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Introduction

Police use of excessive force has drawn a great deal of attention from the media, policymakers, and researchers. As seen in the incidents of Rodney King, Abner Louima, and Sean Bell, police use of excessive force not only results in harm or death to citizens, but also causes criminal and civil liability, community resistance, and loss of public confidence in the police (Ross, 2000). Well cognizant of such detrimental impacts of police use of excessive force, police policies and related research have placed a priority in protecting human rights through minimizing unnecessary force (Hickman & Piquero, 2008; Hontz, 1999). Various aspects of police use of force have been studied over the years including frequency of use of force (Adams, 1995), police officers' attitudes toward force (Westley, 1970), types of force used (Klinger, 1995; Terrill, Leinfelt, & Kwak, 2008), use of excessive or lethal force (Fyfe, 1979; Klockars, 1995), and causes of police force (Alpert, Dunham, & MacDonald, 2004; McElvain & Kposowa, 2008; Worden, 1995).

Most research in this field has focused on the micro level aspects that can influence the amount of police force. While these individual and situational factors are important determinants of levels of police force used, a growing body of research has put a priority on expanding its concerns to macro level factors (Garner, Maxwell, & Heraux, 2002).¹ Some studies implied that neighborhood contextual factors play a critical role in predicting police use of force behavior because hazardous working environments expose police officers to a constant risk of danger and violence (White, 2001). Although police officers are compelled to use reasonable force, dangerous neighborhood environments influence their momentary decision-making ability. Consequently, it can be inferred that police officers working in risky areas are more likely to apply greater force. Despite the potential significance of neighborhood contextual factors, only a few studies have examined these factors in analyzing police use of force (Lawton, 2007; Terrill & Reising, 2003). Previous research, however, drew its conclusions based on a single or few police municipalities, potentially limiting the generalizability of research findings.

Some research in this field also hinted that police training could be an effective countermeasure against police use of excessive force. To protect police officers, citizens, and even criminals, police use of force must be regulated by federal and state laws, court decisions, and municipal policies (Hontz, 1999). Police officers' knowledge of these rules that "control the amount of force used and the circumstances under which it can be used" should be a significant part of police administrative concerns because violations of these regulations can lead to collateral damages to the police (Kappeler, 2006, p. 96). Even so, a review of literature indicates that the impact of police training on the way police officers use force has not been researched much. The research gap on the association between police training and use of force is surprising given that training has been a frequent focus in studies of other police behavior and police liability issues (Haar, 2001; Huisman, Martinez, & Wilson, 2005; Lee & Vaughn, 2010; Lonsway, Welch, & Fitzgerald, 2001).

The current study attempts to bridge this gap in research between contextual factors and police use of force. It also deepens our understandings of the association between organizational factors and use of force by incorporating police training into the analytical model. Finally, this study expands prior research by including multiple police agencies in the sample, thus producing research findings that can be more easily generalized.

Review of Police Use of Force Studies

Individual and Situational Approaches

Previous attempts to explain police use of force can be categorized two ways: who the police encounter or what the citizen does to the police (Terrill & Mastrofski, 2002). Regarding the first aspect, one of the most popular determinants adopted in this area has been race (Alpert, Dunham, & MacDonald, 2004). A considerable amount of research has found that racial minorities, particularly, African Americans, are disproportionately victimized during police encounters (Holmes, 2000; Jacobs & O'Brien, 1998). Blalock's (1967) group threat theory can offer a useful framework to understanding the phenomenon of minorities disproportionately becoming the targets of police force.

Blalock (1967), conceptualizing the relationship between minority percentage and discrimination, explained that every group competes for economic and political dominance over other groups. As the size of minority population increases, the majority—that is, Whites—perceive an increasing threat to their political and economic foothold. In response to the potential loss of their supremacy, the dominant class, blaming African Americans and immigrants for the economic and political threat, develops punitive approaches against them (Perry, 2003). Fear of losing dominance, often in conjunction with fear of crime, derived from the presence or increase of the minority group, contributes to pressure on crime control authorities in order to maintain vested rights (Jackson, 1992). For this purpose, police are often used as a social control mechanism along with incarceration in a prison or mental asylum, which represents coercive control over a social threat (Liska, 1992). Instead of increasing crime prevention activities, law enforcement agencies focus a disproportionate amount of resources on policing minority neighborhoods (Chambliss, 2001; Jackson & Carroll, 1981; Jacobs, 1979; Turk, 1969). The concept of social threat, however, is not sufficient to explain the nature of police use of force against minorities, because mere presence of minorities does not automatically invoke police force.

Concerning the second issue, how citizens affect police, research has shown that patterns of police use of force can be described by examination of citizens' attitudinal effects on police officers (Worden, 1989). The working environment as well as subculture inside the blue wall leads officers to hold authority as one of the most important police values (Westley, 1953, 1970). Numerous studies have found that police officers are more likely to sanction citizens when citizens display an impolite demeanor (Becker, 1963; Worden, Shepard, & Mastrofski, 1996). Citizens' uncivil and hostile attitudes spur police officers to retaliate against the citizens (Kappeler, Sluder, & Alpert, 1998; Lundman, 1994). Police cannot overlook "assholes" who are questioning, challenging, and criticizing police authority because of the police subculture that makes police officers teach a lesson about the inappropriateness of their behavior (Van Maanen, 1978). The demeanor of citizens during encounters with police has a significant impact on police discretion to invoke higher risk of police use of force and being arrested (Bittner, 1967; Black, 1971; Lundman, 1994; Skolnick, 1966; Smith & Visher, 1981; Son, Davis, & Rome, 1998; Sykes & Clark, 1975).

