THE AUDITORY AFFECTIVE VERBAL LEARNING TEST: PERIPHERAL AROUSAL CORRELATES AND IMPLICATIONS FOR THE LATERALIZED PRIMING OF DICHOTIC PROSODY IDENTIFICATION

Katharine A. Snyder

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APPROVED:

David W. Harrison, Ph.D., Chair

Helen J Crawford, Ph.D.

Robin P. Cooper, Ph.D.

Albert M. Prestrude, Ph.D.

Joseph J. Franchina, Ph.D.

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David W. Harrison, Ph.D., Chair

Department of Psychology

ABSTRACT

Few tests are available for the investigation of emotional learning. The purpose of the present study was to create and provide initial data on the utility of affective list alternatives for the well known Rey Auditory Verbal Learning Test (RAVL). Results suggest that all lists (positive, negative, neutral) exhibited a similar acquisition pattern and overall primacy effect. The purpose of the present study was to assess the utility of the AAVL in the production of peripheral arousal and cerebral asymmetry correlates of emotion.

Experiment 1 assessed the utility of the AAVL in the induction of physiological arousal. Sixty-three right-handed male undergraduates participated in the study. It was anticipated that affective verbal learning would lead to arousal patterns characteristic of different emotions (Izard, 1977), with significant increases in blood pressure following negative list learning and significant decreases following positive list learning. Since blood pressure increased significantly following the learning of negatively valenced words and decreased significantly following the learning of positively valenced words, this was supported.

Experiment 2 assessed the influence of the AAVL on functional cerebral asymmetry using a dichotic listening paradigm. Sixty-three right-handed male undergraduates took part in the experiment. It was anticipated that the negative list would prime right cerebral systems, resulting in heightened left ear identification of sad

or angry tones of voice. The positive list was predicted to prime left cerebral systems, resulting in subsequently heightened identification of happy or neutral tones of voice at the right ear. This hypothesis was not supported. The identification of tone of voice was significantly better with left ear (right hemisphere) presentations than with right ear presentations for the identification of sad and angry valences. In partial replication of Bryden and MacRae (1989), the identification of dichotically presented tones of voice also improved with practice across the two blocks of trials for the identification of angry tones of voice.

The AAVL provides an objective measure of emotional learning. Given the abundance of research on lateral asymmetries in emotional and verbal processing, the AAVL may provide an objective means for evaluating individual differences in affective verbal learning and potentially provide a tool for assessment of cerebral dysfunction in the clinic or in the assessment of affective disorders.

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Autonomic Nervous System and Emotion

Most theories of emotion propose that the Autonomic Nervous System (ANS) plays a role in the expression, identification, and/or subjective experience of emotion. Whether ANS activity precedes, causes, or is the result of emotion remains unresolved. Izard (1977), for example, proposed that ANS reactivity precedes and causes the subjective and behavioral correlates of emotion. Anxiety and depression are proposed (Izard, 1977) to have distinct ANS patterns (stable states, reactivity, recovery) which produce the physiological and behavioral correlates of emotion. However, Ekman (1984) proposed that ANS reactivity is not a direct preceding cause of emotion, but rather a feedback response to the perceptual, cognitive, and postural mechanisms underlying emotion.

Part of the difficulty in answering the question of whether ANS activity precedes, results from, or causes emotion results from the many methodological problems inherent to this research. First of all, many studies fail to show correspondence between self report and ANS indices of emotion (Thompson, 1988). Secondly, it is difficult to induce emotions experimentally and to define the physiological onset or offset of the affective state (Wagner & Manstead, 1989). Thirdly, researchers choose the ANS parameter (e.g. blood pressure, heart rate, etc.) that is most convenient rather than evaluating several measures together (Wagner & Manstead, 1989). Given the differing methods of induction, differing choices of physiological (e.g. skin conductance, heart rate, etc.) or self report parameters, and differing methods of analysis (e.g. AC versus DC electrodermal measures), the difficulty of specifying the role of the ANS in emotion is no surprise.

Reactivity

Before the issue of whether ANS activity precedes, causes, or results from emotion can be addressed, research first needs to answer the question of whether specific patterns of ANS activity correlate with specific affective valences. Ax (1953) was one of the first researchers to demonstrate that specific ANS patterns might occur for specific emotions. While manipulating happiness (subjects relaxing on a bed with pleasant music), fear (threat of electric shocks), and anger (abusive polygraph operator), several peripheral measures were recorded. In sum, results suggested that fear and anger led to greater increases in respiration rate, skin conductance, and diastolic blood pressure (DBP). Other studies by Schachter (1957) and Roberts and Weerts (1982) similarly reported that DBP and skin conductance evidenced greater increases during angry and fearful imagery scenes compared to happy imagery scenes.

Further research by Schwartz, Weinberger, and Singer (1981) addressed the question of whether these specific ANS patterns for specific emotions are augmented or reduced with the induction of ANS arousal (exercise). Subjects were instructed to imagine angry, fearful, happy, or sad scenes. After two minutes of baseline recording with imagery alone, subjects exercised on a step and were instructed to verbally describe the emotions associated with the imagined scene. In partial support of earlier findings, baseline DBP and HR increased less during fearful, sad, or happy imagery than during angry imagery. With exercise, DBP differences were not found, potentially due to vasodilation during physical activity. However, the most important finding was that verbal descriptions were required for the specific ANS patterns reported by Ax (1953) to occur with or without exercise.

In addition to the importance of verbal descriptions in the correlation between emotion and ANS reactivity, further research by Funkenstein, King, and Drolette (1957) addressed the question of whether the specific patterns of ANS reactivity for specific emotions vary as a function of how individuals express particular emotions. After manipulating anger (unsolvable problems), subjects were interviewed and classified as anger-in or anger-out and high or low in anxiety. Subjects higher in anxiety or general ANS arousal exhibited greater cardiac output increases than subjects lower in anxiety. In addition, subjects classified as anger-out evidenced reduced heart rate (HR) and stroke volume compared to subjects classified as high in anxiety or anger-in. Anger-out subjects also showed reduced systolic blood pressure (SBP) compared to anger-in subjects.

Recovery to Baseline

In sum, the research by Schwartz et al. (1981) and Funkenstein et al. (1957) suggests that more than the ANS reactivity patterns described by Ax in 1953 are involved in the relationship between peripheral arousal and emotion. The patterns of ANS reactivity for different emotions varied with the initial level of ANS reactivity (e.g. high or low in anxiety; exercise or no exercise) as well as personality characteristics (e.g. anger-out or Anger-in). In light of these individual differences in level of ANS reactivity, research began to address the question of whether specific reactivity, as well as recovery to baseline patterns, occur for specific emotions. For example, Izard (1977) proposed that fear and anger can be differentiated in terms of level of reactivity, as well as rate of recovery to baseline. In sum, Izard (1977) proposed that anger would be slower to recover to baseline than fear, since anger is more involved with peripheral resistance (e.g. DBP) and fear is more involved with peripheral reactivity (e.g. SBP).

However, a great deal of research failed to demonstrate differences between fear and anger in terms of reactivity and recovery to baseline. Greater reactivity and slower returns to baseline follow from the presentation of fearful or angry stimuli in comparison to neutral or happy stimuli (Levenson, 1992). Increased HR acceleration and slower recovery during the presentation of angry stimuli in comparison to happy stimuli has been demonstrated when provoked by criticism (Funkenstein, King, & Drolette, 1957), anger imagery (Schwartz et al., 1981), anger facial posing (Levenson, 1992), and an irritating confederate (Levenson, 1992). Similarly, increased heart rate acceleration and slower recovery to baseline levels are shown during the presentation of fear stimuli when provoked by mild shock (Schachter, 1957), fear imagery (Schwartz et al., 1981), posed fear facial expression (Levenson, 1992), viewing mutilation slides (Levenson, 1992), and strangers getting closer to 6 month or 11 month old infants (Skarin, 1977).

The Priming of Lateralized Cerebral Functions

Specificity of physiological patterns for different emotions goes beyond the ANS and encompasses the cerebral cortex as well. Two lines of research describe the role of the cortex in the expression and identification of emotion. One line of research suggests that the right hemisphere is specialized for emotion (a non-valenced approach; Ley & Bryden, 1982), while another line of research proposes that the left hemisphere plays a role in the expression/identification of positive emotion and the right hemisphere plays a role in the expression/identification of negative emotion (a valenced approach; Tucker, 1981).

Hemi-Activation and Emotion

Research provides some support for the valence approach to emotion. For example, Davidson, Ekman, Saron, Senulis, and Frieman (1990) reported that unpleasant films (disgust) led to greater right relative to left frontotemporal activation, while pleasant films (happy) led to greater left relative to right frontotemporal activation. Davidson (1984) also showed that subjects rating words as being affectively pleasant (a Likert scale for pleasantness) evidenced greater left than right frontotemporal activation, while subjects rating words as affectively unpleasant evidenced greater right than left frontotemporal activation. In addition, Everhart and Harrison (1995) reported on a case study of a closed-head injury subject, high in hostility, who evidenced a topographical pattern of greater right parieto-temporal activation and right frontal deactivation, suggesting a role of many cortical regions in hostility. Likewise, Fox and Davidson (1986) evaluated disgust (giving neonates citric acid) and interest (giving neonates sucrose) in newborns. Although a broad band, 3-12 Hz band, was used, greater left frontotemporal activation was reported with sucrose presentations and greater right frontotemporal activation was reported for citric acid presentations.

However, one confusion in the literature on cerebral asymmetry and affect expression/identification is the relationship between hemispheric specialization and activation. The activation of particular brain regions relates to specialization, but with the development of more systems approaches (e.g. Luria, 1973) it is becoming apparent that there is not necessarily a one-to-one correspondence between hemi-activation (neural imaging) or hemi-deactivation (brain damage) and the specialization of function. In sum, showing anticipated perceptual lateralities in dichotic listening or tachistoscope tasks does not necessarily imply that hemi-activation is limited to one hemisphere (Wagner & Manstead, 1990).

Relative left hemi-activation for positive emotions and relative right hemi-activation for negative emotions does not mean that only the left hemisphere is involved in positive emotion and only the right hemisphere is involved in negative emotion (Wagner & Manstead, 1990). For example, Herridge, Rock, and Harrison (manuscript in preparation for publication) report on a case study of a left-handed male with a convulsive seizure disorder who exhibited reversed laterality in topographical analysis, with greater right hemi-activation (frontotemporal regions) during presentations of happy stimuli to the left visual field (LVF) and greater left hemi-activation (frontotemporal regions) during presentations of angry stimuli to the right visual field (RVF). With the accumulation of literature, specialization is gradually being reconceived of in terms of function within a dynamic cortical, subcortical, peripheral system (Luria, 1973).

Hemi-Activation, Reactivity, and Recovery to Baseline

Nevertheless, differential cortical activation might mediate the relationship between emotion and ANS reactivity / recovery to stable states. For example, Heilman, Watson, and Valenstein (1985) proposed that arousal is mediated by the mesencephalic reticular formation, inferior parietal lobule, posterior cingulate, prefrontal cortex, primary-secondary association areas, and the nucleus reticularis. In this model, damage to the frontal lobe is proposed to lead to stimulation of the nucleus reticularis, which in turn leads to inhibition of the thalamic relay and increments in sensory thresholds. With increments in sensory thresholds, more information is required for recognition of stimuli, and hence, there is decreased overall arousal for environmental stimuli.

The cortex plays a critical role in the interpretation of stimuli which induce autonomic nervous system responses. One proposed pathway through which autonomic arousal leads to hemi-activation is as follows: Stimulation of the vagus nerve leads to activation of the solitary tract nucleaus in the medulla, which in turn projects to the amygdala and insular cortex (Heilman, Bowers, & Valenstein, 1993). The amygdala and insular cortex in turn have projections to frontal, temporal, and parietal regions (Heilman, Bowers, & Valenstein, 1993). Although the exact pathway through which exposure to affectively valenced stimuli leads to changes in peripheral arousal is not known, the amygdala and insular cortex are important regions (Heilman, Bowers, & Valenstein, 1993).

Many studies have also suggested that cortical involvement in peripheral arousal is differentially mediated in the left and right hemispheres. For instance, Heilman, Schwartz, and Watson (1978) demonstrated that patients with right hemisphere damage exhibited decreased skin conductance responses, while patients with left hemisphere damage exhibited increased skin conductance responses relative to control subjects. Yokoyama, Jennings, Ackles, Hood, & Boller (1987) similarly demonstrated that patients with right hemisphere damage exhibited decreased pulse rate responses, while patients with left hemisphere damage exhibited increased pulse rate responses relative to controls.

Damage to the right hemisphere produces perseveration or hyperarousal, while damage to left hemisphere produces behavioral slowing or hypoarousal (Heilman & Valenstein, 1993). The right hemisphere may be more specialized for both negative affect as well as higher peripheral arousal, while the left hemisphere may be more specialized for both positive affect as well as lower peripheral arousal levels. For example, Herridge and Harrison (manuscript submitted for publication) showed that subjects higher in hostility evidenced greater left extremity skin conductance reactivity which persisted or failed to habituate. Given the proposed role of the right hemisphere in peripheral arousal and anger, it is no surprise that Herridge and Harrison (manuscript submitted for publication) reported greater and longer lasting increments in skin conductance at the left extremity during exposure to angry stimuli.

In extension of the Heilman et al. (1985) model, Heller (1993) suggests that interactions between the frontal and parietal lobes produce the differential cortical and autonomic arousal patterns (including pulse and pressure measures) underlying different emotions. Heller (1990) proposes that the frontal lobes play a critical role in valence (positive or negative) and the right parietal lobe plays a critical role in autonomic and overall cortical arousal. Increased cerebral and autonomic arousal has been reported with increased right parietal relative to left parietal activation, while decreased cerebral and autonomic arousal has been reported with decreased activation of the right parietal relative to left parietal cortex (Heller, 1993). Increased left relative to right cerebral activation is also associated with positive affective biases, while increased right relative to left cerebral activation is associated with negative affective biases (Davidson, Schwartz, Saron, Bennett, & Goleman, 1979).

The proposed relationship between the parietal and frontal lobes (Heller, 1993) supports previous research on the role of arousal in emotion. Since anger involves greater right parietal and right hemisphere activation, anger would be expected to lead to higher peripheral arousal levels which are slower to recover or return to baseline. Conversely, since happiness involves greater left parietal and left hemisphere activation, happiness would be expected to lead to lower levels of arousal which are faster to recover or return to baseline.

In sum, research has suggested enhanced left relative to right frontotemporal activation following exposure to pleasant affective stimuli and enhanced right relative to left frontotemporal activation following exposure to negative affective stimuli. For instance, Davidson, Ekman, Saron, Senulis, and Frieman (1990) reported that unpleasant films (disgust) led to greater right relative to left frontotemporal activation, while pleasant films (happy) led to greater left relative to right frontotemporal activation. Everhart and Harrison (1995) similarly showed that a female patient status-post right cerebral vascular accident exhibited increased right relative to left temporal activation along with decreased right relative to left orbitofrontal activation during the experience of negative emotion. Perseveration or a failure to inhibit anger has been demonstrated following stimulation of the amygdala or damage to the orbitofrontal cortex (Heilman & Valenstein, 1993).

Although it is not known whether asymmetrical peripheral arousal precedes, causes, or results from asymmetrical cortical activation, or vice versa, distinct peripheral as well as cortical arousal patterns correlate with the expression/identification of specific affective valences. If listening to, subvocally rehearsing, and verbally recalling affective words is associated with ANS patterns characteristic of the experience of positive or negative emotion, it seems reasonable to speculate that cortical activation patterns characteristic of the differing valences are also taking place. Furthermore, if affective learning produces differential peripheral arousal as a function of valence as well as differential hemi-activation, then the performance of tasks specialized to the activated hemisphere should be affected.

Hemi-activation and Priming

Kinsbourne (1970) proposed a model of selective attention which suggests that engaging in tasks asymmetrically mediated in the cortex enhances performance for tasks also lateralized to that hemisphere. Hence, performance of verbal tasks (e.g. word repetition) would be expected to enhance performance of other tasks lateralized to the left hemisphere (e.g. right-hand tapping), while the performance of spatial tasks (e.g. form recognition) would be expected to enhance performance of other tasks lateralized to the right hemisphere (e.g. left-hand tapping; Hellige, 1983). In support of this, Kinsbourne (1980) demonstrated that instructions to rehearse words subvocally (presumed to be a left lateralized task) enhanced the detection of stimulus gaps in the right visual field.

However, whether or not the performance of tasks specialized to one hemisphere enhances performance of other tasks lateralized to that hemisphere is a function of the type and complexity of the tasks used. For example, Hellige, Cox, and Litvac (1979) used both a verbal (e.g. holding 0, 2, 4, or 6 words in memory) and a spatial task (e.g. recognition of tachistoscopically presented polygon forms). Word rehearsal has been shown to selectively activate the left more than the right hemisphere (e.g. asymmetrical alpha suppression; Warren, Peltz, & Heuter, 1976). In support of Kinsbourne's (1970) theory, rehearsal of two words, a left hemisphere task, enhanced performance for form identification in the RVF (left hemisphere). However, rehearsal of more than two words interfered with form identification in the RVF (left hemisphere). Hence, results support the suggestion that engaging in tasks mediated by one hemisphere will enhance performance for tasks also lateralized to that hemisphere if the task load is not to high (Hellige, 1983).

Researchers have used the Kinsbourne (1970) model to evaluate the influence of affective learning on the performance of subsequent tasks. Kinsbourne's (1970) theory would predict that following the learning of emotional words (greater right hemisphere activation), subjects would be better at the identification of faces portraying negative emotions in the left visual field (right hemisphere; Ley & Bryden, 1979). For example, Bryden and Ley (1983) showed that the subvocal rehearsal of emotional words enhanced both the left ear advantage (LEA) for dichotic phoneme detection, as well as the left visual field advantage for facial stimuli. Ley and Bryden (1979) and Boles (1979) also showed that the rehearsal of four or two emotional words enhanced the identification of affective faces in the LVF. However, the rehearsal of six words interfered with the identification of affective faces in the LVF. Hence, when the priming stimulus and identification task involve the same hemisphere, activation occurs with smaller task loads and interference occurs with greater task loads.

Further research has suggested that the subvocal rehearsal of affective words interferes with left hemisphere performance and enhances right hemisphere performance. For example, Brody, Goodman, Holm, Krinzman, and Sebrechts (1987) showed that accuracy and speed of affective facial recognition was better when affective word primes were previously presented to the LVF (right hemisphere) and worse when previously presented to the RVF (left hemisphere). Similarly, Demakis and Harrison (1994) showed that the subvocal rehearsal of neutral or emotional words reduced accuracy of identification of faces in the RVF (left hemisphere) and enhanced accuracy of identification of faces in the LVF (right hemisphere).

In sum, these studies suggest that the learning of emotional words might be primarily a verbal task taxing the left hemisphere, but also involves the induction of affect. If the learning of emotional words is primarily a verbal (left hemisphere specialized) task, then it is no surprise that interference with RVF facial identification was reported (Brody et al., 1987; Demakis & Harrison, 1994). Likewise, if the learning of emotional words involves the induction of emotion (potential activation of the right hemisphere), it is no surprise that facilitation of LVF facial identification was also reported (Brody et al., 1987).

Other researchers have restated Kinsbourne's (1970) theory in terms of the cerebral distance principle (Hellige, 1983). The cerebral distance principle is that the performance of one task will activate many regions of the brain and the activation will spread to nearby areas as well as analogous areas in the opposite hemisphere (Hellige, 1983). The more difficult the task, the more of the activated areas used in the performance of the task, and the less the capability of effectively performing a concurrent task (interference with high task loads; Hellige, 1983). Conversely, the easier the task, the less of the activated area used for the performance of the task, and the more the capability of performing the concurrent task (Hellige, 1983).

