# Influence of the Negative IAPS and Method of Hemispheric Presentation on Performance on the Affective Auditory Verbal Learning Test

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**(ABSTRACT)**

This investigation examined the effects of emotion and lateralized presentation of a list of affective words on the learning of that list. This investigation also attempted to assess the separate influences of emotion and arousal on verbal performance. Experiment I was a 2x2 factorial design: two types of pictures from the International Affective Picture System (IAPS), negative or neutral and two gender conditions, male and female. Experiment I was used to verify that the IAPS results in an emotional response. Heart rate (HR) and skin conductance level (SCL) were measured during IAPS presentation. Emotion was assessed after IAPS presentation. Results showed the negative IAPS condition elicited significantly greater increases in SCL and decreases in HR, less self-reported of pleasantness and more self-reported activation than the neutral IAPS condition. Women had significantly lower SCL and higher HR than men; men and women did not differ in reported emotion. Experiment I verified that the negative IAPS elicit changes in SCL and negative emotion in men and women. Experiment II was a 2 x 2 x 2 mixed factorial design: two types of IAPS (negative or neutral), two AAVL conditions (positive and neutral AAVL words or negative and neutral AAVL words) and two presentation conditions (AAVL presented to the left ear (LE) or right ear (RE)). The measure of performance on the AAVL was the number of correct responses. HR and SCL were measured during presentation of the IAPS and of the AAVL. In the negative IAPS condition, performance on negative AAVL was significantly better than that for the positive AAVL; for presentation of the AAVL to the RE, performance on the negative AAVL was significantly better than that for the positive and neutral AAVLs. IAPS condition or ear of presentation alone did not significantly impact on AVVL performance or on SCL and HR during the recitation of the AAVL. Evidence showed that the effect of emotion on performance is a function of mood congruent processing and possibly the allocation of hemispheric resources.

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# Influence of the Negative IAPS and Method of Hemispheric Presentation on Performance on the Affective Auditory Verbal Learning Test

**General Introduction:**

In the emotion literature the terms affect, emotion and mood are often used interchangeably (Bower & Forgas, 2000). However, a distinction can be drawn among these three terms. Affect is a general term that can be used to refer to emotions and moods. Emotion, on the other hand, refers to a reaction to a specific stimulus. Typically, an emotion has an identifiable cause, is an intense response and lasts a short period of time. Mood refers to a more subtle response, is long lasting and is less intense than an emotion. According to Bower and Forgas, moods tend to be non-specific whereas, emotions are usually specific and linked to a clear antecedent condition.

The term emotion will be used herein to refer to an intense reaction to a stimulus. An emotion is a quick, organized response and involves complex patterns across different systems such as the autonomic and central nervous system (Davidson, 1984). An emotional response has three components: the perception of the stimulus event that is labeled with an emotion (e.g., happy), the expression of the emotion (e.g., change in skin conductance) and the feeling, assessed with self-report, associated with the emotive label (e.g., "I feel happy") (Heilman, Bowers & Valenstein, 1993).

**The Structure of Affective Space:**

Research has suggested that there are two independent dimensions that underlie emotion, valence and activation (e.g., Thayer & Miller, 1988). Valence refers to the degree of pleasantness associated with the emotion. Activation refers to the level of arousal associated with the emotion. Valence and activation are two separate characteristics of emotion, and as such, are thought of as orthogonal.

The circumplex model of emotion represents emotion in terms of a two-dimensional bipolar space (Appendix E; Russell, 1980, 1997; Heller, 1990, 1993). The relationship among categories of emotion is depicted as a circle that is composed of four quadrants: pleasantness-activation, pleasantness-deactivation, unpleasantness-activation, and unpleasantness-deactivation. The affective space in this model has valence (degree of pleasantness) on a horizontal axis and degree of activation (degree of arousal) on the vertical axis. For example, elation and happiness are both associated with a high degree of pleasantness but elation is characterized by greater activation than is happiness. Similarly, anger and unhappy are both associated with a high degree of unpleasantness but anger is characterized by greater activation than unhappy is.

To test the circumplex model of emotion, Russell (1980) had participants place 28 emotional words into categories based on the similarity of the words in terms of degree of pleasantness and activation. Results showed that a two dimensional bipolar space with the two dimensions, degree of pleasantness and degree of activation, could define the 28 terms. Emotions that were opposite to each other fell approximately 180 degrees apart (e.g., miserable versus pleased). The zero degree point in the circumplex model was defined by emotions that were characterized by moderate activation and high pleasantness (e.g., happy)

Watson and Tellegen (1985) proposed a two-factor structure to define affective space. Watson and Tellegen defined emotion as an aroused or engaged state. The two factors of their model are positive affect and negative affect. Positive affect is defined as “the extent to which a person avows a zest for life” (Watson & Tellegen, 1985). Negative affect is defined as the extent to which a person reports feeling upset or “unpleasantly aroused” (Watson & Tellegen, 1985). In this two-factor model, terms in the same part of the model are highly positively correlated; words that are 90 degrees apart are unrelated to each other.

Zevon and Tellegen (1982) tested their two-factor structure of affective space. Men and women completed a 60-item mood checklist everyday for 90 days. Item response variability was assessed for each participant to investigate the presence of the positive and negative affective dimensions in his/her's response matrix. A two-factor structure of affect was identified within and across participants and accounted for 50-75% of the common variance in the participant's emotional responses.

The two-factor model of emotion is a consistent and robust finding in the literature (for review, see Watson and Tellegen, 1985). To further test their model, Watson and Tellegen reviewed a series of studies that assessed self-reported emotion. From these studies correlation matrices were obtained and subjected to factor analysis. Again, two main factors emerged, positive and negative affect, which accounted for 50-75% of the common variance. There was a high degree of convergence among the different studies on what was construed as positive and negative affect. The convergent coefficients for emotions that were classified as positive affect were greater than .90; convergent coefficients for emotions that were classified as negative affect were greater than .80. These data provide evidence for a two-factor model of emotion.

On the basis of their research with the two-factor model, Watson, Clark and Tellegen (1988) devised the Positive and Negative Affect Schedule (PANAS) as a measure of positive and negative affect. An underlying assumption of this scale is that positive and negative emotions are independent of each other (Barrett & Russell, 1998). The scales in the PANAS do not consider level of activation. However, Barrett and Russell argue that any test of bipolarity between negative and positive emotion must select terms that are bipolar opposites, that represent a full range of unpleasant and pleasant emotions and that take activation into account. If emotions are opposite to each other then they should be opposite both in terms of valence and in terms of activation. Barrett and Russell substantiated that argument with an evaluation of the PANAS in terms of valence and activation.

Barrett and Russell (1998) examined how well Watson et al.'s (1988) PANAS measure of emotion fit a two-dimensional bipolar model of emotion. The negative affect scale of the PANAS was equated to the unpleasant-activation part of the circumplex model; the positive affect scale of the PANAS was equated to the pleasant-activation part of the circumplex model. Since the PANAS included no measures for pleasant-deactivation and unpleasant-activation, Barrett and Russell constructed these measures. Barrett and Russell reported negative correlations that ranged from .32 - .68 between words on the positive affect scale and those on the unpleasant-activation scale; they reported negative correlations that ranged from .50 - .76 between words on the negative affect scale and those on the pleasant-activation scale. These authors suggested that the two principle axes of emotion, activation and valence, are independent of each other. When valence or degree of activation is studied alone, results yield only two valence or two activation dimensions.

Barrett and Russell (1998) also examined the correlations between positive and negative emotion holding activation constant. As predicted from the circumplex model, there was a negative correlation between pleasant and unpleasant emotions ($r$ = -.92) and between activation and deactivation ($r$ = -.84). However, when the entire affective space was considered four factors, namely, unpleasant-activation, unpleasant-deactivation, pleasant-activation, pleasant-deactivation, emerged. The four factors accounted for 87% of the variance in valence and 82% of the variance in activation.

Larsen and Cutler (1996) demonstrated a pattern of results similar to those of Barrett and Russell (1998). Participants completed a mood report twice a day for two months. The mood report consisted of emotions that represented all four quadrants of the circumplex model. When a two-factor structure, such as that of Watson & Tellegen (1985), was used it only accounted for 31-60% of the variance in the participants' scores. More than two factors were needed to account for 50% of the common variance for each participant.

In view of these data it should be noted that Watson and Tellegen (1985) did not imply that all emotional responses could be explained by a two-factor structure. A two-factor structure was meant to be complementary to other multidimensional models such as the circumplex model of emotion. The model of Watson et al. (1988) examines two very specific factors, positive affect and negative affect, and holds activation constant. The result is that the PANAS only provides an index of unpleasant-activation versus pleasant–activation. Such a model neglects emotions that are characterized by low activation. Thus, the Watson et al. scales are not equivalent to positive emotion or negative emotion, as Russell (Barrett & Russell, 1998) proposes in the circumplex model. According to the circumplex model, for example, positive emotion (high or low activation) occupies the entire right side of the model. However, since the positive emotion of Watson et al. is characterized by high activation it is rotated 45 degrees upward from the horizontal axis. It is possible that by ignoring the other two dimensions of emotion, unpleasant-low activation and pleasant– low activation, a clear and comprehensive picture of affective space may not be ascertained. The emotional responses of individuals can be very complex; a two-factor structure may be insufficient to accurately depict the complexity of affective responding. The circumplex model takes into consideration all aspects of affective space and can account for 82-87 % of the variance in an individual's emotional response (Barrett & Russell, 1998).

**The Elicitation of Emotion**

Central Theories:

There are two basic approaches that attempt to explain the elicitation of emotion, the cognitive approach and the central theories approach. Cognitive theories of emotion, such as those of Lazarus (e.g., 1984,1991) and Weiner (e.g., 1974, 1986) investigate the contribution of cognitive appraisal and attributions to the elicitation of emotion. Weiner (1986) proposed an attributional theory of emotion. He integrated the idea of perceived causality and attributions into an understanding of the elicitation of emotional responses. Attributions are the perceived causes of an event. It is these perceived causes that lead to an emotional response. According to Lazarus, (1988), appraisal directly results in an emotion. Appraisals are constructed by an individual's interpretation of facts and events (Clore & Ortony, 2000). According to Lazarus, it is these different interpretations of facts and events, which result in different emotions. Cognitive theories are not relevant to this investigation and will not be discussed any further in this paper.

Central theories of emotion focus on the contribution of cortical and subcortical structures to the elicitation of emotion. Cannon (1927) proposed one of the first central theories of emotion. According to Cannon, stimuli enter the brain via the thalamus and activate the hypothalamus. The hypothalamus controls the endocrine and the autonomic nervous system. Cannon proposed that thalamic-induced changes in the nervous system (e.g. in the autonomic nervous system) were adaptive and aided in the survival of the individuals. Cannon placed minimal emphasis on the role of the cortex in the interpretation of stimuli.

Bard (1934) proposed a role for the cortex in emotional responding. Bard examined the effects of provocation on the emotional responses of cats who had either their cortex or cerebral hemisphere removed. When the cortex was removed, the threshold for eliciting emotion was lowered; decorticate cats responded to mild provocation with aggression. When the entire cerebral hemisphere was removed, including the hypothalamus, the exaggerated emotional response was absent. From this research, Bard concluded that the both the hypothalamus and the cortex were critical for emotion.

In 1927 the notions of Cannon and Bard were incorporated into the Cannon-Bard Theory of Emotion (Cannon, 1927). Bard conducted much of the research upon which the theory was based (Strongman, 1978). The Cannon-Bard theory of emotion postulated that the elicitation and the expression of emotion were parallel to each other but had no causal link to each other. According to the Cannon-Bard theory, emotional stimuli have two separate effects. Emotional stimuli activate the cortex to elicit an emotional response and also elicit generalized sympathetic arousal that prepares the organism for action as in fight or flight. More specifically, environmental stimuli stimulate the cortex, the cortex stimulates the thalamus and thalamic activity leads to an emotional expression. Further, the thalamus relays the information back to the cortex and the cortex stimulates the muscles and viscera.

From another viewpoint Papez (1937) proposed that the experience and expression of emotion are possibly separate phenomena. Like Cannon (1927) and Bard (1934), Papez emphasized the importance of subcortical structures and believed that the hypothalamus was central to emotion. He proposed that the experience of an emotion requires cortical influence but the expression of an emotion depends on the hypothalamus. Papez traced specific pathways between the cortex and the hypothalamus (Heilman, Bowers & Valenstein, 1993; Strongman, 1978). The pathway was composed of fibers that connected the cingulate gyrus, the hippocampus, the fornix, mamillary bodies, and the anterior thalamus. The fibers from the cingulate provided a way by which cortically mediated information could reach the hypothalamus (Bauer, Tobias, & Valenstein, 1993). Cortical input into the hypothalamus originated from the cingulate via the cingulum. Papez believed that the cortex played no role in the production of emotion, but was necessary for transforming the events formed by the limbic circuit into an emotional response. For Papez, an emotional response was centralized in the limbic system.

The James-Lange theory of emotion (James, 1884; Lange, 1885) was one of the first theories of emotion that stressed the importance of the peripheral nervous system. The James-Lange Theory of Emotion proposed that sensory stimuli are received and are interpreted by the cortex. The cortex then triggers changes in the autonomic and somatic nervous system that, in turn, lead to an emotion. The James-Lange theory was based on the premise that different emotional stimuli elicit different patterns of autonomic nervous system activity. If there is no alteration of the autonomic nervous system, there is no emotion. It is the feedback from the peripheral nervous system that causes the felt emotion.

Research conducted in the early 1900's disregarded the cortex as having an important role in emotion; major emphasis was placed on the limbic system, specifically the thalamus and the hypothalamus. This view was prominent until Roger Sperry's research on commisurotomy patients (Heller, Nitschke, & Miller, 1998). The cerebral commisures are the nerves that connect the right and left cerebral hemisphere. A commisurotomy is a procedure in which the connections between the hemispheres are surgically severed. When the cerebral commisures are surgically severed information can no longer transferred between the cerebral hemispheres. Sperry examined the separate role of the right and left hemisphere on performance in commisurotomy patients. For example, Sperry (1974) showed a commisurotomy patient the word 'pencil' in his left visual field and asked the patient to name what he saw; the patient would reply that he saw nothing. Since the connections between the right and left hemisphere were severed there was no way for the information to reach to the left hemisphere. The right hemisphere that processed the word, 'pencil,' is mute. When the patient was then asked to use his left hand to find the object that matched the word; the patient correctly identified the object. Since the right hemisphere primarily controls the movement of the left hand the patient could pick up the object. Sperry's research, as in the previous case study described, stimulated research on hemispheric lateralization and a renewed emphasis was put on the role of the cortex in emotion (Heller et al., 1998)

Research suggests that emotion is lateralized in the brain. Hemispheric preference refers to the idea that specific types of information (e.g., emotional information) are more likely to be processed in one part of the brain than in another part. According to Ley and Bryden (1979, 1982) emotion is primarily processed in the right hemisphere. Ley and Bryden and others came to this conclusion through a series of studies that used visual tasks and dichotic listening tasks. Visual information can be presented to each visual field with a tachistoscope. In visual field tasks that use a tachistoscope, participants are told to fixate on a center point and the visual information is presented in one visual field for a brief period of time. Information presented to the left visual field is preferentially processed in the right hemisphere; information presented to the right visual field is preferentially processed in the left hemisphere. In a visual field task, better recognition of information at the right or left visual field indicates differential cortical processing, in left and right hemisphere, respectively.

For example, Ley and Bryden (1979) presented positive, negative and neutral cartoons to the participant's left or right visual field. Participants identified a greater number of emotionally valenced cartoons when the cartoons were presented to the left visual field than they did when cartoons were presented to the right visual field. These data suggest that the right hemisphere primarily processes emotional information.

Dichotic listening is another technique used to assess hemispheric preference. In dichotic listening tasks, participants are simultaneously presented stimuli to the right and left ear. In anatomical terms, the auditory information moves from the cochlea in the inner ear to the cochlear nucleus, then to the inferior colliculus and the medial geniculate and then to the superior temporal lobe. The fibers from the cochlea to the superior temporal lobe run contralaterally and ipsilaterally; the contralateral fibers are predominant over the ipsilateral fibers (Hugdahl, 1995). According to Hugdahl, information that is presented to the right ear is more strongly represented in the left than in the right temporal lobe; information that is presented to the left ear is more strongly represented in the right temporal lobe than in the left temporal lobe. In a dichotic listening task, better recognition of information at the right or left ear indicates differential cortical processing, in left and right hemisphere, respectively.

Ley and Bryden (1982) and Bryden and McRae (1988) used a dichotic listening task to assess the hemispheric preference for emotion. Ley and Bryden simultaneously presented sentences in either a happy, sad, neutral or angry voice to the participant's right and left ear. Participants were asked to identify the emotional tone of the sentence. Judgment of the emotional tone of the sentences was better, regardless of affective valence, for sentences presented to the left ear than to the right ear. Bryden and MacRae presented two words in two different affective tones to the right and left ear simultaneously. Participants had to signal the presence or absence of a target word and identify the word's affective tone. Participants were better at identifying the affective tone of the word when the word was presented to the left ear than to the right ear. According to the underlying assumption of cortical processing, information presented to the left ear is more strongly represented in the right hemisphere. Thus, since the affective tone of the words was identified better at the left ear than at the right ear the results suggest that the right hemisphere is better at processing emotional information than is the left hemisphere. Bulman-

Fleming and Bryden (1994) reported similar findings. Research on visual presentation of emotional pictures and dichotic presentation of emotional words suggests that there is a right hemispheric preference for the perception and recognition of emotional information regardless of the valence of the emotion.

However, in discussing cerebral asymmetries in emotion it is important to make the distinction between the processing of emotional stimuli, the outward display of an emotion (e.g., facial expression) and the occurrence of the emotion. Evidence suggests that the perception and expression of emotion are a right hemisphere phenomenon (e.g., Ley & Bryden, 1982). For example, the left side of the face, which is predominantly controlled by the right hemisphere, is more expressive of emotion than is the right side of the face (Heilman et al., 1993). In addition to facial expression, emotion can also be expressed by the intonations of a person’s voice. Individuals with right hemisphere damage demonstrate less vocal intonation and less facial expression of emotions than non-brain damaged individuals (Heilman et al., 1993). Individuals with damage to their right cerebral hemisphere have more difficulty saying sentences in an affective tone of voice as compared to individuals with left hemisphere damage. Studies of brain damaged patients suggests that the expression of emotion is also preferentially processed by the right hemisphere.

In contrast, the occurrence of an emotion may be associated with the relative activation of right and left hemisphere. Davidson (e.g., 2000) proposes that the frontal lobe of the left hemisphere and the frontal lobe of the right hemisphere are specialized for the occurrence of emotions and their associated response tendencies. More specifically, the right frontal lobe is associated with negative emotion and the tendency to avoid or withdraw from an aversive stimulus; the left frontal lobe is associated with positive emotion and the tendency to approach a positive goal.

Davidson has conducted numerous studies to examine the validity of his model. For example, Sobotka, Davidson and Senulis (1992) had participants play a video game during which they could win (reward condition) or lose money (punishment condition), depending on their performance. EEG, a measure of cortical activity, was assessed during the video game. Participants were told to press a button when they saw the reward stimulus (approach behavior) or to remove their finger from the button when they saw the punishment stimulus (avoidance behavior). Avoidance responses that often accompany negative emotion were associated with greater activation in the right frontal region than in the left frontal region. Approach responses that often accompany positive emotion were associated with greater activation in the left frontal region than in the right frontal activation. These behavioral and cortical data were consistent with the differential hemispheric processing model of emotion proposed by Davidson.

Further support for Davidson’s model also comes from research on individual differences in cerebral asymmetries. For example, depressed individuals typically have deactivation in the left frontal lobe and hyperactivation in the right frontal lobe. Depressed individuals report more negative emotions and are more likely to avoid situations than are their non-depressed counterparts (Heller, 1993). Tomarken, Davidson and Henriques (1990) examined how baseline asymmetries in cortical activity influenced reports of positive and negative emotion. Baseline asymmetry is the level of cerebral activation in one area of the brain relative to that in another area of the brain. Typically relative activation is a comparison of activation between the right hemisphere and the left hemisphere. Tomarken et al. (1990) measured cortical activity of participants while they viewed film clips that varied in neutral, negative or positive affective valence. In general, participants who showed greater right frontal baseline activation reported more negative affect on the PANAS (Watson et al., 1988) than did participants who showed greater left frontal baseline activation. Participants with greater right frontal activation reported more negative emotion to the negative films than did participants with greater left frontal activation; participants with greater left frontal activation reported more positive emotion to the positive films than did participants with greater right frontal activation. Research by Davidson and his colleagues has demonstrated an association between frontal lobe activity and emotion. Individuals with relative activation of the right frontal lobe activity report negative emotion and display avoidance behaviors; individuals with relative activation of the left frontal lobe report positive emotion and display approach behaviors.

According to Russell's Circumplex Model (1980, 1997) emotion can be defined by two dimensions, pleasantness–unpleasantness and activation-deactivation. To put this model in a cortical context Heller (1990,1993) proposed that the occurrence of emotion is characterized by relative activation of the anterior and posterior brain systems. According to Heller, the anterior region of the brain is associated with the emotional valence of pleasantness and unpleasantness and the posterior temporal parietal region of the brain is associated with level of activation, that is, high to low arousal. More specifically, the right anterior region is involved in unpleasant/negative emotion and the left anterior region is involved in pleasantness/positive emotion; the right posterior region is involved with high arousal and the left posterior region is involved with low arousal. For example, anxiety is characterized as an unpleasant emotion with high arousal. As predicted by Heller's model, anxious participants showed increased right hemisphere activity and increased right posterior activity relative to controls (Heller et al., 1998).

To evaluate Heller's model, Heller, Nitschke, and Lindsay (1997) tested participants on the chimeric faces task. The chimeric faces task is a measure of hemispatial bias. Hemispatial bias is an orienting response toward the side of the space opposite the more active hemisphere. The chimeric faces task consists of pictures of faces that are vertically split, with an emotion being expressed on each side of the face. Participants are asked to report the degree of happiness expressed by each side of the face. Heller suggested that performance on the chimeric faces task was associated with tempoparietal activation. Consistent with Heller's model of emotion (1990, 1993), specifically activation, there was a significant correlation between self-reported arousal and a left hemispatial bias (right hemisphere preference) on the chimeric faces task; faces on the right were reported as happier than were faces on the left.

Heller, Etienne and Miller (1995) also examined hemispheric preference on the chimeric faces task in anxious and depressed individuals. Anxiety is characterized by high arousal and increased right parietal activation. Depression is characterized by low arousal and decreased right parietal activation. Consistent with Heller et al. (1997), there was an overall left hemispatial bias on the chimeric faces task; the left half of the chimeric face was reported as happier than the right half of the chimeric face. Furthermore, the differences in parietal activation between the depressed and anxious participants were consistent with their perception of the chimeric face. Relative to the depressed participants, anxious participants had higher activation in the right parietal area and this increased activation was associated with enhanced attention to the left side of the chimeric face. Anxious participants reported that the faces on the left were happier than those reported by the depressed participants.

The shared involvement of the frontal and posterior regions of the brain in emotion was demonstrated by Smith, Meyers, Kline and Bozman (1987). Smith et al. presented non-verbal sounds to participants and asked them how the sounds made them feel (affective condition) or what the sounds were (cognitive condition). Cortical activity was measured during presentation and evaluation of each sound. Participants in the affective condition showed more right parietal activation and right frontal activation than did the participants in the cognitive condition.

Following the same procedure as Smith et al. (1987), Meyers and Smith (1987) measured cortical activity and electrodermal activity (i.e., SCR) at the right and left hand during presentation of affective non-verbal stimuli. Electrodermal activity (i.e. skin conductance level or responses) is a measure of activation (Bradley & Lang, 2000). According to Heller (1993) the parietal area of the brain is associated with level of activation. There was greater cortical activation in the left hemisphere for the positive non-verbal stimuli than for the negative non-verbal stimuli. In addition, there was more activation in the frontal lobes during the affective condition than during the cognitive condition. Overall, the amplitude of the SCR was greater for negative stimuli than for positive stimuli. SCR at the right hand was greater during the affective condition than during the cognitive condition. The reverse was true for SCR at the left hand. The affective condition was associated with relative activation of the right hemisphere and this activation was accompanied by an increase in SCR at the right hand.

Papousek and Schulter (2001) examined the effects of emotion on hemispheric asymmetry. EEG and electrodermal activity were measured in right-handed depressed and anxious participants. Highly anxious participants had a large amount of skin conductance responses when activation was greater in the right hemisphere than in the left hemisphere, specifically the orbitofrontal region. Depressed participants had a large amount of skin conductance responses when activation was greater in the left hemisphere than in the right hemisphere, specifically in the dorsolateral region. In less depressed participants, more skin conductance responses occurred when the there was greater activation in the right hemisphere than in the left hemisphere.

Research has also shown that damage to specific areas of the brain influences electrodermal responses and self-reported arousal to emotional stimuli. For example, Tranel and Damasio (1994) demonstrated that individuals with bilateral ventromedial prefrontal damage showed less skin conductance responses (SCR) to positive and negative affective pictures than did individuals with no brain damage. Individuals with damage to the right but not to the left inferior parietal had diminished SCR to affective picture and physical stimuli than did individuals with no brain damage.

Bradley and Lang (2000) demonstrated that individuals with right amygdala ablation interpreted affective pictures differently than did individuals with no ablation. The ablation group rated the unpleasant pictures as calm, a neutral-low arousal emotion, and made no response to high arousal-unpleasant pictures. The ablation group and the no ablation group did not differ in rating the pleasantness or unpleasantness of the pictures. These findings of brain damaged individuals lend support for the involvement of the right tempoparietal region in arousal. If there is no activation in the right tempoparietal region then the high arousal dimension of emotion is not represented in the brain and influences the perception of emotional stimuli that are characterized by high arousal. Research has shown that the valence and activation dimensions of emotion are associated with relative activation of the anterior and posterior portions of brain (e.g., Heller, 1990, 1993).

## The Measurement of Emotion

### Autonomic Nervous System:

The valence and activation dimensions of emotion can be measured at the level of the autonomic nervous system. Several common measures of emotions are systolic blood pressure, diastolic blood pressure, heart rate and electrodermal activity.

One of the earliest researchers who examined physiological activity between the different emotional valences was Ax (1953). Ax's research was based on the James-Lange theory of emotion (James, 1884; Lange, 1885). The James-Lange theory of emotion proposed that different emotional stimuli have different patterns of autonomic nervous system activity.

With this premise in mind, Ax (1953) assessed changes in blood pressure, heart rate, skin conductance and muscle tension in men during the elicitation of anger and fear. In the anger condition an experimental confederate entered the room where the participant was, ostensibly to check the wiring on the physiological equipment. The experimental confederate criticized the participant for being late and accused him of shifting the equipment's wiring. In the fear condition, a mild shock of increasing intensity was given to the participant until he reported feeling the shock. Then the experimenter pressed a key that caused a spark. Ax (1953) demonstrated that diastolic blood pressure increased more and heart rate decreased more in the anger than in the fear condition. Skin conductance responses were greater in the fear condition than in the anger condition.

