

***Differential Effects of Hostility on Frontal Lobe Performance: A dual task  
approach with Fluency and Cardiovascular Regulation***

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# Differential Effects of Hostility on Frontal Lobe Performance: A dual task approach with Fluency and Cardiovascular Regulation

John B. Williamson

(ABSTRACT)

The influence of levels of hostility on the lateralized tasks of verbal and nonverbal fluency, and the concurrent cerebral regulation of autonomic nervous system functioning was examined. Forty-eight right-handed males were recruited for participation with half classified as low-hostile and the other half as high-hostile. Previous research has shown that high-hostile males, at rest, have greater right hemisphere arousal relative to low-hostile males. It was predicted that this heightened, at rest, arousal would lead to reduced capacity to perform right hemisphere lateralized proximal tasks simultaneously.

Two commonly used neuropsychological tests sensitive to left and right anterior cerebral systems are the Controlled Oral Word Association Test and the Ruff Figural Fluency Test (RFFT) respectively. Nonverbal fluency, verbal fluency, and perseverative errors were assessed using these measures. Cardiovascular measures of systolic and diastolic blood pressure, and heart rate were assessed using oscillometric technique with a digital blood pressure meter.

A dual-task methodology was used to evaluate these anterior and posterior cerebral systems simultaneously. Since cardiovascular regulation and nonverbal fluency are both right-frontal tasks, it was predicted that high hostile men would evidence increased interference on cardiovascular regulation concurrent with the nonverbal fluency task in comparison with low hostile men. It was also predicted that high-hostile males would display more perseverative errors than low-hostile males on the nonverbal fluency task as a function of regulatory interference.

The results supported a capacity-limited prediction in high-hostile males. High-hostile males evidenced significantly heightened systolic blood pressure responses during the nonverbal fluency task in comparison with low hostile males. Further, high-hostile males displayed more perseverative errors in nonverbal fluency than did the low-hostile males. No differences were found in the overall fluency scores (verbal or nonverbal). These results partially support the expectation that differences exist between high and low hostile males for right frontal functioning. Moreover, these differences manifest in multiple domains of associated right frontal functioning. These findings extend the evidence for the proposed anterior-posterior inhibition model of hostility.

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## ***Differential Effects of Hostility on Frontal Lobe Performance: A dual task approach with Fluency and Cardiovascular Regulation***

Cardiovascular disease is a significant problem facing society today. As of 1992, in the United States alone, close to one million people died of complications due to heart disease. In addition, 1.25 million suffered heart attacks, and over six million displayed heart disease symptoms (Wardlaw et al. 1992). Some populations are at increased risk for the development of heart disease and premature death. Currently, a robust literature exists within the health psychology domain outlining cardiovascular risks attributable to the Type A personality. The primary variable correlated with increased risk has been found to be hostility (see Matthews & Haynes, 1986). Increased reactivity to stress is a hallmark of the Type A personality (Harbin, 1989; Dembroski, Macdougall, Herd & Shields, 1983; Glass & Contrada, 1982). Recurrent cardiovascular reactivity to stress is positively linked with the development of cardiovascular disease (Manuck & Krantz, 1986). Concurrently, a literature exists in neuropsychology dedicated to the examination of emotional valence and the cerebral lateralization of negative affect. Negative affect has been associated with increased autonomic arousal (Heilman and Valenstein, 1993). The negative affect, hostility, has been associated with increased cardiovascular reactivity (Demaree & Harrison, 1997; Shenal & Harrison, 1998; Demaree et al, 1999). This reactivity has corresponded with dynamic changes in functional cerebral laterality (eg. Demaree & Harrison, 1997).

The bulk of research on CNS control of the heart has focused on brainstem mediation, however, there is evidence for cerebral mechanisms in the regulation of the cardiovascular system. Therefore, it is appropriate to analyze these systems from a functional cerebral systems approach. This approach delineates localized cerebral systems contributing to the regulation and to the performance of specialized functions. Intracerebral systems have been extensively described with a regulatory role posited for the anterior cerebral regions over the posterior cerebral regions (Luria, 1966). Generally, the right cerebral hemisphere predominantly modulates the sympathetic nervous system and the left cerebral hemisphere predominantly modulates the parasympathetic nervous system (Yoon et al. 1997). Concordantly, left cerebral activation has been implicated in cardiovascular stability and in decreased blood pressure (Demaree & Harrison, 1997; Shenal & Harrison, 1998). Right cerebral activation has been implicated in cardiovascular reactivity and in increased heart rate and blood pressure (Demaree & Harrison, 1997). Anterior cerebral regions may be responsible for the inhibition or regulation of these cerebral systems (Demaree & Harrison, 1997), with deactivation of the anterior cerebrum leading to increased activation of the posterior cerebrum. The frontal lobe has extensive longitudinal interconnections including interconnections with the anterior temporal lobe.

### The Functional Cerebral Systems model

Our lab is focused on the exploration of emotions through the systematic use of a functional cerebral systems approach. The weight of research to date has implicated the right cerebrum in the reception, comprehension, expression, and regulation of negative

emotions. The research on the lateralization of positive emotions has been less clear (Heilman, Bowers & Valenstein, 1993). The following research illustrates the use of the functional systems model in the study of the emotional valence, hostility. Specifically, the impact of emotional disposition is explored across each sensory and motor modality.

Given that negative emotions have been found to be primarily processed by the right cerebrum, a general disposition, such as hostility, might produce results indicative of this lateralization across multiple functional systems such as, vision, audition, somatosensory, motor, premotor, vestibular, and their associated processing systems. The primary projection area for vision is within the occipital cortex, specifically, Broadman's area 17, with secondary (area 18) and tertiary (area 19) association areas surrounding it. Lateralized differences between males designated high-hostile and males designated low-hostile have been found for visual identification tasks. Harrison, Gorelczenko & Cook (1990) found at rest (no stressor) differences between these groups in the identification of the emotional valence of faces. Specifically, high-hostile males were less accurate in identifying neutral faces and in the perceptual processing of emotional faces presented within the contralaterally-controlled left-visual field. Neutral faces projected to the right cerebrum were reliably identified as "angry" faces by high-hostile males, whereas low-hostile males correctly identified them. In subsequent research a stressor was applied, a cold-pressor task, and it was shown to have a deleterious effect on identification of emotional faces by high-hostile males compared with low-hostile males (Herridge & Harrison, 1996).

Extending this systematic approach among the sensory systems, the auditory affective processing systems were investigated. The primary projection area for audition is within the superior temporal gyrus. Assessing contralateral variables in audition is possible with the use of a dichotic listening task. This method employs headphones and recorded words or sounds presented to either ear and/or concurrently. Following administration of a cold-pressor task, high-hostile males displayed an enhanced left ear advantage in the identification of speech sounds presented through a dichotic listening task. Further, high-hostile males displayed increased cardiovascular reactivity (blood pressure and heart rate) following the cold-pressor task, whereas low-hostile males demonstrated cardiovascular stability. Diametrically opposite cerebral activation patterns were found in low-hostile males, which displayed an enhanced right ear advantage in the identification of the dichotic speech stimuli as a function of cold pressor stress. These results suggest greater right-cerebrum reactivity to stress among high-hostile males and diametrically opposite effects with left cerebral activation to the cold pressor stress among low-hostile males (Demaree & Harrison, 1997).

The somatosensory strip is located immediately posterior to the cruciate fissure and superior to the primary projection area for audition. Extending the functional cerebral systems approach to the somatosensory system yields similar conclusions for

hemispheric lateralization and hostility. Intentional facial affect configuration differentially alters skin conductance and tone among high and low-hostiles. High-hostile males display increased skin conductance at the left hemibody, reduced rate of habituation at the left hemibody, and enhanced sympathetic tone. Low-hostile males display increased skin conductance at the right hemibody, diminished sympathetic tone, and rapid habituation at the left hemibody (Herridge, Harrison, & Demaree, 1997). These results are consistent with increased right cerebral activation in high-hostile males.

Up to this point the presented research has focused on posterior regions of the brain, the parietal, temporal, and occipital regions. The motor strip is immediately anterior to the cruciate fissure. Contralateral control by the motor strip approaches 90 percent for the distal extremities with ipsilateral projection approaching 10 percent for the proximal body regions, making it ideal for the evaluation of group differences in cerebral laterality. Grip strength was assessed by Demaree et al. (1999) among high- and low-hostile males. High-hostile males are significantly stronger at the left hand and significantly weaker at the right hand with diminished functional symmetry among high-hostile males, absent an experimental stressor. These results provide direct evidence through grip strength of both increased right anterior activation (at rest) and decreased left anterior activation among high-hostile males using low-hostile males as a comparison group.

Thus far these results support the “balance model” (e.g. Tucker, 1984) positing general right hemispheric activation with hostility. However, a more refined inhibitory model of anterior cerebral regions providing regulatory control over the posterior cerebral regions could potentially prove more useful in terms of prediction, control, and the understanding of functioning. Thus far only case studies have directly addressed this within one design (Everhart and Harrison, 1995). Previous experiments have had a different emphasis than on the anterior-posterior inhibition-activation relationship. The next logical step in this systematic investigation of hostility’s functional cerebral systems is to move beyond the primary motor system to premotor, or intentional, systems. Also, it is necessary to evaluate the relationship between anterior and posterior cerebral systems within a controlled experimental design. Fluency tasks are an excellent way to evaluate these premotor, intentional systems and, given that these systems extend to the far frontal regions, fluency can potentially serve the purpose of a dual task challenge with the ongoing task of cardiovascular system regulation. The construct of fluency will next be addressed following an explanation of dual task research and functional cerebral distance, both key concepts in the evaluation of functional cerebral systems.