The restatement of Kinsbourne's theory in terms of the cerebral distance principle (see previous paragraph) implies that a source of ambiguity in research on the facilitative or interfering influence of affective word rehearsal on the performance of lateralized tasks is the novelty of the procedure or time allowed for practice. Research has suggested that with practice, difficult tasks become easier to perform (Norman & Shallice, 1986). For example, Norman and Shallice (1986) propose two basic types of attentional processes, controlled attention and automatic attention. Controlled processes occur slowly and require a great deal of effort, while automatic processes occur very fast and require little effort. More complex tasks (e.g. typing for the first time) are proposed to involve primarily controlled processes, while more well learned tasks (e.g. typing for the professional secretary) are proposed to involve more automatic processes. In light of this, future research might assess the interfering or facilitative effects of affective word rehearsal on the performance of lateralized tasks over time or with practice. It could be that the reported interfering effects of affective word rehearsal on the recognition of faces in the RVF reduces with practice, resulting in facilitation.

The purpose of the present research is twofold. Experiment 1 will address the cardiovascular correlates of affective list learning, while Experiment 2 will assess the influence of affective list learning on subsequent dichotic ear advantage.

Experiment 1

Research has demonstrated specificity for patterns of ANS reactivity and recovery when subjects are reciting affective words. Schwartz et al. (1981) required subjects to verbally describe emotional imagery. Weerts and Roberts (1976) as well as Izard (1977) required subjects to verbalize feelings associated with emotional events in their life. Hence, stating emotionally valenced words or verbally describing emotional imagery purportedly results in specific ANS patterns (heart rate, blood pressure, skin conductance, respiration rate, etc.). Reciting negatively valenced words is associated with greater pulse rate and pressure reactivity, with slower recovery to baseline levels, than positive or neutral verbalizations (Izard, 1977; McNaughtan, 1989; Schwartz et al., 1981; Weerts & Roberts, 1976). Conversely, reciting positively valenced words is associated with less reactivity and faster recovery of baseline, than negative or neutral verbalizations (Izard, 1977; McNaughtan, 1989).

Since the verbalization of affectively valenced words is associated with differential pulse rate and pressure patterns, it seems reasonable to expect that attempting to learn emotionally valenced words and being prompted to recall them verbally will lead to similar ANS patterns in pulse rate and blood pressure. Listening to the experimenter read affective words, subvocally rehearsing the affective words, and then verbally recalling the affective words may produce differential ANS pulse rate and pressure patterns for specific emotions.

To evaluate the ANS correlates of affective learning, Experiment 1 will measure pulse rate and pressure over the left brachial artery, before and after the administration of the original (neutral) Rey Auditory Verbal Learning Test (Rey, 1964) as well as two newly devised affective versions of the test (negative and positive). The purpose of Experiment 1 is to assess whether the affective versions of the RAVL are clinically useful and associated with specific ANS arousal patterns.

Since the focus of Experiment 1 is to address the question of whether the affective RAVL is a useful tool in influencing peripheral arousal, the procedure for administration of the RAVL will not be altered and pressure and pulse rate measurement will occur before and after the test. It is hypothesized that a period (before the AAVL, after the AAVL) by list (positive, negative, neutral) interaction will occur, such that pressure and pulse rate will increase following the learning of negative words and remain stable or decrease following the learning of positive words. Since negative emotions have been reported to lead to heightened blood pressure reactivity as well as slower recovery to baseline, previous research supports the above prediction (Izard, 1977; McNaughtan, 1989; Schwartz et al., 1981; Weerts & Roberts, 1976).

Method

Subjects

A total of sixty-three right-handed male subjects were recruited from the departmental undergraduate subject pool (the average age range was between 19 years and 23 years). The research was devised in accordance with the guidelines of the Human Subjects Committee and Institutional Review Board of Virginia Polytechnic Institute and State University. All subjects received extra credit for participation and signed an Informed Consent Form (see Appendix A).

The sign up sheet recruited only right handed males because this subject population has been reported to show the greatest degree of cerebral asymmetry on dichotic listening (a focus in the next study) and other lateralized tasks (Molfese & Segalowitz, 1988). Exclusion of subjects from participation occurred if any historical medical problems were apparent (see Appendix B for a History Questionnaire), right-handedness was not verified (see Appendix C for the Coran, Porac, & Duncan, 1979, scale), or if a stable pulse rate/pressure baseline was not achieved. Each of these criteria will be discussed later. From Experiment 1, three subjects were excluded, two for not exhibiting consistent right-handedness (see the Coran, Porac, & Duncan, 1979, scale discussed below) and one for reporting a mitral valve prolapse and irregular heartbeat condition (see the History Questionnaire discussed below).

Apparatus

Materials for the present study included self report, affective learning, and psychophysiological measures. Self report materials included the History Questionnaire, the Handedness Questionnaire (Coran, Porac, & Duncan, 1979), and the Mood Induction Survey

(O'Berry & Holt, unpublished manuscript). Affective learning materials included the Rey Auditory Verbal Learning Test (Rey, 1964) and the Affective Auditory Verbal Learning Test. Psychophysiological recording was accomplished using a Norelco (Model 3500) blood pressure and heart rate monitor. A Metrosonics dB 307 Noise Dosimeter was used to calibrate sound levels.

Handedness. Using the behaviorally validated questionnaire developed by Coran, Porac, and Duncan (1979; refer to Appendix C), handedness was assessed. The 13 items of this test were developed from former inventories to assess hand, foot, ear, and eye preference. Correspondence between behavioral and self-report measures using the test are approximately .90. Each self-report item received the following scores: +1 for "right", -1 for "left", and 0 for "both" ear, foot, hand, and eye usage. In order to participate in any of the experiments, subjects were required to be consistently right-handed and to have a total score of +7 or above. The maximum score for right-handedness is +13 and the maximum score for left-handedness is -13.

Rey Auditory Verbal Learning (RAVL; Rey, 1964). The RAVL is a well known test frequently used by neuropsychologists and researchers to study the acquisition of verbal information, as well as primacy and recency effects (Shapiro & Harrison, 1990). Differential deficits in RAVL performance have been found for subjects with amnesia, head injury, and attention deficit disorder (Mungas, 1983). In the original RAVL, a list of 15 words (see Appendix G) is read to the subjects five times. Following the reading of the list at each trial, the subject is requested to recall as many words as possible using a free recall paradigm.

Affective Auditory Verbal Learning (AAVL). In the present study, positively and negatively valenced lists were developed for inclusion in the AAVL. The negative and positive word lists of the AAVL were developed using an index of word norms. Toglia and Battig (1978) produced an index of word norms which replicated and expanded the work of many previous researchers (Locascio & Ley, 1972; Perfetti, Lindsey, & Garson, 1971). Subjects consisted of 2500 undergraduates from the University of Colorado. A total of 2854 words were evaluated using a seven point rating scale for concreteness, imagery, categorizability, meaningfulness, familiarity (FAM), number of attributes, and pleasantness (PLS). From the subset of familiar words (an overall mean FAM rating of 5.0 or above), 15 negatively valenced words were selected (those having the lowest PLS ratings) and 15 positive valenced words were selected (those having the highest PLS ratings). See Appendix H for the positive and negative lists of the AAVL test. Refer to Appendix I for the FAM and PLS as well as imagery (IMG) ratings for words from the positive, negative, and neutral lists. As seen in Appendix I, words from each of the three lists were similar in imagery level.

Although four words for the original RAVL were not listed in the Toglia and Battig (1978) index, the original RAVL list was referred to as neutral in the present study since the mean PLS ratings for these words ($M = 4.38$, $SD = 1.26$) were close to the middle of the seven point Likert Scale (4.0). Refer to Appendix I. The original RAVL list can also be said to contain familiar words, since the FAM ratings for these words ($M = 5.82$, $SD = 1.09$) exceeded 5.0 like the other positive and negative words. Refer to Appendix I. Administration and scoring of the AAVL test was identical to the original RAVL procedure, which replicated the protocol outlined by Lezak (1983).

Blood Pressure (BP) and Heart Rate (HR). A Norelco digital pulse rate/pressure machine (model 3500) with automatic printer, inflation, and exhaust functions was used to obtain Korotkoff sounds (mmHg). An AC adapter was used to prevent cumulative changes in battery discharge from influencing the accuracy of measurement. The machine was set to inflate to 160 mmHg before deflating to measure Korotkoff sounds at the left arm as the brachial artery opened. The exhaust rate of the machine was 3 mmHg per sec, which set the error variance at plus or minus 3 mmHg (Harrison & Kelly, 1989). The procedure and machine used in the proposed study were identical to those used by Harrison and Kelly (1989) and follow the procedures set forth by the American Heart Association and the Association for the Advancement of Medical Instrumentation (see Harrison & Edwards, 1988; Harrison, Gorelczenko, & Kelly, 1988).

Procedure

Subject were tested individually throughout the day, between the hours of 10 a.m. and 9 p.m. (a 24 hour clock), in a comfortably lit (about 1300 lx) room with ambient noise levels of about 45.00 $\pm$ 0.32 dB SPL (re. 0.002 dynes/cm squared, A scale). Sound levels were determined by the use of a Metrosonics dB 307 Noise Dosimeter.

Upon arrival to the experiment room, subjects were seated behind a desk in a cushioned recliner in its upright position. The experimenter sat directly opposite the subject at the other side of the table. Following a brief introduction to the purpose, procedure, and policies covered in the Informed Consent Form, subjects were asked to read and sign the form (see

Appendix A). All subjects were informed that observation through the one-way mirror only occurred when the experimenter was out of the room. After signing the Informed Consent Form, subjects received the History (see Appendix B) and Handedness (see Appendix C) Questionnaires.

The experimenter read the History Questionnaire (see Appendix B) to the subjects and explicitly stated the examples of each category listed on the form. For example, under the item of use of alcohol or drugs at present (see Appendix B, Number 8), the experimenter read the example of ETOH usage within the past 48 hours. Subjects were excluded if severe head trauma, stroke, epilepsy or seizures, paralysis, neurological surgery, alcohol or drug problems, and/or other neurological or nervous system problems were reported.

Subjects would only be excluded from participation based on the history questionnaire if they reported a condition which would interfere with blood pressure and pulse recording or the verbal learning test. For instance, reporting use of most prescription medications and medical conditions would have resulted in exclusion. However, some prescription medications (e.g. prescription shampoo for psoriasis) and some medical conditions (e.g. an allergy to bees) which would not interfere with the present study did not lead to exclusion. Only one subject was excluded from Experiment 1 for reporting a mitral prolapse condition and irregular heartbeat.

Following the History Questionnaire, subjects filled out the Handedness Questionnaire. Subjects were given the following instructions with the questionnaire in front of them (see Appendix C): "The following survey will ask you which hand, foot, or eye you would use to perform several tasks. Circle 1 if you would use your right hand, -1 if you would use your left hand, or 0 if you would use both hands." The number circled for each of the 13 questions was added. In order to participate in the rest of the experiment, subjects were required to score +7 or higher, indicating consistent right-handedness. Two subjects were excluded from Experiment 1 for not exhibiting consistent right-handedness.

After the administration of the History and Handedness Questionnaires, the actual experiment began with the first measurement period of heart rate and left arm blood pressure. Subjects were asked to place their left arm on the table with left hand open and palm facing up. The left arm was supported at about the level of the heart. Legs were not crossed. The cuff was positioned over the left brachial artery. Palpation was used to determine the position of the left brachial artery about 2.5 cm superior to the left antecubital space. After turning the machine on, subjects were asked if they were ready, the start button was pushed, and then the cuff was inflated to 160 mmHg before deflating to detect Korotkoff sounds. Blood pressure and heart rate results appeared on the screen. Systolic and diastolic pressure was recorded in mmHg and pulse rate was recorded in beats per minute on the data sheet (see Appendix K). The procedure for pressure and pulse rate measurement used in the present study was identical to the methodology used by Harrison and Edwards (1988) and Harrison, Gorelczenko, and Kelly (1988).

Two measurement periods for pressure and pulse rate occurred, one before and one after the AAVL, as will be discussed later. A maximum of five and a minimum of two pulse rate and pressure measures were taken during the initial measurement period. To demonstrate a stable baseline, successive diastolic and systolic pressure measures were required to be no different than 10 mmHg and successive heart rates no different than 10 beats per minute (Wagner & Manstead, 1989). The final pulse rate and pressure measure taken in the establishment of a stable baseline during the initial measurement period was used in the analysis.

Following the first pulse rate and pressure measurement period, the cuff was removed, and the subject was given the AAVL. The cuff was removed in order to preserve the RAVL test administration procedure described by Lezak (1983). Twenty-one subjects received the neutral version, twenty-one subjects received the negative version, and twenty-one subjects received the positive version (see Appendix G and Appendix H). Assignment of the types of lists was based on order of arrival. The first subject to arrive received the positive list, the second the negative list, the third the neutral list, etc. Subjects arrived for the experiment in a random order and all instructions were prerecorded.

The experimenter left the room for the administration of the AAVL and entered the adjacent observation room. The word lists were read to the subjects using a previously recorded audiotape of a male voice reading the lists at about 1 word per second. Instructions were also read by the male voice on the audio tape. The audio tape was played through the intercom system at about 50 dB as determined by the Metrosonic dB 307 Noise Dosimeter.

Subjects received the following instructions from the original RAVL on Trial 1: "I am going to read you a list of words. Please listen carefully. When I stop, you are to say back as many words as you can remember. Say the words in any order you remember. Just try to remember as many as you can." Instructions for Trial 2 through Trial 5 were also as follows: "Now I'm going to read the same list again. When I stop again, I want you to tell me as many words as you can remember, including words you said the first time. It doesn't matter what order you say them. Just say as many words as you can remember whether or not you said them before." When the subject could no longer recall any more words or a maximum of three minutes had past, the next trial began. Subject's responses were recorded on an audio tape and later transferred to the data sheet (see Appendix G and Appendix H).

With the completion of all five trials of the AAVL, the experimenter returned to the room and sat across from the subject for the second pulse rate and pressure measurement period. Pulse rate and pressure recordings occurred using the same procedure as the first measurement period. The experiment concluded with a self report measure of affect induction in order to determine whether learning different types of affective words influences self reported mood. The Mood Induction Survey devised by O'Berry and Holt (unpublished manuscript; see Appendix L) consists of ten pairs of words of opposite affective valence (positive, negative). Subjects were instructed to rate how they felt on a scale between one (extreme positive valence) and seven (extreme negative valence) for the ten word pairs (see Appendix L). Subjects received the following instructions with the Mood Induction Survey in front of them: "Listed below are ten sets of word opposites and a rating continuum between 1 and 7. Circle the number for each set of opposites that describes how you feel now." Totals were then recorded, with lower scores indicating potential positive mood and higher scores indicating potential negative mood.

Results

Experiment 1 assessed changes in pressure and pulse rate reactivity following the learning of positive, negative, or neutral words. A period (before the AAVL, after the AAVL) by list (positive, negative, neutral) interaction was anticipated, such that pressure and pulse rate would increase following the learning of negative words, remain stable or decrease following the learning of positive words, and not change significantly following the learning of neutral words. In order to control for experimentwise error and variance from having multiple dependent variables (e.g. systolic pressure, diastolic pressure, mean arterial pressure, and heart rate), MANOVA's were used to analyze the data. Following the MANOVA's, ANOVA and Tukey analyses were performed. Refer to Appendix M for the ANOVA source tables of all the analyses.

A 3 x 2 (List x Period) mixed factorial MANOVA with repeated measures on measurement period was performed on the systolic pressure (mmHg), diastolic pressure (mmHg), mean arterial pressure (mmHg), and heart rate (beats per minute) measures. A significant list by period interaction was found using diastolic pressure measures, $F(2,60) = 6.96$, $p = 0.0019$, mean arterial pressure measures, $F(2,60) = 5.66$, $p = 0.0056$, and heart rate measures, $F(2,60) = 3.15$, $p = 0.0502$, but not systolic pressure measures, $F(2,60) = 1.82$, $p = 0.1710$. No main effects were found for any of the cardiovascular measures.

Post hoc analysis using the Tukey Test revealed a significant increase in diastolic pressure and mean arterial pressure, but not heart rate, following the learning of negative words. The Tukey Test revealed that diastolic pressure after learning negative words

(M = 74.81; SD = 18.17) was significantly greater than diastolic pressure before learning negative words (M = 65.67; SD = 13.68). Refer to Table 1 and Figure 1. Similarly, the Tukey Test revealed that mean arterial pressure following the learning of negative words (M = 96.83; SD = 14.16) was significantly greater than mean arterial pressure before learning negative words (M = 91.90; SD = 9.80). Refer to Table 1 and Figure 2.

Post hoc analysis also revealed a significant decrease in diastolic pressure and heart rate, but not mean arterial pressure, following the learning of positive words. The Tukey Test revealed that diastolic pressure following the learning of positive words (M = 68.71; SD = 12.52) was significantly less than diastolic pressure preceding the learning of positive words (M = 73.90; SD = 16.20). Refer to Table 1 and Figure 1. Similarly, a Tukey Test revealed that heart rate following the learning of positive words (M = 76.76; SD = 12.00) was significantly less than heart rate preceding the learning of positive words (M = 80.95; SD = 13.06). Refer to Table 2 and Figure 3.

Finally, post hoc analysis did not reveal any significant changes in diastolic pressure, systolic pressure, mean arterial pressure, or heart rate following the learning of neutral words. Refer to Table 1 and Table 2. Likewise, no list by period interaction was found using the systolic measures. Refer to Table 3. It should also be noted that post hoc analysis revealed that DBP, MAP, and HR prior to the learning of negative words was significantly less than DBP, MAP, and HR prior to the learning of positive and neutral words.

To further assess whether subjects in each list conditioned exhibited varying cardiovascular patterns before having received the AAVL, a one-way MANOVA with the between subjects variable of list (positive, negative, neutral) was performed on the systolic pressure (mmHg), diastolic pressure (mmHg), mean arterial pressure (mmHg), and heart rate (beats per minute) measures for the first measurement period. Results suggested that there was no significant difference between the positive, negative, and neutral list groups at pretest for systolic, diastolic, and mean arterial pressure measures. However, a significant main effect of list was found using heart rate measures, $F(2,60) = 3.41$, $p = 0.0391$. Post hoc analysis revealed that subjects receiving the negative list exhibited significantly lower pretest heart rates ($M = 72.62$; $SD = 9.16$) than subjects receiving the positive list ($M = 80.95$; $SD = 13.06$) or neutral list ($M = 81.48$; $SD = 14.19$) at pretest. Since the previous analysis revealed that heart rate did not change following the learning of negative words (see above), this findings does not necessarily mitigate the previous results.

Finally, to assess whether learning positive, negative, or neutral affective words influences self reported mood, the O'Berry and Holt (unpublished manuscript; see Appendix L) Mood Induction Survey was administered at the end of the study. A one-way ANOVA with the between subjects factor of list (positive, negative, neutral) was performed on the mood survey scores. Higher scores, indicative of more negative mood, was anticipated following negative list learning, and lower scores, indicative of more positive mood, was anticipated following positive list learning. However, no significant effect of list using mood survey scores was found. Subjects receiving the positive list showed nearly identical mood scores ($M = 29.62$; $SD = 9.26$) to subjects receiving the negative list ($M = 31.54$; $SD = 7.29$) and the neutral list ($M = 28.69$; $SD = 8.91$).

Discussion

The purpose of Experiment 1 was to assess the influence of affective list learning on ANS measures of arousal (blood pressure and heart rate). Previous research (Ax, 1953; Schwartz, Weinberger, & Singer, 1981) has suggested that different ANS activity patterns are associated with different affective valences. In sum, ANS reactivity (blood pressure and heart rate) has been reported to increase following exposure to negatively valenced events (imagery, verbal descriptions) and to decrease following exposure to positively valenced events (imagery, verbal descriptions).