Ax's research provided the model for the research by Ekman and Levenson (e.g., Ekman, Levenson & Friesen, 1983; Levenson, Ekman, & Friesen, 1990) on patterns of autonomic activity that are associated with different emotions. Ekman et al. (1983) compared the patterns of heart rate, skin conductance and facial muscle activity that were associated with the emotions of happiness, sadness, anger, fear and disgust. These emotions were elicited via two methods: the Facial Action Task (FAT) and Imagery. The FAT was a step-by-step procedure in which the experimenter told the participant which facial muscles to contract; the sum of all the facial contraction equaled an emotionally specific face. The imagery task required subjects to imagine an experience that elicited a specific emotion. Results showed that the emotions of anger and fear were not differentiable by heart rate but were differentiable by skin conductance responses. Anger yielded higher skin conductance than did fear. Anger also yielded higher skin conductance than did happiness. Heart rate accelerations were greater for anger, fear and sadness than for disgust and surprise.

Levenson et al. (1990) also used the FAT and imagery tasks; participants were asked to report their emotions. Results were similar to those of Ekman's 1983 study, although the patterns of the autonomic nervous system responses did not discriminate emotions as clearly. The autonomic activity patterns were distinguished better when the facial expression of the participant matched that of a model and when the reported emotion matched the facial expression. For example when the facial expression of the participant matched the emotion, heart rate was greater for anger, fear and sadness than for disgust and surprise. Similarly, skin conductance was greater for anger than for happiness or surprise. The magnitudes of the changes in autonomic nervous system activity were less for the imagery task than for the FAT. Overall, there was a greater increase in heart rate for anger, fear and sadness than there was for surprise and happiness. Skin conductance responses were greater for fear and disgust than for happiness and surprise.

Similar patterns of autonomic activity occurred when affective films were used as the emotion elicitation technique. Palomba, Sarlo, Angrilli, Mini and Stegagno (2000) presented participants with two-minute film clips that were unpleasant (e.g., showing threat and surgery) or neutral (e.g., showing a landscape). SCL was higher for the unpleasant than for the neutral film. The threat film evoked an increase in heart rate and the surgery film evoked a decrease in heart rate. There was no significant change in cardiac activity for the neutral film. The physiological changes to the films were consistent with the reported emotion. The unpleasant film was rated higher on fear, disgust and anger than was the neutral film; the neutral film was rated as more pleasant and less arousing than was the unpleasant films.

Snyder, Harrison, and Shenal (1998) had participants complete a verbal learning task in which the lists of words were positively, negatively or neutrally valenced. Blood pressure and heart rate was measured before (baseline) and after the learning of each word list. Diastolic blood pressure increased following the presentation of the negative words relative to baseline. Diastolic blood pressure and heart rate decreased following the presentation of the positive words relative to baseline. Snyder et al. (1998) proposed that the learning of the affective material induced an emotion that, in turn, had an impact on the physiological measures.

Regardless of the elicitation technique, reliable changes in blood pressure, heart rate and electrodermal activity accompany emotion. Emotion is represented at the level of the cortex and the autonomic nervous system. Research has demonstrated that there is a consistent pattern of cortical activity (e.g., Heller, 1993) and autonomic activity (e.g., Ekman et al., 1983) that occur with emotion. It would seem reasonable to assume that there is a connection between these physiological systems.

Central Nervous System Control of Autonomic Nervous System Functioning:

Some researchers have suggested that autonomic functioning is controlled by the central nervous system. Furthermore, anatomical evidence suggests that this control may be lateralized (e.g., Hachinski, Oppenheimer, Wilson, Guiraudon, Cechetto, 1992). For example, Hachinski and colleagues demonstrated that occlusion of the right middle cerebral artery was associated with increased mean arterial pressure and norepinephrine secretion, measures primarily influenced by the sympathetic nervous system. However, occlusion of the left middle cerebral artery did not significantly affect sympathetic activity. Right hemispheric stroke had the greatest impact on sympathetic nervous system activity.

Yoon, Morillo, Cechetto, and Hachinski (1997) used the intracarotid amobarbital sodium test (WADA) and heart rate variability to examine the role of the right and left hemisphere in autonomic nervous system control. Heart rate variability converts the beat to beat changes in heart rate into different frequency bands. The high frequency band is mainly influenced by central and peripheral correlates of respiratory activities that are primarily due to the parasympathetic nervous system. The low frequency band is mainly influenced by the sympathetic nervous system. Results showed that after left hemisphere inactivation, there was a shift to sympathetic nervous system dominance as indicated by the decrease in the high frequency band. After right hemisphere inactivation there was an increase in high frequency power but it was not significant. These data suggest that the right hemisphere predominantly modulates sympathetic nervous system activity. After right hemisphere inactivation there was a slight shift to parasympathetic dominance, a finding that suggests that the left hemisphere may have a role in parasympathetic nervous system activity.

Electrodermal activity (EDA) is primarily mediated by the sympathetic nervous system. There is no general consensus in the literature about the relationship between EDA and cortical activity. Some researchers suggest that cortical influences on EDA are inhibitory; others suggest they are excitatory. Some researcher suggest that the pathways ipsilateral; others suggest they are contralateral (Naveteur, Godefroy, & Sequeira, 1998). Naveteur et al. examined bilateral EDA in patients with right frontal lobe damage to a tone and compared their responses to individuals with no brain damage (controls). Patients showed strong asymmetries in higher skin conductance levels (SCL) relative to controls; patients had SCL in the left hand than controls. There was no difference between patients and controls on SCL in the right hand. These results suggest that the frontal lobe damage leads to contralateral disinhibition of SCL. Thus, the brain may exert contralateral inhibitory control over tonic EDA, skin conductance level. There were no differences in SCR between patients and controls. This finding may suggest that tonic and phasic EDA depend on different central control mechanisms.

Mangina and Beuzeron-Mangina (1996) examined the effects of the stimulation of specific brain areas on EDA in five patients with implanted depth electrodes. Stimulation of the left amygdala, posterior hippocampus, anterior hippocampus and cingulate yielded higher SCR in the left than right hand. Stimulation of the right side of these same structures yielded higher SCR in the right hand than in the left hand. Stimulation of the left and right frontal region yielded weak changes in SCR. This evidence suggests that the limbic structures exert ipsilateral excitatory control over phasic EDA, skin conductance responses. It is possible that the SCR differences are a result of ipsilateral excitation of the limbic structures as suggested by Mangina and Beuzeron-Mangina (1996).

Research by Schulter and Papousek (1998) suggested that hand preference alone may differentially impact on electrodermal activity. Schulter and Papousek showed that right-handed dominant individuals had more electrodermal activity EDA in the left than in the right hand and showed greater left lateral eye movement than right eye movement. Lateral eye movement is an index of hemispheric activation. The reverse pattern of EDA occurred for weak right-handed individuals but the lateral eye movement data did not show a clear pattern of hemispheric dominance. These data suggest that right hand dominant individuals have a different pattern of hemispheric dominance and thus EDA than left hand dominant individuals.

Papousek and Schulter (1999) measured EEG while right-handed participants completed cognitive tasks. Degree of right-handedness was significantly correlated with central and dorsolateral frontal activation during a visual attention task in which the participants had to focus on a point in front of them. The asymmetries in EEG only occurred during the tasks and not when the participant had his/her eyes closed. The authors suggested that the prefrontal cortex contributes to electrodermal activity and that small variations in arousal may impact on EEG patterns.

The results of Yoon and Papousek suggest that there may be multiple mechanisms of cortical control of autonomic nervous system activity. The relationship between cortical asymmetries and autonomic nervous system activity may be modified by emotion. Wittling (1990) examined hemispheric control of the autonomic nervous system in participants' responses to a positive film. Wittling presented a positive film to participant's left or right visual half field and measured systolic and diastolic blood pressure changes. In the visual half field technique visual stimuli are projected to the optical tracts of each eye that only go to the visual areas of the opposite hemisphere. Therefore, presenting visual information to the left visual half field is processed by the visual areas in the right hemisphere; presenting visual information to the right visual half field is processed by the visual areas in the left hemisphere. Wittling showed that greater increases in systolic and diastolic blood pressure occurred when the film was presented to the left visual half field than to the right visual half field. Thus, presentation of material to the right hemisphere had a greater impact on blood pressure than did presentation of the material to the left hemisphere.

Wittling and Roschmann (1993) used a similar paradigm but participants were presented negative film clips and positive film clips to either their right or left visual half field. Greater increases in systolic and diastolic blood pressure occurred when films were presented to the left visual half field than to the right visual half field. Participants reported more arousal for films, regardless of the valence, presented to the left than to the right visual half field. Thus, research has shown a relationship between autonomic nervous system activity, as measured by blood pressure changes, and cortical activity. More specifically, presentation of material to the right hemisphere had a greater impact on blood pressure than did presentation of the material to the left hemisphere. Additionally, the increase in blood pressure was consistent with self-reported arousal. The hemispheres of the brain may not only differ in their role in the perception and expression of emotion but also the regulation of physiological activity.

Later research by Wittling, Block, Genzel, & Schweiger (1998) and Spence, Shapiro and Zaidel (1996) expanded the idea of asymmetrical hemispheric control of autonomic nervous system activity. Wittling et al. (1998) presented a negative film or a neutral film to the right visual half field or to the left visual half field and measured heart rate variability. Results showed that participants who viewed the negative film had higher low frequency power than did those who viewed the neutral film (Yoon et al., 1997). Participants who viewed the neutral film had higher high frequency power than did those who viewed the negative film. There was a higher high frequency power for films presented to the right visual half field than for films presented to the right visual half field. There was higher low frequency power for films presented to the left visual half field than for films presented to the right visual half field. Thus, parasympathetic activation was greater during the negative film than during the neutral film and greater for films presented to the left than to the right visual half field. From these results, parasympathetic control of the heart may be influenced by the right and left hemispheres differentially. When the left hemisphere is stimulated parasympathetic activity is high, relative to right hemisphere stimulation.

Anatomical (e.g., Hachinski et al., 1992) and behavioral evidence suggest that control of autonomic nervous system activity may be lateralized in the central nervous system. Relative activation of the right hemisphere is associated with an increase in sympathetic activity; relative activation of the left hemisphere is associated with parasympathetic activity. Research by Wittling (e.g., 1993) and others suggests a similar pattern of cortical activation with emotional stimuli. The data on asymmetries in autonomic nervous system activity to stimuli presented to the right and left visual fields are consistent with Heller’s (1990, 1993) view of activation. Stimuli presented to the right hemisphere were associated with greater physiological activity (e.g., blood pressure) than were stimuli presented to the left hemisphere.

**Methods of Emotion Elicitation:**

Emotions can be thought of in terms of changes in the autonomic nervous system, the central nervous system and self–report. Changes in physiological activity and self-report can be elicited by various methods. Three common methods are Standard Tasks, such as serial subtraction and unsolvable anagrams, Velten's Mood Induction Procedure (Velten, 1968) and the International Affective Picture System (IAPS; Center for the Study of Emotion & Attention (CSEA-NIMH), 1995).

Standard Tasks:

Standard tasks typically elicit negative emotions, such as anger and frustration, which are accompanied by increased cardiovascular activity. For example, Siegman, Anderson, Herbst, Boyle and Wilkinson (1992) had men perform a serial subtraction task in which they were harassed by the experimenter. Men reported higher levels of negative emotion (e.g., anger) and showed greater increases in systolic and diastolic blood pressure under harassment conditions than did men in the non-harassment condition. Suarez and Williams (1989) and Cosenzo and Franchina (2001) reported similar results. Cosenzo and Franchina (2001) showed that participants who completed a serial subtraction by seven's task reported more negative emotion and exhibited greater changes in blood pressure than did participants who completed a serial subtraction by one's task.

In Weidner, Friend, Ficarrotto and Mendell (1989) participants were asked to solve anagrams that were not solvable after the first one. Participants who worked on unsolvable anagrams reported more negative emotion (e.g., frustration) than those who worked on solvable anagrams. During the task, participants who worked on unsolvable anagrams showed higher systolic and diastolic blood pressure than did those who worked on solvable anagrams. The data of Weidner et al. (1989) and others indicate that in situations that challenge and harass them participants report negative emotion and show increases in blood pressure and heart rate.

Velten's Mood Induction Procedure:

In the Velten Mood Induction Procedure (Velten, 1968) participants are typically asked to read aloud and think about a series of fifty self-referential statements that are printed on cards. The depression cards contain statements that connote low self-worth, pessimism and low energy; the elation cards contain statements that connote confidence, optimism and energy; the neutral cards contain statements that are not self-referential and are unrelated to mood.

Frost and Green (1982) had participants complete the Velten procedures for depression, elation or neutral mood and afterwards report their emotion. Results showed that participants in the elation condition reported less depression than did those in the neutral condition; participants in the depression condition reported more depression than did those in the elation condition.

Schare and Lisman (1984) used the Velten procedure to instigate a depressed or elated mood and examined the reliability of the procedure. Participants either read all fifty statements or read one set of twenty five statements on day one and a second set of twenty five statements on day two. After reading the Velten cards, participants completed a mood scale. Participants in the depressed condition reported a more depressed mood than did those in the elated or neutral condition. The moods reported were consistent from day one to day two. Reading the full set of fifty Velten statements in one session had the greatest impact on the participants' report of mood.  These data suggest that the Velten procedure consistently influence mood.

<u>International Affective Picture System</u>:

The Internal Affective Picture System (IAPS; CSEA-NIMH, 1995) is a quantitative tool developed by Lang, Bradley and Cuthbert (1997) to evoke affective states reliably in laboratory settings. The IAPS is a series of photographs of animals, objects, events and scenes that have been judged as ranging from highly pleasant to neutral to highly unpleasant. An example of a pleasant picture is a baby; a neutral picture is an owl; an unpleasant picture is a woman with a knife to her throat. The general procedure for presenting the IAPS begins with a warning slide that lasts for 5 seconds; each IAPS picture is then presented for 6 seconds.

Research has shown that the IAPS reliably elicits emotion. For example, Davis, Rahman, Smith, Burns, Senecal, McArthur, Halpern, Perlmutter, Sickels, and Wagner (Experiment 1, 1995) presented IAPS pictures to participants and had them report emotion on valence and arousal dimensions. One-hundred of the 114 IAPS pictures used in Davis's experiment elicited emotion. The emotion reported to the picture was consistent with the content of the picture. For example, a picture of a baby and a couple in bed elicited both love and happiness. Pictures of a knife and an aimed gun elicited fear. The distribution of valence and activation level reported for the IAPS was consistent with the circumplex model of emotion (Russell, 1980). In addition, the emotional responses reported by participants in Davis's study were consistent with the emotional responses to the IAPS reported in other studies (e.g., Lang & Greenwald, 1998).

Bradley, Cuthbert and Lang (1996) examined the effects of IAPS presentation on corrugator muscle activity, skin conductance responses and heart rate. The participants were presented a block of twenty-four pleasant, neutral or unpleasant IAPS pictures. Results showed that level of tension in corrugator muscle was greater for unpleasant than for pleasant or neutral pictures. There was an increase in tension of the corrugator muscle with increasing number of exposures to pictures in the unpleasant block. Similarly, the number of SCR was greater for unpleasant than for pleasant or neutral pictures. Heart rate deceleration was larger for unpleasant pictures relative to that for neutral pictures. Bradley et al. (1996) also used a startle probe, a loud noise, to measure the duration of the emotional response to the IAPS. Results showed that larger eyeblinks occurred to unpleasant than to pleasant IAPS pictures. The authors suggested that the eyeblink responses were an indication of the persistence of the affective state after the end of IAPS presentation. Bradley, Codispoti, Cuthbert, and Lang (2001) demonstrated a similar pattern of results.

Data also show that the IAPS is effective in eliciting emotion even with a very brief presentation. For example, Codispoti, Bradley and Lang (2001) presented IAPS pictures for .005 of a second. Pleasant and unpleasant pictures elicited a higher skin conductance level than did neutral pictures. Additionally, startle probes were presented during the IAPS; larger eyeblinks occurred to unpleasant than to pleasant IAPS pictures.

According to Bradley and Lang (2000) the valence of IAPS pictures contributes to changes in heart rate during IAPS presentations. Typically, unpleasant IAPS elicits heart rate decelerations and pleasant IAPS elicits heart rate accelerations. The level of activation (i.e. arousal) that characterizes the IAPS pictures contributes to changes in the electrodermal activity during IAPS presentations. Regardless of the valence of the IAPS, skin conductance is linearly related to the level of activation (i.e., arousal); Lang (1995) reported a positive correlation between activation ratings and skin conductance responses. The more activation reported by participants for the affective IAPS, the greater the number of skin conductance responses. The IAPS consistently elicits enduring emotional responses on a physiological and behavioral level.

**Influence of Emotion and Arousal on Performance**

Emotion and Performance:

According to Bower's Mood Congruent Processing Theory (for review, see Bower & Forgas, 2000), individuals are sensitized to take in information from the environment that agrees with their current emotional state. Information that is congruent with the current emotional state is more salient to the individual than is information that is incongruent. Thus, individuals should attend more to congruent information and learn that information better than they would attend to and learn incongruent information.

Bower and Forgas (2000) reported that Bower used hypnotic suggestion to induce a happy, angry or sad mood in participants. Participants were then read thirty-six happy, anger provoking or sad events. After the events were read to the participant, the mood was neutralized and the participant was asked to recall the events. Participants who were initially in the happy group recalled more happy events, participants who were initially in the angry group recalled more anger provoking events, and participants who were initially in the sad group recalled more sad events. These data were consistent with Bower's Mood Congruent Processing Theory.

Bradley et al. (1996) examined the effects of the IAPS on the rating of affective words. Participants were presented 24 unpleasant or pleasant IAPS pictures. After the IAPS participants were presented pleasant and unpleasant words and were asked to rate the pleasantness of each word. Results showed that following the presentation of unpleasant IAPS pictures, unpleasant words were more likely to be labeled unpleasant than they were following the presentation of pleasant IAPS pictures. The negative IAPS facilitated affective responding in a manner that was consistent with the affective valence of the IAPS. The data fit with Mood Congruent Processing Theory.

Bower (1981) suggested that emotion can also enhance the salience of mood-congruent material in an attention task, such as the Stroop task, and thus enhance responding. He proposed that emotion could cause the mood congruent words to be relevant to the participant. In an emotional Stroop paradigm, participants typically take longer to respond to affective words than to neutral words (Ochsner & Schachter, 2000). This finding may reflect a difficultly in disengaging attention from the emotional words or it may reflect increased attention to the emotional words. For example, participants high on trait anxiety are slower at naming the color of anxiety related words than are non-anxious participants (Williams, Matthew, MacLeod, 1996). Anxious and non-anxious participants do not differ in the naming on non-anxiety related words. The slower naming of the anxiety words may indicate that the participant is attending longer to the anxiety words than to the non-anxiety words.

However, several studies indicate that mood congruence effects fail to appear in some cognitive tasks (Rusting, 1998). For example, Bradley et al. (1996) presented participants with affective words interspersed among presentations of the unpleasant, pleasant or neutral IAPS pictures. Participants were asked to press a button as soon as they determined the affective valence of the word. Participants took longer to determine the valence of the word after unpleasant or pleasant IAPS than after the neutral IAPS. These findings suggest that unpleasant and pleasant IAPS pictures impacted on the participants' attention to the affective words but the valence of the IAPS did not facilitate recognition of similarly valenced words. Several studies that employed the Stroop task have also failed to demonstrate mood-congruency effects. For example, depressed participants do not show longer response latencies to depressed words relative to non-depressed words (Rusting, 1998). Depression is a negative emotion but it is characterized by low activation. The level of activation (high v. low arousal), in addition to the valence of the emotion, may need to be taken into consideration to fully understand the impact of emotion on performance.

Arousal and Performance:

Early arousal theorists, such as Duffy (1951) and Lindsley (1951), proposed that there was a linear relationship between arousal and performance. As an individual's level of arousal increased, his/her performance on a task should increase. De Moja, Reitano, and Caracciolo (1987) examined the impact of induced arousal on performance. Participants completed a tactile discrimination task and a memory task under relaxation conditions or under high arousal conditions. On the tactile discrimination task, the participants had to determine the position and number of pins on a board and also had to determine which of two boards was rougher. In the memory task participants had to learn and recall twelve items. The scores on all the tasks were higher for the high arousal condition than for the relaxation condition.

According to the Optimal Arousal Hypothesis there is an optimal level of arousal for performance. Performance is better at an intermediate level of arousal than at either low or higher levels of arousal. To test this hypothesis, Deshpande and Kawane (1984) had high, moderate and low anxious participants perform a verbal learning task. Anxiety was presumed to be associated with level of arousal. Words were serially presented and the participants had to recall the words. Moderately anxious participants performed better on the verbal learning task than did high or low anxious participants.

Anderson (1994) demonstrated a similar pattern of results. Anderson had participants ingest caffeine and then complete an easy letter cancellation task or a difficult verbal task. The more caffeine the participants had, the better they performed on the easy task. However, the more caffeine the participants had, the worse they performed on the difficult task. These data support the Optimal Arousal Hypothesis but the relationship between arousal and performance may be influenced by characteristics of the task.

To explain the differential effects of arousal on performance Easterbrook (1959) proposed a theory that takes into consideration capacity for information. Easterbrook maintained that individuals have a limited capacity to attend to stimuli in their environment. This capacity is further diminished when an individual is in a high state of arousal. Attending to events in the environment requires attentional resources. If these events are relevant to the individual and need to be attended to, as a result of the diminished capacity, performance will be impaired. However, if these cues are irrelevant and can be ignored then arousal may not impair performance but may actually enhance it since resources are still available to complete the task. Research has suggested that arousal can impact on performance; this relationship may be influenced by characteristics of the task.

Emotion and Arousal Impact on Performance:

Research has shown that task performance is separately influenced by emotion and level of arousal/activation. Mood Congruent Processing Theory (Bower & Forgas, 2000) proposes that if a person in a pre-existing emotional state is presented with information whose emotional content is congruent with the pre-existing emotion, the person’s performance will be facilitated. Emotion is characterized by valence (pleasant-unpleasant) and activation (high-low arousal). According Heller (1990,1993), the occurrence of emotion is a dynamic process that involves patterns of regional brain activity. Heller (1990) proposed that the anterior region of the brain is associated with valence and the posterior region is associated with activation. More specifically, the right anterior region is involved in unpleasant/negative emotion; left anterior region is involved in pleasant/positive emotion. The right posterior is involved with high arousal; left posterior region is involved with low arousal.

If emotion were organized in the brain in the manner just described then the physiological and behavioral reactions based on the emotion would reflect the influence of this organization. Specifically, if an area of the cortex is specialized for processing emotion, as in the perception of an emotion, activity in that area should covary with performance on tasks that use the same area of the cortex. According to Kinsbourne & Bemporad, (1984) when a cerebral region is activated by a task it is primed. Priming a cerebral region may induce a shift in attention or may facilitate performance on a task that is presented to the side contralateral to the primed hemisphere.

For example, Henriques and Davidson (1997) had depressed and non-depressed participants perform a dot localization task or a word finding task. Depression is characterized by left frontal hyperactivation and right posterior hypoactivation. According to Davidson (2000) the dot localization and the word finding tasks elicit right and left posterior activation, respectively. Depressed participants showed impaired performance on the dot localization task relative to non-depressed participants. There was no difference between groups on the word localization task. If depressed participants have decreased activation in the right posterior region and activation in this region was important to successfully complete the dot localization task then the lower level of activation in depressed individuals may have impaired performance on the dot localization task.

In Bartolic, Basso, Schefft, Glauser and Titanic-Schefft (1999) participants were induced into either a euphoric or a depressed mood with the Velten mood induction technique and then completed a design fluency task and a verbal fluency task. The design fluency task is associated with right hemisphere activation; the verbal fluency task is associated with the left hemisphere activation.

Participants in a euphoric mood performed better on the verbal fluency task than they did on the design fluency task; participants in a depressed mood performed better on the design fluency task than they did on the verbal fluency task. These data suggest that when the hemisphere associated with task performance matched the hemisphere associated with the instigated affective state, the primed hemisphere, performance was better than that when the hemisphere associated with task performance did not match the primed hemisphere. These data fit Kinsbourne and Bemporad’s (1984) notion of priming.

Banich, Stolar, Heller and Goldman (1990) used imagery and music to induce a depressed mood in participants. The participants then completed a digit-matching task. The digit-matching task required participants to decide whether a digit on the top of a screen matched the digit on the bottom of the screen. For half of the trials both digits were presented to the same visual field. For the other half of the trials one of the digits was presented to the right visual field and the other digit was presented to the left visual field. Overall, performance was better when the digits were presented to left visual field than to the right visual field. However, when the target was in the left visual field, participants in a depressed mood performed more poorly on the digit-matching task than did those in a non-depressed mood. When the target was in right visual field, there was no difference between those in a depressed mood and those in a non-depressed mood. According to Heller’s model, the right tempoparietal area is associated with an increase in arousal. Depression is characterized by decreased activations in the right tempoparietal area. Decreased activation in the right tempoparietal region may have led to impaired performance on numbers presented to the left visual field since the numbers were represented in the right hemisphere.

According to Kinsbourne and Bemporad (1984), priming effects in facilitating performance do not always occur. If the task is easy priming may occur; if the task is demanding interference may occur. Demanding tasks may overload the cerebrum and result in a decreased capacity to perform the task. Interference may also occur when tasks that are performed compete for resources from similar cerebral regions or in adjacent cerebral regions (Kinsbourne & Hicks, 1978). According to Kinsbourne's notion of functional cerebral space, the degree of interference on a task varies with the functional distance between the cerebral regions that are involved in the tasks; the closer the functional distance between the cerebral regions, the greater the interference.

Compton, Heller, Banich, Palmieri, Patrick and Miller (2000) investigated how hemispheric asymmetry influenced attentional biases. Participants were required to name the color of squares that were presented to the right or left visual field concurrently with neutral, positive or threatening words. Overall, color naming was faster for words presented to the right visual field than for words presented to the left visual field. When the colored squares were presented to a different visual field than were the emotional words, color naming was faster than if the squares and the words were presented to the same visual field. According to Compton, color naming was faster when the colored squares were presented to a different visual field than the emotional words because each hemisphere only processed one piece of information. When the color and the emotional word were presented to the left visual field the resources responsible for processing the emotional stimuli were also responsible for naming the color. This sharing of cerebral space interfered with cognitive processing, as evidenced by a slow reaction time.

Past research has generated information on how emotion and arousal impact on performance. Regardless, of an individual's affective state, when arousal level is generally high performance is high (e.g. Banich et al., 1990). When an individual's pre-existing affective state is congruent with the affective valence of a task performance is better than when the affective state is incongruent with valence of the task. The dimensions of emotional valence and arousal are represented in the brain and the cortical activity associated with the emotion may influence performance.

## Rationale

This project examined the effects of instigated emotion on performance on an affectively laden verbal learning task whose verbal stimuli were presented to the left or right ear. Research has demonstrated that an individual's emotional response can influence subsequent performance (Rusting, 1998). According to Bower's Mood Congruent Processing Theory (Bower & Forgas, 2000), mood impacts on how a person processes information in a given situation. If the affective valence of a situation is congruent with a person's pre-existing emotion, affective responding to the situation should increase.

