1,84) = 2.84, $p$ = .096; in the combined sample, Block linear X Valence X FSS $F$ (1,98) = 7.97, $p$ < .006. This relationship between valence modulation

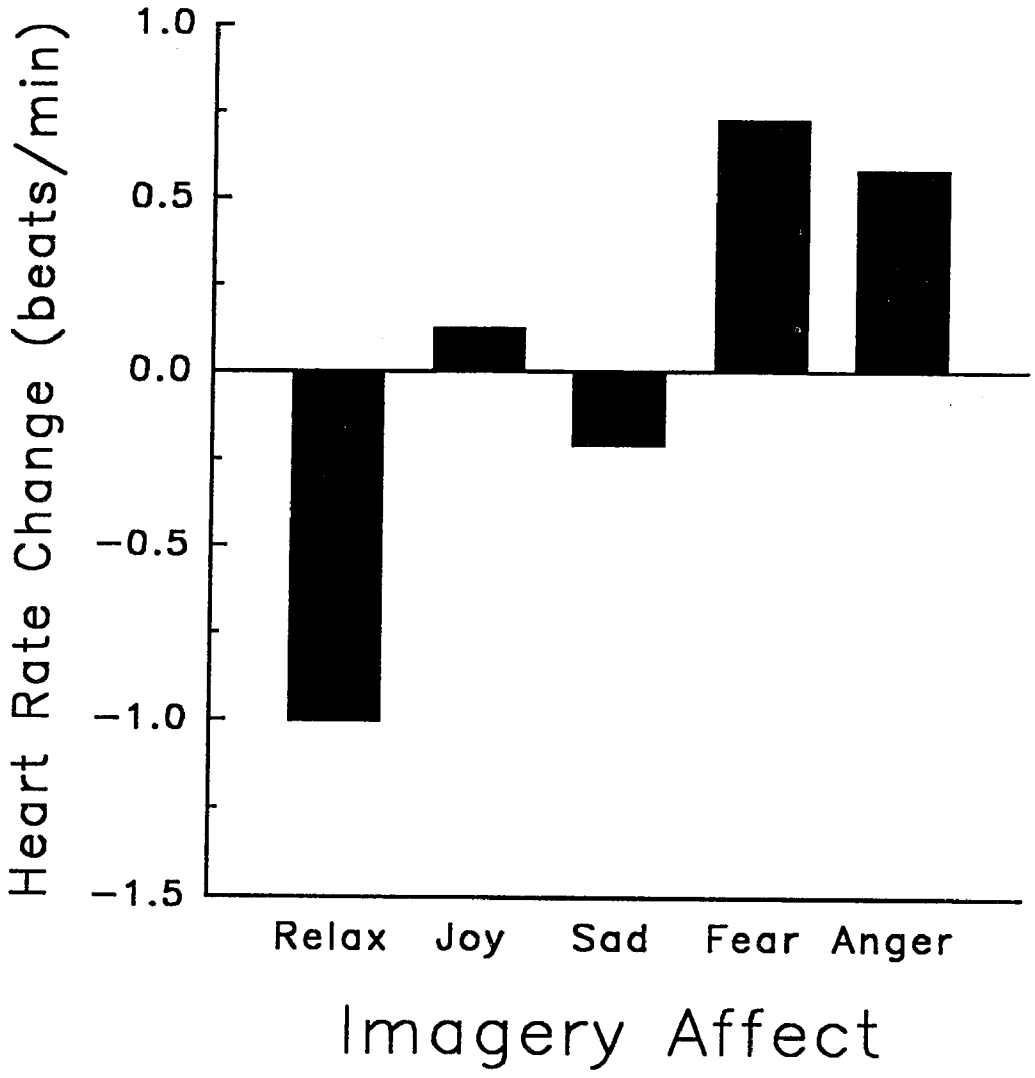


Figure 5. Mean heart rate response during affective imagery, deviated from pretrial baseline, for the full sample.

of heart rate and FSS scores was not reliable in any individual Block, all ps > .07. No other interactions involving trial block were statistically reliable. In addition, there was a positive correlation between FSS scores and HR change from pretrial level to imagery, regardless of affect condition, F (1,98) = 5.65, p < .02. There was no reliable difference in heart rate change between fear and anger imagery, F (1,98) < 1.

Skin conductance. There was a tendency for pretrial skin conductance to be reliably higher for males than for females; means were 2.83 and 1.90 μS, respectively, F (1,99) = 3.41, p = .068. These pretrial levels did not vary reliably with subject questionnaire scores, both Fs (1,99) < 1, n.s.

Figure 6 presents pretrial-adjusted mean skin conductance for all affective imagery conditions across all subjects. As predicted, skin conductance change was related to emotional arousal; that is, it was higher for high-arousal than low-arousal imagery; F (1,98) = 19.20, p < .0002. This arousal effect was particularly demonstrated by low fear subjects in the early trial blocks, Blocks 1 and 2 Fs (1,83) > 4.5, ps < .04, but in Block 3, F < 1; for moderate and high fear subjects, Block linear X Arousal Fs < 1; in the combined analysis, Block linear X Arousal X FSS F (1,97) = 7.05, p < .01. Low fear subjects also demonstrated higher skin conductance change during unpleasant compared to pleasant imagery in the early trials, Block 1 F (1,83) = 7.46, p < .008, but in Blocks 2 and 3, Fs < 1; for the moderate and high fear subjects, Block quadratic X Valence Fs < 1; in the combined analysis, Block quadratic X Valence X FSS F (1,98) = 4.37, p < .04. In addition, the overall valence effect decreased across the imagery trials, F (1,97)

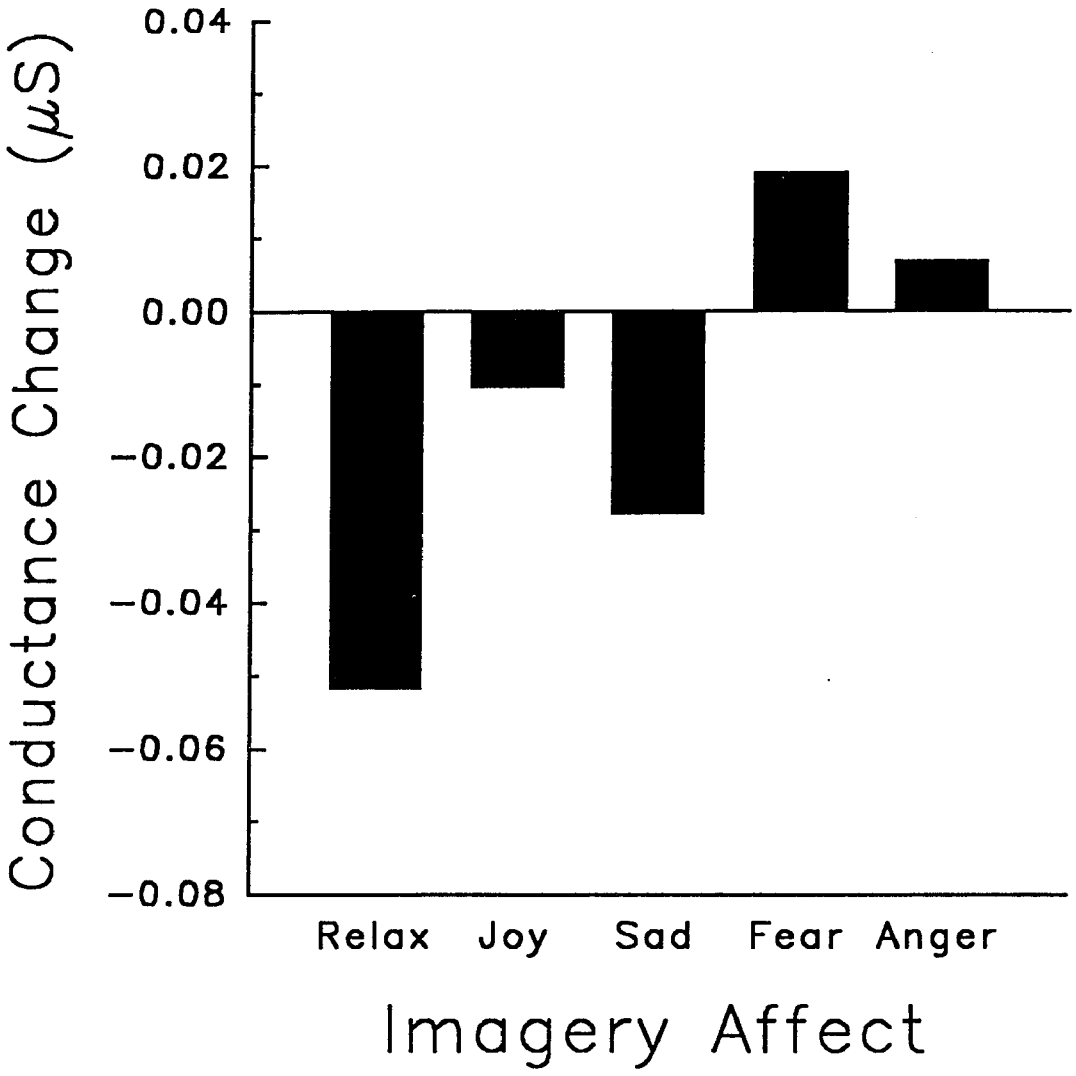


Figure 6. Mean skin conductance level during affective imagery, deviated from pretrial baseline, for the full sample.

= 9.31, $p < .003$. These overall alterations in skin conductance change with imagery content did not vary reliably with questionnaires' scores, all $F$s (1,98) < 1.45, n.s. Averaged across imagery contents, skin conductance level change declined reliably from Block 1 to 3, trial block linear and quadratic $F$s (1,98) = 13.56 and 10.30, $p$s < .0005. No other interactions involving trial block were statistically reliable. Skin conductance change was not different for fear and anger imagery, $F$ (1,98) = 2.15, n.s.

Affective ratings. Table 2 presents mean valence ratings for all affective imagery conditions for the low, moderate, and high fearfulness and schizotypy groups. As predicted, a priori positive scripts (relaxation and joy) were rated as highly pleasant and a priori negative scripts (sadness, anger, and fear) were rated as highly unpleasant, valence $F$ (1,86) = 4887.28, $p < .0002$. In addition, valence ratings of the a priori positive and negative scripts differed for males and females. That is, compared to males, females rated the positive scripts as more pleasant (means = 9.10 and 9.50, respectively) and the negative scripts as more unpleasant (means were 1.06 and .68, respectively); Valence X Gender $F$ (1,86) = 10.30, $p < .002$. Valence ratings of the a priori positive and negative scripts were not associated with questionnaire variables, both $F$s < 1. Across valence categories, a priori high-arousal scripts (joy, fear, and anger) were rated slightly, but significantly less pleasant than low-arousal scripts (relaxation and sadness), $F$ (1,86) = 8.79, $p < .004$. Valence ratings did not differentiate fear and anger scripts, $F$ (1,86) < 1.

Table 3 presents mean arousal ratings for all affective imagery conditions for the low, moderate, and high fearfulness and schizotypy

Table 2

Mean Affective Valence Ratings of Scripts

| | Fear group | | | Schizotypy group | | | |
|---|---|---|---|---|---|---|---|
| Affect | Low | Moderate | High | Low | Moderate | High | All subjects |
| Relax | 9.19 | 9.03 | 9.06 | 9.08 | 8.99 | 9.20 | 9.09 |
| Joy | 9.65 | 9.46 | 9.40 | 9.36 | 9.62 | 9.53 | 9.50 |
| Sad | .48 | .59 | .43 | .52 | .66 | .32 | .50 |
| Fear | 1.29 | .63 | 1.09 | 1.10 | 1.08 | .84 | 1.01 |
| Anger | 1.55 | .98 | .79 | 1.22 | .82 | 1.28 | 1.11 |
| Valence contrast | | | | | | | |
| Positive | 9.42 | 9.24 | 9.23 | 9.22 | 9.31 | 9.37 | 9.30 |
| Negative | 1.03 | .70 | .73 | .89 | .83 | .73 | .82 |
| Arousal contrast | | | | | | | |
| High | 4.87 | 4.42 | 4.48 | 4.59 | 4.58 | 4.60 | 4.59 |
| Low | 4.83 | 4.81 | 4.75 | 4.80 | 4.82 | 4.76 | 4.80 |

Note. The valence dimension measured on an 11-point scale "how unhappy vs. happy" one would feel in the affective script situation. 0 = completely unhappy; 10 = completely happy. For the valence and arousal contrasts, contents were weighted for orthogonality, as described in Data Analysis.

groups. As predicted, a priori high-arousal (joy, fear, and anger) scripts were rated as more arousing than a priori low-arousal (relaxation and sadness) scripts, $F$ (1,43) = 164.71, $p < .0002$. Arousal ratings did not differentiate a priori positive and negative scripts, $F$ (1,86) = 1.03, n.s. Fear scripts were rated as more arousing than anger scripts, $F$ (1,86) = 11.94, $p < .001$, although this difference varied with gender and FSS score, $F$ (1,83) = 6.71, $p < .02$. Among males, only those with high FSS scores rated the fear scripts as more arousing than the anger scripts, $F$ (1,72) = 7.33, $p < .009$; for all males, FSS $F$ (1,83) = 5.58, $p < .03$. In contrast, females' FSS scores were unrelated to the differentiation of fear and anger scripts, $F$ (1,83) = 1.77, n.s.

Imagery phase summary. Consistent with prior studies, startle magnitude was potentiated during unpleasant and arousing affective imagery. Startle was also potentiated during fear relative to anger imagery. Potentiation of startle by unpleasant imagery increased with scores on both questionnaires; that is, both high fear and high schizotypy subjects demonstrated greater startle potentiation during aversive imagery compared to low fear and low schizotypy subjects. High scores on the Pa scale of the MMPI were related to greater affective modulation of startle, and this relationship accounted for variance in startle modulation not previously accounted for by FSS and Per-Mag scores. Startle habituation rate during imagery was unrelated to questionnaires' scores or gender. Heart rate, skin conductance, and affective ratings results generally validated the a priori valence and arousal differences among imagery conditions, replicating prior results.

