ETHNIC DIFFERENCES IN RESPONSES TO MULTIPLE EXPERIMENTAL PAIN STIMULI

By

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A growing body of literature suggests that the experience of clinical pain differs across ethnocultural groups. Additionally, some evidence indicates greater sensitivity to experimentally induced pain among African Americans; however, most studies have included only one pain modality. This study examined ethnic differences in responses to multiple experimental pain stimuli, including heat-pain, cold pressor pain, and ischemic-pain. Subjects included 120 (62 African American, 58 white) healthy young adults. Heat-pain threshold and tolerance and ratings of repetitive suprathreshold heat were obtained. Also, ischemic and cold pressor pain threshold and tolerance were determined, and several psychological instruments were administered. Findings indicated no ethnic group differences on threshold measures, but that African Americans had lower tolerances for heat-pain, cold pressor pain, and ischemic-pain compared to whites. Ratings of both the intensity and the unpleasantness of repetitive suprathreshold heat stimuli were significantly higher among African Americans. No differences in mood appeared, but

African Americans reported greater use of passive pain-coping strategies and higher levels of hypervigilance. Use of pain-coping strategies as a covariate did not account for group differences in pain responses, while use of hypervigilance rendered group differences in heat-pain tolerance and ischemic-pain tolerance nonsignificant. These findings demonstrate that differences in laboratory pain responses between African Americans and whites occur across multiple stimulus modalities; and effect sizes for these differences in pain tolerance were moderate to large. Thus, ethnic differences in experimental pain responses appear to be largest for suprathreshold measures, and these differences were consistent across stimulus modalities and were relatively robust. Additional research to determine the mechanisms underlying these effects is warranted.

CHAPTER 1
INTRODUCTION

Pain is one of today's most expensive public health issues, costing in excess of 125 billion dollars annually (Turk et al., 1999). Each year, more than 35 million new office visits to physicians are caused by pain symptoms (Knapp and Koch, 1984), accounting for 80% of all office visits to physicians annually in the United States (Koch, 1986). Pain's prevalence, severity, and impact on functioning may vary according to an individual's ethnicity (Riley, 2002). To improve pain diagnosis and treatment for individuals from diverse ethnic backgrounds, relationships amongh race, ethnicity and pain must be better understood. In recent years, an expanding body of research has focused on discerning the particular contributions of race and ethnicity to pain responding.

Considerable evidence shows that the experience of clinical pain differs among ethnic groups (Edwards et al., 2001; Green et al., 2003). For instance, African Americans report higher levels of pain in clinical conditions such as glaucoma (Sherwood et al., 1998), AIDS (Breitbart et al., 1996), migraine headache (Stewart et al., 1996), jaw pain (Widmalm et al., 1995), postoperative pain (Faucett et al., 1994; White et al., 1999), myofascial pain (Lawlis et al., 1984; Nelson et al., 1996), angina pectoris (Sheffield et al., 1999), joint pain (Rantanen et al., 1998), nonspecific daily pain (Edwards and Fillingim, 1999), and arthritis (Anderson and Felson, 1987; Creamer et al., 1999), compared to whites. In contrast, others have reported no significant ethnic differences in clinical pain severity (Todd et al., 1994; Jordan, 1999). While research suggests greater severity and prevalence of temporomandibular disorder (TMD) in African Americans (Widmalm et al., 1995), a recent study by Plesh et al. (2002) indicates higher frequency, earlier onset, and greater symptom severity among whites. More recently, several investigators noted ethnic differences in pain-related symptoms among patients with chronic non-cancer pain. Edwards and colleagues (2001) found higher levels of pain and disability among African Americans relative to white patients seen in a multidisciplinary pain center. Other African Americans studied in a chronic pain center reported higher levels of pain unpleasantness, emotional response to pain, and increased pain behaviors relative to whites (Riley et al., 2002; Green et al., 2003). Because ethnic differences in clinical pain responses can be influenced by factors such as disease severity and disparities in pain treatment, it is important to examine ethnic differences in pain perception among healthy individuals (Stewart et al., 1996; Todd, 1996; Cleeland et al., 1997; McCracken et al., 2001). Early laboratory studies, reviewed by Zatzick and Dimsdale, suggested increased experimental pain sensitivity among African Americans as compared to whites (1990). For instance, lower heat-pain thresholds and tolerances were reported decades ago among African American subjects compared to whites by Chapman and Jones (1944). Similarly, cold pressor pain tolerances were lower in a combined group of African Americans and Hispanics in comparison to whites (Walsh et al., 1989).

Two recent studies demonstrated greater sensitivity to heat-pain among African Americans compared to whites, especially for measures of pain unpleasantness (Edwards and Fillingim, 1999; Sheffield et al., 2000). Thus, ethnic differences in responses to both clinical and experimental pain have been reported; however, most previous studies included only one form of experimental pain, and varied considerably in their pain-induction methods (Zatzick & Dimsdale, 1990). Therefore, the pattern of ethnic differences across different stimulus modalities has not previously been evaluated. Moreover, few investigators have examined the contribution of psychological factors to ethnic differences in pain perception, though multiple authors have noted the importance of evaluating the influence of these variables (Zatzick and Dimsdale, 1990; Rollman, 1998; Edwards et al., 2001; Green et al., 2003). This study was designed to further elucidate the nature of ethnic differences in pain perception by investigating responses to multiple experimental pain modalities, and assessing psychosocial variables that may contribute to group differences in pain sensitivity.