### Dual Task Research

Dual task research can potentially provide a powerful framework for the evaluation of the functional cerebral systems in hostility. Distributed attention among concurrent activities has been a topic of concern and debate within cognitive psychology

for decades. This is also true of the neuropsychological approaches to brain-behavior relationships. Filimonov (as cited in Luria, 1966) presented the concept of graded potentials, which he related to functional pluriopotentialism. To summarize, he postulated that no cerebral formation is responsible for one unique task, and that multiple tasks are carried out by the same tissue. Relatedly, Kinsbourne and Hicks (1978) proposed the concept of functional cerebral space. Essentially, the extent of inhibitory interference of one task on others varies inversely with the functional distance between the cerebral regions involved with the performance of each task. A pattern of activation in any one region may spread throughout much of the cerebral cortex via the dendritic network that unifies the entire cortex (Purpura, 1967). Accordingly, Kinsbourne and Hiscock (1983) state the following:

It is through particular spatiotemporal patterns of activation, generated in one local network and spread to others, that behavior is controlled. As an activation pattern spreads through the cortex, it becomes altered and perhaps attenuated. Each synapse slows the neurally transmitted message a little, and, in some instances, mixes the message with others that originate in other local networks. Also, since some synapses are inhibitory, they serve to limit the spread of activation and to protect other local networks from being influenced by what may for them be an irrelevant message.

The interconnection that allows for efficient communication between similar neural patterns, makes it difficult to perform two activities within proximal functional space, concurrently. It is thought that interference occurs when concurrent tasks are attempted that compete for similar or adjacent cerebral areas within the same hemisphere (Everhart, 1997). Although controversial, Kinsbourne's model has been successfully applied to the study of concurrent activities.

Many dual-task investigations have evaluated left and right hand index finger tapping because of their localization of control to the contralateral hemispheres (Satz et al., 1967). For example, susceptibility to verbal interference effects should vary as a function of the space available for performing the concurrent tasks; the distance between functional cortical zones; and the extent of redundant control mechanisms (Harrison, 1990). The following research demonstrates various applications of the Kinsbourne theory to dual task experiments.

Harrison (1991) researched the relationship between distal extremity (finger) and proximal extremity (elbow) tapping rates at both the right and left hands in concurrence with a reading task. The verbal task of reading is largely a left hemisphere task as is the motor control task of tapping at the right hand. Results supported the interference model with performance being significantly worse at the right hand during the reading task. Reading did not interfere as strongly with performance at the left hand, presumably due

to the functional distance between the brain matter responsible for reading and that responsible for motor control of the left hand. Interference was also evident on the reading task during tapping of the left elbow. This project extended this line of research to the proximal body regions with the percent of interference corresponding with the percent of fibers arising from the ipsilateral and contralateral cortical regions (e.g. 10% left motor strip to left proximal extremity versus 90% of the fibers efferent to the contralateral hand). This manifested as an interference effect with the extent of interference equal to the anatomical relationships for the motor control of four separate body regions.

Kinsbourne and Cook in 1971 found that right-handed subjects, asked to balance a dowel rod on their index fingers while speaking, had differential effects on right and left hand performance, purportedly due to left hemisphere involvement, concurrently, in right hand performance and the verbal task (Kinsbourne & Cook, 1971). This model has been used to investigate affective behaviors extending the approach beyond simple motoric control. In 1994 a study was done on affect recognition and rehearsal of neutral and affective words, with the neutral rehearsal purported to affect left hemisphere functioning and the affective rehearsal purported to affect right hemisphere functioning. The dual task stimulus was left visual field and right visual field identification of affective states illustrated by photographs of human facial expressions using a tachistoscope. Interference effects were found at the right visual field during the neutral word presentation. Priming effects were found at the right hemisphere during the affective word presentation (Demakis & Harrison, 1994).

### Fluency

Again, the next logical step beyond the functional analysis of dual sensory and motor challenges is to investigate the premotor regions or intentional cerebral systems. Fluency tasks, during confrontational challenges, may provide an excellent way to evaluate these anterior cerebral regions and, moreover, to investigate the role of frontal systems in the dynamic regulation of cardiovascular systems. With anxious-depressed subjects, Everhart (1997) used fluency as a dual task concurrent with the ongoing regulation of the cardiovascular system. Nonverbal fluency interfered with the ongoing regulation of the sympathetic nervous system, yielding an increase in heart rate and blood pressure, whereas the verbal fluency test did not. This finding is consistent with the hypothesized interference in sympathetic cardiovascular regulation secondary to concurrent administration of the purported right frontal challenge of the nonverbal fluency test.

Fluency is a neuropsychological construct referring to the quantitative output, or generativity, of verbal and/or nonverbal material to confrontation under timed and limited search conditions (Strub & Black, 1985). Verbal fluency tests require listing of words that begin with a pre-specified letter or categorical item whereas nonverbal fluency tests

require the generation of unnamable designs or figures. Performance is dependent on the intentional processes of organization, problem-solving, strategy development and implementation, and the ability to quickly shift to other strategies or “cognitive flexibility.” Without these capabilities, fluency output can be impacted. Individuals with frontal lobe damage have been demonstrated to produce reduced output on these tasks (Lezak, 1983). Further, such deficits are dependent upon the lateralization of damage, with right frontal damage yielding decremental nonverbal fluency performance (Jones-Gotman & Milner, 1977) and left frontal damage yielding decremental verbal fluency performance (Borokowski et al. 1981). Perseverative errors are also assessable using fluency measures. A perseverative error, in the context of fluency, can be quantified as a repetition of a word or a design. An excellent example of frontal lobe perseveration is evidenced with Broca’s most famous client, Tan (Broca, 1861). This particular form of perseveration is referred to as a paraphasic phonemic perseverative error. Fluency performance in individuals with frontal damage is not only low in terms of frequency, or generativity, but also it is marked by consistent perseverative errors (Jones –Gotman & Milner, 1977).

### **Rationale**

Our understanding of the mechanisms resulting in interference or disruption of stable cardiovascular functioning during concurrent tasks in participants with differing physiological reactions to stress is vital for furthering the development of more effective and specialized health treatment methodologies. This importance is notable due to the greater risks carried by high hostiles for heart disease. Hostility has been implicated as a primary variable in Type A personality studies, which have been correlated with cardiovascular disease. An exploration of the cerebral mediation of emotion is a promising pathway towards the goal of decreasing these risks.

The present experiment advances research on the cerebral mediation of the heart. The functional space model proposed by Kinsbourne & Hicks in 1978 is used to advance the understanding of the cerebral lateralization of cardiac regulation in high and in low hostile men through the application of dual-task methodology with the extent of interference expected to correspond to the proximity of the functional tasks.

The concurrent tasks in this experiment consist of fluency (one verbal test purported to be mediated by the anterior left cerebrum and one nonverbal test purported to be mediated by the anterior right cerebrum), and maintenance of ongoing cardiovascular control (parasympathetic, a task regulated by the left anterior cerebral regions, and sympathetic, a task regulated by the right anterior cerebral regions). It should be noted that the application of the functional cerebral distance theory to the cerebral maintenance of the autonomic nervous system is a relatively novel idea within the literature. Usually classic activation tasks are used in dual task research (i.e. finger tapping and reading). To the author’s knowledge, this methodology has only been

applied once before in a similar study of the function of anxiety and depression concurrent with regulation of the ANS (Everhart, 1997).

The nonverbal fluency test is expected to interfere with the right anterior cerebrum resulting in a diminution of that region's inhibitory function yielding sympathetic activation and cardiac de-regulation in high-hostile males. Specifically, an increase in blood pressure is predicted with the concurrent nonverbal fluency tests. A better understanding of these systems may eventually result in a treatment model for hostile men to decrease their risk of systemic cardiovascular failure.

#### *Hypotheses*

1. A group by condition interaction effect is predicted using the cardiovascular measures. Cardiovascular stability is predicted on the concurrent task of verbal fluency whereas increased cardiovascular reactivity will be evidenced with the concurrent task of nonverbal fluency in high-hostile males.
2. A group by condition interaction effect is predicted again using the cardiovascular measures. Cardiovascular stability is predicted on the concurrent task of verbal fluency and also on the concurrent task of nonverbal fluency in low-hostile males.
3. A group by condition effect is expected for fluency performance. High-hostile males should have increased verbal fluency relative to nonverbal fluency. High-hostile males should do better on verbal fluency than low hostile males.
4. High-hostile males will display more perseverative errors on nonverbal fluency than low-hostile males.

#### **Method**

##### Participants

Participants were right-handed men acquired from the undergraduate Psychology pool. Participants had no prior history of hearing problems, uncorrectable visual acuity, major illness or head injury. Only men were used because it was essential that homogeneity be maintained in order for conclusions to be solely attributable to the independent variable manipulation. Participants with significant right hemibody preference based on the Coren, Porac, and Duncan laterality test (Coren, Porac, & Duncan, 1979) (Appendix A), who additionally met the criteria on the Cook-Medley Hostility Scale (CMHS) (Cook & Medley, 1954) (Appendix E) were selected for further participation.

All participants completed a neurological screening questionnaire (Appendix B). This questionnaire evaluates present and past neurologically related problems that might interfere with performance.

There were 25 participants recruited for each category. One participant was removed from each category due to history of head injury for a total of 24 participants in

each group.

### Self-Report

During group testing, participants were required to complete a questionnaire assessing their medical history (neurological screening questionnaire). Participants were then administered the Coren, Porac, and Duncan laterality test to determine hemibody preference. This is a self-report measure that assesses right (-1) and left (+1) hemibody preference based on preferred use of either eye, ear, arm, and leg. The test ranges from scores of -13 to +13, denoting left and right hemibody preference, respectively. A score of +6 or above was required for continued participation in the experiment.

Participants who met the aforementioned criteria were then administered the Cook-Medley Hostility Scale (CMHS). This test is the most frequently utilized measure of hostility and has been shown to be a valid predictor of medical, psychological, and interpersonal outcomes (Conrada & Jussim, 1992). Participants who scored 19 or below on the scale (CMHS), and who met the above criteria were asked to continue with the experimental phase and comprised the low-hostile group. Participants who scored in the range of 20 to 28 points were notified that they would not be asked to participate in the experimental phase of the experiment. Participants who scored 29 or above on the CMHS, and who met the above criteria, comprised the high-hostile group. The participants chosen for the experimental phase were scheduled for further testing.

### *Apparatus*

The laboratory chamber was comprised of a chair facing a one-way mirror within a flat white curtain enclosure. Located in this chamber were the verbal fluency test, nonverbal fluency test, and blood pressure cuff.

