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Gender Differences in Delayed-Type Hypersensitivity Response: Effects of Stress and Coping in First Year Law Students

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Abstract

Law students show significant deficits in emotional and physical well-being compared with groups of students in other areas of higher education. Furthermore, evidence suggests that these effects may be worse for women than for men. The use of active coping can positively affect immunity under stress, but this may be most true for men in the context of law school. The current study examined the delayed-type hypersensitivity (DTH) skin responses of first year law students ($n=121$) and a comparison group ($n=30$). Students' health behaviors, self-evaluative emotions, and coping strategies were also reported. Male law students had larger DTH responses than females, but this gender effect was not present in the comparison group. Endorsement of perseverance under stress ($n = 19$), an active coping strategy, moderated the gender effect on immunity. Perseverance associated with larger DTH responses and more positive self-evaluative emotion, but only among men. These results indicate that active coping may be less efficacious for women than for men in law school, which in turn may limit women's opportunities to attenuate negative effects of law school.

Keywords

law school; stress; gender; DTH immune response; emotion; coping

1. Introduction

1.1 Law School, Stress, and Gender

Researchers generally agree that law students experience significant declines in psychological and physical health after beginning law school (Dammeyer & Nunez, 1999; McIntosh et al., 1994; Reifman et al., 2000). Students tend to enter law school with depression rates similar to the general population (10% -20%), but come out of their first year of law school with much higher rates of depression (30% -50%) (Benjamin et al., 1986). Moreover, law students often report mean scores on anxiety measures that are similar to psychiatric patients (Dammeyer & Nunez, 1999). Law students tend to score significantly worse on these indices when compared to a control group of students in higher education (e.g., medical students), which indicates that there is something uniquely and unduly stressful about the law school experience. Lack of time for relaxation, stress about grades, the Socratic method, and law school's competitive environment can all contribute to students' decreases in well-being (Dammeyer & Nunez, 1999; Prichard & McIntosh, 2003; Reifman et al., 2000; Segerstrom, 1996).

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A large body of research suggests that the implications for women's well-being in legal education may be different than those for men's. Some studies suggest that female law students experience more physical and emotional symptoms and are more likely to drop out of law school and develop a negative attitude toward the legal profession than their male counterparts (Guinier et al., 1994; Granfield, 1992; McIntosh et al., 1994). Females may also experience more school-related anxiety than males during both stressful events (e.g., examinations) as well as over the long term (Martin, 1977). Females are also more likely to report discrimination and greater role conflict than males in the law school environment (McIntosh et al. 1994; Foley & Kidder, 2002), which could largely contribute to females' perceived stress. McIntosh et al. (1994) found that women perceived more instances of sexism by both faculty and students than men. Women were also more likely "to see sexism as ingrained in law school", and all of these things caused significantly more stress in women than in men (p. 1484). Gender discrimination in law school may even be more apparent than other types of discrimination such as ethnic or racial discrimination (Foley & Kidder, 2002).

1.2 Gender Effects on Coping With Law School Stress

Coping can be significantly related to both emotional and immune responses to stress, and in the context of law school, certain coping strategies may be less efficacious for women than for men. Research has suggested that avoidant coping strategies such as emotion-focused coping, (i.e., where the goal is to mitigate the negative emotional states occurring rather than actively focusing on finding a solution to the problem) are more commonly used by women and can be associated with greater perceived stress, depression, and potentially detrimental immune parameters such as lower B-cell count (Futterman et al., 1996; Goodkin et al., 1992a; Ironson et al., 2005; Stowell et al., 2001). Conversely, active coping strategies like problem-focused coping (i.e., where effort is made to change the person-environment relationship) are associated with less depression, feelings of greater mastery over one's environment, and potentially desirable immune parameters such as larger proliferative responses to phytohemagglutinin (PHA) and concanavalin A (Con A) and lower interleukin-6 levels (Stowell et al., 2001; Sjogren et al., 2006).

Although active coping has positive effects on immunity under stress, this may be most true for men in the context of law school. Empirical findings suggest that the consequences of perceived gender biases are feelings of distraction and loss of control (Dardenne et al., 2007; Vescio et al., 2005). As a result, the efficacy of women's active coping mechanisms may be reduced, leading to decreased immune responses. If indeed active coping is less efficacious for women, then they should be less likely than men to feel positive about themselves after engaging in those strategies. Negative self-evaluative emotion has been associated with poorer immune function (Dickerson et al., 2004). Women who are feeling a loss of control over their circumstances may even engage in self-handicapping behaviors to circumvent feelings of negative self-evaluation. On the other hand, perhaps women are simply using more emotion-focused coping strategies and are not receiving the benefits of increased immunity from active coping.