Research has shown that presentation of the IAPS reliably induced an emotion (IAPS; CSEA-NIMH, 1995). Bradley et al. (1996) showed that participants reported more negative emotion following the presentation of unpleasant IAPS pictures than following the presentation of pleasant IAPS pictures. Presentation of unpleasant IAPS pictures increased eye muscle activity, skin conductance, and decreased heart rate relative to that for pleasant IAPS pictures.

Neuropsychological research has demonstrated that an individual's emotional response is related to hemispheric asymmetries. Tomarken et al. (1990) showed that during a negative film clip there was greater activation, as measured by EEG, in the right frontal area relative to that in the left frontal area. During a positive film clip there was greater activation in the left frontal area relative to that in the right frontal area. Davidson (1993) reported that participants who viewed positive, negative or neutral film clips showed greater activation, as measured by EEG, in the right frontal lobe compared to the left frontal lobe during the negative film than during the positive film clip. These data show that during negative emotions there is greater right frontal activity than left frontal activity and during positive emotions there is greater left frontal activation than right frontal activity.

Bradley Cuthbert and Lang (1996) showed similar results with the IAPS. Participants were presented pleasant and unpleasant IAPS followed by acoustic startle probes (i.e. a loud noise) presented to the left or right ear. Following startle probes to the left ear, eyeblinks were larger for unpleasant than for pleasant pictures. There was no difference in eyeblinks between IAPS picture conditions when the startle probe was presented to the right ear. These data suggest that the right hemisphere may process emotion.

The impact of emotion on performance may be a function of priming. If the task is presented to the side contralateral to the activated hemisphere then task performance may be facilitated (Kinsbourne & Bemporad, 1984). On the other hand, according to Kinsbourne's model of functional cerebral space, performance may be hindered if the tasks that are performed compete for resources from similar cerebral regions or in adjacent cerebral regions (Kinsbourne & Hicks, 1978).

Spence and colleagues (1996) examined the effects of lateralized presentation of emotional stimuli on reaction times for labeling the stimuli. Emotional stimuli presented to the left visual field resulted in slower reaction time than emotional stimuli presented to the right visual field. According to Spence et al. (1996), when an emotional stimulus is presented to the left visual field the resources responsible for processing the stimulus in the right hemisphere are also responsible for generating the appropriate physiological response. This sharing of cerebral space in turn interferes with later cognitive processing and results in slow reaction time. When emotional stimuli are presented to the right visual field the resources responsible for processing the stimulus are in the left hemisphere and the resources responsible for generating the appropriate physiological response are in the right hemisphere. Since there is no competition for right hemispheric resources reaction time is faster.

Results of Tomarken et al. (1990) and Spence et al. (1996) are consistent Heller's model of emotion (1990, 1993). Heller proposes that the anterior region of the brain is associated with pleasant and unpleasant emotion. Heller also proposed that the temporal parietal region of the brain is involved with high to low activation. An emotional response may impact on performance depending on the level of activation in the area of the brain responsible for the emotional response and the area of the brain responsible for the completion of the task.

Previous research has suggested a relationship among induced emotion, hemispheric activation and the learning of affective material (e.g. Spence et al., 1996). The present investigation examined the effects of instigated emotion and lateralized presentation of verbal stimuli on the learning of an affectively laden list of word. The present investigation also attempted to assess the separate influences of emotion and arousal on verbal performance.

This investigation consisted of two experiments. Experiment I was a 2x2 factorial design and was used to verify that the IAPS results in an emotional response. There were two types of IAPS, negative or neutral and two gender conditions, male and female. Heart rate and bilateral skin conductance level were measured during the IAPS presentation. Self-reported emotion was assessed after the IAPS. The design of the Experiment II was a 2 x 2 x 2 mixed factorial design. Two independent groups of participants viewed either negative or neutral IAPS pictures (IAPS condition). Each group was presented either a list of positive and a list of neutral AAVL words or a list of negative and a list of neutral AAVL words (Type of AAVL condition). Lists were delivered to the left or to the right ear (Ear condition). The measure of performance on the AAVL was the number of correct responses. Heart rate and bilateral skin conductance level were measured during presentation of the IAPS and of the AAVL.

## Hypotheses

Experiment I

1. Participants in the negative IAPS condition will report more unpleasant emotion, less pleasant emotion, and will exhibit greater changes in heart rate and higher skin conductance levels than participants in the neutral IAPS condition.

Experiment II

1. According to Mood Congruent Processing Theory, participants in the negative IAPS condition who are presented the negative AAVL will perform better than participants in the negative IAPS condition who are presented the neutral AAVL. According to Heller's view of emotional valence, the magnitude of the effect will be greater for presentation of the AAVL to the left ear than to the right ear.
2. According to Mood Congruent Processing Theory, participants in the negative IAPS condition who are presented the negative AAVL will perform better than participants in the negative IAPS condition who are presented the positive AAVL. According to Heller's view of emotional valence, performance on the negative AAVL presented to the left ear will better than presentation of the positive AAVL to the same ear. However performance on the negative AAVL presented to the right ear will be poorer than presentation of the positive AAVL to the right ear.
3. According to Heller's view of emotional valence, irrespective of IAPS condition, performance on the negative AAVL presented to the left ear will be better than performance on the neutral AAVL presented to the same ear. No difference between negative and neutral AAVL is expected for presentation of the AAVL to the right ear. Performance on the negative AAVL

presented to the left ear will be better than performance on the positive AAVL presented to the same ear. However, performance on the negative AAVL presented to the right ear will be poorer than presentation of the positive AAVL to the same ear.

4. According to Heller's view of activation, participants in the negative IAPS condition will perform better on the AAVL, irrespective of the affective valence of the AAVL, than participants in the neutral IAPS condition. Performance on the AAVL presented to the left ear may be poorer than presentation of the AAVL to the right ear.
5. According to Heller's view of activation, irrespective of the affective valence of the AAVL, performance on the AAVL presented to the left ear will be better than performance on the AAVL presented to the right ear. There will be a greater increase in heart rate and higher skin conductance level for the AAVL presented to the left ear than for the AAVL presented to the right ear.

## Method

This investigation consisted of a Screening phase, Experiment I and Experiment II.

Screening Phase:

Participants. Men and women from the subject pool of students in psychology courses at Virginia Polytechnic Institute and State University were recruited to participate in the screening phase. Approximately 20 right-handed men and 20 right-handed women were screened for Experiment I; approximately 120 right-handed men were screened for Experiment II. Participants received extra credit toward their course grade and had the option of withdrawing from the screening phase at any time without penalty.

Procedure. The screening phase was conducted with groups of approximately 25 students per session. Participants were given an informed consent form to sign (Appendix F). They were told that this was the first part of two- part study. Participants were asked to write their names and phone numbers on the front of the questionnaire packet, if they wanted to be contacted for the second part. After the screening procedures were explained to the participants, questions answered and the informed consent forms signed, a packet of questionnaires was administered. The packet contained a demographics questionnaire, Neurological Evaluation Form, and the Laterality Questionnaire (Coren, Porac & Duncan, 1979).

Measures:

Demographics Questionnaire. The Demographics Questionnaire was used to obtain information about the participant's gender, age, and academic level (Appendix G).

Neurological Evaluation. The Neurological Evaluation is a 16-item questionnaire that identifies medical conditions (Appendix H). Participants were asked questions regarding current and past medical conditions including medications, stroke, alcohol usage and head trauma. The questionnaire required a detailed explanation of any of the aforementioned conditions. The questionnaire was used to exclude participants who were taking any medication, had severe head injury and/or psychological disorders. This was to ensure that the participants had no medical condition that would negatively influence the physiological recordings or would endanger the participants' health during the study.

Laterality Questionnaire (Coren, Porac & Duncan, 1979). The Laterality Questionnaire consists of 13 items that assess lateral preference (Appendix I). The questionnaire has been validated behaviorally for hand, foot, eye and ear preference. Laterality preference scores were calculated by adding 1 point for right preference, subtracting 1 point for left preference and adding 0 points for both "right" and "left" side preferences. This questionnaire was used to select participants who were right hand dominant. Research by Schulter and Papousek (1998) suggests that hand preference differentially impacts electrodermal activity. Schulter and Papousek showed that right hand dominant individuals have a different pattern of hemispheric dominance and thus, electrodermal activity, than left hand dominant individuals. Since skin conductance level from the left and right hand was compared in this study, handedness needed to be consistent across participants.

Experiment I:

Participants. Participants were 25 right-hand dominant men (n=13) and women (n=12) who reported no medical conditions that would negatively influence the physiological recordings or would endanger their health during the study. The mean age of the participants was 18.9 years (Range 17-23). Ninety-one percent of the sample was Caucasian and 8.7% were Asian-American. College freshman constituted 47.8% of the sample (Sophomore = 34.7%, Junior= 13.2% and Senior=4.3%).

Design. Experiment I was a 2x2 between groups factorial design. There were two types of IAPS (negative or neutral) and two levels of gender (male or female).

Apparatus:

International Affective Picture System (IAPS). The IAPS is a collection of color pictures (CSEA-NIMH, 1995). The pictures are of objects (e.g. fork, iron, gun), people (e.g. old man, woman, mangled face) and scenes (e.g. chess, shipwreck, a man hitting a woman). The negative and neutral IAPS pictures were selected from a table in the IAPS manual (Lang et al., 1997) that showed normative values of affective valence (i.e. degree of pleasantness) and activation (i.e. degree of arousal) for men. Scores ranged from one (low) to nine (high) on each rating scale. IAPS pictures with affective valence ratings between 1 and 3 and the activation scores was between 6 and 9 were selected as negative pictures. IAPS pictures with affective valence ratings between 4 and 5 and the activation scores was between 0 and 3 were selected as neutral pictures. Appendix L contains a list of the IAPS pictures that were used in this study.

Davis et al. (1995) reported a reliability coefficient of .91 for the affective valence of the IAPS. A categorical analysis of the IAPS showed that the IAPS elicited significant affective responses, $p$'s $<.05$. The affective responses elicited were consistent with the picture content (Davis et al., 1995).

Physiological Measures. Skin conductance level (SCL) was measured using the Coulbourn S71-23 constant voltage (0.5v) Isolated Skin Conductance Coupler and recorded by the MCA CODAS computer software. The skin conductance couplers were calibrated to record a range from 0-40 microsiemens. The participant’s skin was prepared by the experimenter’s using a nail file to abrade the medial phalanges of the second and third fingers of the left and right hand. The experimenter then applied a small amount of electrode gel to that area. Electrode collars were placed on standard Ag-AgCl electrodes and the electrodes were filled with gel and attached the participant's medial phalanges.

Heart rate (HR) was obtained using the Coulbourn S71-40 Optical Pulse Coupler and recorded by the MCA CODAS computer software. HR was measured using a finger plethysmograph connected to the first finger of the left hand.

Emotion Questionnaire. The emotion questionnaire used in Experiment I was developed by Barrett and Russell (1998) (Appendix M). The questionnaire contains a list of emotions from the PANAS (Watson et al., 1988) and additional emotions that represent the dimensions of emotion not represented in the PANAS. The PANAS is a list of six pleasant-high activation (i.e. upset, scared) and six unpleasant-high activation emotions (i.e. upset, scared). Barrett and Russell added eleven additional emotions so that the scale represented all quadrants of the circumplex model of emotion. Barrett and Russell included five pleasant-low activation emotions (i.e., calm, at ease) and six unpleasant-low activation emotions (i.e., dull, bored). Participants were asked to rate how much of an emotion they felt as a result of the pictures they viewed. The scores for each emotion could range from one (none at all) to five (a lot). The participant circled 1 if they did not feel any of a particular emotion; they circled 5 if they felt a lot; they circled 3 if they felt an intermediate amount. The questionnaire was scored by averaging the responses separately for the pleasant-low activation, unpleasant-low activation, pleasant-high activation and unpleasant-high activation emotions.

Watson et al. (1988) reported Cronbach's coefficients of reliability that ranged from .84 to .87 for the unpleasant scale of the PANAS and from .86 to .90 for the pleasant scale of the PANAS. Correlations for convergent validity for the PANAS ranged from .89 to .95. Cronbach alpha for the emotion questionnaire in the present experiment was .74.

Procedures. The experimenter telephoned each participant a day before his/her scheduled appointment as a reminder of the appointment time and location. The participants were asked to abstain from caffeine 24 hours prior to the experiment. Quinlan, Lane, Moore Aspen, Rycroft, and O'Brien (2000) showed that caffeine in coffee and tea slightly increases blood pressure, heart rate and skin conductance. Additionally, the half-life of caffeine is five to six hours (Sobotka, 1989). Based on this information, participants were asked to abstain from caffeine for twenty-fours hours to minimize the possibility that the caffeine in his/her system would contaminate the physiological measures

Upon arrival at the laboratory, the participant was asked to leave the lab and wash his/her hands with warm water but without soap in lavatory nearby. When the participant returned to the lab he/she was presented with two copies of an informed consent form (Appendix J). The participant was asked to read and sign both copies; one copy was kept by the experimenter. At the start of the experiment the study was briefly described to participants as one investigating how visual stimuli impact on physiological activity. Participants were then seated on a recliner chair in an adjacent laboratory room and fitted with the physiological recording equipment.

Once the participant was set-up with the physiological equipment, the experimenter closed the laboratory room door and went into an adjoining room. The experimenter communicated with the participant through an intercom system.

The participant was asked to relax for five minutes with his/her eyes open and baseline measures of SCL and HR were recorded for the last two minutes. Then the participant was presented the negative or neutral IAPS pictures, depending on his/her condition. Each series of IAPS pictures, negative IAPS and neutral IAPS, consisted of 24 negative or neutral pictures. The IAPS pictures were presented in a dim room on a 17- inch computer monitor. The participant was presented a warning slide for six seconds followed by the series of 24 IAPS pictures. Each picture was presented for six seconds and the last picture in the IAPS presentation was black. The duration of the IAPS presentation was two minutes and six seconds. SCL and HR were recorded continuously throughout IAPS presentation. After the last picture ended the participant was asked to rate how he/she felt after viewing the pictures by completing the Emotion Questionnaire.

After the participant completed the Emotion Questionnaire, the experimenter told the participant that she was entering the subject room to remove the finger plethysmograph and electrodes. The participant was thanked for his/her participation. The experimenter told the participant that the pictures were designed to evoke an emotional response and the participant was asked if he/she felt okay after viewing the pictures.

Experiment II:

Participants. Participants were 100 right-hand dominant men that had no medical conditions that would negatively influence the physiological recordings or would endanger their health during the study. The mean age of the participants was 19.1 years (Range 17-24). Seventy-six percent of the sample was Caucasian (African American=15%, Hispanic=2.2%, Asian=5.4%, and Other=1.1%). College freshman constituted 49.5% of the sample (Sophomore = 25.8%, Junior= 17.2% and Senior=7.5%).

Design. The design of Experiment II was a 2x2x2 mixed factorial design. There were two types of IAPS presented (negative or neutral), two affective auditory verbal learning conditions (negative and neutral AAVL words or positive and neutral AAVL words) and two presentation conditions (AAVL presented to the left ear or to the right ear). Type of IAPS, AAVL condition, and ear of presentation were between subjects factors. The IAPS pictures were those used in Experiment I.

Apparatus:

The Affective Auditory Verbal Learning Test (AAVL The AAVL (Appendix N) is composed of three lists of words each, that differ in affective valence: positive, negative and neutral (Snyder & Harrison, 1997). The AAVL was developed from an index of word norms established by Toglia and Battig (1978). The words that comprised the negative AAVL were those with the lowest pleasantness rating; the words that comprised the positive AAVL were those with the highest pleasantness rating. The original Rey Auditory Verbal Learning Test (Rey, 1964) served as the neutral list. The pleasantness rating of the neutral list was 4.0 on a 7-point likert scale. Examples of the words were: Negative words-morgue, murder, kill; Positive words-sunset, garden, beach; Neutral words-drum, curtain, bell. Instructions to the participant about the AAVL and the AAVL word lists were recorded on a compact disk.

Procedures. The experimenter called the participant a day before his scheduled appointment as a reminder of the appointment time and location. As in Experiment I, the participants were asked to abstain from caffeine for 24 hours prior to the experiment. This request was intended to minimize the possibility that the caffeine in the participants' system might contaminate the physiological measures (Quinlan et al., 2000). Upon arrival at the laboratory, the participant was asked to leave the lab and wash his hands with warm water but without soap in lavatory nearby. When the participant returned to the lab he was presented two copies of an informed consent form (Appendix K). The participant was asked to read and sign both copies; one copy was kept by the experimenter. The purpose of the experiment was explained to the participants as one investigating the relationship between picture viewing, physiology and memory. The participant was then seated on a recliner chair in an adjacent laboratory room and fitted with head-phones and the same physiological recording equipment used in Experiment I.

Once the participant was set-up with the physiology measures, the experimenter closed the laboratory room door and went into an adjoining room. The experimenter communicated with the participant through an intercom system. The participant was asked to relax for five minutes with his/her eyes open and baseline measures of SCL and HR were recorded for the last two of those minutes. Then the participant was presented the negative or neutral IAPS pictures depending on his/her condition. Each series of IAPS pictures, negative IAPS and neutral IAPS, consisted of 24 negative or neutral pictures. Immediately following the IAPS presentation, the AAVL was presented to the participant's left of right ear.

The participant completed a pair of lists, either a positive and neutral list or a negative and a neutral list. The experimenter recited the AAVL to the participant's left or right ear, depending on his assigned condition. Following the experimenter's recitation, the participant spoke outloud as many words as he could remember. The AAVL words were read to the participant three times. The experimenter used a checksheet to record the total number of words recalled. The participant was told the following before each AAVL presentation,

"I am going to read you a list of words. Please listen carefully.  When I stop, please say aloud as many words as you can remember in any order. Try to remember as many words as you can."

After the participant completed the third AAVL trial, the participant was asked to relax for five minutes; baseline measures of SCL and HR were recorded for the last two minutes.  The participant was presented another set of the IAPS pictures in the same affective condition as that presented earlier. After the IAPS the participant was presented a second AAVL to his same ear as before. The affective valence of the AAVL was different from that of the first AAVL. For example, if the affective valence of the first AAVL was negative and was presented to the right ear, the second AAVL was the neutral

AAVL and was presented to the right ear. The order of presenting the affective (positive or negative) and neutral AAVL lists was counterbalanced between participants. SCL and HR were continuously measured during the IAPS presentation and the experimenter's recitation of the AAVL.

## Data Reduction

Skin Conductance Level (SCL). The waveform obtained for skin conductance level from the right and left hand was partitioned and analyzed with the WINDAQ waveform browser. SCL for the right and left hand were calculated for baseline, IAPS presentation, and presentation of the AAVL. WINDAQ was used to calculate the mean amplitude in volts of the selected portion of the waveform. The mean voltage for each part of the waveform was converted to microsiemens, using the following formula:

SCL [microsiemens] = 2 (Mean Amplitude [volts] + 5)

Heart Rate (HR). The waveform obtained from the finger plethysmograph was partitioned for analyses. Using WINDAQ waveform browser, the parts of the waveform associated with baseline, presentation of the IAPS and presentation of the AAVL were saved as separate ASCI files. I obtained two programs from Dr. Michael Allen, MATHRESH and MABEAT, which were used to calculate the average heart rate for each file. MATHRESH calculated a threshold value, 60% of the height of the R spike. The threshold value was used to determine the heart rate of the participant. The threshold value and the sampling rate were entered into MABEAT; MABEAT calculated the heart rate from the threshold value and the sampling rate.

## Data Analyses

Experiment I:

Hypothesis 1 for SCL and HR was analyzed with a repeated measures ANOVA. The between subjects factors were Type of IAPS (negative v. neutral) and Gender (male v. female). The within subjects factor was Change, which was the difference in SCL or HR between baseline and that during the presentation of the IAPS.

Hypothesis 1 for reported pleasantness to the IAPS was analyzed with a repeated measures ANOVA. The between subjects factors were Type of IAPS and Gender. The within subjects factor was Self-reported Pleasantness (pleasant v. unpleasant).

Hypothesis 1 for reported activation to the IAPS was analyzed with a repeated measures ANOVA. The between subjects factors were Type of IAPS and Gender. The within subjects factor was Self-reported Activation (activation v. deactivation).

Experiment II:

Data for SCL and HR to the IAPS in Experiment II were analyzed with a repeated measures ANOVA. The between subjects factor was Type of IAPS (negative v. neutral). The within subjects factors were IAPS presentation (presentation 1 v. presentation 2) and Change, which was the difference in SCL or HR between baseline and that during the presentation of the IAPS.

Hypothesis 1 was analyzed with a repeated measures ANOVA. The between subjects factors were Type of IAPS (negative v. neutral) and Ear of presentation (LE v. RE). The within subjects factors were Type of AAVL (negative v. neutral) and Trials (1 v. 2 v. 3). The interaction of Type of AAVL x Ear of presentation predicted in Hypothesis 3 was tested with this analysis.

Hypothesis 2 was analyzed with a repeated measures ANOVA. The between subjects factors were Type of IAPS, and Ear of presentation. The within subjects factors were the Type of AAVL (negative v. positive) and Trials. The interaction of Type of AAVL x Ear of presentation predicted in Hypothesis 3 was tested with this analysis.

Hypothesis 4 was analyzed with a repeated measures ANOVA. The between subjects factors were Type of IAPS and Ear of presentation. The within subjects factor was Trials. The main effect for ear of presentation predicted in Hypothesis 5 was tested with this analysis.

Hypothesis 5 was analyzed with a repeated measures ANOVA. The between subjects factor was Ear of presentation. The within subjects factor was Change, which was the difference in SCL or HR and that during the recitation of the AAVL.

# Results

## Experiment I:

Appendix A contains the tables of means and standard deviations for SCL, HR and reported emotion. Appendix B contains figures for Experiment I.

SCL and HR to the IAPS:

Table 1 shows the means and standard deviations for SCL during baseline and picture in the negative and neutral IAPS condition for men and women.

A repeated measures ANOVA revealed significant effects for Change x IAPS, $F$ (1,21) = 8.25, $p$ = .00, IAPS x Gender, $F$ (1,21) = 5.37, $p$ = .03, Change, $F$ (1,21) = 8.25, $p$ = .00 and IAPS, $F$ (1,21) = 9.15, $p$ = .00. No other factors were significant.

To explain the interaction of Change x IAPS an ANOVA was applied to the data for the negative and neutral IAPS separately. Results showed that SCL significantly increased from baseline to picture for the negative IAPS, $F$ (1,12) = 15.45, $p$ = .00 but not for the neutral IAPS, $F < 1.0$. The SCL data supported Hypothesis 1. Results for the interaction of IAPS x Gender showed that for the neutral IAPS men had higher SCL than women, $F$ (1,10) = 16.04, $p$ = .00. There was no significant difference in SCL between men and women for the negative IAPS condition, $F < 1.0$.

Table 2 shows the means and standard deviations for HR during baseline and picture in the negative and neutral IAPS condition for men and women.

A repeated measures ANOVA revealed significant effects for Change, $F$ (1,21) = 15.22, $p$ = .00, IAPS, $F$ (1,21) = 4.32, $p$ = .05 and Gender, $F$ (1,21) = 4.63, $p$ = .04. No other factors or interactions were significant. An examination of the means showed that there was a significantly greater decrease in HR for the negative IAPS than for the neutral IAPS. Overall, women had a higher HR than did men. There was a significant decrease in HR from baseline to the picture. The HR data supported Hypothesis 1.

Reported Emotion After the IAPS:

Table 3a, b and c show the means and standard deviations of ratings for the valence dimension of emotion (pleasant/unpleasant), the activation dimension (activation/deactivation) and both dimensions combined, respectively, in the negative and neutral IAPS condition for men and women.

A repeated measures ANOVA for men and women revealed significant effects for Valence x IAPS, $F$ (1,21) = 17.09, $p$ = .00, Activation x IAPS, $F$ (1,21) = 18.02, $p$ = .00, Valence, $F$ (1,21) = 17.76, $p$ = .00 and IAPS, $F$ (1,21) = 10.91, $p$ = .00. The interaction of Valence x Activation was not significant, $F$ (1,21) = 3.44, $p$ = .07. There was no significant difference in reported emotion between men and women, $p$ > .10.

To explain the interaction of Valence x IAPS an ANOVA was applied to the data for unpleasantness and pleasantness separately. Results showed that more pleasantness was reported for the neutral IAPS than for the negative IAPS, $F$ (1,23) = 26.64, $p$ = .00. There was no significant difference between the negative IAPS and neutral IAPS for unpleasantness, $F$ <1.0.

To explain the interaction of Valence x IAPS an ANOVA was applied to the data for deactivation and activation separately. Results showed that more deactivation was reported for the neutral IAPS than for the negative IAPS, $F$ (1,23) = 26.14, $p$ = .00. There was no significant difference between the negative IAPS and neutral IAPS for activation, $F$ (1,23) = 1.10, $p$ = .30. The emotion data supported Hypothesis 1.

**Experiment II:**

Appendix C contains the tables of means and standard deviations for SCL, HR and AAVL performance. Appendix D contains figures for Experiment II.

In Experiment II the IAPS was presented before each AAVL task. So the order of IAPS presentations (IAPSORDER) was counterbalanced. ANOVAs showed that IAPSORDER did not have a significant effect on SCL, HR or number correct on the AAVL, p's>.05. Therefore, IAPSORDER was not included in any further analyses.

SCL and HR to the IAPS:

Table 1 shows the means and standard deviations for SCL during baseline and picture in the negative and neutral IAPS condition for presentation 1 and 2.

A repeated measures ANOVA revealed significant effects for Change x IAPS, $F$ (1,98) = 19.56, $p$ = .00, Change x Presentation, $F$ (1,98) = 20.02, $p$ = .00, Change, $F$ (1,98) = 13.93, $p$ = .00 and Presentation, $F$ (1,98) = 101.31, $p$ = .00. No other factors were significant.

To explain the interaction of Change x IAPS an ANOVA was applied to the data for negative and neutral IAPS separately. Results showed that SCL increased significantly from baseline to picture for the negative IAPS, $F$ (1,49) = 24.84, $p$ = .00 but not for the neutral IAPS, $F$ < 1.0.

The results for SCL during the IAPS presentation 1 in Experiment II were consistent with the results of Experiment I for men. An ANOVA for IAPS presentation 1 revealed a significant interaction of Change x IAPS, $F$ (1,98) = 16.95, $p$ = .00 and Change, $F$ (1,98) = 40.59, $p$ = .00. To explain the interaction of Change x IAPS an ANOVA was applied to the data for the negative and neutral IAPS separately. Results showed that SCL significantly increased from baseline to picture for the negative IAPS, $F$ (1,49) = 45.73, $p$ = .00 but not for the neutral IAPS, $F$ (1,49) = 3.18, $p$ = .08.

To explain the interaction of Change x Presentation an ANOVA was applied to the data for presentation 1 and presentation 2 separately. Results showed that SCL significantly increased from baseline to picture for presentation 1, $F$ (1,99) = 34.96, $p$ = .00 but not for presentation 2, $F$ <1.0.

