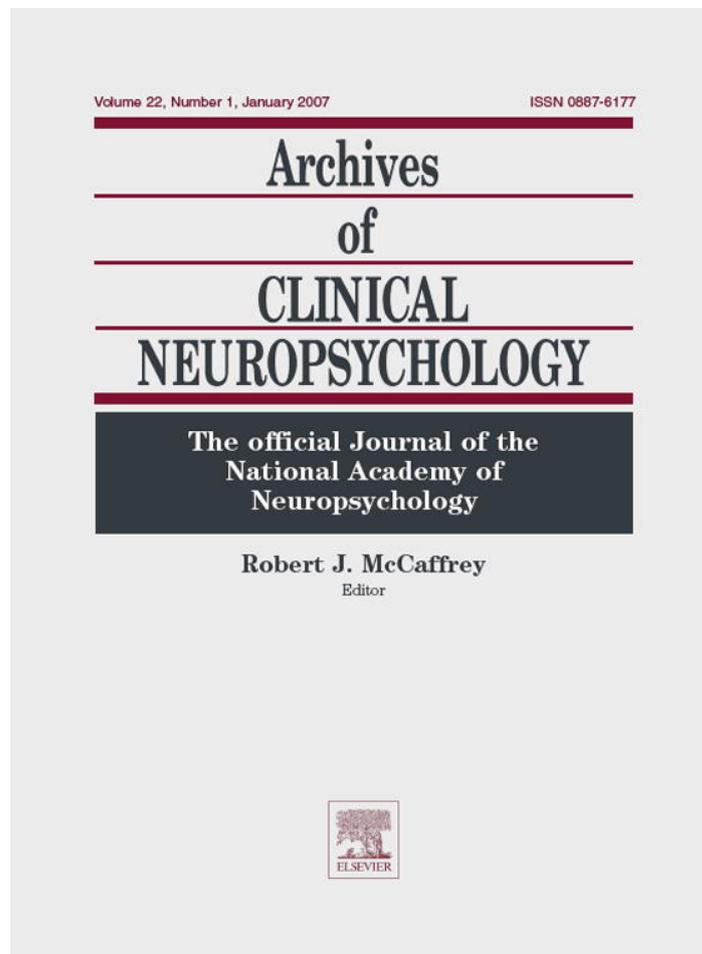


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Affective verbal learning in hostility: An increased primacy effect and bias for negative emotional material

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Abstract

The current experiment examined the effects of hostility and a pain stressor on affective verbal learning. Participants were classified as high or low hostile and randomly assigned to a cold pressor or a non-cold pressor group. The subsequent effects on acquisition of the Auditory Affective Verbal Learning Test [AAVLT; Snyder, K. A., & Harrison, D. W. (1997). The Affective Verbal Learning Test. *Archives of Clinical Neuropsychology*, 12(5), 477–482] were measured.

As expected, high hostiles learned negative emotional words significantly better than they learned positive words. Additionally, high hostiles were impaired in their acquisition of verbal material relative to low hostile participants. A significant primacy effect for negative emotional words and an overall better recall of negative information was also found. These results support the idea that high hostiles differ from low hostiles in a number of modalities and demonstrate the persistence of negative emotional material. Future work should address the implications these results have on high hostiles in daily interactions.

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The influences of negative emotion on health, behavior, and cognition have been investigated in a number of experiments (e.g., Frasure-Smith, Lesperance, & Talajic, 1993; Shenal & Harrison, 2003; Shimojima et al., 2003; Sirois & Burg, 2003). In the context of this research, hostility has arisen as one of the most examined emotional constructs due to its correlation with the development of cardiovascular disease (CVD). Behaviorally, hostility is described as an attitude that motivates aggressive behavior towards objects and people (Spielberger et al., 1985). It is a negative emotional trait that encompasses cynicism, suspiciousness towards others, and proneness to anger (Prkachin & Silverman, 2002). Physiologically, high hostility may result in over activation of the sympathetic nervous system (Keefe, Castell, & Blumenthal, 1986) and hyper-reactivity to environmental (Frederickson et al., 2000) and laboratory stress (Demaree & Harrison, 1997a).