CHAPTER 2
METHODS

Participants

The total study sample consisted of 120 healthy young adults (62 African American, 58 white) recruited from a southeastern university. Subjects received course credit for their participation in the study. Participant's demographic information is presented in Table 1. The University of Alabama at Birmingham's Institutional Review Board approved all study procedures.

Table 1. Demographic Variables for African Americans and Whites.

Variable	African Americans (n=62)	Whites (n=58)
Age (SD)	20.1 (2.6)	22.1 (5.8)
Sex (% female)	67.6	47.1

All subject participated in a single experimental session involving psychophysical testing. The data reported below represent information collected in two different experiments, and not all experiments included every pain task. Therefore, the number of subjects differs across pain tasks; however, the two ethnic groups were equally distributed across experiments. For all studies, verbal and written informed consent were obtained on arrival; after which, participants completed a health history questionnaire, which indicated that all were in good health and had no prior history of pain problems. Ethnicity was determined using self-report. Subjects who described themselves as either African American or non-Hispanic white were included in the analyses. Participants from other ethnic groups were not included in the analysis. This included 11 Asians, 1

Hispanic, 1 Native American, and 4 who endorsed the "other" ethnic category. Next, subjects completed several psychological measures (see below).

After the questionnaires, the laboratory pain-induction procedures were administered. In one experiment, 3 pain procedures were conducted: thermal pain, ischemic-pain, and cold pressor pain. In the other experiment, each of these procedures except for cold pressor pain was conducted. The thermal procedure was conducted first, followed by ischemic and cold pressor procedures (when applicable), and also administered in counterbalanced order. A 15-minute rest period was allowed between pain-induction procedures.

Psychophysical Measures

Thermal Pain Procedures

Threshold/tolerance. Contact heat stimuli were delivered using a computer-controlled Medoc Thermal Sensory Analyzer (TSA-2001, Ramat Yishai, Israel), a peltier-element-based stimulator with a 30 x 30 mm surface area. Heat-pain threshold (HPTh) and heat-pain tolerance (HPTo) were assessed on the ventral forearm using an ascending method of limits. The temperature increased from a baseline of 32˚C with a 0.5˚C/sec rate of rise, until the subject responded by pressing a button. Between trials, the positioning of the thermode was moved up the arm slightly, to avoid overlapping the testing sites, and a 30-second interstimulus interval was maintained. The cutoff temperature (to avoid tissue damage) for all trials was 52˚C.

Heat-pain threshold was determined first. Subjects were instructed to press a button on a hand-held device when the thermode first produced a painful sensation. Each time the button was pressed, the temperature of the thermode was recorded. Four trials were conducted in order to obtain consistent results; the heat-pain threshold was determined as the average of these trials.

Heat-pain tolerance was then determined by instructing the subjects to press a button when the pain from the thermode became intolerable.

The temperature of the thermode at the time the button was pressed was recorded. Four trials were conducted and heat-pain tolerance was determined by averaging these trials.

Temporal summation. After a 5-minute rest, the thermode described above was placed on the dorsal forearm. A series of brief, repetitive, noxious thermal stimuli were administered twice in ascending order. The two inter-trial intensities were 38˚C and 41˚C, and the target temperatures were 49˚C and 52˚C, respectively. The target temperature was delivered for a 1.5-second duration, with a 3-second inter-pulse interval at the inter-trial intensity. Subjects provided either intensity or unpleasantness ratings of each stimulus using 0-20 box scales (Coghill and Gracely, 1996). Both series of stimuli were delivered twice, once for intensity ratings, and once for unpleasantness, in counterbalanced order. Subjects were instructed regarding the distinction between intensity and unpleasantness using a standardized script (Price et al., 1983). The trial was terminated if the subject said, “stop” at any point or if they provided a rating of 20. Numerical ratings of each pulse were recorded.

Ischemic-pain Procedure

Ischemic-pain was induced using a modified submaximal effort tourniquet procedure (Moore et al., 1979). The left arm was exsanguinated by elevating it above heart level for 30 seconds. The arm was then occluded using a 10 cm wide straight segmental blood pressure cuff (model SC-10) inflated to 240 mm Hg using a Hokanson cuff inflator and air source (Bellevue, WA). Subjects performed 20-handgrip exercises of 2-second duration at 4-second intervals at 50% of their maximum grip strength. Subjects were instructed to say "pain" when they first felt pain and to continue until the pain became intolerable. The time to pain threshold and pain tolerance were recorded. Every 60 seconds, subjects were prompted, to rate the unpleasantness and intensity of their lower arm and hand pain using the 0 to 20 box scales. The test was terminated when the subjects indicated they wanted to stop by saying, "stop," when they reached 20 on either the intensity or unpleasantness scales, or when they reached an uninformed time limit of 15-minutes.