Table 2 shows the means and standard deviations for HR from baseline to picture in the negative and neutral IAPS condition for presentation 1 and 2.

A repeated measures ANOVA revealed significant effects for Change x IAPS, $F$ (1,96) = 4.84, $p$ = .03, and Presentation, $F$ (1,96) = 8.93, $p$ = .00. No other factors were significant.

To explain the interaction of Change x IAPS an ANOVA was applied to the data for negative and neutral IAPS separately. Results showed that HR significantly decreased from baseline to picture for the negative IAPS, $F$ (1,49) = 7.48, $p$ = .00 but not for the neutral IAPS, $F$ < 1.0. An examination of the mean HR for presentation 1 and 2 showed that overall heart rate was lower during presentation 2 than during presentation 1.

The results for HR during the IAPS presentation 1 in Experiment II were consistent with the results of Experiment I for men. An ANOVA for IAPS presentation I revealed no significant effects for Change x IAPS, $F$ (1,98) = 1.64, $p$ = .20 and Change, $F$ (1,98) = 2.62, $p$ = .10.

<u>AAVL Performance</u>:

In Experiment II participants were presented an affective, positive or negative, and a neutral AAVL. The order of the affective (e.g. positive) and the neutral AAVL was counterbalanced between participants. An ANOVA showed that AAVL order did not have a significant effect on performance on the AAVL, $p$ >.10.

Table 3 shows the means and standard deviation for the number of correct responses on Trial 1 to 3 for the negative and neutral AAVL presented to the right ear in the negative and neutral IAPS condition. Table 4 shows the same measures for the AAVL presented to the left ear.

To evaluate Hypothesis 1 a repeated measures ANOVA for the negative IAPS condition was conducted. The ANOVA revealed no significant effects for Ear of presentation or Type of AAVL, p's>.10. An ANOVA was applied to the data for the negative IAPS and left and right ears separately. Results of the ANOVA for the negative IAPS and RE condition revealed a significant effect for Trials x AAVL, $F$ (2,20) = 4.09, $p$ = .03. ANOVAs for the negative IAPS and LE, neutral IAPS and RE and neutral IAPS and LE conditions revealed no significant effects for AAVL, p's >10.

To explain the interaction of Trials x AAVL for the Negative IAPS and RE condition an ANOVA was applied to the data for Trial 1, 2 and 3 separately. Results showed that more words were correctly recalled for the negative AAVL than for the neutral AAVL on Trial 2, $F$ (2,20) = 14.32, $p$<.01. There was no significant difference between the negative and neutral AAVL for Trial 1 or 3, $F$ < 1.0 and $F$ (2, 20) = 1.82, $p$ >.05, respectively. Hypothesis 1 was partially supported by the results of Trial 2.

Table 5 shows the means and standard deviation for the number of correct responses on Trial 1 to 3 for the negative and positive AAVL presented to the right ear in the negative and neutral IAPS condition. Table 6 shows the same measures for the AAVL presented to the left ear.

To evaluate Hypothesis 2 a repeated measures ANOVA for the negative IAPS condition was conducted. The ANOVA revealed a significant effect for Trials x AAVL, $F$ (2,84) = 4.82, $p$ = .01. There was no significant effect for ear of presentation, $p$>.10. To explain the interaction of Trials x AAVL an ANOVA was applied to the data for Trial 1, 2 and 3 separately. Results showed that more words were correctly recalled for the negative AAVL than for the positive AAVL on Trial 2 and 3, F (1,98) = 8.06, p= .00 and F (1,98) = 8.05, p= .00, respectively. There was no significant difference between the negative and positive AAVL for Trial 1, F > 1.0. Hypothesis 2 was partially supported by the results of Trial 2 and 3.

To evaluate Hypothesis 2 an ANOVA was applied to the data for the negative IAPS and left and right ears separately. The ANOVA for the negative IAPS and RE condition revealed a significant effect for Trials x AAVL, F (2,42) = 4.41, p = .01. ANOVAs for the negative IAPS and LE, neutral IAPS and RE and neutral IAPS and LE conditions revealed no significant effects for AAVL, p's >10.

To explain the interaction of Trials x AAVL for the Negative IAPS and RE condition an ANOVA was applied to the data for Trial 1, 2 and 3 separately. Results showed that more words were correctly recalled for the negative AAVL than for the positive AAVL on Trials 2 and 3, F (2,42) = 4.06, p<.05 and F (2,42) = 6.18, p<.01, respectively. There was no significant difference between the negative and positive AAVL for Trial 1, F (2, 42) = 1.51, p >.05. Hypothesis 2 was partially supported by the results of Trial 2 and 3.

Table 7 shows the means and standard deviation for the number of correct responses on Trial 1 to 3 for the negative and neutral AAVL presented to the left ear and right ear. To evaluate Hypothesis 3 a repeated measures ANOVA for the RE was conducted. The ANOVA revealed no significant effects of AAVL: Trials x AAVL, F < 1.0, AAVL, F < 1.0. A repeated measures ANOVA for the LE revealed no significant effects of AAVL: Trials x AAVL, F < 1.0 and AAVL, F < 1.0. These data failed to support Hypothesis 3.

Table 8 shows the means and standard deviation for the number of correct responses on Trial 1 to 3 for the negative and positive AAVL presented to the left ear and right ear. To evaluate

Hypothesis 3 a repeated measures ANOVA for the LE was conducted. The ANOVA revealed significant effects for Trials x AAVL, F (2, 96) = 3.00, p=.05 and AAVL, F (1,48) = 5.43, p=.02. A repeated measures ANOVA for the RE revealed no significant effects: Trials x AAVL, F (2, 96) = 1.94, p=.14 and AAVL, F (1,48) = 1.66, p=.20. No other factors were significant.

To explain the interaction of Trials x AAVL for the LE an ANOVA was applied to the data for Trial 1, 2 and 3 separately. Results showed that more words were correctly recalled for the negative AAVL than for the positive AAVL in Trial 2 and 3, F (1,48) = 5.89, p=.01 and F (1,48) = 5.85, p=.01, respectively, but not for Trial 1, F < 1.0. Hypothesis 3 was partially supported by the results of Trial 2 and 3.

Table 9 shows the means and standard deviation for number of correct of responses on Trial 1 to 3 for the affective AAVL presented to the left ear and right ear in the negative and neutral IAPS condition.

To evaluate Hypothesis 4 and 5 a repeated measures ANOVA was conducted. The ANOVA revealed no significant effects involving IAPS condition or ear of presentation, Trials x IAPS x Ear, Trials x IAPS, Trials x Ear, and Ear x IAPS, p's>.10, Ear, F (1, 96) = 2.99, p=.08 and IAPS F (1,96) = 2.83, p=.09. These data failed to support Hypothesis 4 and 5.

SCL and HR to the AAVL:

To test the effect of ear of AAVL presentation on SCL and HR, as predicted in Hypothesis 5, a baseline measure had to be established. In Experiment II, order of the AAVL was counterbalanced; some participants received the affective AAVL after IAPS presentation 1 and other participants received the affective AAVL after IAPS presentation 2. Since carryover effects may have obscured the effects of ear of presentation on SCL and HR, SCL and HR during the IAPS that preceded the affective AAVL were used as baseline measures for the analyses of SCL and HR during the presentation of the AVVL. IAPS presentation 1 was used as the baseline when the affective AAVL was completed first; IAPS presentation 2 was used as a baseline when the affective AAVL was completed second.

Table 10a and 10b shows the means and standard deviation for SCL from the right and left hand during the baseline IAPS that preceded the AAVL and at the recitation of the AAVL to the right ear and left ear.

Table 10a show mean SCL when the affective AAVL was received after IAPS presentation 1. A repeated measures ANOVA for SCL revealed no significant effects involving hand or ear, F's $< 1.0$.

Table 10b shows mean SCL when the affective AAVL was received after IAPS presentation 2. A repeated measures ANOVA revealed a significant effect of Change x Hand x Ear, $F(3,147) = 5.93$, $p=.00$. No other factors were significant. To explain the interaction an ANOVA was applied to the data for the RE and LE separately. Results for the RE showed a significant effect for Change x Hand, $F(3,60) = 5.48$, $p=.00$. The were no significant effects for the LE, F's $<1.0$. To explain the interaction in the ANOVA for the RE ANOVAs were conducted for the left and right hand separately. Results showed a significant effect for the change variable for SCL at the right and left hand, $F(3,60) = 7.19$, $p=.00$ and $F(3,60) = 4.69$, $p=.00$. SCL increased more from IAPS presentation to the recitation of the AAVL for the right hand than for the left hand.

Table 11a and 11b shows the means and standard deviation for HR during baseline IAPS that preceded the AAVL and at the recitation of the AAVL to the right ear and left ear.

Table 11a shows mean HR when the affective AAVL was received after IAPS presentation 1. A repeated measures ANOVA revealed no significant effects involving ear, F's $< 1.0$.

Table 11b shows mean HR when the affective AAVL was received after IAPS presentation 2. A repeated measures ANOVA revealed no significant effects involving ear, F's < 1.0. These data failed to support Hypothesis 5.

# Discussion

The present investigation examined the effects of instigated emotion and lateralized presentation of verbal stimuli on the learning of an affectively laden list of word. The present investigation also attempted to assess the separate influences of emotion and arousal on verbal performance. Emotion was elicited using the International Affective Picture System developed by Lang et al. (1997). Experiment I was designed to verify that the negative IAPS does, as the literature suggests, elicit changes in skin conductance level, heart rate and emotion (e.g., Bradley et al., 1996). This experiment also examined gender differences in physiological and emotional responses to the IAPS.

Results of Experiment I demonstrated that presentation of the negative IAPS significantly increased skin conductance level and decreased heart rate relative to that for the neutral IAPS. These results were consistent with the results of Bradley et al. (1996). Bradley showed that unpleasant pictures elicited a greater number of skin conductance responses and a greater deceleration in heart rate relative to that for neutral pictures.

Results for Experiment I also showed that men in the neutral IAPS condition had higher SCL than women did but there were no gender differences in SCL to the negative IAPS condition. Bradley, Codispoti, Sabatinelli, and Lang (2001) also showed that men and women have similar skin conductance response patterns when viewing unpleasant IAPS pictures. The gender differences in the neutral IAPS condition may reflect the finding that men had higher baseline levels of SCL than women. Comparison of the change in SCL from baseline to IAPS picture showed similar increments for men and women. Thus, the finding of a significant gender effect for the neutral IAPS may have been due to initial baseline differences. Additionally, women had higher HR than did men, regardless of IAPS condition. The higher HR for women may be the result of a general physiological difference between men and women. Lash, Gillespie, Eisler and Southard (1991) also showed that women had higher HR than men.

For the measures of self-report of emotion, Experiment I showed that participants in the negative IAPS condition reported less deactivation emotion and less pleasant emotion than did participants in the neutral IAPS condition. These results for the negative IAPS were consistent with characteristics previously reported about the IAPS (Davis et al., 1995). The negative IAPS used in Experiment I have been characterized as being high on unpleasant and activation dimensions of emotion; the neutral IAPS have been characterized as being low on the activation dimension of emotion (Lang et al., 1997). According to the circumplex model of emotion, (Russell, 1980), the dimensions of valence and activation are orthogonal. ANOVA of Experiment I showed that the interaction between valence and activation was not significant.

According to Bradley and Lang (2000), there is a relationship between skin conductance and self-reported level of activation. In Experiment I, the negative IAPS condition was associated with less deactivation and higher SCL than the neutral IAPS condition. The correlation between SCL during the IAPS, controlling for baseline SCL, and self-reported deactivation was $r = -.49$, $p = .01$. The less deactivation reported by the participant, the higher his/her SCL.

In Experiment I there were significant gender differences on the physiological measures of SCL and HR but not in self-reports of emotion, either valence or activation. Kring and Gordon (1998) showed gender differences in SCR but not in reported emotion. Kring and Gordon had men and women view sad, happy and fearful film clips and measured SCR and self-reported emotion to the films clips. Results showed that men had more SCR's than did women to the fearful and happy films. Women had more SCR's to the sad films than did men. However, men and women did not differ in reported emotion to the film clips. Patrick and Lavaro (1997) had men and women view negative, positive and neutral IAPS pictures and had them completed the PANAS (Watson et al., 1988). Results showed that men and women did not differ in their overall report of positive and negative emotion to the IAPS. The only effect of gender occurred when individual IAPS pictures were examined. For example, men rated pictures of snakes higher on positive emotion and pictures of wild animals higher on negative emotion than did women. The lack of gender differences in self-reported emotion in Experiment I were consistent with other research findings.

Experiment II examined the effects of the same IAPS as that used in Experiment I on the learning of the AAVL. As in Experiment I, SCL and HR were measured during the IAPS. The results of SCL and HR data in Experiment II were consistent with those for men in Experiment I. In Experiment II for the first presentation of the IAPS, men in the negative IAPS condition had higher SCL and a greater heart rate deceleration than did men in the neutral IAPS condition. However, in Experiment II the change in SCL and HR from baseline to IAPS presentation was not significant for the second presentation of the IAPS. Figures D1 and D2 show a general trend of increasing SCL and decreasing HR from baseline to picture for presentation 2 that was similar to that for presentation 1 but the changes were not significant.

The main focus of Experiment II was to examine the effects of elicited emotion on performance on the AVVL. Hypothesis 2 predicted that men in the negative IAPS condition would perform better on the negative AAVL than on the positive AAVL. Results showed that men in the negative IAPS condition made significantly more correct responses on the negative AAVL than on the positive AAVL on Trial 2 and 3. These results supported Hypothesis 2 for Mood Congruent Processing Theory (Bower & Forgas, 2000).

According to Bower, individuals are sensitized to information from the environment that is consistent with their current emotional state. The emotion primes the individual's attention to information that is congruent with their current emotional state. As a result the individual should learn that information better than information that is incongruent with their current emotional state. Experiment I demonstrated that the negative IAPS elicited less pleasant emotion than did the neutral IAPS. Since the IAPS in Experiment II are the same as that in Experiment I, the IAPS in Experiment II should have elicited unpleasant emotion. As a result after presentation of the negative IAPS, men may have attended more to the negative AAVL words that were consistent with the negative emotion elicited by the IAPS. Thus, emotional priming lead to better performance on the negative AAVL than on the positive AAVL. Nasby and Yando (1982) reported similar results. They used the Velten Mood Induction Procedure to induce a positive or negative mood in men and had them complete a recall task with affect-laden material. Men in a positive mood demonstrated better recall of positive material than did men in a negative mood. Thus, an induced emotion can facilitate performance when the affect of the test material is consistent with the induced emotion.

From a Mood Congruent Processing view, Hypothesis 1 predicted that men in the negative IAPS condition would perform better on the negative AAVL than on the neutral AAVL. Results showed that for the negative IAPS condition, performance on the negative and neutral AAVL did not differ. These findings failed to support Mood Congruent Processing Theory (Bower & Forgas, 2000). However, it is possible that the presentation of the negative IAPS influenced the men's perceptions of the neutral AAVL in a manner consistent with their existing emotional state. That is the negative IAPS may have elicited a negative emotion that consequently biased the men's' perception of the neutral AAVL toward a negative emotion. If so, the difference in emotional valence between the neutral AAVL and the negative AAVL may have been reduced, mitigating the facilitative effects of negative mood induction on processing the negative AAVL. Isen and Shalker (1982) showed that neutral material is susceptible to mood induction effects. They had participants in either a positive or negative mood view ambiguous slides of local scenes. Participants in a negative mood rated the ambiguous slides as less pleasant than did individuals in a positive emotional state. Finegan and Seligman (1993) asked participants in a positive or negative mood to evaluate a hypothetical inn. Participants in a negative mood reported a more negative attitude toward the inn than did individuals in a positive mood. These two studies showed that the valence of an induced emotion may influence performance on a neutral task. If a similar effect occurred in Experiment II, it could explain the lack of a difference in performance between the negative and neutral AAVL following the negative IAPS presentation.

In Experiment II the AAVL was presented to men's left or right ear. According to Hugdahl (1995), information that is presented to the right ear is more strongly represented in the left than in the right hemisphere; information that is presented to the left ear is more strongly represented in the right than in the left hemisphere. Monoaural presentation of the AAVL was used in Experiment II to assess the involvement of the right and left hemisphere in emotion. Further, Heller (1990, 1993) proposed that negative emotion is associated with relative activation in the right hemisphere and positive emotion is associated with relative activation in the left hemisphere.

From the perspective of Heller, Hypothesis 2 predicted that men in the negative IAPS condition would perform better on the negative AAVL than on the positive AAVL when the AAVL was presented to the left ear; men in the negative IAPS condition would perform more poorly on the negative AAVL than on the positive AAVL when the AAVL was presented to the right ear. Overall analyses of the data showed no interaction of AAVL Type and Ear of presentation. Slight evidence was obtained for the effects of ear of presentation on AAVL performance for analyses of each ear separately but these effects were opposite to what was predicted. Results for right ear presentations showed that men in the negative IAPS condition performed significantly better on the negative AVVL than on the positive AVVL on trial 2 and 3. For left ear presentations, there was no difference in performance between the negative AAVL and the positive AAVL. These results were opposite to those predicted in Hypothesis 2 for the effects of ear of presentation.

Hypothesis 1 predicted that men in the negative IAPS condition would perform better on the negative AVVL presented to the left ear than for the negative AAVL presented to the right ear. Overall analyses of the data showed no effects for AAVL Type or Ear of presentation. Slight evidence was obtained for analyses of each ear separately but these effects were opposite to what was predicted. Results for right ear presentations showed that men in the negative IAPS condition performed significantly better on the negative AVVL than on the neutral AVVL on trial 2. For left ear presentations, there was no difference in performance between the negative AAVL and the neutral AAVL. These results were opposite to those predicted in Hypothesis 2 for the effects of ear of presentation.

One possible explanation of the effect of ear of presentation on AAVL performance may be in terms of allocation of hemispheric resources. According to Kinsbourne and Bemporad (1984) priming effects on performance do not always occur. Interference occurs when tasks are demanding and/or if tasks that are performed compete for resources from similar cerebral regions or in adjacent cerebral regions (Kinsbourne & Hicks, 1978). According to Kinsbourne’s notion of functional cerebral space, the degree of interference on a task varies with the functional distance between the cerebral regions that are involved in the tasks; the closer the functional distance between the cerebral regions the greater the interference.

For example, Damakis, Harrison and Campen (1993) presented high imagery words to participants and asked them to think about the meaning of the words, in order to prime cortical regions. After completing the priming condition, the participants were presented happy or angry faces to the right visual field or left visual field and were asked to identify the emotion displayed by the face. It was predicted that in the imagery condition the time it took to identity the faces would be faster for faces presented to the visual field that was contralateral to the activated hemisphere. Demakis et al. showed that, irrespective of visual field presentation, reaction time was slower for happy than for angry faces in the imagery condition. The happy faces may have involved activation in both hemispheres; the angry faces may have only involved the right hemisphere. Furthermore, the imagery task may have also recruited resources from both hemispheres. As a result there may have been a decrease in available processing resources for processing the emotional faces, which resulted in a slower reaction time for identifying the happy faces relative to the angry faces.

The impact of emotion-inducing stimuli, like the IAPS pictures, on performance presumably involves cortical activity, more specifically activation of the right and left hemispheres. Research by Bradley, Codispoti, Cuthbert and Lang (2001) showed that the negative IAPS pictures that depict threat, mutilation and accidents, elicit negative emotion. Bradley et al. (1996) suggest that the presentation of the negative IAPS pictures may be associated with relative activation of the right hemisphere. Bradley et al. (1996) presented startle probes, loud noises, to the right or left ear during the presentation of negative and positive IAPS pictures and measured eyeblinks to the startle probe. Bradley et al. (1996) showed that when the startle probe was presented to the left ear eyeblinks were larger for negative than for positive IAPS but there was no difference in eyeblinks when the startle probe was presented to the right ear.

The negative IAPS pictures in Experiment II were similar to those used in Bradley (1996). The negative IAPS contained pictures of threat, mutilation and accidents and may have been associated with greater right hemisphere activation. Following the IAPS, the AAVL was presented to the left or right ear. Presentation of the AAVL to the right ear may have resulted in activation of the left hemisphere; presentation of the AAVL to the left ear may have resulted in activation of the right hemisphere. If emotion is organized in the brain in this manner, then it is possible that an emotional response may impact on performance depending not only on the affective valence of the stimulus as suggested by Bower (e.g. 1981) but also on the level of activation in the brain.

Compton et al. (2000) examined how hemispheric asymmetries influenced attention to emotional information. Participants were required to name the color of squares that were presented to the right or left visual field concurrently with neutral, positive or threatening words Compton et al. showed that when the colored squares were presented to a different visual field than the emotional words were, color naming was faster than it was when squares and words were presented to the same visual field. According to Compton, color naming was faster when the squares and words were presented to different visual fields because separate hemispheres processed one piece of information each. When the colored squares and words were presented to the same visual field, one hemisphere had to process both pieces of information and interference occurred.

In Experiment II for presentation of the AAVL to the right ear performance on the negative AVVL was significantly better than that on the positive AAVL. Performance on the negative AVVL was also significantly better than that on the neutral AVVL. Presentation of the negative IAPS may have elicited relative activation of the right hemisphere; presentation of the AAVL to the right ear may have elicited relative activation of the left hemisphere. Thus, separate hemispheres processed only one piece of information each. The right hemisphere processed the negative IAPS; the left hemisphere processed the AAVL. Since there was no competition for hemispheric resources, differential performance on the negative and positive or neutral AVVL occurred. These differences between the negative and positive AAVL occurred because mood congruency and affective priming facilitated performance. The negative IAPS may have biased the men's attention to the negative AVVL and as a result performance was better on the negative than the positive or neutral AAVL. Further, the negative IAPS may have engaged and primed the neural structures engaged in negative emotion (i.e., the right frontal lobe). The representations and action tendencies linked to the engaged system may have been primed (Bradley & Lang, 2000). Priming may have increased the probability that the representations in the brain for negative emotional information were accessed more than the representations for positive emotion. As a result performance was facilitated on the negative AAVL.

In Experiment II for presentation of the AAVL to the left ear there was no difference in performance between the negative and positive or neutral AAVL. Presentation of the negative IAPS may have elicited relative activation of the right hemisphere; presentation of the AAVL to the left ear may have also elicited relative activation of the right hemisphere. Thus, one hemisphere had to process both pieces of information. As a result of this competition for right hemispheric resources, there were no differences in performance between the negative and neutral AAVL or between the negative and positive AAVL. Figures D4 and D6 show the mood congruency effects were attenuated for presentation of the AAVL to the left ear.

Hypothesis 3 predicted that performance on the negative AVVL would be better than performance on the positive AAVL when the AAVL was presented to the left ear; performance on the negative AVVL would be poorer than performance on the positive AAVL when the AAVL was presented to the right ear. Results for left ear presentations showed that significantly more correct responses occurred for the negative AVVL than for the positive AVVL on Trial 2 and 3. For right ear presentations, there was no difference in performance between the negative AAVL and the positive AAVL. These results partially support Hypothesis 3 and Heller's model of emotion (1990, 1993).

According to Heller (1990, 1993), relative activation of the right hemisphere is associated with negative emotion; relative activation of the left hemisphere is associated with positive emotion. The reason that presentation of the negative AAVL to the left ear was better than the positive AVVL may have been due to the fact that the negative AAVL was presented to the hemisphere that preferentially processes negative emotional information, the right hemisphere.

Hypothesis 3 also predicted that performance on the negative AVVL would be better than performance on the neutral AAVL when the AAVL was presented to the left ear. Results of Experiment II showed that performance on the negative AVVL did not differ from that on the neutral AAVL regardless of ear of presentation. These results failed to support Hypothesis 3. This result was surprising and a clear explanation cannot be given at this time.

Hypothesis 4 and 5 evaluated an activation interpretation of the data. Hypothesis 4 predicted that men in the negative IAPS condition would perform better on the AAVL than men in the neutral IAPS condition. It was also predicted that performance on AVVL may be poorer when the AAVL was presented to the left ear than the right ear. Men in the negative IAPS condition did not differ from the men in the neutral IAPS condition on AAVL performance regardless of ear of presentation. There was no difference in performance on the AAVL presented to the left and right ear. These data failed to support Hypothesis 4 and 5. The failure to support these hypotheses suggests that activation is not a plausible explanation for performance differences on the AAVL. The affective valence of the IAPS and the AAVL may have been more salient in this experiment than the level of activation was. As a result, analyses of the effect of activation on performance were not significant. Further, the effects of the negative IAPS on SCL were transient. The effects of the negative IAPS on SCL was only significant for IAPS presentation 1.

Hypothesis 5 predicted that that there would be a greater increase in SCL and HR for the AAVL presented to the left ear than for the AAVL presented to the right ear. To examine Hypothesis 5, SCL and HR during IAPS presentation that preceded the AAVL were used as baseline for each measure. There was no significant change in SCL from baseline to presentation of the AAVL to the left ear, regardless of whether the AAVL was presented after IAPS presentation 1 or 2. However, when the AAVL was presented after IAPS presentation 2 and presented to the right ear, there was a significant change in SCL from the IAPS to the AAVL for the left and right hand. When the AAVL was presented to the right ear there was a greater increase in SCL from the right hand than from the left hand. There were no significant changes in HR from baseline to the presentation of the AVVL presented the left or right ear, regardless of whether the AVVL was presented after IAPS presentation 1 or 2. These data failed to support Hypothesis 5. The data for SCL to the AAVL were inconclusive and fail to support an activation explanation for differences in AAVL performance.

<ins>Summary.</ins> Experiment I verified that the negative IAPS elicited changes in SCL and HR. After viewing the negative IAPS, men and women reported less pleasant emotion and less deactivation. Experiment II showed that presentation of the negative IAPS impacted on performance of an affectively

laden verbal learning task. Support was demonstrated for Bower's Mood Congruent Processing Hypothesis (Bower & Forgas, 2000). After the negative IAPS, men performed better on the negative AAVL than on the positive AAVL. Experiment II also examined how the ear of AAVL presentation influenced the relationship between IAPS-elicited emotion and performance. After the negative IAPS, for the presentation of the AAVL to the right ear but not the left ear, men performed better on the negative AAVL than the positive or neutral AVVL. Evidence suggested that hemispheric interference may play a role in the relationship between emotion and performance. Further, mood congruent processing is influenced by hemispheric interference. The results failed to support an activation explanation for the effects of emotion on performance. Thus, it seems that the effect of emotion on performance is a function of mood congruent processing and the allocation of hemispheric resources.

Future Directions. In Experiment I, SCL and HR were averaged across the IAPS presentation. In future studies SCL and HR should be measured at the beginning, middle and end of the IAPS presentation. By measuring SCL and HR at different points during the IAPS, the effects of gender on physiological responding to the IAPS may be elucidated. Research has suggested that there are gender differences in emotional expression (e.g. Bradley et al., 2001) and the lack of significant gender differences in physiological and emotional responses to the IAPS in Experiment I was surprising.