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While the traditional approach to hostility is examination of physiological reactivity to stress, an emerging line of research has focused on the neuropsychological underpinnings of hostility. High hostile individuals are noted to display decreased performance on design fluency (Williamson & Harrison, 2003), dichotic listening (Demaree & Harrison, 1997a), and facial affect perception (Herridge, Harrison, Mollet, & Shenal, 2004). Further, in a facial affect perception task, Harrison and Gorelczenko (1990) found that high hostile participants identified significantly more neutral faces as angry, suggesting a negative emotional bias in the identification of facial affect.

Hostility's influence on a number of laboratory tasks underscores the need to further investigate how the trait may influence real-world interactions and clinical treatment of individuals with hostility disorders. Affective learning and communication are an important part of daily interactions with the self and others. The documented negative bias in the visual modality suggests that high hostile individuals may perseverate on and seek out negative information. This may lead to increased learning, comprehension, and expression of negative emotion. Moreover, the noted increased reactivity to stress may divert cerebral resources away from cognition in order to regulate blood pressure (BP) and heart rate (HR). Negative reactions to stress may further diminish the ability to perceive positive affect. These aspects of hostility may be particularly important for clinicians. In a clinical setting, patients with hostility disorders may inaccurately perceive the clinician as negative, thus exacerbating the hostility disorder and reducing the likelihood of an effective therapeutic intervention.

The current experiment sought to explore the relationship between hostility, stress, and emotional learning through the use of the Auditory Affective Verbal Learning Test (AAVLT; Snyder & Harrison, 1997). The AAVLT measures the ability to learn neutral, positive, and negative word lists. Investigations of the AAVLT have revealed that list learning differs as a function of affective valence. A number of experiments (e.g., Demaree, Shenal, Everhart, & Robinson, 2004; Everhart & Demaree, 2003; Everhart, Demaree, & Wuensch, 2003; Snyder & Harrison, 1997) have indicated that the negative list produces an increased primacy effect, while the positive list produces an increased recency effect. Neurophysiological differences during learning of the negative list of the AAVLT are also evident in the literature. Everhart and Demaree (2003) found that low alpha power within the parietal regions is significantly reduced during negative list learning.

Recently, the effects of hostility on the AAVLT have also been investigated. Demaree et al. (2004) found no significant effects of hostility on learning the AAVLT; however, in a related study Everhart et al. (2003), found significant differences in brain activation in high and low hostiles during learning of the negative list. Specifically, low hostiles evidenced reduced low alpha power during negative list learning relative to high hostiles. The authors speculate that differences in brain activation during negative list learning might reflect trait differences in response to negative affect. A goal of the current experiment was to re-examine hostility's role in negative learning. For verbal learning data, it was predicted that high hostile participants would have difficulties learning the neutral and positive lists relative to low hostile participants; however, on the negative list high hostiles were expected to outperform low hostiles due to evidence of a negative emotional bias in hostility. In accordance with previous research, a primacy effect for the negative list and a recency effect for the positive were predicted.

A second goal of the experiment was to examine the relationship that pain stress may play in hostility and affective verbal learning. Pain stress was induced using a cold pressor.¹ In both groups, it was thought that the cold pressor would facilitate negative emotional learning by inducing a stressful pain state in participants. This effect was expected to be the largest in the high hostile group.

The final goal of the experiment was to examine self-awareness in hostility. Previous research has linked hostility with a lack of self-awareness (Demaree & Harrison, 1997b). It is thought that diminished self-awareness contributes to habitual hostile attributions of others. On the behavioral level, understanding how hostility is manifested during interpersonal interactions is of utmost importance. In order to assess this aspect of hostility, participants were asked to predict how many words they thought they would recall from the first trial of each list. It was hypothesized that hostiles would either under- or over-predict their performance.

In order to increase the homogeneity of variance, only men were recruited for participation. Although controversial, evidence suggests that sex differences in emotional processing (Crews & Harrison, 1994; Harrison, Gorelczenko, & Cook, 1990) may exist.

¹ The cold pressor was also included to examine group differences in physiological reactivity to stress. Hypotheses, recording procedures, and the data regarding the physiological measurements are reported elsewhere.

1. Method

1.1. Participants

Participants were recruited from an undergraduate psychology pool. Criteria for inclusion included: ages ranging from 18 to 25 years, right-handedness, and no prior or current major neurological or medical issues. A brief medical history questionnaire was given to assess prior neurological damage, illnesses, and alcohol and drug use. Participants were screened for handedness using the Coren, Porac, and Duncan Laterality Test (Coren, Porac, & Duncan, 1979). The Cook–Medley Hostility Scale (Cook & Medley, 1954) was administered to assess hostility level. Eligible participants were invited to the lab for participation.

