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EVALUATING THE EFFECTS OF FATIGUE ON POLICE PATROL OFFICERS

FINAL REPORT

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Executive Summary

Police accidents, injuries, and misconduct extract heavy human and economic costs. Empirical research and practical experience indicate that fatigue associated with the pattern and length of work hours contribute to these problems. Fatigue arising from sleep loss, circadian disruption, and other factors worsens mood and may be expected to increase the probability that officers will be involved in official misconduct. At the same time, it worsens relations with their co-workers, their families, and the communities they serve. Fatigue also increases the probability that police officers will be involved in accidents that put themselves and their communities at risk due to decreased alertness and impaired performance.

With the exception of research on shift rotation and moonlighting, little attention has been paid to the ways that police officers' hours of work affect their performance. Perhaps as a result, many law enforcement agencies fail to limit hours of work. Although the work hours of many other occupational groups are regulated to protect worker and public safety, double and triple work shifts are common in police agencies, with some officers working well over 1,000 hours of overtime a year. In addition to sleep loss, this overtime leads to erratic work hours that magnify fatigue-related problems by causing chronic sleep disruption.

Further, the focus on community policing places additional demands on personnel resources. Police managers often meet such demands by increasing the amount of overtime that officers work (Worden 1995). Ironically, recent research raises the possibility that excess fatigue associated with police overtime may have adverse effects on police-community relations and public safety. This pilot project evaluated the prevalence of objectively measured fatigue in a sample of patrol officers. Additional data were collected to explore the possible causes of officer fatigue (such as department

policies and practices) and its potential effects (such as poor performance, health, safety and community relations).

This project's findings have great relevance since increased fatigue worsens mood and adds to the likelihood of poor judgment and the misuse of force (see Vila 1996). This, in turn, impacts police integrity by increasing the probability of misconduct, which corrodes fragile police-community interactions built on the cumulative history of police-citizen encounters. Moreover, the likely effects of fatigue on officer stress, reactions to stressful circumstances, and family well being are central to law enforcement family support.

This project considered the prevalence and possible consequences of excess work-hour related fatigue among patrol officers in four major police agencies in different regions of the country. To collect this information, researchers:

- collected and analyzed data on police work hours, work hour policies and procedures, accidents, injuries, illnesses, misconduct, and citizen complaints;
- conducted self-report surveys and focus groups involving officers and their families to gather information about subjective experiences of fatigue and impressions about its effects on professional performance, physical and emotional well-being, and personal lives; and
- measured the extent of officer fatigue using computer-based noninvasive eye reaction tests of readiness for duty.

The data revealed significant levels of fatigue among officers who reported that they routinely worked more consecutive hours than would be legal in other public service industries. In fact, from the objective measures, levels of fatigue six times higher than those found among shift workers in industrial and mining jobs were discovered. In addition, high levels of sleep pathologies were found from the self-report measures of sleep quality where only 26 percent of officers reported averaging the seven or more hours of sleep per day that research finds are minimally required for good health. The

project also examined many causes and correlates of fatigue and reached preliminary conclusions about its impact on the health, safety, and performance of officers. Several guidelines for reducing fatigue or ameliorating its effects are offered.

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Section 1:
Introduction

In her 1994 address to the American Society of Criminology, Attorney General Janet Reno criticized researchers for failing to deal with practical concerns and provide timely public policy guidance (Reno 1995). With that concern in mind, this research is an effort to help police officers and managers better address a serious potential threat to the safety and health of officers and the communities they serve – a threat that strikes at the heart of sound police-community relations. Specifically, we set out to objectively measure the extent of fatigue in patrol officers. We also sought to identify possible connections between administratively controllable factors and fatigue, and the relationship between fatigue and police performance, health, and safety.

The effects of fatigue on human behavior, performance, and physiology are well understood and widely known. Excess fatigue arising from sleep loss, circadian disruption and other factors tends to decrease alertness, impair performance, and worsen mood. As such, it is reasonable to expect that the performance, health, and safety of patrol officers, as well as police-community relations, are adversely affected by the fatigue officers experience. Moreover, there is evidence that much of the fatigue patrol officers experience could be controlled administratively, just as we control the working hours of many other occupational groups (Vila 1996). In light of the significance of the issue, we selected a multidisciplinary, multi-method approach to examine physiological and psychological effects associated with fatigue and how those effects may be expected to influence the performance, health, and safety of patrol officers.

Fatigue Ignored

Fatigue is widespread in police work. Rookies adjust to it as they do to the chafe of their

body armor. Veterans, including managers, scarcely notice the weight it adds to their professional burden and how it abrades their family life. Psychologists, health care professionals, researchers, and practitioners all acknowledge fatigue as a fundamental source of stress in the police environment (e.g., Brown and Campbell 1994; Burke 1994; Kroes 1985:32-36; Tang and Hammontree 1992; Violanti and Aron 1993; Violanti, Vena, and Marshal 1986; Yarmey 1990). That practitioners and administrators alike see fatigue as part of the police environment, however, has made it easy for both groups to ignore the possibility that it could be controlled. In addition, the current view of fatigue in policing has obscured possible links between fatigue and a number of seemingly intractable police problems. We control the work hours of truck drivers, pilots and medical interns – why do we ignore the obvious dangers associated with tired cops?

One reason for ignoring fatigue may be that we often have unrealistic physical and emotional expectations of patrol officers. While they frequently are called upon to resolve complicated, emotionally charged situations while facing threats to themselves and the public, they also struggle to stay alert during long periods of crushing boredom. Of course, these factors are compounded by job-related conditions that result in chronic lack of sleep and irregular sleep patterns (e.g., overtime assignments, sleep disruption associated with off-duty court appearances, and shift changes). Although much of this could be modified by administrative and regulatory action, all too often we not only fail to regulate the hours police officers work, we do little to monitor important administratively controllable sources of fatigue such as overtime. When we do, issues such as overtime are almost always treated as economic issues rather than performance, health, or safety concerns.

Common Sources of Fatigue

Beyond the physical and emotional stressors of policing, a number of factors that are amenable to administrative control are allowed to contribute to officer fatigue. For example, it is common for patrol officers to work double shifts to replace sick colleagues or in response to demands for service such as those that community-oriented policing programs often require (Worden 1995). Although the extent to which community-policing programs are dependent upon overtime officers is not yet fully understood, double and even triple shifts are hardly unknown (e.g., Bayley 1994:68). Such practices persist despite the awareness that overtime work adds to fatigue both by increasing the amount of work performed and by disrupting sleep patterns. Other job-related sources of fatigue include off-duty court appearances (e.g., Boorstin 1986; Duggan, 1993; Harriston 1993; Kroes 1985), shift changes (O'Neill and Cushing 1991; Pierce and Dunham 1992; Scott 1990), and the demands for additional training and education for officers.

Unfortunately, the effects of such stressors in the police patrol environment are also cumulative and synergistic. For example, overwork, boredom, and high anxiety each impact sleep and sleep patterns, thereby increasing fatigue and the rate at which it accumulates. The net effect of these multiple stressors, however, can be more than additive. Chronic exposure only magnifies the effects as maladaptations are developed in response. As the after effects spill over into leisure time, recuperation becomes all but impossible (Gardell 1987:65-66). The result is a vicious cycle where fatigue diminishes the ability to cope with other job stressors in a healthy manner. This, in turn, further disrupts sleep and sleep patterns and increases fatigue (e.g., Hockey 1986; Mitler et al. 1988; Monk 1990). In time, this process accelerates to seriously erode an officer's ability to function effectively.

Pervasiveness of Fatigue and Overtime

According to Vila (1996), the best previous evidence of the pervasiveness of fatigue comes from official data showing that officers in most law enforcement agencies work overtime and that overtime expenditures constitute a substantial proportion of many police agencies overall operating expenditures. While there is no direct information about how this overtime is distributed among officers or its impact, a recent preliminary survey of 10 of the largest U.S. police agencies indicates that formal policies limiting hours worked are almost nonexistent. As a result, patrol officers in high-crime urban areas routinely work a substantial amount of overtime, while some officers at times routinely work extended hours (Vila and Taiji 1999).

Although the limited information available tells us little about police fatigue directly, comparing police hours worked practices with those in other high-risk occupations suggests important public safety implications. For example, logic suggests the following propositions:

- Police patrol officers sometimes work overtime in excess of standards for other occupations where employee performance has important public safety implications and for which empirically based standards are enforced to avoid accidents and injuries caused by the detrimental effects of fatigue on worker performance.