Cold Pressor Pain Procedure

Cold pressor pain was assessed by having the subjects immerse their left hand up to the wrist in 5°C water. The water temperature was maintained ($\pm$ 0.1°C) by a refrigeration unit (Neslab, Portsmouth, NH), and was constantly circulated to prevent local warming around the submerged hand. The subject was instructed to keep his/her hand in the water for as long as possible, however if the pain became intolerable, participants were told that they could remove their hand at any time. Cold-pressor pain threshold was determined to be the time when the participant said, "pain" and tolerance was recorded when the hand was withdrawn from the water. Subjects were prompted to rate the unpleasantness and intensity of the cold-pressor pain using the 0 to 20 box scales at 30-second intervals. Subjects continued until they reported intolerable pain or until a 5-minute uninformed time limit was reached.

Psychological Measures

To determine the contribution of psychosocial factors to group differences in experimental pain responses, all subjects completed the following psychological questionnaires.

The Coping Strategies Questionnaire (CSQ) (Rosenstiel and Keefe, 1983) consists of 44 items relating to how individuals cope with pain. It yields seven subscales based on the pain-coping strategies that individuals report using: diverting attention, catastrophizing, praying and hoping, ignoring pain sensations, reinterpreting pain sensations, increasing behavioral activity, and coping self-statements. It has been widely used with various pain populations (Keefe et al. 1987; Parker et al. 1989) as well as with healthy young adults (Lefebvre et al., 1995).

The Kohn Reactivity Scale (KRS) consists of 24 items that assess an individual's level of reactivity or central nervous system arousability. It has been recently used as a measure of the construct of hypervigilance (McDermid et al., 1996). This measure has been shown to correlate negatively with pain tolerance (Dubreuil and Kohn, 1986) and has been reported to have adequate internal consistency, ranging from alpha of 0.73 to 0.83 (Kohn, 1985).

The Pennebaker Inventory of Limbic Languidness (PILL) assesses the frequency of occurrence of 54 common physical symptoms and sensations and appears related to the construct of somatization or to the general tendency to endorse physical symptoms. It has been reported to have high internal consistency (alpha = 0.88) and adequate test-retest reliability (0.70 over two months) (Pennebaker, 1982). Recently it has been used as a measure of hypervigilance in fibromyalgia patients. These patients demonstrated lower pressure pain thresholds and tolerances and higher scores on the PILL compared to arthritis patients and pain-free controls (McDermid et al., 1996).

The Profile of Mood States- Bi-Polar (POMS-Bi) consists of 72 mood-related items, and subjects indicate the extent to which each item describes their current mood. This questionnaire assesses both positive and negative affective dimensions. The POMS has been well validated with other mood measures and is sensitive to subtle differences in affective state (Lorr and McNair, 1988). Though the POMS yields a variety of subscale scores, only the global indices of positive affect and negative affect were used in our study.

CHAPTER 3
RESULTS

A total of 120 participants were studied, including 62 African Americans (41 female, with a mean age of 20.1 $\pm$ 2.6 years) and 58 whites (24 female, having a mean age of 22.1 $\pm$ 5.8 years). Age and sex differed between ethnic groups (p's < 0.05); therefore, they were used as covariates in subsequent analyses. Analyses of covariance (ANCOVAs) revealed no significant differences in measures of HPTh, IPTh, or CPTh. However, significant group differences emerged for HPTo, IPTo, and CPTo (p's < 0.05), with African Americans displaying lower tolerances than whites. Significant differences also appeared for ratings of intensity and unpleasantness during the temporal summation procedure at both 49˚ Celsius (p's $\leq .005$), with African Americans reporting greater pain compared to whites. Data for each of the experimental pain tasks are presented in Table 2. In addition, effect sizes and F-values for group differences on each pain measure are indicated. Figure 1 shows these data graphically, after standardizing the variables such that each pain measure had a mean of 50 and a standard deviation of 10.

ANCOVAs, controlling for sex and age, were also conducted on psychological variables in order to determine the reliability of between-group differences. These analyses revealed no group difference on the POMS, the PILL, or the Active Coping subscale of the CSQ. However, significant group differences emerged on the Passive Coping subscale of the CSQ ($p = 0.0001$) and the KRS scale ($p = 0.003$), with African Americans scoring higher than whites (Table 2). To determine whether these

Table 2. Means (SD) for Experimental Pain Measures for African Americans and Whites, Including Sample Size, Effect Sizes, and F-Values

Variable	N (AA/W)	African Americans Mean (Std Dev)	Whites Mean (Std Dev)	Effect Size	F-value
HPTh	120 (62/58)	41.89 (4.02)	43.42 (3.91)	0.39	(1,115) 1.03
HPTo*	120 (62/58)	46.17 (3.56)	48.44 (2.86)	0.70	(1,115) 7.16
IPTh	114 (58/56)	150.9 (160.15)	119.05 (78.23)	0.27	(1,109) 1.59
IPTo*	114(58/56)	362.93 (253.28)	462.95 (268.4)	0.38	(1,109) 4.9
CPTh	64 (40/24)	11 (7.6)	12.7 (7.3)	0.23	(1,60) 0.52
CPTo*	64 (40/24)	25.7 (54.4)	77.1 (55.4)	0.94	(1,60) 11.31
Unpleas. Rating @ 49 °C*	119 (61/58)	12.4 (5.04)	8.95 (3.37)	0.82	(1,114) 9.91
Unpleas. Rating @ 52 °C*	118(60/58)	15.79 (4.39)	12 (5.49)	0.77	(1,113) 12.19
Intensity Rating @ 49 °C*	119(61/58)	13.66 (4.43)	10.61 (5.01)	0.65	(1,114) 8.25
Intensity Rating @ 52 °C*	118(60/58)	16.91 (3.42)	13.14 (5.41)	0.86	(1,113) 14.76