Hence, it was hypothesized that there would be a period (before the AAVL, after the AAVL) by list (positive, negative, neutral) interaction, whereby blood pressure and pulse rate would increase following the learning of negatively valenced words and decrease or remain stable following the learning of positively valenced words. Full support for the hypothesis was found using diastolic pressure measures, since diastolic pressure significantly increased for subjects learning negatively valenced words and significantly decreased for subjects learning positively valenced words. Refer to Table 1 and Figure 1. Partial support for the hypothesis was also found using mean arterial pressure measures, since mean arterial pressure significantly increased for subjects learning negative words (refer to Table 1 and Figure 2) and heart rate significantly decreased for subjects learning positive words (refer to Table 2 and Figure 3).

All ANS measures (diastolic pressure, systolic pressure, mean arterial pressure, heart rate) were not equally affected. The findings of diastolic and mean arterial pressure suggest similar response patterns. However, the primary influence on diastolic pressure suggests that affective verbal learning has a greater influence on psychophysiological resistance parameters. In the present study, blood pressure refers to the pressure exerted by blood as it presses against the left brachial artery. Pressure measures were taken during ventricular systole and diastole. Systolic blood pressure is a measurement of the force of blood passing through the left brachial artery during ventricular contraction (Tortora & Anagnostakos, 1990). Diastolic pressure is a measurement of the force of blood passing through the left brachial artery during ventricular relaxation (Tortora & Anagnostakos, 1990). Thus, systolic pressure provides information on the force of left ventricular contraction, whereas diastolic pressure provides information on the resistance level of the left brachial artery (Tortora & Anagnostakos, 1990).

Hence, diastolic but not systolic pressure may have showed a significant increase following the learning of negatively valenced words and significant decrease following the learning of positively valenced words because affective verbal learning influences blood pressure resistance more so than the force of left ventricular contraction. Previous research would support this interpretation since the presentation of affective stimuli has often been reported to influence diastolic but not systolic pressure. For example, both Ax (1953) and Schwartz et al. (1981) reported that exposure to affective stimuli influenced diastolic but not systolic pressure.

The finding of a significant increase in mean arterial pressure following the learning of negatively valenced words does not refute the above argument that affective verbal learning may have more of an influence on resistance pressure than the force of ventricular contraction. Although it seems that the mean arterial pressure reflects the average of the systole and diastole pressures, this is not necessarily the case. Since arterial pressure is nearer to the diastolic than systolic levels for a longer period throughout the cardiac cycle, mean arterial pressure does not necessarily reflect the true average pressure on the left brachial artery (Smith & Bickley, 1964). Hence, the mean arterial pressure is most likely less than that reflected by taking the average of the diastolic and systolic measures (Smith & Bickley, 1964). Hence, the significant increase in mean arterial pressure following the learning of negative words does not necessarily suggest that the force of ventricular contraction (systolic pressure) was influenced by negative list learning.

Similar to previous research using systolic pressure measures, the influence of affective stimuli on heart rate has yielded inconsistent findings. Research assessing heart rate reactivity or the magnitude of heart rate changes following exposure to affective stimuli has been inconsistent, with some studies showing significant heart rate changes following exposure to affective stimuli (Schwartz et al., 1981) and other studies not finding significance (Ax, 1953). However, research assessing the rate of recovery or return to baseline for heart rate measures following exposure to affective stimuli has led to more consistent findings, with slower recovery following exposure to negatively valenced stimuli (e.g. criticism, imagery, facial posing) in comparison to positively valenced stimuli (Funkenstein, King, & Drolette, 1957; Levenson, 1992; Schwartz et al., 1981).

In the present study, heart rate significantly decreased following the learning of positively valenced words, as anticipated. However, it was also predicted that heart rate would increase following the learning of negatively valenced words and this was not found. Given the inconsistencies in previous research on heart rate reactivity, it is not surprising that the expected results for heart rate measures were found only for subjects learning positive words. Future research might resolve this issue by assessing the rate of recovery or return to baseline of heart rate measures as opposed to overall changes in reactivity.

The finding of significantly decreased heart rate following the learning of positively valenced words is useful, however, since this contradicts some verbal learning literature in support of arousal theories. Lacey and Lacey (1974), for example, demonstrated greater heart rate acceleration with more complex verbal processing tasks. In addition, Lacey and Lacey (1974) had subjects perform mental arithmetic tasks with or without concurrent or delayed verbalization and found that heart rate acceleration occurred for verbalization groups only. Hence, this verbal learning literature would predict that heart rate would increase following the learning of positive, negative, and neutral words since this is a relatively difficult task and involves verbalization. However, the finding of a significant decrease in heart rate following the learning of positively valenced words does not support this prediction. Hence, results of the present study using heart rate provide support for the contention that learning positive and negative words is analogous to previous research on exposure to affective stimuli (e.g. Ax, 1953).

In sum, Experiment 1 suggests that learning positively or negatively valenced words significantly influences diastolic pressure. Research has yet to answer the question of whether ANS reactivity precedes, causes, or results from emotion. Whether affective verbal learning is or is not associated with the arousal correlates of emotion cannot be answered, since self reported emotional state as assessed by the Mood Induction Survey did not vary as a function of list condition. It is unlikely that whether or not subjects guessed that the study was interested in emotion influenced responding on the mood survey, since many of the expected results in arousal measures were found. A great deal of previous research has similarly failed to show a correspondence between self report and arousal correlates of emotion (Thompson, 1988).

Many other questions will be addressed in future research. For example, to distinguish whether listening to affective words as opposed to verbally recalling affective words leads to arousal changes, blood pressure and heart rate measures will need to be taken after the experimenter reads the list on each trial, as well as after the subject verbally recalls the words on each trial. Future research will include more measurement periods, as well as more unobtrusive measures (e.g. blood volume or skin conductance).

Experiment 2

In addition to producing differential pulse rate and pressure patterns, the verbalization (vocally or subvocally) of affectively valenced words has been shown to lead to differential patterns of hemi-activation. For example, Davidson et al. (1979) summarizes several studies using various psychophysiological measures (EEG, PET, rCBF) which suggest greater activation of right hemisphere regions during negative affect (e.g. verbally describing unhappy experiences) and greater activation of left hemisphere regions during positive affect (e.g. verbally describing happy experiences).

In fact, following activation of a particular hemisphere with the verbalization of positive (left hemisphere) or negative (right hemisphere) affective words, research has suggested that subjects are either better (facilitation) or worse (interference) at performing other tasks lateralized to that hemisphere depending on task load or difficulty. For example, as previously mentioned, Ley and Bryden (1979) demonstrated that the subvocal rehearsal of two or four affective words (right hemisphere) enhanced the identification of faces presented to the left visual field (right hemisphere). However, the rehearsal of six affective words (right hemisphere) interfered with the perception of faces in the left visual field (right hemisphere).

The present study will assess whether the learning of different emotional words is associated with differential hemi-activation. Since regions of the right and left hemispheres are differentially involved in positive and negative emotion as well as arousal, it could be that the differential peripheral pulse rate and pressure patterns for specific emotions reflect asymmetrical cerebral activation. Since right hemisphere regions are more involved in negative emotions as well as higher peripheral arousal, the ANS patterns observed with the learning of negative emotional words could be associated with activation of right hemisphere areas. Conversely, since left hemisphere regions are more involved in positive emotions as well as lower levels of peripheral arousal, the ANS patterns observed with the learning of positive emotional words could be associated with activation of left hemisphere areas.

In light of potential differential hemi-activation with the learning of affective words, it is anticipated that learning emotional words will influence subsequent performance on lateralized tasks, such as ear advantage for the identification of prosody in the dichotic listening paradigm. If the learning of negative words produces greater activation of the right hemisphere, then subjects previously learning negative words will be better at the identification of sad or angry tones of voice presented to the left ear. Conversely, if the learning of positive words produces greater activation of the left hemisphere, then subjects previously learning positive words will be better at the identification of happy tones of voice presented to the right ear.

Experiment 2 will assess the priming of ear advantages by administering the Dichotic Emotional Words Tape (Bryden & MacRae, 1989) immediately following the neutral, positive, or negative versions of the AAVL. The Dichotic Emotional Words Tape developed by Bryden and MacRae (1989) consists of dichotically presented words (bower, dower, tower, power) spoken in different affective tones (happy, sad, angry, neutral). Bryden and MacRae (1989) showed that subjects exhibited a greater LEA (left ear advantage or right hemisphere superiority) for the identification of types of affective tone and a greater right ear advantage (REA; left hemisphere superiority) for word recognition (a non-valenced result). Bryden and MacRae (1989) also reported that REA (right ear advantage or left hemisphere superiority) scores were greater for the identification of happy tones of voice, while LEA (right hemisphere superiority) scores were greater for the identification of angry or sad tones of voice (a valenced result).

It was hypothesized that there would be a three-way list (positive, negative, neutral) by ear (left, right) by prosody (happy, sad, angry, neutral) interaction, such that subjects previously learning negative words, potentially activating the right hemisphere, will be better at the identification of sad and angry tones of voice presented to the left ear than to happy or neutral tones of voice for the first block of dichotic trials. Conversely, subjects previously learning positive words, potentially activating the left hemisphere, will be better at the identification of happy and neutral tones of voice presented to the right ear than to sad or to angry tones of voice for the first block of dichotic trials.

Method

Subjects

A total of sixty-three right-handed male subjects were recruited from the departmental undergraduate subject pool (the average age range was between 19 years and 23 years). The research was devised in accordance with the guidelines of the Human Subjects Committee and Institutional Review Board of Virginia Polytechnic Institute and State University. All subjects received extra credit for participation and signed the Informed Consent Form (see Appendix D).

The sign up sheet recruited only right handed males. Exclusion of subjects from participation occurred if any history problems were apparent (see Appendix B for a History Questionnaire), right-handedness was not verified (see Appendix C for the Coran, Porac, & Duncan, 1979, scale), or Practice Test 2 of the Bryden Dichotic Listening Tape was failed two times (see Appendix F). Each of these criteria will be discussed later. From Experiment 2, one subject was excluded for reporting use of Ritalin for attention deficit disorder (see the History Questionnaire discussed below).

Apparatus

Materials for the present study included self report, affective learning, and dichotic listening measures. Self report materials included the History Questionnaire, the Handedness Questionnaire (Coran, Porac, & Duncan, 1979), and the Mood Induction Survey (O'Berry & Holt, unpublished manuscript). Affective learning materials included the Rey Auditory Verbal Learning Test (Rey, 1964) and the Affective Auditory Verbal Learning Test. A Metrosonics dB 307 Noise Dosimeter was used to calibrate sound levels.

Dichotic Emotional Words Tape (Bryden & MacRae, 1989). Individual differences in cerebral activation for auditory affect perception was assessed using the Dichotic Emotional Words Tape developed by Bryden and MacRae (1989). The tape consisted of four words (dower, tower, power, bower) spoken by a male voice in four different affective intonations (happy, sad, angry, neutral). On some of the trials the sad tones of voice are slightly louder (e.g. 2-4 dB) than the happy, angry, and neutral tones of voice. These 16 items were digitally produced on a PDP 11/40 computer, edited to an average duration of 500 ms, and equalized for decibel level. Ratings from 20 naive subjects were used to assess the validity of the affective intonations. Subjects were able to identify which affective tone of voice was being portrayed in about ninety-six percent of the trials.

Order of presentation of affective tones and type of words were completely counterbalanced. Following each series of eighteen dichotic trials, there was a 10 second break. A total of 288 trials made up the entire tape, with a different word and affective tone combination occurring concurrently in each ear for each trail. The tape is divided into four blocks of 72 trials each. Each of the four words and each of the four affective tones are presented eighteen times in each block. See Appendix J for Block 1 and Block 2 trials of the tape.

<u>Procedure</u>

Each subject was tested individually throughout the day, between the hours of 10 a.m. and 9 p.m. (a 24 hour clock), in the same comfortably lit (about 1300 lx) room with ambient noise levels of approximately 45.00 + 0.32 dB SPL (re. 0.002 dynes/cm squared, A scale). Upon arrival to the experiment room, subjects were seated behind a desk in a cushioned recliner in its upright position and the experimenter sat facing the subject at the other side of the table. After a short introduction to the purpose and procedures covered in the Informed Consent Form, subjects were asked to read and sign the form (see Appendix D). All subjects were informed that observation through the one-way mirror occurred only when the experimenter was out of the room.

After signing the Informed Consent Form, subjects received the History (see Appendix B) and Handedness (see Appendix C) Questionnaires. The procedures for administration and scoring of the History and Handedness Questionnaires were identical to those used in Experiment 1. Likewise, the same exclusion criteria for the History and Handedness Questionnaires used in Experiment 1 was also applied to Experiment 2. One subject was excluded from participation in Experiment 2 because of reporting use of Ritalin for attention deficit disorder.

Following the History and Handedness questionnaires, subjects were given Practice Test 1 (see Appendix E) and Practice Test 2 (see Appendix F) of the Bryden and MacRae (1989) Dichotic Emotional Words Tape. The experimenter left the room to enter the adjacent observation room and then instructed subjects to put on the headphones from the intercom. Headphone position was reversed for every other subject and analysis (see results section) verified the accuracy of the counterbalancing procedure. The tape was then played at approximately 50 dB through the headphones, as determined by a Metrosonics 307 Noise Dosimeter. Practice Test 1 was included for auxiliary information only, to familiarize subjects with the dichotic listening procedure.

Practice Test 1 consisted of nine trials of dichotically presented syllables. While referring to a stimulus card (28 cm by 21 cm) placed on the table in front of the subject, which had all of the syllables printed on it, the experimenter gave the following instructions: "When I switch on the tape, you will hear several trials of different syllables being read. Referring to the card in front of you, the syllables are (referring to the stimulus card): pa, ba, ga, and ka. After each trial, tell me what you hear. Even if you have to guess, always tell me what you hear. Do you have any questions?" After responding to questions, the experimenter started the tape and recorded the subjects responses on the data sheet (see Appendix E). The stimulus card was in front of the subject throughout Practice Test 1.

After the administration of Practice Test 1, Practice Test 2 was given. Practice Test 2 consisted of 17 monaural trials of different words (bower, tower, power, dower) spoken in differing tones of voice (happy, sad, angry, neutral). While referring to a stimulus card (28 cm by 21 cm), also placed on the table in front of the subject, which had facial drawings of the tones of voice, the experimenter gave the following instructions: "When I switch on the tape, you will hear several trials of words being spoken in different tones of voice. Referring to the card in front of you, the tones of voice are happy, sad, angry, and neutral. After each trial, tell me what you heard, even if you have to guess." Subjects were required to identify all but three of the tones of voice to pass. If the subject could not pass Practice Test 2 by the second administration due to an acuity problem or difficulty identifying the tones of voice, the experiment was terminated. No subjects were excluded based on performance on the practice tests.

Following the practice tests, subjects were instructed through the intercom to remove the headphones, and then received the AAVL test. Like Experiment 1, subjects received either the neutral list, the negative list, or the positive list (see Appendix G and Appendix H) based on order of arrival. A total of 63 subjects were run for Experiment 2, with 21 subjects receiving each AAVL list (neutral, happy, angry). The procedure for administration of the AAVL was identical to Experiment 1.

Once the five trials of the AAVL were completed, subjects were instructed through the intercom to put on the headphones again, and then received the first two blocks of trials of the Bryden and MacRae (1989) tape. Instructions were as follows: "When I switch on the tape, you will hear several trials of words being spoken in different tones of voice. Referring to the card in front of you, the tones of voice are happy, sad, angry, and neutral. After each trial or time that the syllables are spoken, tell me what you heard. Even if you have to guess, always tell me what you heard. Do you have any questions?" The index card (28 cm by 21 cm) with the four types of affective tones (happy, sad, angry, neutral) depicted as facial drawings was on the table about 0.5 m from the subject. On the data sheet (see Appendix J), the experimenter circled correct responses and wrote the incorrect answers next to the accurate ones. The total number of correct identifications for stimuli presented to the right ear or the left ear would then be counted for each of the four affective tones separately for each block (see Appendix J).

Results

Dichotic Listening Accuracy Scores

Experiment 2 assessed whether affective verbal learning would influence subsequent dichotic affect identification. A 3 x 2 x 2 x 4 (List x Block x Ear x Tone) mixed factorial MANOVA with the between subjects variable of list (positive, negative, neutral) and repeated measures factors of block of dichotic trials (Block 1, Block 2), ear of presentation (left ear, right ear), and tone of voice (happy, sad, angry, neutral) was performed on the dichotic listening accuracy scores. Following the MANOVA, ANOVA and Tukey analyses were performed. Refer to Appendix M for the ANOVA source tables. Accuracy scores consisted of the total number of correct identifications for each tone of voice presented to each ear in both blocks of trials on the Dichotic Emotional Words Tape. The maximum accuracy score was 18. Although a three-way list by ear by tone interaction, with subjects learning negative words exhibiting higher left ear scores for sad or angry affect identifications and subjects learning positive words exhibiting higher right ear scores for happy or neutral affect identifications, was anticipated, list did not significantly interact with any other variable in Experiment 2.

However, main effects of block, $F(21,60) = 18.60$, $p = 0.0001$, ear, $F(1,60) = 73.38$, $p = 0.0001$, and tone, $F(3,180) = 8.62$, $p = 0.0001$ were found. The Tukey Test revealed that scores for the second block of trials (M = 9.71; SD = 4.88) were significantly greater than scores for the first block of trials (M = 9.08; SD = 4.45). Refer to Table 4. A Tukey Test also revealed that scores for dichotic stimuli presented to the left ear (M = 11.57; SD = 3.61) were significantly greater than scores for dichotic stimuli presented to the right ear (M = 7.22; SD = 4.61). Refer to Table 4. Finally, a Tukey Test revealed that scores for the identification of sad tones of voice (M = 10.28; SD = 4.90) was significantly greater than scores for the identification of happy tones of voice (M = 8.42; SD = 4.72), potentially due to the fact that sad tones of voice were on several trials 2-4 dB louder than all other tones of voice. Refer to Table 4.

A significant block by tone, $F(3,180) = 7.62$, $p = 0.0001$, interaction was also found. Post hoc analysis revealed that scores for the identification of angry tones of voice during Block 2 (M = 10.60; SD = 4.91) were significantly greater than scores for the identification of angry tones of voice during Block 1 (M = 8.95; SD = 4.39). Scores for the identification of sad (M = 10.28; SD = 4.94) and angry (M = 10.60; SD = 4.91) tones during Block 2 were also significantly greater than scores for the identification of happy and neutral tones of voice during both blocks. Refer to

Table 5 and Figure 4.

In addition, a significant ear by tone, $F(3,180) = 7.27$, $p = 0.0001$, interaction was found. Post hoc analysis revealed that scores for the identification of all tones of voice were significantly better for presentations to the left ear than the right ear. In addition, post hoc analysis revealed that scores for the identification of sad ($M = 12.56$; $SD = 3.56$) and angry ($M = 12.37$; $SD = 3.34$) tones of voice presented to the left ear were significantly greater than scores for the identification of happy ($M = 10.60$; $SD = 3.78$) and neutral ($M = 10.75$; $SD = 3.32$) tones of voice presented to the left ear. Scores for the identification of sad ($M = 8.00$; $SD = 5.02$) tones of voice presented to the right ear were also significantly greater than scores for the identification of happy ($M = 6.23$; $SD = 4.56$) tones of voice presented to the right ear. Refer to Table 6 and Figure 5.