Table 3

Mean Affective Arousal Ratings of Scripts

| | Fear group | | | Schizotypy group | | | |
|---|---|---|---|---|---|---|---|
| Affect | Low | Moderate | High | Low | Moderate | High | All subjects |
| Relax | 4.58 | 4.05 | 5.57 | 4.43 | 4.40 | 5.38 | 4.73 |
| Joy | 8.86 | 8.51 | 8.68 | 8.48 | 8.80 | 8.78 | 8.68 |
| Sad | 5.84 | 6.10 | 5.35 | 5.68 | 5.29 | 6.33 | 5.76 |
| Fear | 7.75 | 9.13 | 8.41 | 8.45 | 8.37 | 8.46 | 8.43 |
| Anger | 7.54 | 8.13 | 7.76 | 7.97 | 7.42 | 8.04 | 7.81 |
| Arousal contrast | | | | | | | |
| High | 8.15 | 8.58 | 8.33 | 8.32 | 8.27 | 8.47 | 8.36 |
| Low | 5.21 | 5.07 | 5.46 | 5.05 | 4.84 | 5.85 | 5.25 |
| Valence contrast | | | | | | | |
| Positive | 6.72 | 6.28 | 7.13 | 6.45 | 6.60 | 7.08 | 6.71 |
| Negative | 6.89 | 7.55 | 6.94 | 7.15 | 6.80 | 7.42 | 7.13 |

Note. The arousal dimension measured on an 11-point scale how "unaroused vs. aroused" one would feel in the affective script situation. 0 = completely unaroused; 10 = completely aroused. For the valence and arousal contrasts, contents were weighted for orthogonality, as described in Data Analysis.

Picture Phase

Startle magnitude. Figure 7 presents mean startle magnitudes for pleasant, neutral, and unpleasant affective conditions across all subjects. As predicted, startle magnitudes were primarily sensitive to affective valence; that is, startles were larger for unpleasant compared to pleasant affective pictures, $F$ (1,93) = 5.87, $p < .02$. Although valence modulation of startle magnitude was unrelated to FSS score in the full sample, the omnibus analysis suggested a relationship between these factors that differed for males and females, Valence X FSS X Gender $F$ (1,90) = 3.04, $p = .085$. Potentiation of startle magnitude by unpleasant pictures increased with FSS score among females, $F$ (1,90) = 4.82, $p < .04$; although males showed reliable modulation of startle by emotional valence, $F$ (1,90) = 5.00, $p < .03$, the amount of modulation did not vary with FSS, $F < 1$.

Females had larger startles than males overall, means = 7.22 and 5.32 $\mu$V, $F$ (1,93) = 4.45, $p < .04$. Females also showed greater potentiation of startle by emotionally arousing pictures, Arousal X Gender $F$ (1,93) = 4.50, $p < .04$. Neither Per-Mag scores nor the MMPI clinical scales were related to modulation of startle by affective valence or arousal, all $p$s > .15. As expected, startle magnitude continued to habituate across picture trials, trial block linear and quadratic $F$s (1,93) = 86.03 and 30.16, $p$s < .0002. In addition, there was a tendency for high compared to low schizotypy subjects to show differential startle responses across trials to the affective pictures, Block linear X Valence X Per-Mag $F$ (1,93) = 3.12, $p = .08$. Because the relationship between startle habituation and schizotypy was a primary focus of this study, follow-up analyses were performed. Figure 8

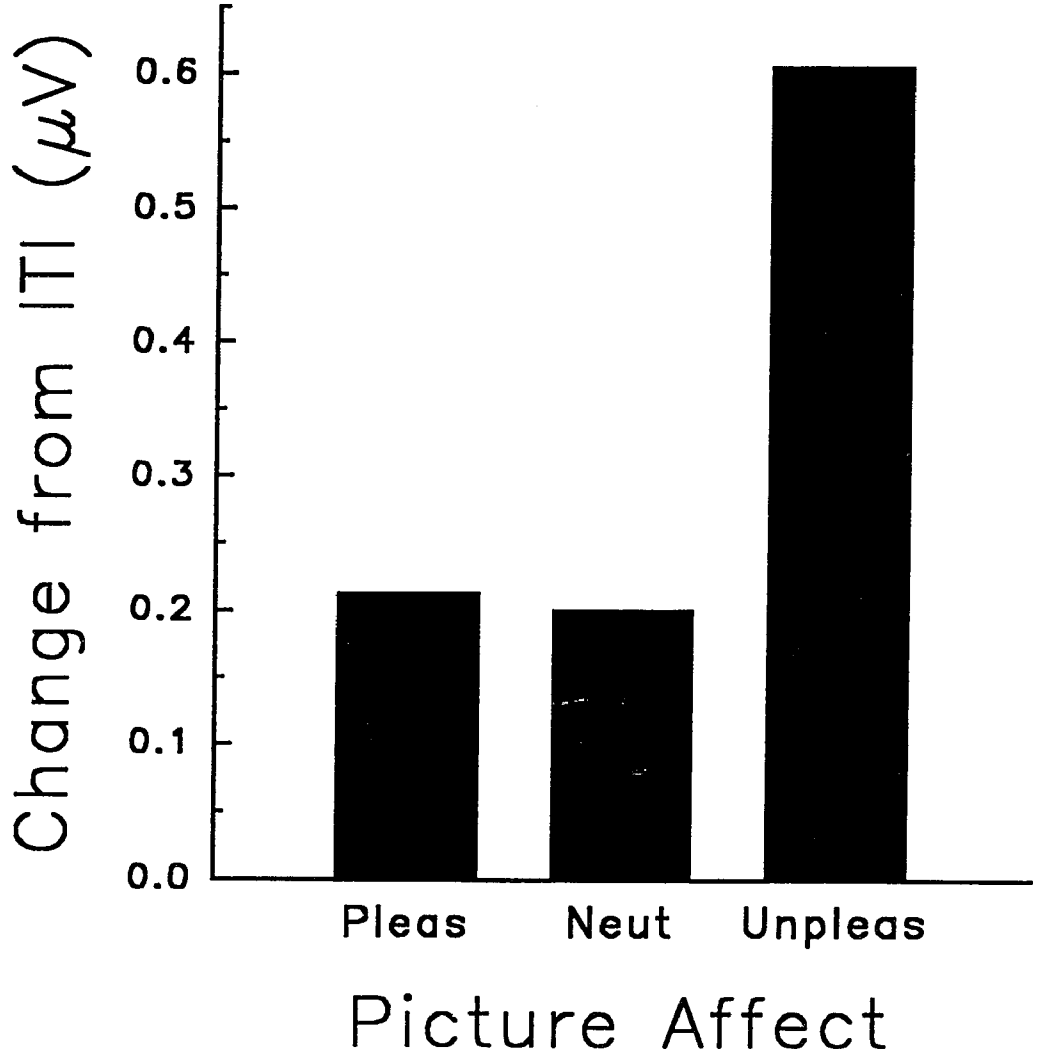


Figure 7. Mean startle magnitude potentiation during the affective pictures, averaged across the entire sample. Values are deviated from subject averages during the intertrial interval.

presents habituation curves during aversive pictures across trial blocks for the low, moderate, and high schizotypy groups. Consistent with predictions, high schizotypy compared to low schizotypy subjects demonstrated reduced startle habituation across unpleasant pictures trials; for unpleasant pictures, Block linear X Per-Mag $F$ (1,90) = 6.65, $p < .02$; for neutral and pleasant pictures, both Fs < 1.[5]

Heart rate. Figure 9 presents mean heart rate change scores for pleasant, neutral, and unpleasant affective conditions across all subjects. As predicted, heart rate change was primarily sensitive to affective valence; that is, greater heart rate deceleration was observed for aversive compared to pleasant and neutral pictures, Valence X Seconds linear $F$ (1,93) = 17.82, $p < .0002$; Seconds linear $F$ (1,93) = 17.56, $p < .0002$.

Averaged across affects, mean heart rate responses to pictures varied with Per-Mag score, Seconds linear X Per-Mag $F$ (1,93) = 9.34. As shown in Figure 10, all groups decelerated to about the same point, but deceleration began and ended more quickly for the high schizotypy group; for low and moderate schizotypy subjects, Seconds linear Fs (1,79) = 21.61 and 10.25, respectively; for high schizotypy subjects, $F$ (1,79) = 1.30, n.s. As in previous studies, baseline heart rate was reliably faster for females than for males; means were 71.35 and 65.39 bpm, respectively, $F$ (1,93) = 11.13, $p < .002$.

Skin conductance. Figure 11 presents mean skin conductance change scores for pleasant, neutral, and unpleasant affective conditions across

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[5]Startle magnitude during the ITI of Trial Block 1 was tested as a potential covariate to ensure that group differences were unrelated to initial values. This procedure had no effect on the pattern of significant effect in the reported follow-up analyses.

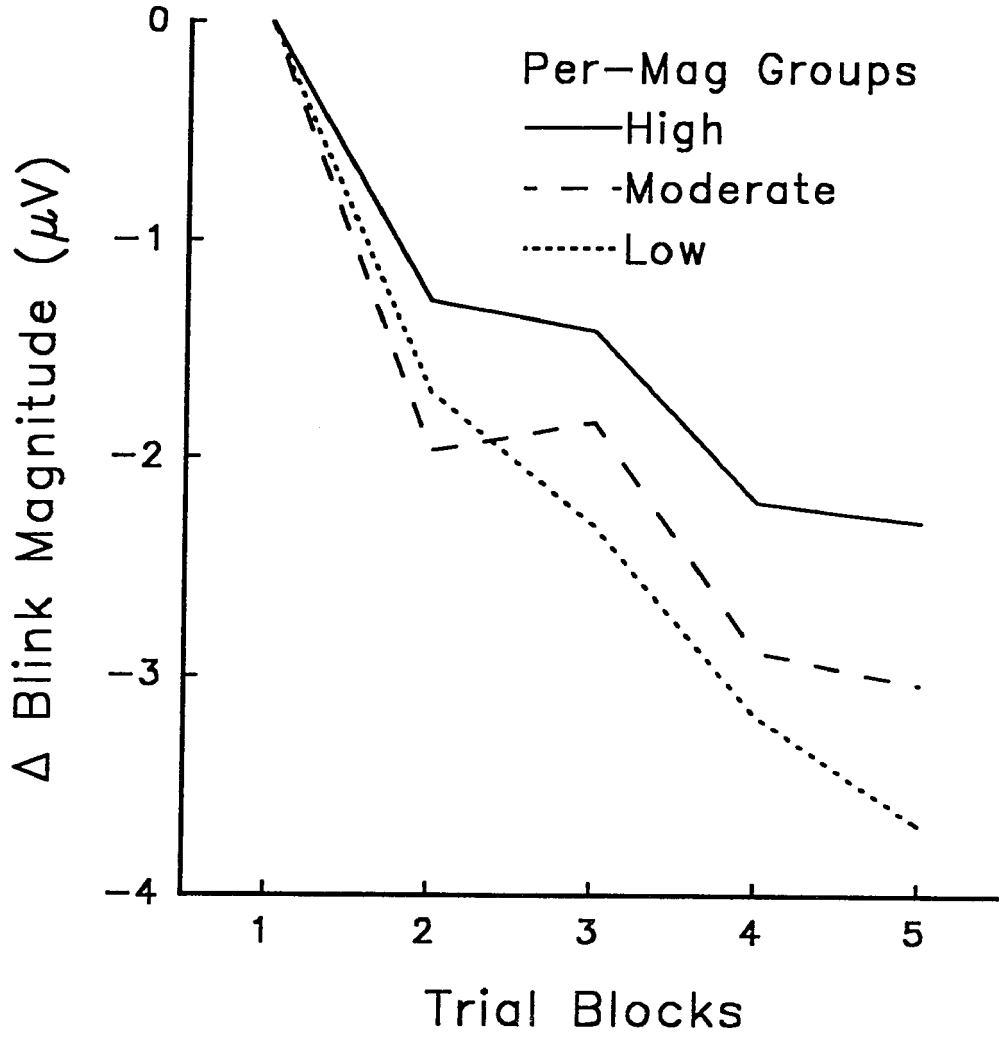


Figure 8. Habituation curves (decrease from Block 1) during aversive pictures across trial blocks for the low, moderate, and high schizotypy groups.

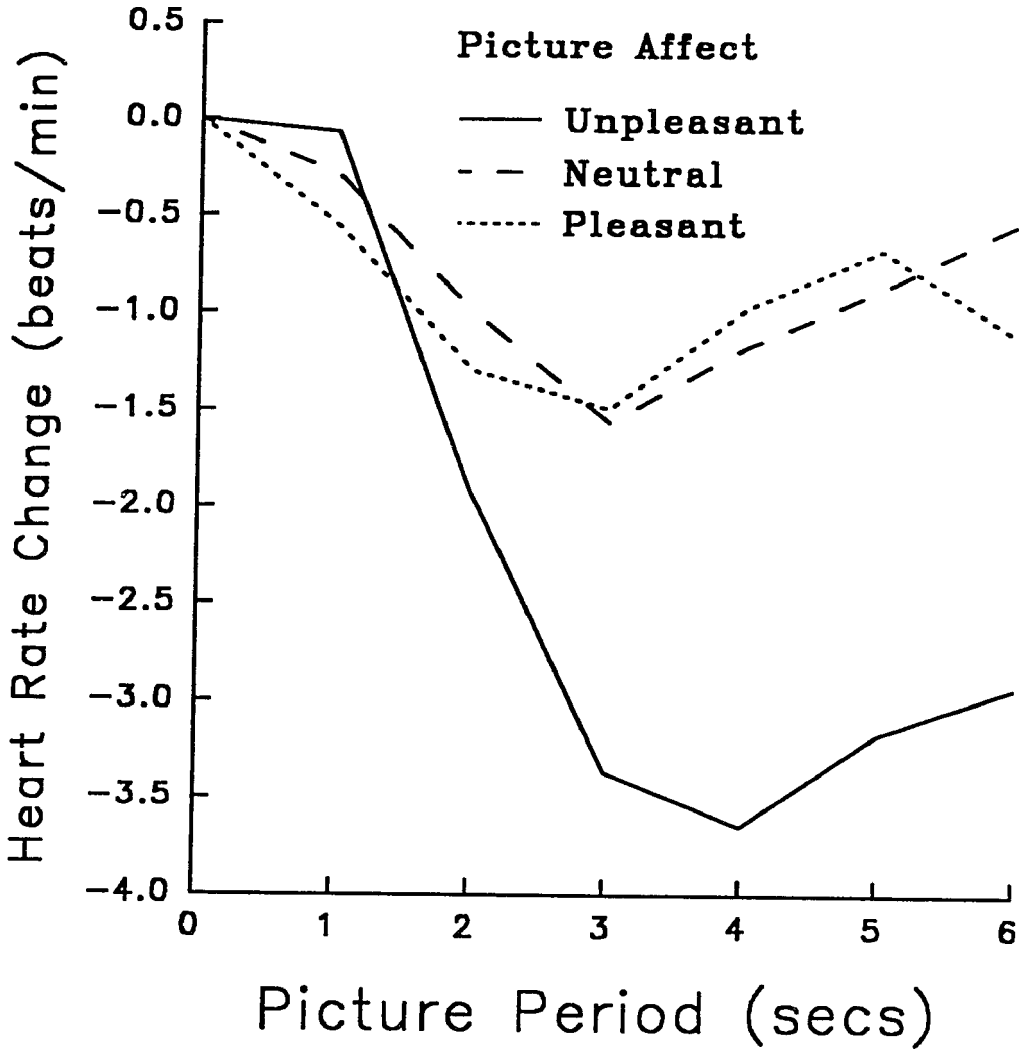


Figure 9. Mean heart rate change during the affective pictures, averaged across the entire sample. Values are deviated from pretrial baseline.