Physiological Systolic Blood Pressure, Diastolic Blood Pressure, and Heart Rate were assessed using the Norelco Healthcare Electronic Digital Blood Pressure / Pulse Meter with Microphoneless Cuff and oscillometric technique (1985; Model HC3030). Accuracy of this device has been obtained in previous work (Harrison & Kelly, 1987).

Verbal Fluency The Controlled Oral Word Association Test (COWAT) (Appendix D) assesses the oral or written production of words beginning with a designated letter (Benton & Hamsher, 1976). It consists of three trials in which participants are instructed to write as many words as possible in one minute beginning with a specified letter (e.g. F, A, or S). Proper names, numbers, and the same word with different endings are not permitted. The final score is the sum of all acceptable words produced across trials. The letters F, A, and S are the most frequently utilized, however, the present experiment used a variation of the protocol. Specifically, the letters F, S, and T were used. These letters were chosen based on the tendency of normals to produce an equal number of responses for each letter (approximately 11-12 words per minute)

(Everhart, 1997).

Nonverbal Fluency For nonverbal fluency the Ruff Figural Fluency Test (RFFT) was used. It consists of five parts, each containing different stimulus presentations. Each part has 35 dot matrices arranged in a 5 X 7 array. Participants were instructed to connect the dots in as many unique ways that they can conceive within a one minute period (See Appendix C). It is scored by counting the number of unique designs and number of perseverations for each trial. A perseveration is any repetition of a previous design within the participant's responses. Nonverbal fluency is then considered the total number of unique designs minus the number of perseverations within each part. Three sheets, instead of the standard five, were used in this experiment in order to maintain consistency with the COWAT (Everhart 1997).

### Procedure

Upon arrival at the testing center, participants were administered the CMHS to check for test-retest reliability of the hostility grouping. Participants were only tested if the score was consistent. They were then fitted with the blood pressure monitor. The researcher left the testing room and gave the following instructions over the intercom: "Please take about one minute to become accustomed to your surroundings. Please sit still in the chair and face forward." Participants were then informed that they would be asked to complete the verbal and the nonverbal fluency tests. Following a 90 second adaptation period, baseline SBP, DBP, and HR were recorded. Immediately following the recording of the physiological data, the subject was asked to complete the RFFT (Appendix C) or the COWAT (Appendix D) using the appropriate instruction set for the test. Order of the fluency tests was administered in a counterbalanced fashion. Upon completion of the fluency task SBP, DBP, and HR was recorded again. Following 90 seconds of adaptation, presentation of the second test was administered following the same procedures.

### Data Analysis

Data analyses for the dependent measures of systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) consisted of a mixed design ANOVA with the fixed effects of group (2) and condition (2) and the repeated measure of trial (2). In order to test the hypothesis that high hostile men have more difficulty than low hostile men regulating cardiovascular functioning when performing a nonverbal fluency test (RUFF) an ANOVA consisting of group (high and low) X condition (1 and 2) with the repeated measure of trial (2) was performed.

In order to test the hypothesis that high hostile males would have more difficulty with nonverbal fluency than low hostile males an analysis of fluency was conducted with a mixed design ANOVA with the fixed effects of group (2) (high hostility and low hostility) and condition (2) (verbal and nonverbal fluency) and with the repeated measure

of trial (3). The dependent variable was the total number of words produced (fluency score) (See Table 2). Further, an analysis of the perseverative errors was performed with a mixed design ANOVA with group (2) (high hostility and low hostility) and condition (2) (nonverbal or verbal) with the repeated measure of trial (3). The total number of perseverative errors was the dependent variable. All post hoc analyses were completed utilizing Tukey's Studentized Range Test to control for experimentwise error rate (Weiner, 1971).

## Results

### Descriptive Statistics

A total of 48 college-aged right-handed males were selected for participation in the experiment. Participants were assigned to groups (low and high hostile) based on CMHS scores (19 and below = "low-hostile" and 29 and above = "high-hostile").

It was hypothesized that high-hostile men would evidence increased cardiovascular reactivity following administration of a nonverbal fluency test (condition 2). An ANOVA consisting of group (high and low) X condition (1 and 2) with the repeated measure of Trial (1 and 2) was performed (See Table 1). A significant group X condition X trial interaction was found for systolic blood pressure (SBP),  $F(1,46) = 3.96$ ,  $p \leq .05$  (See Figure 1). Systolic blood pressure increased following the nonverbal fluency confrontation test in high-hostile males. Systolic blood pressure decreased following the verbal fluency confrontation test in high-hostile males. No change was evident in systolic blood pressure following the nonverbal fluency confrontation test in low-hostile males. Finally, verbal fluency produced an increase in systolic blood pressure following the verbal fluency test in low-hostile males. Post-hoc analyses indicate that the rise in systolic blood pressure following administration of the nonverbal fluency test to high-hostile males is the only significant change by itself within the interaction.

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Insert Table 1 about here.

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Insert Figure 1 about here.

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A significant main effect for group was found for diastolic blood pressure (DBP),  $F(1,46) = 4.34$ ,  $p \leq .05$  (See Figure 2). Post hoc analyses on the main effect of group using Tukey's HSD test demonstrated that low-hostile males DBP (68.83 mmHg) was significantly lower than high-hostile males DBP (73.677) taken over all trials.

Table 1.  
Analysis of Variance for physiological variables

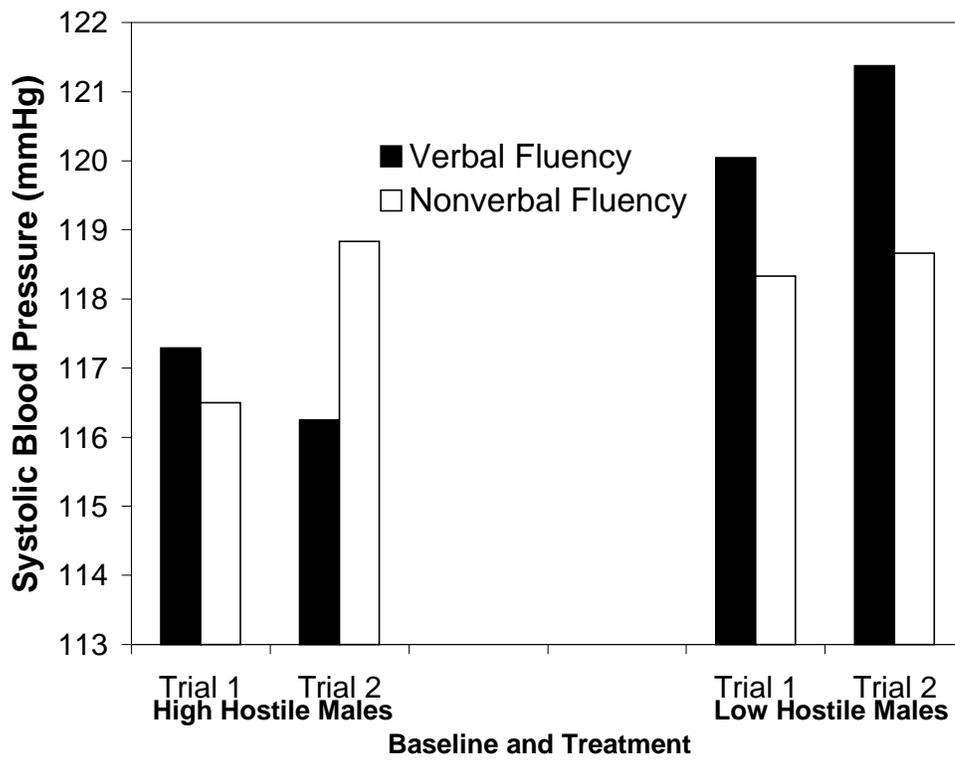
Source	df	F
Systolic blood pressure		
Group x Condition x Trial	(1, 46)	3.96*
Group x Condition	(1, 46)	1.95
Condition x Trial	(1, 46)	0.59
Group x Trial	(1, 46)	1.74
Trial	(1, 46)	0.08
Group	(1, 46)	0.36
Diastolic blood pressure		
Group x Condition x Trial	(1, 46)	0.03
Group x Condition	(1, 46)	1.38
Condition x Trial	(1, 46)	0.15
Group x Trial	(1, 46)	1.76
Trial	(1, 46)	3.42
Group	(1, 46)	4.34*
Heart Rate		
Group x Condition x Trial	(1, 46)	0.04
Group x Condition	(1, 46)	0.49
Condition x Trial	(1, 46)	0.17
Group x Trial	(1, 46)	1.76
Trial	(1, 46)	1.63
Group	(1, 46)	1.54

\* $p \leq .05$ .

#### Figure Caption

Figure 1. Systolic Blood Pressure in mmHg as a function of group (high- and low- hostile

males) condition (Verbal and Nonverbal Fluency tests), and trial (baseline and post test).



Insert Figure 2 about here.

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In order to test the hypothesis that high hostile men evidence decreased performance on nonverbal fluency during ongoing mediation of cardiovascular activities an ANOVA consisting of the fixed effects of group and condition with the repeated measure of trial was performed on the fluency data (See Table 2). For this analysis, group = high and low hostile participants, trial = 3, and fluency = verbal fluency and nonverbal fluency tests.

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Insert Table 2 about here.

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No significant interactions were found. A significant main effect was found for condition,  $F(1, 46) = 28.52, p \leq .05$  (See Figure 3). Post hoc analyses revealed that nonverbal fluency scores were significantly higher than verbal fluency scores collapsed across groups. Further, a significant main effect for trial was found across both conditions,  $F(2,92) = 8.95, p \leq .05$  (See Figure 4). Post hoc analyses revealed that trial 1 scores were significantly lower than trials 2 and 3 collapsed across groups.

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Insert Figure 3 about here.

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Insert Figure 4 about here.

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In order to further test the hypothesis that high hostile men evidence decreased performance on nonverbal fluency during ongoing mediation of cardiovascular activities, an ANOVA consisting of the fixed effects of group and condition with the repeated measure of trial was performed using perseverative errors on the fluency tests as data (See Table 3). A significant group X condition interaction was found. High-hostile males, as predicted, produced more perseverative errors on nonverbal fluency than did the low-hostile males,  $F(1,46) = 8.99, p \leq .05$  (See Figure 5). Overall, there was a main effect for Group with high-hostile males displaying more perseverative errors than low-hostile males,  $F(1, 46) = 10.07, p \leq .05$  (See Figure 6).