1.3 The DTH Response as a Measure of Cell-Mediated Immunity

The delayed-type hypersensitivity skin test (DTH) is a measure of antigen-specific, cell-mediated immune response. Depending on the antigen, the response mediates both beneficial aspects of immune function such as resistance to bacteria, viruses, and fungi, as well as harmful aspects such as allergic dermatitis and autoimmunity (Dhabhar & McEwen, 1997). DTH response causes induration at the site of the antigen injection, and the size of the induration is a measure of the cell-mediated immune response. Because DTH response represents a group of related reactions to the antigen rather than single phenomenon, it characterizes an adaptive and clinically important aspect of cell-mediated immunity (Black, 1999). Moreover, DTH

prospectively predicts clinical benefits such as mortality (Christou et al., 1995) and survival with HIV (Dolan et al., 1995) suggesting that it is a good measure of immunity against infection. Although there are several studies that show relationships between stress and DTH (e.g., Dhabhar & McEwen, 1997), to our knowledge this is the first study to measure direct relationships among gender, coping, and DTH responses.

1.4 Summary and Hypotheses

Law students experience significant declines in physical and emotional health during the first semester in law school, and these declines may continue on through their legal education and careers. A large body of evidence suggests that these declines are worse for women than men. The coping literature suggests that active coping strategies have positive consequences for immunity under stress, where as emotion-focused coping strategies can have negative effects on immunity. Women in law school may have less efficacious active coping or use more emotion-focused coping strategies. Each of these possibilities may lead women law students to have worse immune responses when compared to men.

The current study aims to test three specific hypotheses. First, male law students will have better immune responses than female law students. Second it is predicted that coping may mediate this sex difference in immunity such that women will use less active coping and more emotion focused coping than men. Last, coping will be tested as a moderator of the sex difference in immunity, where active coping strategies will have more positive effect on immunity for men and less of a positive effect for women.

2. Method

2.1 Subjects

Subjects were 121 first-year law students and 30 comparison subjects from the same age group as the students but not on an academic schedule (e.g., eligible university staff members could not have higher workloads during finals week). Law students had a mean age of 23.9 years ($SD = 2.9$, range = 21-37). They were 45% male; 91% of the law students were white; 1%, Asian; 7%, African-American; and 1%, more than one race. Comparison subjects had a mean age of 26.1 years ($SD = 3.6$, range = 21 - 35). They were 30% male; 80% of the comparison sample was white and 20%, African-American.

2.2 Procedure

During the summer before beginning law school, all members of the incoming class were sent recruitment packets. If interested, they returned consent forms and screening questionnaires. Eligible students did not report significant fear of blood or needles, serious mental or physical health problems (e.g., active mononucleosis, depression), or immunotropic or psychotropic medication (e.g., prednisone, antidepressants). All eligible students were scheduled for assessment at 5 waves across the first year of law school: at the start of the first semester, midway through the first semester, during finals week, at the start of the second semester, and one month through the second semester. Each assessment included completion of a questionnaire packet that included demographics (first wave only), mood (each wave), and health behaviors (each wave). In addition, at each wave, a registered nurse (RN) administered students a delayed-type hypersensitivity skin test to assess cell-mediated immunity. All skin tests were administered between 7 and 9 am to control for circadian variation. At the final wave, students were interviewed individually regarding a number of aspects of their law school experience, including ways that they coped with the stress of law school. Comparison participants were recruited by flyers on campus and met the same enrollment criteria. They participated in the same 5 waves as law students; however, they reported only on demographics and health behaviors and were administered the skin test.

2.3 Measures

2.3.1 Demographic—All participants reported their age, gender, and race. In addition, law students reported on their undergraduate LSAT scores and GPA. Comparison of these academic qualifications with those of the entering class as a whole revealed that the sample was representative of the entering class.

2.3.2 Mood—Law students completed the PANAS-X (Watson & Clark, 1994) for three days: the day before the skin test was administered, the first day after the skin test was administered, and the second day after the skin test was administered. The PANAS-X yields Positive Affect and Negative Affect subscales as well as specific affect scales including Fear, Hostility, Guilt, Sadness, Joviality, Self-Assurance, Attentiveness, Shyness, Fatigue, Serenity, and Surprise. All scales had adequate inter-item reliability in the present sample ($\alpha \geq .72$). Because the present study focused on self-evaluation, a positive self-evaluation index was created from the Self-Assurance (e.g., proud, strong, confident) and Guilt (e.g., ashamed, disgusted with self, dissatisfied with self) scales. Positive values indicate greater mean Self-Assurance; negative values, greater mean Guilt.