The most severe attack on police authority that increases the possibility of the use of force is physical resistance (McElvain & Kposowa, 2008). Citizens who show disrespectful and uncooperative demeanor and use physical resistance are more likely to be punished regardless of their race (Black & Reiss, 1970; Sherman, 1980; Smith & Visher, 1981; Terrill, 2003; Terrill, Alpert, Dunham, & Smith, 2003). Examination of citizens' resistance is critical to comprehend the context in which police use force.

Neighborhood contextual approaches

Police officers are primarily involved in non-dangerous order-maintenance activities; therefore, chances of risky situations, especially using deadly force, are relatively low (Hudson, 1970; Wilson, 1968). Although most police-citizen encounters are resolved without relying on force, law enforcement officers are constantly exposed to potential danger of death or injury. In 2007, 140 officers were feloniously or accidentally killed, and approximately 12 out of 100 sworn officers were assaulted in the line of duty (Federal Bureau of Investigation, 2007). Under these circumstances, police officers develop a street wisdom to identify potential violence and danger through personal experience and interaction with colleagues. Police officers' perceived risk of danger or threat to their safety can be intensified by the neighborhood context, which affects levels of force (Klinger, 1997; Mastrofski, Reisig, & McCluskey, 2002; Schafer, Huebner, & Bynum, 2003; Slovak, 1986; Smith, 1986; Sun, Payne, & Wu, 2008; Terrill & Reisig, 2003).

Recent research has posited that race at micro levels does not solely determine the severity of police use of force despite the assertions of racial threat considering citizens' resistance to police mostly affects police use of force (Lawton, 2007). In contrast, the influence of overall racial composition of neighborhoods on police behavior has been proposed. Smith (1986) studied interactions between racial heterogeneity of communities and levels of coercive authority during police-citizen encounters in 60 neighborhoods served by 24 police departments. He found that police officers showed a propensity to exercise more coercive authority toward citizens encountered in predominantly minority or racially mixed areas. More recently, Lawton (2007) examined the impact of racial heterogeneity on actual police use of force incidents occurred in the Philadelphia PD by adopting a multilevel analysis. His study, however, showed an insignificant relationship between racial heterogeneity and levels of police force.

Many studies on the issues of neighborhood context have focused on crime rates as well; however, the impact of crime rates in neighborhoods on police use of force is inconclusive. Some scholars suggested that police officers apply higher levels of force against citizens encountered in higher crime rate areas (Bayley & Mendelsohn, 1967). Conversely, Klinger (1997) argued that police officers use less severe force in high-crime areas because those officers are accustomed to handling citizens' deviant acts. A few quantitative studies have connected crime rates to police use of force. Terrill and Reisig (2003), who first adopted a multilevel analysis in predicting police use of force, found positive interactions between severity of police force and homicide rates in 24 beats in Indianapolis and St. Petersburg. In Lawton's (2007) Philadelphia study, however, the violent crime rate failed to be significant. Additionally, higher probabilities of encountering disrespectful citizens in economically disadvantaged areas can lead police officers to use more severe force. In fact, recent research examining the impact of disadvantaged areas on police, including areas of high unemployment rates, found that police officers working in disadvantaged neighborhoods are more likely to use more force (Terrill & Reisig, 2003).

Police training

Police officers can legitimately use force when exposed to imminent danger of death or injury to themselves and others. When police officers are exposed to these hazards, situational and environmental factors mostly influence police officers' decision to use force (White, 1999). When the amount of danger is decreasing, however, organizational factors highlighted by training play a critical role, and the importance of situational and environmental factors is diminished (White, 1999). Because trained officers are better able to resolve conflict with less lethal force, proactive police organizations train and qualify their inexperienced officers to minimize use of unnecessary force (Bayley & Bittner, 1997; Bittner, 1970; Dias & Vaughn, 2006). Proper police management also acknowledges the importance of division of labor because lack of training can invoke municipal liability under Title 42 U.S. Code Section 1983 (*City of Canton v. Harris*, 1989).

Most police training is a combination of pre-service training that police recruits receive at the police academy and in-service training offered by their departments throughout the duration of employment (Morrison, 2006). Although the length of academy training varies by state and by department within a state (Langworthy, Hughes, & Sanders, 1995), the average duration of academy training is around 660 hours according to the 2003 Law Enforcement Management and Administrative Statistics (LEMAS). Police officers also receive approximately 380 hours of field-training and 43 hours of in-service training (Law Enforcement Management and Administrative Statistics, 2003). More than 90 percent of police academy curriculum focuses on developing basic repetitive skills and knowledge about weaponless and weapon tactics, criminal law, civil liability, and citizen encounters (Bradford & Pynes, 1999; Buerger, 1998; Gallo, Collyer, & Gallagher, 2008; Langworthy, Hughes, & Sanders, 1995). Pre-employment training often includes field-training as an extension of the traditional in-class police academy training to fill the gap between academy training and real-life situations (Alpert, Dunham, & Stroshine, 2006; Morrison, 2006). Police recruits under close supervision of field-training officers of the employing departments can learn how to apply the skills and knowledge obtained from police academies to real encounters with citizens.

Although successful pre-service training helps officers peacefully resolve encounters with civilians, the skills and knowledge must be constantly refreshed by departments to adapt to changing rules, procedures, and tactics (Alpert, Dunham, & Stroshine, 2006). Because police in-service training focuses on sharpening skills and knowledge on proper use of force, high-speed pursuit tactics, and peaceful encounters with citizens, periodic in-service training has become mandatory in many states (Alpert, Dunham, & Stroshine, 2006). In sum, "this combination of pre-service

and in-service training places a ceiling on the crucial knowledge, skills and decision-making experiences that officers will depend upon during dangerous field encounters” (Morrison, 2006, p. 229).