No significant interactions were found. A significant main effect was found for condition,  $F(1, 46) = 28.52, p \leq .05$  (See Figure 3). Post hoc analyses revealed that nonverbal fluency scores were significantly higher than verbal fluency scores collapsed across groups. Further, a significant main effect for trial was found across both conditions,  $F(2,92) = 8.95, p \leq .05$  (See Figure 4). Post hoc analyses revealed that trial 1 scores were significantly lower than trials 2 and 3 collapsed across groups.

Figure Caption

Figure 2. Diastolic blood pressure in mmHg as a function of group (high- and low hostile males).

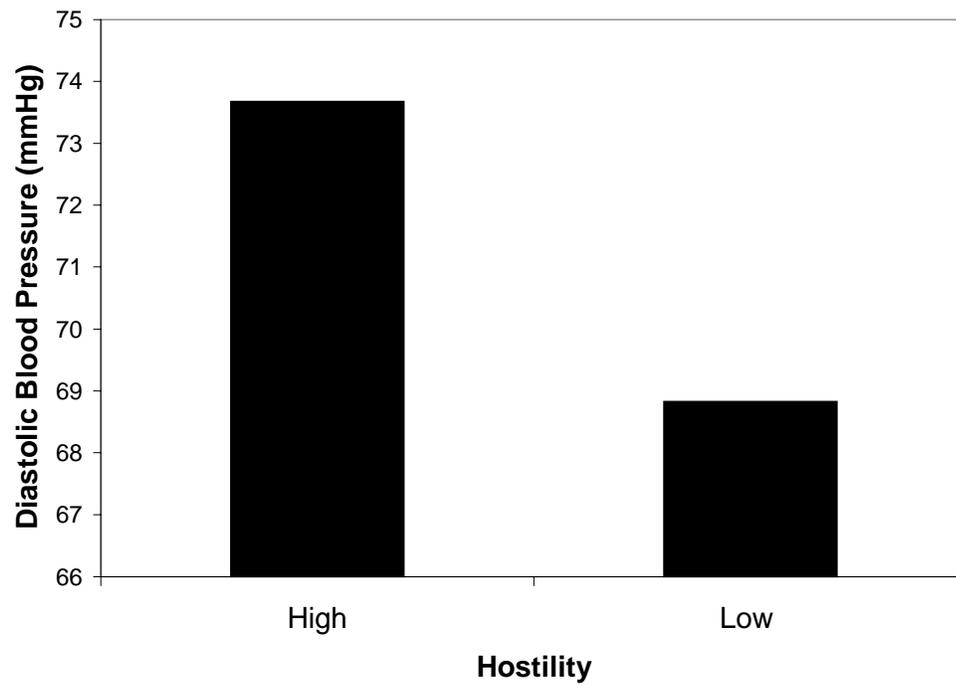


Table 2

Analysis of Variance for Fluency Output

Source	<u>df</u>	<u>F</u>
Group x Condition x Trial	(2, 92)	0.72
Group x Condition	(1, 46)	0.88
Condition x Trial	(2, 92)	1.06
Group x Trial	(2, 92)	0.17
Trial	(2, 92)	8.95*
Group	(1, 46)	0.07
Condition	(1, 46)	28.52*

\* $p \leq .05$ .

Figure Caption

Figure 3. Number of unique word or figures produced as a function of condition.

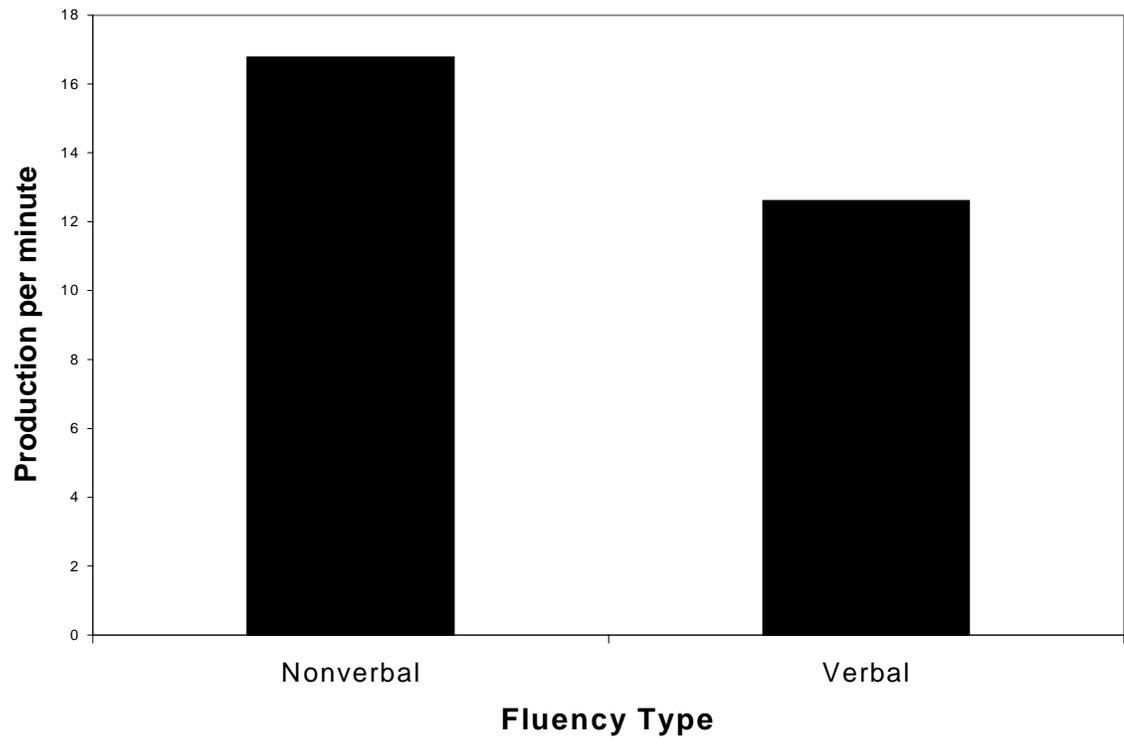
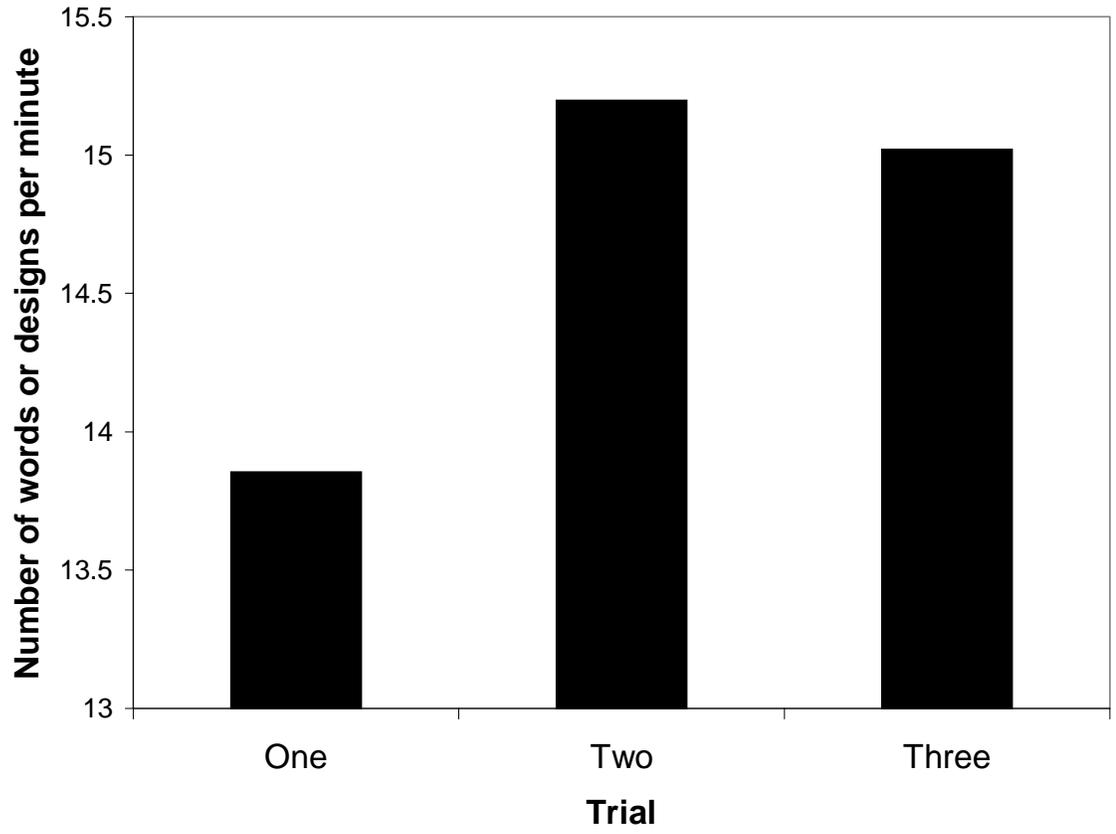


Figure Caption

Figure 4. Total number of words or designs produced as a function of trial.



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Insert Table 3 about here.

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Insert Figure 5 about here.

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Insert Figure 6 about here.

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This variance is mostly attributable to the large number of nonverbal fluency perseverative errors produced by high-hostile males. Post hoc analyses revealed that errors were significantly more frequent among high-hostile males. Further, there was a main effect for condition with more perseverative errors made on the nonverbal fluency tests than on the verbal fluency tests for both groups,  $F(1, 46) = 31.48, p \leq .05$  (See Figure 7). Post hoc analyses revealed that condition 1 scores were significantly lower than condition 2 scores. Specifically, an average of .84 perseverative errors was found on the nonverbal fluency test in comparison to .03 perseverative errors on the verbal fluency test.

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Insert Figure 7 about here.