- Police are at least as vulnerable to fatigue as members of other occupational groups whose hours of work are regulated as a matter of public safety. This is a reasonable assumption since the physiological, psychological, and cognitive demands of police work on officers in the patrol environment often equal or exceed the occupational demands placed on those groups.

- The potential social, economic, and human costs of fatigue-related impairment to police performance are equal to or greater than those for occupational groups where hours of work are regulated as a matter of public safety.

Few should dispute, then, that a focus on administratively controllable factors that influence fatigue is appropriate.

How Fatigue Affects Officer Performance, Health, and Safety

The literature on the effects of fatigue on performance, health, and safety has been developed extensively over the last half-century in such diverse fields as industrial and safety engineering, management, ergonomics, human factors, medicine, psychology, and sociology. Much of this research is directly relevant to police work. We know, for example, that fatigue associated with cumulative sleep loss and disruption of circadian rhythms due to such things as shift work and overtime assignments can decrease alertness, impair performance, and worsen mood (Bonnet 1985; Broughton and Ogilvie 1992; Mitler et al. 1994). As Rosekind et al. noted in their study of potential fatigue countermeasures, "Although many factors may affect the subjective report of fatigue (e.g., workload, stress, environmental factors), the most substantial empirical data suggest that the two principal physiological sources of fatigue are sleep loss and circadian disruption" (1994:328).

Fatigue and Cognitive Performance. As Cottam and Marenin advised, "Before the quality of patrol work can be improved, one needs to understand the obstacles which prevent accurate perception, information processing and judgment formation" (1981:132). Fatigue seems likely to interfere with decision making in three ways that are particularly problematic for police officers: first, by interfering with the formation of sound judgments; second, by encouraging unnecessarily constrained choices; and third, by inducing poor responses via increased irritability.

Mentally and emotionally, fatigue tends to reduce the abstractive and integrative

frames of reference that support and give perspective to our thoughts, activities, and perceptions. Because it narrows perspective, fatigue also tends to increase anxiety and fearfulness, thus lowering a person's ability to handle complex stressful situations appropriately and increasing the likelihood of stress-related illness (e.g., Brown and Campbell 1994; Kroes 1985:147-148; Monk 1990). As Park (1987) notes, fatigue tends to lower the quality of decision-making processes – and thus increase the probability that sub-optimal decisions will be made. Our personal experiences have taught us that tired people also are more irritable and prone to anger (e.g., Thayer 1989:110-136).

Recent research reported in the journal *Nature* equates 17 hours of sustained wakefulness with the level of psycho-motor impairment caused by a blood alcohol level of .05 percent. Twenty-four hours of sustained wakefulness decreases performance to a level equivalent to a blood alcohol concentration of .10 percent – legally drunk in every U.S. jurisdiction (Dawson and Reid 1997:235).

Fatigue and Officer Misconduct. Because fatigue tends to increase irritability and anxiety while diminishing the capacity of officers to make sound decisions, it is likely to increase the probability of officer misconduct, especially misconduct associated with the use of force. The hypothesis here is that excess fatigue will tend to promote officer misconduct above and beyond that which arises from venal, self-serving motivations. Even the best officers who are impaired by fatigue or chronic fatigue will, on occasion, overreact in threatening situations, lose their tempers, and make bad (perhaps illegal) decisions. Having done so, many may do as police officers and others in similar positions of power and authority have done in the past – lie about their misconduct and the misconduct of their peers (Bayley 1994:67; Christopher 1991:168-169; Knapp, 1972; Rudovsky 1992:482; Vila 1992).

Fatigue, Safety, and Accidents. Data on police accidents are sparse. Since the widespread adoption of soft body armor began reducing fatal shootings in the late-1970s, however, on average each year as many officers have been killed accidentally as feloniously. In other words, vehicle accidents (even excluding those during pursuits), falls, and accidental shootings now pose more risk to officers than gunfights, family disturbances, arrest situations, and traffic stops (Maguire and Pastore 1994:Tables 3.154, 3.157, and 3.160).

This is important since the link between fatigue and accidents in other occupational groups has been well established since early in this century (e.g., Münsterberg 1913; Dwyer 1991:57-58). Research consistently has shown that fatigue tends to undermine a person's ability to make sound decisions, control his or her emotions, and perform complex motor tasks such as driving a vehicle (e.g., Brown 1994; Viteles 1932:438-511). During periods of low activity, fatigue tends to increase accident-proneness. In other words, tired people have more accidents because they tend to be less attentive, slower to react to impending hazards, and more likely to respond inappropriately (Dwyer 1991; Lauber and Kayten 1988).

Thus far there has been little research on the effects of fatigue on police patrol officers *per se* – a gap this study begins to fill.

Obstacles to Reform

Vila (1996) has argued that the two major internal forces that could reform fatigue-related police problems appear to have been largely neutralized. For their part, managers often have little motivation to combat officer fatigue because their economic utility functions do not accurately reflect the true costs of overtime work. In fact, overtime provides them with

needed staffing flexibility. Employee organizations, meanwhile, are similarly unmotivated to improve things because their constituents tend to depend on overtime pay to maintain their lifestyles. Off-duty court appearances, one of the primary external sources of overtime, are similarly unlikely to be controlled; status differentials between police and the legal profession – and the fact that the courts are not charged for officer overtime – leave the judiciary with little motivation to curb overtime. Perhaps most important, the public, police managers and officers, health care professionals, and researchers generally appear to have been blinded by the misperception that fatigue is an immutable part of the police environment.

Research Goals and Key Questions

The research described here is an effort to assess the connections between administratively controllable sources of fatigue among police patrol officers and problems such as diminished performance, accidents, and illness. If existing research is correct in suggesting that such a relationship exists, then policy guidelines that lead managers and policy makers to minimize these threats are needed.

To address this question, this research employed a variety of methods, including self-report surveys, interviews, and focus groups with officers. For a more objective physiological measurement of fatigue, the *FIT Workplace Safety Screener* also was used. The FIT screener assesses fatigue by measuring a variety of physiological responses, including pupil response time. These data were used to focus on the following research questions:

What is the prevalence of officer fatigue and what are officers' attitudes toward it?

- How fatigued are patrol officers as measured by objective physiological measurements?

- How fatigued are patrol officers as measured by self-report?
- What are officers' attitudes toward fatigue in themselves and their peers?
- What do the families of police officers report about the prevalence of serious fatigue among officers?

What are the causes or correlates of officer fatigue?

- What is the relationship between fatigue and the number, type and pattern of hours worked per day, week, month, and year by patrol officers?
- What role do internal policies regarding shift schedules and rotation play in differences in overtime requirements between similar departments? That is, how much control do different policies provide managers regarding demand for overtime?
- Does officer fatigue differ based on age, gender, attitude, or work experience?

What are the effects of officer fatigue?

- What do patrol officers report about the subjective effects of fatigue and strategies for managing it?
- What do the families of police officers report about the effects of fatigue on officers and their families?
- Is there a relationship between fatigue and diminished performance as measured by such things as frequency of on-duty accidents, injuries or illness?

Can we measure officer fatigue objectively?

- How feasible is the use of objective, noninvasive eye reaction (Corfitsen 1993, 1994) and computer-based tests of readiness for duty?

A Summary of Ideas

Research on people in other occupational groups indicates that fatigue tends to decrease

alertness, impair performance, and worsen mood, and that sleep loss and circadian disruption are the two principal physiological sources of fatigue. Official statistics and anecdotal evidence indicate that excess fatigue may be prevalent in police work – especially among patrol officers in high-crime urban areas. Although we regulate the working hours of truck drivers, pilots, power plant operators, and medical interns, the need to control police fatigue has been all but ignored. Our traditional indifference toward this problem appears to have been bolstered by the social and economic construction of police work. The emergence of the community policing philosophy has challenged these constructs and compelled this research.

Section 2:
The Research Process

Four local police agencies participated in this study of fatigue and its effects upon patrol officer health, safety, and performance. Each agency was selected in response to its stated interest and willingness to participate in the research as well as the differences they represented in geographic location, shift and scheduling arrangements, and opportunities for overtime. Each agency is briefly described below.

Lowell, Massachusetts

This department's 250 sworn officers serve 103,000 residents – a ratio of approximately 2.4 officers per 1,000 residents. Although the department's authorized sworn personnel decreased by 8 percent in the early 1990s, since 1994 increased local funding and federal grants from the Department of Justice's COPS office have supported the addition of nearly 100 officers. Currently, 94 percent of the department's sworn personnel are assigned to field operations, over half of whom (56%) respond to calls for service. With a staff that is white (92%) and male (95%), the department's reliance on five 8-hour shifts per week and heavy use of two officer patrol units (53%) makes it more traditional in its personnel practices than the other project sites.