In Experiment II, presentation of the negative IAPS did not facilitate performance on the negative AAVL relative to the neutral AAVL. This finding suggests that men's interpretation of neutral AAVL may have been influenced by their affective state that was elicited by the IAPS. Future research should further examine the effect of negative emotion on the perception and learning of neutral information. Further, the effects of ear of presentation on AAVL performance in the negative IAPS condition were opposite to the predicted direction. For example, for left ear presentations there were more correct responses for the negative AVVL than for the positive AVVL; there was no difference in performance between AAVL types for left ear presentations. A closer examination is needed of the role of hemispheric resources in the relationship between emotion and performance. This study and others may give researchers a better understanding of the relationship between cognition and emotion and the factors that moderate this relationship.

Implications. The findings of Experiment II may be relevant to understanding individual differences in the perception and recall of affective situations. For example, high hostile individuals are more prone to experience anger and also have a tendency to interpret situations more negatively than low hostile individuals. This difference may be a function how emotion impacts on cognitions. If this is the case then research may be directed at finding ways to redirect the negative influence of emotion so that it has beneficial effects. Results of Experiment II may also be used to further understand the effect that neurological damage has on performance and may lead to the development of treatments to overcome performance deficits in different populations.

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**Appendix A**

Tables for Experiment I

Table 1. Mean (standard deviations) SCL during baseline and picture in the negative and neutral IAPS condition for men and women.

| | | Baseline | Picture |
|---|---|---|---|
| Negative IAPS | Men | 9.12 (4.65) | 12.17 (5.47) |
| | Women | 7.50 (3.54) | 11.36 (5.31) |
| Neutral IAPS | Men | 12.25 (6.28) | 12.43 (4.73) |
| | Women | 3.28 (2.17) | 3.05 (1.81) |

Table 2. Mean (standard deviations) HR during baseline and picture in the negative and neutral IAPS condition for men and women.

| | | Baseline | Picture |
|---|---|---|---|
| Negative IAPS | Men | 64.51 (5.89) | 60.56 (74.87) |
| | Women | 77.33 (12.45) | 74.54 (13.00) |
| Neutral IAPS | Men | 76.46 (7.76) | 74.87 (9.81) |
| | Women | 79.21 (10.30) | 78.27 (10.58) |

Table 3a. Mean (standard deviation) pleasant and unpleasant dimension of emotion in the negative and neutral IAPS condition for men and women.

| | | Pleasant | Unpleasant |
|---|---|---|---|
| Negative IAPS | Men | 2.028 (.599) | 1.790 (.325) |
| | Women | 1.783 (.509) | 1.997 (.637) |
| Neutral IAPS | Men | 3.237 (.560) | 1.795 (.477) |
| | Women | 2.750 (.483) | 1.705 (.542) |

Table 3b. Mean (standard deviation) activation and deactivation dimension of emotion in the negative and neutral IAPS condition for men and women.

| | | Activation | Deactivation |
|---|---|---|---|
| Negative IAPS | Men | 2.207 (.498) | 1.611 (.698) |
| | Women | 1.991 (.611) | 1.788 (.328) |
| Neutral IAPS | Men | 2.050 (.454) | 2.983 (.361) |
| | Women | 1.760 (.331) | 2.700 (.744) |

Table 3c. Mean (standard deviation) emotion (unpleasant activation, pleasant activation, unpleasant deactivation and pleasant deactivation) in the negative and neutral IAPS condition for men and women.

| | | Unpleasant Activation | Pleasant Activation | Unpleasant Deactivation | Pleasant Deactivation |
|---|---|---|---|---|---|
| Negative IAPS | Men | 2.12 (.394) | 2.28 (.861) | 1.45 (.524) | 1.77 (.962) |
| | Women | 2.21 (1.13) | 1.76 (.355) | 1.77 (.201) | 1.80 (.769) |
| Neutral IAPS | Men | 1.38 (.462) | 2.71 (.667) | 2.20 (.674) | 3.75 (.512) |
| | Women | 1.32 (.422) | 2.19 (.447) | 2.08 (.998) | 3.31 (.664) |

**Appendix B**

<u>Graphs for Experiment I</u>

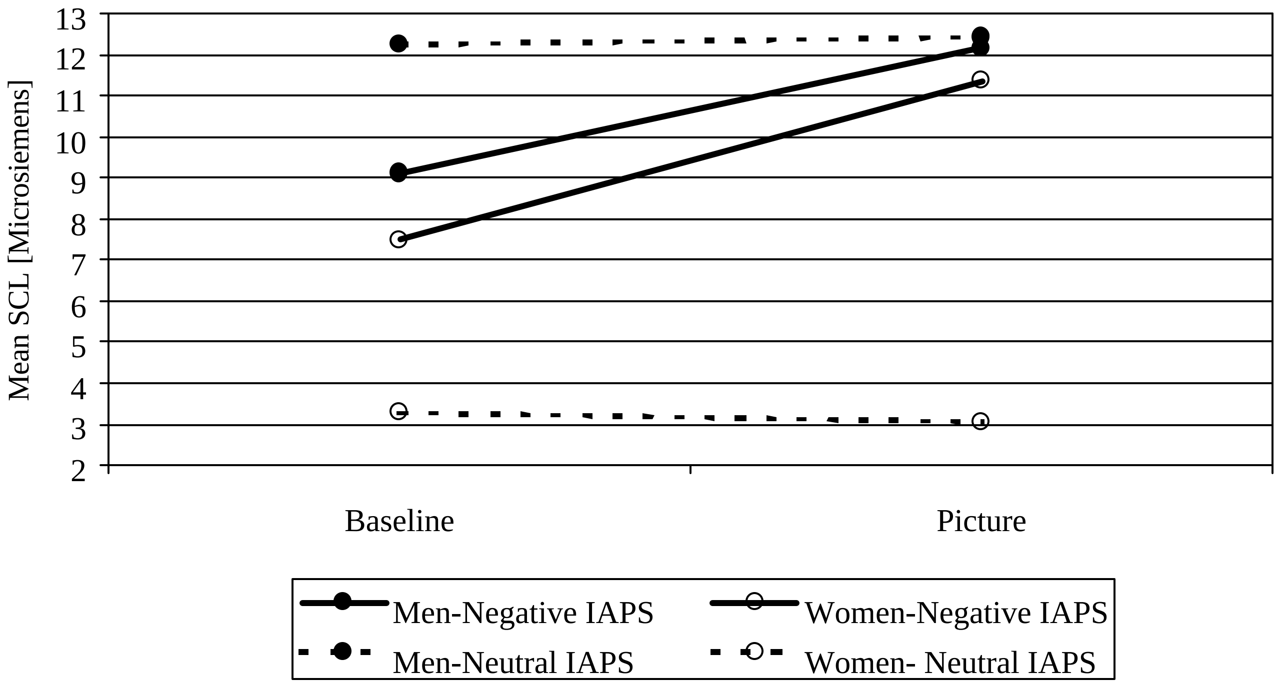



Figure B1. Mean SCL during baseline and picture in the negative and neutral IAPS condition for men and women.

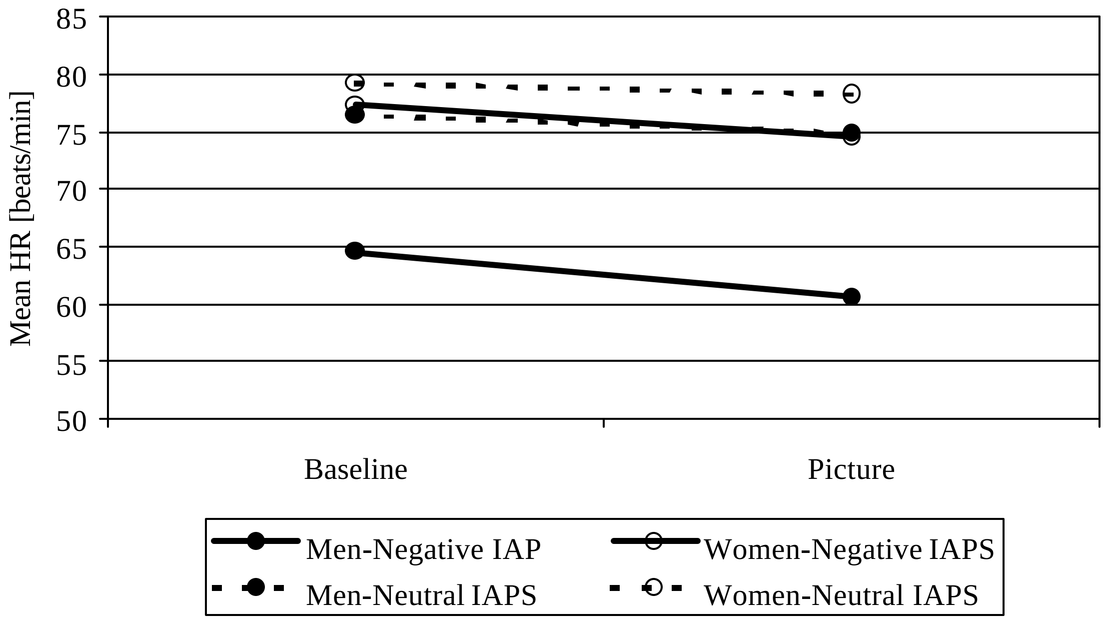



Figure B2. Mean HR during baseline and picture in the negative and neutral IAPS condition for men and women.

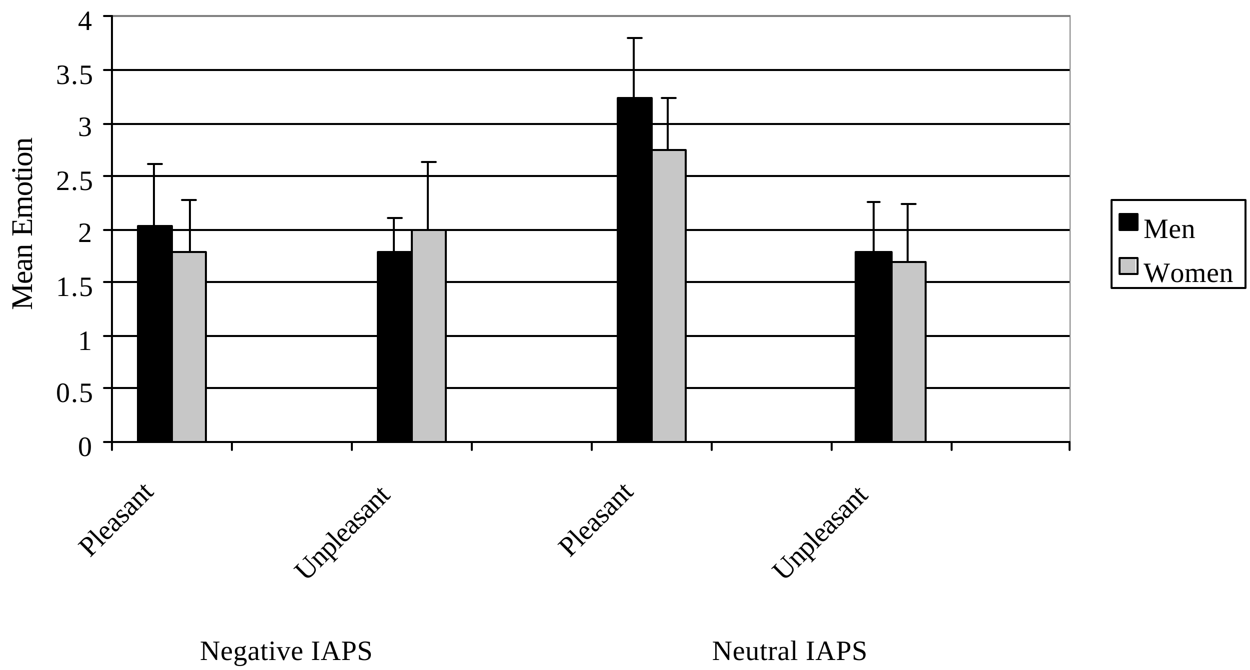



Figure B3. Mean pleasant and unpleasant emotion in the negative and neutral IAPS condition for men and women.

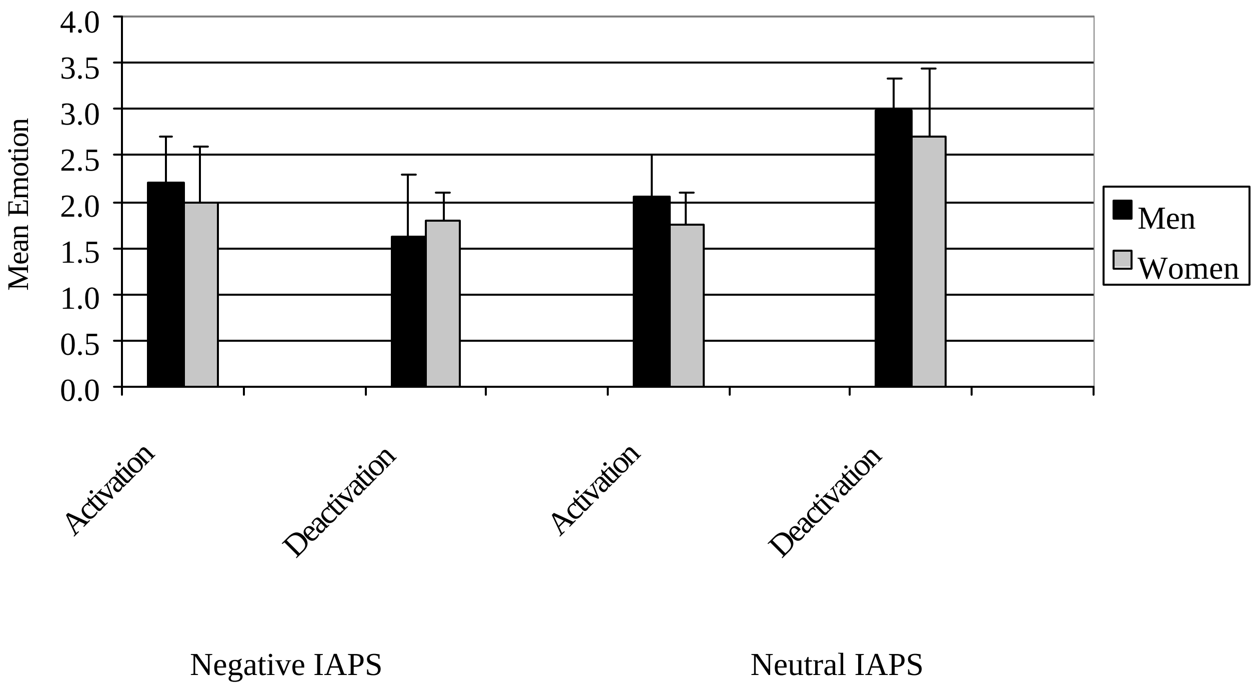



Figure B4. Mean activation and deactivation dimension of emotion in the negative and neutral IAPS condition for men and women.

**Appendix C**

Tables for Experiment II

Table 1. Mean (standard deviations) SCL during baseline and picture in the negative and neutral IAPS condition for presentation 1 and 2.

| | | Baseline | Picture |
|---|---|---|---|
| Negative IAPS | Presentation 1 | 8.90 (4.65) | 10.64 (4.94) |
| | Presentation 2 | 11.60 (5.06) | 12.17 (5.74) |
| Neutral IAPS | Presentation 1 | 9.40 (5.76) | 9.78 (6.03) |
| | Presentation 2 | 11.84 (6.33) | 11.72 (6.09) |

Table 2. Mean (standard deviations) HR during baseline and picture in the negative and neutral IAPS condition for presentation 1 and 2.

| | | Baseline | Picture |
|---|---|---|---|
| Negative IAPS | Presentation 1 | 71.82 (10.26) | 70.66 (10.18) |
| | Presentation 2 | 71.05 (9.41) | 69.75 (8.65) |
| Neutral IAPS | Presentation 1 | 73.46 (13.21) | 73.33 (12.90) |
| | Presentation 2 | 71.79 (12.54) | 72.13 (12.07) |

Table 3. Mean (standard deviations) Number of Correct Responses on Trial 1 to 3 for the Negative and Neutral AAVL Presented to the Right Ear in the Negative and Neutral IAPS Condition

| | | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|
| Negative IAPS | Negative AAVL | 6.83 (1.85) | 9.75 (2.17) | 10.50 (2.02) |
| | Neutral AAVL | 7.00 (2.89) | 8.53 (2.46) | 10.08 (2.03) |
| Neutral IAPS | Negative AAVL | 6.69 (1.43) | 9.15 (1.14) | 10.38 (1.80) |
| | Neutral AAVL | 7.23 (1.48) | 9.23 (1.83) | 10.61 (1.89) |

Table 4. Mean (standard deviations) Number of Correct Responses on Trial 1 to 3 for the Negative and Neutral AAVL Presented to the Left Ear in the Negative and Neutral IAPS Condition

| | | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|
| Negative IAPS | Negative AAVL | 6.83 (1.11) | 9.33 (1.23) | 10.25 (1.42) |
| | Neutral AAVL | 6.83 (1.58) | 8.66 (1.96) | 10.0 (2.62) |
| Neutral IAPS | Negative AAVL | 6.58 (1.16) | 8.91 (1.78) | 9.66 (2.01) |
| | Neutral AAVL | 5.58 (1.50) | 8.33 (1.72) | 9.50 (1.93) |

Table 5. Mean (standard deviations) Number of Correct Responses on Trial 1 to 3 for the Negative and Positive AAVL Presented to the Right Ear in the Negative and Neutral IAPS Condition

| | | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|
| Negative IAPS | Negative AAVL | 6.83 (1.85) | 9.75 (2.17) | 10.50 (2.02) |
| | Positive AAVL | 7.38 (1.32) | 8.84 (1.46) | 9.38 (1.93) |
| Neutral IAPS | Negative AAVL | 6.69 (1.43) | 9.15 (1.14) | 10.38 (1.80) |
| | Positive AAVL | 6.25 (1.91) | 8.58 (1.72) | 9.75 (2.13) |

Table 6. Mean (standard deviations) Number of Correct Responses on Trial 1 to 3 for the Negative and Positive AAVL Presented to the Left Ear in the Negative and Neutral IAPS Condition

| | | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|
| Negative IAPS | Negative AAVL | 6.83 (1.11) | 9.33 (1.23) | 10.25 (1.42) |
| | Positive AAVL | 6.92 (1.55) | 8.38 (1.04) | 9.15 (1.77) |
| Neutral IAPS | Negative AAVL | 6.58 (1.16) | 8.91 (1.78) | 9.66 (2.01) |
| | Positive AAVL | 6.15 (1.51) | 7.53 (2.36) | 8.30 (1.88) |

Table 7. Mean (standard deviations) Number of Correct Responses on Trial 1 to 3 for the Negative and Neutral AAVL Presented to the Right and Left Ear

| | | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|
| Negative AAVL | Right Ear | 6.76 (1.61) | 9.44 (1.70) | 10.44 (1.87) |
| | Left Ear | 6.76 (1.12) | 9.12 (1.51) | 9.95 (1.73) |
| Neutral AAVL | Right Ear | 7.12 (2.22) | 8.92 (2.13) | 10.36 (2.03) |
| | Left Ear | 6.20 (1.64) | 8.50 (1.81) | 9.75 (2.26) |

Table 8. Mean (standard deviations) Number of Correct Responses on Trial 1 to 3 for the Negative and Positive AAVL Presented to the Right and Left Ear

| | | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|
| Negative AAVL | Right Ear | 6.76 (1.61) | 9.44 (1.70) | 10.44 (1.87) |
| | Left Ear | 6.70 (1.12) | 9.12 (1.51) | 9.95 (1.73) |
| Positive AAVL | Right Ear | 6.84 (1.70) | 8.72 (1.56) | 9.56 (2.00) |
| | Left Ear | 6.53 (1.55) | 7.96 (1.84) | 8.73 (1.84) |

Table 9. Mean (standard deviations) Number of Correct Responses on Trial 1 to 3 for the Affective AAVL Presented to the Right and Left Ear in the Negative and Neutral IAPS Condition

| | | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|
| Negative IAPS | Right Ear | 7.12 (1.58) | 9.28 (1.86) | 9.92 (2.01) |
| | Left Ear | 6.88 (1.33) | 8.84 (1.21) | 9.68 (1.67) |
| Neutral IAPS | Right Ear | 6.48 (1.66) | 8.88 (1.45) | 10.08 (1.95) |
| | Left Ear | 6.36 (1.35) | 8.20 (2.17) | 8.96 (2.03) |

Table 10a. Mean (standard deviation) SCL from the right and left hand during IAPS Presentation 1 and at the recitation of the AAVL presented to the left and right ear.

| | | IAPS 1 | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|---|
| Right Ear | Right Hand | 10.43 (5.07) | 14.49 (5.28) | 15.69 (4.61) | 15.04 (4.45) |
| | Left Hand | 10.22 (5.21) | 14.08 (5.75) | 15.76 (4.45) | 15.07 (4.30) |
| Left Ear | Right Hand | 10.90 (5.80) | 14.85 (5.99) | 15.32 (4.93) | 15.13 (4.84) |
| | Left Hand | 11.06 (6.25) | 14.70 (6.15) | 15.08 (5.15) | 15.08 (5.09) |

Table 10b. Mean (standard deviation) SCL from the right and left hand during IAPS Presentation 2 and at the recitation of the AAVL presented to the left and right ear.

| | | IAPS 2 | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|---|
| Right Ear | Right Hand | 10.32<br>(5.91) | 12.43<br>(5.50) | 13.49<br>(4.20) | 13.02<br>(3.77) |
| | Left Hand | 10.52<br>(5.72) | 12.64<br>(5.92) | 12.99<br>(4.20) | 12.53<br>(3.73) |
| Left Ear | Right Hand | 11.43<br>(6.63) | 12.77<br>(6.76) | 13.17<br>(6.02) | 12.87<br>(6.11) |
| | Left Hand | 11.35<br>(6.65) | 12.54<br>(6.67) | 13.16<br>(6.13) | 13.11<br>(5.92) |

Table 11a. Mean (standard deviation) HR during IAPS Presentation 1 and at the recitation of the AAVL presented to the left and right ear.

| | IAPS 1 | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|
| Right Ear | 71.65<br>(9.71) | 82.75<br>(14.42) | 80.73<br>(12.12) | 77.66<br>(11.62) |
| Left Ear | 70.63<br>(14.11) | 80.49<br>(18.68) | 78.30<br>(15.25) | 76.77<br>(15.64) |

Table 11b. Mean (standard deviation) HR during IAPS Presentation 2 and at the recitation of the AAVL presented to the left and right ear.

| | IAPS 2 | Trial 1 | Trial 2 | Trial 3 |
|---|---|---|---|---|
| Right Ear | 69.46<br>(72.63) | 81.70<br>(11.85) | 77.32<br>(14.40) | 77.26<br>(12.49) |
| Left Ear | 72.63<br>(8.91) | 85.20<br>(14.35) | 80.24<br>(12.20) | 77.81<br>(10.55) |

**Appendix D**

Graphs for Experiment II

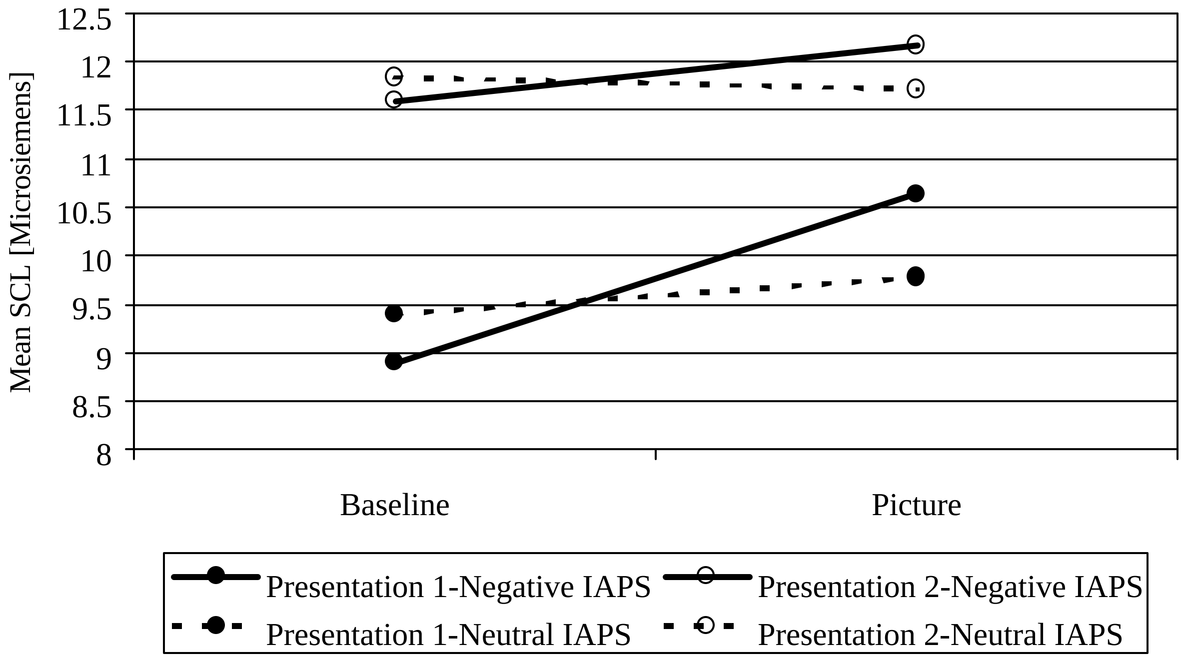



Figure D1. Mean (standard deviations) SCL during baseline and picture in the negative and neutral IAPS condition for presentation 1 and 2.

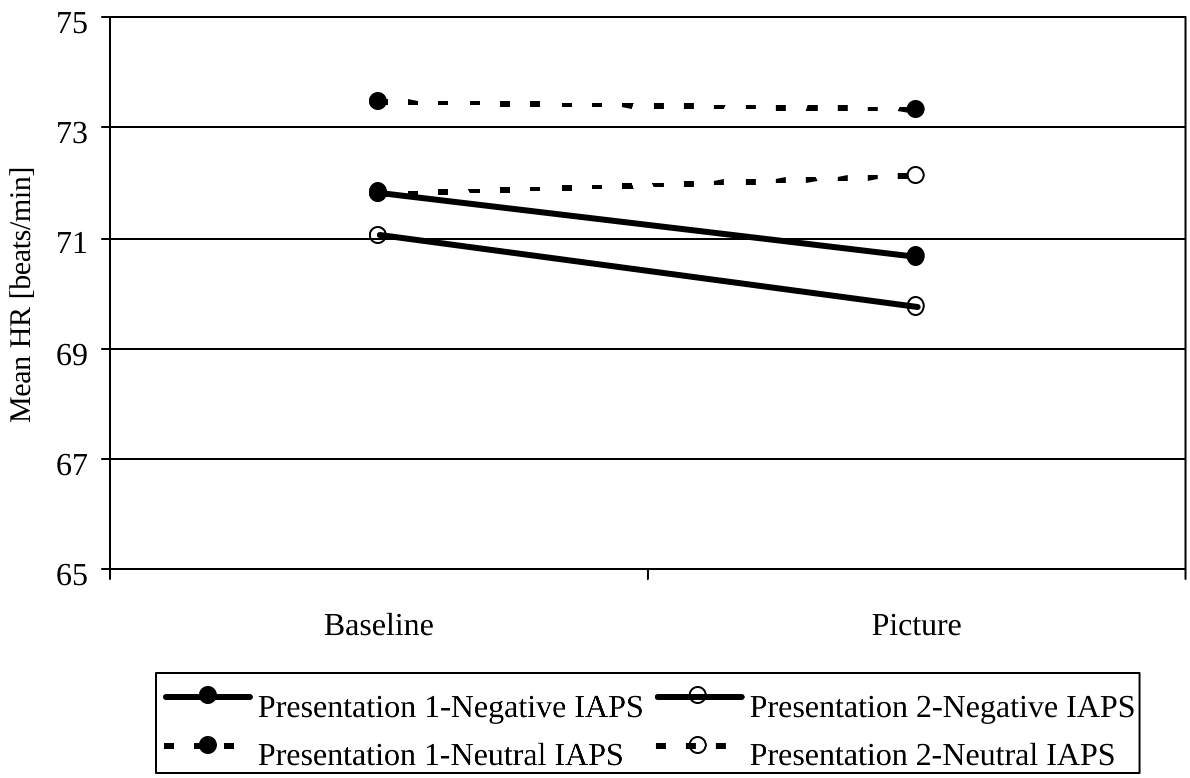



Figure D2. Mean HR during baseline and picture in the negative and neutral IAPS condition for presentation 1 and 2.