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Table 3

Analysis of Variance for Perseverative Errors

Source	<u>df</u>	<u>F</u>
Group x Condition x Trial	(2, 92)	0.13
Group x Condition	(1, 46)	8.99*
Condition x Trial	(2, 92)	0.08
Group x Trial	(2, 92)	1.74
Trial	(2, 92)	0.58
Group	(1, 46)	10.07*
Condition	(1, 46)	31.48*

\* $p \leq .05$ .

Figure Caption

Figure 5. Average number of perseverative errors as a function of group (high- and low-hostile males) and condition (Verbal and Nonverbal Fluency).

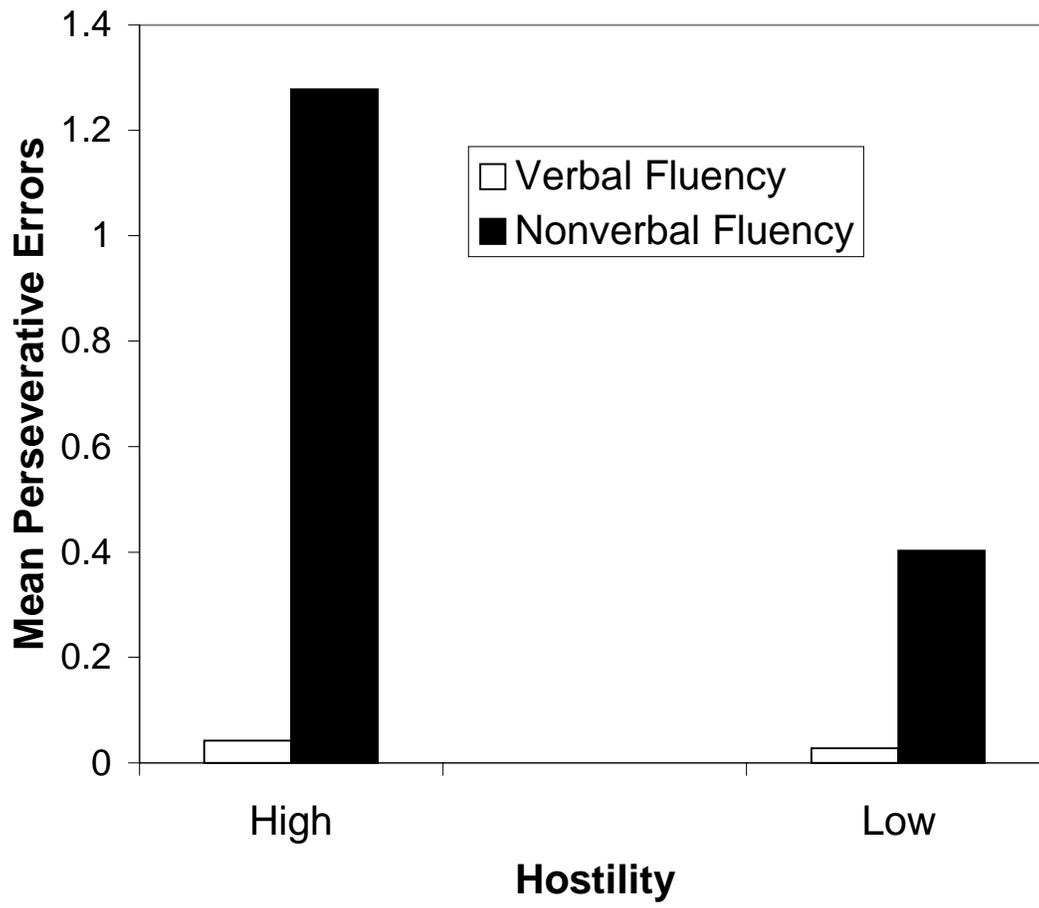


Figure Caption

Figure 6. Average number of perseverative errors as a function of group (high- and low-hostile males).

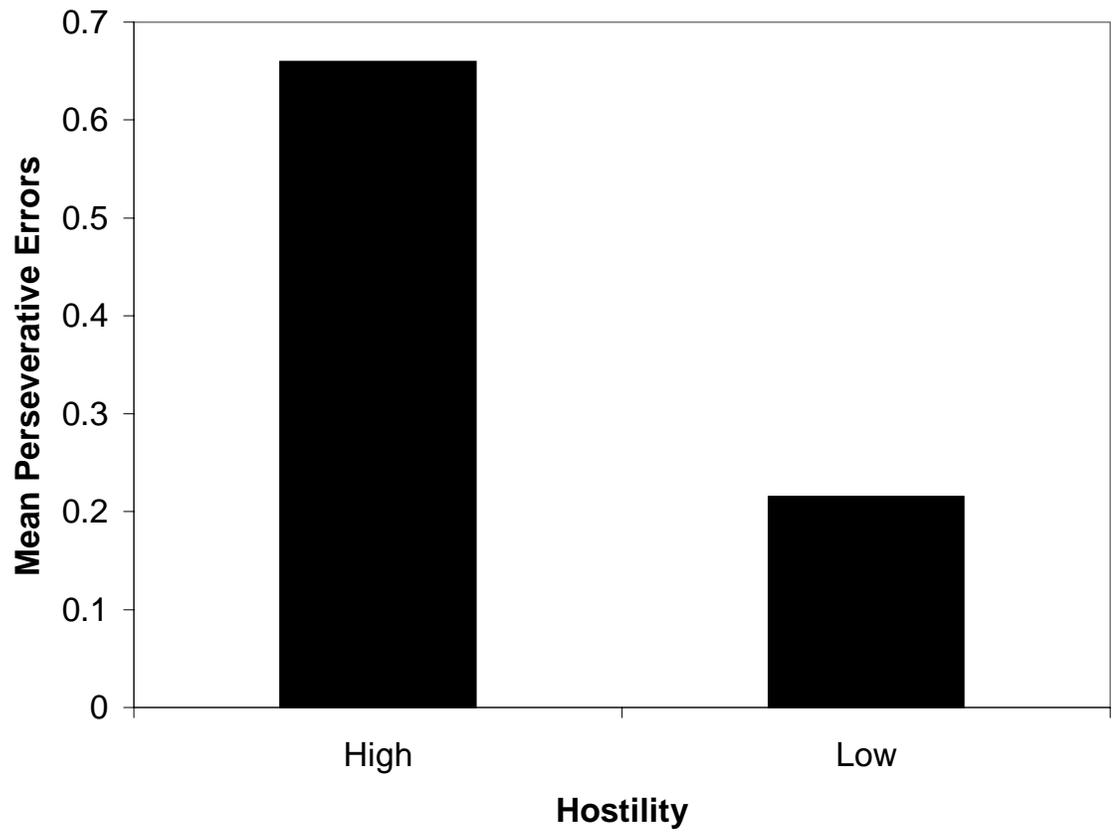
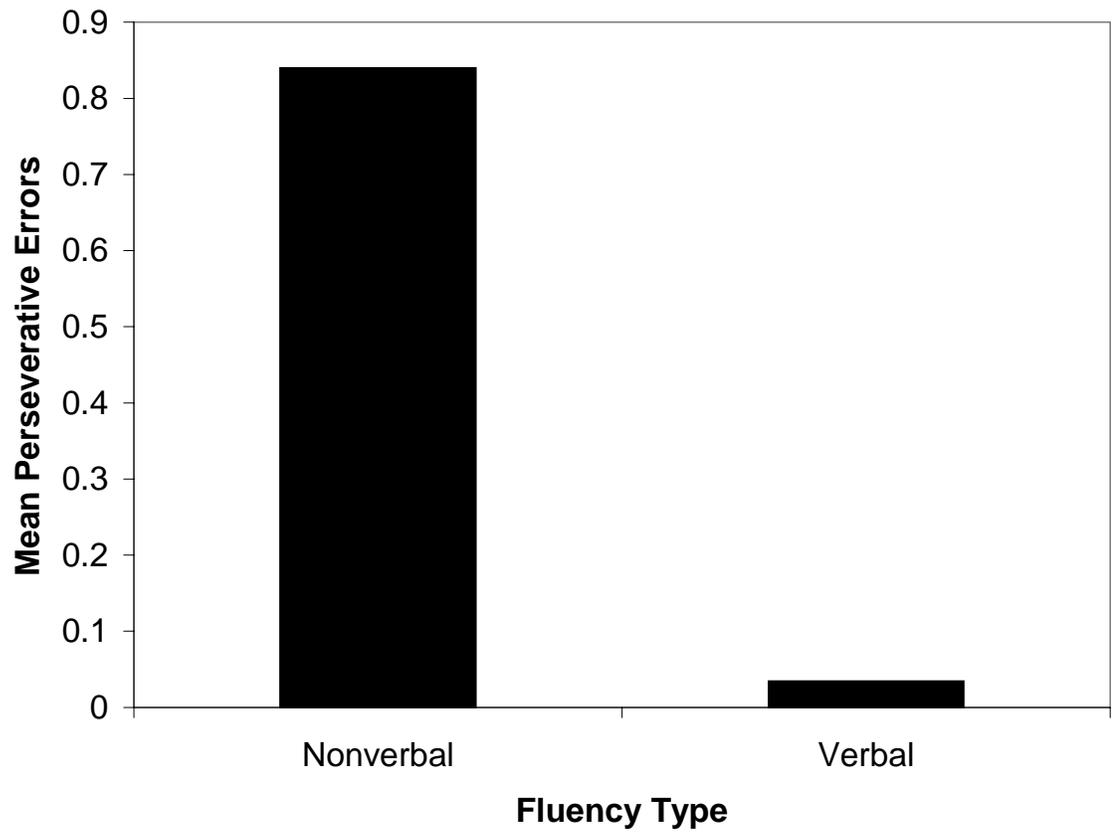


Figure Caption

Figure 7. Average number of perseverative errors as a function of fluency condition.