Dichotic Listening Accuracy Scores: Block 1 Only

To more closely address the hypothesis, which predicts results for only Block 1 of the dichotic listening tape, a 4 x 2 x 2 (List x Ear x Tone) mixed factorial MANOVA with the between subjects variable of list was performed on the dichotic listening accuracy scores for Block 1 of the dichotic listening tape. The same results were found with the analysis of Block 1 data as were found when block of trials was factored into the MANOVA previously. Following the MANOVA, ANOVA and Tukey analyses were performed. Refer to Appendix M for the ANOVA source tables.

Main effects of ear, $F(1,60) = 72.48$, $p = 0.0001$, and tone, $F(3,180) = 7.40$, $p = 0.0001$, were found. Post hoc analysis revealed that accuracy scores for stimuli presented to the left ear ($M = 11.17$; $SD = 3.58$) were significantly greater than accuracy scores for stimuli presented to the right ear (*M* = 6.99; *SD* = 4.25). In addition, post hoc analysis revealed that accuracy scores for the identification of sad tones of voice (*M* = 10.28; *SD* = 4.89) were significantly greater than accuracy scores for the identification of happy (*M* = 8.33; *SD* = 4.58), angry (*M* = 8.95; *SD* = 4.39), and neutral (*M* = 8.76; *SD* = 3.64) tones of voice. Refer to Table 7.

In addition, a significant ear by tone, $F(3,180) = 7.23$, $p = 0.0001$, interaction was found. Post hoc analysis revealed that scores for the identification of sad (*M* = 12.67; *SD* = 3.74) tones of voice presented to the left ear were significantly greater than scores for the identification of happy (*M* = 10.60; *SD* = 3.78), neutral (*M* = 10.75; *SD* = 3.32), and angry (*M* = 11.44; *SD* = 3.27) tones of voice presented to the left ear. Scores for the identification of sad (*M* = 12.67; *SD* = 3.74) and neutral (*M* = 11.44; *SD* = 3.27) tones of voice presented to the right ear were also significantly greater than scores for the identification of happy tones of voice (*M* = 6.17; *SD* = 4.39) presented to the right ear. Refer to Table 8.

Dichotic Listening Error Totals

To further assess whether affective verbal learning influences subsequent dichotic affect perception, analysis of error rates was performed using the dichotic listening data. Each block contains 72 dichotic trials, with 18 concurrent presentations of each of the four tones of voice in a randomized order. Hence, within each block, the maximum score for identification of any of the four affective valences is 18. To obtain error totals, the accuracy scores or the number of correct affect identifications within each block were subtracted from 18. A 3 x 2 x 2 x 4 (List x Block x Ear x Tone) mixed factorial MANOVA with the between subjects factor of list (positive, negative, neutral) and the repeated measures factor of ear of presentation (left ear, right ear), tone of voice (happy, sad, angry, neutral), and block of dichotic trials (Block 1, Block 2) was performed on the dichotic listening error totals. Results are nearly identical to those obtained using accuracy scores. Following the MANOVA, ANOVA and Tukey analyses were performed. Refer to Appendix M for the ANOVA source tables.

The same main effects revealed with accuracy scores were also found using error totals. Main effects of Block, $F(1,60) = 19.29$; $p = 0.0001$, ear, $F(1,60) = 75.83$; $p = 0.0001$, and tone, $F(3, 180) = 9.03$; $p = 0.0001$, were found. Post hoc analysis revealed that significantly less error occurred for Block 2 dichotic trials ($M = 8.26$; $SD = 4.87$) than Block 1 dichotic trials ($M = 8.90$; $SD = 4.44$). Refer to Table 9. Significantly less error was also found to occur for left ear presentations ($M = 6.39$; $SD = 3.58$) than right ear presentations ($M = 10.78$; $SD = 4.60$). Refer to Table 9. Error totals for sad affective presentations ($M = 7.66$; $SD = 4.89$) were also significantly less than error totals for happy affective presentations ($M = 9.58$; $SD = 4.73$). Refer to Table 9.

A significant block by tone interaction, $F(3,180) = 7.59$, $p = 0.0001$, was also found. Like the results using accuracy scores, post hoc analysis revealed that error totals for sad ($M = 7.66$; $SD = 4.95$) and angry ($M = 7.40$; $SD = 4.90$) tones of voice during Block 2 were significantly less than the error totals for happy and neutral tones during both blocks. Like the analysis using accuracy scores, significantly less error occurred for Block 2 angry presentations ($M = 7.40$; $SD = 4.90$)

than Block 1 angry presentations (*M* = 9.06; *SD* = 4.36). Post hoc analysis also revealed that error was significantly greater for neutral than sad tones in both blocks. Refer to Table 5 and Figure 6.

A significant ear by tone interaction, $F(3,180) = 6.65$, $p = 0.0003$, was also found. Like the analysis using accuracy scores, post hoc analysis revealed that error total for sad (*M* = 5.33; *SD* = 3.48) and angry (*M* = 5.66; *SD* = 3.30) tones presented to the left ear were significantly less than error totals for happy (*M* = 7.39; *SD* = 3.79) and neutral tones (*M* = 7.19; *SD* = 3.28) presented to the left ear. Similar to the analysis using accuracy scores, right ear sad, angry, and neutral tones led to significantly less error totals than right ear happy tones. Refer to Table 6 and Figure 7.

Headphone Position Counterbalancing

To control for headphone position, 33 subjects from Experiment 2 used the standard position (right earphone covering the right ear) and 30 subjects from Experiment 2 used the reversed position (right earphone covering the left ear). Headphone position was reversed for every other subject. Effectiveness of the headphone counterbalancing procedure was assessed by a 2 x 2 x 2 x 4 (Earphone Position x Block x Ear x Tone) mixed factorial MANOVA with repeated measures on block, ear of presentation, and tone of voice. It was anticipated that there would not be a significant difference in dichotic accuracy scores as a function of headphone position. In support of the validity of the headphone counterbalancing procedure, no significant main effect of headphone position as well as no significant interactions between headphone position and other factors were found using dichotic accuracy scores.

Mood Induction Survey Scores

To assess whether self reported mood was influenced by learning positive, negative, or neutral affective words, the O'Berry and Holt (unpublished manuscript; see Appendix L) Mood Induction Survey was administered at the end of the study. A one-way ANOVA with the between subjects factor of list (positive, negative, neutral) was performed on the scores. Lower scores, indicative of more positive mood, was anticipated following positive list learning, and higher scores, indicative of more negative mood, was anticipated following negative list learning. However, no significant effect of list using Mood Induction Survey was found. Subjects receiving the positive list showed nearly identical mood scores (M = 31.81; SD = 11.37) to subjects receiving the negative list (M = 31.86; SD = 9.18) and the neutral list (M = 31.05; SD = 4.53).

The Affective Auditory Verbal Learning Test

Following the assessment of the cardiovascular data from Experiment 1 and the dichotic listening data from Experiment 2, additional post hoc analysis was done on the verbal learning patterns of the AAVL. To assess acquisition patterns as well as primacy and recency effects, a 3 x 5 x 3 (List x Trial x Location) post hoc mixed factorial ANOVA with the repeated measures factors of trial (Trial 1 through Trial 5) and location (first five words, middle five words, last five words) was performed on the total number of words recalled. Following the MANOVA, ANOVA and Tukey analyses were performed. Refer to Appendix M for the ANOVA source tables of all the analyses. The procedure for administration of the affective verbal learning test was identical in both Experiment 1 and Experiment 2. The same results were obtained when the verbal learning tests from Experiment 1 and Experiment 2 were evaluated separately. The analysis below comprises data from all the verbal learning tests to more closely approximate a normative sample (over 100 subjects).

A significant main effect of trial, $F(4,372) = 33.43$, $p = 0.0001$, was found. Post hoc analysis revealed that the mean number of words recalled for Trial 1 ($M = 6.84$; $SD = 1.53$) and Trial 2 ($M = 9.50$; $SD = 1.91$) were significantly less than the mean number of words recalled for Trial 3 ($M = 11.92$; $SD = 7.30$), Trial 4 ($M = 11.65$; $SD = 1.78$), and Trial 5 ($M = 12.17$; $SD = 1.86$). The mean number of words recalled for Trial 1 ($M = 6.84$; $SD = 1.53$) was also significantly less than the mean number of words recalled for Trial 2 ($M = 9.50$; $SD = 1.91$). Refer to Table 10.

The acquisition patterns of the present study replicate those reported by previous research using the RAVL and hence, suggest that the positive and negative lists produce similar learning patterns as the neutral list. Like the present study, research using the original RAVL has reported a typical learning curve during acquisition, with the total number of words recalled increasing with each successive trial (Ryan & Geisser, 1986). The present study found a similar acquisition pattern for positive, negative, and neutral list learning.

A significant main effect of location, $F(2,186) = 84.85$, $p = 0.0001$, as well as a significant interaction between list and location, $F(4,186) = 13.05$, $p = 0.0001$, were also found. Post hoc analysis revealed that mean scores for the first five words ($M = 3.96$; $SD = 1.01$) were significantly greater than mean scores for the middle five words ($M = 2.94$; $SD = 1.38$) and the last five words ($M = 3.35$; $SD = 1.22$). Refer to Table 10. Post hoc analysis also revealed that the first five words of the negative list produced the highest mean (M = 4.41; SD = 0.71), which was significantly greater than all other list positions. Refer to Table 11 and Figure 8. In addition, the last five words of the positive list (M = 3.51; SD = 1.06) yielded significantly greater means than the middle five words of the positive, negative, and neutral lists. Refer to Table 11 and Figure 8. See Table 12 (included for auxiliary information only) for normative data for each list by location and trial.

Although acquisition patterns for all lists were similar, the learning of positive and negative words produced differential patterns of acquisition as a function of list location (primacy and recency effects). Results revealed that recall of the first five words for each list significantly exceeded recall for the middle or last five words of each list. Hence, the learning of positive, negative, and neutral lists tends to produce a significant primacy effect. However, the list by location interaction of the present study also shows diametrically opposite effects as a function of list location (primacy and recency) of negative and positive word lists. The learning of a negative word list produced a significantly greater primacy effect than learning positive or neutral lists. However, the learning of a positive word list produced a significantly greater recency effect than the learning of negative or neutral lists.

Discussion

The purpose of Experiment 2 was to assess the influence of affective list learning on subsequent dichotic ear advantage. Verbalization of affectively valenced words has been shown to lead to differential patterns of hemi-activation as well as differing pulse rate and pressure patterns. Davidson et al. (1979), for example, demonstrated increased right frontotemporal activation during verbal descriptions of negative life events and greater left frontotemporal activation during verbal descriptions of positive life events using many psychophysiological measures (EEG, PET, rCBF). Research has also suggested that the verbalization of negative or positively valenced words may influence subsequent performance of tasks lateralized to the right or left hemisphere. For example, research has suggested that with activation of the right or left hemisphere with subvocal rehearsal of positive or negative affective words (two or four words), subjects are better (facilitation) at performing tasks (facial identification) also lateralized to the activated hemisphere (Ley & Bryden, 1979).

Experiment 2 assessed whether learning affective words would facilitate the identification of tones of voice dichotically presented. A list (positive, negative, neutral) by ear (left, right) by tone (happy, sad, angry, neutral) interaction was anticipated, with subjects previously learning negative words being better at the identification of sad or angry tones of voice presented to the left ear (right hemisphere facilitation) and subjects previously learning positively valenced words being better at the identification of happy or neutral tones of voice presented to the right ear (left hemisphere facilitation). However, a list by ear by tone interaction was not found for accuracy or error scores, suggesting that learning affective words does not influence subsequent ear advantage. Since there was no difference in self-reported mood state following each type of list, there may have been no differential hemi-activation following the learning of the different lists.

Previous research on the influence of affective verbal rehearsal has almost always involved concurrent visual or auditory tasks. For example, Bryden and Ley (1983) showed that subvocal rehearsal of emotional words enhanced the left ear advantage for dichotic phoneme detection as well as the left visual field advantage for identification of faces. Unlike the present study, the affective words were rehearsed subvocally during the dichotic listening and facial identification tasks. Hence, affective list learning may have not influenced dichotic prosody identification in the present study because the lists preceded the dichotic listening task and there was no subvocal rehearsal. Future research may attempt to shorten the dichotic task and to instruct subjects to subvocally rehearse the words from the lists between the dichotic trials.

Previous research also suggests that the influence of affective verbal learning is a function of task difficulty. For example, Hellige et al. (1979) demonstrated that rehearsing two words enhanced the right visual field identification of forms (facilitation); however, rehearsing more than two words hindered right visual field form identification (interference). In sum, the greater the task load or the more words that subjects rehearsed, the less facilitation and the more interference. If rehearsal and verbalization of 15 words is conceived of as a high task load, than it could be that affective verbal learning interfered with right ear (left hemisphere and verbal learning tasks) performance. In partial support of this, a significant ear by tone of voice interaction was found, with subjects being better at the identification of negative affective tones of voice (sad and angry) presented to the left ear (right hemisphere) in comparison to the right ear (left hemisphere).

Although affective verbal learning did not influence subsequent dichotic ear advantage, Experiment 2 provided a great deal of information on the affective dichotic listening procedure. Bryden and MacRae (1989) used a between subjects design, with different subjects listening for different tones of voice. Subjects were instructed to respond yes or no as to whether they thought a particular affective tone occurred on a particular trial. For example, a subject might be instructed to listen for a sad tone of voice and to respond yes or no as to whether or not they think they heard a sad tone of voice. Unlike Bryden and MacRae (1989), the present study used a within subjects methodology, with all subjects listening for all tones of voice. Subjects were instructed to say the affective tones that they think they heard after each trial, similar to the procedure used for the administration of the Dichotic CV's Tape put out by the Kresge Hearing Research Laboratory. A within subjects approach reduces error as well as reduces the number of subject groups required for the present study from 12 (three lists by four tones of voice) to three (positive, negative, neutral lists). The results of the present study support the validity of the within subjects administration procedure of the Dichotic Emotional Words Tape (Bryden & MacRae, 1989). However, future research may better address the utility of affective verbal learning in influencing dichotic ear advantage by using the former between subjects methodology.

Research on the laterality of emotion has been mixed, with some studies suggesting that right hemisphere regions are specialized for affect (a non-valenced approach; Ley & Bryden, 1982) and other studies suggesting that the left hemisphere regions play a role in the expression/identification of positive emotion while the right hemisphere regions play a role in the expression / identification of negative emotion (a valenced approach; Tucker, 1981). A great deal of dichotic listening research has reported that the identification of affective content or affective tones of voice is better for stimuli presented to the left ear (right hemisphere; Bryden & MacRae, 1989; Ley & Bryden, 1982; Safer & Leventhal, 1977). The present study similarly supports a nonvalenced approach, with the identification of all affective tones being better (enhanced accuracy, reduced error) for stimuli presented to the left ear (right hemisphere). Refer to Table 4.

The present study also revealed a significant block by tone interaction for the identification of negatively valenced tones of voice. Accuracy scores for the identification of angry tones of voice were significantly greater during Block 2 than Block 1. In addition, accuracy scores for the identification of both angry and sad tones of voice during Block 2 were significantly greater than the identification of both happy and neutral tones in both blocks. Refer to Table 5 and Figure 4. Previous research has suggested that accuracy scores are better for sad or angry tones in comparison to happy tones (Bryden & MacRae, 1989; Snyder, Harrison, & Gorman, 1996). The present study shows this (refer to Table 4), but also suggests that the identification of negatively valenced tones gets significantly better over time (increased accuracy or reduced error) while the identification of happy or neutral tones do not. Analysis using error totals replicated the above findings (Refer to Table 5 and Figure 6).

In addition, the present study revealed a significant ear by tone interaction. Accuracy scores for the identification of sad and angry tones of voice were significantly greater than accuracy scores for the identification of happy or neutral tones of voice for presentations to the left ear (right hemisphere). This finding was replicated using the error totals. Accuracy scores for the identification of sad tones of voice were also significantly greater than accuracy scores for the identification of happy tones of voice for presentations to the right ear (left hemisphere). Error totals also replicated this finding.

As mentioned, previous research has suggested that accuracy scores are better for sad or angry tones than happy or neutral tones of voice overall (Bryden & MacRae, 1989; Snyder, Harrison, & Gorman, 1996). Again, the present study shows this (refer to Table 4), but while accuracy scores for the identification of sad stimuli are significantly greater than accuracy scores for the identification of happy stimuli for presentations to both ears, accuracy scores for the identification of angry stimuli are significantly greater than accuracy scores for the identification of neutral stimuli only for presentations to the left ear (right hemisphere) in the present study (refer to Table 6 and Figure 5). However, before this interpretation can be accepted, research, previous as well as present, needs to assess why the identification of sad tones of voice leads to the best accuracy scores (refer to Table 4) and the lowest error totals (refer to Table 9). This is potentially due to the fact that on many of the trials sad tones of voice were spoken louder (2-4 dB) than happy, angry, or neutral tones of voice.

General Discussion

Relatively few tests are available for the investigation of emotional comprehension and learning. One solution to this problem is to create an affective version of well known tests like the RAVL. The purpose of the present research was to create and to provide initial data on auditory affective list comparisons (positive and negative valences) for the RAVL. By creating an affective version of the RAVL, the Affective Auditory Verbal Learning Test, clinicians will be provided with an objective measure of auditory affective verbal processing. Since verbal processing is primarily a left hemisphere task (e.g. Hugdahl & Anderson, 1987) and emotional perception/comprehension has also been reported to be lateralized (e.g. the left hemisphere for positive emotions and the right hemisphere for negative emotions; Bryden & MacRae, 1989), the AAVL may provide a useful tool in the assessment of cerebral dysfunction as well as affective disorders in the clinic.

Post hoc analysis of the results support the contention that the negative and positive lists are suitable for inclusion into the AAVL and that the AAVL may have clinical and experimental utility. Research using the original RAVL has reported a typical learning curve pattern, with recall increasing with each successive trial (Ryan & Geisser, 1986). The negative and positive lists are suitable for inclusion into the AAVL, since they show a similar pattern of acquisition and overall primacy as do the original neutral words. Refer to Table 10. However, the significantly enhanced primacy for negative list learning and significantly enhanced recency for positive list learning suggests that the AAVL is useful in detecting how learning varies as a function of valence.

Next, Experiment 1 was an investigation of the influence of affect learning on blood pressure. The affective lists were effective in leading to physiological patterns associated with exposure to affective stimuli, since diastolic pressure decreased significantly following the learning of positive words and increased significantly following the learning of negative words.

Additionally, Experiment 2 of the present study assessed how useful the affective lists were in influencing subsequently lateralized tasks (dichotic listening). List learning was not effective in influencing subsequently lateralized tasks, since no interaction between list, ear of presentation, and tone of voice were found for dichotic accuracy or error totals. As discussed, this is most likely due to the fact that word rehearsal did not occur during the dichotic task as it did with other studies (Bryden & Ley, 1983). In the present study, the dichotic listening task was administered following the verbal learning test with no prompts for subjects to keep rehearsing the words. Also, the high number of words in the present study (15 words), compared to previous research (2 words to 6 words), could have led to interference rather than to facilitation (Hellige et al., 1979).

With the AAVL, psychologists can now assess how individuals vary from this initial data on affective list learning. The RAVL has been used as a measure of malingered amnesia (Greiffenstein, Baker, & Gola, 1994), as well as deficits following closed-head injuries (Blachstein, Vakil, & Hoofien, 1993), acquired immunodeficiency syndrome (Ryan, Paolo, & Skrade, 1992), malnutrition and combat (Sutker, Allain, Johnson, & Butters 1992), and alcoholism or depression (Query &

Megran, 1984). Clinical psychologists may find the affective lists useful in further study of these patient populations.

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Herridge, M.L., Rock, C., & Harrison, D.W. (1995). Right hemi-activation and positive affect: A case study. Manuscript in preparation for publication.