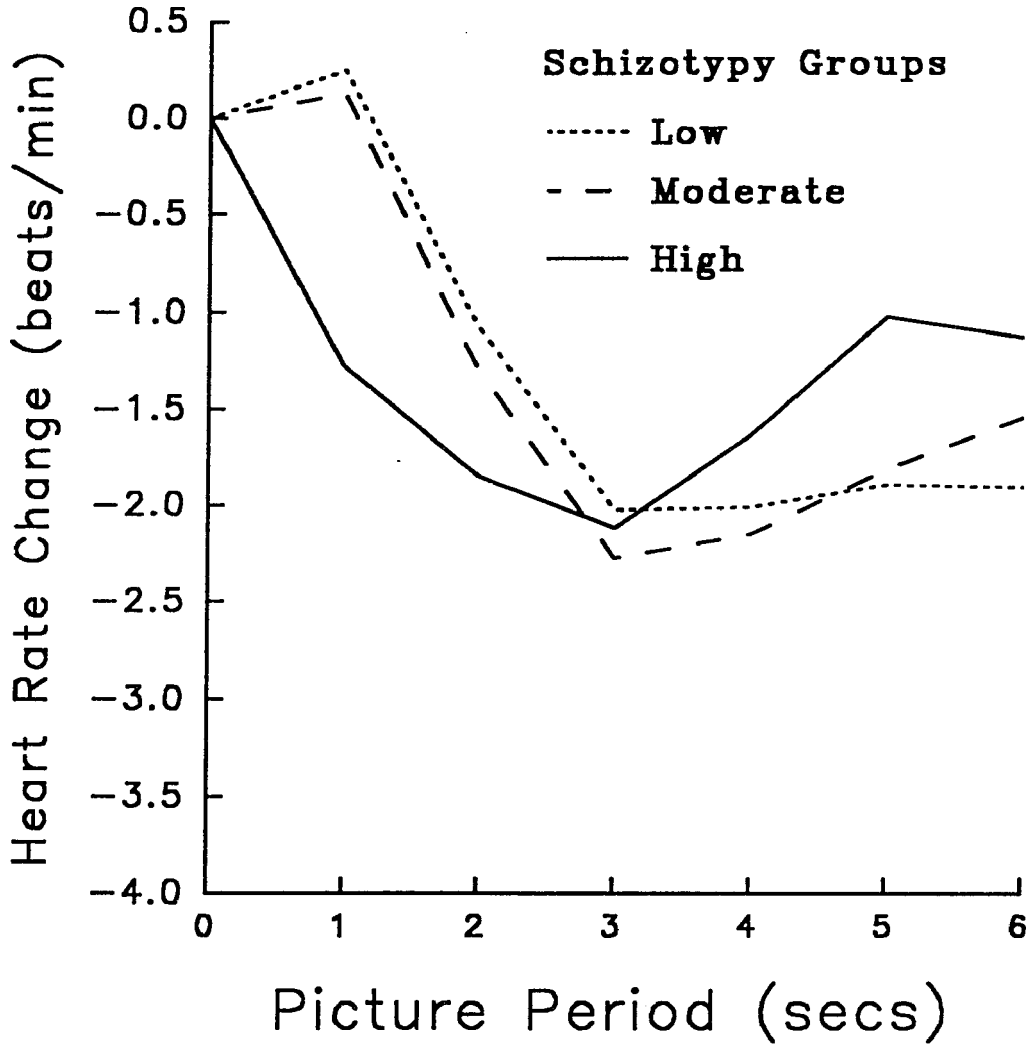


Figure 10. Mean heart rate change for the low, moderate, and high schizotypy groups, averaged across affective conditions.

all subjects. As predicted, skin conductance change was primarily sensitive to emotional arousal; that is, it increased reliably over time during emotionally arousing (pleasant and aversive) compared to neutral pictures, Arousal X Seconds linear $F$ (1,93) = 18.18, $p < .0002$. In addition, skin conductance increases were greater during pleasant compared to unpleasant pictures, Valence X Seconds linear $F$ (1,93) = 7.02, $p < .01$; Seconds linear $F$ (1,93) = 7.01, $p < .01$.

Across affects, high compared to low schizotypy males demonstrated a greater increase in skin conductance across time, Seconds linear X Per-Mag $F$ (1,90) = 6.84, $p < .02$. In contrast, females' Per-Mag scores were unrelated to skin conductance change, $F < 1$, leading to an interaction among schizotypy, gender, and skin conductance change across time, $F$ (5,450) = 4.46, $p < .02$.

Pretrial baseline skin conductance was reliably higher for males than for females; means were 2.77 and 1.77 $\mu S$, respectively, $F$ (1,93) = 4.20, $p < .05$.

Affective ratings. Tables 4 and 5 present mean valence and arousal ratings of all affect conditions and groups. As predicted, a priori pleasant pictures were rated as highly pleasant and a priori unpleasant pictures were rated as highly aversive, valence $F$ (1,82) = 887.97, $p < .0002$. Although all groups showed this effect, the degree to which valence ratings differentiated a priori pleasant and unpleasant pictures differed with FSS score and gender. As shown in Table 4, high compared to low fear subjects rated the unpleasant pictures as more aversive, FSS $F$ (1,82) = 11.74, $p < .002$. In contrast, ratings of pleasant pictures did not differ with FSS scores, $F$ (1,82) = 1.45, n.s., leading to a significant Valence X FSS interaction, $F$ (1,82) = 6.65, $p <$

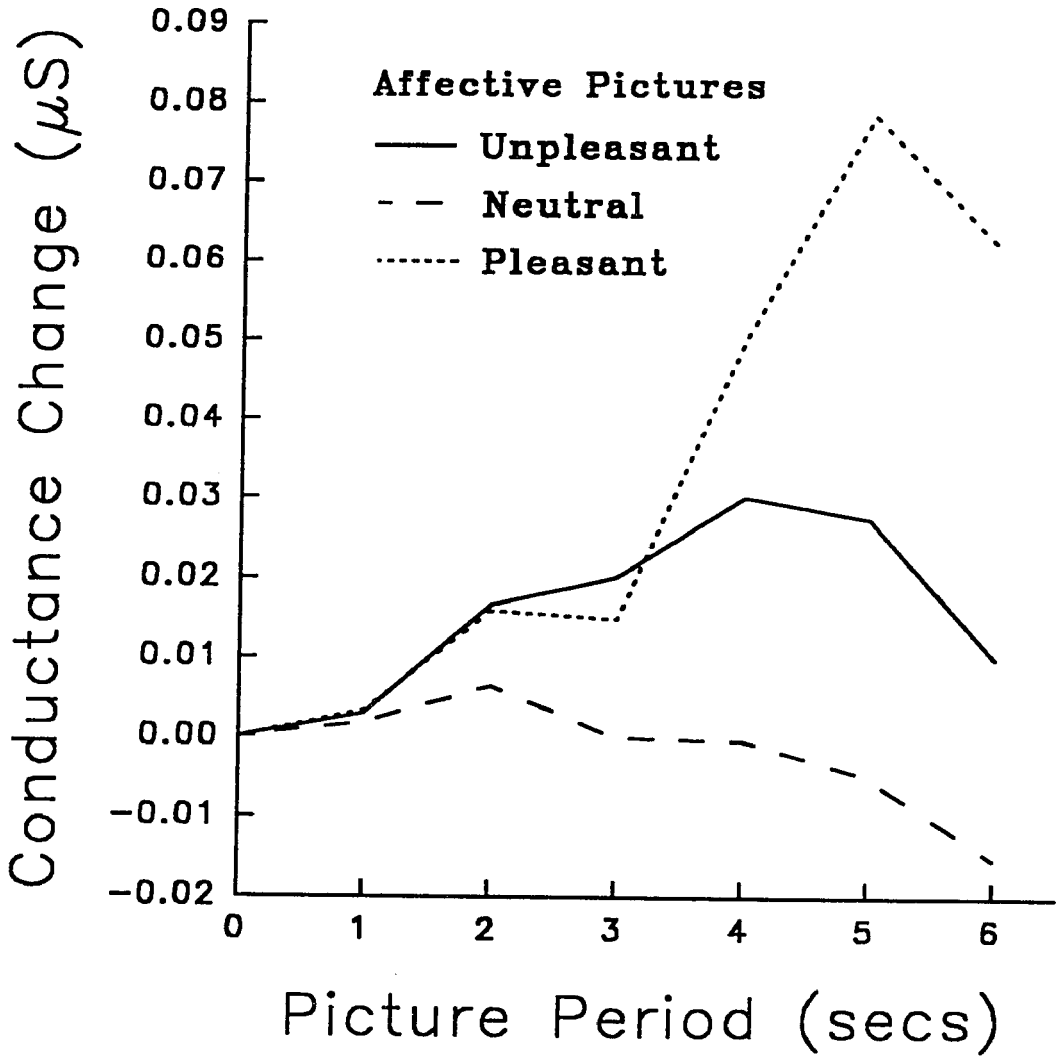


Figure 11. Mean skin conductance during the affective pictures, averaged across the entire sample. Values are deviated from pretrial baseline.

Table 4

Mean Affective Valence Ratings of Pictures

| | Fear group | | | Schizotypy group | | | |
|---|---|---|---|---|---|---|---|
| Affect | Low | Moderate | High | Low | Moderate | High | All subjects |
| Pleasant | 6.95 | 6.63 | 7.37 | 6.87 | 6.98 | 7.10 | 6.98 |
| Neutral | 2.97 | 2.44 | 2.56 | 3.17 | 2.10 | 2.71 | 2.66 |
| Unpleasant | 1.52 | 0.84 | 0.59 | 0.88 | 0.86 | 1.21 | 0.98 |

Note. The valence dimension measured on an 11-point scale how "unhappy vs. happy" one felt while viewing the affective picture. 0 = completely unhappy; 10 = completely happy.

Table 5

Mean Affective Arousal Ratings of Pictures

| | Fear group | | | Schizotypy group | | | |
|---|---|---|---|---|---|---|---|
| Affect | Low | Moderate | High | Low | Moderate | High | All subjects |
| Pleasant | 6.71 | 6.14 | 7.23 | 6.49 | 7.11 | 6.48 | 6.69 |
| Neutral | 1.48 | 1.46 | 1.15 | 1.28 | 1.20 | 1.61 | 1.36 |
| Unpleasant | 6.16 | 5.97 | 5.69 | 5.57 | 6.14 | 6.10 | 5.94 |

Note. The arousal dimension measured on an 11-point scale how "unaroused vs. aroused" one felt while viewing the affective picture. 0 = completely unaroused; 10 = completely aroused.

.02. In addition, females compared to males rated unpleasant pictures more negative (means = 0.68 and 1.28, respectively) and pleasant pictures more positive (means = 7.48 and 6.49, respectively), Gender *F*s (1,82) = 12.18 and 8.02, respectively; *p*s < .009; across all affective contents, Valence X Gender *F* (1,82) = 15.69, *p* < .0003. Neutral pictures were rated closer in affective valence to a priori unpleasant than pleasant pictures, leading to a significant arousal effect in the valence ratings, *F* (1,82) = 49.95, *p* < .0002.

Arousal ratings were clearly higher for affective compared to neutral pictures (see Table 5), arousal *F* (1,82) = 490.35, *p* < .0002. This arousal effect was unrelated to the questionnaires or gender, all *F*s < 1. Males rated pleasant pictures as more arousing than unpleasant pictures, *F* (1,84) = 11.71, *p* < .002, but females did not, *F* < 1; overall in the analysis of arousal ratings, Valence X Gender *F* (1,82) = 4.91, *p* < .03.

Picture phase summary. As expected, startle magnitudes were primarily sensitive to affective valence, as reflected by greater startle potentiation during unpleasant compared to pleasant affective pictures. This potentiation of startle magnitude by unpleasant pictures increased with FSS score among females but not males. Startle magnitude continued to habituate across the picture trials, and, consistent with predictions, this habituation rate was related to schizotypy. That is, high schizotypy compared to low schizotypy subjects habituated more slowly during the aversive pictures. Heart rate was primarily sensitive to affective valence, and skin conductance was primarily sensitive to emotional arousal, as expected. In general, ratings validated the a

priori affective categories as well as the valence and arousal contrasts.