A total of 58 healthy men completed the experiment. Eight participants were excluded for not meeting the scoring criteria on the Cook–Medley Hostility Scale on the testing day. One participant was excluded from the high hostile group for reporting a head injury. One participant scored in the low hostile range during pre-screening and in the high hostile range on the testing day. This participant was also excluded. This resulted in 12 low hostile and 12 high hostile participants in the cold pressor group and 12 low hostile and 12 high hostile participants in the no cold pressor group. Average age was 19 years. Thirty-seven participants reported being Caucasian, 3 reported Asian descent, 3 were African-American, 1 was Native American, and 1 reported South American descent. The remaining 3 participants did not report their background.

1.2. Self-report questionnaires

1.2.1. Medical History Questionnaire

The medical history questionnaire is a 33 item self-report questionnaire assessing current and prior issues. Participants who answered “yes” to any of the questions were asked to explain their answers and were contacted by the experimenter to assess whether or not they were eligible for continued participation. Common exclusionary criteria included prior head injuries, current or past mental health problems, and substance abuse.

1.2.2. Coren, Porac, and Duncan Laterality Test

This self-report questionnaire measures left or right hemibody preference. The questionnaire consists of 13 items assessing preference for hand, foot, eye, and ear. Items are scored +1 for right, –1 for left, and 0 for both. Scores range from +13 to –13, indicating extreme right- or left-handedness. A score of +7 was required for participation.

1.2.3. Cook–Medley Hostility Scale

The Cook–Medley Hostility Scale is a self-report questionnaire purported to tap cynicism, anger, suspiciousness, and resentment in the hostility construct (Smith & Frohm, 1985). The scale consists of 50 true false items. Individuals who scored 28 or above on the test were placed in the high hostile group, while those who scored 20 or below were classified as low hostile. This grouping criterion has been used previously in our lab (Demaree & Harrison, 1997a; Harrison & Gorelczenko, 1990; Williamson & Harrison, 2003) and found to be successful. The general nature of the questions make it a trait, rather than state indicator of hostility (Demaree & Harrison, 1997a).

1.2.4. Affective Auditory Verbal Learning Test

The AAVLT (Snyder & Harrison, 1997) is composed of three word lists differing in affective valence: positive, negative, and neutral. The lists were derived from an index of word norms established by Toggia and Battig (1978). The negative word list is comprised of words that were rated as the lowest in pleasantness, while the words that received the highest pleasantness ratings make up the positive word list. The words were also chosen based on how often they occur in the English language. The neutral list is taken from the original Rey Auditory Verbal Learning Test (RAVLT; Rey, 1964). Each list is comprised of 15 words. The negative list included words, such as “morgue,” “murder,” and “kill,” while the positive list included words, such as “sunset,” “garden,” and “beach.” The neutral list consists of words, such as “drum,” “curtain,” and “bell.” Instructions for the AAVLT and the three word lists were read by a woman speaker and recorded on compact disc. The word lists were recorded so that participants heard approximately 1 word/s.

1.2.5. Cold pressor

Ice water for the cold pressor was maintained at 0–3 °C using a small ice cooler. Water temperature was measured using a standard mercury thermometer. The cooler was located next to the participant's left arm. In the no cold pressor condition, the cooler was empty.

1.2.6. Procedure

An online pre-screening consisting of an Informed Consent Form, the Medical History Questionnaire, the Coren, Porac, and Duncan Laterality Test, and the Cook–Medley Hostility Scale was used to identify eligible participants. Eligible participants were randomly assigned to either the cold pressor or no cold pressor conditions.

Upon arrival in the lab, participants were seated in a sound attenuated lab and completed the Informed Consent Form. A woman experimenter then fitted the participant with the BP cuff and left the room. Participants heard all instructions and the verbal learning test through a speaker located at midline directly behind them. To begin the experiment the participants in the cold pressor group were told the following:

You will be hearing lists of words and asked to learn the lists. Before the lists are presented, your BP will be taken, and you will be asked to put your hand in some water. More specific instructions will be given at the beginning of each task. Before you hear the first list, I want you to try and predict how many words you will be able to remember from a list of 15 words on the first trial.