Despite the emphasis on police training, studies on satisfaction with academy training have claimed recruit training does not fully prepare police recruits to perform their duties (Marion, 1998; Morrison, 2006). Police also perceive that in-service training is not comprehensive enough to deal with dangerous encounters with citizens (Schwartz & Yonkers, 1991). As a countermeasure, improvement of the quantity of police training has been suggested because the amount of training is expected to lower the highest level of force used during encounters with citizens (Ness, 1991).

Two recent studies on police use of force (Lawton, 2007; Terrill & Reisig, 2003) incorporated individual, situational, and neighborhood contextual factors in their multilevel analyses, although organizational factors were excluded. Since these two studies centered on variations within only one or two police departments, differences among various police departments have not been explored. Moreover, no research has examined the relationship between the levels of police training and the amount of force used, even though the amount of training police officers receive can impact whether the force used is reasonable. Accordingly, the current study attempts to examine if neighborhood contextual factors and the amount of police pre-service and in-service training influence the levels of police force across multiple police agencies.

Methods

Data

The data for the current study were derived from several primary sources. Three sets of police use of force data were obtained from the Interuniversity Consortium for Political and Social Research (ICPSR). The first data set was collected from 7,512 adult custody arrests in the six municipalities between 1996 and 1997 in which Charlotte-Mecklenburg (North Carolina) Police Department (PD), Colorado Springs (Colorado) PD, Dallas (Texas) PD, St. Petersburg (Florida) PD, San Diego (California) PD, and San Diego County (California) Sheriff’s Department participated (Garner & Maxwell, 2001). For the second data set, 1,826 adult arrests made in Phoenix (Arizona) PD in 1994 were collected (Garner, Schade, Hepburn, & Mulcahy, 1994). To record the characteristics of the arrest situation, the suspects, the officers, and the specific behavioral acts of officers and suspects in an arrest situation, a self-survey form was used in each department. Third, the current study also used 882 official reports on control of persons in Metro-Dade (Florida) PD between the last quarter of 1993 and 1995 (Alpert & Dunham, 2001).

A total of 8,798 arrest situations from the above eight police agencies were included in the current analysis after data cleaning.² In addition, this study also utilized Census, Uniform Crime Reports (UCR), Bureau of Labor Statistics (BLS), and 1997 Law Enforcement Management and Administrative Statistics (LEMAS) to obtain racial composition, violent crime rates, unemployment rates, and hours of pre-service and in-service training of the eight police agencies.

Dependent Variable

The dependent variable of the current study is the highest level of force used by police during citizen-police encounters. Dichotomous measures of police use of force have been adopted in many studies (Croft, 1985; Engel, Sobol, & Worden, 2000; Friedrich, 1980; Klinger, 1995; Langan, Greenfeld, Smith, Durose, & Levin, 2001; Lundstorm & Mullan, 1987). While simple measures of no force and force are particularly beneficial to apply “consistently across all jurisdictions and types of law enforcement agencies” (Garner et al., 2002, p. 724), a use of force continuum has been used to “explain the levels of force necessary to meet a suspect’s threat or resistance” for the last three decades (Alpert et al., 2006, p. 191; Skolnick & Fyfe, 1993; Terrill & Reisig, 2003). Since the force continuum can reflect the ethos of objective reasonableness in police use of force (*Graham v. Connor*, 1989; Terrill et al., 2003), the current study measured the amount of force in escalating scales: (1) officer presence including verbal commands, (2) empty hand control,³ and (3) any weapons embracing deadly and non-deadly force.

The eight police agencies have different types of continuum of force ranging from five to nine levels. St. Petersburg PD has a nine-tiered continuum of force: officer presence (minimum force), verbal direction, restraint devices, transporter, take down, pain compliance, countermoves, intermediate weapons, and lethal force (maximum force).

Dallas PD has a five-level of force continuum: officer presence (minimum force), verbal control, empty hand control, intermediate weapons, and lethal weapon (maximum force). Because of the discrepancy across jurisdictions, abridging the use of force continuum in the participating jurisdictions is inevitable to create a unified force continuum. In case of St. Petersburg PD, the nine levels of use of force continuum were recoded by adding up 'restraint devices, transporter, take down, pain compliance, and countermoves' to constitute 'empty hand control' and adding up 'intermediate weapons and lethal weapon' to create 'any weapon use.' In the case of Dallas PD, intermediate weapons and lethal weapons were combined to 'any weapon.' For convenience, the use of force continuum was inversely coded: 1 = any weapon, 2 = empty hand control, and 3 = officer presence or verbal control.

Independent Variables for Individual Level Characteristics

Demographic variables for arrestees and officers. Several demographic variables for each arrestee and officer were included in the analysis. Age measured the age category of the arrestees (1 = below 26, 2 = 26 ~ 35, 3 = 35 and above) and officers (1 = below 25, 2 = 25-34, 3 = 35 and above). Arrestees' race was measured as a dichotomous variable based on prior research (0 = White arrestee, 1 = non-White arrestee) while race of officers was inversely coded (0 = non-White officer, 1 = White officer). Gender for both arrestees and officers was also measured as a binary variable (0 = female, 1 = male). Regarding the incongruent effect of race on police use of force, the encounters in which non-White arrestees were contacted by White officers were calculated as a dichotomous variable (0 = no, 1 = yes).