MMPI and Questionnaire Variables

Figures 12 and 13 present MMPI profiles for the low, moderate, and high fearfulness and schizotypy groups. The MMPI clinical scales were reliably associated with the FSS and Per-Mag scores used to select subjects and assign group membership, FSS and Per-Mag scores multivariate *F*s (8,76) = 11.88 and 3.94, respectively; *p*s < .0006. Univariate follow-up tests indicated that high FSS scores were reliably associated with high elevations on scale 2 (D; depression) and scale 7 (Pt; psychasthenia), *F*s (1,83) = 14.18 and 14.02, respectively, *p*s < .0004. In addition, high FSS scores were associated with higher score elevations on scales Pa and Sc, both *F*s (1,83) > 7.00, *p*s < .006. High Per-Mag scores were reliably associated with higher scores on the psychotic tetrad scales: 6 (Pa; paranoia), 7 (Pt; psychasthenia), 8 (Sc; schizophrenia), and 9 (Ma; hypomania), all *F*s (1,83) > 26.00, *p*s < .0002. High Per-Mag scores were also associated with higher score elevations on scales 1 (Hs; hypochondriasis), 3 (Hy; hysteria), and 4 (Pd; psychopathic deviance), all *F*s (1,83) > 5.30, *p*s < .03. Subjects with both high Per-Mag and high FSS scores, compared to other configurations of fearfulness and schizotypy, demonstrated the highest reliable elevations on the Pa, Pt, and Sc scales, FSS X Per-Mag univariate *F*s (1,83) > 9.00, *p*s < .004; overall FSS X Per-Mag multivariate *F* (8,76) = 2.35, *p* < .03.

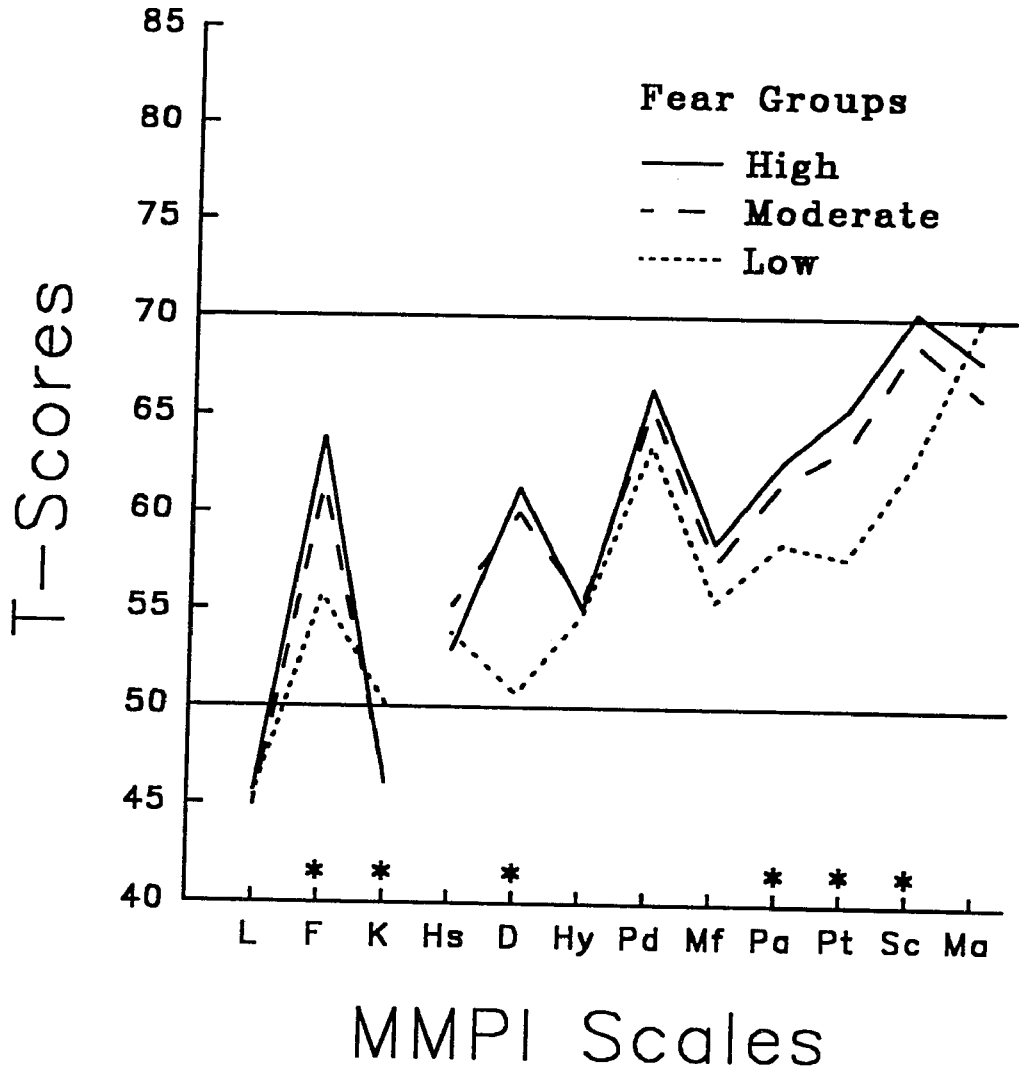


Figure 12. Mean MMPI profiles for the low, moderate, and high fear groups. The asterisk (*) denotes significance at $p < .006$.

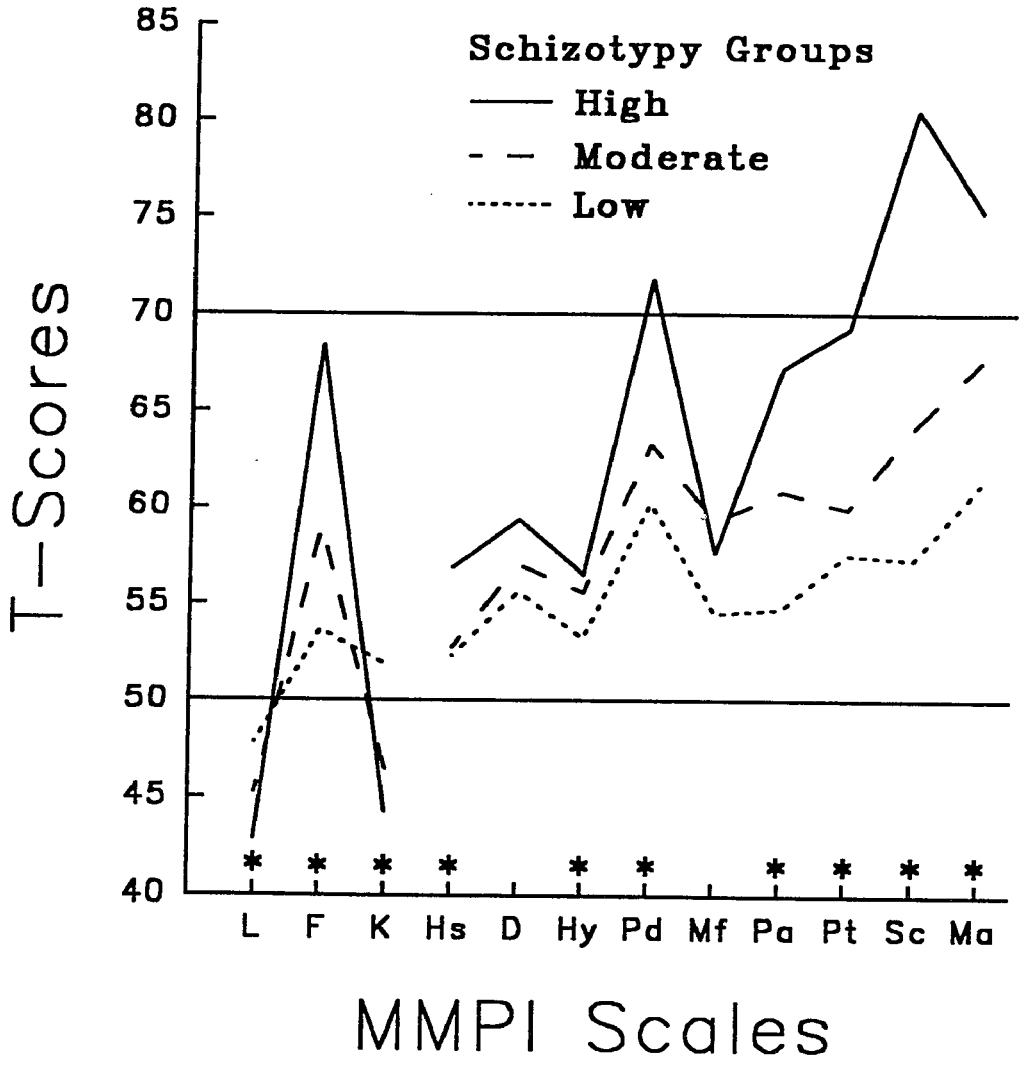


Figure 13. Mean MMPI profiles for the low, moderate, and high schizotypy groups. The asterisk (*) denotes significance at $p < .03$.

## Discussion

The results of the present investigation were consistent with substantial prior evidence indicating that the startle reflex is potentiated by negative affect. In the present study, mean startle blink magnitude was larger during aversive compared to pleasant affective imagery and picture viewing. These findings replicate prior findings for affective startle modulation produced by imagery (e.g., Cook et al., 1991; Stevenson et al., 1991), photographic slides (e.g., Bradley et al., 1990, 1991; Cook et al., 1992; Vrana et al., 1988), shock threat/anticipation (e.g., Foot et al., 1990; Grillon, Ameli, Woods, Merikangas, & Davis, 1991; Grillon, Ameli, Merikangas, Woods, & Davis, 1993), and shock exposure (Greenwald et al., 1990, 1991).

The main purpose of the present study was to examine how this valence effect on startle varied with fearfulness and schizotypy. Subjects were selected for low, moderate, and high scores on both FSS and Per-Mag scales. The paradigm consisted of both affective imagery (imagery phase) and pictures (picture phase) within a single experimental session. Results indicated that both subject characteristics were related to startle modulation. First, high fear compared to low fear subjects demonstrated enhanced potentiation of startle magnitude by negative affective imagery. This finding replicates Cook et al. (1991), whose paradigm closely paralleled the imagery phase of the present study. In addition, support for the

relationship between valence modulation and subject fearfulness was obtained during the picture phase, but only for females. That is, high fear compared to low fear females showed reliable potentiation of startle magnitude during the aversive pictures. This finding replicates at least three prior studies (e.g., Cook et al., 1992; Greenwald et al., 1990; Hamm, Greenwald, Bradley, & Lang, 1993) demonstrating a relationship between high trait fear and startle modulation during affective slides. Additional paradigms demonstrating this relationship include shock threat/anticipation (e.g., Foot et al., 1991) and actual shock exposure (e.g., Greenwald et al., 1991). Thus, the present results provide further evidence that enhanced startle responsivity is associated with individual differences in fearfulness, and this phenomenon appears independent of experimental methodology.

High schizotypy scores (reflecting subclinical perceptual aberrations and magical ideations) were also associated with enhanced potentiation of startle magnitude during negative affect. That is, high compared to low schizotypy subjects, regardless of fearfulness, showed larger startle magnitudes during aversive compared to pleasant imagery. This finding replicates Stevenson et al. (1991), the first known startle study to demonstrate a relationship between affective modulation of startle and schizotypal characteristics. The imagery paradigm of Stevenson et al. (1991) closely resembled the imagery phase of the present study. In a study using photographic slides, Schlenker, Hopmann, and Cohen (1993) demonstrated that patients with schizophrenia also showed enhanced startle potentiation during aversive compared to pleasant slides. In contrast, in another slide study Hamm, Spies,

Weber, and Globisch (1994) found that patients with schizophrenia and controls did not differ in startle modulation by affective valence.

The finding in the present study that affective modulation of startle is not specifically correlated with fearfulness may suggest three alternative hypotheses. First, affective modulation of startle may index a general tendency toward psychopathology, reflected in phobic fear, perceptual distortions, and beliefs in unusual causal mechanisms. Alternatively, valence modulation may be related more broadly to negative affectivity (Tellegen, 1985; Watson, Clark, & Carey, 1988) rather than fear specifically, as suggested by Cook et al. (1991) and Cook, Stevenson, and Hawk (1993). Third, affective modulation of startle may be specific to a dimension that is correlated with both fearfulness and schizotypy.

The MMPI data obtained in this study provide stronger support for the latter alternative explanation, which assumes that startle modulation covaries with some common correlate of fearfulness and schizotypy, rather than with a broadband dimension like negative affectivity or general psychopathology. If startle modulation were related to general psychopathology, then it would be expected to correlate with scores on the F validity scale. The F scale has been interpreted as a global psychopathology index, which taps a wide variety of obvious and unambiguous content areas, including strange thoughts, peculiar experiences, feelings of isolation, and unlikely or contradictory beliefs, expectations, and self-description (Dahlstrom et al., 1972). Inconsistent with the general psychopathology interpretation, F scale score in this study was unrelated to valence modulation ($r < .1$). In addition, probable MMPI correlates of negative

affectivity (e.g., D, Pt) were unrelated to startle modulation in this study, providing little support for our prior interpretation of startle modulation as indexing this broad dimension (Cook et al., 1991, 1993). In fact, of nine MMPI clinical scales, only Pa (scale 6) was reliably correlated with affective startle modulation ($r$ = +.39). Elevated Pa scores reflect paranoid tendencies, suspiciousness, and interpersonal sensitivity (Greene, 1980). This variable was actually a better predictor of valence modulation than FSS and Per-Mag in the present study, as neither selection variable accounted for unique variance when Pa was partialled out in a regression model. The relationship between startle modulation and Pa scores may indicate that affective modulation of startle is more closely related to wariness and hyper-responsivity to environmental threat, as suggested by Cook et al. (1992). Other MMPI correlates of both FSS and Per-Mag might be associated primarily with general distress rather than wariness. For example, in the present study scales F, Pt, and Sc were correlated with FSS and Per-Mag ($r$ values > +.25), but unrelated to startle modulation.