*$p < 0.05$

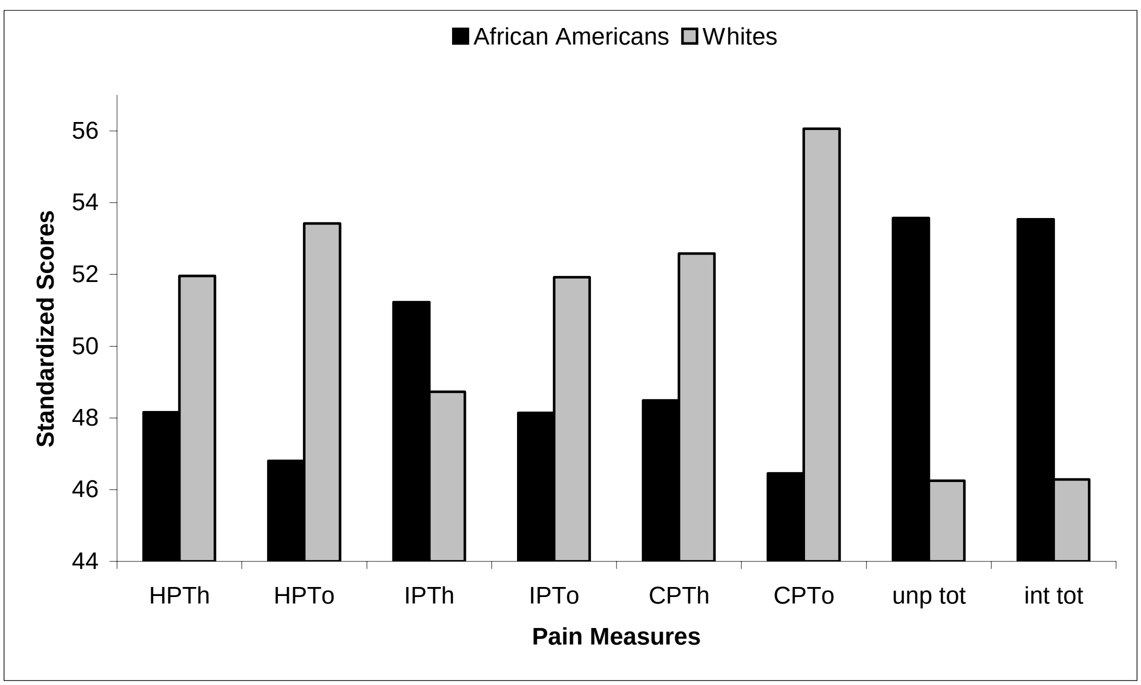

Figure 1. Standardized Means (Mean=50) for all Experimental Pain Measures in African Americans and Whites

psychological variables contributed to ethnic group differences in pain responses, ANCOVAs were performed. Group differences remained significant for all variables after adjusting for the Passive Coping subscale. However, controlling for KRS scores, both HPTo and IPTo became nonsignificant, while all other measures remain unchanged. Thus, KRS scores may have contributed to the group differences in heat-pain tolerance and ischemic-pain tolerance.

Table 3. Means (SD) for Psychological Measures for African Americans and Whites

Variable	N (AA/W)	African Americans Mean (Std. Dev.)	Whites Mean (Std. Dev.)	Effect Size	F-Value
Coping, Active	114 (58,56)	7.82 (3.41)	8.5 (4.15)	0.18	(1,110) 0.88
Coping, Passive*	114(58,56)	3.86 (1.94)	1.99 (1.61)	1.05	(1,110) 25.34
POMS, Positive Mood	113 (58,55)	49.41 (13.94)	52.85 (14.95)	0.24	(1,109) 0.73
POMS, Negative Mood	113(58,55)	29.4 (17.58)	29.78 (17)	0.02	(1,109) 0.05
PILL	100 (50,50)	103.12 (24.95)	104.34 (21.16)	0.05	(1,96) 0.12
KRS*	105 (53,52)	77.85 (10.36)	68.73 (12.42)	0.80	(1,101) 9.17

*$p < 0.05$

Correlations were calculated in order to characterize the associations across stimulus modalities, and to determine whether inter-task correlations differed across ethnic groups. Results are shown in Tables 4 and 5. Modest correlations emerged across stimulus modalities, with stronger relationships within modalities. Additionally, the intra- and inter-task correlations were similar across ethnic groups.