Polk County, Florida

With 359 sworn deputies (1993), the Polk County, Florida Sheriff's Department is larger than the Lowell Police Department, although the county's 400,000 residents result in a much lower ratio of deputies to residents (0.9 per 1,000 residents). Here, too, the vast majority of the department's deputies are white (93%) males (89%) assigned to field operations (94%) where more than half (57%) respond to calls-for-service. Unlike Lowell,

however, the sheriff's department has not experienced recent growth in the number of authorized positions. Throughout the project period, deputies in Polk County worked fixed 12-hour shifts.

Portland, Oregon

The largest department in the study, the Portland Police Bureau's 900 sworn officers (1993) serve a population of more than 450,000 residents – a ratio of 2.0 officers per 1,000 residents. The bureau's percentage of white officers (91%) is nearly identical to that of Lowell and Polk County, with its percentage of female officers (14%) falling between Lowell's five percent and Arlington's 19 percent. While Portland did not report the percentage of its officers assigned to respond to calls for service, the bureau indicated that around one in five patrol units was staffed with more than one officer. Because of the bureau's larger size, this project's data collection was limited to the Northeast Precinct, where the 97 officers work fixed 8-hour shifts.

Arlington County, Virginia

This municipal-styled sheriff's department provides all local police services in the county. In 1993, the department assigned 88 percent of its 321 sworn officers (1.9 officers per 1,000 residents) to field operations where 48 percent respond to calls for service – a relatively small proportion that reportedly results from the department's commitment to community-oriented activities at the expense of traditional patrol duties. In contrast to Lowell, where two or more officers worked together in slightly more than half of the patrol units, all of Arlington County's patrol units are one-person units. Arlington also stands out with the highest percentage of non-white (17%) and women (19%) officers. Arlington's officers work four 10-hour shifts each week.

Table 2.1
Characteristics of Study Site Agencies

Issue	*Portland OR*	*Lowell, MA*	*Polk, County, FL*	*Arlington County, VA*
Sworn Personnel	888	162	359	321
Answering Calls for Service	Unknown	56%	57%	48%
Per 10K Residents	20	16	9	19
Change 90-93	+15%	-8%	0	+4%
% in Field OPS	Unknown	94	94	88
% Male	86	95	89	81
% White	91	92	93	83
Mean Annual Overtime per Officer – 1993*	Unknown	$ 1,069	$ 153	$ 3,261
Mean Annual Comp Time per Officer – 1993*	Unknown	46 Hours	11 Hours	79 Hours
One Officer Patrol Units	79%	47%	100%	100%

* Includes all sworn personnel.

Collecting the Data

Once the agencies were recruited to participate, on-site coordinators were appointed to facilitate data collection. At each site, this person was responsible for maintaining the FIT screener, downloading and e-mailing the FIT data on a weekly basis, and coordinating the collection of the administrative data. The on-site coordinator maintained regular contact with PERF staff. In both Portland and Lowell the on-site coordinator was a patrol

officer/union representative who, we found, lacked the interest, time or authority needed to facilitate project activities. As a result, the pupilometry response rates were unacceptably low at both of these sites. In an attempt to improve response rates, a sergeant was selected in Arlington and the District Captain accepted the role in Polk County. Both of these sites had far higher participation.

Managing the Project Sites

Beyond the technical difficulties, several organizational issues also emerged to lower officer interest and participation. For example, of considerable consequence was the felonious killing of two Portland patrol officers and the wounding of three others in three separate shootings at the beginning, mid-point, and end of the six-month data collection period. Since officer participation in providing pupilometer readings was voluntary, these tragic events undoubtedly had an impact.

Project Support from the Unions

Being aware of the natural suspicions of officers, we had early concerns about how the project was to be introduced to them. Since Portland and Lowell both are unionized, we reasoned that their collective bargaining units would be valuable allies in ensuring a good reception and subsequent officer participation. In fact, we felt that union endorsement, support, and assistance could go far to reduce the resistance that we expected from some officers and increase interest in the project. Because participation in both the initial survey and the on-going pupilometry readings was voluntary, we hoped that the union's involvement might produce higher participation levels than otherwise might be expected.

In Portland we purposely down-played management's support, though managers were crucial at the outset and final stages of data collection. Except for a single meeting

during the first day of our initial site visit, we limited our visible official contact with department managers at the Northeast Precinct. We wanted officers to be certain that managers had no access to the data we were collecting. As such, we requested that the Portland Police Association's (PPA) president participate in roll call briefings to show support for the project. In addition, we asked for the precinct's PPA vice president to assist with enrolling officers in the study. The vice president also served as the local contact for officers who were newly assigned or otherwise arrived at the precinct following our visit. Unfortunately, the PPA vice president was ineffective in this role because of frequent absences, conflicts with his regular assignments, and the fact that his term of office expired in the middle of the study.

Data collection in Lowell began immediately after our initial site work in Portland. Again we relied heavily on a union representative and attempted to minimize the involvement of managers and administrative staff in the collection of the daily FIT data. Once again, despite the efforts of the PBA representative, FIT data collection fizzled due to inadequate training and inappropriate placement of the machines. As a consequence, voluntary participation rates declined as officers became discouraged by machine malfunctions and an inability to successfully provide results. Here, however, we also experienced a series of rumors among the officers that further discouraged participation. On several site visits we learned that officers had become convinced that the data were surreptitiously being monitored by managers and that the machine itself could damage a subject's eyes. While we attempted to dispel these rumors at roll call briefings, their impact on participation appears to have been considerable.

When the project was begun six months later in Polk County, it also met initial suspicion. Many deputies reportedly were certain that the project was an effort by the administration to justify removal of their 12-hour shift schedules. Despite our assurances

to the contrary, deputies continued to report their suspicions during the entire length of the research. Unfortunately, these suspicions apparently were reinforced by our follow-up contacts with deputies who had failed to provide pupilometry readings for several days in a row. In those cases, a popular captain who had agreed to administer and maintain the FIT screener was asked to send notes to each deputy at roll call inquiring about his or her absence. That their identity could be determined apparently caused many to wonder if our promises of confidentiality were being kept. Even so, participation remained strong in Polk County.

To our knowledge, no such issues arose in the Arlington County department. We attribute much of the improvement in both Polk and Arlington counties to more thorough and lengthy initial training, proper installation of the FIT machines, and close involvement of a well-liked and respected officer who made sure that the machines were functioning properly. This on-site person also regularly encouraged officer participation.

The Impact of Staffing Levels

An additional concern in Portland, which was less of an issue in the other agencies, was the generally low level of staffing at the Northeast Precinct – which remained at roughly 70 percent of its authorized strength before and during the study. Overtime had been so widely used to stretch resources at Northeast that it became difficult to cover officers' use of compensatory, vacation, or sick days through volunteers. As a result, officers at the Northeast Precinct sometimes covered two beats. This necessarily strained the officers in answering calls-for-service, engaging in traditional officer-initiated activities, and carrying out specific community-oriented responsibilities.

Threats to Validity

An additional confound that is difficult to control for in fatigue research is the need to differentiate between the effects of fatigue and those of enthusiasm – or a lack thereof – for the job. The hypotheses being tested posit relationships between fatigue as measured by the number and pattern of hours worked and accidents, illness, injuries, and misconduct. It is not hard to imagine that more hard-working and enthusiastic officers might incur more injuries simply in the course of making more arrests or handling more incidents. Because those arrests also tend to generate more court cases and thus more overtime, the possibility exists that fatigue and/or enthusiasm are positively related to the dependent variables.

Moreover, contrary effects might be associated with disaffected officers who attempt to avoid as much work as possible, tend to pad overtime (e.g., Bayley, 1994; Duggan 1993), and perhaps are prone to exaggerate injuries and take advantage of workers' compensation benefits. In order to deal with these potential threats to validity and discern the causal relationships more clearly, future research should include data from officers' performance evaluations as well as measures of work activity and productivity.

The Research Participants

The participants themselves included all sworn, nonsupervisory police officers assigned full time to patrol and/or community policing functions on the day that data collection began at each site. Unfortunately, it was not possible to enroll all officers who met these criteria. For example, in the Polk and Arlington County departments, officers assigned to some community policing details were not enrolled because they did not routinely attend the pre-shift briefing sessions where the pupilometry was to be administered. Because

the validity of the FIT tests is influenced by their frequency, these officers were excluded. Other groups, such as motorcycle officers in Polk County and Portland, were not included for similar reasons. Once the appropriate officers were identified and the purpose of the research was explained during officers' roll calls sessions, officers were asked to volunteer to participate at each site. In all, 89 officers in Portland's Northeast Precinct, 53 officers working regular patrol shifts from Lowell's headquarters stationhouse, 182 Arlington officers, and 55 deputies from Polk County's North substation were enrolled. As we will discuss later, however, not all officers participated either regularly or in all aspects of the study.