Instructions for the no cold pressor group were identical except that “some water” was replaced with “the cooler.” The experimenter first recorded the prediction of recall for the first trial and baseline BP and HR were recorded. Participants in the cold pressor condition then heard the following instructions:

When instructed, please place your left hand in the water to a point about one inch above your wrist. Please keep your hand in the water until instructed to remove it. This may be uncomfortable or painful, but please try and keep your hand in the water for the entire time. Do you have any questions? Begin.

In the no cold pressor condition, “water” was again replaced with “cooler” and the third sentence was omitted. Participants kept their hand in the ice water or cooler for 45 s. Upon completion, BP and HR were recorded. Participants then heard the following:

You are going to hear a list of words. Listen carefully to the words. When the list is finished, I want you to tell me as many words as you can remember. You may say the words in any order. Just try to remember as many as you can.

The experimenter recorded all responses on a data sheet. When the participant ceased to recall words the trial ended. Trial 1 was followed by trials 2–5. The following instructions were given:

You are going to hear the same list of words. Again, listen carefully to the words. When the list is finished I want you to tell me as many words as you can remember, including the words you told me before. You may say the words in any order. Just try to remember as many as you can.

Responses were recorded in the same manner as in trial 1. The entire procedure was repeated with the other two lists. The neutral list was always given first. Order for the negative and positive lists was counterbalanced among each group. Upon completion, participants re-took the Cook–Medley Hostility Scale, were debriefed, and then allowed to leave the lab. The experiment took about 50 min to complete.

2. Results

2.1. Self-report questionnaire analysis

Separate *t*-tests were used to compare the group scores from the Coren, Porac, and Duncan Laterality Questionnaire and the Cook–Medley Hostility Scale. On the Coren, Porac, and Duncan Laterality Questionnaire the high hostile group ($M = 10.67$, $S.D. = 2.18$) did not differ from the low hostile group ($M = 11.13$, $S.D. = 2.11$) ($t(46) = -0.740$, $p > 0.05$). On the Cook–Medley Hostility Scale, the high hostile group ($M = 34.00$, $S.D. = 4.19$) scored significantly higher than the low hostile group ($M = 14.58$, $S.D. = 3.52$) ($t(46) = 17.37$, $p < 0.05$).

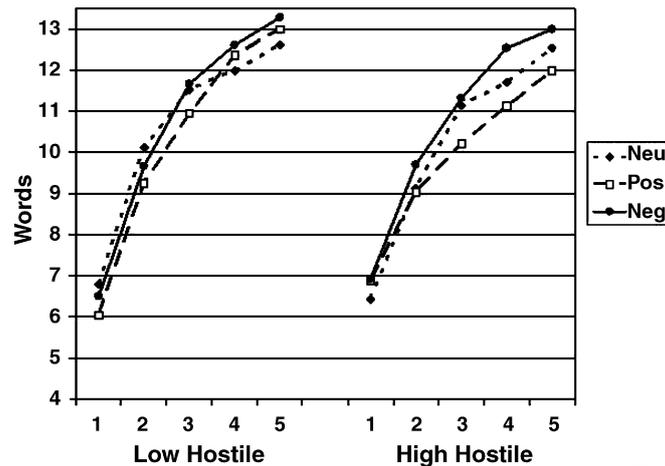


Fig. 1. Mean number of words recalled at each trial for each list by high and low hostile participants.

2.2. AAVLT analysis

The verbal learning data was analyzed using two different designs. To investigate the effects of hostility and the cold pressor stressor on affective learning across the lists, data was analyzed using a four factor mixed design ANOVA with the fixed effects of group (high and low hostile) and condition (cold pressor and no cold pressor) and repeated measures of affective valence (neutral, positive, and negative), and trial (verbal learning trials 1–5). To investigate primacy and recency effects a five factor mixed design ANOVA was used. The second ANOVA included the following factors: fixed effects of group (high and low hostile) and condition (cold pressor and no cold pressor) and repeated measures of affective valence (neutral, positive, and negative), trial (verbal learning trials 1–5), and word location (beginning, middle, and end). All post hoc pairwise comparisons among the means were made using Tukey's HSD test (Winer, 1971) with the a priori $p \leq 0.05$.

For total recall data, a significant main effect was found for list ($F(2, 88) = 5.90, p < 0.05$). Negative words ($M = 10.73$, $S.D. = 2.86$) were recalled significantly more than positive words ($M = 10.09$, $S.D. = 2.73$). Recall of neutral words ($M = 10.4$, $S.D. = 2.81$) did not differ significantly from negative or positive words.