If our hypothesis holds that wariness and harm avoidance are associated with exaggerated startle in a negative affective context, then any clinical sample that is characterized by these features might be expected to show a similar startle response. For example, exaggerated startle response has been associated with trauma-related psychological problems in the literature (e.g., Kalman, 1977; Kinzie, Fredrickson, Ben, Fleck, & Karls, 1984; Langley, 1982; McCaughey, 1986). Posttraumatic stress disorder (PTSD) is a specific anxiety disorder that includes exaggerated startle among its diagnostic criteria, and this disorder is characterized by "persistent avoidance of stimuli associated

with the trauma and numbing of general responsiveness" (DSM IV; American Psychiatric Association, 1994, p. 424). Only a few studies have demonstrated empirical support for the inclusion of the exaggerated startle criterion for PTSD. For example, Butler et al. (1990) showed that veterans diagnosed with PTSD had enhanced startle reactivity compared to non-PTSD controls. Consistent with this finding, in the present study fearfulness was associated with enhanced startle magnitudes, particularly during negative affective imagery. In addition, Butler et al. (1990) demonstrated that, among veterans diagnosed with PTSD, those who also presented with schizotypal symptoms (e.g., perceptual aberration and atypical thought) showed the greatest startle reactivity. However, no relationship was found between overall startle magnitude and the selection questionnaires in the present study. Additional laboratory studies of startle response in varying anxiety and thought disorder populations are needed to better understand the relationship between exaggerated startle, fearfulness, and schizotypy.

Startle Habituation and Schizotypy

Another objective of the present study was to assess startle habituation among subjects reporting schizophrenia-related symptoms (i.e., perceptual aberration and magical ideation). The present study provided some support for the hypothesis that perceptual aberration and magical ideation are associated with deficits in sensory gating; however, the findings suggest that affect influences these sensory processing deficits. Thus, in this study high schizotypy subjects exhibited reliably slower habituation while viewing aversive pictures; no schizotypy differences in habituation during pleasant and neutral pictures were observed.

Several previous laboratory studies have demonstrated that individuals with schizophrenia (e.g., Dawson, Hazlett, Filion, Nuechterlein, & Schell, 1993; Geyer & Braff, 1987; Geyer et al., 1990) show deficits in inhibiting startle responses. Startle habituation and prepulse inhibition are the two main paradigms that have been used to investigate this phenomenon. Geyer et al. (1990) reviewed several studies demonstrating that individuals with schizophrenia showed deficits in startle habituation and prepulse inhibition. Although most of the research in this area has targeted patients with schizophrenia, these sensory processing deficits have also been demonstrated in individuals with DSM III-R schizotypal personality disorder (i.e., Cadenhead, Geyer, & Braff, 1993) and related schizotypal features (Losito & Simons, 1988; Perlstein et al., 1989; Simons, 1990). Perhaps because the information processing deficits associated with schizophrenia are generally considered cognitive phenomena (e.g., the "cognitive slippage" described by Meehl, 1990), these prior studies did not consider affect as a potential modulator of sensory gating deficits. Neither affect manipulation nor the affective state of the subjects were reported in these studies. This is noteworthy, given that the testing session may have been an aversive context for these subjects, and this extraneous variable may have influenced or contributed to these prior findings.

More generally, the present results are also consistent with previous studies suggesting that emotional factors may influence the cognitive deficits that characterize schizophrenia. Shimkunas (1972) presented persons with schizophrenia with descriptions of interpersonal situations that were either negative-affect-laden or emotionally

detached, and asked them to describe their own responses. Substantially greater thought disorder was evident in the verbal responses to the affect-laden descriptions, a result that is consistent with the view that negative affect exacerbates at least one aspect of schizophrenic thought disorder. More recently, a substantial body of research suggests that symptoms of schizophrenia are exacerbated when previously-hospitalized individuals with schizophrenia are returned to family environments involving high levels of expressed emotion. For example, a review of 12 studies in this area by Parker and Hadzi-Pavlovic (1990) indicated a relapse rate 3.7 times as high among persons with schizophrenia from high "expressed emotion" families than from low expressed emotion families. Thus, there is reason to expect that sensory gating deficits among individuals with schizophrenia-spectrum disorders and schizotypal characteristics (e.g., perceptual aberrations and magical ideations) may be exacerbated by negative affective stimuli, and startle modulation may serve as a useful laboratory paradigm for exploring this effect. The present study suggests that it is important to control or measure the affective state of subjects participating in future sensory gating studies.

Specificity of Fear

As discussed earlier, it has been demonstrated empirically that startle magnitude is potentiated by negative emotion. Among the many studies that have demonstrated this potentiation effect, several have specifically manipulated fear in animal (Brown, Kalish, & Farber, 1951; Davis, 1986) and human (Vrana and Lang, 1990; Grillon et al., 1991; Grillon, Ameli, Foot, & Davis, 1993; Grillon, Ameli, Merikangas, Woods, & Davis, 1993) subjects. The present study tested the contrasting

hypotheses of startle potentiation by fear (Davis, 1986) versus general negative affect (Lang, Bradley, & Cuthbert, 1990). The study done by Cook et al. (1991) was the first study to actually address this question. Although Cook et al. (1991) demonstrated that startles were generally larger during aversive compared to pleasant imagery, startle potentiation was not specific to fear. Startle potentiation during anger imagery was as large as that observed during fear imagery, further supporting the general negative affect hypothesis. Similar findings from the imagery paradigm were obtained by Hawk et al. (1992) and Stevenson (1991). In a second study addressing the fear specificity hypothesis, Balaban and Taussig (in press) conducted two studies in which they presented subjects with acoustic probes as they viewed photographic slides that depicted positive, neutral, frightening, or disgusting scenes. Consistent with the fear specificity hypothesis (but inconsistent with the prior Cook lab studies), Balaban and Taussig obtained larger blink magnitudes during frightening compared to positive pictures and concluded that blinks during neutral and disgusting conditions did not differ. Two factors that may explain the discrepant findings between Cook et al. (1992) and Balaban and Taussig (in press) include stimulus modality (imagery vs. slides) and the negative affect categories compared (anger and sadness vs. disgust). The present study refuted the first alternative explanation, as startle potentiation occurred during both aversive imagery (imagery phase) and pictures (picture phase). The second explanation is more viable. Although disgust, anger, and sadness are generally considered as negatively valent, disgust as shown by Balaban and Taussig (in press) was

associated with less startle potentiation than sadness and anger as shown by Cook et al. (1992).

Unlike prior studies in our laboratory, the present study supported the fear specificity hypothesis. That is, across all subjects, startle magnitudes were significantly larger during fear compared to anger imagery. Although Cook et al. (1991) and the present study used identical affective scripts and similar imagery paradigms, script rating procedures were different in the two studies. In the present study, the experimental subjects rated each script (for affective valence and arousal), whereas Cook et al. (1991) obtained these ratings from subjects other than those who participated in their study. Subjects in the present study rated the fear compared to anger scripts as higher in arousal, although autonomic response did not differ between these affects. It is uncertain whether the subjects in the Cook et al. (1991) study would have rated the scripts similarly. This difference in rated arousal for these two a priori high arousal, negative valent affective conditions may explain the greater potentiation during fear imagery in the present study, as arousal has reliably contributed to enhanced startles in prior imagery studies (e.g., Hawk et al., 1992; Stevenson et al., 1991). Fear scripts were rated as more arousing than anger scripts in the Stevenson et al. (1991) study but not in the Hawk et al. (1992) study; however, in neither study did startle differ between these two affect conditions. Thus, the specificity of the affective stimulus, which potentiates the human startle response, remains unclear. Additional research, which assesses startle during a variety of negative emotions that are similar in

affective ratings and physiological constituents, is needed to better clarify this specificity question.

Summary and Conclusions

The results of the present study suggest that affective modulation of startle is not as specific to individual differences in fearfulness as previously thought. As in the Stevenson et al. (1991) study, high scores on the schizotypy scales also predicted increased startle modulation by affect. The MMPI data suggest that startle modulation may covary with wariness or guardedness--a common correlate of both fearfulness and schizotypy. In addition, in this study schizotypy was associated with impaired startle habituation during aversive pictures. The findings provide further evidence for the relationship between affective modulation of startle and individual differences dimensions related to psychopathology, and, in particular, suggest that further research on sensory gating deficits in schizophrenia take affect into account.

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# Appendix A

## Questionnaires

**FSS**

Following is a list of things and situations that many people mention as being somewhat anxiety or fear producing. Please rate how much fear, anxiety, or unpleasantness each of them causes you. If it helps, try to imagine yourself in each of these situations and describe what your common reaction is. Read each statement and then blacken in the box by the corresponding number on the purple answer sheet.

Fill in A for **None At All**
Fill in B for **A Little**
Fill in C for **Somewhat**
Fill in D for **Much**
Fill in E for **Very Much**

1. Open wounds
2. Being alone
3. Being in a strange place
4. Dead people
5. Speaking in public
6. Crossing streets
7. Falling
8. Being teased
9. Failure
10. Entering a room where other
11. High places on land
12. People with deformities
13. Worms
14. Receiving injections
15. Strangers
16. Bats
17. Journeys by train
18. Journeys by bus
19. Journeys by car
20. People with authority
21. Flying insects
22. Seeing people injected
23. Crowds
24. Large open spaces
25. One person bullying another
26. Tough-looking people
27. Being watched working
28. Dirt
29. Crawling insects
30. Sight of fighting
31. Ugly people
32. Sick people
33. Being criticized
34. Strange shapes
35. Being in an elevator
36. Witnessing surgical operations people are already seated
37. Mice
38. Human blood
39. Animal blood

40. Enclosed places
41. Feeling rejected by others
42. Airplanes
43. Medical odors
44. Feeling disapproved of
45. Harmless snakes
46. Cemeteries
47. Being ignored
48. Nude men
49. Nude women
50. Doctors
51. Making mistakes
52. Looking foolish

## Per-Mag Scale

Please answer each of the following items TRUE or FALSE, using the following key:

Fill in A for **TRUE** Fill in B for **FALSE**

Please do not skip any items. It is important that you answer every item, even if you are not quite certain which is the best answer. An occasional item may refer to experiences which you have had only when taking drugs. Unless you have had the experience at other times, mark it as if you have not had that experience.

Some of the items may sound like others, but all of them are slightly different. Answer each item individually, and don't worry about how you answered a somewhat similar previous item.

1. I sometimes have had the feeling that some parts of my body are not attached to the same person. (Per-TRUE)

2. I have sometimes had the passing thought that strangers are in love with me. (Mag-TRUE)

3. Occasionally it has seemed as if my body had taken on the appearance of another person's body. (Per-TRUE)

4. The hand motions that strangers make seem to influence me at times. (Mag-TRUE)

5. Sometimes people whom I know well begin to look like strangers. (Per-TRUE)

6. I have never combed my hair before going out in the morning. (not keyed)

7. Good luck charms don't work. (Mag-FALSE)

8. Numbers like 13 and 7 have no special powers. (Mag-FALSE)

9. I have never had the passing feeling that my arms or legs have become longer than usual. (Per-FALSE)

10. I have sometimes been fearful of stepping on sidewalk cracks. (Mag-TRUE)

11. I sometimes have to touch myself to make sure I'm still there. (Per-TRUE)

12. I have had the momentary feeling that I might not be human. (Mag-TRUE)

13. I think I could learn to read others' minds if I wanted to. (Mag-TRUE)

14. My hands or feet have never seemed far away. (Per-FALSE)

15. Often I have a day when indoor lights seem so bright that they bother my eyes. (Per-TRUE)

16. I have noticed sounds on my records that are not there at other times. (Mag-TRUE)

17. At time I perform certain little rituals to ward off negative influences. (Mag-TRUE)

18. Sometimes part of my body has seemed smaller than it usually is. (Per-TRUE)

19. I have felt that my body and another person's body were one and the same. (Per-TRUE)

20. I have had the momentary feeling that someone's place has been taken by a look-alike. (Mag-TRUE)

21. I have felt that something outside my body was a part of my body. (Per-TRUE)

22. Now and then, when I look in the mirror, my face seems quite different than usual. (Per-TRUE)

23. I have sometimes felt that some part of my body no longer belongs to me. (Per-TRUE)

24. Sometimes when I look at things like tables and chairs, they seem strange. (Per-TRUE)

25. I have sometimes felt confused as to whether my body was really my own. (Per-TRUE)

26. Sometimes I have felt that I could not distinguish my body from other objects around me. (Per-TRUE)

27. On some mornings, I didn't get out of bed immediately when I first woke up. (Inf-FALSE)

28. I sometimes have had the feeling that my body is abnormal. (Per-TRUE)

29. I have sometimes had the feeling that my body is decaying inside. (Per-TRUE)

30. It has seemed at times as if my body was melting into my surroundings. (Per-TRUE)

31. Sometimes I have had a passing thought that some part of my body was rotting away. (Per-TRUE)

32. I have never doubted that my dreams are the products of my own mind. (Mag-FALSE)

33. I have sometimes had the feeling that one of my arms or legs is disconnected from the rest of my body. (Per-TRUE)

34. I have wondered whether the spirits of the dead can influence the living. (Mag-TRUE)

35. I have never felt that my arms or legs have momentarily grown in size. (Per-FALSE)

36. At times, I have felt that a professor's lecture was meant especially for me. (Mag-TRUE)

37. There have been a number of occasions when people I know have said hello to me. (Inf-FALSE)

38. The boundaries of my body always seem clear. (Per-FALSE)

39. I have felt as though my head or limbs were somehow not my own. (Per-TRUE)

40. I have never had the feeling that certain thoughts of mine really belonged to someone else. (Mag-FALSE)

41. Occasionally I have felt as though my body did not exist. (Per-TRUE)

42. I have occasionally had the silly feeling that a TV or radio broadcaster knew I was listening to him. (Mag-TRUE)

43. Sometimes I have had the feeling that a part of my body is larger than it usually is. (Per-TRUE)

44. I can remember when it seemed as though one of my limbs took on an unusual shape. (Per-TRUE)

45. I have felt that I might cause something to happen just by thinking too much about it. (Mag-TRUE)

46. I have sometimes sensed an evil presence around me, although I could not see it. (Mag-TRUE)

47. I have had the momentary feeling that the things I touch remain attached to my body. (Per-TRUE)

48. I believe that most light bulbs are powered by electricity. (not keyed)

49. I sometimes have a feeling of gaining or losing energy when certain people look at me or touch me. (Mag-TRUE)

50. It is not possible to harm others merely by thinking bad thoughts about them. (Mag-FALSE)

51. At times I have wondered if my body was really my own. (Per-TRUE)

52. The government refuses to tell us the truth about flying saucers. (Mag-TRUE)

53. If reincarnation were true, it would explain some unusual experiences I have had. (Mag-TRUE)

54. I have had the momentary feeling that my body has become misshapen. (Per-TRUE)

55. I almost never dream about things before they happen. (Mag-FALSE)

56. Horoscopes are right too often for it to be a coincidence. (Mag-TRUE)

57. Sometimes I feel like everything around me is tilting. (Per-TRUE)

58. People often behave so strangely that one wonders if they are part of an experiment. (Mag-TRUE)

59. I have sometimes felt that strangers were reading my mind. (Mag-TRUE)

50. Sometimes I have had feelings that I am united with an object near me. (Per-TRUE)

61. Some people can make me aware of them just by thinking about me. (Mag-TRUE)

62. I have worried that people on other planets may be influencing what happens on Earth. (Mag-TRUE)

63. I cannot remember a time when I talked with someone who wore glasses. (Inf-TRUE)

64. Parts of my body occasionally seem dead or unreal. (Per-TRUE)

65. Things sometimes seem to be in different places when I get home, even though no one has been there. (Mag-TRUE)

66. For several days at a time I have had such a heightened awareness of sights and sounds that I cannot shut them out. (Per-TRUE)

67. I have felt that there were messages for me in the way things were arranged, like in a store window. (Mag-TRUE)

68. Ordinary colors sometimes seem much too bright to me. (Per-TRUE)

69. When introduced to strangers, I rarely wonder whether I have known them before. (Mag-FALSE)

70. My hearing is sometimes so sensitive that ordinary sounds become uncomfortable. (Per-TRUE)

# Appendix B

## Imagery Material and Affective Rating Scales

## Imagery Materials

### Sad or Depressed

1. You are attending the funeral of a close family member. Your eyes burn with tears and you hear others weeping as you realize you will never see that person again.