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Table 1

Descriptive Data For The Significant List by Period Interactions Using Diastolic and Mean Arterial Pressure Measures

	DBP		MAP	
List	Mean	SD	Mean	SD
Positive				
Before	73.90	16.20	94.50	11.16
After	68.71	12.52	91.43	11.02
Negative				
Before	65.67	13.68	91.86	9.80
After	74.81	18.17	96.83	14.16
Neutral				
Before	74.48	19.04	97.12	13.30
After	69.19	13.99	92.64	11.21

Table 2

Descriptive Data For The Significant List by Period Interaction Using Heart Rate Measures

List	Mean	SD
Positive		
Before	80.95	13.06
After	76.76	12.00
Negative		
Before	72.62	9.16
After	74.19	12.20
Neutral		
Before	81.48	14.19
After	80.52	12.32

Table 3

Descriptive Data For List by Period Using Systolic Pressure Measures

List	Mean	SD
Positive		
Before	115.10	12.00
After	111.86	13.05
Negative		
Before	118.05	20.88
After	118.86	20.84
Neutral		
Before	119.76	17.60
After	116.10	19.12

Table 4

Descriptive Data For The Significant Main Effects Using Dichotic Listening Accuracy Scores

Significant Main Effect	Mean	SD
Block		
Block 1	9.08	4.45
Block 2	9.71	4.88
Ear		
Right Ear	7.22	4.61
Left Ear	11.57	3.61
Tone		
Happy	8.42	4.72
Sad	10.28	4.90
Angry	9.78	4.72
Neutral	9.12	4.14

Note. Scores consist of the total number of tones of voice correctly identified in each ear during each block of trials. A maximum score of 18 is possible.

Table 5

Descriptive Data for the Significant Block by Tone Interaction Using the Dichotic Listening Accuracy Scores and Error Totals

Block	Accuracy Scores Mean	SD	Error Totals Mean	SD
Block 1				
Happy	8.33	4.58	9.67	4.59
Sad	10.28	4.89	7.66	4.86
Angry	8.95	4.39	9.06	4.36
Neutral	8.77	3.64	9.23	3.64
Block 2				
Happy	8.51	4.87	9.49	4.87
Sad	10.29	4.94	7.66	4.95
Angry	10.60	4.91	7.40	4.90
Neutral	9.44	4.57	8.50	4.55

Note. Accuracy scores consist of the total number of tones of voice correctly identified in each ear during each block of trials. Error totals consist of the number of tones of voice not identified in each ear during each block of trials. A maximum score of 18 is possible.

Table 6

Descriptive Data for the Significant Ear by Tone Interaction Using the Dichotic Listening Accuracy Scores and Error Totals

	Accuracy Scores		Error Totals	
Ear	Mean	SD	Mean	SD
Right Ear				
Happy	6.23	4.56	11.77	4.56
Sad	8.00	5.02	9.99	5.00
Angry	7.19	4.49	10.81	4.49
Neutral	7.46	4.22	10.54	4.22
Left Ear				
Happy	10.60	3.78	7.39	3.79
Sad	12.56	3.56	5.32	3.48
Angry	12.37	3.34	5.32	3.48
Neutral	10.75	3.32	7.19	3.28

Note. Accuracy scores consist of the total number of tones of voice correctly identified in each ear during each block of trials. Error totals consist of the number of tones of voice not identified in each ear during each block of trials. A maximum score of 18 is possible.

Table 7

Descriptive Data For The Significant Main Effects Using Dichotic Listening Accuracy Scores For Block 1 Only

Significant Main Effect	Mean	SD
Ear		
Right Ear	6.99	4.25
Left Ear	11.17	3.58
Tone		
Happy	8.33	4.58
Sad	10.28	4.89
Angry	8.95	4.39
Neutral	8.76	3.64

Note. Scores consist of the total number of tones of voice correctly identified in each ear during Block 1 of the dichotic listening tape. A maximum score of 18 is possible.

Table 8

Descriptive Data for the Significant Ear by Tone Interaction Using the Dichotic Listening Accuracy Scores For Block 1 Only

Ear	Mean	Standard Deviation
Right Ear		
Happy	6.17	4.39
Sad	7.89	4.76
Angry	6.46	3.95
Neutral	7.43	3.66
Left Ear		
Happy	10.48	3.69
Sad	12.67	3.74
Angry	11.44	3.27
Neutral	10.11	3.10

Note. Accuracy scores consist of the total number of tones of voice correctly identified in each ear during Block 1. A maximum score of 18 is possible.

Table 9

Descriptive Data For The Significant Main Effects Using Dichotic Listening Error Totals

Significant Main Effect	Mean	SD
Block		
Block 1	8.90	4.44
Block 2	8.26	4.88
Ear		
Right Ear	10.78	4.61
Left Ear	6.39	3.58
Tone		
Happy	9.58	4.73
Sad	7.66	4.89
Angry	8.23	4.71
Neutral	8.87	4.13

Note. Scores consist of the total number of tones of voice not identified in each ear during each block of trials. A maximum total of 18 is possible.

Table 10

Descriptive Statistics For The Main Effects Using The AAVL

Main Effect	Mean	*SD*
Trial		
Trial 1	6.84	1.53
Trial 2	9.50	1.91
Trial 3	11.92	7.30
Trial 4	11.65	1.78
Trial 5	12.17	1.86
Location		
First Five Words	3.96	1.01
Middle Five Words	2.94	1.38
Last Five Words	3.35	1.22

Note. Scores on the AAVL are the total number of words recalled for each trial (list presentation) in each location.

Table 11

Descriptive Data For The List By Location Interaction Using The AAVL

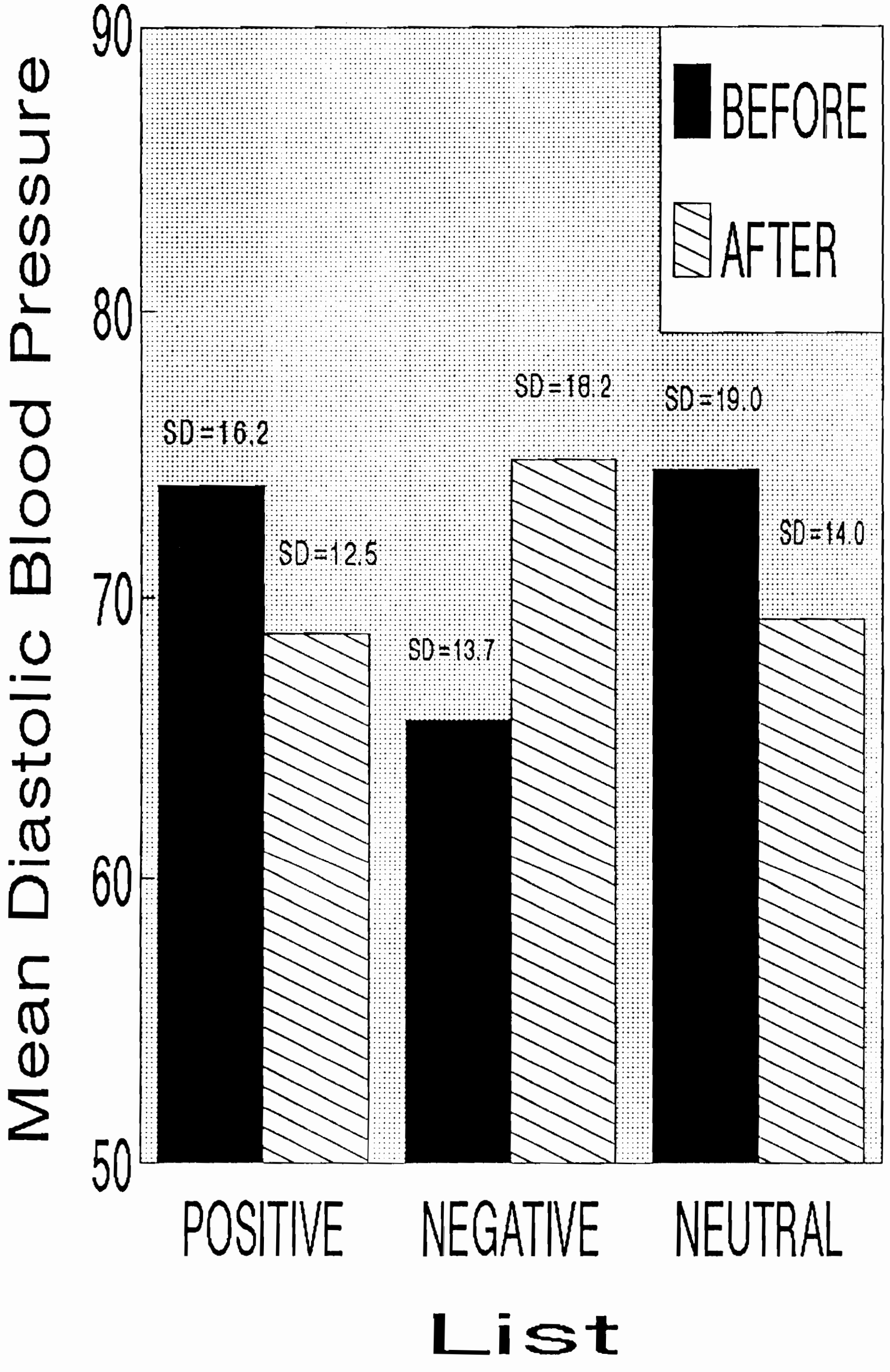
List	Mean	SD
Positive		
First Five Words	3.51	1.06
Middle Five Words	3.03	1.20
Last Five Words	3.46	1.02
Negative		
First Five Words	4.41	0.71
Middle Five Words	2.89	1.45
Last Five Words	3.09	1.31
Neutral		
First Five Words	3.96	1.08
Middle Five Words	2.89	1.44
Last Five Words	3.49	1.37

Note. Scores on the AAVL are the total number of words recalled for each trial (list presentation) in each location.

Table 12
Normative Data For Each List By Location and Trial

Location and Trial	Positive List Mean (SD)	Negative List Mean (SD)	Neutral List Mean (SD)
First Five Words			
Trial 1	2.47 (0.88)	3.91 (0.64)	3.00 (1.32)
Trial 2	3.22 (1.01)	4.38 (0.79)	3.90 (0.96)
Trial 3	3.84 (0.85)	4.63 (0.61)	3.94 (0.91)
Trial 4	3.94 (0.91)	4.56 (0.67)	4.38 (0.79)
Trial 5	4.06 (0.76)	4.56 (0.62)	4.56 (0.56)
Middle Five Words			
Trial 1	2.03 (0.97)	1.16 (0.95)	1.31 (0.97)
Trial 2	2.81 (1.03)	2.44 (1.12)	2.50 (1.32)
Trial 3	3.19 (1.12)	3.50 (1.14)	3.06 (1.08)
Trial 4	3.50 (1.16)	3.66 (0.90)	3.63 (1.07)
Trial 5	3.63 (1.07)	3.69 (1.26)	3.94 (1.08)
Last Five Words			
Trial 1	2.63 (1.01)	1.84 (0.72)	2.19 (1.33)
Trial 2	3.34 (1.15)	2.81 (1.14)	3.09 (1.23)
Trial 3	3.66 (0.94)	3.44 (1.32)	3.94 (1.13)
Trial 4	3.75 (0.62)	3.53 (1.19)	3.94 (1.11)
Trial 5	3.94 (0.80)	3.84 (1.08)	4.28 (0.92)

Figure 1. Mean diastolic pressure as a function of list (positive, negative, neutral) and measurement period (before the AAVL, after the AAVL).



Mean Diastolic Blood Pressure
90
80
70
60
50
BEFORE
AFTER
SD=16.2
SD=12.5
SD=13.7
SD=18.2
SD=19.0
SD=14.0
POSITIVE
NEGATIVE
NEUTRAL
List

Figure 2. Mean arterial pressure as a function of list (positive, negative, neutral) and measurement period (before the AAVL, after the AAVL).

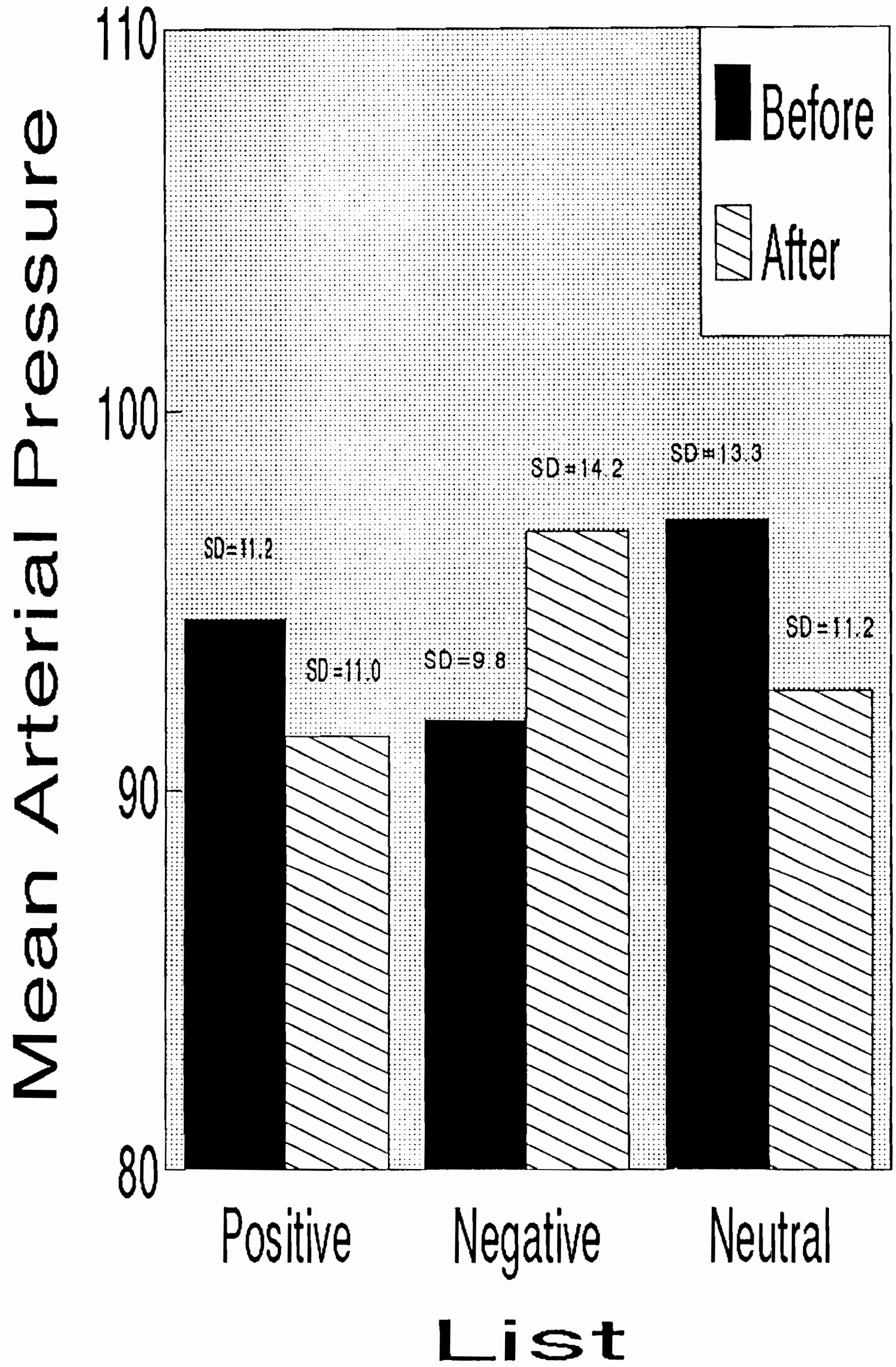

Mean Arterial Pressure
110
100
90
80
Before
After
SD=11.2
SD=11.0
SD=9.8
SD=14.2
SD=13.3
SD=11.2
Positive
Negative
Neutral
List

Figure 3. Mean heart rate as a function of list (positive, negative, neutral) and measurement period (before the AAVL, after the AAVL).

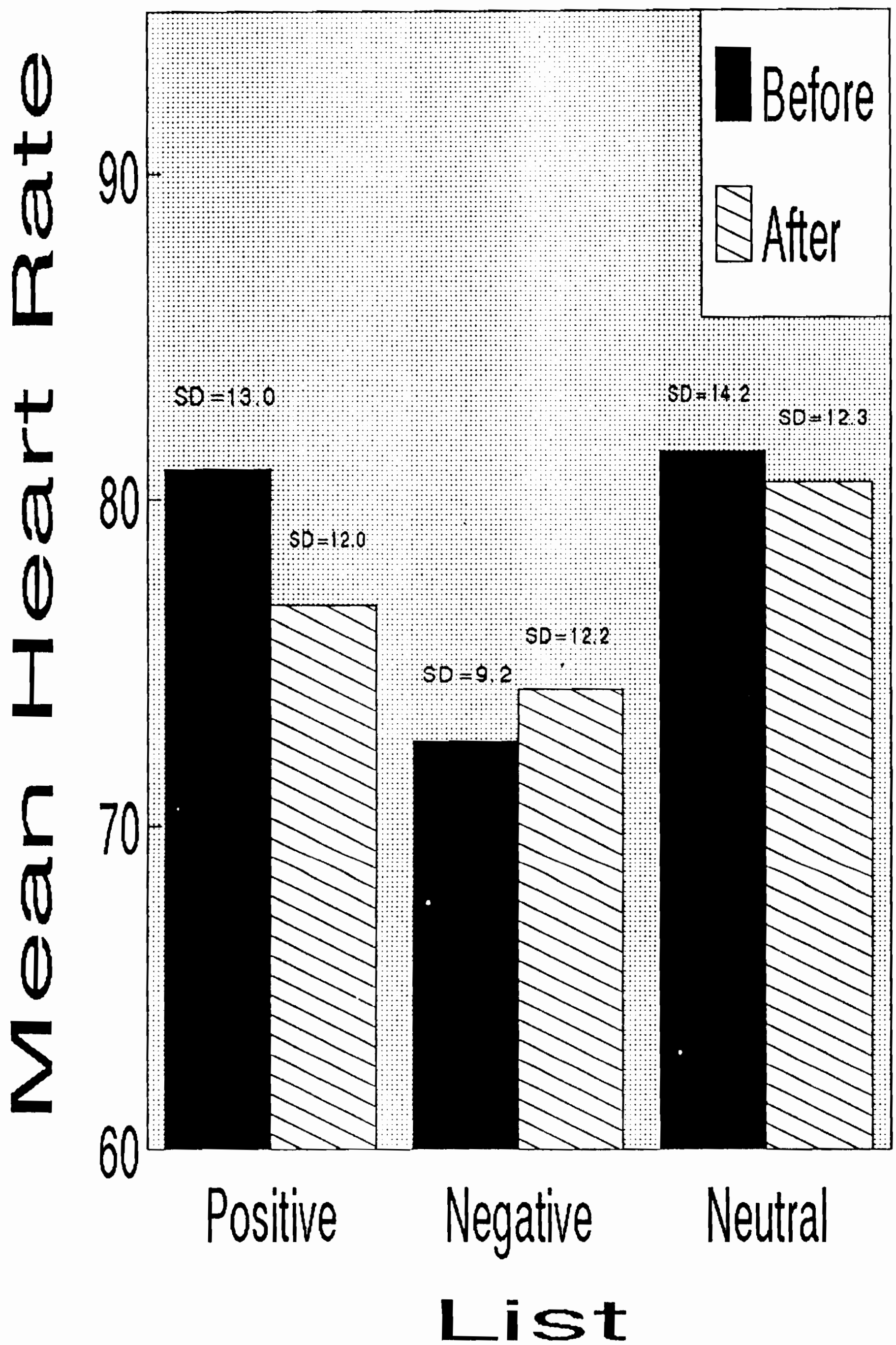

Mean Heart Rate
90
80
70
60
Before
After
SD=13.0
SD=12.0
SD=9.2
SD=12.2
SD=14.2
SD=12.3
Positive
Negative
Neutral
List

Figure 4. Mean dichotic accuracy score as a function of affective tone (happy, sad, angry, neutral) and block of trials (Block 1, Block 2).