## Discussion

The primary findings of the experiment are as follows. First, verbal and nonverbal fluency test performance produced diametrically opposite effects on systolic blood pressure in high-hostile males. Specifically, nonverbal fluency yielded heightened systolic blood pressure, whereas verbal fluency resulted in decreased systolic blood pressure in this group. Secondly, verbal fluency produced opposite effects among the groups with decreased systolic blood pressure in the high-hostile group in contrast to increased systolic blood pressure in the low-hostile group. Low-hostile males tolerated the nonverbal fluency test with stability across blood pressure measures. Third, the high-hostile males produced perseverative or organizational errors on the nonverbal fluency test not found in the low-hostile males. As predicted by the functional cerebral systems approach, the functional cerebral distance principle, and the hostility model, high-hostile males demonstrated increased interference and potentially reduced capacity within right frontal systems when compared with low-hostile males.

Cerebral regulation of cardiovascular functions has previously been described with cerebral laterality for sympathetic and parasympathetic systems. Specifically, sympathetic nervous system influences on cardiovascular functions have been purported to be largely a function of the right cerebrum and parasympathetic functioning has been purported to be largely a function of the left cerebrum (Yoon et al. 1997; Wittling et al, 1997). Along these lines, left posterior cerebral activation has been implicated in cardiovascular stability and in decreased blood pressure (Demaree & Harrison, 1997; Shenal & Harrison, 1998). Right posterior cerebral activation has been implicated in cardiovascular reactivity with increased heart rate and blood pressure (Demaree & Harrison, 1997).

Regulation of these posterior systems is a function of interconnected intracerebral systems. These systems have been described with a regulatory role posited for the anterior cerebral regions over the posterior cerebral regions (Luria, 1966). A review of the relevant neuropsychological research indicated that the anterior-right cerebrum is responsible for the inhibition or the regulation of sympathetic cardiovascular responses and that the anterior-left cerebrum is responsible for the inhibition or the regulation of parasympathetic cardiovascular responses. These same systems may be involved in the concurrent processing of emotion and in emotional regulation. Our lab has mainly focused on the functional cerebral systems of hostility, specifically, the systematic analysis of sensory and motor modalities through hypothesis testing based on hemispheric asymmetries and anterior-posterior interactions in hostility.

Functional systems analyses of hostility have shown that, at rest, high-hostile males have heightened right cerebral activation in comparison to low-hostile males with differences in behavioral output evident across multiple sensory and motor systems. One neuropsychological explanation of hostility would suggest that the anterior-right

cerebrum is responsible for the inhibition or the regulation of sympathetic cardiovascular functioning as well as the expression of heightened hostility (Everhart & Harrison, 1995; Demaree & Harrison, 1997). The orbital-frontal region has extensive interconnections with the amygdaloid bodies of the anterior temporal region via the uncinate fasciculus. Activation in the latter region has been correlated with increasing hostility. These regions interact to produce relatively stable aggression levels among normal individuals (Heilman et al. 1993). Functional cerebral systems research has yielded support for this relationship with hostility through the evaluation of sensory modalities (vision, audition, somatosensory) and motor modalities (strength and fatigue) (e.g. Herridge, Harrison, & Demaree; Demaree & Harrison, 1997, Harrison & Gorelczenko, 1990, Demaree, et al. 1999). It is necessary to evaluate the relationship between anterior and posterior cerebral systems within a controlled experimental design. Further, prior to this experiment, premotor systems had yet to be explored through our functional systems analysis of hostility.

The next logical step in the systematic investigation of hostility's functional cerebral systems was to move beyond the primary motor system to the premotor, or intentional, cerebral systems. Fluency tests present as an ideal method of evaluating these systems. The premotor systems are proximal to the anterior cerebral systems purported to regulate cardiovascular functions. This proximity allows for fluency to potentially serve as a dual-task for cardiovascular regulation. Dual task research can, potentially, provide a powerful framework for the evaluation of the functional cerebral systems in hostility. Dual-task methodology allows for a parsimonious test of the anterior-posterior relationship forwarded as integral to the emotional regulation of negative affect. The fluency tests theoretically were concurrent tasks involving anterior cerebral systems also involved with the inhibition of cardiovascular responses. Dual task research explores the extent of interference resulting from the performance of multiple tasks concurrently. Susceptibility to interference effects should vary as a function of the cerebral space available for performing the concurrent tasks; the distance between functional cortical zones; and the extent of redundant control mechanisms (Harrison, 1990). This follows from Kinsbourne and Hicks (1978) proposed concept of functional cerebral space. Essentially, the extent of inhibitory interference of one task on others varies inversely with the functional distance between the cerebral regions involved with the performance of each task.

It was hypothesized that high-hostile males would display increased interference on sympathetic cardiovascular regulation with the concurrent performance of a nonverbal fluency confrontation challenge (purportedly a right frontal challenge). Specifically, it was expected that high-hostile males would display increased blood pressure subsequent to the completion of the nonverbal fluency test. High-hostile males did show an increase in blood pressure following the completion of the nonverbal fluency confrontation challenge. Specifically, systolic blood pressure increased reliably in this

group as a function of nonverbal fluency. Studies have previously shown that right frontal damage is associated with difficulties in self-regulation or self-modulation of ongoing behaviors (Teuber et al., 1951).

Further, it was hypothesized that high-hostile males would produce more perseverative errors on the nonverbal fluency test than low-hostile males. As predicted, high-hostile males displayed more perseverative errors than low-hostile males on the nonverbal fluency confrontational test. Output of nonverbal fluency on patients with right frontal lobe lesions has been marked by perseverative errors (Jones-Gotman, 1977). Taken together (i.e. increased blood pressure and more perseverative errors in high-hostile males) these results lend validity to the use of cardiovascular functions and cognitive tasks such as fluency as concurrent tasks within an experimental model.

In contrast to the experimental predictions, high-hostile males did not display reduced design output on the nonverbal fluency test. The failure to support this hypothesis may have resulted from restricted time allocation for the completion of the fluency tests. One-minute intervals, as used in this experiment, are relatively short. Research on the frontal lobe in generativity and organizational regulation has generally indicated increased sensitivity to so called “frontal lobe tests” with extended duration. This has been related by some to vigilance or concentration difficulties or dysfunction within the intentional regulation systems over time. Along these lines, increasing the time allotted for fluency production might make the tests more sensitive and uncover the predicted group differences in output of fluency on this test in addition to the perseverative errors already evident (e.g. Demakis, 1995).

In contrast, low-hostile males did not show any evidence of reduced right-frontal capacity. As predicted, low-hostile males did not display an increase in blood pressure subsequent to the completion of the nonverbal fluency test. In fact the baseline systolic blood pressure (118.33 mmHg) was almost identical to the post-nonverbal fluency confrontation systolic blood pressure (118.66 mmHg). Interestingly, compared to high-hostile males, low-hostile males did show a diametrically opposite increase in systolic blood pressure subsequent to completion of the verbal fluency test. Post hoc analysis revealed that compared to low-hostile males verbal fluency baseline systolic blood pressure baseline this increase was not significant, but an opposite effect may suggest differential cerebral cardiovascular regulation in low-hostile males.

The fluency confrontation test scores did not provide any consistency with the increased blood pressure response in low-hostile males to the verbal fluency test. Low-hostile males did not show a significant amount of perseverative errors in comparison to high-hostile males on either fluency test. Further, there were no output differences on either fluency test between the two groups. One interesting possibility is that the performance of the verbal fluency confrontation test did not interfere with low-hostile

males cerebral regulation of cardiovascular functions. Given that the verbal fluency test is purportedly a left frontal task, activation in this area without interference might produce more inhibition of the left posterior cerebrum, resulting in, possibly, a slight relative activation of the right posterior cerebrum. This might manifest as increased blood pressure. Taken together, that the nonverbal fluency test produced little change in blood pressure and that the verbal fluency test produced an increase in blood pressure, these results might suggest that low-hostile males are less susceptible bilaterally to frontal lobe interference.

This experiment uncovered results consistent with the proposed hypotheses. High-hostile males evidenced both cognitive and physiological differences in comparison to their low-hostile counterparts. Taken together, these results suggest general differences in right frontal lobe capacity in high-hostile males relative to low-hostile males. This may help explain the link between hostility and cardiovascular disease (Kubany et al, 1994). That is, high-hostile males experience more interference effects on tasks that require right frontal lobe resources due to increased at-rest arousal, perhaps producing increased right posterior hemispheric activation resulting in increased physiological lability and possibly contributing to cardiovascular disease. This dual task methodology may also aid in the development of cognitive intervention strategies for this population. Dual tasks may be identified specifically for interference of inhibitory left frontal systems to promote parasympathetic arousal and increased vagal tone. For example, verbal fluency confrontation did have the effect of slightly reducing systolic blood pressure in the high hostile group. Further stressing the left frontal lobe might produce a more significant effect, perhaps through exercise and range of motion of the right hemibody, through propositional speech, or through pleasant learning tasks that may be beneficial (Snyder, Harrison & Shenal, 1997; Shenal et al, 1997; Harrison & Kelly, 1987).

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Appendix A  
**Handedness Questionnaire**

Subject #: \_\_\_\_\_

Circle the appropriate number after each item.

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

*# of Right + # of Left = Total Score*

\_\_\_\_\_ + \_\_\_\_\_ = \_\_\_\_\_

*Is mother left or right hand dominant?* \_\_\_\_\_

*Is father left or right hand dominant?* \_\_\_\_\_

*Appendix B*  
**History Questionnaire**

Name: \_\_\_\_\_

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 response and explain *AYes@* answers below.