Arrestees' resistance. To measure arrestees' attitude toward police officers, this study examined arrestees' resistance to police during encounters. Resistance included arrestees' use of physical force and weapons (0 = no, 1 = yes). Arrestees resisted police arrest in six percent of the cases.

Independent Variables for the Eight Jurisdictions

Racial heterogeneity value. While the race of a citizen and police officer can explain some portion of police use of force, the influence of the overall racial composition in each jurisdiction might outweigh the individual impact of race on police use of force. Racial heterogeneity values were calculated by subtracting the percentage of African American population from 50 and taking the absolute value. Lawton (2007) computed the heterogeneity values, including only the percentage of African Americans, based on the finding that police officers were more likely to apply force against citizens encountered in African-American neighborhoods (Smith, 1986).

Violent crime rates. Violent crime rates were adopted to examine the patterns of individual officers' decisions to choose adequate force across different jurisdictions. Violent crime rates represent the number of violent crimes per 100,000 residents in each agency obtained from the UCR. Murder, robbery, rape, and aggravated assault were included in the measurement of the violent crime rates.

Unemployment rates. As violent crime rates and heterogeneity values represent the level of social threats that can increase police officers' perceived danger in the community, unemployment rates are also expected to have a positive impact on police perception of danger. The unemployment rates in the eight jurisdictions were obtained from the BLS.

Pre-service and in-service training hours. Pre-service training hours and in-service training hours were used because they constitute most of law enforcement training. Pre-service training hours included the police academy classroom hours and the field training hours that recruits received before they were employed. In-service training hours represented the total hours of training required for field officers per year. Both pre-service and in-service training hours were obtained from 1997 LEMAS.

Analytic Strategies

Since the current study focused on the relationships among neighborhood contextual and organizational factors, individual level variables, and police use of force, a multilevel analysis or hierarchical linear modeling (HLM) can appropriately test the research questions. The outcome variable in the current study does not exclude the possibility of being ordinal because the concept of use-of-force continuum was created based on hierarchy from deadly weapon to officer presence. However, the result of the Brant test of parallel regression assumption revealed that four out of

eight coefficients of individual level variables were significantly different across two logit regression models (Long & Freese, 2006, p.452).⁴ As a result, this study adopted a multinomial logistic regression model using HLM instead of an ordinal regression model. Treating “officer presence or verbal command” as the reference category, this study created two independent logit models. The first logit model (Contrast 1) identified the odds of choosing “any weapon” relative to “officer presence or verbal command.” The second logit (Contrast 2) model examined the odds of using “empty hand control” relative to “officer presence or verbal command.”

Unconditional model (ANOVA). The HLM analysis began with a simple unconditional (ANOVA) model where no predictors were included to test the ecological variation of the outcome variable in the level-2 and to obtain reliability estimates for the dependent variable at the aggregate level (Raudenbush & Bryk, 2002). As a prerequisite to multilevel analysis, the unconditional model was expressed as:

$$\text{Level-1 model: Contrast } m: \eta_{mij} = \log(\varphi_{mij} / \varphi_{Mij}) = \beta_{0j(m)},^5$$

$$\text{Level-2 model: Contrast } m: \beta_{0j(m)} = \gamma_{00(m)} + u_{0j(m)}, \quad m = 1 \text{ \& } 2$$

The level-1 model in this unconditional model accounts for variation in log-odds of use of force continuum within each jurisdiction, where η_{mij} is the contrast m of continuum of force for police officer i in jurisdiction j , the intercept $\beta_{0j(m)}$ represents the average log-odds on use of force continuum of jurisdiction j . For the individual level, no error term was included in the model (Raudenbush & Bryk, 2002). The level-2 model represents variation in log-odds of use of force continuum between jurisdictions where the intercept $\gamma_{00(m)}$ symbolizes the grand mean of use of force continuum across the eight municipalities.

Random intercept model (Model 1). This model included only level-1 variables to examine multivariate associations between individual factors and use of force continuum. Two contrasts of this model enabled the current study to investigate the variability of use of force continuum across police departments. Each variable was centered on its grand mean.

$$\text{Level-1 model: Contrast } m: \eta_{mij} = \beta_{0j(m)} + \beta_{1j(m)} (\text{Arrestee age})_{ij} + \beta_{2j(m)} (\text{Arrestee race})_{ij} + \beta_{3j(m)} (\text{Arrestee gender})_{ij} + \beta_{4j(m)} (\text{Officer age})_{ij} + \beta_{5j(m)} (\text{Officer race})_{ij} + \beta_{6j(m)} (\text{Officer gender})_{ij} + \beta_{7j(m)} (\text{Office suspect race interaction})_{ij} + \beta_{8j(m)} (\text{Resistance})_{ij}$$

$$\begin{aligned} \text{Level-2 model: Contrast } m: \beta_{0j(m)} &= \gamma_{00(m)} + u_{0j(m)} \\ \beta_{1j(m)} &= \gamma_{10(m)}, \\ &\sim \\ \beta_{8j(m)} &= \gamma_{80(m)}. \end{aligned} \quad m = 1 \text{ \& } 2$$