Trial also produced a significant main effect ($F(4, 176) = 395.46, p < 0.05$). Each trial was significantly different from the others (trial 1: $M = 6.59$, $S.D. = 1.45$; trial 2: $M = 9.49$, $S.D. = 1.71$; trial 3: $M = 11.14$, $S.D. = 1.90$; trial 4: $M = 12.06$, $S.D. = 1.94$; trial 5: $M = 12.74$, $S.D. = 1.73$).

A three-way interaction was present for group by list by trial ($F(8, 352) = 2.47, p < 0.05$) (Fig. 1). Within the high hostile group, post hoc comparisons indicated that neutral words were recalled significantly more than positive words on trials 1 and 3–5. Negative words were recalled significantly more than positive words on trials 2–5. Neutral words were recalled significantly less than negative words, except on trial 3.

For the low hostiles, negative words were recalled significantly more than positive words on the first through third trials; however, no significant differences were found for positive words and negative words in the fourth and fifth trials. Neutral learning was significantly greater than positive learning in trials 1–3. However, positive learning was significantly higher than neutral learning in trials 4 and 5. A similar pattern was present for neutral and negative learning. In trials 1 and 3, low hostiles did not significantly differ on neutral and negative lists. On trial 2, neutral words were recalled significantly more than negative words, this pattern was reversed on trials 4 and 5 with negative words being recalled significantly more than neutral words.

Between groups comparisons show that by trial 5, low hostiles outperformed high hostiles on all three lists; however, the only significant difference was on the positive list. Low hostiles were significantly better at learning the positive list on trials 3–5. On the neutral list, groups differed significantly on trials 1–3, with low hostiles outperforming high hostiles. The only significant difference on the negative list was on trial 1, where high hostiles recalled more negative words than low hostiles. The results indicate that low hostiles are able to learn better than high hostiles, except when negative information is involved.

In order to more clearly establish the effects of hostility on learning neutral, positive, or negative lists, separate more refined ANOVAs were computed. A condition (cold pressor and no cold pressor) by list (neutral, positive, and

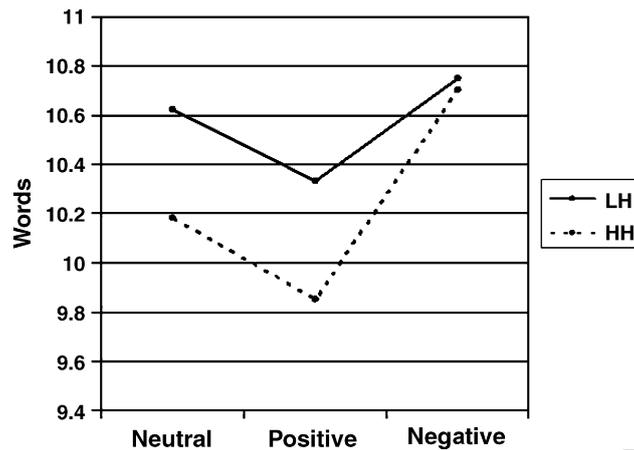


Fig. 2. Analysis of the groups separately revealed that the high hostile group remembered significantly more negative words than positive words, however, this effect was not present in the low hostile group.

negative) by trial (verbal learning trials 1–5) ANOVA was computed for each group. The data provide further support for a negative emotional bias in the high hostile group. The analyses revealed a main effect for list in the high hostile group ($F(2, 44) = 5.55, p < 0.05$), but not in the low hostile group (Fig. 2). Post hoc comparisons for the high hostiles indicated that negative words were recalled significantly more than positive words; however, neutral word recall was not significantly different from positive or negative word recall.

For primacy and recency data, a main effect was found for location ($F(2, 88) = 77.44, p < 0.05$). Post hoc comparisons indicated that recall at the beginning of the list ($M = 3.95, S.D. = 1.08$) was significantly higher than recall at the middle of the list ($M = 2.98, S.D. = 1.47$) and recall at the end of the list ($M = 3.48, S.D. = 1.18$), indicating a reliable primacy effect. Recall at the middle of the list was also significantly lower than recall at the end of the list.