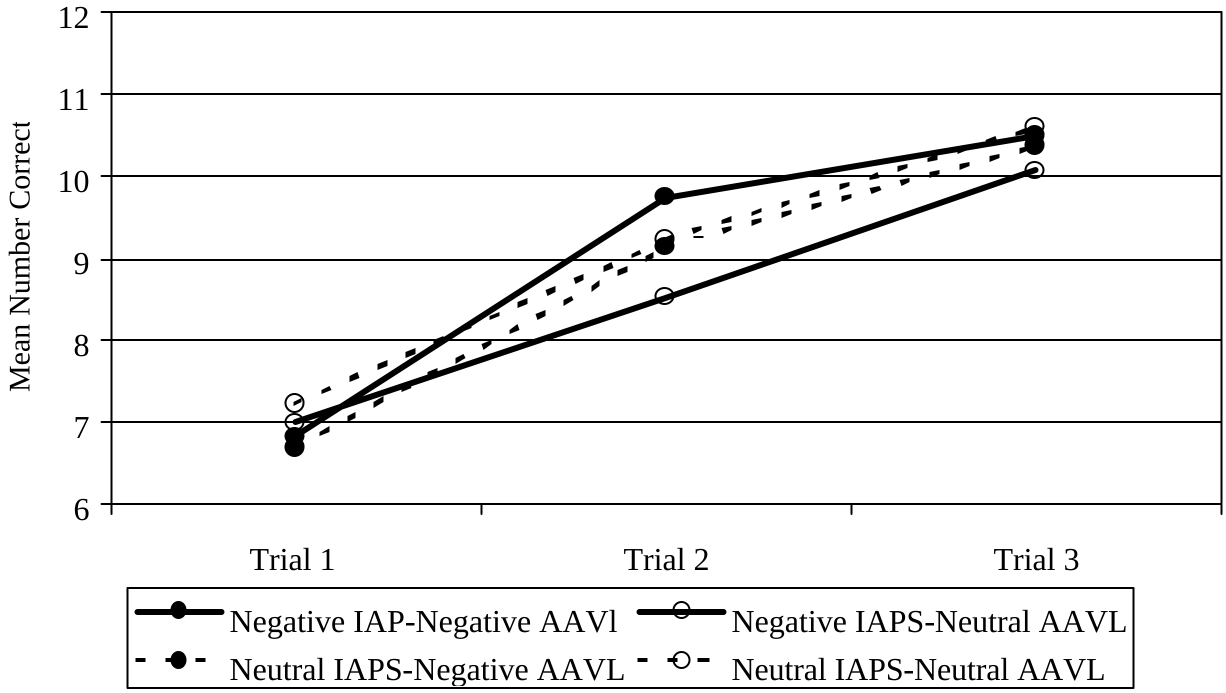



Figure D3. Mean Number of Correct Responses on Trial 1 to 3 for the Negative and Neutral AAVL Presented to the Right Ear in the Negative and Neutral IAPS Condition.

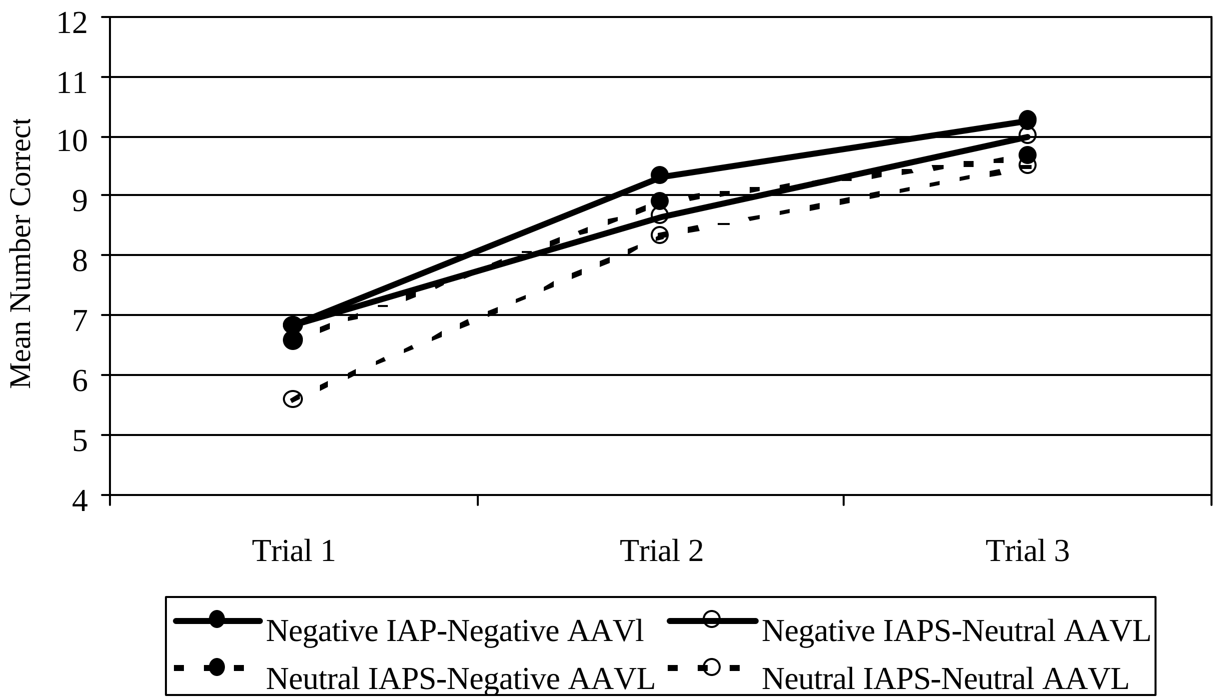



Figure D4. Mean Number of Correct Responses on Trial 1 to 3 for Negative and Neutral AAVL Presented to the Left Ear in the Negative and Neutral IAPS Condition.

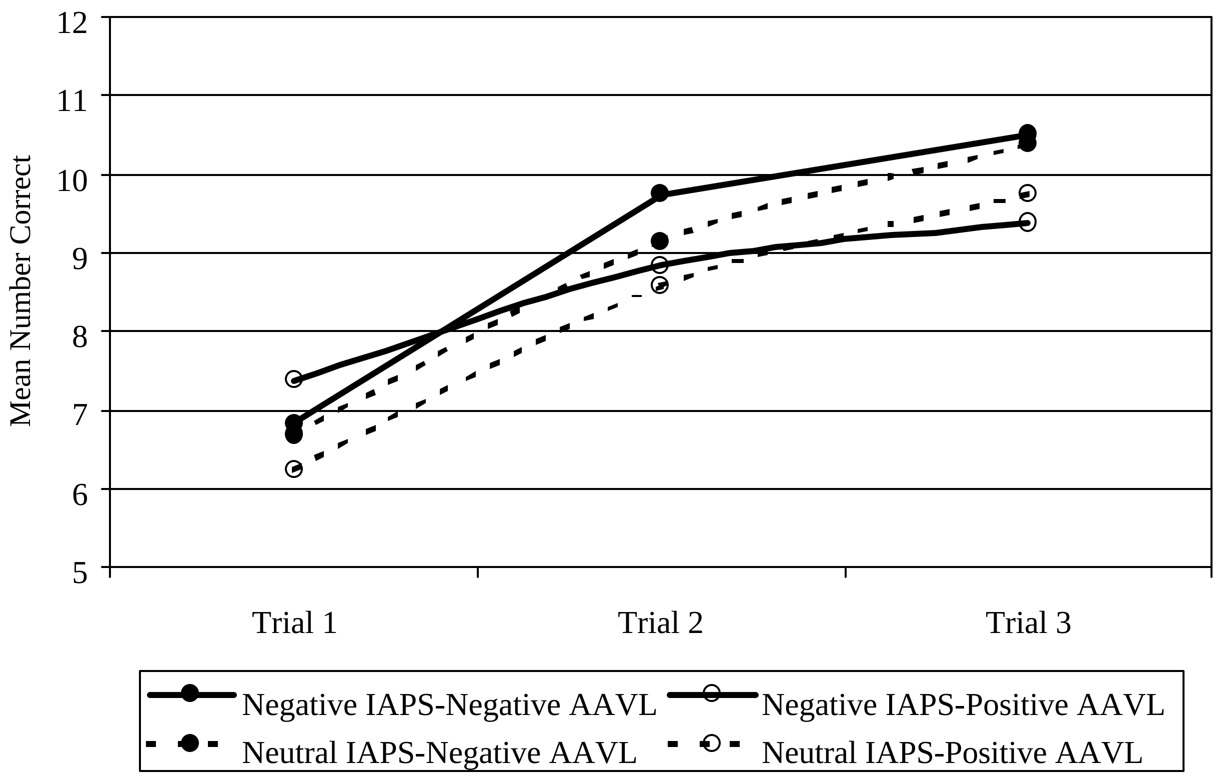



Figure D5. Mean Number of Correct Responses on Trial 1 to 3 for the Negative and Positive AAVL Presented to the Right Ear in the Negative and Neutral IAPS Condition.

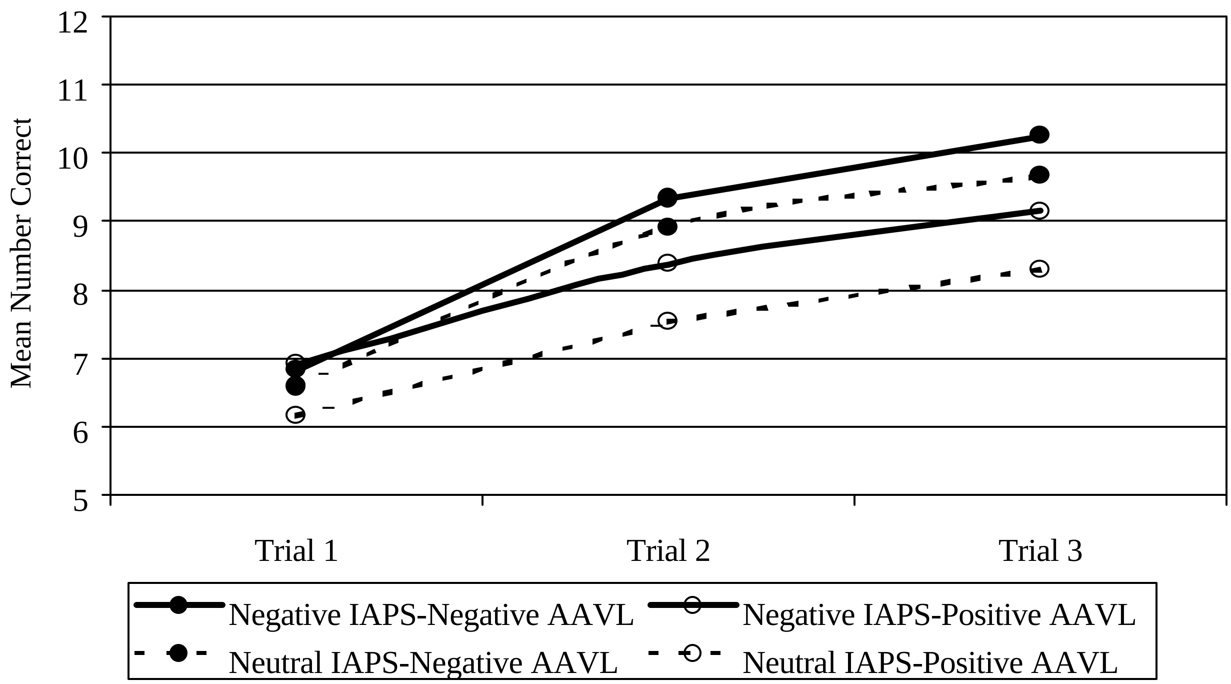



Figure D6. Mean Number of Correct Responses on Trial 1 to 3 for the Negative and Positive AAVL Presented to the Left Ear in the Negative and Neutral IAPS Condition

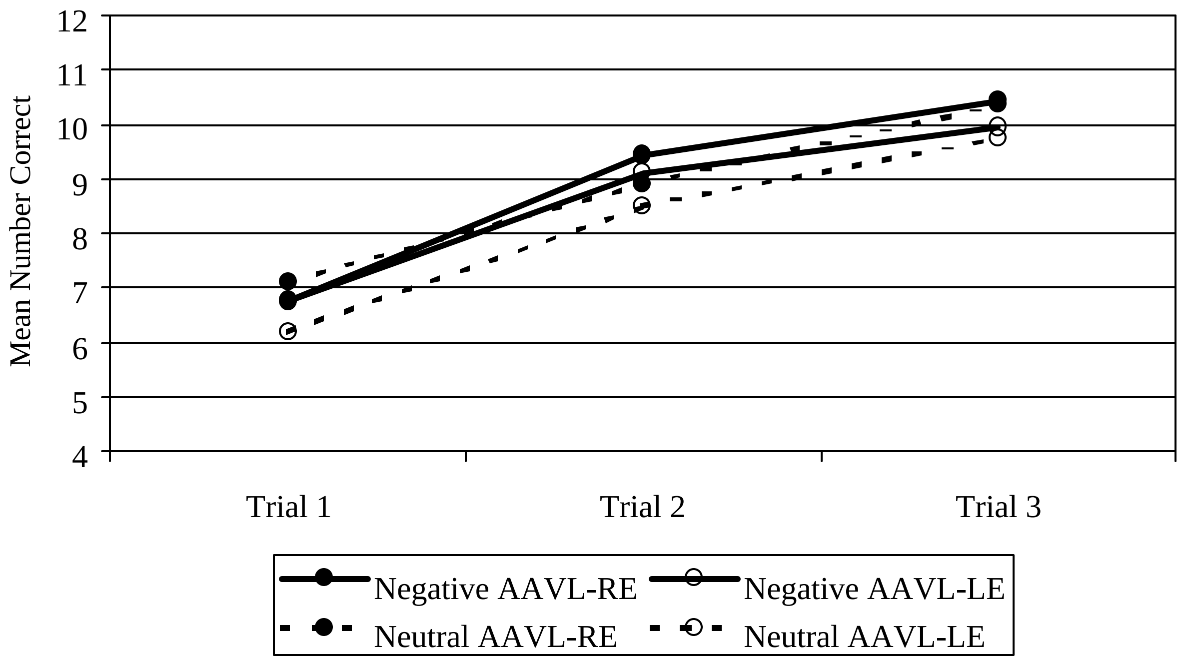
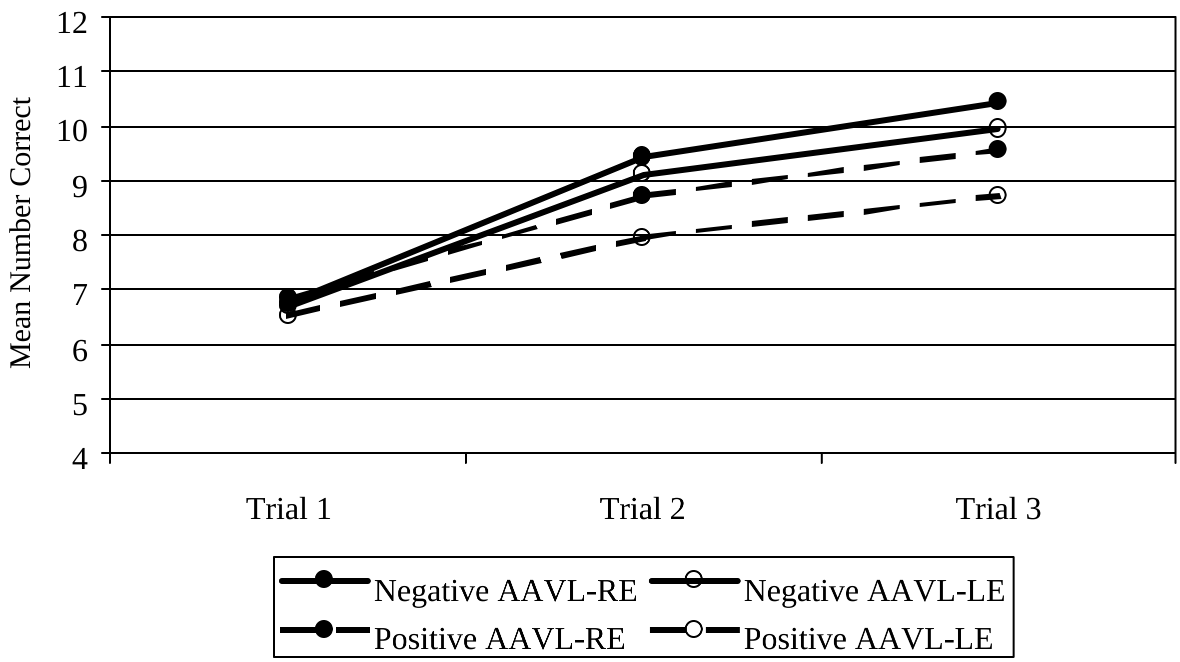
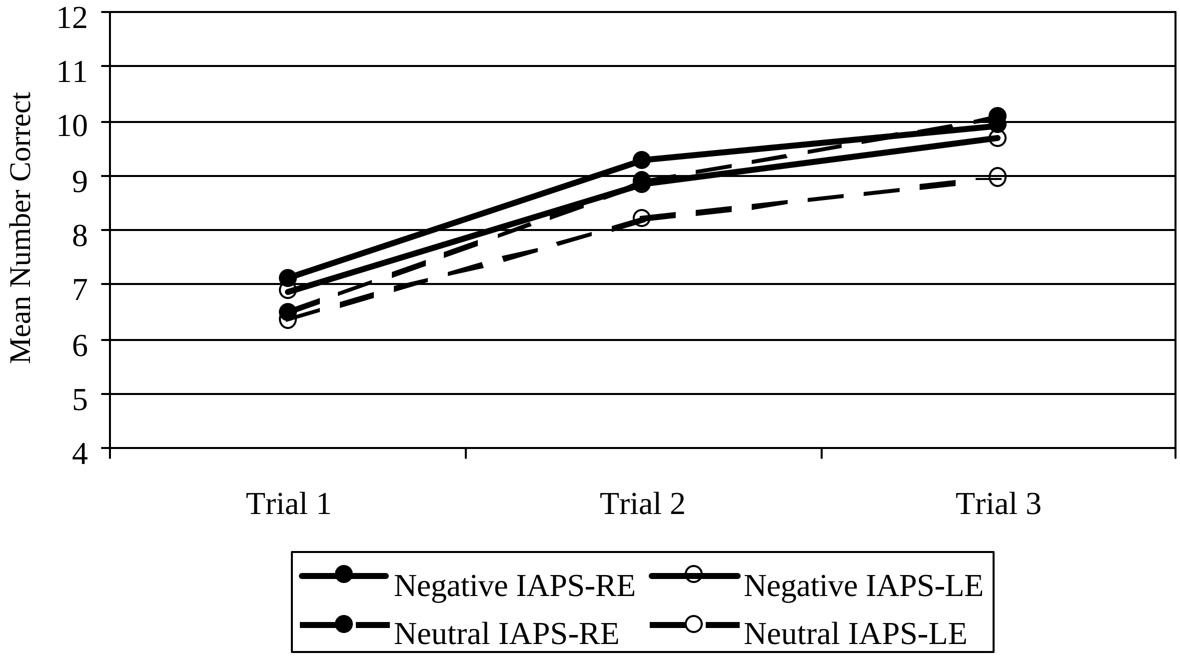



Figure D7. Mean Number of Correct Responses on Trial 1 to 3 for the Negative and Neutral AAVL Presented to the Right and Left Ear




D8. Mean Number of Correct Responses on Trial 1 to 3 for the Negative and Positive AAVL Presented to the Right and Left Ear




D9. Mean Number of Correct Responses on Trial 1 to 3 for the Affective AAVL Presented to the Right and Left Ear in the Negative and Neutral IAPS Condition

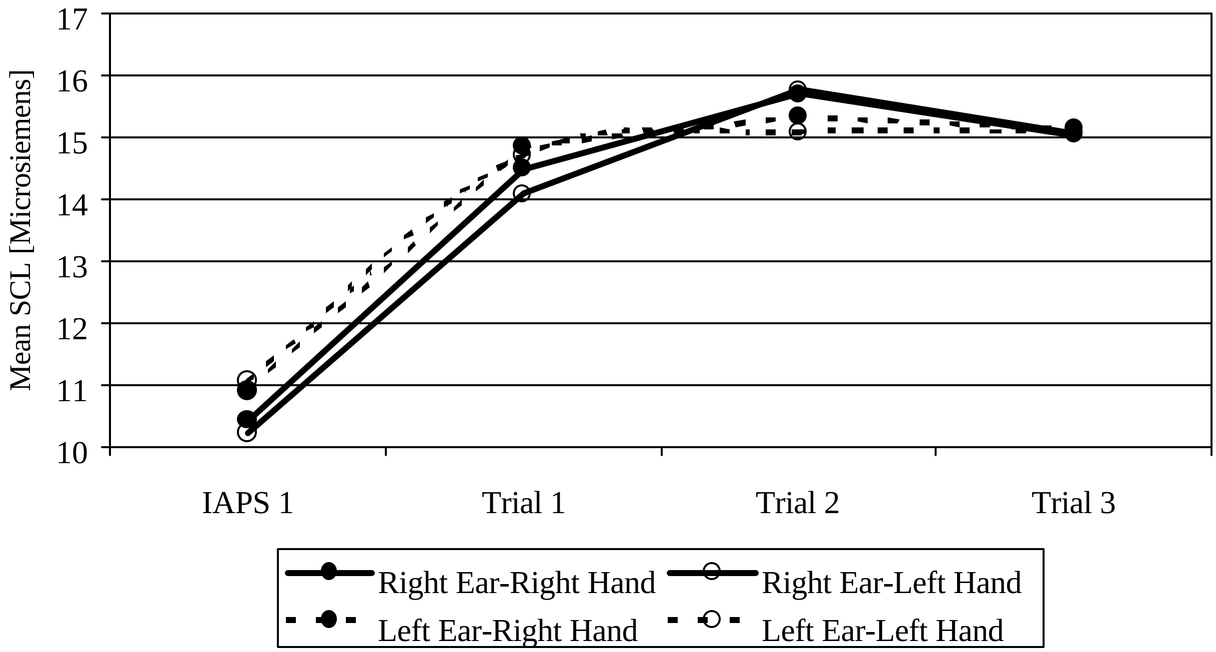



Figure D10. Mean (standard deviation) SCL from the right and left hand during IAPS Presentation 1 and at the recitation of the AAVL presented to the left and right ear.

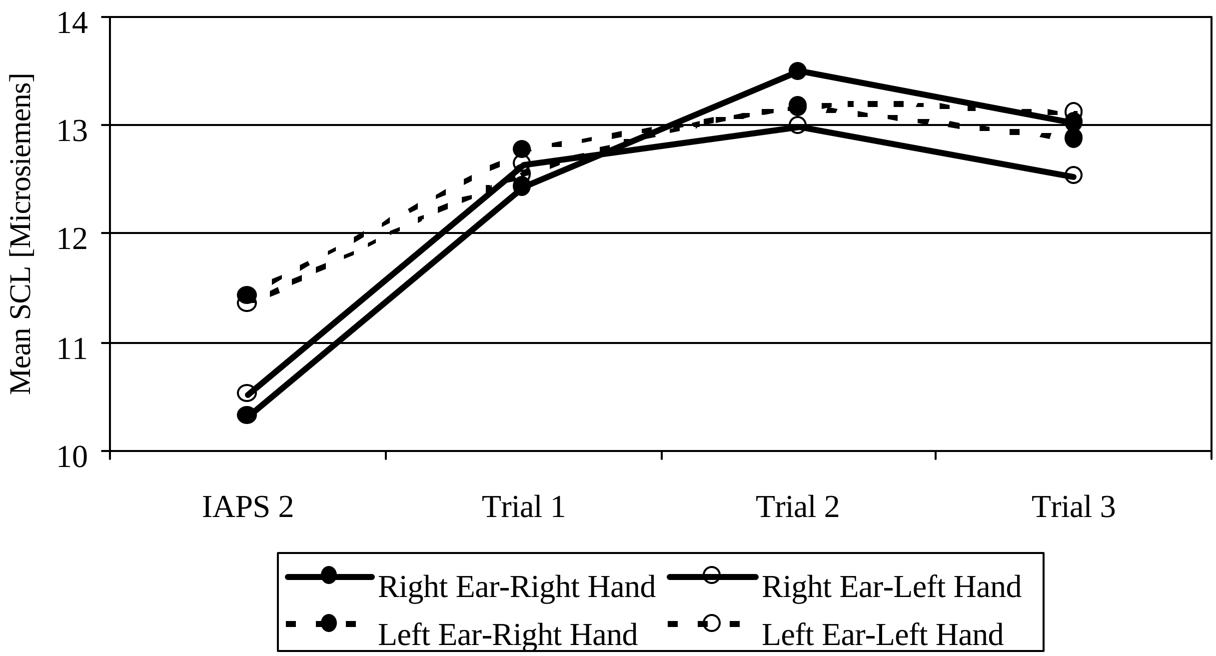



Figure D11. Mean (standard deviation) SCL from the right and left hand during IAPS Presentation 2 and at the recitation of the AAVL presented to the left and right ear.