2.3.3 Coping—Coping was coded from a structured interview that was conducted individually with each student. This interview contained various questions regarding the participant's law school experience (e.g., why they decided to go to law school, how the first semester was like or unlike their expectations). Students were also asked to describe how they attempted to cope with stressors during their first year of law school. The interviews were audio-taped and transcribed, and participants' responses were coded using a coding scheme described below.

Students were asked, “When you felt stressed, what sorts of things have you done to try to feel better?” In order to analyze their responses, a subset of 10 interviews was reviewed to generate a list of reported coping strategies. This list was condensed into categories based on similar strategies, resulting in a comprehensive list of 7 coping strategies. For example, golfing, running, and working out were all categorized under the broad label of “exercising”. The scale categories were as follows: seek social support; exercise or be physically active; use distraction, avoidance, or escape; pray or go to church; use cognitive restructuring; drink alcohol or use drugs; and work harder or persevere. All reported attempts at coping fit into a category and were coded. Each response was coded by 2 independent raters. Based on their responses, participants were classified as either having utilized a strategy (1) or not using a strategy (0). Inter-rater reliability was high, with kappa ranging from .99 to 1.0 for each coping strategy.

2.3.4 Health behavior—At each wave, all participants reported on a range of health behaviors, including substance and medication use, exercise, and sleep. Female participants reported on their menstrual phase (days from the first day of their last period).

2.3.5 Cell-mediated immunity—At each wave, 0.1 ml of a commercially prepared antigen, either mumps (MSTA; Aventis Pasteur) or candida (Canden; Allered) was injected intradermally into the subject's nondominant forearm. Induration size was read by a laboratory research assistant at 48 hours using the ball-point pen method (Longfield et al., 1984), and subjects were questioned about the presence of symptoms of cold/flu, other infections, allergy, and asthma. Because of significant between-batch differences in induration size (see below), analyses were performed on standardized variables within antigen batch ($M = 0$, $SD = 1$).

2.4 Data analysis

Data were analyzed using multi-level models in SAS Proc Mixed (Singer, 1998). Multilevel models were most appropriate for these data because they (1) accommodate differing numbers

of waves from different people and therefore all missing data patterns, unlike repeated measures analyses; (2) accommodate time-varying covariates such as health behavior; and (3) can test both wave-level and person-level effects as well as their interactions.

At level 1 (wave), each observation i from person j was modeled as a function of that person's intercept (which, in the absence of level 1 predictors, is the equivalent of the person's mean across waves) and deviations from that mean at each wave; thus, $X_{ij} = b_{0j} + e_{ij}$. At level 2 (person), each level 1 intercept was modeled as a function of a level 2 intercept and the effect of gender; thus, $b_{0j} = \gamma_{00} + \gamma_{01}(\text{gender})$. Analyses including wave extended this model so that $X_{ij} = b_{0j} + b_{1j}(\text{wave}) + e_{ij}$; $b_{0j} = \gamma_{00} + \gamma_{01}(\text{gender})$; and $b_{1j} = \gamma_{10} + \gamma_{11}(\text{gender})$. Other analyses included main effects of coping and the coping by gender interaction at level 2 and positive self-evaluation at level 1. Gamma weights are reported with their associated t tests. Because these are unstandardized estimates similar to unstandardized beta weights, we also give the effect size η , calculated from the Type III sums of squares F test provided for each effect.

Missing data occurred within cases, mainly due to drop-out but also due to adverse reactions to the skin test (e.g., blistering). In addition, eleven observations were dropped for idiosyncratic use of potentially immunotropic substances such as narcotics. However, multilevel models can accommodate partial cases, and so these cases were not excluded from analysis. Missing data occurred between cases because not all students participated in the interview ($n = 109$). However, cases missing interview data were included in analyses of gender effects.

The relationship of DTH induration size to antigen type (MSTA vs. Camden), antigen batch, age, race (white vs. nonwhite), menstrual phase, use of 6 classes of medication (antihistamine, antibiotic, topical steroid, hormonal birth control, acid inhibitor, antidepressant, and decongestant), alcohol use, caffeine use, smoking, exercise, cold symptoms, and acute allergy symptoms. Only antigen batch ($p < .0001$) and alcohol use ($p < .005$) were associated with DTH induration. Therefore, induration size was standardized by batch, and alcohol use was entered as a covariate in all analyses.