- |                                                                            |     |    |
|----------------------------------------------------------------------------|-----|----|
| 1. Severe head trauma/injury                                               | Yes | No |
| 2. Stroke                                                                  | Yes | No |
| 3. Learning disabilities (problems of reading, writing, or comprehension?) | Yes | No |
| 4. Epilepsy or seizures                                                    | Yes | No |
| 5. Paralysis                                                               | Yes | No |
| 6. Neurological surgery                                                    | Yes | No |
| 7. Other neurological/nervous system problems                              | Yes | No |
| 8. Alcohol or drug problems                                                | Yes | No |
| 9. Using alcohol or drugs (other than for purposes prescribed) at present? | Yes | No |
| 10. Past psychological/psychiatric problems                                | Yes | No |
| 11. Are you currently taking any prescription medication or drugs?         | Yes | No |
| 12. Are you currently suffering from any medical conditions or illnesses?  | Yes | No |

Please explain any Yes responses:

*Appendix C*  
**Ruff Figural Fluency Test**

Administration

Begin with sample items of Part 1

**IN FRONT OF YOU ARE THREE SQUARES, EACH CONTAINING FIVE DOTS. NOTE THAT THE ARRANGEMENT OF THE FIVE DOTS IS ALWAYS THE SAME. I WANT YOU TO CONNECT TWO OR MORE DOTS BY ALWAYS USING STRAIGHT LINE. YOU DO NOT NEED TO CONNECT ALL FIVE DOTS. THE PURPOSE OF THE TEST IS FOR YOU TO MAKE AS MANY DESIGNS OR FIGURES AS POSSIBLE, BUT EACH DESIGN HAS TO BE DIFFERENT IN SOME WAY FROM ALL THE OTHERS. ANY QUESTIONS?**

Following completion of the sample, give feedback as to errors, i.e. if there are two identical designs, point out the duplicated designs and repeat the instructional set. If the sample designs are elaborate (e.g. all five dots are consistently connected) re-emphasize the instructions that a design can be drawn by connecting two or more dots. Following completion of the sample, turn the page and state:

**TURN THE PAGE. DO NOT BEGIN UNTIL INSTRUCTED. ON THIS PAGE, DRAW AS MANY DIFFERENT DESIGNS OR FIGURES AS POSSIBLE. CONNECT AT LEAST TWO DOTS WITH A STRAIGHT LINE. YOU DO NOT NEED TO USE ALL FIVE DOTS. WORK AS QUICKLY AS POSSIBLE AND MAKE EVERY DESIGN DIFFERENT. GET READY B GO.**

Allow one minute for each part of the test. When this time is up, say **ASTOP.** Allow about 5 seconds and then instruct the subject. **TURN THE PAGE AND COMPLETE THE PRACTICE TRIALS.** Allow about 20 seconds for this. Then, **TURN THE PAGE, START IN THE UPPER LEFT SQUARE, AND WORK FROM LEFT TO RIGHT. WORK AS QUICKLY AS POSSIBLE AND MAKE EVERY DESIGN DIFFERENT. GET READY. GO.**

*Appendix D*

*Controlled Oral Word Association Test*

Administration

I AM GOING TO SAY A LETTER OF THE ALPHABET AND I WANT YOU TO WRITE AS QUICKLY AS YOU CAN ALL THE WORDS YOU CAN THINK OF THAT BEGIN WITH THAT LETTER. FOR INSTANCE, IF I SAY AB@ YOU MIGHT WRITE ABARK, BATTALION, BEAST@ OR WORDS LIKE THAT. DO NOT USE WORDS WHICH ARE PROPER NAMES SUCH AS ABOSTON, BETTY, BUICK@ OR NUMBERS. ALSO, DO NOT USE THE SAME WORD WITH A DIFFERENT PREFIX OR SUFFIX, SUCH AS ABEAT@ OR ABEATING@, OR THE SAME WORD IN A DIFFERENT TENSE, SUCH AS AFIGHT, OR AFOUGHT@. YOU WILL HAVE ONE MINUTE FOR EACH LETTER AND I WILL NOTIFY YOU WHEN ONE MINUTE HAS PASSED. FOLLOWING COMPLETION OF THE FIRST LETTER I WILL HAND YOU A SHEET FOR THE SECOND AND THIRD LETTERS. ANY QUESTIONS? BEGIN WHEN I SAY THE FIRST LETTER. THE FIRST LETTER IS A. . . .@ GO AHEAD.

Timing begins immediately and one minute is allowed for each letter. When one minute is up, say STOP. Wait about 5 seconds before beginning the next trial. Next, say; ABEGIN WHEN I SAY THE NEXT LETTER. THE NEXT LETTER IS A...@ GO AHEAD. The scores is the total number of acceptable words produced over the three minutes.

Appendix E  
**Cook Medley Hostility Scale**

Directions: If a statement is true or mostly true, as pertaining to you, circle the letter T. If a statement is false or usually not true about you, circle the letter F. Try to give a response to every statement.

- |                                                                                                                            |   |   |
|----------------------------------------------------------------------------------------------------------------------------|---|---|
| 1. When I take a new job, I like to be tipped off on who should be gotten text to.                                         | T | F |
| 2. When someone does me wrong I feel I should pay him back if I can, just for the principle of the thing.                  | T | F |
| 3. I prefer to pass by school friends, or people I know but have not seen for a long time, unless they speak to me first.  | T | F |
| 4. I have often had to take orders from someone who did not know as much as I did.                                         | T | F |
| 5. I think a great many people exaggerate their misfortunes in order to gain sympathy and help of others.                  | T | F |
| 6. It takes a lot of argument to convince most people of the truth.                                                        | T | F |
| 7. I think most people would lie to get ahead.                                                                             | T | F |
| 8. Someone has it in for me.                                                                                               | T | F |
| 9. Most people are honest chiefly through the fear of getting caught.                                                      | T | F |
| 10. Most people will use somewhat unfair means to gain profit or an advantage rather than to lose it.                      | T | F |
| 11. I commonly wonder what hidden reason another person may have for doing something nice for me.                          | T | F |
| 12. It makes me impatient to have people ask my advice or otherwise interrupt me when I am working on something important. | T | F |
| 13. I feel that I have often been punished without cause.                                                                  | T | F |
| 14. I am against giving money to beggars.                                                                                  | T | F |
| 15. Some of my family have habits that bother and annoy me very much.                                                      | T | F |
| 16. My relatives are nearly all in sympathy with me.                                                                       | T | F |
| 17. My way of doing things is apt to be misunderstood by others.                                                           | T | F |
| 18. I don't blame anyone for trying to grab everything he can get in this world.                                           | T | F |
| 19. No one cares much what happens to you.                                                                                 | T | F |

- |                                                                                                                                        |   |   |
|----------------------------------------------------------------------------------------------------------------------------------------|---|---|
| 20. I can be friendly with people who do things which I consider wrong.                                                                | T | F |
| 21. It is safer to trust nobody.                                                                                                       | T | F |
| 22. I do not blame a person for taking advantage of someone who lays himself open to it.                                               | T | F |
| 23. I have often felt that strangers were looking at me critically.                                                                    | T | F |
| 24. Most people make friends because friends are likely to be useful to them.                                                          | T | F |
| 25. I am sure I am being talked about.                                                                                                 | T | F |
| 26. I am likely not to speak to people until they speak to me.                                                                         | T | F |
| 27. Most people inwardly dislike putting themselves out to help other people.                                                          | T | F |
| 28. I tend to be on guard with people who are somewhat more friendly than I had expected.                                              | T | F |
| 29. I have sometimes stayed away from another person because I feared saying or doing something that I might regret afterwards.        | T | F |
| 30. People often disappoint me.                                                                                                        | T | F |
| 31. I like to keep people guessing what I'm going to do next.                                                                          | T | F |
| 32. I frequently ask people for advice.                                                                                                | T | F |
| 33. I am not easily angered.                                                                                                           | T | F |
| 34. I have often met people who were supposed to be experts who were no better than I.                                                 | T | F |
| 35. I would certainly enjoy beating a crook at his own game.                                                                           | T | F |
| 36. It makes me think of failure when I hear of the success of someone I know well.                                                    | T | F |
| 37. I have at times had to be rough with people who were rude or annoying.                                                             | T | F |
| 38. People generally demand more respect more respect for their own rights than they are willing to allow for others.                  | T | F |
| 39. There are certain people whom I dislike so much that I am inwardly pleased when they are catching it for something they have done. | T | F |
| 40. I am often inclined to go out of my way to win a point with someone who has opposed me.                                            | T | F |
| 41. I am quite often not in on the gossip and talk of the group I belong to.                                                           | T | F |
| 42. The man who had the most to do with me when I was a child (such as my father, step-father, etc. . .) was very strict with me.      | T | F |

43. I have often found people jealous of my good ideas just because they had not thought of them first. T F
44. When a man is with a woman he is usually thinking about things related to sex. T F
45. I do not try to cover up my poor opinion or pity so that he won't know how I feel. T F
46. I have frequently worked under people who seem to have things arranged so that they get credit for good work but are able to pass off mistakes onto those under them. T F
47. I strongly defend my own opinions as a rule. T F
48. People can pretty easily change me even though I thought that my mind was already made up on a subject. T F
49. Sometimes I am sure that other people can tell what I am thinking. T F
50. A large number of people are guilty of bad sexual conduct. T F

Appendix F  
Informed Consent Form

**Title of Experiment:** Differential Effects of Hostility on Frontal Lobe Performance: A dual task approach with Fluency and Cardiovascular Regulation

**Principle Investigator:** John B. Williamson

1. Purpose of this research: You are invited to participate in a study about cerebral laterality. This study will involve measurements of fluency, blood pressure, and heart rate.
2. Procedures: To accomplish the goals of this study, you will be asked to do written tests, and submit to blood pressure and heart rate measurement, which will take approximately fifteen minutes total. There are no risks or potential harm associated with participation in this study.
3. Benefits of this project: Your participation in this research will help clinical psychologists better understand physiological correlates of emotion. 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 if you wish for a synopsis.
4. Anonymity and Confidentiality: The results of this study will be confidential. At no time will the researchers release your results to anyone other than the individuals working with the project without your prior 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 enrolled in. For alternative methods of receiving extra credit talk to your professor. If, as a result of this procedure, you should seek counseling or medical treatment, treatment will be made available at the Psychological Services Center and the University Counseling Center.
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 forms 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 Subject Committee of the department of psychology and the Institutional Review Board of Virginia Polytechnic and State University.
10. Participants responsibilities:  
I know of no reason I cannot participate in this study.