Data were collected at each site for a minimum of four months.

Table 2.2
Pupilometry Data Collection

Project Site	Date Begun	Date Complete
Portland	July 1997	January 1998
Lowell	August 1997	February 1998
Polk County	December 1998	June 1998
Arlington County	March 1998	June 1998

Assessing Officer Fatigue

Subjective Measures

To begin data collection at each site, all participating officers were assigned an identification number and given a self-report survey to complete during a roll call briefing. This five-minute survey asked officers about their experience with fatigue and explored their impressions about its effects on their professional performance, physical and

emotional well-being, and personal lives. While command or supervisory staff began these sessions by restating the goals of the research, project staff administered all surveys to maintain the participants' confidentiality.

The instrument itself included all 19 items from the *Pittsburgh Sleep Quality Index* (PSQI), combined with 25 questions developed by the research team in consultation with the departments (see Appendix A). The PSQI is scored as a global index as well as on seven subscales. These include subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction (Buysse et al, 1989). This instrument has been shown to discriminate between good and poor qualities of sleep with a high sensitivity and specificity (Buysse et al, 1989).

The additional survey questions were modeled on a mail-in survey developed by Vila and pilot tested in Stockton and Santa Ana, California. These questions were designed to capture information on officer demographics, experience, attitudes regarding fatigue in themselves and their peers, and perceptions regarding the causes and effects of fatigue. The resulting survey contained forced-choice and single-item fill-in responses. Prior to administration, the survey was pre-tested on a convenience sample of 20 patrol officers in an Orange County, California police department to identify terminology issues that might interfere with comparability of data between departments.

Objective Measures

In addition to the subjective measures of fatigue, all officers were asked to take a noninvasive eye-reaction test throughout the study period at the beginning of each on-duty shift. This objective test, referred to as the fitness-for-duty (FIT) workplace screener test, was developed by PMI, Inc. to identify changes in the central nervous system that

result from the influence of fatigue. The tester itself is a self-contained, tabletop unit that requires the test subject to look into a view port and visually follow a lighted target for approximately 30 seconds. This noninvasive test is completely safe and causes no discomfort to the participant.

Based on several decades of cognitive, neurophysiological and pharmodynamics research, the FIT test relies on involuntary eye reactions to light and measures the eye's saccadic velocity – the speed with which the eye follows a moving target. As such, unlike skill-based measures, the person being tested cannot consciously control the results. Validation studies on the instrument and methodology include research by Alcoa Aluminum, the Federal Railroad Administration, and fatigue research by the Walter Reed Army Medical Center on soldiers in combat (see Krichmar et al. 1997, 1998a, 1998b).

Each time an officer's fatigue scores fell in the top 10 percent of measures (the most tired), he or she was asked to complete a brief questionnaire designed to gather additional information to help explain his or her current fatigue level. For example, questions asked about medication use, the weather, or poor sleep during the previous day. A copy of this questionnaire is also contained in Appendix A.

Officer Demographics

Basic demographic information about participating officers was collected on two occasions: on the initial self-report survey and later on a *Demographic Data Form* (see Appendix A). In Polk and Arlington Counties, a Demographic Data Form was placed in each officer's mailbox with instructions to complete it and turn it in to the on-site study coordinator. In addition to age, sex, race, and marital status (which also were collected on the self-report sleep survey), this form included questions about years of police experience, amount of time on the officer's current shift, commuting time (as opposed to

commute distance), and the most recent performance rating. In Portland and Lowell, these data were collected through a review of administrative records – a cumbersome and labor-intensive process that motivated us to develop the Demographic Data Form used in Polk and Arlington.

Administrative Data

Administrative data also were collected from each participating agency through review of existing records. Among the data gathered were the number of work and leave hours taken by each participating officer during the study period, the shifts each officer worked, and the number and type of accidents, injuries, complaints and commendations each incurred during the study period.

At each site, project staff worked with department personnel to collect the administrative data from personnel files, payroll records, and other relevant administrative files. Because each organization has different record keeping procedures, however, the actual mechanics of data collection varied from department to department, with some departments refusing access to particularly sensitive information. For example, Arlington refused access to data on citizen complaints against officers because of confidentiality concerns. In addition, we were unable to obtain demographic data for Lowell officers from administrative records because of the department's record keeping procedures.

Below, table 2.2 summarizes the various data gathered.

Interviews with Department Command Staff

In addition to specific individual-level data, descriptive data were collected from each department on their policies and practices that might reasonably be expected to influence

Table 2.3
Administrative Data Gathered

Independent Variables	Data Elements	Data Source	Collection Method
Demographic, descriptive data	Age, gender, race, years of experience, commute distance, performance rating	Officer self-report	Survey and administrative records
Department policies and practices	Shift rotation practices, community policing practices	Staff interviews	Interviews
Number of work hours	Date and number of hours worked	Payroll data	Administrative records review
Pattern of work hours	Sequence of days on/ off, consistency of pattern	Payroll data	Administrative records review
Shift worked	Beginning and ending time of work	Payroll data	Administrative records review
Vacation hours	Date and number of vacation hours	Payroll data	Administrative records review
Other leave hours	Date and number of leave hours	Payroll data	Administrative records review

Dependent Variables	Data Elements	Data Source	Collection Method
On-duty accidents	Date, time and type of accident	Department records	Administrative record review
On-duty injuries	Date, time and type of injury	Department records	Administrative record review
Citizen complaints	Date and type of complaint	Department records	Administrative record review
Commendations	Date and type of commendation	Department records	Administrative record review

Officer illness	Number of sick hours	Payroll records	Administrative records review
Officer fatigue	Pupilometry reading total index	FIT Test	Daily eye test
Officer fatigue (self-report)	PSQI global index score	Officer self-report	Survey

hours worked and fatigue. Information was requested on the departments' shift length and pattern, community policing strategies, staffing levels, and budgetary allocations. These data were gathered at the end of the project during telephone contacts with representatives from each department's command staff. A copy of the data collection instrument is contained in Appendix B.

Focus Groups

Following the completion of the objective measures of fatigue, group discussions were held with two groups of officers and one group of spouses in Polk County and one group of officers in Arlington. One supervisor's wife was unable to attend the focus group meeting in Polk County, but spoke with the researchers in an interview setting.

The goal of each group discussion was to identify overlooked aspects of police fatigue, elicit unique personal observations and opinions, and generate explanations of preliminary findings. The sessions were conducted in facilities recommended by each department, and were open-ended and unstructured. In Polk County, the discussions with deputies were held in a small conference room adjacent to the roll call room at the North Substation during the shift change (between 5:00 p.m. and 6:00 p.m.) on two consecutive days. Day shift deputies attended during the last hour of their workdays while the

oncoming night shift deputies participated at the beginning of their workdays. The discussion session involving deputies' spouses was held at a local hotel meeting room. This session lasted nearly two hours. The solo spousal interview was conducted in a temporarily vacant office at the substation and lasted approximately 90 minutes.

Each Polk County discussion group involved approximately 12 deputies, all of whom were well acquainted with one another. Because of their comfort with one another, an informal atmosphere that might not have been possible with larger, less cohesive groups was adopted. This resulted in a smooth, comfortable pace that never became troublesome.

In all, 20 deputies, two shift commanders (lieutenants), and three field supervisors (sergeants) participated in the officer discussions in Polk County. These individuals represented two day (0600-1800) and night (1800-0600) shift teams. Their length of service varied from slightly more than a year to more than two decades. Both single and married officers were present, with the latter being from both young families and those where adult children no longer lived at home. Only one female deputy participated.

In Arlington County, approximately 15 officers participated in a single two-hour long focus group discussion. The session was held in the department headquarters in a room normally used to test taxi drivers. All of the participants were male and the group included both rookies and seasoned veterans who lived in a wide variety of household arrangements (single, married and with or without children). The participants had either volunteered to participate or were asked to join in the discussion by their supervisors.

At least two project staff members were involved in each focus group discussion (see Appendix B for protocol), with a female staff member leading the all-female spouse focus group in Polk County. Each participant was encouraged to recall his or her own experiences and discuss impressions about fatigue and work-hour issues. To safeguard

confidentiality, no audio or video recordings were made. Instead, researchers took notes by hand.