2. You are in your car at a red light downtown and see an old woman hobbling down the street. Your body feels heavy as you turn away but can still hear her digging through a garbage can for food.

3. You are talking to your boyfriend on the phone and he tells you that your relationship is over. Feeling sad, you slump heavily into a chair.

4. You are talking to your girlfriend on the phone and she tells you that your relationship is over. Feeling sad, you slump heavily into a chair.

5. You are standing in front of your house saying goodbye to a close friend who is moving far away. You begin to cry, knowing you may never see that person again.

6. You walk outside and call your old, sick dog. You look around and listen for him to respond. Your body feels heavy when you see him lying stiff under a tree, dead.

7. You run into a close friend on the street and he tells you he was just diagnosed with a malignant brain tumor. Your heart skips a beat and you start to cry as you realize your friend might die.

### Pleasantly Relaxed

1. You are lying on the beach without a care in the world. You feel relaxed all over as the warm sun beams down on you and the gentle sound of the waves lulls you to sleep.

2. You are riding in a car, heading for one of your favorite vacation spots. Your heart slows as you relax and enjoy the trip, watching the scenery and listening to the radio.

3. You are lying on a hammock, quietly resting on a summer afternoon. You feel utterly calm as a cool breeze blows past, gently rustling the leaves in the trees above.

4. You are sitting in a bubble bath after a long day. Your body tingles and feels warm as you close your eyes, lay your head back against a soft towel, and listen to the faucet drip into the still water.

5. You are sitting on the deck of a sailboat on a beautiful summer day. You breathe slowly and evenly as waves nudge the boat and seagulls flutter and screech in the distance.

6. You have just finished a pleasant dinner and are curled up on the couch with a friend, watching your favorite show. You feel peaceful and relaxed as you enjoy the show and the company of your friend.

Fearful or Anxious

1. You are at home alone at night when you hear footsteps outside. Your heart races as a window shatters and you hear someone coming down the hall.

2. You are walking alone in a bad part of town and a strange man is following you. As you hear his footsteps getting closer, sweat pours down your face and you try to figure out what to do.

3. You are driving fast down a two-lane road. Suddenly, a truck swerves into your lane. Tires squeal and you heart pounds as you realize there is no way to avoid a collision.

4. You are climbing up the side of a steep mountain. You slip and tumble from a ledge. Your heart pounds and rocks crash around you as you fall faster and faster, grabbing at the smooth rock.

5. Walking through the woods, you trip over a log and fall into a pile of leaves. Your heart skips a beat as you look up, directly into the face of a hissing rattlesnake.

6. You are in the emergency room, anxious to hear some news about your friend who was in a car accident. Your stomach is in a knot. As you look around the waiting area, you hear your friend's agonizing screams.

Happy and Excited

1. You are out on your first date with someone really special. As the radio plays softly and your heart races, the date ends with the warm sensation of a good-night kiss.

2. You are about to be married, standing in a beautifully decorated church filled with friends and family. You feel warm all over as you hear your husband-to-be repeat his wedding vows.

3. You are about to be married, standing in a beautifully decorated church filled with friends and family. You feel warm all over as you hear your wife-to-be repeat her wedding vows.

4. You are watching your favorite team playing in a championship game. The announcer goes wild and you cheer madly as your team surges forward to win in the final seconds.

5. You are at the greatest party you have ever been to. Your favorite song begins to play and your heart beats faster when someone you have been dying to meet steps up and asks you to dance.

6. You are with friends, listening to the radio. Your spirit soars as the DJ announces that you have won a trip to meet your favorite musician.

7. You are in class watching your professor pass back an important exam. When he hands you your test, you see that the grade is "A+." You feel your face flush with excitement as he smiles and says "good work!"

Angry

1. You stay after class to talk to a professor about an unfair grade he gave you on an essay. Your face feels flush and your heart pounds as he criticizes you and your work.

2. You are walking toward your car and hear the loud crunch of a collision. You are furious and your heart races as you see that someone has just hit your car and is racing away without stopping.

3. Your parents wrongfully accuse you of drinking. You feel a desire to smash something as they repeat their complaints, disregard your plea of innocence, and ground you for a month.

4. You are in a supermarket line and the woman in front of you is screaming at her young child. You try to control your rage as the woman starts to whip the helpless, crying child.

5. You are walking across campus, when you see your boyfriend and one of your best friends holding hands. You heart pounds as you hear them talking and laughing. Filled with rage, you walk quickly toward them.

6. You are walking across campus, when you see your girlfriend and one of your best friends holding hands. You heart pounds as you hear them talking and laughing. Filled with rage, you walk quickly toward them.

7. It is Halloween night and you are walking outside. You become enraged and begin to perspire as you observe a teenager snatch a screaming child's bag of candy and run.

## Affective Rating Scales

During the recall session, each subject rated the selected scripts and the pictures for affective valence and arousal using the 11-point paper-and-pencil Likert scales below.

Unhappy 0 1 2 3 4 5 6 7 8 9 10 Happy

Unaroused 0 1 2 3 4 5 6 7 8 9 10 Aroused

# Appendix C

## Laboratory Session Protocols and Consent Form

VSPHD Study Protocol
for Telephone Contact

Call males and females in according to the priority status assigned by Dr. Cook.

Protocol

1. "Hi, my name is _____ and I am a graduate student (or research assistant) in the Psychology Department at UAB, working with Dr. Cook. We are conducting a research project with members of the introductory psychology classes."

   "I'd like to take a couple of minutes to tell you about the project and invite you to participate. Would that be okay?"

   [if the subject is not interested and doesn't volunteer the reason, ask if they would mind telling you why they aren't interested, because that's useful information for you to have to know whether you're getting a biased sample. Record the reason on the subject list. In any case, be nice, thank them for their time, and hang up.]

2. Read:
   "The project we are running involves measuring people's physiological and emotional reactions to different situations. Some are pleasant and some are unpleasant. You would be asked to imagine a series of situations and view a series of pictures on a TV screen. Physiological responses will be measured as you imagine these situations. The entire procedure takes about 2 hours, and you would receive 4 experimental credit points for your participation. Do you have any questions?"

3. Questions:

   The procedure for answering questions is approximately what you use when subjects fill out the consent form. Here are some notes on how to answer common types of questions:

   Questions about specific procedures:

   If they ask, tell them that they will receive all specific instructions when they come in for the laboratory session. We do this because it's important that everybody gets the same instructions in the same order. If they have any specific concerns, you would try to address them now, over the phone.

   Shocks.

   "There aren't any."

Why are you calling me?

"You may recall the screening questionnaires that you filled out in class. We are calling people who responded in different ways on those questionnaires. I can't tell you exactly how you scored, because I am specifically kept unaware of what groups people are in. We do this because when experimenters know the group membership of people who participate in studies, they sometimes treat them differently without being aware of it. At the end of the study, however, we can provide that information for you."

4. Quick health screening

"I'd just like to ask you a few brief health questions. We ask for this information because we're measuring physiological responses."

"Have you ever had heart disease or any heart problems?"

"Do you have any problems with your eyes?"

"Do you have any hearing problems?"

"Are you regularly using any prescription or non-prescription drugs or time medication?"

Use the same exclusionary criteria that you would use if the person were in the lab, and explain that because we are running an experiment, it is important that there not be other factors that could influence a person's responses. Don't alarm them about their health problems, just explain that we need to be conservative and exclude people who might give different responses than other subjects because of some medical problem or because of their medical history. Thank them for their time. Record subject name and reason for exclusion on Excluded Subject List.

5. Schedule a time for them to participate. If no time can be found when the lab is available, find out what other times would suit them, and tell them you will call them back the following day.

6. Tell them to meet you in the Psychology lobby, opposite room 201 Campbell Hall.

7. Pre-experimental requests:

   a. Please do not drink to the point of intoxication within 24 hours prior to the experiment, and avoid caffeinated beverages for 2 hours prior to the experiment.

   b. Verify home and any other phone numbers. Tell them that you will try to call them the day before the experiment, just to remind them and make sure that they are clear on where and what time they should come in.

# VSPHD Study Protocol

## I. Before the subject arrives

### A. Assign a 4-digit subject number

The subject number is the next one available on the SUBJECT NUMBERS sheet for the subject's gender. The complete interpretation of subject numbers is as follows:

| Digit | Meaning |
|---|---|
| 1 | Gender (1 = males, 2 = females) |
| 2 | Order number (1 - 6) |
| 3-4 | Sequential subject number within cell. |

### B. Set up forms on table in subject chamber

Mark subject record sheet with subject's number.

Have available:

Consent form

Script list

2 pencils

In folder (for end of session):

PRI-1 (1st half of Per and Mag scales)

FSS

PRI-2 (2nd half of Per/Mag)

3 Computer answer sheet, marked PRI-1, FSS, and PRI-2

### C. Set up lab and computer in Room I

1. Switch on 3 power strips (main computer, video, and rack)
2. Make sure that computer on top of rack is OFF
3. Set the computer to the "D:\VSPHD>>" directory with the following commands:

```
D:
NCD VSPHD
```

4. Insert VSPHD videocassette into PC-VCR.

5. Run data acquisition program. Type:

RUN n1 n2 n3 n4 firstname lastname

6. Coulbourn equipment.

EMG bioamplifiers: (lower row, columns 2 and 3)

| | |
|---|---|
| GAIN knob | = 5.0 |
| COUPLING switch | = 1 Hz |
| GAIN switch | = X 10 |
| HI CUTOFF | = 250 Hz |
| LO CUTOFF | = 90 Hz |

EKG bioamplifier: (lower row, column 4)

| | |
|---|---|
| GAIN | = around 5 |
| COUPLING switch | = 1 Hz |
| GAIN switch | = X 10 |
| HI CUTOFF | = 13 Hz |
| LO CUTOFF | = 8 Hz |
| PERCENT OF GAIN | = 30 |

SCL Coupler: (upper row, column 1)

| | |
|---|---|
| SUBJ CONDUCTANCE | = 1.04 (locked) |
| EXCITATION | = DC |
| COUPLING | = DC |
| SENSITIVITY | = 100 |
| VERNIER | = CAL |

Voltage Controlled Oscillator

FREQUENCY SWEEP RANGE = B, BIPOLAR

Shaped Rise/Fall Gate

RISE/FALL TIME = 1.5, NONLINEAR

AMPLITUDE RMS = 2V (all the way up)

7. Audio amplifier Power ON

8. Voice-activated relay

Power ON, SENSITIVITY = approx. 2.0,
DELAY = 1.25.

9. Equalizer

60, 150, and 400 Hz at 0
1, 2.4, 6, and 15 kHz at -12
Both POWER and BYPASS buttons IN.

10. Visual monitoring of subject.

| | | |
|---|---|---|
| a. | Panasonic VCR: | Power ON |
| b. | ABC switch | A (Panasonic) |
| c. | TV: | Power ON, volume about 12:00 |
| d. | Mixer: | Power ON<br>MONO<br>Far left volume = 10<br>All other volumes = 0 |
| e. | Switchbox: | All switches down |

D. Prepare chamber for Phase I

Lights ON
Camera and power supply ON.
Sony TV OFF.

| | |
|---|---|
| VHold | horizontal white tape |
| Shapeness | center |
| Hue | center |
| Color | center |
| Brightness | far right (max bright) |

E. Electrode setup

5 large and 4 small electrodes, all with long leads

EKG: 2 large electrodes

SC: 2 large electrodes

GND: 1 large electrode

Blink: 4 small electrodes

For blink, position tabs & clip collars for recording close to the eye.

(2 tabs should point in one direction, and 2 in the other direction)

2 pieces of tape, each about 3" long, for EKG and SC strain relief

II. When the subject arrives  Note: Instructions to subjects are in " "s.

A. Meet the subject and bring him/her to room 239H

Place "SESSION IN PROGRESS" sign on door

B. Consent forms and intro

"The first thing that I would like you to do is to read over this consent form. Let me know if you have any questions. Otherwise, I'd like you to sign and date it at the bottom."

While the subject reads the consent forms put gel in the electrode cups.