3. Results

3.1 Gender Differences in Immune Function

It was initially predicted that males would have a stronger immune response to the DTH skin test than females. Using gender as a predictor variable in the model, this hypothesis was confirmed, where men had a significantly larger skin test response than women, $\gamma = 0.40$ (0.13), $t(119) = 3.12$, $p < .01$. The gamma weight was derived from the standardized skin test values and therefore represents a difference of .40 SD between men and women (after controlling for alcohol use). For illustrative purposes, across antigen batches, this effect represents a difference of 2.4 – 3.6 mm induration between men and women. Although there was a significant main effect of wave, with the largest indurations at the first wave and the smallest at the last, $F(4, 389) = 17.30$, $p < .0001$, there was not a significant interaction between gender and wave, $F(4, 389) = 1.56$, $p > .05$.

One possibility for this result is that gender differences in DTH responses are biologically based. In order to rule out this possibility, the same model was tested with the comparison group not enrolled in law school. There was no gender difference in DTH responses in this group, with men only having a 0.02 SD larger DTH skin test response than women, $\gamma = 0.02$ (0.26), $t(28) = 0.07$, $p > .05$. For illustrative purposes, across antigen batches, this effect represents a difference of 0.1 – 0.2 mm induration between men and women. This null result suggests, therefore, that there is something about the law school experience that generates a gender difference in this measure of immune function.

3.2 Gender, Coping, and Immune Function

Our second prediction suggested that men may cope differently than women in law school. More specifically, we were interested in knowing whether men endorsed more active coping strategies and women endorsed more emotion-focused coping strategies. Chi-square analyses were used to test the use of coping strategies across gender (see Table 1). There were no significant gender differences in the use of cognitive restructuring, distraction, exercise, prayer, or alcohol use (all p 's > .05). However, men were more likely to use the active coping strategy of perseverance ($\chi^2(1, N=109) = 4.14, p < .05$), and women were more likely to use the emotion-focused coping strategy of seeking social support ($\chi^2(1, N = 109) = 5.39, p < .05$).

The next model tested whether these coping differences mediated the gender effect. If men and women are coping differently in law school, this may be responsible for their differences in DTH response. To test whether coping mediates the gender effect on the size of DTH induration, each coping strategy was added to a multi-level model separately, but none of them predicted DTH response (γ 's ranged from -0.13 – 0.03, all p 's > .05).

If the use of different coping strategies does not mediate the gender differences in the measure of immune response, then a second possibility is that active coping may be more efficacious for men than for women in the context of law school. This prediction was supported by a significant gender $\times$ coping interaction, $F(1,103) = 4.22, p < .05$, where men who used the active coping strategy of perseverance had a larger DTH response than men who did not and all women. The effect may in fact have reversed for women using perseverance (see Figure 1), but the small number of women reporting the use of perseverance as a coping strategy ($n = 7$) suggests this interaction is largely driven by the effect in men. The use of distraction, cognitive restructuring, or exercise did not moderate the gender effect on DTH response. The small numbers for prayer and alcohol use precluded testing moderation by these strategies.

3.3 Gender, Coping, and Emotion

More positive self-evaluative emotions were associated with larger DTH responses, $\gamma = 0.09$ (0.05), $t(397) = 1.98, p < .05$. Men and those using perseverance had more positive self-evaluative emotions than women and those not using perseverance: $\gamma = 0.82(0.35)$, $t(103) = 2.34, p < .05$, and $\gamma = 0.65(0.29)$, $t(103) = 2.23, p < .05$, respectively. However, these main effects were qualified by a tendency for the combination of gender and perseverance coping to predict positive self-evaluative emotions, $\gamma = 0.72(0.38)$, $t(103) = 1.88, p < .06$. In this interaction, men who endorsed perseverance had the most positive self-evaluative emotions ($M = 0.79, SD = 0.83$), followed by men who did not endorse perseverance ($M = 0.73, SD = 0.93$), women who did not endorse perseverance ($M = 0.63, SD = 1.03$), and women who did endorse perseverance ($M = -0.02, SD = 0.84$). In order to identify the relationship between emotions, gender, and coping, a mediational test was conducted to see how much of the gender $\times$ coping interaction were accounted for by emotion. The results of these tests revealed that emotion accounted for about 25% of the variance in the interaction between gender and coping where $\eta^2 = .04$ without emotion in the model, but decreased to $\eta^2 = .03$ when emotion was added.