No group discussions were held in Lowell or Portland because we were unable to interest officers in participating.

Section 3:
Comparing the Sites

The analysis of fatigue began with a focus on the policies and practices of each agency that might impact the fatigue levels among patrol officers. These include technological issues, conditions that relate to working conditions, and other programmatic issues. Since these issues provide the context for the analysis of the objective measures of fatigue, we discuss them first.

Shift Schedules, Workday Length, and Days Off

Several aspects of shift work influence patrol officers' levels of fatigue. For example, work schedules may rely either on shifts that are fixed and allow officers to work regular portions of their day for extended periods of time, or that rotate and require officers to work around the clock every few weeks. Research elsewhere (Scott 1990) has demonstrated that such cycles are significant for the quality and regularity of sleep. In addition to rotation patterns, however, in policing the workday length also must be considered since 8-, 10-, and 12-hour schedules are in use.

Since the research on rotating shifts is clear as to their adverse impact (see, for example, Lewis 1985a; Mitler, Dinges, and Dement 1994; Monk 1990; Moore-Ede 1997), we agreed early on that this project's comparisons should be limited to "fixed" shift agencies representing 8-, 10-, and 12-hour schedules. Lowell and Portland, for example, rely on 8-hour shifts that easily and conveniently split the 24-hour day into three equal segments. Still, these agencies arrange their work cycles differently. In Lowell, officers work a "four on, two off" arrangement introduced over a quarter-century ago. From our

conversations, the officers generally seem to be satisfied with their 37-hour workweek. Portland's officers, on the other hand, work the more traditional "five and two" 40-hour week involving five workdays followed by two days off.

Until shortly before this study, Portland precinct commanders were given discretion to implement 10-hour shifts using a "four-on and three-off" arrangement for some or all of their patrol officers. At the Northeast Precinct, this alternative schedule had been available to some officers working the evening and early morning hours. Since then, however, bureau-wide policy has mandated 8-hour shifts, a reversion driven by budgetary constraints and the needs of managers who must contend daily with chronically low staffing levels. Many officers we met reported that they missed the 10-hour shift and desired its return since "compressed" work cycles increased their number of days off.

The three-hour difference in total hours worked between Lowell's "four-two" and Portland's "five-two" arrangements is likely to have little bearing on fatigue. The departments, however, do differ in other important ways. In Portland, the department's seven-day cycle results in regular days off on the same days every week. This is beneficial for those officers who manage to get (and retain) weekends off, but other officers complained of less desirable schedules.

The Lowell department, however, uses an even-numbered work cycle that results in a backward rotation of days off. As a result, over a seven-week period the schedule for each employee's days off covers all possible pairings. While this rotational arrangement results in irregular schedules, it has the advantage of giving every officer equal access to weekends off – regardless of seniority.

Arlington County employs a work cycle that consists of four consecutive 10-hour shifts followed by three days off. Since this seven-day cycle is continuously repeated,

officers' workdays and days off do not vary. While this arrangement leads to overlapping shifts (the 24-hour day is not evenly divisible by 10), patrol officers and first line supervisors appear to prefer it. In addition, according to the focus group participants, the overlap allows for additional in-service training and department or unit meetings. The department's managers, however, report that the agency's recent adoption of geographic-based responsibility has left them with "24/7" responsibilities, so they derive no direct benefit from their subordinates' 10-hour shifts.

Polk County, meanwhile, has utilized a 12-hour workday for several years. Approximately one year prior to this study, the department also moved from rotating to fixed shifts. The present fixed work cycle lasts 14 days and is arranged to ensure that deputies have two three-day weekends each month. The Polk County work schedule requires of deputies:

- two work days followed by two days off;
- three work days followed by two days off; and
- two work days followed by three days off.

As a general rule, no deputy works more than three consecutive days in any single 14-day cycle.

Shift and Schedule Predictability

In addition to shift schedules and length of workday, the participating agencies were compared on employee and organizational factors that might be expected to influence levels of fatigue. Included here were the degree to which patrol officers could expect to (1) enjoy predictable work schedules, (2) exercise influence over their individual

schedules, (3) maximize their access to shift work aspects generally thought desirable, as well as (4) limit their exposure to the undesirable aspects. For example, what influence or control could officers expect to exert over their preferences for particular shifts or days off, and how easily, or how often, could they be "bumped" to something less desirable through bidding mechanisms? Fixed intervals and seniority are the key features of Polk County and Lowell's approaches, but their intervals are quite different at six (January and June) and 18 months, respectively. Furthermore, Lowell's shift scheduling is contractual.

Among the more interesting and relevant policies we found included one in Polk County whereby lower level supervisors (sergeants and lieutenants) shift-bid before patrol deputies, thereby allowing the latter an opportunity to follow (or presumably avoid) certain supervisors. While patrol officers at the three other departments often might be able to accomplish the same end, it would be primarily informal and thus be far less predictable. Since a patrol officer's relationship with an immediate supervisor clearly bears on job satisfaction, performance appraisal, desirable assignments and promotion (see Brown and Campbell 1994), Polk County's approach could go far toward mitigating stress associated with unpredictability in one's shift, team members and days off. Interestingly, this system did not result from collective bargaining – indeed, the Polk County department is not a collective bargaining agency. Arlington does not engage in collective bargaining either. Portland and Lowell are unionized departments. Nonetheless, each agency has a bidding process for determining when, where, and with whom each police officer works. Arlington (non-unionized) and Portland (unionized) do not have formal bidding intervals as such, so the officers in those agencies face less predictable assignments.

In Arlington, retirements, resignations, and transfers at the middle and upper levels create occasional vacancies that echo through the department as officers migrate

toward what they perceive as more desirable positions. Obtaining a transfer within one of the county's four districts or commands is almost completely a matter of officer seniority. This means that employee movement often can occur quite quickly. In contrast, an inter-district transfer puts the transferring officer's seniority on hold for six months. This, of course, leaves the newly transferred officer at the bottom of the new district's seniority list and gives preference to officers with longer service within the district. As such, even with substantial seniority an officer generally cannot transfer to a new district *and* expect to receive a desirable work assignment.

Portland's bidding process also is seniority-based and includes the officer's shift (hours of the day), platoon (first-line supervisor and colleagues) and days off assignments. Unlike in Arlington, however, officers with seniority can bump junior officers in any of these assignment areas. The officer who is bumped is then given a 45-day delay in which he or she can bid for his or her second preference as well as make personal adjustments such as changes in child care. While we learned from our interviews that the seniority of officers can vary widely within precincts, this arrangement creates a situation where the transfer of a single senior officer can easily disrupt the work arrangements of the entire group.

Take-home Cars

Polk County provides its patrol deputies with official vehicles in which to commute to and from work. Although traffic officers in Portland can ride their motorcycles home and Arlington officers residing within the county have take-home cars (about one-quarter of the patrol officers), this practice is widespread only in Polk County.

Report Writing

Since report writing consumes substantial amounts of most officers' workdays, it was important to compare how each department managed this process. Arlington's focus on "customer satisfaction," for example, has led them to encourage complainants to report minor crimes (e.g., larceny) and cold crimes (e.g., a burglary discovered long after being committed) by telephone. Officers are dispatched on such calls only if complainants specifically requested them. Portland, too, has a telephone reporting unit. In addition, Portland officers often are available at precincts to take reports from citizens who walk up to the service counter. If an officer is not available for a walk-in complaint, the beat officer (or another officer who is reasonably close by) is dispatched to the precinct station to take the report.

In Polk County, reports are taken over the telephone only when (1) crimes are not in progress, (2) there are no suspects at the scene of a crime, or (3) there is no crime scene available. We were not able to obtain an estimate of the proportion of crime reports taken using this system.

Of the four departments, only Lowell does not take crime reports over the telephone, though complainants may travel to department headquarters for reporting purposes if the waiting time for an officer to arrive at the scene is objectionable. Based on observations during our six site visits to Lowell, it appeared that personnel staffing the desk considered these reports routine and generally were able to work them into their other duties.

Prior to the project period, Polk County deputies also were allowed to submit completed reports of minor crimes or infractions after their shift had ended. This allowed misdemeanor reports to be turned in at a later time rather than on overtime. At the end of

the pupilometer phase of the project's data collection, however, this practice was ended since it interfered with the department's computerized, automated crime analysis system called PROCAP. As such, by the end of the project none of the departments provided a means by which officers could reduce their shift-related report writing.