General guidelines for answering questions are as follows:

If the subject asks about whether the procedures are painful, or whether shocks will be administered, say no.

If the subject asks about details of the procedures, tell them that we will give them more detailed instructions in a few minutes, and that we will explain everything to them after the experiment.

If the subject expresses concern about signing the consent form without knowing the exact procedures, remind them that they can withdraw from the experiment at any time if there is a problem.

"Most of the instructions for the experiment will be read to you. We do this because it's important that everyone gets the instructions in the same way. However, if you have any questions, please interrupt me so that I can make things more clear."

C. Health questions and screening

Record answers for this section on the Subject Record Form

"As you read in the consent form, in this experiment we are measuring your physiological responses to some sensory stimuli. For this reason, we routinely ask about some health-related factors that might influence our recordings. This information, like all other information that we collect from you in this experiment, is completely confidential."

How old are you?

Are you right- or left-handed?

Have you ever had heart disease or any heart problems?

Do you have any problems with your eyes?

Do you have any hearing problems?

If the subject has any heart, eye, or hearing problems, explain that because we are running an experiment, it is important that there not be other factors that could influence a person's responses. Don't alarm them about their health problems, just explain that we need to be conservative and exclude people who might give different responses than other subjects because of some medical problem or because of their medical history. Thank them for their help, give them one credit slip (up to 4 at the end of the quarter if they are desperate) and document on the excluded subject list. Otherwise, continue with the following questions:

"Have you used any prescription or non-prescription drugs in the last 24 hours?"

> Exclude for use of medication that might have a significant effect on the subject's mental state or autonomic nervous system response. For example, exclude subjects on medication to help them relax or sleep. Do not exclude subjects who have used aspirin, antibiotics, or birth control pills. If subject is only using the medication temporarily, reschedule their laboratory session.

"Any alcoholic beverages in the past 24 hours?"

> Reschedule if the subject used alcoholic beverages to the point of intoxication within that time period.

"Any caffeinated beverages or cigarettes in the past two hours?"

D. Attach the electrodes

*** IMPORTANT ***

EKG, blink, and eye movement must be plugged in and tested before skin conductance. This is because plugging the EKG electrodes into the skin conductance cable would apply a small but potentially dangerous voltage to the subject's heart. By plugging in and testing EKG, blink, and eye movement first, this danger is avoided.

1. Instructions:

> "I would now like to attach the sensors that we use to record your responses. The sensors are not painful--they are just taped to your skin. You will be wearing the sensors for about the next hour and a half. If you need to use the rest room, now would be a good time."

When the subject is ready to continue, seat him or her in recliner.

During this procedure, answer any questions about what is being measured by telling the subject that we will explain what the sensors are measuring at the end of the experiment.

At the beginning, ask the subject to remove his or her watch, as this can interfere with physiological recording. Also, ask subjects who are wearing glasses to remove them, at least during the during the hookup.

When the subject is ready to continue, say:

"I'll be attaching two sensors to your sides, four near your eyes, two to your hand, and one to your forehead."

"I'll be rubbing your skin with alcohol first, in order to get a good signal. Different people have more or less sensitive skin, and it is sometimes difficult to tell if I am rubbing too much unless you let me know. Please tell me know if this hurts at any time, and I will stop."

2. EKG

Prepare the skin by cleaning the areas with alcohol and rubbing briefly with a small amount of electrode gel. Remove excess gel.

Place one electrode on each side of the lower chest, over the lowest ribs.

Tape down a loop of wire by each electrode as a strain relief.

3. Blink

Prepare the skin under both eyes as for EKG: clean with alcohol followed by a small amount of gel.

For females, be sure to remove all makeup from the areas. Be careful not to rub hard, as this skin is very sensitive on most subjects.

Since the alcohol may be irritating, have the subject close his eyes during this procedure.

For each eye:

Place one electrode under each eye, directly beneath the outer points where the eyelids meet (the "outer canthus").

Place the second electrode directly under the pupil, overlapping the collars, but not so close that the contact of the second electrode is on top of the collar for the first electrode.

Tape down the wires to the temple. Hook the wires behind the subject's ear. Tell the subject that they electrodes may feel a little unusual, but most people do get used to them as time goes on.

4. Skin conductance.

Recall from record form whether subject is right- or left-handed. Electrodes are applied to the thenar and hypothenar eminences (fatty areas on each side of the lower palm) of the non-dominant hand.

Rinse the skin first with distilled water on a tissue, then wipe dry. Wipe the skin with Unibase, and then gently wipe off the excess with a tissue.

Apply electrodes.

Put loops in the wires and tape them down over the wrist.

5. Ground

After cleansing as for EKG, attach the electrode to the center of the forehead.

6. Plug in and test the EKG and blink electrodes.

| Lead from | connect to |
|---|---|
| left chest | 4L |
| right chest | 4R |
| right outer | 1R (white tape) |
| right center | 1L |
| left outer | 2R (white tape) |
| left center | 2L |
| ground | GND (top of box) |

"I would like to take a moment now to make sure that we are getting a good recording. Please sit quietly and relax."

7. Enter Room I:

Press <ENTER>
at D:\VSPHD>>RUN n1 n2 n3 n4 firstinitial lastname

Press ESC to shut down the network, and enter the password to install the network (as needed).

Check EKG.

In an acceptable EKG display, every R-wave appearing on the light red analog display has a matching white dot on the event marker line. Also, the Last Time value remains fairly consistent, varying only within a few hundred points (generally between 500 and 1300). Check for the following problems and adjust accordingly if you have trouble. Also, it may help in some cases to reverse the polarity of the electrodes.

| Problem | Solution |
|---|---|
| signal is a flat line | Electrodes plugged in? |
| signal doesn't look like EKG | Electrodes plugged in?<br>Subject sitting still? |
| too few dots, or missed R-waves (no dots), times too long | Turn gain up. |
| too many dots or times too short | Turn gain down. |

Check blink signal. When relaxed, channels 6 and 7 should generally read less than 30 a/d units.

Re-enter the subject chamber.

"Now I would like to present a couple of the noises that you will hear during the experiment, so that you will know what to expect and so that I can make sure that the equipment is working okay. To do this, I need to put the headphones on you."

Put the headphones on the subject. Have the subject adjust them to make sure that they are comfortable.

"I'm going to go into the next room to present the noises. While I'm gone, please just sit quietly and relax, and look straight ahead."

Present two startles by pressing L-shift to make sure that you are getting good blink reflexes (.75 to 1.5 inches high) on each channel (channels 6 and 7, yellow and white). Wait for DELAY=1 to press L-shift for 2nd startle.

NOW re-enter the subject chamber and plug Skin Conductance electrodes into outer jacks on white cable.

Check for variability on channel 4 (light blue). If none, have the subject take a deep breath, which will usually produce a response.

E. Have the subject choose scripts

Present the gender-specific list of script texts to the subject.

"In this experiment we are interested in your physiological responses while you are imagining and viewing different situations. These situations will differ in their emotional content."

"I would like you to read over the short descriptions on this page. Then I would like you to tell me which three situations make you feel most sad or depressed. That is, which three of these situations give you the strongest and most vivid image of feeling sad or depressed."

[allow subject to make choices and record on subject record sheet.]

"Good, now [turn page] I would like you to read this new set of descriptions, and tell me which three make you feel most pleasantly relaxed. That is, do the same thing for this group of situations as you did for the last, but look for situations that make you feel most pleasantly relaxed."

[allow subject to make choices and record on subject record sheet.]

"Okay, from this next group of situations [turn page] please tell me which three make you feel most fearful or anxious."

[allow subject to make choices and record on subject record sheet.]

"Fine, now [turn page] I'd like you to select the three situations that make you feel most happy and excited. That is, which three of these situations give you the strongest and most vivid image of feeling happy and excited."

[allow subject to make choices and record on subject record sheet.]

"Okay, from this last group of situations [turn page] lease tell me which three make you feel most angry."

[allow subject to make choices and record on subject record sheet.]

"Good."

F. Entering the script selections

"I would like to take a moment to enter your script selections in the next room. Please sit quietly and relax."

Press R-shift

Enter Password

Enter the script selections followed by <ENTER>

RETURN TO CHAMBER TO GIVE FINAL INSTRUCTIONS.

G. Final Instructions for Phase I

1. In Subject Chamber

"During this part of the experiment, you will be asked to imagine the situations that you picked out earlier. Each of the situations has been recorded for you to hear, and you will imagine each situation more than once."

"To begin the procedure, the lights will be dimmed like this (DIM LIGHTS), and I will be in the next room. When I leave, please just sit quietly, relax, and wait for the reading of the first script."

"Listen carefully as each script is read, and form an image of the scene as it is described. When the description ends, continue imagining the scene as vividly as you can, starting from the beginning of the script. By a vivid image, we mean that we would like you to imagine the situation just as if it were really happening to you at this moment."

After a short time, you will hear a soft tone. When you hear this tone, you should stop imagining the situation and focus on relaxing your muscles. If you need to adjust your position, a good time to do this is just after the tone.

At various times during this procedure, you will hear the loud noises like I played for you before. Try to ignore the noises, and, instead focus on the imagery task.

"During the experiment, please sit up in the chair, and do not shut your eyes for any extended period of time. Normal blinking is fine, but please do not shut your eyes for much longer than that at any time during the experiment."

"Please face the front of the room (motion to front wall), and look forward as well. Try not to focus on any particular object in the room, but, instead, focus your attention on the imagery task."

"During the experiment, this door will be closed. If you need to talk to me, just speak up. I can hear you over the intercom and see you through the camera."

Shut the door.

2. In the Control Room

Speak briefly with the subject over the intercom.

[Press button to talk to the subject. Release the button to hear the reply.]

"subject's first name" (Listen for reply)

"Can you hear me okay?" (Listen for reply)

"The experiment will begin in just a few minutes. Before we begin, I'd like to give you a few reminders about the procedure. First, form an image of each scene as it is described. Continue to imagine the scene after the description, until you hear the tone. After the tone, simply relax and wait for the next description."

"Any questions?"

If a question is asked, return to the subject chamber to discuss the issue with the subject.

Check the subject's posture on the TV monitor.

[If the subject has reclined the chair or put the foot rest up, reenter the subject chamber and explain that to keep the experiment as similar as possible from subject to subject, and because it is so easy to fall asleep in that chair, we ask that everyone have the chair all the way up, though resting the head against the back of the chair is just fine. Make light of it!]

H. Running Phase I

Type RIGHT SHIFT key to begin the imagery procedure.

Trials 1-45

1. Monitor physiological displays for problems

2. Make any adjustments during the Variable Intertrial Interval (see message line on screen). If an adjustment is necessary and it cannot be made in a few seconds...

   a. Type ALT-W (for wait) during the Variable ITI to stop the program to make the adjustment:

      Heart rate. Adjustment is done with the GAIN X 1000 knob. See chart, above. If movement artifact is excessive, ask the subject over the intercom not to move around so much.

Blink. Generally, blink will not need to be adjusted. Habituation is normal for this channel. If baseline is too high (e.g., greater than 50) the subject may be squinting. Ask the subject over the intercom to please relax their eyes.

b. Type ALT-N (for next) to resume. If you spoke to the subject, wait until physiological measures have returned to baseline.

3. Visually monitor the subject.

Look for excessive movement, eyes closed, etc. (anything that might affect the experiment). If necessary, use the intercom to communicate with the subject.

Breaks

Note: Breaks are 3 minutes long; a soft tone will signal the end of breaks.

After trial 15 and 30 have completed, the message line on the screen will read "Break". When this occurs...

1. Open the door to the subject chamber and turn on the lights.

"We are now going to take a short break, so that you can relax and stretch for a few minutes."

2. Talk to the subject.

a. Ask the subject how things are going, and if he is having any problems.

b. Ask if the subject has been able to concentrate on the imagery.

c. Ask him if he has been able to ignore the noises.

d. Ask if he has been able to keep his eyes open.

[Although these are questions, the main purpose is to remind subjects of the instructions.]

e. Make small talk (how's your psych class, who's the instructor, what else are you taking, etc.) until about four minutes have elapsed. Be friendly and informal.

3. Exercises.

"In order to help you maintain your alertness throughout the experiment, I would like you to do a few brief exercises. You can do these while remaining in the chair."

a. Arm circles.

"First, I would like you to do 10 forward arm circles. (DEMONSTRATE) Please do those now. (Wait for subject to complete the exercise.) Fine."

b. Leg raises.

"I'd now like you to place your feet flat on the floor, like this (DEMONSTRATE). Now, I would like you to 10 vigorous leg raises with you left leg (DEMONSTRATE). Now, please do 10 more with your right leg."

c. Arm circles (second set).

"Finally, I'd like you to do another set of 10 forward arm circles. (Wait for subject to complete the exercise.) Great. Thanks."

4. Reminders.

"Before I leave, just a few reminders: Form an image of each scene as it is read. When the description ends, continue imagining the scene as vividly as possible. When the tone sounds, stop imagining, relax, and wait for the next description."

Remember to imagine the situations with your eyes open. Face the front of the room, and try not to focus your attention on any particular object; instead focus on imagining the situations.

"Any questions?"

5. Exit.

<u>Dim lights</u> and exit, closing the door behind you.

6. Check the heart rate as in the first part.

7. Type either SHIFT key to resume the experiment.

II. End of Phase I after trial 45

A. Re-enter the chamber and give break

1. Talk to subject briefly.

2. Exercises (as in 3 above).

B. Prepare chamber for Phase II

Sony TV ON

C. Give instructions for Phase II

"During this second part of the experiment, you will be asked to do a new task. You will be asked to sit comfortably, relax, and view pictures presented on the TV screen. Some pictures will be pleasant, some will be unpleasant, and some will be neutral - neither pleasant nor unpleasant."

"It is important that you view each picture for the entire time that it is presented. Again, you will occasionally hear noises which you should try to ignore, and instead focus on the pictures."

"Again, during this part of the experiment, please sit up in the chair, and do not shut your eyes for any extended period of time. Normal blinking is fine, but please do not shut your eyes for much longer than that at any time during the experiment."

"Also, continue to face the front of the room . When no picture is visible, just relax and look in the direction of the video monitor so you can view the next picture as soon as it comes on."