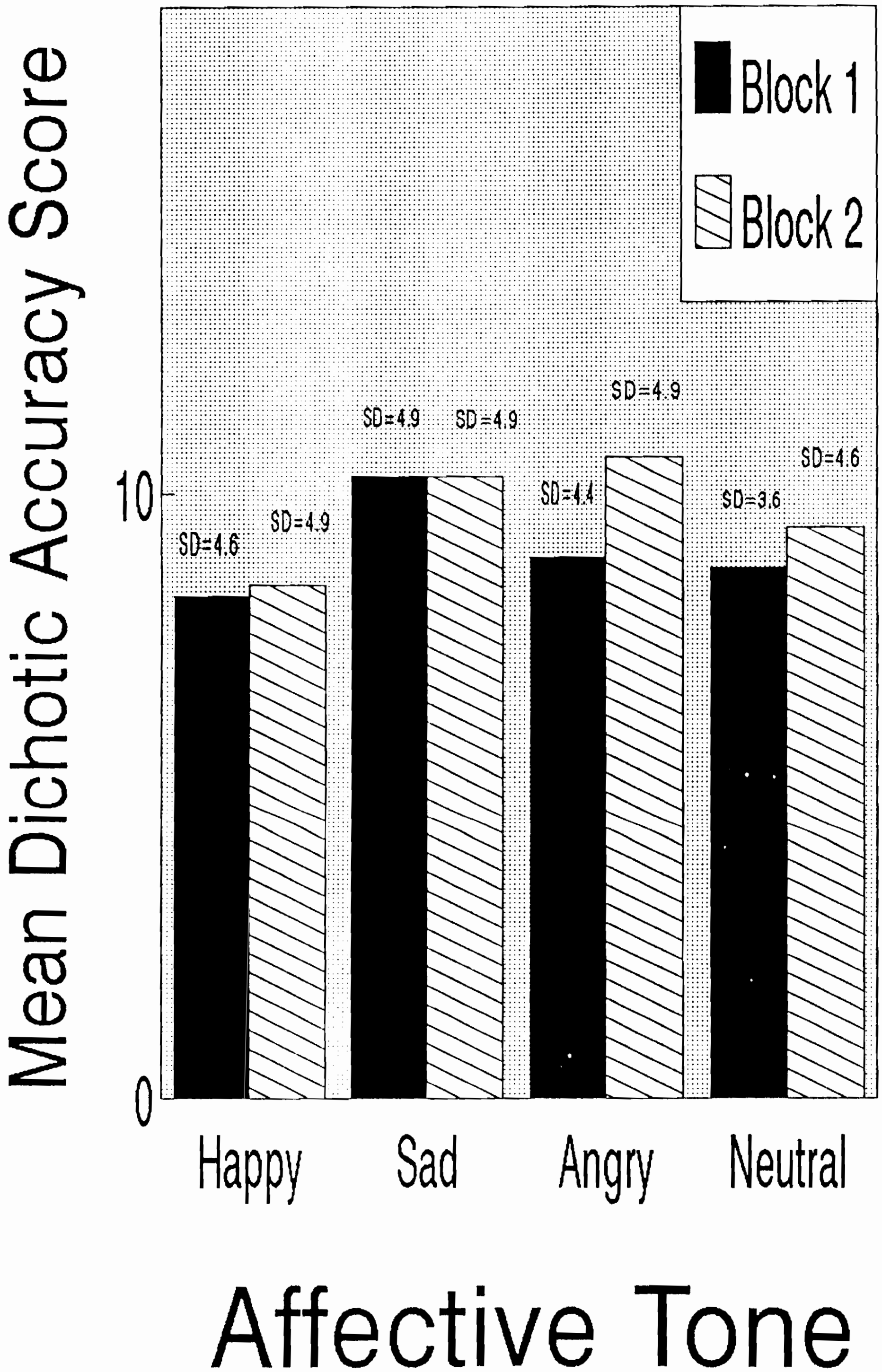

Block 1
Block 2
Mean Dichotic Accuracy Score
10
0
SD=4.6
SD=4.9
SD=4.9
SD=4.9
SD=4.4
SD=4.9
SD=3.6
SD=4.6
Happy
Sad
Angry
Neutral
Affective Tone

Figure 5. Mean dichotic accuracy score as a function of affective tone (happy, sad, angry, neutral) and ear of presentation (left ear, right ear).

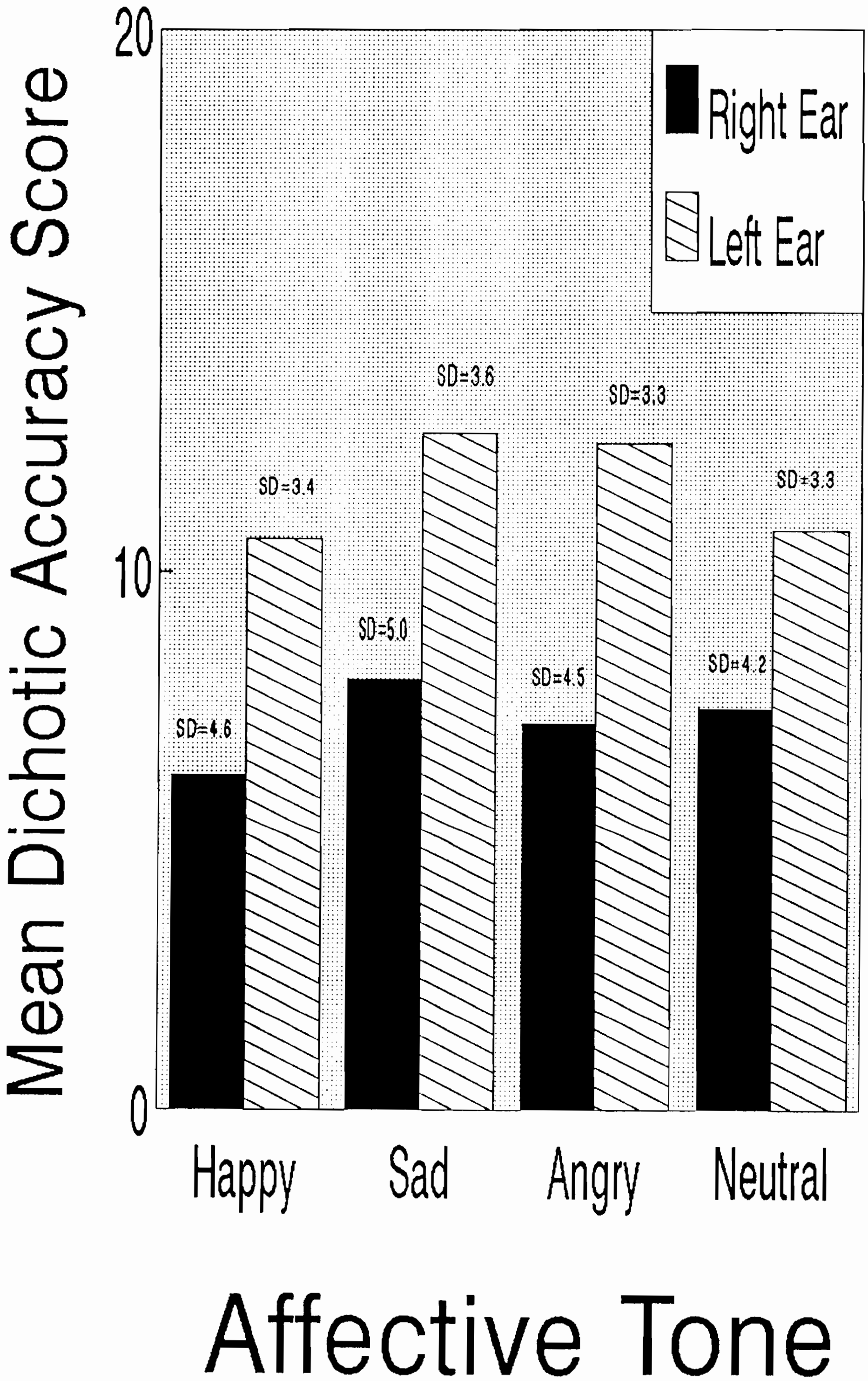
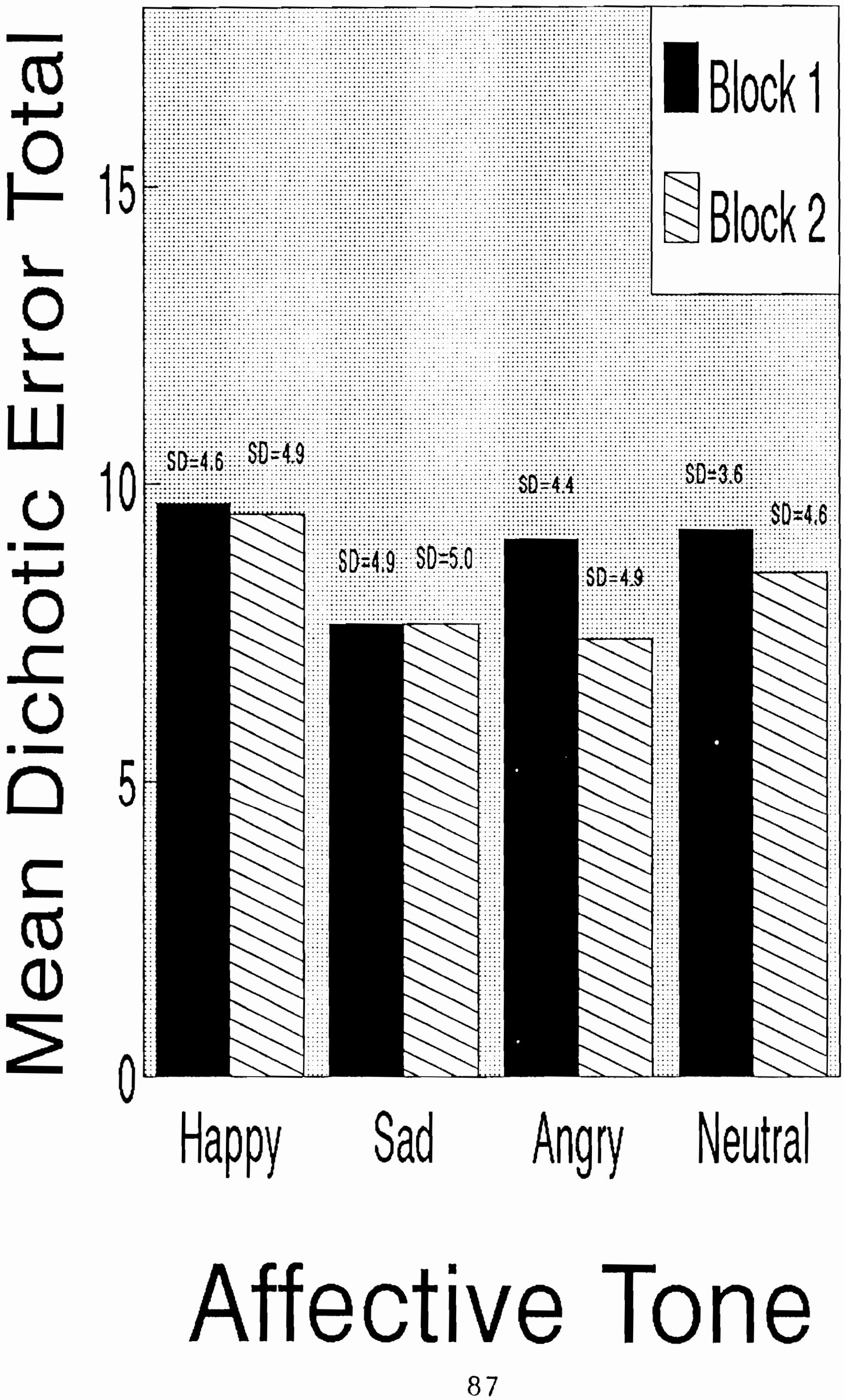

20
10
0
Right Ear
Left Ear
SD=4.6
SD=3.4
SD=5.0
SD=3.6
SD=4.5
SD=3.3
SD=4.2
SD=3.3
Happy
Sad
Angry
Neutral
Mean Dichotic Accuracy Score
Affective Tone

Figure 6. Mean dichotic error total as a function of affective tone (happy, sad, angry, neutral) and block of trials (Block 1, Block 2).



Mean Dichotic Error Total
0
5
10
15
Block 1
Block 2
SD=4.6
SD=4.9
SD=4.9
SD=5.0
SD=4.4
SD=4.9
SD=3.6
SD=4.6
Happy
Sad
Angry
Neutral
Affective Tone

Figure 7. Mean dichotic error total as a function of affective tone (happy, sad, angry, neutral) and ear of presentation (left ear, right ear).

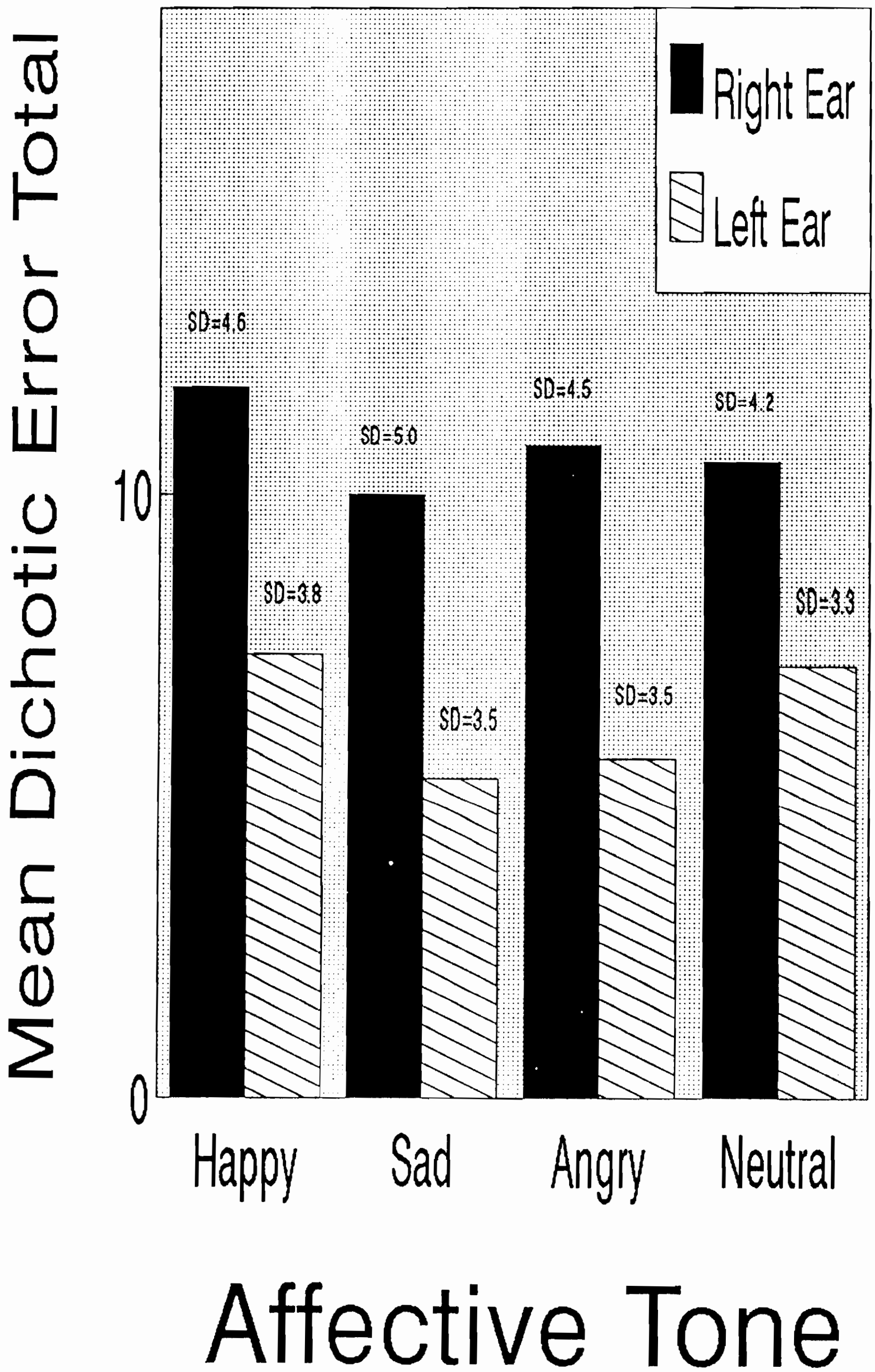
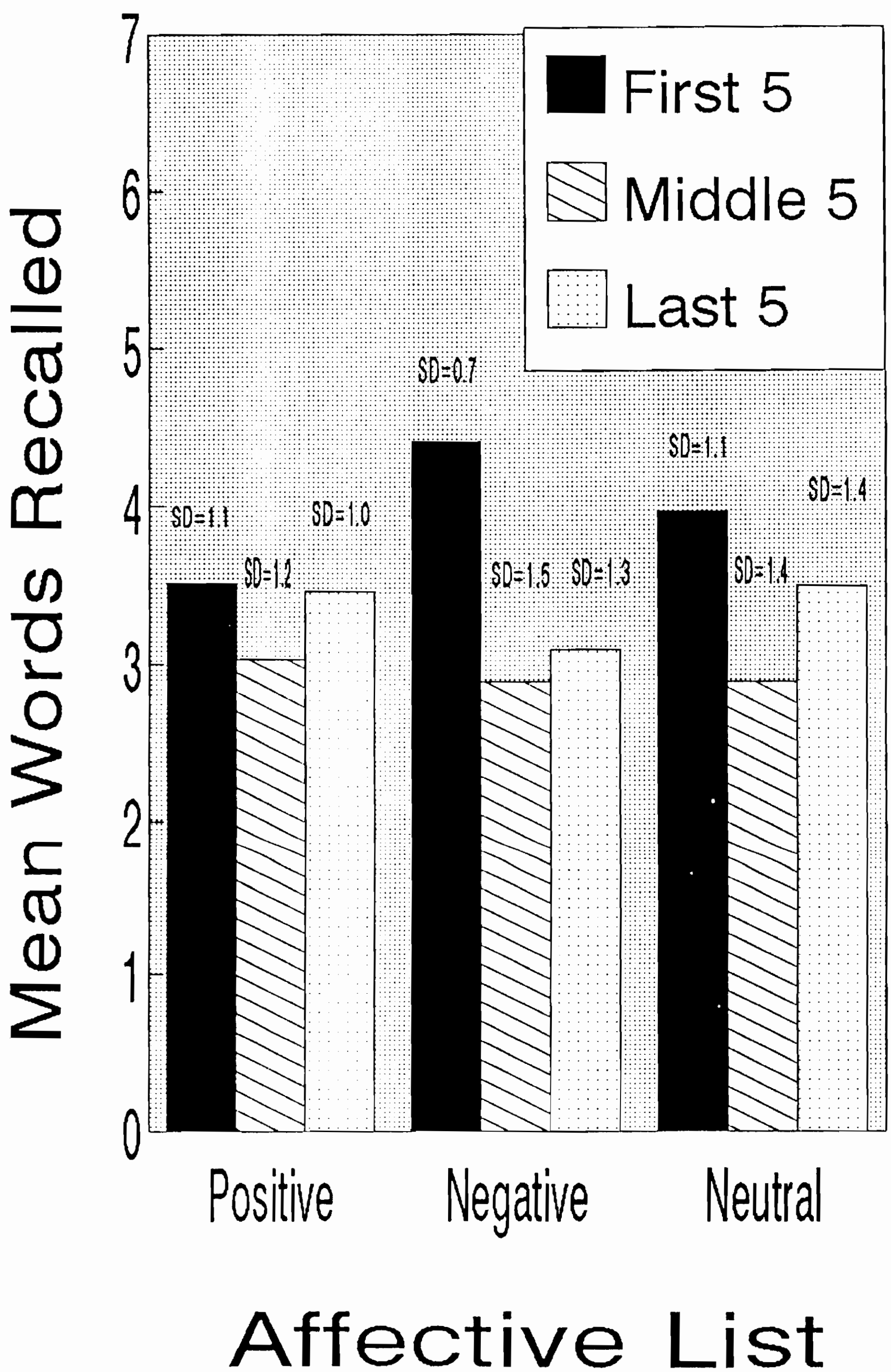

Mean Dichotic Error Total
Right Ear
Left Ear
SD=4.6
SD=3.8
SD=5.0
SD=3.5
SD=4.5
SD=3.5
SD=4.2
SD=3.3
10
0
Happy
Sad
Angry
Neutral
Affective Tone

Figure 8. Mean number of words recalled as a function of affective list (positive, negative, neutral) and location (first five words, middle five words, last five words).