List by location ($F(4, 176) = 13.79, p < 0.05$) was significant. Post hoc comparisons revealed that negative words at the beginning of the list were recalled significantly more than neutral or positive words at the beginning of the list (see Table 1). Recall at the middle of the list was not significantly different by list. For words at the end of the list, neutral and positive recall did not differ significantly; however, neutral and positive words were recalled significantly more than negative words. Comparisons of the different locations revealed that recall at the beginning and end of the list was significantly higher than recall at the middle for all three lists. Recall at the beginning of the negative and neutral lists was significantly different from recall at the end, indicating a greater primacy than recency effect for those lists. For the positive list, words recalled at the end and beginning did not differ significantly.

Location by trial ($F(8, 352) = 9.28, p < 0.05$) was significant. Post hoc analysis revealed that each trial was significantly different within each location (see Table 2). Recall at the beginning location was significantly higher than the middle or end location across all five trials indicating a robust primacy effect. Words at the end of the list were recalled significantly more than words at the middle of the list indicating that a recency effect was also present.

List by location by trial ($F(16, 704) = 4.01, p < 0.05$) (Fig. 3) was significant. Post hoc comparisons revealed that words at the beginning of the negative list were recalled significantly more than words at the beginning the neutral or positive lists across all five trials. A less clear pattern of recall was found for words at the middle and end of the list. For the middle location there was a general trend for better recall of negative words, which is supportive of the main effect of list. Post hoc comparisons of words at the end of the list indicated a mild primacy effect for positive words (see Fig. 3).

Table 1
Means and standard deviations (S.D.) for each word list by location

List	Beginning		Middle		End	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Positive	2.91	1.19	2.91	1.36	3.58	1.09
Negative	4.36	0.86	3.03	1.57	3.33	1.26
Neutral	3.90	1.05	2.98	1.45	3.52	1.19

Table 2
Means and standard deviations (S.D.) of location by trial

Trial	Beginning		Middle		End	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
First	2.90	1.12	1.40	0.93	2.29	0.95
Second	3.77	1.02	2.44	1.93	3.27	1.00
Third	4.22	0.86	3.28	1.21	3.64	1.09
Fourth	4.38	0.80	3.70	1.15	3.99	0.87
Fifth	4.49	0.74	4.06	1.03	4.19	0.96

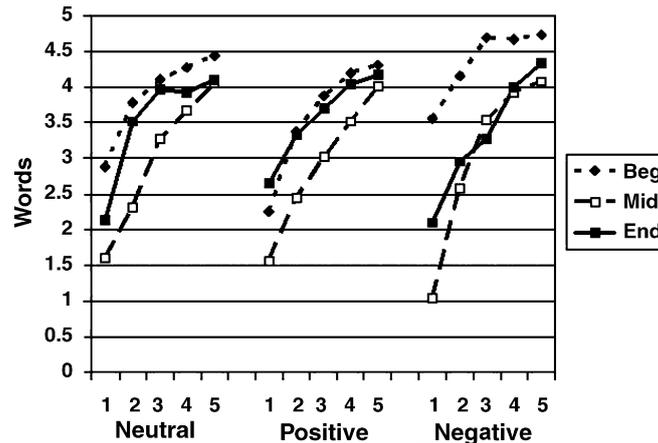


Fig. 3. Mean number of words across the five trials at each location for each list.

No other main effects or interactions effects were significant. Since the cold pressor did not produce significant effects on learning, physiological data are reported elsewhere.

2.3. Prediction of recall analysis

For prediction of recall, a group (high or low hostile) by condition (cold pressor or no cold pressor) by prediction (prediction for trial 1 on lists 1–3) ANOVA was performed using the number predicted as the dependent variable. A main effect of prediction was found ($F(2, 88) = 3.84, p < 0.05$). Participant predictions for the first trial of list 1 were significantly higher ($M = 6.90, S.D. = 1.66$) than predictions for the first trial of list 2 ($M = 6.33, S.D. = 1.34$). Prediction for the first trial of list 3 ($M = 6.54, S.D. = 1.25$) did not differ significantly from the first or second trials.

All results were computed using Statistical Analysis Software (SAS).

3. Discussion

The current experiment was designed to evaluate the effects of hostility level and a negative emotional/pain state on affective verbal learning. Participants were assigned to one of four groups (low hostile, cold pressor; low hostile, no cold pressor; high hostile, cold pressor; high hostile, no cold pressor) and completed the AAVLT.