Technology Issues

The increasing use of computers in policing has had a significant impact on officer workloads. As in-car laptops become more available, the requirements of written reports that are physically submitted to supervisors have been greatly simplified. In Lowell and Polk County, for example, every patrol unit is so equipped and deputies at the latter explained that their electronic link to the department's mainframe computer simplifies their work in many ways. In Arlington and Portland, however, officers have access only to mobile terminal displays (MDTs) for dispatch and car-to-car communication. These units do not support the reporting process. While not a factor in this study, the Portland department is experimenting with laptop computer replacements for MDTs in one precinct which eventually will allow officers to move to a "paperless" reporting system. This test precinct was not involved in the study, however.

Officers in Court

Because of their ability to tightly control their professional affairs and run their courts largely as they see fit, the needs of the judiciary are typically superordinate to those of the police. While not completely insensitive to police agency or officer needs with regard to working schedules, special details, vacations, days off, and sleep patterns, influence over case scheduling is seldom extended to the police. This is so despite the awareness that

the only courtroom participants who routinely have non-typical work schedules are the officers who are required to attend, but seldom are needed, for the process. Indeed, judges, prosecutors, and defense attorneys who make up the courtroom workgroup typically confine their work to the daylight hours. While the vast majority of criminal cases are adjudicated through plea bargaining – and thus officers usually can count upon a final disposition around the time of the preliminary hearing – scheduling and appearing in court nonetheless present serious challenges for the police. As such, our research also was concerned about the steps that the participating agencies had taken to make court appearances a more manageable and less stressful activity.

One goal of case management from the perspectives of both the court and the police might be to ensure that officers are present only for those cases where their testimony is needed. While postponing (or losing) cases as a result of officer absence should be unacceptable, wasting an officer's time and impacting a police department's budget unnecessarily should be equally undesirable.

In the United States, coordination between the courts and the police generally has improved during the past few decades, and the participating departments proved no exception. For example, Arlington's department-based court coordinator helps to reduce unnecessary trips to court regarding felony cases. Officers call the day before a court date to find out the status of their case. Misdemeanor or infraction cases, however, enjoy no such attention. It is unclear whether this system excludes minor cases due to their greater numbers or because the charges are less serious.

In Lowell, a police sergeant coordinates between the court and officers slated to testify. Patrol officers receive some consideration regarding work cycles and days off through the district attorney's office and subsequent requests before the court. Similarly,

vacation and sick days can influence scheduling and court appearances in Polk County. There, deputies also call the day before a court date to confirm the need for their presence. In addition, with at least five days notice, court cases can be postponed for deputies with acceptable reasons.

In Portland, advance notice of the need to appear in court is provided through a Bureau-based court coordination office. Officers who call in by 5:00 p.m. the afternoon before a court date can find out if they still need to appear. Additionally, the subpoena process in Portland is now automated so that officers can determine if they have been subpoenaed simply by logging on through a computer terminal. Court dockets, however, are likely to be adjusted only for long-planned vacations or a change in an officer's days off.

Finally, only Polk County provides its patrol officers with electronic pagers to smooth the court appearance process. In each of the participating agencies, detectives or other specialized personnel routinely are so equipped.

Insights from the Focus Groups

Focus groups with officers were conducted in Arlington and Polk Counties to better understand the complexities of shift work issues. Among the subjects for discussion were officers' views on their shift arrangements, overtime, part-time work opportunities, educational requirements, and the impacts from each of these on safety and interactions between offices and the public. In all, one group of 15 officers met with project staff in Arlington and two groups totaling officers met in Polk County. An additional discussion group of four officers' wives volunteered to meet with project staff in Polk County. Efforts to organize officer groups in Portland were unsuccessful. No effort was made to conduct

focus groups in Lowell due to the poor participation by that department's officers in the project's pupilometry data collection.

Shift Arrangements

Interestingly, the participating deputies from Polk County were in nearly complete agreement that their agency's fixed 12-hour shift schedule significantly reduced their fatigue. In addition, they declared that their work schedules both increased work quality and improved their personal and family lives. These benefits, they explained, were the result of not just the 12-hour schedule, but the manner in which it was employed by their department. For example, road deputies and their supervisors previously (approximately one year prior to the start of this project) had worked rotating 12-hour shifts that moved them forward through the clock from days to nights and back to day shift work over a two-week cycle. The ill effects of these continually adjusting sleep cycles were compounded by the department's need for "relief" assignments that inserted deputies into varying shifts and locations over two- or three-day periods.

According to the discussion groups, the relief status was the worst aspect of their previous shift arrangement since it not only guaranteed constantly alternating sleep patterns but also introduced considerable unpredictability, a widely recognized and major stress agent. Both deputies and their spouses noted that the combination routinely left them sleep-deprived, irritable, and unable to plan for family or social events.

As for their current schedule, the deputies agreed that while 12-hour workdays are indeed quite long, each one-month period requires only 14 working days with stable sleep schedules. As a result, they contended that their fixed 12-hour shifts leave them feeling fresher on both workdays and days off while the predictability of schedules supports the

pursuit of personal interests and allows them to honor family responsibilities. Even so, when we suggested alternative 12-hour arrangements – such as when officers work four days followed by three days off – the deputies were less supportive. They explained that given the lengths of their shifts, they could feel the difference between their second and third day on duty. A fourth consecutive 12-hour day would be far less appealing. Indeed, having to work only one three-day work period each 14-day cycle was viewed as highly desirable by comparison.

The deputies' spouses echoed many of these sentiments, and provided additional details about the shift schedules' impact on their personal and family lives. One spouse, who noted that her husband had worked "every conceivable shift" in his 25 years as a police officer, was especially supportive of the current schedule. Although she agreed that the arrangement still failed to provide what might be termed a normal life, it was a dramatic improvement over the alternatives she had experienced. Still, being unable to start their day together due to her husband's early rise to make the 6:00 a.m. shift was a disappointment for at least one spouse. Her disappointment, however, was offset by the ability to play more golf together and schedule family activities.

While support for the 12-hour shift was considerable, it was not unanimous. For example, one spouse noted that her husband had previously worked 10-hour shifts at another agency and had found that adding two hours to the workday was more difficult than anticipated. The longer shift leaves him more fatigued at the end of the day and with fewer hours for family on workdays. She added that their son's approaching teenage years now has them wondering about the lengthy workday. A peer in this discussion group, however, responded that she too had seen a dramatic change in her husband, who had been chronically tired and "cranky" on the previous rotating shifts. In her case,

she explained, the 12-hour schedule had made her husband far more available to her, their two teenagers, and their 22-month old child.

The participating spouses were unanimous about the positive impacts from the fixed 12-hour shifts on their ability to pursue their *own* educational, work, and recreational interests, including family activities. While this relatively long shift reduced time with their husbands on workdays, they agreed that it significantly enhanced the time they have together on days off. Importantly, the fixed 12-hour day also allows for less expensive child care options since baby-sitters are needed only an average of three days a week.

In describing their work-related fatigue, deputies also mentioned the weather (especially foggy or rainy conditions during the night shift) as an important contributing factor. Even during the daylight hours, however, they noted that bad weather requires more conscious effort to maintain concentration. An officer's supervisor, shift (day or night), and relationship with co-workers also were described as important factors that either ease or exacerbate the strains of the job.

Although this study focused on uniformed patrol officers, project staff also met with line supervisors and watch commanders to explore their views. In Polk County, watch commanders reported that they routinely work 14-hour days since they arrive early to familiarize themselves with the previous day's activities and remain late to review the shift's paperwork. One lieutenant's spouse pointed out that stress and fatigue were most noticeable when her husband was involved in either disciplinary action against a subordinate or coping with heavy paperwork. Finally, general issues of field supervision were seen as less important causes of fatigue than were low staffing levels, routine or chronic family problems, and financial issues.

Shift-Related Overtime

Among the most significant sources of officer fatigue is an agency's use of duty-related overtime and special details. According to the discussion group participants, Polk County special details are available irregularly across the budget year. As the end of the budget year nears, overtime money typically runs out and compensatory time is substituted. This presents additional problems, however, since compensatory time must be used within the two-week pay period during which it was earned – one cannot "bank" compensatory time for later use. As for shift-related overtime, these officers explained that most results from calls for service or officer-initiated activity late in the shift, delays in processing arrests, and the need to put finishing touches on reports. As might be expected, each of these are more commonly associated with the day shift.

The deputies' also noted that considerable day shift fatigue stems from boredom on unusually quiet days. In contrast, night shift officers are usually occupied through the late night hours. This is usually followed by a relatively quiet period during the early morning that allows them to finish paperwork on time. Even an arrest long after midnight typically can be completed well before the end of the shift.