Mean Words Recalled
7
6
5
4
3
2
1
0
First 5
Middle 5
Last 5
SD=1.1
SD=1.2
SD=1.0
SD=0.7
SD=1.5
SD=1.3
SD=1.1
SD=1.4
SD=1.4
Positive
Negative
Neutral
Affective List

Appendix A
Informed Consent Form: Experiment 1

Title: The Auditory Verbal Learning Test

Principle Investigator: Katharine Snyder

1. Purpose Of This Research: You are invited to participate in a study on the physiological correlates of learning.

2. Procedures: To accomplish the goals of this study, you will be asked to do both written (a History Questionnaire and Handedness Questionnaire) and verbal recall tests. In addition, blood pressure and heart rate measures will be taken throughout the study and the entire experiment will require approximately 30 min of your time. There are no risks or potential harm associated with participation in this study.

3. Benefits of this project: The results of your participation in this research may help clinical psychologists better understand learning. No promise of benefits has been made to encourage you to participate. You may receive a synopsis or summary of this research when it is completed. Please give a self addressed stamped envelope to the experimenter for this.

4. Anonymity and Confidentiality: The results of this study will be strictly confidential. At no time will the researchers release your results to anyone other than individuals working with the project without your written consent. The information you provide will have your name removed and only a subject number will identify you during the analysis and write up.

5. Discomforts/Risks: There are no apparent risks to you for participation in this study.

6. Compensation: You may receive one extra credit point for the psychology class you are enrolled in. For alternative methods of receiving extra credit talk to your professor.

7. Freedom to Withdraw: You are free to withdraw from this study at any time without penalty. If you choose to withdraw, you will still receive the extra credit and will not be penalized by any reduction in points. Talk to your professor if alternative sources of extra credit are desired.

8. Use of the Research Data: The information from this project may be used for scientific or educational purposes. It may be used for scientific meetings or be published in professional journals or books, or used for any other purpose which Virginia Tech's department of psychology considers proper in the interest of education, knowledge, or research.

9. Approval of the Research: This research has been approved by the Human Subjects Committee of the department of psychology and the Institutional Review Board of Virginia Polytechnic Institute and State University.

10. Subjects 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. Should I have any questions about this research or its conduct, I will contact:

______________________ Subject	
______________________ Investigator	953-3467 Phone
David W. Harrison Faculty Advisor	1x4422 Phone
Ernest R. Stout Chair, IRB Research Division	1x9359 Phone
Richard M. Eisler Chair, HSC	1x7001 Phone

Appendix B
The History Questionnaire

Subject Number ______________________ Age __________

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 responses and explain "yes" answers below.

1.	Severe head trauma/injury (e.g. an accident or fall leading to dizziness or loss of consciousness)	Yes No
2.	Stroke	Yes No
3.	Learning disabilities (problems reading, writing, or comprehension) If yes, how did you find out about it?	Yes No
4.	Epilepsy or seizures	Yes No
5.	Paralysis	Yes No
6.	Neurological Surgery	Yes No
7.	Other neurological or nervous system problems (e.g. migraine headaches, muscular spasms)	Yes No
8.	Alcohol or drug problems	Yes No
9.	Using alcohol or drugs (other than for purposes prescribed) at present? (e.g. caffeine or ETOH within 48 hours)	Yes No
10.	Are you currently taking any prescription medications/drugs?	Yes No
11.	Are you currently suffering from any medical conditions or illnesses? (e.g. high blood pressure, high cholesterol, tachycardia, etc.)	Yes No

Please explain any "yes" responses:

____

____

Appendix C
Handedness Questionnaire

Subject Number: _______

Circle the appropriate number after each item.

		RT	LT	Both
1)	With which hand would you throw a ball to hit a target................................	1	-1	0
2)	With which hand do you draw?..............	1	-1	0
3)	With which hand do you use an eraser on paper?................................	1	-1	0
4)	With which hand do you remove the top card when dealing?......................	1	-1	0
5)	With which foot do you kick a ball?......	1	-1	0
6)	If you wanted to pick up a pebble with your toes, which foot would you use?..........	1	-1	0
7)	If you had to step up onto a chair, which foot would you place on the chair first?..	1	-1	0
8)	Which eye would you use to peep through a keyhole?................................	1	-1	0
9)	If you had to look into a dark bottle to see how full it was, which eye would you use?................................	1	-1	0
10)	Which eye would you use to sight down a rifle?................................	1	-1	0
11)	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
12)	If you wanted to listen to someone's heartbeat, which ear would you place against their chest?......................	1	-1	0
13)	Into which ear would you place the earphone of a transistor radio?....................	1	-1	0

Score = # of Right + # of Left = Total

_______ + _______ = ____

Is mother left or right hand dominant? __________

Is father right or left hand dominant? __________

Appendix D
Informed Consent Form: Experiment 2

Title: The Auditory Verbal Learning Test

Principle Investigator: Katharine Snyder

1. Purpose of This Research: You are invited to participate in a study on affective priming and dichotic listening performance.

2. Procedures: To accomplish the goals of this study, you will be asked to do both written (a History Questionnaire and Handedness Questionnaire), verbal recall, and auditory perception tests (dichotic listening) which will take approximately 45 min of your time.

3. Benefits of this project: The results of your participation in this research may help clinical psychologists better understand learning as well as performance on dichotic listening tests. No promise of benefits has been made to encourage you to participate. You may receive a synopsis or summary of this research when it is completed. Please give a self addressed stamped envelope to the experimenter for this.

4. Anonymity and Confidentiality: The results of this study will be strictly confidential. At no time will the researchers release your results to anyone other than individuals working with the project without your written consent. The information you provide will have your name removed and only a subject number will identify you during the analysis and write up.

5. Discomforts/Risks: There are no apparent risks to you for participation in this study.

6. Compensation: You may receive one extra credit point for the psychology class you are enrolled in. For alternative methods of receiving extra credit talk to your professor.

7. Freedom to Withdraw: You are free to withdraw from this study at any time without penalty. If you choose to withdraw, you will still receive the extra credit and will not be penalized by any reduction in points. Talk to your professor if alternative sources of extra credit are desired.

8. Use of the Research Data: The information from this project may be used for scientific or educational purposes. It may be used for scientific meetings or be published in professional journals or books, or used for any other purpose which Virginia Tech's department of psychology considers proper in the interest of education, knowledge, or research.

9. Approval of the Research: This research has been approved by the Human Subjects Committee of the department of psychology and the Institutional Review Board of Virginia Polytechnic Institute and State University.

10. Subjects 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. Should I have any questions about this research or its conduct, I will contact:

____________________ Subject	
____________________ Investigator	953-3467 Phone
David W. Harrison Faculty Advisor	1x4422 Phone
Ernest R. Stout Chair, IRB Research Division	1x9359 Phone
Richard M. Eisler Chair, HSC	1x7001 Phone

Appendix E

Practice Test 1 from the Bryden and MacRae (1989) Tape

Standard Headphone Positioning:
Right Ear Phone Over The Right Ear

1. Ready Signal

	Left Ear	Right Ear
2.	BA	KA
3.	PA	GA
4.	BA	KA
5.	GA	PA
6.	PA	GA
7.	KA	BA
8.	KA	BA
9.	GA	PA

Reversed Headphone Positioning:
Right Ear Phone Over The Left Ear

1. Ready Signal

	Left Ear	Right Ear
2.	KA	BA
3.	GA	PA
4.	KA	BA
5.	PA	GA
6.	GA	PA
7.	BA	KA
8.	BA	KA
9.	PA	GA

Appendix F

Practice Test 2 from the Bryden and MacRae (1989) Tape

1. Ready Signal
2. Sad Power
3. Angry Power
4. Sad Tower
5. Neutral Bower
6. Sad Bower
7. Angry Dower
8. Sad Dower
9. Angry Bower
10. Happy Power
11. Happy Tower
12. Angry Tower
13. Neutral Dower
14. Neutral Power
15. Happy Dower
16. Neutral Tower
17. Happy Bower

Appendix G

Rey Auditory Verbal Learning Test (RAVL)

LIST A	IA	IIA	IIIA	IVA	VA
DRUM	____	____	____	____	____
CURTAIN	____	____	____	____	____
BELL	____	____	____	____	____
COFFEE	____	____	____	____	____
SCHOOL	____	____	____	____	____
SUBTOTAL	____	____	____	____	____
PARENT	____	____	____	____	____
MOON	____	____	____	____	____
GARDEN	____	____	____	____	____
HAT	____	____	____	____	____
FARMER	____	____	____	____	____
SUBTOTAL	____	____	____	____	____
NOSE	____	____	____	____	____
TURKEY	____	____	____	____	____
COLOR	____	____	____	____	____
HOUSE	____	____	____	____	____
RIVER	____	____	____	____	____
SUBTOTAL	____	____	____	____	____
TOTAL	IA	IIA	IIIA	IVA	VA
	____	____	____	____	____

Appendix H

The Affective Auditory Verbal Learning Test
Positively Valenced List

LIST A	IA	IIA	IIIA	IVA	VA
SMILE	____	____	____	____	____
FREEDOM	____	____	____	____	____
CHEERFUL	____	____	____	____	____
FRIEND	____	____	____	____	____
MUSIC	____	____	____	____	____
SUBTOTAL	____	____	____	____	____
JOY	____	____	____	____	____
HAPPY	____	____	____	____	____
WISDOM	____	____	____	____	____
BLOSSOM	____	____	____	____	____
LAUGH	____	____	____	____	____
SUBTOTAL	____	____	____	____	____
BEAUTY	____	____	____	____	____
PEACE	____	____	____	____	____
SUNSET	____	____	____	____	____
GARDEN	____	____	____	____	____
BEACH	____	____	____	____	____
SUBTOTAL	____	____	____	____	____
TOTAL	IA	IIA	IIIA	IVA	VA
	____	____	____	____	____

Appendix H Continued

The Affective Auditory Verbal Learning Test
Negatively Valenced List

LIST A	IA	IIA	IIIA	IVA	VA
MORGUE	____	____	____	____	____
MURDER	____	____	____	____	____
KILL	____	____	____	____	____
PIMPLE	____	____	____	____	____
GUN	____	____	____	____	____
SUBTOTAL	____	____	____	____	____
GREEDY	____	____	____	____	____
LICE	____	____	____	____	____
MEASLES	____	____	____	____	____
SLAY	____	____	____	____	____
DEFACE	____	____	____	____	____
SUBTOTAL	____	____	____	____	____
CRUEL	____	____	____	____	____
FAILING	____	____	____	____	____
HATE	____	____	____	____	____
ACNE	____	____	____	____	____
GRAVE	____	____	____	____	____
SUBTOTAL	____	____	____	____	____
TOTAL	IA	IIA	IIIA	IVA	VA
	____	____	____	____	____

Appendix I
Mean Familiarity and Pleasantness Ratings for the AAVL Test Taken From Toglia and Battig (1978)

Familiarity (FAM) and Pleasantness (PLS) Ratings From Toglia and Battig (1978)

Positive List	FAM Mean (SD)	PLS Mean (SD)	Negative List	FAM Mean (SD)	PLS Mean (SD)	Neutral List	FAM Mean (SD)	PLS Mean (SD)
Smile	6.41	6.23	Morgue	5.48	1.87	Drum	*5.87	4.47
	(1.36)	(1.15)		(1.74)	(1.45)		(1.55)	(1.25)
Freedom	6.40	+6.30	Murder	6.08	*1.75	Curtain	unlisted	
	(1.06)	(1.10)		(1.39)	(1.31)		unlisted	
Cheerful	6.15	5.90	Kill	6.23	1.95	Bell	6.25	4.23
	(1.34)	(1.29)		(1.38)	(1.58)		(1.23)	(1.40)
Friend	6.50	6.16	Pimple	+6.31	1.81	Coffee	6.39	4.73
	(1.19)	(1.33)		(1.25)	(1.09)		(1.23)	(1.52)
Music	6.77	6.22	Gun	6.28	1.98	School	6.47	3.84
	(0.74)	(1.23)		(1.56)	(1.35)		(1.16)	(1.59)
Joy	6.27	6.00	Greedy	5.94	1.88	Parent	unlisted	
	(1.30)	(1.37)		(1.33)	(1.28)		unlisted	
Happy	+6.84	6.10	Lice	*5.38	2.02	Moon	6.26	5.48
	(0.55)	(1.49)		(1.85)	(1.62)		(1.28)	(1.45)
Wisdom	6.34	6.03	Measles	5.61	2.00	Garden	6.53	+6.07
	(1.30)	(1.15)		(1.86)	(1.37)		(0.94)	(1.20)
Blossom	5.85	5.91	Slay	5.55	2.03	Hat	6.55	*3.80
	(1.52)	(1.17)		(1.64)	(1.37)		(0.95)	(1.20)
Laugh	6.68	6.00	Deface	5.64	2.10	Farmer	unlisted	
	(0.87)	(1.33)		(1.72)	(1.25)		unlisted	
Beauty	6.52	6.07	Cruel	5.95	2.06	Nose	6.23	4.09
	(1.11)	(1.20)		(1.47)	(1.39)		(1.43)	(1.27)
Peace	6.45	6.00	Failing	5.85	2.15	Turkey	unlisted	
	(1.00)	(1.23)		(1.61)	(1.42)		unlisted	
Sunset	6.25	6.04	Hate	6.29	2.06	Color	+6.60	5.22
	(1.23)	(1.47)		(1.38)	(1.32)		(1.03)	(1.51)
Garden	*5.53	6.07	Acne	5.97	+2.16	House	6.34	5.08
	(0.94)	(1.20)		(1.67)	(1.51)		(1.13)	(1.27)
Beach	6.27	*5.81	Grave	5.89	2.07	River	6.37	5.49
	(1.40)	(1.41)		(1.53)	(1.55)		(1.13)	(1.43)
Overall Means:								
	6.35	6.06		5.90	1.99		6.44	4.77

Note. The following abbreviations indicate the range of the ratings: Highest value (+) and lowest value (*).

Appendix I Continued

Mean Imagery Ratings for the AAVL Test Taken From Toglia and Battig (1978)

Imagery Ratings From Toglia and Battig (1978)

Positive List	Mean	SD	Negative List	Mean	SD	Neutral List	Mean	SD
Smile	5.96	1.74	Morgue	5.95	1.58	Drum	5.93	1.48
Freedom	4.48	2.14	Murder	5.34	1.74	Curtain	Not Listed	
Cheerful	4.93	2.06	Kill	4.75	1.99	Bell	6.04	1.53
Friend	5.63	1.67	Pimple	6.11	1.50	Coffee	5.79	1.76
Music	5.30	2.24	Gun	5.88	1.60	School	5.72	1.61
Joy	5.25	1.83	Greedy	4.35	1.98	Parent	Not Listed	
Happy	5.41	1.86	Lice	5.16	1.90	Moon	5.72	1.80
Wisdom	3.78	2.20	Measles	5.76	1.90	Garden	6.23	1.43
Blossom	6.02	1.36	Slay	4.48	1.84	Hat	5.56	1.77
Laugh	5.22	1.81	Deface	4.19	1.80	Farmer	Not Listed	
Beauty	5.21	1.64	Cruel	4.16	1.90	Nose	6.01	1.51
Peace	4.40	2.25	Failing	4.13	2.11	Turkey	Not Listed	
Sunset	6.21	1.55	Hate	4.38	2.14	Color	5.41	1.91
Garden	6.23	1.43	Acne	4.37	2.23	House	5.79	1.58
Beach	6.61	0.77	Grave	6.23	1.05	River	6.35	1.06
Overall Means (Range):								
	5.38 (3.78-6.61)			5.02 (4.13-6.23)			5.87 (5.41-6.35)	

Appendix J
Data Recording Sheets for Block 1 Standard Presentations
The Right Earphone Covers the Right Ear

H = Happy	S = Sad	A = Angry	N = Neutral
B = Bower	D = Dower	P = Power	T = Tower

Left-Right Ear	Left-Right Ear	Left-Right Ear	Left-Right Ear
1. NP-HT	19. HP-ST	37. AB-HT	55. HT-AD
2. NT-AP	20. ST-AD	38. ST-HP	56. HB-SP
3. HP-AD	21. NB-AT	39. ND-SB	57. AB-SP
4. AD-NB	22. NB-HD	40. AP-HT	58. NP-HB
5. SP-AD	23. AT-HP	41. HT-ND	59. AT-SD
6. AD-NP	24. ST-ND	42. AD-SB	60. ND-SP
7. SD-HP	25. HB-AT	43. SP-HT	61. HP-ND
8. AD-HB	26. AP-ST	44. NB-AP	62. SD-AP
9. SB-AT	27. SB-NT	45. HD-AP	63. NB-SP
10. HT-SB	28. SB-HP	46. HP-NB	64. HD-SB
11. NP-AB	29. NT-SB	47. SD-HT	65. NT-HD
12. SD-NB	30. HD-SP	48. SP-AT	66. NP-SD
13. SD-NT	31. AP-ND	49. HB-ND	67. AB-ST
14. AD-NT	32. HD-NP	50. AP-HB	68. AT-NP
15. HP-AB	33. HB-SD	51. AB-HD	69. ST-HD
16. HP-NT	34. NB-ST	52. ND-AT	70. NT-HB
17. NT-AB	35. SB-AP	53. SP-NT	71. ND-AB
18. ST-HB	36. HT-NB	54. AT-HD	72. AB-SD

Correct Happy Identifications

____ ____ L R   ____ ____ L R   ____ ____ L R   ____ ____ L R

Sum of L scores = ________ = LEA for Happy
Sum of R scores = ________ = REA for Happy

Correct Sad Identifications

____ ____ L R   ____ ____ L R   ____ ____ L R   ____ ____ L R

Sum of L scores = ________ = LEA for Sad
Sum of R scores = ________ = REA for Sad

Correct Angry Identifications

____ ____ L R   ____ ____ L R   ____ ____ L R   ____ ____ L R

Sum of L scores = ________ = LEA for Angry
Sum of R scores = ________ = REA for Angry

Correct Neutral Identifications

____ ____ L R   ____ ____ L R   ____ ____ L R   ____ ____ L R

Sum of L scores = ________ = LEA for Neutral
Sum of R scores = ________ = REA for Neutral