Intercept as outcome models (Model 2 through 6). In addition to the random intercept model, variables for municipalities were addressed in the intercept as outcome model. Due to the small sample size of level-2 variables, heterogeneity values (Model 2), violent crimes rates (Model 3), unemployment rates (Model 4), pre-service training hours (Model 5), and in-service training hours (Model 6) were entered one by one.⁶ These models can make it possible to examine the impact of each of level-2 variables on the levels of force adopted by police with all the level-1 independent variables controlled. Each model was expressed as:

$$\text{Level-1 model: Contrast } m: \eta_{mij} = \beta_{0j(m)} + \beta_{1j(m)} (\text{Arrestee age})_{ij} + \beta_{2j(m)} (\text{Arrestee race})_{ij} + \beta_{3j(m)} (\text{Arrestee gender})_{ij} + \beta_{4j(m)} (\text{Officer age})_{ij} + \beta_{5j(m)} (\text{Officer race})_{ij} + \beta_{6j(m)} (\text{Officer gender})_{ij} + \beta_{7j(m)} (\text{Office suspect race interaction})_{ij} + \beta_{8j(m)} (\text{Resistance})_{ij}$$

$$\begin{aligned} \text{Level-2 model: Contrast } m: \beta_{0j(m)} &= \gamma_{00(m)} + \gamma_{01(m)} (\text{Level-2 variable}) + u_{0j(m)} \\ \beta_{1j(m)} &= \gamma_{10(m)}, \\ &\sim \\ \beta_{8j(m)} &= \gamma_{80(m)}. \end{aligned} \quad m = 1 \text{ \& } 2$$

Results

Table 1 reported descriptive statistics about all the variables included in the analysis. Concerning the dependent variable, levels of police force adopted during arrest situations, most of police encounters with citizens (77.1 percent) were resolved peacefully, where only ‘officer presence or verbal command’ was sufficient to arrest suspects. In 20.6 percent of cases, police officers used ‘empty hand control’ tactics to subdue arrestees. ‘Any weapons’ were adopted in only 2.3 percent of cases, which supported the previous findings that police use of a weapon is a rare event (Bayley & Garofalo, 1989).

For the individual level variables, 27.4 percent of arrestees were younger than 25 years old, 40 percent of them were between 25 and 35, and 32.6 percent of them were older than 35. Almost half of the arrestees were either African American or Hispanic, and four fifths of the arrestees were male. In contrast, 7.2 percent of officers were younger than 25 years old, 62.3 percent of them were between 25 and 34, and the rest of 30.6 percent of officers were older than 34. Most officers were white (77%), and 90 percent of the officers were male. In 40 percent of police citizen encounters, white officers arrested non-white suspects. Finally, suspects resisted police arrest in six percent of the total encounters.

For the inter-jurisdictional independent variables, the mean of racial heterogeneity values was 35.95 (SD = 10.09). The average violent crime rates among the eight jurisdictions were 947.5 per 100,000 population (SD = 609.03), and the average unemployment rates were 4.96 (SD = 1.05). The mean hours of pre-service training for the eight police agencies were 1,149 (SD = 516.18). The participating agencies also provided 34.63 hours of annual in-service training (SD = 36.97). Compared to the nation-wide averages of 1,040 hours of pre-service training and 43 hours of annual in-service training, the current study sample showed little discrepancy.

< Insert Table 1 here >

All results of HLM analyses were reported in Table 2. The one-way ANOVA model via generalized HLM revealed significant between-jurisdiction differences for both contrasting odds ratios. For Contrast 1 of the ANOVA model, the log-odds of using “any weapon” was significantly smaller than the log-odds of using “officer presence or verbal command” ($\gamma_{00(1)} = -3.692, p < .001$). For Contrast 2 of the ANOVA model, the log-odds of using “empty hand control” was also significantly smaller than the log-odds of the reference category ($\gamma_{00(2)} = -1.269, p < .05$). For both contrasts, there was statistically significant variation between jurisdictions in the log-odds of using “any weapon” and “empty hand control” relative to the reference category (see Table 2). Both contrasts produced relatively high reliability estimates (for contrast 1 = .975, for contrast 2 = .996). Thus, the one-way ANOVA model satisfied the eligibility for further complicated multi-level analyses.

The results of the generalized HLM for both the random intercept model (Model 1) and the intercept as outcome models (Model 2 through Model 6) were also reported in Table 2. Model 1 observed the impact of individual level variables on police officers’ decision-making on use of force continuum. In terms of the first contrast of Model 1, the log-odds of using “any weapon” relative to “officer presence or verbal command” became significantly higher when arrestees were male ($B = 1.018, \text{Odds-ratio} = 2.767, p < .01$), and they resisted police arrests ($B = 1.155, \text{Odds-ratio} = 3.174, p < .001$).⁷ Arrestees’ age and race, all demographic variables for police officers, and incongruent impact of race did not produce any significant impact on the levels of force used by police officers.

In the second contrast of Model 1, the log-odds of using “empty hand control” relative to “officer presence or verbal command” produced similar patterns. Arrestees’ gender ($B = .312, \text{Odds-ratio} = 1.366, p < .001$) and their resistance to the police ($B = 1.602, \text{Odds-ratio} = 4.964, p < .001$) remained statistically significant. When arrest situations involved experienced police officers ($B = -.160, \text{Odds-ratio} = .852, p < .01$), police empty control tactics were less applied. Arrestees’ age and race, officers’ race and gender, and racial interaction between arrestees and officers were not significant predictors in both contrasts.

< Insert Table 2 here >

In Model 2 through Model 6, the impact of both individual and municipal variables on police officers’ decision-making regarding use of force continuum was examined. As explained, heterogeneity values, violent crime rates, unemployment rates, pre-service training hours, and in-service training hours were addressed in each model as a

municipal variable. All individual factors in these five intercept as outcome models showed similar signs and values of significance as in Model 1. Regardless of the municipal variable included in each model, arrestees' gender and their resistance to police mainly determined police adoption of any weapons. Arrestee's gender, their resistance to police, and officers' age showed statistically meaningful effects on police 'empty hand controls' during arrest situations.