Extra-Departmental Work

Beyond their duty-required overtime and details, the discussion group participants also were asked about the impact that extra-departmental employment might have on their overall levels of fatigue. Although several deputies acknowledged that such outside work could be an important factor, they emphasized that in Polk County few officers took such jobs due to the ready availability of department sponsored work. For example, at least one small town in the county (Polk City) contracts with the sheriff's department for police

services. To meet the need, approximately 12 deputies work extra 8-hour shifts several times a month on their regular days off. The duty was not described as onerous, although it added substantially to these officers' incomes.

The preferred overtime opportunity, however, comes through the need for construction zone safety. Here, deputies can earn a county ordinance guaranteed $18 per hour monitoring traffic and providing a visible presence. While boring, the discussants explained that the work is neither stressful nor physically fatiguing since it usually involves little more than directing traffic. As a result, some deputies reported working as much as 30 extra hours a week. Four to six details a month (totaling between 30 and 40 hours) is more common, however.

In summarizing their off-duty employment, several discussion group participants noted that financial need made extra-duty jobs a necessity. For them, the department's use of fixed 12-hour shifts was especially important. The added days off, they explained, allowed time to generate supplemental income without undue difficulty. Other schedules, they added, often would require them to repeatedly work two jobs in a single day.

Educational Opportunities

Although a less significant influence, both line officers and supervisory participants in the discussion groups agreed that college attendance also contributes to fatigue. Yet the 12-hour shift arrangement actually makes it more difficult for officers to further their educations despite their own apparent interest and the department's strong encouragement, because the use of varying days off conflicts with class schedules.

Performance and Public Interactions

There also was general agreement among the participants that fatigue can and does degrade their interactions with the public. Specifically, this included reduced patience, increased irritability, and a diminished capacity to identify alternative responses to both specific incidents and the broader issues that might lend themselves to problem solving. Additionally, they were concerned that the quality of both routine and crisis decision-making is degraded by fatigue and that the overall quality and quantity of work suffers as tired officers become less engaged in self-initiated activity.

Officer Safety

Finally, the focus groups were concerned that officer safety can be compromised by fatigue since it decreases alertness, leads to complacency, and slows cognitive and physiological response times. However, several participants thought that the adrenaline rush associated with potentially perilous situations enabled officers to handle them even when tired. Unfortunately, adrenaline neither instantaneously nor easily ameliorates chronic fatigue. Furthermore, this stimulus-response mechanism itself contributes to fatigue (Bonnet 1985; Hockey 1986; Thayer 1989; Broughton and Ogilvie 1992). Still, the few officers who spoke out on this matter dismissed the idea that fatigue might affect their ability to recognize important cues. No one mentioned the possibility that their personally degraded performance might adversely affect the safety margin for their colleagues.

Section 4:
The Extent, Causes, and Impacts of Officer Fatigue

The wealth of data collected during this pilot study – nearly 60,000 observations on up to 75 raw and calculated variables – will take years to analyze completely. In the interim, however, our analyses in this section of the report will summarize the relationships between important variables, identify promising areas for additional research and data collection, and address what we feel are the three most pressing issues. Specifically,

1. To what extent are patrol officers fatigued?
2. What are the causes and correlates of their fatigue?
3. How does fatigue affect officer safety, health, and job performance?

Because this was a pilot study, identifying the methods to examine the issues of fatigue was the first research task at hand. While various strategies were available, their applicability to the police setting had not been explored and the comparability of results between methods was not known. As a result, we focused on three diverse approaches that we attempted to administer at each of the four sites.

- First, we used self-report questions developed by project staff to ask officers about their own levels of fatigue and their concerns about other officers who are tired.

- In addition, we administered the *Pittsburgh Sleep Quality Index* (PSQI), a well-validated psychiatric questionnaire (Buysse et al. 1989) that is effective for assessing the usual quality of subjects' sleep and identifying clinical sleep pathologies.

- Finally, we employed the *FIT™ Workplace Safety Screener*, a well-validated pupilometry device that performs a brief eye test to screen for involuntary eye responses that are sensitive to performance risk factors associated with excessive sleepiness. This instrument was selected as an objective measure of officers' fitness for duty.

As we noted earlier, participation by officers varied considerably – both between sites and among the methods used.

Self-Reports of Fatigue Prevalence and Attitudes Toward Fatigue

As the initial measure of the prevalence of fatigue – and to gather information on officers' attitudes concerning the associated issues – a self-report instrument was developed and administered to all participating officers during each initial site visit. Specifically, the instrument sought to identify each officer's sleep habits, the quality of sleep experienced, and the attitudes and issues that each officer associates with fatigue. In an effort to minimize the inconvenience to officers, questions used to calculate the PSQI global scores were combined and administered with this instrument. In all, 298 officers (79% of the total eligible) – 44 in Lowell (83%), 42 in Portland (47%), 56 in Polk County (100%), and 156 in Arlington County (86%) – completed the instrument, which asked each officer about:

1. The number of hours of actual sleep he or she had experienced each day during the past month [SLEEP].
2. How often he or she feels tired at the beginning of his or her work shift [TIRED].
3. How concerned he or she would be if another patrol officer on his or her shift was very tired [CONCERN].
4. How much of a problem it has been during the past month for him or her to maintain sufficient enthusiasm to get things done [PROBLEM]
5. How often during the past month he or she has had trouble staying awake while driving, eating meals, or engaging in social activities [TROUBLE].
6. The degree to which overtime work affects basic aspects of his or her life, including

- Family and personal relationships [FAMILY],
- Social and recreational activities [SOCIAL],
- Physical fitness and health [PHYSICAL],
- Income [INCOME], and
- Job performance [JOB]

A copy of the instrument is included as Appendix A.

As table 4.1 demonstrates, only 47 percent of officers reported averaging seven or more hours of sleep per night, an amount that health experts and sleep researchers are unanimous is minimally needed (see, for example, Moore-Ede 1993; Monk and Follard 1992). In fact, as a group the officers reported receiving an average of only 6.6 hours per day, while 4 percent averaged fewer than five hours. Aside from the issues of sleep quality and recuperative time, these results support an initial hypothesis that fatigue is a pervasive police issue.

Table 4.1
Average Hours Officers Slept per Day During the Previous Month

Hours of Sleep Reported	*Portland*	*Lowell*	*Polk County*	*Arlington County*	*All Officers*
4 Hours	0%	5%	0%	0%	1%
4 to 5	2	5	0	4	3
5 to 6	21	14	9	16	15
6 to 7	38	26	42	32	34
7 to 8	26	30	35	28	30
8 or More	12	21	15	19	17
Average Hrs	6.4	6.6	6.7	6.6	6.6
S.D.	0.96	1.30	0.91	1.18	1.18
N=	42	43	55	158	298

As table 4.2 demonstrates, the extent to which officers were concerned about fatigue issues also is consistent with the idea of its pervasiveness in their work. For example, 14 percent of participating officers reported that they are "always" or "usually" tired at the beginning of their work shifts, with 18 percent adding that during the previous month they have had either "somewhat of a problem" or "a big problem" keeping up enough enthusiasm to get things done. Similarly, 16 percent reported that they have had trouble more than once a week staying awake while driving, eating meals, or engaging in a social activity.

Table 4.2
Distribution of Officer Responses on the Issues of Fatigue

	Most/Always				*Least/Never*
	1	*2*	*3*	*4*	*5*
How Tired	3%	11%	55%	29%	2%
How Concerned	19	35	24	18	4
Extent a Problem*	1	17	45	36	n/a
Extent Trouble*	4	12	24	60	n/a
Effect on:					
Family	4	35	45	8	8
Social	6	40	43	9	2
Physical	8	44	43	4	2
Income	1	<1	11	37	51
Job	1	16	62	17	4

* Variables Problem and Trouble were derived from the PSQI and were ranked on a 4-point scale.

Officers also reported considerable concern regarding fatigue in their co-workers. More than half (54%) advised that they would be "concerned" or "very concerned" if another patrol officer on their shift was working while very tired. Nearly half (46%) also

noted that overtime work was "somewhat harmful" or "very harmful" to social and recreational activities that help people recover from job stress and fatigue and to family and personal relationships that help keep officers grounded emotionally. Overtime, however, was acknowledged by nine in 10 (88%) officers as being very helpful financially, and relatively few thought that overtime work affected their own job performance. This view is, of course, at odds with the nearly 50 percent of officers who reported that overtime assignments are sometimes, usually, or always responsible for them feeling tired at the beginning of a work shift. This and similar findings will be discussed further when we explore the causes and correlates of officer fatigue.