Table 4. Correlations of Experimental Pain Measures for African Americans

Variable	HPTh	HPTo	IPTh	IPTo	CPTh	CPTo	Int. Total	Unp. Total
HPTh	1.0	0.80230***	0.22646	0.33577*	0.08386	0.16139	-0.37384**	-0.44604***
HPTo		1.0	0.28203*	0.39278**	0.21553	0.41301**	-0.65205***	-0.63236***
IPTh			1.0	.67882***	0.34831*	0.02470	-0.05682	-0.00919
IPTo				1.0	0.08821	0.20864	-0.23472	-0.19284
CPTh					1.0	0.53908***	-0.01728	-0.01738
CPTo						1.0	-0.37967	-0.38268
Int. Total							1.0	0.76679***
Unp. Total								1.0

*p < 0.05, **p < 0.01, ***p < 0.001

Table 5. Correlations of Experimental Pain Measures for Whites

Variable	HPTh	HPTo	IPTh	IPTo	CPTh	CPTo	Int. Total	Unp. Total
HPTh	1.0	0.71941***	0.05783	0.16456	0.42628*	0.44495*	0.50641***	-0.51893***
HPTo		1.0	0.20722	0.42432**	0.52871**	0.51050*	-0.56487***	-0.64823***
IPTh			1.0	0.0273*	-0.9614	0.11579	-0.17650	-0.24719
IPTo				1.0	0.30961	0.62946**	-0.39577**	-0.50531***
CPTh					1.0	0.48479*	-0.09374	-0.13788
CPTo						1.0	-0.54830**	-0.39260
Int. Total							1.0	0.79769***
Unp. Total								1.0

*p < 0.05, **p < 0.01, ***p < 0.001

CHAPTER 4
DISCUSSION

The findings of this study provide evidence of ethnic differences in laboratory pain responses across multiple stimulus modalities. While African Americans did not differ from whites on threshold measures of heat-pain, ischemic-pain, and cold pressor pain, they exhibited significantly lower tolerances for each of the stimulus modalities. Group differences also emerged for ratings of the intensity and unpleasantness of suprathreshold heat-pain, with African Americans providing higher ratings compared to whites. The effect sizes for these group differences in pain responses ranged from small to large, with the average effect size being moderate. Thus, ethnic differences in tolerance measures of experimental pain responses appear to be consistent across pain tasks and relatively robust. That the largest effects were found on supra-threshold measures may be important, as these procedures have been found to be among the most clinically relevant experimental pain-induction tasks (Edwards et al., 2001; Petersen-Felix and Arendt-Nielsen, 2002).

Pain tolerance and suprathreshold ratings of pain unpleasantness may primarily reflect the affective-motivational dimension of pain, while pain threshold and suprathreshold ratings of pain intensity may be more strongly associated with sensory-discriminative aspects of the experience (Price, 1994). It has been theorized that ethnic differences in pain responses may be most apparent for the affective-motivational dimension of pain (Edwards and Fillingim, 1999; Sheffield et al., 2000; Riley et al., 2002). However, in the present study African Americans reported suprathreshold heat pulses to be more intense and unpleasant at both 49˚ and 52˚ Celsius when compared to whites. These findings suggest group differences in the sensory-discriminative aspects as well as the affective-motivational dimensions of pain perception. Taken together, these results are generally consistent with previous findings of ethnic differences in experimental pain (Chapman and Jones, 1944; Woodrow et al., 1972; Walsh et al., 1989; Zatzick and Dimsdale, 1990; Edwards and Fillingim, 1999; Sheffield et al., 2000) and chronic pain (Lawlis et al., 1984; Nelson et al., 1996).

Differences in pain sensitivity across ethnic groups are often attributed to “psychological factors” such as anxiety, depression, and hypervigilance (Zatzick and Dimsdale, 1990; Jordan et al., 1998; Rollman, 1998; Edwards and Fillingim, 1999; Edwards et al., 2001; Green et al., 2003). In the current study, no differences were observed in mood measures or in somatic complaints between groups. African Americans did, however, score higher on a measure of hypervigilance, the Kohn Reactivity Scale (KRS), than whites; and this psychological factor was correlated with pain perception. Statistically controlling for KRS scores rendered group differences in HPTo and IPTo nonsignificant, while CPTo and heat-pain ratings remained significantly different. This measure previously has been shown to negatively correlate with pain tolerance (Dubreuil & Kohn, 1986). One possible explanation for the change in significance of HPTo and IPTo could be that KRS data were missing for several subjects (5 African Americans, and 4 whites); therefore, introducing this variable into the model reduced the power of the analysis. Although the mechanisms underlying this effect are unclear, heightened attention to painful stimuli may contribute to ethnic differences in pain responding.

Coping styles and strategies may also moderate the relationship between ethnicity and pain; and have been found to vary by culture (Jordan et al., 1998; Moore and Brodsgaard, 1999). Catastrophizing, an aspect of passive coping, has been associated with pain responses in both experimental (Sullivan et al., 1995; Sullivan et al., 1997; Sullivan and Neish, 1998) and clinical populations (Keefe et al, 1989; Tan et al, 2001). Catastrophizing is theorized to increase the attentional focus and/or increase emotional reactivity to pain, thereby amplifying its experience (Sullivan et al., 2001). Although African American participants reported greater use of passive pain-coping strategies, including catastrophizing, this factor did not account for differences in pain responses between groups. However, it is important to note that the coping measure used in this study queried subjects as to their typical method of pain-coping, and it is possible that subjects used different strategies to cope specifically with the experimental pain stimuli. Moreover, psychological factors not assessed in the present study could have influenced the current findings. For example, sociocultural or environmental influences may play a role in a person's perception and response to pain and those factors were not directly assessed in this study. Given the consistency of ethnic differences in pain perception across stimulus modalities, these findings demonstrate the need for future research to address psychological variables and factors effecting pain-coping and pain responses.