*Signature*

11. Subject permission:

I have read and understand the informed consent and conditions of this project. I have had 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 further questions about this research or its conduct, I will contact:

\_\_\_\_\_  
John Williamson  
Investigator

231-6914  
Phone

<hr/>	<u>231-6914</u>
David Harrison	Phone
Faculty Advisor	
<hr/>	<u>231-5281</u>
H. T. Hurd	Phone
Chair, IRB, Research Division	

Appendix G  
Raw Data Physiological Variables

```
DATA THESIS;  
  INPUT SUBJ 1-2 LAT 3-4 HOSTLITY 5-6 ORD 7 COND 8 TRIAL 9 SBP 10-12 DBP  
  13-15 HR 16-18;
```

```
  IF HOSTLITY GE 28 THEN GROUP = 'HIGH';  
  ELSE GROUP = 'LO';
```

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010935112119080097  
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030732122123092094  
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041031222120070075  
041031211113070077  
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301108122108054094  
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340615121122075064  
340615122123083068  
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351118122116069068  
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360819121114062083  
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461116212117084077  
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481038112113086093  
481038121111081085  
481038122126088088  
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491129212126081078  
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500634222133078087  
500634211126068083  
500634212130073086  
;

## Appendix H

### Raw Data Perseverative Errors

```
DATA THESIS;  
  INPUT SUBJ 1-2 LAT 3-4 HOSTLITY 5-6 ORD 7 COND 8 TRIAL 9 PERS 10-11;  
  
  IF HOSTLITY GE 28 THEN GROUP = "HIGH";  
  ELSE GROUP = "LO";  
CARDS;  
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01093511300  
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01093512300  
02072922101  
02072922201  
02072922302  
02072921100  
02072921200  
02072921300  
03073211100
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13073011300

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48103812200  
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49112922202  
49112922301  
49112921100  
49112921200  
49112921300  
50063422101  
50063422200  
50063422301  
50063421100  
50063421200  
50063421300

## Appendix I Fluency Data

```
OPTIONS LS= 80 NODATE NOCENTER;  
DATA THESIS;  
  INPUT SUBJ 1-2 LAT 3-4 HOSTLITY 5-6 ORD 7 COND 8 TRIAL 9 FLUENCY 10-11;  
  
  IF HOSTLITY GE 28 THEN GROUP = "HIGH";  
  ELSE GROUP = "LO";  
CARDS;  
01093511114  
01093511214  
01093511316  
01093512107  
01093512215  
01093512316  
02072922114  
02072922214  
02072922315  
02072921109  
02072921213  
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03073211107
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03073211212  
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07073311110  
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49112922318  
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49112921321  
50063422116  
50063422220  
50063422315  
50063421112  
50063421213  
50063421312

## CURRICULUM VITA

*John B. Williamson*

Born: April 24, 1974, Miami, FL

Marital Status: Married

Business Address: Department of Psychology  
Virginia Polytechnic Institute and State University  
Blacksburg, VA 24061-0436

### *Education*

M.S. M.S. in Psychology expected to be completed in 1999  
Virginia Polytechnic Institute and State University  
Specialty: Clinical Neuropsychology

B.A. Bachelor of Arts in Psychology (B.A.)  
The Florida State University  
April, 1996  
Major: Psychology

### *Awards and Honors*

1992-1996 Florida Undergraduate Scholars

Honors within major awarded upon graduation after completion of Honors Thesis

### *Honor Societies*

Phi Beta Kappa

Golden Key National Honor Society

### *Clinical Training*

1998-1999 Graduate Clinician- Clinical Practicum Team  
Psychological Services Center  
Virginia Tech  
Assessment and treatment of a variety of psychological disorders, including depression, anxiety, learning disabilities, attention deficit disorder (ADHD), and relationship problems through individual, couples, and family therapies.  
Supervisor: Russell Jones, Ph.D.  
Approximate number of hours: 300

1999 Graduate Clinician  
Hollins Head Injury Program  
Assessment and treatment of issues related to traumatic brain injury and other neuropsychological disorders.  
Supervisor: Bill James, LPC  
Approximate number of hours: 100

1999 Graduate Clinician  
Virginia Neuropsychology Associates, INC  
Dementia Assessment and Neuropsychological research  
Supervisor: Dave Crews, Ph.D.  
Approximate number of hours: 40

- 1998 Graduate Clinician, Paid Position  
Post Traumatic Stress Clinic  
Intellectual and achievement assessment.  
Supervisor: David Ribbe, Ph.D.  
Approximate number of hours: 40
- 1997-Present Graduate Clinician - Neuropsychological Practicum Team  
Psychological Services Center, Virginia Tech  
Graduate level practicum team specializing in the assessment and treatment of neuropsychological disorders related to TBI, stroke, dementia, learning disability, and headaches.  
Supervisor: David W. Harrison, Ph.D., ABVN  
Approximate number of hours at present: 675

***Other Related Clinical Experience***

- 1996-1997 Behavior Specialist  
Apalachee Center for Human Services  
Pace Secondary School-  
Population: Severely Emotionally Disturbed Middle/High School Students  
Assessment and treatment of behavior problems within the school setting utilizing functional assessment techniques.

***Teaching Experience***

- 1997-1999 Teaching Assistant  
Virginia Polytechnic Institute and State University, Blacksburg, VA.  
Taught 2 introduction to psychology laboratories per semester. Duties involved teaching a laboratory section associated with an undergraduate introductory psychology class, writing and administering exams, grading essays and providing individual assistance to students.

***Professional Activities***

***Membership***

- American Psychological Association (APA) - student affiliate  
Division 40 (Neuropsychology) - student affiliate  
Southeastern Psychological Association (SEPA) - student affiliate  
Virginia Psychological Association (VPA) - student affiliate

***Current Research and Scholarly Interests***

Cortical, subcortical, and autonomic correlates of emotion and cardiovascular reactivity, especially in relation to hostility; methods in neuropsychology (fMRI, QEEG, etc. . .), psychophysiology, and psychopharmacology.

***Publications***

- Williamson, J. B. (in press). Can You Block Out Distracting Information? In Helena K. Chandler & Jack W. Finney (Eds.) *Exploring Psychology: Reader and Workbook*. New York: McGraw-Hill, Inc.
- Williamson, J. B., Everhart, E., Emerson, C. (1999). Receptive prosodic ability in depressed and non-depressed school aged boys. *The Clinical Neuropsychologist*, *13*, 2, 211-244.
- Williamson, J. B., Everhart, E., Emerson, C. (1999). Hand fatigue asymmetry in the motor

performances of depressed boys. *The Clinical Neuropsychologist*, 13, 2, 211-244.

Crews, W. D. Jr., Jefferson, A. L., Broshek, D. K., Rhodes, R. D., Williamson, J., B., Brazil, A., Barth, J. T., and Robbins, M. K. (1999). Neuropsychological Dysfunction in Patients with End-Stage Pulmonary Disease: Lung Transplant Evaluation. *Archives of Clinical Neuropsychology*, 14, 646.

### ***Manuscripts in Submission***

Williamson, J., Shenal, B. V., Rhodes, R. D., & Harrison, D.W. (1999). Case Study: Topographical Brain Mapping in an adolescent diagnosed expressive aprosodic. Manuscript submitted for publication.

Everhart, D., Demaree, H., Harrison, D., Williamson, J. Delusions of Space: A Case Study Utilizing Topographical Brain Mapping and QEEG. Manuscript submitted for publication.

Foster, P., Webster, D., Williamson, J. The Psychophysiological Differentiation of Actual, Imagined, and Recollected Mirth. Manuscript submitted for publication.

### ***Manuscripts in Preparation***

Crews, Jr., W. D., Jefferson, A. L., Broshek, D. K., Rhodes, R. D., Williamson, J. B., Brazil, A., Barth, J. T., & Robbins, M. K., Neuropsychological dysfunction in patents with end-stage pulmonary disease: Lung transplant evaluation. Manuscript in progress.

Shenal, B. S., Williamson, J. B. Affective Auditory Verbal Learning-Revised. Manuscript in progress.

Everhart, E.V., Shenal, B.S., Williamson, J. B. Neuropsychological Effects of Anxiety Without Depression on Functional Motor Asymmetry. Manuscript in progress.

Demaree, H., Higgins, D., Williamson, J. B., Harrison, D. W. Differential Effects of Hostility Level on Hand Fatigue Asymmetry. Manuscript in progress.

### ***Presentations***

Williamson, J. B., Everhart, E.V., Harrison, D.W. Cerebral asymmetry in the dual-task performances of high-hostile males. Submitted to American Psychological Association, Washington, D.C., 2000.

Williamson, J. B., Foster, P. S., Harrison, D. W., Differential Effects of Hostility Level on Nonverbal and Verbal Fluency. Submitted to Southeastern Psychological Association, New Orleans, 2000.

Foster, P.S., Williamson, J.B., Webster, D. G. Emotional Memories: The relationship between age of memory and the corresponding psychophysiological responses. Submitted to Southeastern Psychological Association, New Orleans, 2000.

Crews, Jr., W. D., Jefferson, A. L., Broshek, D. K., Rhodes, R. D., Williamson, J., Brazil, A., Barth, J. T., & Robbins, M. K., Neuropsychological dysfunction in patents with end-stage pulmonary disease: Lung transplant evaluation. Paper to be presented at the Nineteenth Annual Academy of Neuropsychology Meeting, November, 1999.

Higgins, D., Demaree, H., Williamson, J. Differential Effects of Hostility Level on Hand Fatigue Asymmetry. . Paper to be presented at INS, 1999.

Williamson, J., Everhart, E., Emerson, C. Receptive prosodic ability in depressed and non-depressed school aged boys. American Psychological Association, Boston, MA, August 1999.

Williamson, J., Everhart, E., Emerson, C. Hand fatigue asymmetry in the motor

performances of depressed boys. American Psychological Association, Boston, MA, August 1999.

Williamson, J., Higgins, D., Demaree, H. Differential Effects of Hostility Level on Hand Fatigue Asymmetry. Southeastern Psychological Association, Savannah, GA, March 1999.

Foster, P. S., Webster, D., Williamson, J., The Psychophysiological Differentiation of Actual, Imagined, and Recollected Mirth. Southeastern Psychological Association, Savannah, GA, March 1999.

Williamson, J., Emerson, Everhart. (April 1998). An investigation of receptive prosodic ability in depressed and non-depressed school aged boys. Annual meeting of the Virginia Psychological Association (VPA), Wintergreen, VA. April, 1998.

Steele, S., Williamson, J, Emerson, C., Everhart, E. (April, 1998) An investigation of receptive prosodic ability in depressed and non-depressed school aged boys. Poster presented at Virginia Tech.