4. Discussion

4.1 Gender, Coping, and DTH Among Law School Students

As predicted, first year male law students showed significantly larger DTH skin test responses than first year female law students, but a gender difference was not found in a comparison group. This result supports the general finding that men fare better than women in the context of law school (McIntosh et al., 1994); in this case, men had more robust DTH responses to intradermal antigen challenge than women. The DTH skin test response measures only one

aspect of the immune system (cellular immunity); however, the DTH response is clinically important, for example, as a predictor of resistance to infectious disease (Christou et al., 1995).

In addition, men who used perseverance to cope with stress during law school had larger DTH responses than those who did not and women. One question of interest in light of these results is whether active coping in law school enhances DTH responses for men, or failing to cope actively suppresses them. Although we cannot specifically determine the direction of this effect, the predicted DTH response from the multi-level models for men using perseverance ($Z = 0.29$) was somewhat larger than that for the comparison group ($Z = 0.16$), which in turn was larger than that for men not using perseverance ($Z = .03$) (see Figure 1). In the context of coping with law school, active coping may be serving to keep men's DTH responses at or even slightly above average levels. In contrast, failure to cope actively may result in lower than average DTH responses. This finding is consistent with other results in which active coping associated with potentially healthier (i.e., higher cellular and lower proinflammatory) immune parameters during stress (Stowell et al., 2001; Sjogren et al., 2006).

For women, active coping may be failing as a buffer against the negative effects of stress on DTH and may be further decreasing this aspect of immunity for women who attempt to persevere under stress. The number of female law students who reported using perseverance as a coping strategy was relatively small ($n = 7$), so it is difficult to tell the degree to which the use of this strategy is reliably immunosuppressive for these women. However, future research should pursue this potentially interesting finding. One possibility is that women in the law school context experience benevolent sexism, which can lead to increased distraction and feelings of loss of control over outcomes (Dardenne et al., 2007). Therefore, women who attempt to make changes in their environment but feel that their outcomes are not contingent on their efforts may not be benefiting from the positive emotional and immunological responses that active coping usually provides.

4.2 Self-evaluative Emotions and Sexism

There was a roughly parallel interaction between gender and persistence in predicting positive self-evaluative emotions. Men who endorsed persistence had the most positive (e.g., confident) and least negative (e.g., dissatisfied with self) self-evaluative emotions, and women who endorsed persistence, the least positive and most negative. In turn, positive self-evaluative emotions were negatively correlated with DTH responses, consistent with other findings that these emotions are important correlates of neuroendocrine and immune function (Dickerson et al., 2004; Kemeny et al., 2004). However, self-evaluative emotion accounted for only about 25 percent of the interaction between gender and coping. The self-evaluative emotion index was created *post hoc*, and a measure that focused on more specific emotions would be a more robust mediator. One candidate for a more focused measure is shame. Shame is thought to arise specifically when negative outcomes arise from an uncontrollable aspect of the self, such as gender (Tangney et al., 1992). The experience of sexism may therefore specifically elicit shame and the resultant physiological correlates (Dickerson et al., 2004; Kemeny et al., 2004).

A specific limitation of this study was that perceived sexist biases were not directly measured. Therefore, we cannot be certain that these perceptions are the driving force behind sex differences in DTH. However, the literature suggests that a benevolent sexist environment is common in law schools (McIntosh et al., 1994). Perceived sexism is a likely moderator of the relationship between active coping and DTH, and future research should include measures of perceived sexism (both hostile and benevolent) to more precisely investigate whether this interaction in fact results in decreased efficacy of women's active coping strategies. Moreover, there may be other kinds of benevolent biases (e.g., racism, socio-economic bias) that may have similar influences on coping, emotion, and immune function.

4.3 Conclusion

This study showed that the law school experience may have detrimental effects on women's cellular immune function as reflected in DTH responses. Active coping such as persevering under stress does not buffer against this effect and may even further suppress DTH responses. Women may be more likely to feel that their outcomes are not contingent on their efforts due to their sex, to avoid active coping or fail to benefit from active coping attempts, and to experience negative self-evaluative emotions such as shame. Future research should directly measure the impact that perceived gender biases have on women's emotional and physical health in law school and whether the efficacy of active coping continues to differ between men and women over the remainder of law school and their legal careers. Finally, future research should also examine situations other than law school where discrimination could eliminate the usually positive relationship between active coping mechanisms and cellular immune function.

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Figure 1. Predicted DTH skin test response (as Z score) from the multi-level model as a function of gender and coping

Table 1
Coping Strategy Endorsement by Gender

	Men	Women
<u>Strategy</u>		
Cognitive restructuring	9	12
Distraction	33	49
Exercise	25	28
Prayer	0	3
Alcohol use	5	4
Perseverance *	12	7
Social Support *	22	44

*
 $p < .05$