Regarding the level-2 variables, the main focus of the current study, not all of municipal variables were found to be significant. First, a measure of municipal racial homogeneity was examined in Model 2. The heterogeneity values failed to be significant throughout both contrasts (for contrast 1: $B = .019$, Odds-ratio = 1.019, $p < .80$; for contrast 2: $B = .003$, Odds-ratio = 1.003, $p < .95$). Although a previous study suggested "more homogenous districts are more likely to have higher levels of force" (Lawton, 2007, p. 177), the current study reports a dissimilar result that racial homogeneity values across police municipalities do not have any effect on the levels of police force.

Second, Model 3 utilized violent crime rates as a municipal variable. The log-odds of choosing both "any weapon" and "empty hand control" relative to "officer presence or verbal command" were higher where violent crime rates were also high (for contrast 1: $B = .002$, Odds-ratio = 1.002, $p < .10$; for contrast 2: $B = .001$, Odds-ratio = 1.001, $p < .10$). Despite the marginal significance, this could support the previous similar findings that areas "with higher [violent] crime rates are more likely to have incidents of ... force" because levels of police force mainly depend on the levels of violence or resistance during encounters with citizens (Lawton, 2007, p. 177). Third, unemployment rates were included in Model 4. In Contrast 1 of Model 4, the log-odds of using "any weapon" relative to "officer presence or verbal command" were higher in jurisdictions with higher unemployment rates ($B = 1.147$, Odds-ratio = 3.150, $p < .05$). In Contrast 2 of Model 4, the log-odds of using "empty hand control" relative to the reference category were also higher in municipalities with higher unemployment rates ($B = .726$, Odds-ratio = 2.067, $p < .05$).

Finally, the amount of pre-service training and the annual average of in-service training hours were examined in the last two models. The amount of pre-service training in Model 5 did not show any meaningful effect on police use of force in both contrasts. In Model 6, the length of annual in-service training showed positively significant relationships in both contrasts. In the first contrast, the log-odds of using "any weapon" relative to "officer presence or verbal command" were higher in jurisdictions that had a larger amount of annual in-service training hours ($B = 0.37$, Odds-ratio = 1.038, $p < .05$). In the second contrast, the odds of choosing "empty hand control" were also statistically higher than the odds of "officer presence or verbal command" where police agencies provided more in-service training hours ($B = .028$, Odds-ratio = 1.029, $p < .01$). It is reasonable to expect that police agencies with more managerial problems such as excessive use of force would provide more in-service training to handle the issue. Because the proof of appropriate in-service training can be used to help defend law suits against agencies and supervisors, agencies with relatively greater usage of force showed longer in-service training hours.

Discussion & Conclusion

Although examinations of situational, environmental, and organizational factors have been constantly recommended in the study of police use of force, most research has selectively focused only on some, not all, of those factors. Greater concentrations of individual factors such as race, gender, age, and resistance to police often resulted in limited understanding of the impact of environmental and organizational factors on police use of force. Most prior studies on the influence of poverty, crime rates, and racial heterogeneity were based on a relatively small number of police departments. The current study addressed the issue by examining neighborhood contextual and organizational factors in various police agencies with individual variables controlled.

Initially, the current study examined the impacts of individual level variables on police use of force. Although being a minority has played an important role in explaining police use of force, the current analysis of 8,798 arrest cases in the eight police agencies does not support one of the assertions of social threat or racial threat theories that a certain racial minority becomes a target of police use of force. Arrestees' race was not statistically significant in both contrasts of all HLM analyses. In addition, officers' race and racial interaction effects between officers' being white and arrestees' being non-white did not produce a significant relationship. Instead, the current study confirmed the previous finding that resistance to police mainly determines police use of force (Garner et al., 2002; McElvain & Kposowa, 2008; Son et al., 1998). Police officers in the current study were approximately three times more likely to apply weapons and five times more likely to employ an empty hand control when they were confronted with resistance, especially by male arrestees. Except the officers' age in Contrast 2 of Model 1 through Model 6, which

was found to have a significant and negative relationship with using ‘empty hand control’ tactics, none of other level-1 variables produced a significant relationship. The current finding does not automatically support the concepts of symbolic assailants because this study did not focus on whether police officers’ authority was challenged by arrestees’ antagonistic demeanor. This study, however, can suggest that police use of force is not affected by arrestees’ race, at least in the eight jurisdictions.

Second, this study found some influences of neighborhood contextual variables on police use of force. In regards to composition of racial minorities at an aggregate level, this research does not sustain racial threat theories. The HLM analysis controlling for racial heterogeneity values did not reveal any tangible explanations about disproportionate victimizations of racial minorities from police use of force. Unlike a recent study where racial heterogeneity values indicated a marginal, although insignificant, relationship with levels of police force (Lawton, 2007), the current research found that race does not play an important role in predicting levels of police force at both individual and aggregate levels. This study also incorporated violent crime rates and unemployment rates under the premise that residents in areas with higher violent crime rates and unemployment rates often times are labeled as a social threat. Although Lawton (2007, p. 180) suggested that “officers exposed to areas with higher rates of use-of-force incidents may develop coping strategies by which they use the higher levels of force less frequently,” theoretically, the total number of incidents of police use of force might be increased in areas with higher violent crime rates. This study, with a weak significance ($p < .10$), may indicate that police officers working in municipalities with higher crime rates use weapon or empty hand control tactics more frequently than those working in areas with lower violent crime rates. The discrepancy with the previous finding might result from the differences in study areas and units of analysis. While Lawton’s (2007) suggestion was based on 23 districts in one city, the current study examined variations across different cities. This study also found that unemployment rates showed a positive and statistically significant impact on police use of higher levels of force. This finding, with no surprise, confirms the previous finding that higher unemployment rates increase the levels of police force (Smith, 1986).