Results of the correlational analysis, performed on the experimental pain tasks, indicated that participant's responses were moderately correlated across stimulus modalities, and these relationships were comparable across ethnic groups. This is consistent with previous reports (Janal, et al. 1994; Lautenbacher, et al., 1993). These results illustrate the potential importance of using multiple stimulus modalities when assessing pain perception and the differences therein.

Several limitations of our study should be noted when interpreting the results. First, all of the tasks were acute, controlled painful experiences. Given the artificial nature of the experimental procedures, the outcomes may have limited practical utility. However, several studies have shown the relevance of using experimental pain-induction procedures in order to predict clinical pain (Langemark et al., 1989; Fillingim et al., 1996; Clauw et al., 1999; Edwards, et al. 2003a; 2003b; Granot, et al. 2003). In addition, because all participants were healthy college students recruited from a homogenous population, the degree to which these findings generalize to other populations, including older and more poorly educated samples, is unknown. Another limitation is the relatively small sample size for the cold pressor procedure, which may have reduced our ability to detect group differences on this task. Another issue is that the considerable heterogeneity within the broader category of “African American” and “white” was not investigated in the present study. Differences in experimental pain responses among subgroups within larger Ethnic categories have been reported (Chapman and Jones, 1944; Sternbach and Tursky; 1965); however, others have reported no significant intra-ethnic differences in pain responding (Lipton and Marbach, 1984; Greenwald, 1991).

These limitations notwithstanding, these findings indicate relatively consistent ethnic differences in responses to multiple experimental pain modalities, and the effects are generally moderate in magnitude. Also, the largest ethnic differences emerged for suprathreshold pain measures. Some group differences in psychological measures, such as coping and hypervigilance, were observed; however, these variables did not fully account for the ethnic differences in pain responses. Current findings provide further evidence for the existence of ethnic differences in experimental pain perception, and additional research to elucidate the mechanisms and clinical relevance of these effects is warranted.

LIST OF REFERENCES

Anderson J, Felson D. Factors associated with osteoarthritis of the knee in the first National Health and Nutrition Survey (HANES I): evidence for the association with overweight, race, and physical demands of work. Am J Epidemiol 1987;128:179-89.

Breitbart W, McDonald M, Rosenfeld B, Passik S, Hewitt D, Thaler H, Portenoy R. Pain in ambulatory AIDS patients. I. Pain characteristics and medical correlates. Pain 1996;68:315-21.

Chapman W, Jones C. Variations in cutaneous and visceral pain sensitivity in normal subjects. J Clin Invest 1944;23:81-91.

Clauw DJ, Williams D, Lauerman W, Dahlman M, Aslami A, Nachemson AL, Kobrine AI, Wiesel SW. Pain sensitivity as a correlate of clinical status in individuals with chronic low back pain. Spine 1999;24(19):2035-41.

Cleeland C, Gonin R, Baez L, Loehrer P, Pandya K. Pain and treatment of pain in minority patients with cancer. Ann Intern Med 1997;127:813-16.

Coghill RC, Gracely RH. Validation of combined numerical-analog descriptor scales for rating pain intensity and pain unpleasantness. Proc Amer Pain Soc 1996;86(15):35.

Creamer P, Lethbridge-Cejku M, Hochber M. Determinants of pain severity in knee osteoarthritis: effect of demographic and psychosocial variables using 3 pain measures. J Rheumatol 1999;26:1785-92.

Dubreuil DL, Kohn PM. Reactivity and response to pain. Pers Indiv Diff 1986;7:907-9.

Edwards CL, Fillingim RB, Keefe FJ. Race, ethnicity and pain. Pain 2001;94:133-7.

Edwards RR, Doleys DM, Fillingim RB, Lowery D. Ethnic differences in pain tolerance: clinical implications in a chronic pain population. Psychosom Med 2001;63:316-23.

Edwards RR, Doleys DM, Lowery D, Fillingim RB. Pain tolerance as a predictor of outcome following multidisciplinary treatment for chronic pain: differential effects as a function of sex. Pain 2003a;106:419-426.

Edwards RR, Fillingim RB. Ethnic differences in thermal pain responses. Psychosom Med 1999;61:345-54.

Edwards RR, Ness TJ, Weigent DA, Fillingim RB. Individual differences in diffuse noxious inhibitory controls (DNIC): association with clinical variables. Pain 2003b;106:42

Faucett J, Gordon N, Levine J. Differences in postoperative pain severity among four ethnic groups. J Pain Symptom Manage 1994;9:383-9.

Fillingim RB, Maixner W, Kincaid S, Sigurdsson A, Harris MB. Pain sensitivity in patients with temporomandibular disorders: relationship to clinical and psychosocial factors. Clin J Pain 1996;12(4):260-9.