Results revealed that negative words were recalled significantly more than positive words irrespective of emotional/pain state or hostility level. This finding is congruent with previous research (see Abele, 1985; Dahl, 2001) and suggests that negative emotional words are obtrusive and of greater importance to an individual (Dahl, 2001).

Results were congruent to prior research indicating a primacy effect for the negative list of the AAVLT (Demaree et al., 2004; Everhart & Demaree, 2003; Everhart et al., 2003; Snyder & Harrison, 1997). The primacy effect for the negative list was heightened across all five trials. The proactive interference across all trials suggests persistence of the memory trace for negative information. For high hostiles, the persistence of negative information was especially high. Significant relationships were found between hostility level and the increased recall of negative information. Minimal

support for the predicted increased primacy effect on the positive list was found. A significant recency effect for the positive list was found in post hoc comparisons of the list by location by trial interaction. However, this effect was small in comparison with the primacy effect found for the negative list.

Perhaps the most important finding of the experiment, was that the low hostile group evidenced a significantly faster rate of learning relative to the high hostile group. Low hostiles recalled significantly more words than did high hostiles on trials 1–3 of the neutral list. However, on trials 4–5 groups performed at near equal levels. On the positive list, low hostiles recalled significantly more words than the high hostiles on trials 1–2 and 4–5. On the negative list high hostiles learned more words on the first trial, but no significant group effects were noted on trials 2–5. Taken together, the results indicate that high hostiles are most impaired in learning positive information, but can learn negative information relatively easy. In the more refined ANOVAs on the low and high hostile participants separately, only the high hostile men showed a main effect of list, with the negative list being recalled more frequently. This effect was not evident in the low hostile men. The differential appearance of this effect may highlight a negative emotional bias in the high hostile group.

The group differences in acquisition and negative bias are in contrast to a similar investigation by Demaree et al. (2004). Demaree et al. (2004) did not find any effects of hostility on the AAVLT. However, the median score of the high hostile group in Demaree et al. (2004) was 23.3 as opposed to 34.0 for the current group. This may suggest that level of hostility plays a role in verbal learning performance. In considering clinical practice and research, this effect may be of particular importance. Individuals with profound hostility disorders may perform poorly on neuropsychological tests that involve verbal learning.

A second goal of this experiment was to examine how the cold pressor would influence affective verbal learning. It was hypothesized that high hostiles in the cold pressor condition would outperform low hostiles in the cold pressor group on the negative list. It was also predicted that the cold pressor would decrease positive list learning and increase negative list learning regardless of hostility. No support was found for these hypotheses. This conflicts with previous research indicating that pain impairs memory regardless of the valence of the stimuli (Kuhajda, Thorn, & Klinger, 1998; Kuhajda, Thorn, Klinger, & Rubin, 2002) and that acute pain facilitates the acquisition of negative emotional material and disrupts the encoding of positive material (Seltzer & Yarczower, 1991). One explanation may be that too much time passed between cold pressor administration and the administration of the list. Blood pressure was recorded twice after the hand was removed from the water and then list learning began. Additionally, participants may have habituated to the cold pressor after the first trial with it. Thus, during the positive and negative lists the effects of the cold pressor may have been diminished. In future work, a manipulation check assessing the pain and stress produced by the cold pressor may be helpful.

The prediction of recall analyses did not support the hypotheses that high hostiles would show a lower level of self-awareness. However, the prediction of recall analysis did show that all participants lowered their predictions following the first list. A potential confound could have been that participants were recruited from undergraduate psychology classes. They would have been previously exposed to the 7 ± 2 rule for verbal list recall. Additionally, participants were aware that the experimenter was watching them. This may have been a social demand that confounded the data.

Overall, the current experiment suggests that negative information is more persistent, may enhance memory, and that level of hostility influences affective verbal learning. The results may have important implications in the way high hostiles interact and respond in social situations. Negative emotional bias concurrent with impairments in verbal memory may lead to increased hostility and aggression. Hostiles may falsely recall situations or people as negative and may need repeated exposure to information before they learn it. Moreover, the robust primacy effect of the negative list suggests that negative material may be persistent over time.

A future extension of this work may be to examine how affective verbal learning performance influences clinical treatment. Specifically, research may want to address whether or not a negative affective bias hinders treatment for a hostility disorder. It may also be interesting to examine how accurately high hostile individuals report what they hear from their clinicians. Additionally, similar experiments of this nature may be conducted in populations of individuals with other emotional disorders, such as anxiety and depression.

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