Finally, this study, by including police pre-service and in-service training hours in the analyses, attempted to reflect the recommendations of prior research that organizational factors are one of the strongest determinants of predicting police use of force. As good police management reduces unnecessary use of force by training subordinates, police officers with more training can be expected to rely on less lethal force. This study, contrary to the expectations, found that the level of training at the police academy does not explain officers’ decision-making on the use of force continuum. In addition, the length of annual in-service training at the department level showed a statistically significant but positive relationship with higher levels of force.

Careful attention, however, must be paid to the finding. It can be interpreted two different ways. First, the causal direction between in-service training hours and use of force may have been opposite from our expectation. Because this study used cross-sectional data, it was impossible to examine the effect of in-service training hours on the level of police use of force. This study just showed a simultaneous relationship between in-service training hours and police use of force. The significant positive relationship between in-service training hours and police use of force, then, would mean that agencies with higher levels of excessive use of force just provided longer in-service training hours in order to handle the use of force problem by the agency administration. Second, this result may not imply that pre-service training and in-service training cannot reduce the amount of police force in a given situation. Rather, the finding indicates that overall training hours do not measure police training that predicts levels of force used by officers because police academy training, field training, and departmental in-service training do not exclusively focus on use of force. Therefore, studies in this field must directly connect police use of force with the details of police academy training and departmental policies such as force continuum, simulation training, weaponless tactics, and requalification (Conti, 2006; Gallo et al., 2008).

This study has several limitations. First, the sample of this study does not represent the United States (Garner et al., 2002). Instead, it was collected by a convenient sampling method. Its limited external validity requires cautious interpretations of the study findings. Although this study employed HLM as an analytic tool, the level-2 variables could not be included in the same model because of the limited level-2 sample size. Second, as indicated earlier, more accurate measures of police training are required to evaluate the actual impacts of police training on the levels of force used by officers. Third, police organizational factors also include requalification, discipline, supervision, communication, and hierarchy of authority (Dias & Vaughn, 2006). Therefore, future studies are advised to include detailed police training programs and other administrative factors in the analysis model where a larger number of randomly selected police departments participate.

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Table 1. Descriptive Statistics for Variables in the Analysis ($N = 8,798$)

	<i>M</i>	<i>SD</i>	<i>Mdn</i>	<i>Min</i>	<i>Max</i>
Dependent Variable	—	—	3	1	3
1 = Any weapons ($n = 206, 2.3\%$)					
2 = Empty hand control ($n = 1,810, 20.6\%$)					
3 = Officer presence or verbal command ($n = 6,782, 77.1\%$)					
Independent Variables for Level 1					
Arrestee age	—	—	2	1	3
1 = Below 25 ($n = 2,414, 27.4\%$)					
2 = 25 ~ 35 ($n = 3,520, 40.0\%$)					
3 = 36 and above ($n = 2,864, 32.6\%$)					
Arrestee race (Black or Hispanic = 1)	.54	.50	—	0	1
Arrestee gender (Male = 1)	.81	.39	—	0	1
Officer age	—	—	2	1	3
1 = Below 25 ($n = 631, 7.2\%$)					
2 = 25 ~ 34 ($n = 5,477, 62.3\%$)					
3 = 35 and above ($n = 2,690, 30.6\%$)					
Officer race (White = 1)	.77	.42	—	0	1
Officer gender (Male = 1)	.90	.30	—	0	1
White officer/Non-white arrestee (Yes = 1)	.40	.49	—	0	1
Arrestee resistance (Yes = 1)	.06	.24	—	0	1
Independent Variables for Level 2					
Heterogeneity value	35.95	10.09	39.35	20.00	47.00
Violent crime rate	947.50	609.03	846.00	229.00	1,919.00
Unemployment rate	4.96	1.05	5.05	3.30	6.80
Pre-service training	1,149.00	516.18	944.50	641	2,146
In-service training	34.63	36.97	23.50	8.00	120.00