Granot M, Lowenstein L, Yarnitsky D, Tamir A, Zimmer EZ. Postcesarean section pain prediction by preoperative experimental pain assessment. Anesthesiology 2003;98:1422-1426.

Green CR, Anderson KO, Baker TA, Campbell LC, Decker S, Fillingim RB, Kaloukalani DA, Lasch KE, Myers C, Tait RC, Todd KH, Vallerand AH. The unequal burden of pain: confronting racial and ethnic disparities in pain. Pain Med. 2003;4(3):277-94.

Greenwald HP. Interethnic differences in pain perception. Pain 1991;44:157-63.

Janal MN, Glusman M, Kuhl JP, Clark WC. On the absence of correlation between responses to noxious heat, cold, electrical and ischemic stimulations. Pain 1994;58(33):403-411.

Jordan JM. Effect of race and ethnicity on outcomes in arthritis and rheumatic conditions. Curr Opin Rheumatol 1999;11:98-103.

Jordan M, Lumley M, Leisen J. The relationships of cognitive coping and pain control beliefs to pain and adjustment among African-American and Caucasian women with rheumatoid arthritis. Arthritis Care Res 1998;11:80-8.

Keefe FJ, Brown GK, Wallston KA, Caldwell DS. Coping with rheumatoid arthritis pain: catastrophizing as a maladaptive stratey. Pain 1989;37:51-6.

Keefe FJ, Caldwell DS, Queen KT, Gil KM, Martinez S, Crisson JE, Ogden W, Nunley J. Pain-coping strategies in osteoarthritis patients. J Consult Clin Psychol 1987;55:208-212.

Knapp DA, Koch H. The management of pain in office-based ambulatory care: National Ambulatory Medical Care Survey, National Center for Health Statistics, 1980 and 1981 (Advance Data from Vital and Health Statistics, No. 97; DHHS Publication No. PHS 84-1250). Hyattsville, MD: U.S. Public Health Service, 1984.

Koch H. The management of chronic pain in office based ambulatory care: National Ambulatory Medical Care Survey (Advanced Data from Vital and Health Statistics, No. 123; DHHS Publication No. PHS 86-1250). Hyattsville, MD:U.S. Public Health Service, 1986.

Kohn PM. Sensation-seeking, augmenting-reducing, and strength of the nervous system. In: J.T.Spence and D.E.Izard (Eds.), Motivation, Emotion, and Personality. Elsevier, Amsterdam, 1985, pp. 167-73.

Langemark M, Jensen K, Jensen TS, Olesen J. Pressure pain thresholds and thermal nociceptive thresholds in chronic tension-type headache. Pain 1989;38(2):203-10.

Lautenbacher S, Rollman GB. Sex differences in responsiveness to painful and non-painful stimuli are dependent upon the stimulation method. Pain 1993;53(3):255-264.

Lawlis G, Achterberg L, Kopetz K. Ethnic and sex differences in response to clinical and induced pain in chronic spinal pain patients. Spine 1984;9:751-4.

Lefebvre JC, Lester N, Keefe FJ. Pain in young adults II: The use and perceived effectiveness of pain-coping strategies. Clin J Pain. 1995;11:36-44.

Lipton JA, Marbach JJ. Ethnicity and the pain experience. Soc Sci Med 1984;19:1279-98.

Lorr M, McNair DM. Profile of Mood States: Bipolar Form, Educational and Industrial Testing Service, San Diego, 1988.

McCracken LM, Matthews AK, Tang TS, Cuba SL. A comparison of blacks and whites seeking treatment for chronic pain. Clin J Pain 2001;17(3):249-55.

McDermid AJ, Rollman GB, McCain GA. Generalized hypervigilance in fibromyalgia: evidence of perceptual amplification. Pain 1996;66:133-44.

Moore PA, Duncan GH, Scott DS, Gregg JM, Ghia JN. The submaximal effort tourniquet test: its use in evaluating experimental and chronic pain. Pain 1979;6:375-82.

Moore R, Brodsgaard I. Cross-cultural investigations of pain. In: Crombie ID, editor. Epidemiology of pain. Seattle: IASP Press; 1999. pp. 53-80.

Nelson D, Novy D, Averill P, Berry L. Ethnic comparability of the MMPI in pain patients. J Clin Psychol 1996;52:485-97.

Parker JC, Smarr KL, Buescher KL, Phillips LR, Frank RG, Beck NC, Anderson SK, Walker SE. Pain control and rational thinking: Implications for rheumatoid arthritis. Arthritis Rheum 1989;32:984-90.

Pennebaker JW. The psychology of physical symptoms. Springer-Verlag, New York, 1982.

Petersen-Felix S, Arendt-Nielsen L. From pain research to pain treatment: the role of human experimental pain models. Best Pract Res Clin Anaesthesiol 2002;16(4):667-80.

Plesh O, Crawford PB, Gansky SA. Chronic pain in a biracial population of young women. Pain 2002;99:515-23.

Price DD. Psychophysical measurement of normal and abnormal pain processing. In: Boivie J, Hansson P, Lindblom U, editors. Touch, temperature, and pain in health and disease. Vol 3: Mechanisms and assessments, progress in pain research and management. IASP Press, Seattle, 1994. pp. 3-25.