Appendix J Continued

Data Recording Sheets for Block 1 Reversed Presentations

Right Earphone Covers the Left Ear

H = Happy	S = Sad	A = Angry	N = Neutral
B = Bower	D = Dower	P = Power	T = Tower

Left-Right Ear	Left-Right Ear	Left-Right Ear	Left-Right Ear
1. HT-NP	19. ST-HP	37. HT-AB	55. AD-HT
2. AP-NT	20. AD-ST	38. HP-ST	56. SP-HB
3. AD-HP	21. AT-NB	39. SB-ND	57. SP-AB
4. NB-AD	22. HD-NB	40. HT-AP	58. HB-NP
5. AD-SP	23. HP-AT	41. ND-HT	59. SD-AT
6. NP-AD	24. ND-ST	42. SB-AD	60. SP-ND
7. HP-SD	25. AT-HB	43. HT-SP	61. ND-HP
8. HB-AD	26. ST-AP	44. AP-NB	62. AP-SP
9. AB-SB	27. NT-SB	45. AP-HD	63. SP-NB
10. SB-HT	28. HP-SB	46. NB-HP	64. SB-HD
11. AB-NP	29. SB-NT	47. HT-SD	65. HD-NT
12. NB-SD	30. SP-HD	48. AT-SP	66. SD-NP
13. NT-SD	31. ND-AP	49. ND-HB	67. ST-AB
14. NT-AD	32. NP-HD	50. HB-AP	68. NP-AT
15. AB-HP	33. SD-HB	51. HD-AB	69. HD-ST
16. NT-HP	34. ST-NB	52. AT-ND	70. HB-NT
17. AB-NT	35. AP-SB	53. NT-SP	71. AB-ND
18. HB-ST	36. NB-HT	54. HD-AT	72. SD-AB

Correct Happy Identifications

___ ___   ___ ___   ___ ___   ___ ___
L R   L R   L R   L R

Sum of L scores = _______ = LEA for Happy
Sum of R scores = _______ = REA for Happy

Correct Sad Identifications

___ ___   ___ ___   ___ ___   ___ ___
L R   L R   L R   L R

Sum of L scores = _______ = LEA for Sad
Sum of R scores = _______ = REA for Sad

Correct Angry Identifications

___ ___   ___ ___   ___ ___   ___ ___
L R   L R   L R   L R

Sum of L scores = _______ = LEA for Angry
Sum of R scores = _______ = REA for Angry

Correct Neutral Identifications

___ ___   ___ ___   ___ ___   ___ ___
L R   L R   L R   L R

Sum of L scores = _______ = LEA for Neutral
Sum of R scores = _______ = REA for Neutral

Appendix J Continued
Data Recording Sheets for Block 2 Standard Presentations
Right Earphone Covers the Right Ear

H = Happy	S = Sad	A = Angry	N = Neutral
B = Bower	D = Dower	P = Power	T = Tower

Left-Right Ear	Left-Right Ear	Left-Right Ear	Left-Right Ear
1. HT-SP	19. HP-SB	37. HT-AP	55. SB-ND
2. HP-SD	20. HB-NT	38. SP-ND	56. ST-AP
3. AB-NP	21. AT-HB	39. NB-HT	57. HB-NP
4. NB-HP	22. NT-AD	40. AP-SB	58. AP-NT
5. NP-HD	23. NP-SB	41. SD-NP	59. SB-HD
6. AD-HT	24. NT-HP	42. AP-SD	60. NT-SP
7. AT-SB	25. HT-AB	43. HD-NB	61. AD-HP
8. NP-ST	26. ST-NB	44. NT-SD	62. AT-NB
9. ND-AP	27. HP-AT	45. AP-HD	63. SP-HD
10. HD-ST	28. AB-NT	46. NB-SD	64. SB-AD
11. NB-AD	29. HB-ST	47. SP-AB	65. ND-HB
12. ST-HP	30. ND-HT	48. SB-NT	66. SD-AT
13. HB-AP	31. HT-SD	49. NP-AD	67. ND-ST
14. AT-ND	32. HT-NP	50. SP-NB	68. AT-SP
15. SD-HB	33. SD-AB	51. ST-AB	69. AB-ND
16. AB-HP	34. NP-AT	52. ND-HP	70. HD-AB
17. HB-AD	35. HD-NT	53. HD-AT	71. SB-HT
18. AP-NB	36. AD-SP	54. AD-ST	72. SP-HB

Correct Happy Identifications

____ ____ L R   ____ ____ L R   ____ ____ L R   ____ ____ L R

Sum of L scores = ________ = LEA for Happy
Sum of R scores = ________ = REA for Happy

Correct Sad Identifications

____ ____ L R   ____ ____ L R   ____ ____ L R   ____ ____ L R

Sum of L scores = ________ = LEA for Sad
Sum of R scores = ________ = REA for Sad

Correct Angry Identifications

____ ____ L R   ____ ____ L R   ____ ____ L R   ____ ____ L R

Sum of L scores = ________ = LEA for Angry
Sum of R scores = ________ = REA for Angry

Correct Neutral Identifications

____ ____ L R   ____ ____ L R   ____ ____ L R   ____ ____ L R

Sum of L scores = ________ = LEA for Neutral
Sum of R scores = ________ = REA for Neutral

Appendix J Continued

Data Recording Sheets for Block 2 Reversed Presentations

Right Earphone Covers the Left Ear

H = Happy S = Sad A = Angry N = Neutral

B = Bower D = Dower P = Power T = Tower

Left-Right Ear	Left-Right Ear	Left-Right Ear	Left-Right Ear
1. SP-HT	19. SB-HP	37. AP-HT	55. ND-SB
2. SD-HP	20. NT-HB	38. ND-SP	56. AP-ST
3. NP-AB	21. HB-AT	39. HT-NB	57. NP-HB
4. HP-NB	22. AD-NT	40. SB-AP	58. NT-AP
5. HD-NP	23. SB-NP	41. NP-SD	59. HD-SB
6. HT-AD	24. HP-NT	42. SD-AP	60. SP-NT
7. SB-AT	25. AB-HT	43. NB-HD	61. HP-AD
8. ST-NP	26. NB-ST	44. SD-NT	62. NB-AT
9. AP-ND	27. AT-HP	45. HD-AP	63. HD-SP
10. ST-HD	28. NT-AB	46. SD-NB	64. AD-SB
11. AD-NB	29. ST-HB	47. AB-SP	65. HB-ND
12. HP-ST	30. HT-ND	48. NT-SB	66. AT-SD
13. AP-HB	31. SD-HT	49. AD-NP	67. ST-ND
14. ND-AT	32. NP-HT	50. NB-SP	68. SP-AT
15. HB-SD	33. AB-SD	51. AB-ST	69. ND-AB
16. HP-AB	34. AT-NP	52. HP-ND	70. AB-HD
17. AD-HB	35. NT-HD	53. AT-HD	71. HT-SB
18. NB-AP	36. SP-AD	54. ST-AD	72. HB-SP

Correct Happy Identifications

___ ___ L R   ___ ___ L R   ___ ___ L R   ___ ___ L R

Sum of L scores = ________ = LEA for Happy

Sum of R scores = ________ = REA for Happy

Correct Sad Identifications

___ ___ L R   ___ ___ L R   ___ ___ L R   ___ ___ L R

Sum of L scores = ________ = LEA for Sad

Sum of R scores = ________ = REA for Sad

Correct Angry Identifications

___ ___ L R   ___ ___ L R   ___ ___ L R   ___ ___ L R

Sum of L scores = ________ = LEA for Angry

Sum of R scores = ________ = REA for Angry

Correct Neutral Identifications

___ ___ L R   ___ ___ L R   ___ ___ L R   ___ ___ L R

Sum of L scores = ________ = LEA for Neutral

Sum of R scores = ________ = REA for Neutral

Appendix K
Pressure and Pulse Rate Data Recording Sheet

	Measurement Period 1	Measurement Period 2
Systolic (mmHg)		
	1.	1.
	2.	2.
	3.	3.
	4.	4.
	5.	5.
Diastolic (mmHg)		
	1.	1.
	2.	2.
	3.	3.
	4.	4.
	5.	5.
Heart Rate (beats per minute)		
	1.	1.
	2.	2.
	3.	3.
	4.	4.
	5.	5.

Appendix L

Instructions: Listed below are ten sets of word opposites and a rating continuum between 1 and 7. Circle the number for each set of opposites that describes how you feel now.

HAPPY	1	2	3	4	5	6	7	SAD
GOOD	1	2	3	4	5	6	7	BAD
PLEASANT	1	2	3	4	5	6	7	UNPLEASANT
CHEERFUL	1	2	3	4	5	6	7	GLOOMY
SATISFIED	1	2	3	4	5	6	7	WORRISOME
OPTIMISTIC	1	2	3	4	5	6	7	PESSIMISTIC
JOYFUL	1	2	3	4	5	6	7	SORROW
BLISSFUL	1	2	3	4	5	6	7	MISERABLE
MERRY	1	2	3	4	5	6	7	BLUE
HOPEFUL	1	2	3	4	5	6	7	HOPELESS

Appendix M

ANOVA Source Tables

Table 1

Source Table for the DBP Analysis

Source	DF	Sum of Squares	F	PR > F
L	2	55.54	0.07	0.9321
P	1	6.22	0.06	0.8076
L*P	2	1447.73	9.96	0.0019
S(L)	60	23657.43		
P*S(L)	60	6241.05		

Note. Factors are defined as follows: List (L), Period (P), and Subjects Within List [S(L)].

Appendix M Continued

ANOVA Source Tables

Table 2

Source Table for the SBP Analysis

Source	DF	Sum of Squares	F	PR > F
L	2	628.05	0.54	0.5873
P	1	130.03	3.69	0.0594
L*P	2	128.11	1.82	0.1710
S(L)	60	35088.67		
P*S(L)	60	2112.86		

Note. Factors are defined as follows: List (L), Period (P), and Subjects Within List [S(L)].

Appendix M Continued

ANOVA Source Tables

Table 3

Source Table for the MAP Analysis

Source	DF	Sum of Squares	F	PR > F
L	2	82.15	0.18	0.8391
P	1	23.14	0.48	0.4913
L*P	2	546.30	5.66	0.0056
S(L)	60	14007.85		
P*S(L)	60	2895.56		

Note. Factors are defined as follows: List (L), Period (P), and Subjects Within List [S(L)].

Appendix M Continued

ANOVA Source Tables

Table 4

Source Table for the HR Analysis

Source	DF	Sum of Squares	F	PR > F
L	2	1288.11	2.37	0.1026
P	1	44.64	1.60	0.2103
L*P	2	175.19	3.15	0.0502
S(L)	60	16338.76		
P*S(L)	60	1670.67		

Note. Factors are defined as follows: List (L), Period (P), and Subjects Within List [S(L)].

Appendix M Continued

ANOVA Source Tables

Table 5

Source Table for the SBP, DBP, MAP, and HR Analysis at Pretest Only

Source	DF	Sum of Squares	F	PR > F
Systolic Blood Pressure:				
L	2	234.03	0.39	0.6750
S(L)	60	17796.57		
Diastolic Blood Pressure:				
L	2	1020.60	1.89	0.1600
S(L)	60	16241.71		
Mean Arterial Pressure:				
L	2	290.72	1.10	0.3400
S(L)	60	7950.52		
Heart Rate:				
L	2	1037.17	3.14	0.0390
S(L)	60	9115.14		

Note. Factors are defined as follows: List (L), Period (P), and Subjects Within List [S(L)].

Appendix M Continued

ANOVA Source Tables

Table 6

Source Table for the Dichotic Listening Accuracy Analysis: Significant Effects

Source	DF	Sum of Squares	F	PR > F
B	1	99.69	18.60	0.0001
E	1	4771.08	73.38	0.0001
T	3	497.15	8.62	0.0001
B*T	3	102.76	7.62	0.0001
E*T	3	116.04	7.27	0.0001
B*S(L)	60	321.51		
E*S(L)	60	3901.32		
T*S(L)	180	3459.75		
B*T*S(L)	180	809.70		
E*T*S(L)	180	957.56		

Note: Factors are defined as follows: Block (B), Ear (E), Tone (T), and Subjects Within List [S(L)].

Appendix M Continued

ANOVA Source Tables

Table 7

Source Table for the Dichotic Listening Accuracy Analysis Using Only Block 1 Data: Significant Effects

Source	DF	Sum of Squares	F	PR > F
E	1	2208.38	72.48	0.0001
T	3	266.69	7.40	0.0001
E*T	3	102.72	7.23	0.0001
E*S(L)	60	1828.14		
T*S(L)	180	2161.48		
E*T*S(L)	180	852.38		

Note: Factors are defined as follows: Ear (E), Tone (T), and Subjects Within List [S(L)].

Appendix M Continued

ANOVA Source Tables

Table 8

Source Table for the Dichotic Listening Error Analysis: Significant Effects

Source	DF	Sum of Squares	F	PR > F
B	1	103.50	19.29	0.0001
E	1	4849.72	75.83	0.0001
T	3	516.17	9.03	0.0001
B*T	3	105.34	7.59	0.0001
E*T	3	109.53	6.65	0.0003
B*S(L)	60	321.87		
E*S(L)	60	3837.18		
T*S(L)	180	3431.22		
B*T*S(L)	180	833.30		
E*T*S(L)	180	987.56		

Note: Factors are defined as follows: Block (B), Ear (E), Tone (T), and Subjects Within List [S(L)].

Appendix M Continued

ANOVA Source Tables

Table 9

Source Table for the AAVL Analysis: Significant Effects

Source	DF	Sum of Squares	F	PR > F
T	4	1961.22	33.43	0.0001
LOC	2	253.17	84.85	0.0001
L*LOC	4	77.88	13.05	0.0001
T*S(L)	372	207.35		
LOC *S(L)	186	277.48		

Note: Factors are defined as follows: Block (B), Ear (E), Tone (T), and Subjects Within List [S(L)].

Katharine Ann Snyder
311 Hunt Club Rd Apt. 6300A
Blacksburg Virginia, 24060
(703) 953-3467

EDUCATION

1993-Present	Virginia Polytechnic Institute and State University, Doctoral Program in Behavioral/Experimental Neuropsychology.
1992-1993	M.S., Virginia Polytechnic Institute and State University, Applied Experimental Psychology.
1988-1992	B.A., West Virginia Wesleyan College. Graduated Magna Cum Laude from the Honors Program as a Psychology Major, Biology Minor, and Religion Minor.

EMPLOYMENT: TEACHING POSITIONS

1995-1996	Instructor for two undergraduate Psychology of Learning classes at Virginia Polytechnic Institute and State University.
Summer 1995	Instructor for the Advanced Social Psychology Lab at Virginia Polytechnic Institute and State University.
Spring 1995	Instructor for two undergraduate Advanced Learning Labs at Virginia Polytechnic Institute and State University.
Fall 1994	Instructor for two undergraduate Cognitive Psychology Labs at Virginia Polytechnic Institute and State University.
1992-1993	Instructor for four Introductory Psychology labs at Virginia Polytechnic Institute and State University.
Jan. 1992	Team Instructor for Introduction to Psychological Experimentation at WV Wesleyan College for Richard S. Calef, Ph.d.

Spring 1992	Instructor for the Learning and Memory Lab at WV Wesleyan College for Michael C. Choban, Ph.d.
1989-1992	Academic Peer Counselor/Instructor at WV Wesleyan College for Ruth A. Calef, Ph.D.
1988-1992	Psychology Tutor/Instructor for learning disabled students at the WV Wesleyan Learning Center.

EMPLOYMENT: TEACHING ASSISTANT POSITIONS

Summer 1994	Graduate Teaching Assistant for the undergraduate Nervous Systems and Behavior course for David W. Harrison, Ph.D., at Virginia Polytechnic Institute and State University.
Spring 1994	Graduate Teaching Assistant for the undergraduate Cognitive Psychology Course for Helen J. Crawford, Ph.D., at Virginia Polytechnic Institute and State University.
Fall 1993	Graduate Teaching Assistant for Biological Basis of Behavior for David W. Harrison, Ph.D., at Virginia Polytechnic Institute and State University.
Summer 1993	Graduate Teaching Assistant for Introductory Psychology for David W. Harrison, Ph.D., at Virginia Polytechnic Institute and State University.
1990-1992	Undergraduate Teaching Assistant for Advanced Experimental Psychology at WV Wesleyan College for Richard S. Calef. Ph.d.
1990-1992	Undergraduate Teaching Assistant for Physiological Psychology at WV Wesleyan College for Richard S. Calef, Ph.d.
1991-1992	Undergraduate Teaching Assistant for the Behavior Modification class at WV Wesleyan College for Richard S. Calef, Ph.d.

1990-1992 Undergraduate Teaching Assistant for Introduction to Psychology at WV Wesleyan College for Richard S. Calef, Ph.D.

1989-1992 Undergraduate Computer Assistant for Statistics for Psychological Research at WV Wesleyan College for Michael C. Choban, Ph.d.

PUBLICATIONS

Snyder, K. A., Calef, R. S., Choban, M. C., and Geller, E. S., (1992). Frequency of verbal transformations as a function of word presentation styles. Bulletin of the Psychonomic Society, 30(5), 363-364.

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PROFESSIONAL PRESENTATIONS

Snyder, K. A., & Calef, R. S. (1992, March). Frequency of verbal transformations as a function of word presentation styles. Poster session presented at the West Virginia Psychological Association Convention, Cannan Valley, W.V.

Snyder, K.A., & Harrison, D.W. (April 6, 1995). The neurobehavioral correlates of affect perception as a function of function of verbal fluency classification. Paper presented at the Virginia Psychological Association Convention, Alexandria, Virginia.

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Snyder, K.A., & Harrison, D.W. Autonomic reactivity and the affective auditory verbal learning test. Paper submitted for presentation at the American Psychological Association Convention.

OTHER PROFESSIONAL CONFERENCES ATTENDED

Fall 1993	Conference on Geriatric Health, Virginia Polytechnic Institute and State University.
Spring 1993	Conference on the Neuropsychology of Attention, Radford University.

HONORS

WV Psychological Association Undergraduate Research Award (1992).

West Virginia Wesleyan College Class Key Award

Sigma Alpha Iota Music Scholar Award.

Undergraduate Scholarship Awards:

Basal Burns Memorial Psychology Scholarship (91-92)
WV Wesleyan Music Scholarship (1988-1992)
Calvin West Scholarship (1988-1992)
MD Senatorial Scholarship (1988-1992)
National United Methodist Bass Scholarship (1992)
Baltimore Methodist Conference Scholarship (88-92)
Linthicum Methodist Church scholarship (1988-1994)

Undergraduate Honor Societies:

Psi Chi (Psychology)
Beta Beta Beta (Biology)
Sigma Alpha Iota (Music)
Mortarboard (Scholarship)
Phi Kappa Phi (Scholarship)
Omicron Delta Kappa (Leadership)
Alpha Lambda Delta (Scholarship)

Psychological and Research Societies:

American Psychological Association
Virginia Psychological Association
Cognitive Neuroscience Society
Sigma Xi (Scientific Research Society).

REFERENCES

David W. Harrison, Ph.D., Professor of Psychology and Committee Chair, (703) 231-4422, Dept. of Psychology, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24060.

Albert M. Prestrude, Ph.D., Professor of Psychology and Committee Member, (703) 231-5673, Dept. of Psychology, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24060.

Robin P. Cooper, Ph.D., Professor of Psychology and Committee Member, (703) 231-5938, Dept. of Psychology, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24060.

Joseph J. Franchina, Ph.D., Professor of Psychology and Committee Member, (540) 231-5664, Dept. of Psychology, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24060.

Richard A. Winett, Ph.D., Professor of Psychology, (540) 231-8747, Dept. of Psychology, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24060.

Richard S. Calef, Ph.D., Psychology Dept. Chair at WV Wesleyan College, (304) 472-0357, 45 Carol Street, Buckhannon WV, 26201.

Michael C. Choban, Ph.D., Professor of Psychology and Computer Sci.,(304) 473-8095, 30 Boggess Street, Buckhannon WV, 26201.

Katharine Snyder