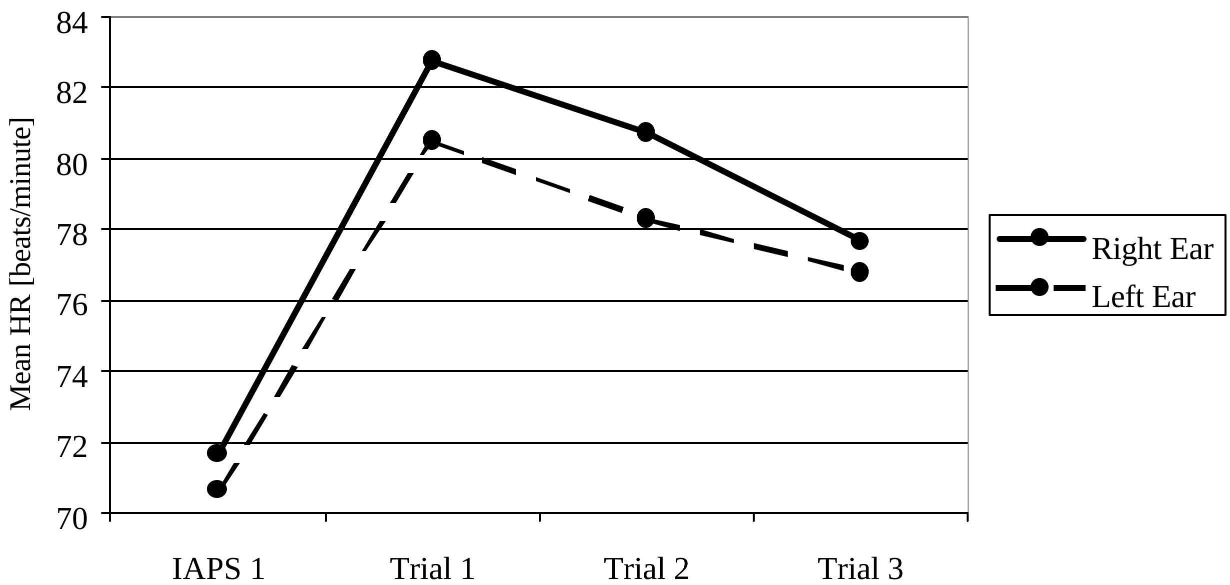



Figure D12. Mean (standard deviation) HR during IAPS Presentation 1 and at the recitation of the AAVL presented to the left and right ear.

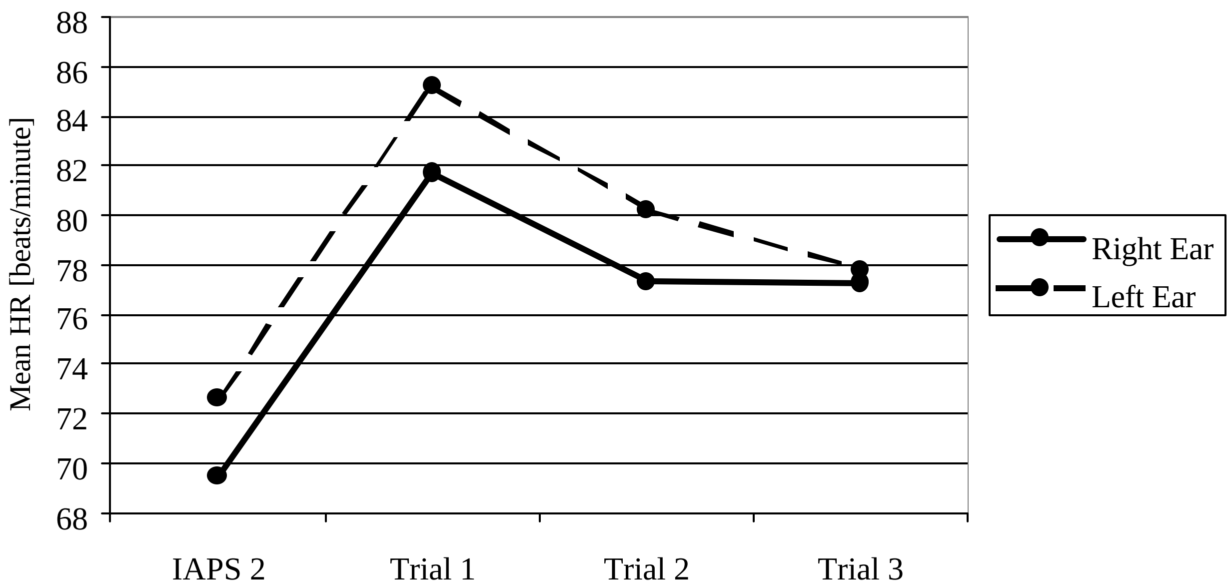
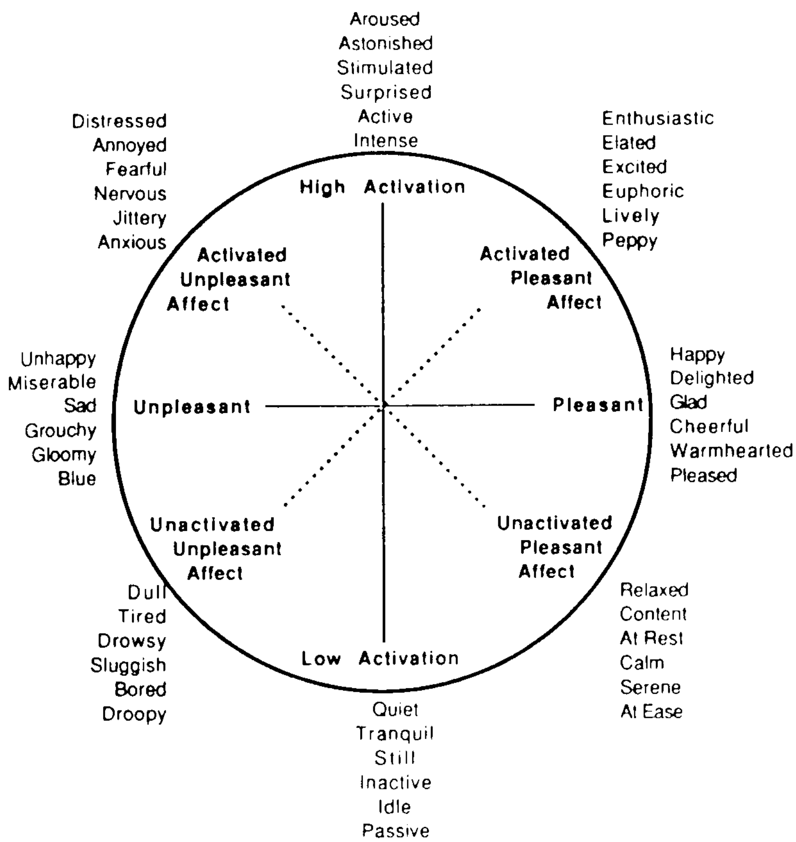



Figure D13. Mean (standard deviation) HR during IAPS Presentation 2 and at the recitation of the AAVL presented to the left and right ear.

## Appendix E

The Circumplex Model of Emotion



**Appendix F**

Informed Consent for Participants in the Screening Phase

**Title of Project:** Cognitive and Physiological Responses in College Students
**Investigators:** Keryl Ann Cosenzo, B. A., Joseph J. Franchina, Ph.D.

I. **The Purpose of this Project.** The purpose of this study is to assess your characteristics for phase II of this experiment. The main experiment will examine the cognitive and physiological responses of college students.

II. **Procedures.** You will be asked to come to an assigned room at an assigned time and complete the questionnaires given to you. These questionnaires will assess various characteristics about you. Additionally, you will receive a form requesting your participation in a subsequent phase of this study. This process should require less than one hour.

III. **Risks.** There are no apparent risks to you for participating in this study. However, you may contact Counseling Services (231-6557) or the Psychological Services Center of Virginia Tech (231-6914) if you should have any problems.

IV. **Benefits.** Your responses will provide us with valuable information that will help us determine if your characteristics fit the criteria for phase II of this study.

V. **Extent of Anonymity and Confidentiality.** The responses that you provide will be completely confidential. That is, your responses will not be released to anyone other than individuals working on the project without your consent. Additionally, your names will not be attached to the questionnaires and this consent form will be collected prior to your receiving the questionnaires. If you choose to participate in the second phase of this study, the contact information you provide will be destroyed upon completion of your participation.

VI. **Compensation.** You may receive one point extra credit toward your psychology course for participation in the present study. Please check with your instructor or your instructor's syllabus for alternative ways to receive extra credit in the course. Additionally, you may have the opportunity to earn one additional point extra credit through participation in the latter phase of the study.

VII. **Freedom to Withdraw.** You may skip questions that you do no want to answer and you are free to withdraw your participation at any time without penalty.

VIII. **Approval of Research.** This research project has been approved, as required, by the Human Subjects Committee of the Department of Psychology and by the Institutional Review Board of Virginia Tech.

IX. **Subject's Responsibilities.** I voluntarily agree to participate in this study and complete the questionnaires.

X. **Subject's Permission.** I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project.

If I participate, I may withdraw at any time without penalty. I agree to abide by the rules of this project.

__________________________________ ____________________

Signature Date

Should I have any questions about this research or its conduct, I may contact:

| | |
|---|---|
| Primary Researchers: | Keryl A. Cosenzo, Joseph J. Franchina, Ph.D<br>231-5388 |
| Research Advisor: | Joseph J. Franchina, Ph.D.<br>231-5664 |
| Chair, Human Subjects Committee: | Dave W. Harrison, Ph.D<br>231-4422 |
| Chair, Institutional Review Board: | David M. Moore, DVM<br>231-4991 |

You will receive a copy of this form.

**Appendix G**

Demographics Questionnaire

1. Age:_____

2. Academic Level: Circle One
   1. Freshman
   2. Sophomore
   3. Junior
   4. Senior

3. Ethnicity: Circle One
   1. Caucasian
   2. African-American
   3. Hispanic
   4. Asian-American
   5. Other________

**Appendix H**

<u>Neurological Screening Form</u>

Have you ever experienced or been diagnosed with any of the following, or are you experiencing any of the following at present? Please circle the appropriate response and explain "Yes" answers below.

| | | | |
|---|---|---|---|
| 1. | Vision difficulties, blurred vision, or eye disorders | Yes | No |
| 2. | Blindness in either eye | Yes | No |
| 3. | If Yes to either of the above, have problems been corrected | Yes | No |
| 4. | Severe head trauma/injury | Yes | No |
| 5. | Stroke | Yes | No |
| 6. | Learning disabilities (problems of reading, writing, or comprehension) | Yes | No |
| 7. | Epilepsy or seizures | Yes | No |
| 8. | Paralysis | Yes | No |
| 9. | Neurological surgery | Yes | No |
| 10. | Alcohol abuse | Yes | No |
| 11. | Prescription medication | Yes | No |
| 12. | Psychiatric difficulties | Yes | No |
| 13. | Arthritis | Yes | No |
| 14. | Heart or lung problems | Yes | No |
| 15. | Reynaud's syndrome | Yes | No |
| 16. | Psoriasis or skin problems | Yes | No |

Please explain any "Yes" responses:

**Appendix I**

Laterality Questionnaire

Circle the appropriate number after each item:

| | Right | Left | Both |
|---|---|---|---|
| With which hand would you throw a ball to hit a target? | 1 | -1 | 0 |
| With which hand do you draw? | 1 | -1 | 0 |
| With which hand do you use an eraser on paper? | 1 | -1 | 0 |
| With which hand do you remove the top card when dealing? | 1 | -1 | 0 |
| With which foot do you kick a ball? | 1 | -1 | 0 |
| If you wanted to pick up a pebble with your toes, which foot would you use? | 1 | -1 | 0 |
| If you had to step up onto a chair, which foot would you place on the chair first? | 1 | -1 | 0 |
| Which eye would you use to peep through a keyhole? | 1 | -1 | 0 |
| If you had to look into a dark bottle to see how full it was, which eye would you use? | 1 | -1 | 0 |
| Which eye would you use to sight down a rifle? | 1 | -1 | 0 |
| If you wanted to listen to a conversation going on behind a closed door, which ear would you place against the door? | 1 | -1 | 0 |
| If you wanted to listen to someone's heartbeat, which ear would you place against their chest? | 1 | -1 | 0 |
| Into which ear would you place the earphone of a transistor radio? | 1 | -1 | 0 |

# of Right + # of Left = Total Score

___________+___________= Total Score

Is mother left or right hand dominant? __________ Is father left or right hand dominant? __________

**Appendix J**

Informed Consent for Participants in Experiment I

**Title of Project:** The Effects of Picture Viewing on Physiological Activity
**Investigators:** Keryl Ann Cosenzo, M.S., Joseph J. Franchina, Ph.D.

I. **The Purpose of this Project.** You are invited to participate in a study that will examine how viewing pictures influences physiological activity.

II. **Procedures.** The aim of this study is to understand the effects of viewing stimuli on physiological activity. I will explain each task to you before you have to do the task. Your heart rate and skin conductance will be measured during the experiment. I will place electrodes on the second and third fingers of your left and right hand. Heart rate will be measured using a finger plethysmograph connected to the first finger of your left hand.

III. **Risks.** There are no apparent risks to you for participating in this study. However, you may contact Counseling Services (231-6557) or the Psychological Services Center of Virginia Tech (231-6914) if you should have any problems.

IV. **Benefits.** Your responses will provide us with valuable information that will help us more formally explore the relationship between visual stimuli and physiological activity.

V. **Extent of Anonymity and Confidentiality.** The responses that you provide will be completely confidential. That is, your responses will not be released to anyone other than individuals working on the project without your consent. Additionally, your names will not be attached to the questionnaires and this consent form will be collected prior to your receiving the questionnaires. If you choose to participate in the second phase of this study, the contact information you provide will be destroyed upon completion of your participation.

VI. **Compensation.** You may receive one point extra credit toward your psychology course for participation in the present study. Please check with your instructor or your instructor's syllabus for alternative ways to receive extra credit in the course. Additionally, you may have the opportunity to earn one additional point extra credit through participation in the latter phase of the study.

VII. **Freedom to Withdraw.** You may skip questions that you do no want to answer and you are free to withdraw your participation at any time without penalty.

VIII. **Approval of Research.** This research project has been approved, as required, by the Human Subjects Committee of the Department of Psychology and by the Institutional Review Board of Virginia Tech.

IX. **Subject's Responsibilities.** I voluntarily agree to participate in this study and complete the questionnaires.

X. **Subject's Permission.** I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project.

If I participate, I may withdraw at any time without penalty. I agree to abide by the rules of this project.

____________________________________ ______________________

Signature Date

Should I have any questions about this research or its conduct, I may contact:

| | |
|---|---|
| Primary Researchers: | Keryl A. Cosenzo, Joseph J. Franchina, Ph.D<br>231-5388 |
| Research Advisor: | Joseph J. Franchina, Ph.D.<br>231-5664 |
| Chair, Human Subjects Committee: | Dave W. Harrison, Ph.D<br>231-4422 |
| Chair, Institutional Review Board: | David M. Moore, DVM<br>231-4991 |

You will receive a copy of this form.

**Appendix K**

Informed Consent for Participants in Experiment II

**Title of Project:** The Effects of Picture Viewing on Physiological Activity and Task Performance
**Investigators:** Keryl Ann Cosenzo, M.S., Joseph J. Franchina, Ph.D.

I. **The Purpose of this Project.** You are invited to participate in a study that is examining how picture viewing influences physiological activity and task performance

II. **Procedures.** The aim of this study is to understand the effects of physiological activity on task performance. I will explain each task to you before you have to do the task. You will wear headphones to hear components of the task and to block out any distracting noise. Your heart rate and skin conductance will be measured during the experiment. I will place electrodes on the second and third fingers of your left and right hand. Heart rate will be measured using a finger plethysmograph connected to the first finger of your left hand.

III. **Risks.** There are no apparent risks to you for participating in this study. However, you may contact Counseling Services (231-6557) or the Psychological Services Center of Virginia Tech (231-6914) if you should have any problems.

IV. **Benefits.** Your responses will provide us with valuable information that will help us more formally explore the relationship between visual stimuli, physiological activity and task performance.

V. **Extent of Anonymity and Confidentiality.** The responses that you provide will be completely confidential. That is, your responses will not be released to anyone other than individuals working on the project without your consent. Additionally, your names will not be attached to the questionnaires and this consent form will be collected prior to your receiving the questionnaires. If you choose to participate in the second phase of this study, the contact information you provide will be destroyed upon completion of your participation.

VI. **Compensation.** You may receive one point extra credit toward your psychology course for participation in the present study. Please check with your instructor or your instructor's syllabus for alternative ways to receive extra credit in the course. Additionally, you may have the opportunity to earn one additional point extra credit through participation in the latter phase of the study.

VII. **Freedom to Withdraw.** You may skip questions that you do no want to answer and you are free to withdraw your participation at any time without penalty.

VIII. **Approval of Research.** This research project has been approved, as required, by the Human Subjects Committee of the Department of Psychology and by the Institutional Review Board of Virginia Tech.

IX. **Subject's Responsibilities.** I voluntarily agree to participate in this study and complete the questionnaires.

X. **Subject's Permission.** I have read and understand the Informed Consent and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project.

If I participate, I may withdraw at any time without penalty. I agree to abide by the rules of this project.

____________________________________ ______________________

Signature Date

Should I have any questions about this research or its conduct, I may contact:

| | |
|---|---|
| Primary Researchers: | Keryl A. Cosenzo, Joseph J. Franchina, Ph.D<br>231-5388 |
| Research Advisor: | Joseph J. Franchina, Ph.D.<br>231-5664 |
| Chair, Human Subjects Committee: | Dave W. Harrison, Ph.D<br>231-4422 |
| Chair, Institutional Review Board: | David M. Moore, DVM<br>231-4991 |

You will receive a copy of this form.

**Appendix L**

International Affective Picture System

Negative IAPS:

| Description (Set) | Slide # | Valence | Arousal |
|---|---|---|---|
| Mutilation (1) | 3000 | 1.69 (1.47) | 6.74 (1.47) |
| Mutilation (4) | 3000 | 2.21 (1.86) | 6.92 (2.44) |
| Mutilation (2) | 3010 | 2.20 (1.36) | 6.83 (2.86) |
| Mafia Hit (3) | 3010 | 2.19 (1.42) | 7.12 (1.75) |
| Mutilation (1) | 3030 | 2.31 (1.87) | 3.97 (2.59) |
| Burn Victim (7) | 3053 | 1.50(1.16) | 6.20(2.71) |
| Mangled Face (5) | 3060 | 1.94 (1.39) | 6.89 (2.08) |
| Throat Slash (6) | 3071 | 2.06 (1.59) | 6.61 (2.13) |
| Mangled Face (6) | 3080 | 1.63 (1.11) | 6.84 (2.06) |
| Burn Victim (2) | 3100 | 1.88 (1.14) | 5.88 (2.34) |
| Burn Victim (7) | 3102 | 1.62 (1.39) | 5.88 (2.39) |
| Burn Victim (6) | 3110 | 2.10 (1.56) | 6.43 (2.26) |
| Body (1) | 3120 | 1.80 (1.32) | 6.20(1.55) |
| Body (1) | 3130 | 1.90 (1.57) | 6.56 (2.11) |
| Finger (2) | 3150 | 2.59 (1.56) | 6.10(2.29) |
| Baby w/Tumor (3) | 3170 | 1.77 (1.31) | 6.79 (1.93) |
| Chest Cavity (3) | 3250 | 3.92 (1.96) | 6.10 (1.75) |
| Severed Hand (5) | 3400 | 2.67 (2.01) | 6.67 (2.29) |
| Gun (5) | 3500 | 2.50 (1.24) | 6.80 (2.04) |
| Gun in Mouth (6) | 3530 | 2.10 (1.53) | 6.85 (2.13) |
| Aimed Gun (1) | 6200 | 3.36 (1.60) | 5.80 (2.36) |
| Aimed Gun (2) | 6230 | 2.73 (1.63) | 7.10 (2.07) |
| Aimed Gun (5) | 6250 | 2.98 (1.97) | 6.35 (2.74) |
| Aimed Gun (6) | 6260 | 2.53 (1.63) | 7.10 (1.90) |
| Knife (5) | 6300 | 3.30 (1.67) | 6.37 (1.73) |
| Abduction (8) | 6312 | 2.88 (1.48) | 5.90 (2.35) |
| Attacking (7) | 6313 | 2.43 (1.42) | 6.54 (2.11) |
| Knife (5) | 6350 | 2.39 (1.42) | 7.04 (1.73) |
| Ski Mask (5) | 6370 | 3.24 (1.55) | 6.28 (1.97) |
| Man w/Knife (6) | 6510 | 2.86 (1.76) | 6.76 (2.33) |
| Hitting Woman (6) | 6530 | 2.86 (1.94) | 6.02 (2.09) |
| Man w/ Knife (6) | 6540 | 2.53 (1.84) | 6.51 (2.27) |
| Knife (6) | 6550 | 3.39 (2.63) | 6.98 (2.13) |
| Gun (5) | 6560 | 2.57 (1.49) | 6.17 (2.28) |

| | | | |
|---|---|---|---|
| Gun Tohead (6) | 6570 | 2.29 (1.84) | 6.06 (2.44) |
| Plane Crash (2) | 9050 | 3.05 (1.07) | 6.05 (2.01) |
| Soldier (2) | 9160 | 3.71 (1.49) | 5.66 (1.96) |
| War Victim (3) | 9250 | 2.85 (1.47) | 6.50 (1.66) |
| Dead Body (7) | 9252 | 2.51 (1.78) | 6.27 (2.30) |
| Mutilation (9) | 9253 | 2.51 (1.23) | 5.38 (2.16) |
| Soldier (4) | 9410 | 1.96 (1.56) | 6.38 (2.26) |
| Ship (5) | 9600 | 3.11 (1.80) | 6.20 (2.13) |
| Shipwreck (8) | 9620 | 3.27 (1.61) | 5.88 (2.10) |
| Bomb (6) | 9630 | 2.96 (1.94) | 6.29 (2.38) |
| Skinhead (6) | 9800 | 2.48 (1.85) | 5.96 (2.66) |
| KKK Rally (6) | 9810 | 2.25 (1.84) | 6.74 (2.33) |
| Auto Accident (5) | 9910 | 2.35 (1.34) | 6.00 (2.10) |
| Fire (7) | 9921 | 2.60 (1.68) | 6.09 (1.88) |

Neutral IAPS:

| Description (Set) | Slide # | Valence | Arousal |
|---|---|---|---|
| Cow (2) | 1670 | 5.76 (1.36) | 3.10 (1.88) |
| Happy Adult (1) | 2000 | 5.93 (1.86) | 2.92 (1.75) |
| Happy Adult (1) | 2010 | 5.75 (1.71) | 2.90(1.95) |
| Happy Adult (1) | 2020 | 5.40 (1.82) | 3.28 (1.78) |
| Man (4) | 2190 | 4.73 (1.25) | 2.27 (1.72) |
| Neutral Adult (1) | 2200 | 4.64 (1.18) | 2.33 (1.78) |
| Neutral Face (2) | 2210 | 4.81 (.087) | 2.66 (1.71) |
| Neutral Boy (9) | 2270 | 5.69 (1.04) | 3.07 (1.87) |
| Young Girl (10) | 2320 | 5.45 (1.33) | 2.56 (1.68) |
| Neutral Girl (10) | 2440 | 4.44 (1.08) | 2.44 (1.57) |
| Elderly Man (9) | 2480 | 4.76 (1.23) | 2.80 (1.81) |
| Old Man (10) | 2570 | 4.60 (1.37) | 2.51 (1.84) |
| Chess (9) | 2580 | 5.25 (1.33) | 2.72 (1.79) |
| Woman (4) | 2620 | 5.73 (1.35) | 3.04 (2.39) |
| Male (4) | 2630 | 4.88 (1.38) | 2.38 (1.91) |
| Male Urinating (4) | 2720 | 5.71 (1.53) | 3.00 (1.90) |
| Chess (10) | 2840 | 4.92 (1.79) | 2.31 (1.88) |
| Tourist (9) | 2850 | 4.69 (1.40) | 2.58 (1.79) |
| Boy in Car (9) | 2870 | 5.17 (0.94) | 2.87 (1.75) |
| Shadow (9) | 2880 | 5.13 (0.77) | 2.68 (1.93) |

| | | | |
|---|---|---|---|
| Twin Men (5) | 2890 | 4.87 (1.08) | 3.02 (1.94) |
| Male Nude (3) | 4470 | 4.79 (1.16) | 3.31 (2.02) |
| Male Erotic (2) | 4520 | 4.76 (0.86) | 2.68 (1.77) |
| Man (8) | 4532 | 5.15 (1.36) | 2.73 (1.74) |
| Male Erotica (7) | 4534 | 4.72 (1.27) | 3.11 (2.06) |
| Man (9) | 4536 | 5.24 (1.08) | 2.96 (1.92) |
| Man (10) | 4571 | 4.73 (1.28) | 2.31 (1.85) |
| Flowers (1) | 5030 | 5.88 (1.67) | 2.43 (2.00) |
| Pine Needles (9) | 5120 | 4.72 (0.93) | 2.85 (2.04) |
| Pot and Rock (10) | 5130 | 4.37 (1.17) | 2.33 (1.50) |
| Rowboats (10) | 5390 | 5.13 (1.56) | 2.95 (1.83) |
| Mushroom (1) | 5500 | 5.49 (1.67) | 2.82 (2.58) |
| Mushroom (1) | 5510 | 5.20 (1.52) | 2.78 (2.29) |
| Mushroom (1) | 5520 | 5.28 (1.74) | 2.95 (2.63) |
| Mushroom (1) | 5530 | 5.33 (1.64) | 2.87 (2.47) |
| Mushroom (8) | 5533 | 5.12 (1.29) | 3.08 (2.02) |
| Mushroom (8) | 5534 | 4.71 (1.60) | 2.88 (2.18) |
| Door/Flowers (8) | 5731 | 5.19 (1.62) | 2.44 (1.87) |
| Plant & Soil (10) | 5740 | 5.07 (1.27) | 2.36 (1.77) |
| Rolling Pin (2) | 7000 | 4.93 (0.45) | 2.73 (1.86) |
| Towel (7) | 7002 | 4.91 (0.97) | 2.99 (1.81) |
| Spoon (9) | 7004 | 4.89 (0.60) | 2.09 (1.75) |
| Bowl (8) | 7006 | 4.65 (1.10) | 2.08 (1.58) |
| Mug (7) | 7009 | 4.96 (1.05) | 2.69 (1.95) |
| Basket (1) | 7010 | 4.95 (1.43) | 1.55 (1.36) |
| Fan (9) | 7020 | 5.02 (1.22) | 2.15 (1.71) |
| Iron (6) | 7030 | 4.82 (0.99) | 2.76 (2.13) |
| Hammer (8) | 7034 | 5.00 (1.10) | 3.15 (1.93) |
| Mug (8) | 7035 | 4.81 (1.05) | 2.56 (1.80) |
| Dust Pan (5) | 7040 | 4.72 (1.19) | 2.46 (1.86) |
| Hair Dryer (2) | 7050 | 4.81 (0.71) | 2.59 (1.79) |
| Trash Can (2) | 7060 | 4.59 (0.86) | 2.71 (1.75) |
| Fork (1) | 7080 | 5.43 (1.26) | 1.98 (1.63) |
| Boot (1) | 7090 | 4.95 (1.54) | 2.30 (1.90) |
| Fire Hydrant (3) | 7100 | 5.29 (0.92) | 3.08 (1.67) |
| Hammer (10) | 7110 | 4.51 (1.02) | 1.91 (1.39) |
| Truck (3) | 7130 | 4.79 (1.14) | 3.54 (2.01) |
| Bus (6) | 7140 | 5.59 (1.34) | 2.67 (2.33) |
| Umbrella (2) | 7150 | 4.76 (0.73) | 2.66 (1.68) |
| Fabric (9) | 7160 | 4.98 (0.97) | 3.06 (2.08) |
| Light bulb (2) | 7170 | 4.90 (0.94) | 3.15 (1.85) |
| Lamp (10) | 7175 | 4.78 (1.18) | 1.55 (0.96) |
| Chair w/ neon (10) | 7180 | 4.76 (1.43) | 3.41 (2.04) |

| | | | |
|---|---|---|---|
| Square Block (10) | 7185 | 4.84 (1.07) | 2.56 (2.13) |
| Three Oval Blocks (10) | 7187 | 4.87 (1.12) | 2.16 (1.63) |
| Scarves (10) | 7205 | 5.35 (1.35) | 2.87 (2.29) |
| Fabric/Beads (8) | 7207 | 5.00 (1.48) | 3.31 (2.23) |
| Clothes Rack (8) | 7217 | 4.63 (1.15) | 2.31 (1.64) |
| Plate (7) | 7233 | 5.01 (1.21) | 2.51 (1.74) |
| Chair (7) | 7235 | 4.85 (1.13) | 2.68 (1.90) |
| Tomatoes (7) | 7285 | 5.30(1.23) | 3.52 (1.74) |
| House (4) | 7490 | 5.31 (1.27) | 2.71 (2.58) |
| Lab Building (9) | 7491 | 4.87 (0.94) | 2.60 (1.95) |
| Building (2) | 7500 | 5.44 (1.36) | 3.46 (2.23) |
| Workers-Trash (9) | 9700 | 5.00 (1.08) | 3.11 (1.98) |

*Note: The mean (standard deviation) valence and arousal ratings of the slides were obtained from a table of normative values for men from the technical manual for the International Affective Picture System (CSEA-NIMH, 1997).