Price DD, McGrath PA, Rafii A, Buckingham B. The validation of visual analogue scalesas ratio scale measures for chronic and experimental pain. Pain 1983;17:45-56.

Rantanen T, Guralnik JM, Leveille S, Izmirlian G, Hirsch R, Simonsick E, Ling S, Fried LP. Racial differences in muscle strength in disabled older women. J Gerontol A Biol Sci Med Sci 1998;53:B355-61.

Riley JL, Wade JB, Myers CD, Sheffield D, Papas RK, Price DD. Racial/ethnic differences in the experience of chronic pain. Pain 2002;100:291-8.

Rollman GB. Culture and pain. In: Kazarian SS, Evans DR, editors. Cultural clinical psychology: theory, research, and practice, New York, NY: Oxford University Press, 1998. pp. 267-86.

Rosenstiel AK, Keefe FJ. The use of coping strategies in chronic low back pain patients: Relationship to patient characteristics and current adjustment. Pain 1983;17:33-44.

Sheffield D, Biles PL, Orom H, Maixner W, Sheps DS. Race and sex differences in cutaneous pain perception. Psychosom Med 2000;62:517-23.

Sheffield D, Kirby D, Biles P, Sheps D. Comparison of perception of angina pectoris during exercise testing in African Americans versus Caucasians. Am J Cardiol 1999;83:106-8.

Sherwood M, Garcia-Siekavizza A, Meltzer M, Hebert A, Burns A, McGorray S. Glaucoma's impact on quality of life and its relation to clinical indicators. Ophthalmology 1998;105;561-6.

Sternbach R, Tursky B. Ethnic differences among housewives in psychophysical and skin potential responses to electrical shock. Pscyhophysiology 1965;1:241-6.

Stewart W, Lipton R, Liberman J. Variation in migraine prevalence by race. Neurology 1996;47:52-9.

Sullivan MJL, Bishop S, Pivik J. The pain catastrophizing scale: development and validation. Psychol Assess 1995;7:524-632.

Sullivan MJL, Neish N. Catastrophizing, anxiety and pain during dental hygiene treatment. Community Dent Oral Epidemiol 1998;37:243-50.

Sullivan MJL, Rouse D, Bishop S, Johnston S. Thought suppression, catastrophizing, and pain. Cognit Ther Res 1997;21:555-68.

Sullivan MJL, Thorn B, Haythornthwaite JA, Keefe F, Martin M, Bradley LA, Lefebyre JC. Theoretical perspectives on the relation between catastrophizing and pain. Clin J Pain 2001;17:52-64.

Tan G, Jensen MP, Robinson-Whelen S, Thornby JI, Monga TN. Coping with chronic pain: a comparison of two measures. Pain 2001;90:127-33.

Todd K. Pain assessment and ethnicity. Ann Emerg Med 1996;27:421-3.

Todd KH, Lee T, Hoffman JR. The effect of ethnicity on physician estimates of pain severity in patients with isolated extremity trauma. JAMA 1994;271:925-8.

Turk DC, Okifuji A, Kalauokalani D. Clinicial outcome and economic evaluation of multidisciplinary pain centers. In A.R. Block, E. F. Kremer, & E. Fernandez (Eds.), Handbook of pain syndromes: Biopsycosocial perspectives. Mahwah, NF: Erlbaum 1999, p. 77-98.

Walsh N, Schoenfeld L, Ramamurth S, Hoffman J. Normative model for the cold pressor test. Am J Phys Med Rehabil 1989;68:6-11.

White S, Asher M, Lai S, Burton D. Patients' perceptions of overall function, pain, and appearance after primary posterior instrumentation and fusion for idiopathic scoliosis. Spine 1999;16:1693-1700.

Widmalm S, Gunn S, Christiansen R, Hawley L. Association between CMD signs and symptoms, oral parafunctions, race and sex, in 4-6 year-old African American and Caucasian children. J Oral Rehabil 1995;22:95-100.

Woodrow K, Friedman G, Siegelaub A, Collen M. Pain tolerance: differences according to age, sex, and race. Psychosom Med 1972;34:548-56.

Zatzick D, Dimsdale J. Cultural variations in response to painful stimuli. Psychosom Med 1990;52:544-57.

BIOGRAPHICAL SKETCH

Claudia M. Campbell received her Bachelor of Science degree in psychology with a minor in women's studies from the University of Florida in 2001. As a result of her interdisciplinary background, she developed an interest in the psychological aspects of diversity, specifically in the field of pain research. Upon completion of her Bachelor degree, Ms. Campbell accepted a research assistant position in the sensory testing laboratory of Dr. Roger Fillingim. Thus, she has been able to pursue her research endeavors investigating sex and ethnic differences in pain perception. She continues her work through the pursuit of a doctoral degree in Clinical and Health Psychology at the University of Florida.

Ms. Campbell has also been the recipient of several awards from the American Pain Society, which include a Citation Award and two Young Investigator Awards, the later of which facilitated travel to the national meetings. Current memberships include the American Pain Society, American Psychological Association, and Florida Psychological Association.