Table 2. Hierarchical Linear Modeling Results

Variables	ANOVA	Model 1	Model 2	Model 3
Contrast 1 (Any weapon use vs. Officer presence or verbal command)				
<i>Level 1</i>		<i>Coefficient/Odds Ratio</i>		
Arrestee age	—	-.131/.877	-.130/.878	-.130/.878
Arrestee race	—	.638/1.894	.643/1.902	.637/1.890
Arrestee gender	—	1.018/2.767**	1.016/2.762**	1.018/2.767**
Officer age	—	.253/1.288	.252/1.286	.255/1.291
Officer race	—	.480/1.616	.479/1.615	.482/1.620
Officer gender	—	.498/1.646	.498/1.645	.496/1.642
WO/NWA ^a	—	-.167/.846	-.166/.847	-.169/.845
Arrestee resistance	—	1.155/3.174***	1.152/3.164***	1.151/3.162***
<i>Level 2</i>				
Heterogeneity value	—	—	.019/1.019	—
Violent crime rate	—	—	—	.002/1.002 [†]
Unemployment rate	—	—	—	—
Pre-service training	—	—	—	—
In-service training	—	—	—	—
$\gamma_{00(1)}$	-3.692/.025***	-3.804/.022***	-3.805/.022***	-3.812/.022***
<i>Random Effect</i>				
χ^2	756.979***	637.127***	622.123***	300.006***
Variance	3.080	2.683	3.095	1.842
Reliability estimate	.975	.971	.975	.958
Contrast 2 (Empty hand control vs. Officer presence or verbal command)				
<i>Level 1</i>				
Arrestee age	—	-.082/.922	-.082/.921	-.082/.921
Arrestee race	—	.244/1.277	.244/1.276	.243/1.276
Arrestee gender	—	.312/1.366***	.312/1.366***	.312/1.366***
Officer age	—	-.160/.852**	-.160/.852**	-.159/.853**
Officer race	—	-.069/.933	-.068/.934	-.068/.934
Officer gender	—	.185/1.203	.185/1.203	.185/1.203
WO/NWA ^a	—	.012/1.012	.012/1.012	.012/1.012
Arrestee resistance	—	1.602/4.964***	1.600/4.952***	1.599/4.950***
<i>Level 2</i>				
Heterogeneity value	—	—	.003/1.003	—
Violent crime rate	—	—	—	.001/1.001 [†]
Unemployment rate	—	—	—	—
Pre-service training	—	—	—	—
In-service training	—	—	—	—
$\gamma_{00(2)}$	-1.269/.281*	-1.295/.274*	-1.295/.274*	-1.295/.274*
<i>Random Effect</i>				
χ^2	991.869***	673.008***	670.713***	633.998***
Variance	2.011	1.392	1.623	.975
Reliability estimate	.996	.994	.995	.991

^a WO = white officer, NWA = non-white arrestee.

[†] $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2. (continued)

Variables	Model 4	Model 5	Model 6
Contrast 1 (Any weapon use vs. Officer presence or verbal command)			
<i>Level 1</i>			
	<i>Coefficient/Odds Ratio</i>		
Arrestee age	-.133/.875	-.131/.877	-.130/.878
Arrestee race	.639/1.894	.640/1.896	.639/1.895
Arrestee gender	1.017/2.764**	1.017/2.765**	1.017/2.765**
Officer age	.245/1.278	.252/1.287	.252/1.286
Officer race	.486/1.625	.482/1.619	.484/1.622
Officer gender	.500/1.649	.497/1.644	.498/1.645
WO/NWA ^a	-.167/.847	-.168/.845	-.169/.844
Arrestee resistance	1.151/3.160***	1.152/3.165***	1.147/3.149***
<i>Level 2</i>			
Heterogeneity value	—	—	—
Violent crime rate	—	—	—
Unemployment rate	1.147/3.150*	—	—
Pre-service training	—	-.000/.999	—
In-service training	—	—	.037/1.038*
$\gamma_{00(1)}$	-3.799/.022***	-3.809/.022***	-3.808/.022***
<i>Random Effect</i>			
χ^2	185.700***	615.950***	96.386***
Variance	1.416	3.106	.921
Reliability estimate	.948	.975	.922
Contrast 2 (Empty hand control vs. Officer presence or verbal command)			
<i>Level 1</i>			
Arrestee age	-.082/.921	-.082/.922	-.081/.922
Arrestee race	.245/1.277	.245/1.278	.244/1.276
Arrestee gender	.312/1.366***	.312/1.366***	.312/1.366***
Officer age	-.161/.852**	-.161/.852**	-.161/.851**
Officer race	-.068/.934	-.069/.933	-.067/.936
Officer gender	.185/1.203	.185/1.203	.186/1.204
WO/NWA ^a	.012/1.012	.012/1.012	.010/1.011
Arrestee resistance	1.599/4.950***	1.600/4.951***	1.594/4.926***
<i>Level 2</i>			
Heterogeneity value	—	—	—
Violent crime rate	—	—	—
Unemployment rate	.726/2.067†	—	—
Pre-service training	—	-.000/.999	—
In-service training	—	—	.028/1.029**
$\gamma_{00(2)}$	-1.295/.274*	-1.295/.274*	-1.294/.274***
<i>Random Effect</i>			
χ^2	574.660***	676.818***	336.964***
Variance	.946	1.593	.353
Reliability estimate	.991	.994	.976

^a WO = white officer, NWA = non-white arrestee.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Notes

¹ Garner et al. (2002) provided in their paper all information about racial composition, percentage employed, crime rates, and hours of recruit training of the participating police agencies, however, they did not include those organizational and contextual variables in their analysis because of their analytic method.

² For more details on these three sets of data see Garner et al. (2002), Garner, Schade, Hepburn, & Buchanan (1995), and Alpert and Dunham (1998).

³ While the location of chemical prays on the continuum of force has failed to gain unanimous approvals by practitioners and researchers, many police departments consider nonimpact weapons less lethal than batons (Alpert & Dunham, 1999; Lawton, 2007). Most law enforcement agencies in the current study also placed pepper sprays less fatal than impact weapons; therefore, empty hand control included use of pepper sprays.

⁴ The ordinal logit regression model used the cumulative probability, which led to the cumulative logit, or a “proportional odds” (Raudenbush & Bryk, 2002, p. 319). This model assumed that there was the same magnitudes of effects by independent variables toward every cumulated attributes of the dependent variable (Long & Freese, 2006). That is, the coefficients of the independent variable in the model should be identical across each regression model.

⁵ *m* represents the answer categories of the dependent variable (any weapons and empty hand control) while *M* denotes the reference category of the outcome variable (officer presence or verbal command).

⁶ The limited number of cases for police agencies prohibited the current models from including all municipal variables at the same time since ten cases are ideally required for every level-2 variable (Raudenbush & Bryk, 2002).

⁷ Considering the relatively large sample size ($N = 8,798$), the current study reported only *p*-values less than .01 for level-1 variables.