**Appendix M**

Emotion Questionnaire

**Indicate by circling on the answer sheet, how much of an emotion you feel right now as a result of the pictures you just viewed. If you do not feel any of a particular emotion, circle 1. If you feel a lot, circle 5, or an intermediate amount, circle 3, ect.**

| | | | | | |
|---|---|---|---|---|---|
| 1.) Interested | 1 | 2 | 3 | 4 | 5 |
| 2.) Sluggish | 1 | 2 | 3 | 4 | 5 |
| 3.) Relaxed | 1 | 2 | 3 | 4 | 5 |
| 4.) Distressed | 1 | 2 | 3 | 4 | 5 |
| 5.) Excited | 1 | 2 | 3 | 4 | 5 |
| 6.) Upset | 1 | 2 | 3 | 4 | 5 |
| 7.) Tired | 1 | 2 | 3 | 4 | 5 |
| 8.) Strong | 1 | 2 | 3 | 4 | 5 |
| 9.) Droopy | 1 | 2 | 3 | 4 | 5 |
| 10.) Guilty | 1 | 2 | 3 | 4 | 5 |
| 11.) At Rest | 1 | 2 | 3 | 4 | 5 |
| 12.) Scared | 1 | 2 | 3 | 4 | 5 |
| 13.) Hostile | 1 | 2 | 3 | 4 | 5 |
| 14.) Enthusiastic | 1 | 2 | 3 | 4 | 5 |
| 15.) Serene | 1 | 2 | 3 | 4 | 5 |
| 16.) Proud | 1 | 2 | 3 | 4 | 5 |
| 17.) At Ease | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| 18.) Irritably | 1 | 2 | 3 | 4 | 5 |
| 19.) Alert | 1 | 2 | 3 | 4 | 5 |
| 20.) Bored | 1 | 2 | 3 | 4 | 5 |
| 21.) Ashamed | 1 | 2 | 3 | 4 | 5 |
| 22.) Calm | 1 | 2 | 3 | 4 | 5 |
| 23.) Inspired | 1 | 2 | 3 | 4 | 5 |
| 24.) Nervous | 1 | 2 | 3 | 4 | 5 |
| 25.) Determined | 1 | 2 | 3 | 4 | 5 |
| 27.) Attentive | 1 | 2 | 3 | 4 | 5 |
| 28.) Dull | 1 | 2 | 3 | 4 | 5 |
| 29.) Jittery | 1 | 2 | 3 | 4 | 5 |
| 30.) Active | 1 | 2 | 3 | 4 | 5 |
| 31.) Afraid | 1 | 2 | 3 | 4 | 5 |
| 32.) Drowsy | 1 | 2 | 3 | 4 | 5 |

**Appendix N**

Auditory Affective Verbal Learning Test

| Neutral List: | Negative List | Positive List |
|---|---|---|
| Drum | Morgue | Smile |
| Curtain | Murder | Freedom |
| Bell | Kill | Cheerful |
| Coffee | Pimple | Friend |
| School | Gun | Music |
| Parent | Greedy | Joy |
| Moon | Lice | Happy |
| Garden | Measles | Wisdom |
| Hat | Slay | Blossom |
| Farmer | Deface | Laugh |
| Nose | Cruel | Beauty |
| Turkey | Failing | Peace |
| Color | Hate | Sunset |
| House | Acne | Garden |
| River | Grave | Beach |

**Appendix O**

Experiment I - Instructions for Running Subjects

Ten Minutes Before Subject Arrives:

1. Lights on in main conference room and both labs
2. Clear any materials from conference table and place two consent forms, an opscan form (for extra credit) and a pencil (located on top of desk in the experiment room) on the conference table
3. Turn "Experiment in Progress" signs on conference room door to indicate experiment in progress

4. In Subject room, check that:

   Door unlocked
   Chair upright
   Clipboard with Emotion Scale placed on table
   Make sure 6 electrodes are placed on crate and clean and connected.
   Make sure the snap-on electrodes are not oxidized (center of electrode should be silver).
   Insert a pair of electrode leads (white wires with snap-like end) into the positive and negative inputs on the electrode cable. Attach a pair of snap-on electrodes (orange) to the other end of the electrode leads.
   Make sure heart rate sensor is connected to cuff.
   Turn on Monitor

5. In Experimenter's room:

   Turn on IAPS computer.
   Open the appropriate slide show. In Power Point, go to SLIDE SHOW and click SET UP SLIDE SHOW. Select show on: DEFAULT MONITOR. Click OK.
   Make sure arrow is on lab monitor not subject

   Turn on monitor and Coulbourn – **COMPUTER STAYS ON AT ALL TIMES!!**
   On Coulbourn unit, make sure:
   Wires are not adjusted or removed
   If wires are moved:

   > Locate the High Speed Vidoegraph I/O port. This is located to the far right of the Skin Conductance Couplers. Run a patch cord from the HR monitor to the output #. Run a patch cord from the first output (Left) on the skin conductance coupler to analog input on the I/O port. The top SC coupler (right hand) goes to output #2 and the bottom SC unit (left hand) goes to output #3.

Heart rate "sensitivity" is set to 2

Set both Isolated Skin Conductance Couplers to DC – **Do not connect the SCL Cable**
Locate the Isolated Skin Conductance Coupler. This is located in the center of the Coulbourn unit. Turn the subject sensitivity conductance knob to 10. Set the sensitivity setting to 500uV/uMho. Switch the excitation voltage to DC. Switch the amplifier coupling to DC.

Make sure the vernier knob is clicked into the "Cal" position.

Computer should be in DOS mode
At c:\> prompt type "cd.. enter and then "cd codas" enter
At c:\codas> prompt type "acodas [subject number] 800K

Press F4 to enter into the prerecord operating mode (Standby).

When display appears:
Hit Shift 5
Hit F2 and type "1 enter 2 enter 3 enter enter"
Change the gain for each screen. Type in the number of the screen.
Adjust the gain by pressing the up arrow key repeatedly until the upper screen limit displays 10V. If the gain does not adjust to 10V, adjust it to the next lowest value.

Hit + key until speed shows 250

Plug the electrode cable into the isolated input on the amplifier. The signal should go beyond the upper limit of the screen. The line on the monitor should be as flat and as close to the –5V as possible. Depress the 10uMho calibration switch. Use the vernier calibration knob to adjust the signal to -5V.

**Subject Arrival:**

- Greet subjects by saying, "Hello, are you ____? Great, thanks for coming today.
- Ask subject to wash his/her hands with warm water NO SOAP.
- Ask subject to take a seat at the conference table.
- Close the conference room door
- After subject is seated say:
  "**Thank you for participating in this study. Before we begin, please read these consent forms. If you have any questions, please ask. Please sign and date both copies. One is for our records and the other if for you to keep."**

- After the subjects signs the consent form have him/her complete the opscan if he/she is participating for extra credit for Intro Psych (Name, Seat #, and SS#). If he/she is participating for extra credit for another course sign and date the form and mark that the individual will receive one point of extra credit for participating.

- Explain the procedure to the subjects as follows:

  **"Thank you for your participation in this study. This aim of this study is to understand the effects of viewing pictures on physiological activity. I will explain each task to you before you have to do the task. Your heart rate and skin conductance will be monitored during the experiment. Electrodes will be placed on the second and third fingers of your left and right hand and a finger plethysmograph (which looks like a clothespin), will be placed on the first finger of your left hand. You should experience no discomfort from the electrodes or finger plethysmograph. Do you have any questions before we begin?**

- Answer the questions briefly and direct him/her into the subject room.

- Ask the participant to be seated in the chair. Once subject's seated say,

  **"Please sit up-right in the chair. It is very important that you do not slouch or shift your body once you are seated. Try to keep your feet flat on the floor. Use the markers as a guideline for your feet."**

- Clip the electrode cables to the subject's shirt sleeve.

- Fill the electrode with electrolyte gel just to the level of the collar.

- Pull the covering from the collar and apply the electrode to the subject's $2^{nd}$ and $3^{rd}$ finger. Repeat this procedure with the other fingers. The positive and negative leads can be placed on the medial phalanges of the second and third finger.

- Attach the heart rate cuff to left thumb-push firmly onto thumb (sensor on inside of thumb)

- Ask the participant if the electrodes and finger plethysmograph are comfortable. Then say to him/her,

- 

  **"Now that the physiological equipment is in place, do not move you head, shoulder, wrist or hand from their current position because it may make our readings inaccurate. Please do not turn around during the experiment. Try to keep your body still. Just speak clearly and I will be able to hear you. Are there any questions before we begin?"**

- Answer any questions briefly.

- **“I am now going to the other room from which I will give you further instructions.”**

- Close the experiment room door. Partially close subject door and turn off lights.

- **“I am going to ask you to relax for 5 minutes while I prepare.”**

- Start recording (Press F4)

- Start stopwatch and the end of three minutes begin to record SCL and HR measures for two minutes.
  Begin: Press ALT and space bar and label **BB + enter**
  End: Press ALR and space bar and label **BE + enter**

- Move the monitor if necessary and then say,
  **“I am now going to present a series of pictures. Please pay attention to each picture displayed on the screen.**

  **Press F5 on the IAPS computer to begin the slide show.**

  Begin of Pictures: Press ALT and space bar and label **PB+ enter**
  End: Press ALT and space bar and label **PE+ enter**

- Present the pictures. Then say,
  **“Please answer the Emotions Questionnaire on the table next to you. You can move your hands. Do not worry about the electrodes. "**

- Stop Recording **(Press ALT+F4)**

- When the participant is done inform the participant that you will be entering the room to remove the physiological equipment.

- After the physiological equipment and headphones are removed, say to the subject,
  **“The pictures you viewed were designed to provoke an emotional reaction. Do you feel okay after viewing the pictures?”**

- Thank the subject for his/her participation.

## Appendix P

Experiment II - Instructions for Running Subjects

Ten Minutes Before Subject Arrives:

1. Lights on in main conference room and both labs
2. Clear any materials from conference table and place two consent forms, an opscan form (for extra credit) and a pencil (located on top of desk in the experiment room) on the conference table
3. Turn "Experiment in Progress" signs on conference room door to indicate experiment in progress

4. In Subject room, check that:

   Door unlocked
   Chair upright
   Make sure 4 electrodes are placed on crate and clean and connected.
   Make sure the snap-on electrodes are not oxidized (center of electrode should be silver).
   Insert a pair of electrode leads (white wires with snap-like end) into the positive and negative inputs on the electrode cable. Attach a pair of snap-on electrodes (orange) to the other end of the electrode leads.
   Make sure heart rate sensor is connected to cuff.
   Turn on Monitor

5. In Experimenter's room:

   Headphones – Plug in the proper headphone extension into the adapter.
   Right ear – Red plug  Left ear – Blue Plug

   Put in the RAVL CD.

   Turn on IAPS computer.
   Open the appropriate slide show. In Power Point, go to SLIDE SHOW and click SET UP SLIDE SHOW. Select show on: DEFAULT MONITOR. Click OK.
   Make sure arrow is on lab monitor not subject

   Turn on monitor and Coulbourn – **COMPUTER STAYS ON AT ALL TIMES!!**
   On Coulbourn unit, make sure:
   Wires are not adjusted or removed
   If wires are moved:

      Locate the High Speed Vidoegraph I/O port.  This is located to the far right of the Skin Conductance Couplers.  Run a patch cord from the HR monitor to the output #.  Run a patch cord from the first output (Left) on the skin conductance coupler to analog input on the I/O port. The top SC coupler (right hand) goes to output #2 and the bottom SC unit (left hand) goes to output #3.

Heart rate "sensitivity" is set to 2

Set both Isolated Skin Conductance Couplers to DC – **Do not connect the SCL Cable**
Locate the Isolated Skin Conductance Coupler. This is located in the center of the Coulbourn unit. Turn the subject sensitivity conductance knob to 10. Set the sensitivity setting to 500uV/uMho. Switch the excitation voltage to DC. Switch the amplifier coupling to DC.

Make sure the vernier knob is clicked into the "Cal" position .

Computer should be in DOS mode
At c:\> prompt type "cd.. enter and then "cd codas" enter
AT c:\codas> prompt type "acodas [subject number] 1200K

When display appears:
Hit Shift 5
Hit F2 and type "1 enter 2 enter 3 enter enter"

Hit + key until speed shows 250

Press F4 to enter into the prerecord operating mode (Standby).

Change the gain for each screen. Type in the number of the screen.
Adjust the gain by pressing the up arrow key repeatedly until the upper screen limit displays 10V.

Plug the electrode cable into the isolated input on the amplifier. The signal should go beyond the upper limit of the screen. The line on the monitor should be as flat and as close to the horizontal axis as possible. Depress the 10uMho calibration switch. Use the vernier calibration knob to adjust the signal to -5V (G).

**Running Subjects**

- Greet subjects by saying, "Hello, are you ____? Great, thanks for coming today.
- Ask subject to wash his/her hands with warm water NO SOAP.
- Ask subject to take a seat at the conference table.
- Close the conference room door

- After subject is seated say:
  "**Thank you for participating in this study. Before we begin, please read these consent forms. If you have any questions, please ask. Please sign and date both copies. One is for our records and the other if for you to keep."**

- After the subjects signs the consent form have him complete the opscan if he is participating for extra credit for Intro Psych (Name, Seat #, and SS#). If he is participating for extra credit for another course sign and date the form and mark that the individual will receive one point of extra credit for participating.

- Explain the procedure to the subjects as follows:

  **"Thank you for your participation in this study. This aim of this study is to understand the effects of viewing pictures on physiological activity and task performance. I will explain each task to you before you have to do the task. You will wear headphones to hear components of the task and to block out any distracting noise. Your heart rate and skin conductance will be monitored during the experiment. Electrodes will be placed on the second and third fingers of your left and right hand and a finger plethysmograph (which looks like a clothespin), will be placed on the first finger of your left hand. You should experience no discomfort from the electrodes or finger plethysmograph. Do you have any questions before we begin?"**

- Answer the questions briefly and direct him into the subject room.

- Ask the participant to be seated in the chair. Once subject's seated say,

  **"Please sit up-right in the chair. It is very important that you do not slouch or shift your body once you are seated. Try to keep your feet flat on the floor. "**

  **"I am now going to put on the headphones. If you need to adjust them, please do so."**

**REMEMBER THAT THE BLUE SIDE OF THE EARPHONES FACES THE WALL…**

- Abrade the participant's finger with a clean nail file. Rub a small amount of electrode gel on the area.

- Fill the electrode with electrolyte gel just to the level of the collar.

- Pull the covering from the collar and apply the electrode to the subject's 2$^{nd}$ and 3$^{rd}$ finger. Repeat this procedure with the other fingers. The positive and negative leads can be placed on any medial phalanges of the second and third finger.

- Attach the heart rate cuff to left thumb-push firmly onto thumb (sensor on inside of thumb)

- Ask the participant if the electrodes and finger plethysmograph are comfortable. Then say to him,

  **"Now that the physiological equipment is in place, do not move you head, shoulder, wrist or hand from their current position because it may make our readings inaccurate." "Please do not turn around during the experiment. Try to keep your body still. Just speak clearly and I will be able to hear you. Are there any questions before we begin?"**

- Answer any questions briefly.

- **"I am now going to the other room from which I will give you further instructions."**

- Close the experiment room door.

- **"I am going to ask you to relax for 5 minutes while I prepare."**

- Start recording (Press F4)

- Start stopwatch and the end of three minutes begin to record SCL and HR measures for two minutes.
  Begin: Press ALT and space bar and label **BB1 + enter**
  End: Press ALT and space bar and label **BE1 + enter**

- Move the monitor if necessary and then say,
  **"I am now going to present a series of pictures. Please pay attention to each pictures displayed on the screen."**

  **Press F5 on the IAPS computer to begin the slide show.**

  Begin of Pictures: Press ALT and space bar and label **PB1+ enter**
  End: Press ALT and space bar and label **PE1**+ **enter**

- Press ESC at the end of the show

- **Beginning of RAVL –**
  **Track 1- Negative RAVL**
  **Track 2- Positive RAVL**
  **Track 3-Neutral RAVL**

  **(Trial 1)** Push play on the CD player.
  Begin of List: Press **space bar**
  End: Press **space bar**

Press stop on the CD player when the word list is over.

Record words repeated.

**(Trial 2)** Push play on the CD player.
Begin of List: Press **space bar**
End: Press **space bar**

Press stop on the CD player when the word list is over.

Record words repeated.

**(Trial 3)** Push play on the CD player.
Begin of List: Press **space bar**
End: Press **space bar**

Press stop on the CD player when the word list is over.

Record words repeated.

- During break say to subject, **"We are now going to take a short break. During this break I would like you to rate how comfortable you feel? On a scale from 1 to 10, ten being very comfortable, how comfortable do you feel?"**

- Say, "**"I am going to ask you to relax for 5 minutes."**

- If rating is less then 5 ask the subject if he is comfortable enough to continue in the experiment**.**

- Start stopwatch and the end of three minutes begin to record SCL and HR measures for two minutes.
  Begin: Press ALT and space bar and label **BB2 + enter**
  End: Press ALT and space bar and label **BE2 + enter**

- **During the break set up the next slide show. Open the other IAPS file (i.e. A or B) that is the same affective valence. Remember to set up the pictures to show on the default screen.**

- After the break say,
  **"I am now going to present a second series of pictures. Please pay attention to each pictures displayed on the screen.**

  **Press F5 on the IAPS computer to begin the slide show.**

Begin of Pictures: Press ALT and space bar and label **PB2+ enter**
End: Press ALT and space bar and label **PE2**+ enter

- **Beginning of RAVL –** Present the second RAVL. If the first RAVL was affective the second will be neutral. If the first RAVL was neutral the second will be affective.

  **Track 1- Negative RAVL**
  **Track 2- Positive RAVL**
  **Track 3- Neutral RAVL**

  **(Trial 1)** Push play on the CD player.
  Begin of List: Press **space bar**
  End: Press **space bar**

  Press stop on the CD player when the word list is over.

  Record words repeated.

  **(Trial 2)** Push play on the CD player.
  Begin of List: Press **space bar**
  End: Press **space bar**

  Press stop on the CD player when the word list is over.

  Record words repeated.

  **(Trial 3)** Push play on the CD player.
  Begin of List: Press **space bar**
  End: Press **space bar**

  Press stop on the CD player when the word list is over.

  Record words repeated. Press Alt+F4 to change recording to standby.

- When the participant is done inform the participant that you will be entering the room to remove the physiological equipment and the headphones

- After the physiological equipment and headphones are removed, say to the subject,
  **"The pictures you viewed were designed to provoke an emotional reaction. Do you feel okay after viewing the pictures?"**

  Thank the subject for his participation. Ask him not to disclose anything that was done in the lab.

**Curriculum Vitae**

**KERYL ANN COSENZO**

**EDUCATION:**

1997 – present Virginia Polytechnic Institute and State University- Blacksburg, Virginia
Doctor of Philosophy – Defended April 16, 2002
Psychological Sciences
Concentration - Biopsychology
Advisor: Joseph J. Franchina, Ph. D
*Dissertation:* Influence of the IAPS and Method of Hemispheric Presentation on Performance on the Affective Auditory Verbal Learning Test

Master of Science – December, 1999
Psychology
Advisor: Joseph J. Franchina, Ph. D
*Thesis:* The Roles of Cardiovascular Activity and Negative Affect on the Attributions of High and Low Hostile Men to Provocative Female Behavior

HONORS/AWARDS:
Graduate Student Association Research Award, 2000
Graduate Student Association Research Travel Award, 2000

1993 – 1997 Loyola College - Baltimore, Maryland
Bachelor of Arts – May, 1997, Cum Laude
Major - Psychology, Pre-Medicine
Overall QCA: 3.501

HONORS/AWARDS:
Dean's List - 1994-1997
Psi Chi

**PROFESSIONAL EXPERIENCE:**

5/99 – 8/99 Virginia-Maryland Regional College of Veterinary Medicine
Assistant to the Dean of Graduate Studies – Revised course lecture materials. Learned the intricate details of the everyday activities required to maintain a graduate program.

6/98-8/98 Veterans Administration Hospital, East Orange, NJ
Internship - Lab Technician in the Neurology Research Lab.
Research Lab Goal: Develop an Animal Model of Obesity

Focused on In Situ Hybridization of Leptin Receptors in Rat Brains, Operation of a cryostat, Slide preparation of brain tissue, and Basic Stereotaxic Surgery Techniques.

**ACADEMIC EXPERIENCE:**

8/01-Present Radford University-Radford, Virginia
Adjunct Faculty – Psychology Department

8/00-Present Virginia Polytechnic Institute and State University- Blacksburg, Virginia
Graduate Teaching Assistant: Psychology Instructor
Responsible for the planning and instruction of undergraduate level courses
Courses Taught: Learning Psychology, Principles of Psychological Research and Developmental Psychology

9/99- 8/01 Virginia Polytechnic Institute and State University- Blacksburg, Virginia
Undergraduate Advisor – Advise undergraduates on course work, applications to graduate school and post-graduation career opportunities.

1/99 – 5/99 Virginia Polytechnic Institute and State University- Blacksburg, Virginia
Graduate Teaching Assistant:
Advanced Learning Laboratory Instructor
Responsible for two lab sections: Lecture preparation and course instruction

9/97 – 12/98 Virginia Polytechnic Institute and State University- Blacksburg, Virginia
Graduate Teaching Assistant:
Introductory Psychology Instructor
Responsible for several recitation sections: Lecture preparation and course instruction

**RESEARCH AND SCHOLARLY INTERESTS:**

Central and autonomic nervous system correlates of emotion; Influence of stressors and concomitant emotion on cognitive processes; Stress, Emotion and Health related issues; Individuals differences and health behaviors; Methods in psychophysiology.

**RECENT RESEARCH ACTIVITIES:**

Effect of induced physiological activity (BP and HR) and subsequent emotion, via serial subtraction, on the attributions of high and low hostile men to provocative partner behavior (Thesis).

Effect of induced physiological activity and subsequent emotion, via serial subtraction, on the attributions and cardiovascular recovery of high and low MGRS men to provocative partner behavior.
Examination of how type of instructions impacts on physiological activity and performance on the subtraction task.

The effect of negative emotion on the performance of high and low MGRS men on a verbal learning task.

The effect of inducing negative emotion using the International Affective Picture System and lateralized verbal stimulus presentation on performance on the Auditory Affective Verbal Learning Test (Dissertation).

**PUBLICATIONS:**

Cosenzo, K.A. and Franchina, J.J. (2001). The Roles of Negative Affect and Cardiovascular Activity on the Attributions of Males to Provocative and Non-Provocative Female Behavior. Psychology of Men and Masculinity,2,100-107.

**MANUSCRIPTS IN PREPARATION:**

Cosenzo, K.A. and Franchina, J.J. (In Preparation). Effects of a Stressor Task on Cardiovascular Activity, Attributions and Affective Responses of High MGRS Men to Provocative or Neutral Partner Behavior.

Cosenzo, K.A., Franchina, J. J., Eisler, R. J. and Krebs, D. (To Be Submitted). Effects of Gender Relevant Instructions on the Cardiovascular Activity and Task Performance of High MGRS Men. Psychology of Men and Masculinity.

**CONFERENCE PRESENTATIONS:**

Moore, T.M. Rhatigan, S.L., Cosenzo, K.A., Franchina, J.J. and Eisler, R.M. (1998). “Attributional and Physiological Responses of Abusive Males To Intimate Partner Conflict.” Paper Presented at the Association for the Advancement of Behavioral Therapy Convention, 1998.

Cosenzo, K.A. and Franchina, J.J. (2000). “Effects of Cardiovascular Reactivity and Negative Affect on the Attributions of Hostile Men to Provocative or Neutral Partner Behavior.” Paper Presented at Eastern Psychological Association, 2000.

Cosenzo, K.A. and Franchina, J.J. (2000). “Effects of Cardiovascular Reactivity and Negative Affect on the Attributions of Hostile Men to Provocative or Neutral Partner Behavior.” Presented at the Graduate Student Association Research Symposium at Virginia Tech, 2000.

Cosenzo, K.A. and Franchina, J.J. (2000). "Differences in Emotional Expression in Hostile Males.” Paper Presented at the Society For Psychophysiological Research, 2000.

Sahni, N., Cosenzo, K.A., and Franchina, J.J. (2000). "The Effects of the Affective Valence of Abusive Male Behavior and Women's Abuse History on Attributions and Affective Responses Toward Male

Abuse." Paper Presented at the Association for the Advancement of Behavioral Therapy Convention, 2000.

Cosenzo, K.A. and Franchina, J.J. (2001). "Effects of a Stressor Task on Cardiovascular Reactivity, Attributions and Affective Responses of High MGRS Men to Provocative or Neutral Partner Behavior." Paper Presented at the Graduate Student Association Research Symposium at Virginia Tech, 2001.

Cosenzo, K.A. and Franchina, J.J. (2001). "Effects of a Stressor Task on Cardiovascular Reactivity, Attributions and Affective Responses of High MGRS Men to Provocative or Neutral Partner Behavior." Paper Presented at the Eastern Psychological Association, 2001.

Cosenzo, K.A. and Franchina, J.J. (2002). "The effect of induced negative emotion on performance on the Auditory Affective Verbal Learning Test. Paper submitted to the Society for Psychophysiological Research, 2002.

**COMPUTER SKILLS:**

MS Excel, Access, Word and Powerpoint
SPSS
Windaq Waveform Browser