Shut the door.

D. Running Phase (Trials 46-105)

Press either shift to continue

1. Monitor physiological displays for problems

2. Make any adjustments during the Variable Intertrial Interval (see message line on screen). If an adjustment is necessary and it cannot be made in a few seconds...

   a. Type ALT-W (for wait) during the Variable ITI to stop the program to make the adjustment:

      Heart rate. Adjustment is done with the GAIN X 1000 knob. See chart, above. If movement artifact is excessive, ask the subject over the intercom not to move around so much.

Blink. Generally, blink will not need to be adjusted. Habituation is normal for this channel. If baseline is too high (e.g., greater than 50) the subject may be squinting. Ask the subject over the intercom to please relax their eyes.

b. Type ALT-N (for next) to resume. If you spoke to the subject, wait until physiological measures have returned to baseline.

3. Visually monitor the subject.

Look for excessive movement, eyes closed, etc. (anything that might affect the experiment). If necessary, use the intercom to communicate with the subject.

4. View trial 46 picture to ensure still screen.

ABC switch C (PCVCR)

Return to: ABC switch A (Panasonic)

E. Breaks

Note: Breaks are 3 minutes long; a soft tone will signal the end of breaks.

After trial 75 has completed, the message line on the screen will read "Break". When this occurs...

1. Open the door to the subject chamber and turn on the lights.

"We are now going to take a short break, so that you can relax and stretch for a few minutes."

2. Talk to the subject.

a. Ask the subject how things are going, and if he is having any problems.

b. Ask if the subject has been able to continuously view the pictures.

c. Ask him if he has been able to ignore the noises.

d. Ask if he has been able to keep his eyes open.

[Although these are questions, the main purpose is to remind subjects of the instructions.]

3. Exercises.

"In order to help you maintain your alertness throughout the experiment, I would like you to do a few brief exercises. You can do these while remaining in the chair."

a. Arm circles.

"First, I would like you to do 10 forward arm circles. (DEMONSTRATE) Please do those now. (Wait for subject to complete the exercise.) Fine."

b. Leg raises.

"I'd now like you to place your feet flat on the floor, like this (DEMONSTRATE). Now, I would like you to 10 vigorous leg raises with you left leg (DEMONSTRATE). Now, please do 10 more with your right leg."

c. Arm circles (second set).

"Finally, I'd like you to do another set of 10 forward arm circles. (Wait for subject to complete the exercise.) Great. Thanks."

4. Reminders.

"To just remind you about the procedure, remember that it is important that you view each picture for the entire time that it is presented, eventhough some may be difficult to look at."

"Again, you will occasionally hear noises which you should try to ignore, and instead focus on the pictures."

"During this part of the experiment, please sit up in the chair, and do not shut your eyes for any extended period of time."

"Please face the front of the room (motion to front wall), and look forward as well. When the picture is no longer visible, try not to focus on any particular object in the room, but, instead, just relax and wait for the next picture to appear."

F. After trial 105, the program will exit

G. Detach eyeblink electrodes

Gently, detach the eyeblink electrodes. After electrodes are detached, wipe first with a wet tissue and then dry with a second tissue.

H. Have subjects complete the Per-Mag and FSS

"Now I'd like you to fill out a couple of questionnaires."

Show them the PRI-1, FSS, and PRI-2.

"These questionnaires ask you about certain attitudes, experiences, and fears that many people have. Please answer each questionnaire on the computer answer sheet marked with the questionnaire's name, shown here at the top." [point]

"Try not to think too long about any single question. Generally, your first answer is the one we want. If you have any questions while you are answering these forms, just let me know."

"I am going to leave the room while you complete the questionnaire. When you finish, or if you have any questions, just speak up."

If subjects are concerned about their scores on the Per-Mag scales and their selection for the study, informed them that subjects are selected for all possible scores, and that you are blind to individual scores.

IV. Wrap-up

1. Detach remaining electrodes (as above) and debrief subject:

"We're recording three things with the sensors: heart rate from EKG, eyeblink startle response, and sweat gland activity from skin conductance (sometimes called GSR or galvanic skin response)."

We're interested in whether the startle responses during the image period change as a result of the different emotions induced.

We "manipulate" the emotions by using descriptions and picture of situations and objects that other people have rated in different ways.

Talk a little about the rationale, animal conditioning work, expected findings from this study.

a. Startle is natural reflex involving few synapses.

b. Early startle studies included animal conditioning paradigms with rats. Startle has been shown to be potentiated by fear in these animals. These responses were enhanced when animals were presented with a cue (e.g., light) that had previously been paired with shock.

c. we expect: larger startles during negative compared to positive emotions.

Ask the subject if they have any questions.

2. Explain briefly a required short second session for rating scripts, pictures, and completing an additional questionnaire. SCHEDULE THE SECOND SESSION.

3. Give the subject 1 credit slip per half-hour of participation, or portion thereof (e.g., 1 hour and 40 minutes = 4 credit slips).

4. Thank the subject for participating.

5. Ask the subject not to discuss the experiment with other people in his/her class.

6. Take down "SESSION IN PROGRESS" sign on door.

V. Finish.

A. Clean electrodes.

Clean electrodes with water from the wash bottle labelled "Distilled $H_2O$". Do not touch the contact area of the electrode with your finger or anything else. Let the water do the work.

B. File materials.

1. Make sure that the subject number is on all materials.
2. File the materials.
3. Add subject name to appropriate subject list.

CONSENT FORM

You are being asked to participate in a study of physiological responses to auditory and visual stimuli. You will be imagining situations and viewing pictures which people describe as making them feel different pleasant and unpleasant emotions. You will also hear some brief noises.

1. The following procedures are used in the study:

   a. Sensors will be attached to your lower chest, face, and hand in order to record your physiological reactions. These sensors will not harm you or cause pain.

   b. You will be wearing headphones for approximately 1 hour while the stimuli are presented. During this time, you may communicate with the experimenter if necessary over an intercom.

   c. You will be asked to complete some brief questionnaires concerning your attitudes, experiences, and reactions to some common objects and events.

   d. You will return for a second session to rate the imagery and visual materials used in today's session, and to complete one additional questionnaire. This second session will last approximately 1 1/2 hours.

2. The procedures that we use in this study are not expected to cause any harm or discomfort.

3. If you have any questions about the procedures, we will be glad to answer them for you. If you have a question later, you may contact Dr. Cook at 934-3850.

4. You may withdraw from the study at any time and will receive credit for time that you have spent.

5. All of the information that we obtain from you in this study will be kept confidential from anyone not directly involved in the study.

6. You do not give up any legal rights by agreeing to participate in this study.

7. Your signature below indicates that you have read the above information.

_____ _____

SIGNATURE OF SUBJECT TODAY'S DATE

_____ _____

PLEASE PRINT YOUR NAME BIRTHDATE

_____ _____

SIGNATURE OF WITNESS DATE

# Appendix D

## Recall Session Protocol

# VSPHD Recall Session Protocol

## I. Setup

Gender-specific slide tray in projector (on blank slot 1). Check focus.

## II. When subjects arrive

Give each subject a subject-specific rating booklet.

Rating booklet contents:
Picture rating forms - 4 pages
Selected scripts - 15 pages

Make sure that each subject has a pencil or pen.

## III. Instructions to subjects (in " "s).

### A. Intro

"Thank you for coming today. We appreciate very much your participation in the second part of this experiment. This session will involve rating the situations and pictures that you imagined and viewed in the first part of the experiment. Finally, at the end of this session, you will complete one additional questionnaire."

"Each of you should have a rating booklet. The first 4 pages will be used for rating the pictures. Make sure that you have 4 pages (numbered 1-60 across the sheets) with 'Picture Ratings' at the top."

[Give subjects missing sheets as needed.]

"Now go ahead and make sure that your name or a 4-digit code is at the top or bottom of each page of the booklet."

[Pause until all subjects are finished.]

### B. Picture ratings

"Now I'll explain your involvement in more detail. Beneath your name on each of these pages, you will notice two numbered dimensions (from 0 to 10). You will rate each picture along the two numbered dimensions."

The first dimension is how unhappy vs. happy you felt while viewing the picture:

Answer "0" at the "unhappy" end of this scale if you felt COMPLETELY and ABSOLUTELY unhappy, annoyed, unsatisfied, melancholic, despairing, or bored--that is, 100% unhappy without any happy feelings.

Answer "10" at the "happy" end of this scale if you felt COMPLETELY and ABSOLUTELY happy, pleased, satisfied, contented, or hopeful in the situation--in other words, 100% happy without any unhappy feelings.

Use the ratings 1 through 9 for intermediate feelings, neither completely unhappy nor completely happy.

The second dimension we would like you to rate is how unaroused vs. aroused you felt while viewing the picture:

Answer "0" at the "unaroused" end of this scale if you felt COMPLETELY and ABSOLUTELY relaxed, calm, sluggish, dull, sleepy, or unaroused--that is, 100% calm without any feelings of excitement.

Answer "10" at the "aroused" end of the scale if you felt COMPLETELY and ABSOLUTELY stimulated, excited, frenzied, jittery, wide-awake, or aroused--in other words, 100% aroused without any calm feelings.

Again, use the ratings 1 through 9 for intermediate feelings, neither completely aroused nor completely unaroused.

For about the next 20 minutes, you will be looking at different slides projected on the screen. We would like you to rate each slide on the two dimensions by writing in the numbers corresponding to your ratings on the line for that particular slide.

Be sure to write in the numbers for your ratings separately for each slide.

"Some of the slides may prompt emotional experiences; others may seem relatively neutral. Your rating of each slide should reflect your immediate personal experience, and no more. Please rate each one AS YOU ACTUALLY FELT WHILE YOU WATCHED THE SLIDE."

There are no right or wrong answers in doing this. We want your honest and accurate reaction to the pictures.

"Our procedure is as follows: BEFORE each of the slides which you will rate, I will say 'Get ready.' This should prompt you to quickly complete the previous rating if you have not done so and look up at the screen."

It is important that your eyes be directed towards the screen when the pictures to be rated are shown. You have only a few seconds to watch each slide. Please view the slide for the ENTIRE time it is on and write down your ratings immediately AFTER the slide is removed. If, for some reason, you should MISS viewing any slide, please write the word "MISSED" on the line corresponding to that slide and continue on the next pair for the next slide.

AFTER each slide, there will be nothing on the screen. Take this time to record your ratings in the booklet, as I've already said. It is very important NOT to dwell on your ratings of the slides, since there will not be much time.

We are interested in your own PERSONAL ratings of the slides. Therefore, please don't make any comments during the slides which might influence other people's ratings. I'm sure that you can understand how this might bias our results.

Are there any questions before we begin?

[Look around. Answer any questions].

[Then, turn down the lights, and turn on the projector lamp to bring up a blank screen. Make sure lamp is on HIGH.]

"Reminders":

"View the picture slide for the entire time it is on the screen."

"After the slide goes off, make your ratings on BOTH dimensions as quickly as possible and get ready for the next picture."

"It is important that we have information from <u>each</u> of you on <u>all</u> of these slides. Try not to miss any slides. There are no right or wrong answers. BE SURE TO RATE EVERY SLIDE ON BOTH DIMENSIONS."

"Are there any questions before we continue?"

Begin:

To begin, say "Get ready."

As the slide comes on, say "View the slide."

As the slide goes off, say "Now rate the slide number [1-60] as quickly as possible."

After a few slides, abbreviate commands, ultimately to "Ready", "View", and "Rate on #."

C. Running slides

When the last slide in the tray goes off, switch projector to FAN.

"We'll have a short break here. Are there any questions."

Replace tray1 (slides 1-30) with tray2 (slides 31-60). Position at slot 1.

"We'll continue in a moment. Make sure that you are on picture rating page 3."

Good. Thank you.

D. Script rating

"Now we will prepare to rate the scripts that you imagined earlier. Turn to the page 5 of your rating booklet where you will notice the same two numbered dimensions at the top of the page and beneath them a 2-3 sentence script."

"You will again use the two numbered dimensions to rate each script."

"Make your ratings separately on each page by circling the number that describes how you would feel in the situation at this moment."

As a reminder,

"The first dimension is how unhappy vs. happy you would feel if you were in the situation described:

Circle "0" at the "unhappy" end of this scale if you would feel COMPLETELY and ABSOLUTELY unhappy or unsatisfied--that is, 100% unhappy without any happy feelings.

Circle "10" at the "happy" end of this scale if you would feel COMPLETELY and ABSOLUTELY happy or satisfied in the situation--in other words, 100% happy without any unhappy feelings.

Use the ratings 1 through 9 for intermediate feelings, neither completely unhappy nor completely happy.

Again, the second dimension is how unaroused vs. aroused you would feel if you were in the situation described:

Circle "0" at the "unaroused" end of the scale if you would feel COMPLETELY and ABSOLUTELY relaxed or unaroused--that is, 100% calm without any feelings of excitement.

Circle "10" at the "aroused" end of the scale if you would feel COMPLETELY and ABSOLUTELY stimulated or aroused--in other words, 100% aroused without any calm feelings.

Again, use the ratings 1 through 9 for intermediate feelings, neither completely aroused nor completely unaroused.

Go ahead now and read each of the 15 scripts silently, and make your ratings.

Be sure you have rated each script on both dimensions. Please be quiet and look forward when you have finished."

"Good. Thank you."

IV. Questionnaire Administration

Pass out questionnaires with inserted answer sheets.

"Now we would like you to complete this questionnaire. Be sure to read the instructions. Please let me know if you have questions."

"When you finish, take a few minutes to make sure you have answered each item on the questionnaire and have rated each script."

"Then, bring your rating booklet and questionnaire materials to the front of the room."

V. End of session

Hand out subject envelopes with credit slips or cash as you collect booklets.

GRADUATE SCHOOL
UNIVERSITY OF ALABAMA AT BIRMINGHAM
DISSERTATION APPROVAL FORM

Name of Candidate Victor E. Stevenson

Major Subject Medical Psychology

Title of Dissertation Affective Modulation of Startle in Fearful and Schizotypal College Students

Dissertation Committee:

Edwin W. Cook III, Ph.D., Chairman

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