PSQI Measures of Sleep Quality

The assumption supporting our use of this instrument is that people who regularly obtain sufficient good quality sleep will tend to be less fatigued than those whose sleep quality usually is poor. In describing the PSQI itself, its developers note that the instrument "provides a standardized, quantitative measure of sleep quality that quickly identifies good and poor sleepers, and compares favorably with the 'gold standard' of clinical and laboratory diagnosis....A global PSQI score > [greater than] 5 provided a sensitive and specific measure of poor sleep quality relative to laboratory measures" (Buysse et al. 1989:205). The 19 questions from the PSQI contribute to both a global index of sleep quality as well as seven subscales that assess subjects'

- perceptions of the quality of their sleep;
- length of time to fall asleep;
- length of actual sleep;
- efficiency of sleep (i.e., how much actual rest it provides);
- presence of sleep disturbances;

- use of sleep medications; and
- the extent to which sleep difficulties interfere with day-to-day activities.

A copy of the index is included in Appendix A.

For this study, a total of 303 officers from the four participating departments responded to the PSQI questions. Five officers, however, failed to do so completely. Of the remaining 298 officers, two out of five (41%) demonstrated clinical sleep pathologies as evidenced by global scores greater than 5.0. In fact, the average global score for all officers was 5.28 (SD 2.70), a level twice as high as the mean global score (2.67 with a SD of 1.70) found in the control group used in the original PSQI validation study (Buysse et al. 1989:200). Table 4.3 below shows the PSQI scores by department. Figure 4.1 shows the relative distributions of PSQI global scores.

From these findings, it appears that clinical sleep pathologies are widespread in each of the participating agencies. This was especially so in Portland, where 55 percent of the officers who completed the PSQI had global scores greater than 5.0 – indeed, 36 percent scored above 7.0. In contrast, only about one third of the Lowell officers received scores above 5.0. Nevertheless, a far higher proportion of Lowell's officers (5%) scored above 13.0, indicating extreme sleep pathology.

FIT Test

The *FIT™ Workplace Safety Screener* provides a direct, objective measure of an officer's fatigue level on the job each day. Because nearly all of the pupilometry readings were taken at the beginning of officers' work shifts, it is reasonable to assume that the instrument's readings provide a conservative measurement of officer fatigue over the

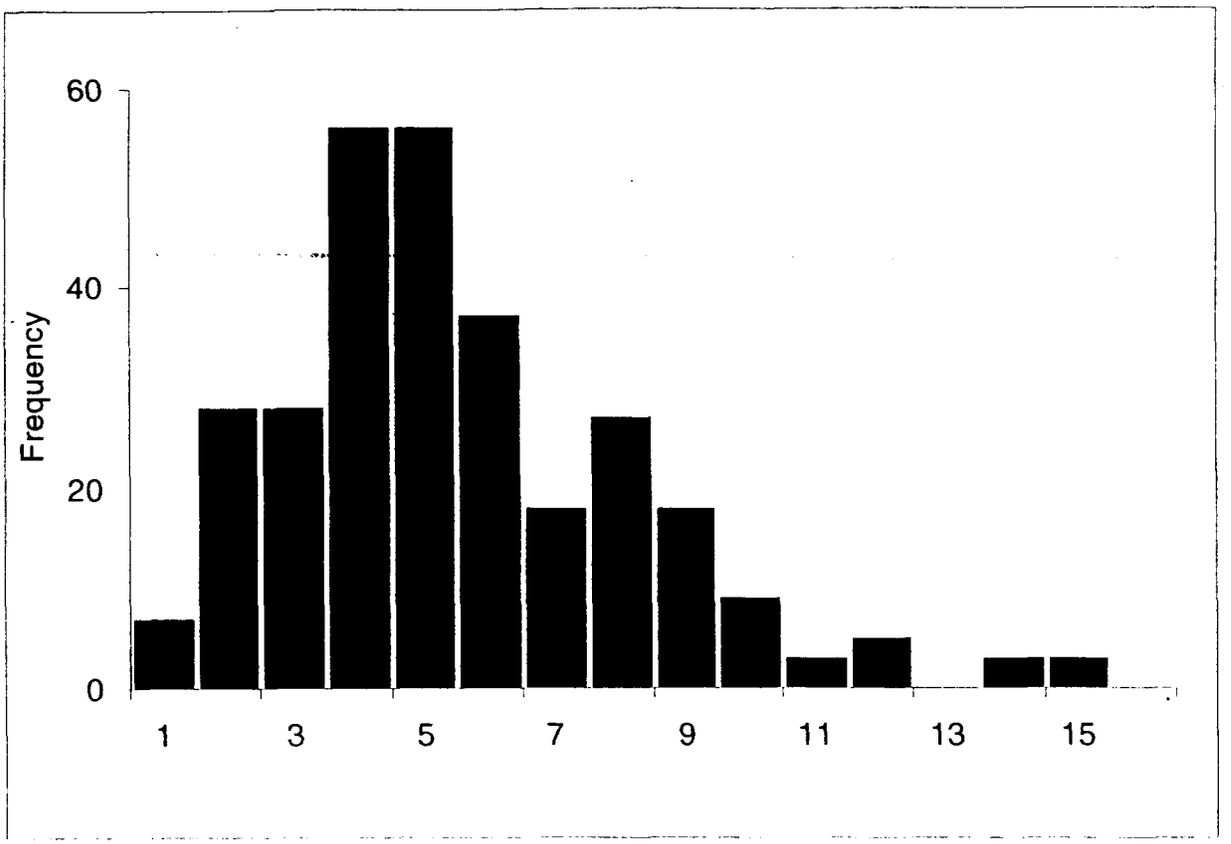
Table 4.3
Comparison of PSQI Global Scores
(by department)

PSQI Global Scores	*Portland*	*Lowell*	*Polk County*	*Arlington County*	*All Officers*
5 or Below	45%	66%	59%	60%	59%
Greater than 5	55	34	41	40	41
Greater than 7	36	23	21	20	23
Greater than 9	12	7	5	8	8
Greater than 11	7	5	2	3	4
Greater than 13	2	5	4	1	2
Average Score	6.1	5.3	5.1	5.1	5.28
S.D.	2.90	2.96	2.49	2.61	2.70
Modal Score	4.5	4.5	4.0	3.5	4.5
N=	42	44	56	156	298

course of a shift; officers may be expected to become more fatigued as their shifts wear on. Importantly, recent research comparing cognitive psycho-motor performance impairment due to sustained wakefulness with impairment from alcohol consumption found that 17 hours of sustained wakefulness decreased performance to a level equivalent to a blood alcohol concentration of .05 percent – the standard in many European countries for alcohol intoxication. Twenty-four hours of sustained wakefulness was equivalent to a blood alcohol concentration of .10 percent (Dawson & Reid 1997).

Because there was substantial variation in the regularity with which officers from the different departments took the pupilometry test, our analysis paid special attention to not only the prevalence of fatigue, but whether significant differences existed between officers who provided regular pupilometry readings and those who did not. This included

Figure 4.1
Distribution of PSQI Scores



a comparison of overtime work and work hour regularity on days where pupilometry readings were provided and those for which no *FIT* test was taken.

The Extent of Fatigue

The FIT test measures four different parameters during each test:

- pupil diameter,
- pupil response delay to a standard change in light level,
- magnitude of pupil constriction in response to standard light level change, and
- saccadic velocity (the speed with which the eye follows a moving target).

These measurements then are compared to each individual's baseline parameters using squared z-scores which provide a standardized measure of deviance from mean baseline scores for each parameter throughout each subject's participation. Because these z-scores are independent, the sum of the squared z-scores provides a joint probability distribution or "Index" score for each test session that is described by the chi-square distribution. Under this scheme, large Index scores indicate poorer performance relative to the baseline established by each individual.

Applying the chi-square distribution allows us to calculate the chances that an unimpaired person will receive a particular Index score. Given four degrees of freedom (four different parameters are measured), 99.9 percent of normal test subjects will score less than 18.5, 99.0 percent will score less than 13.3, and 95 percent will score less than 9.5. Respectively, then, we may use Index scores as indicators of the probability that a test subject is highly impaired.[1] Table 4.4 below describes the prevalence of FIT Index scores at various levels among the 379 officers from whom a total of 5,274 pupilometry test results were collected during the study.

Perhaps the first observation from these data is the extent to which the pupilometry results are dominated by the Polk and Arlington County departments. Still, with the possible exception of Lowell, where participation was by far the lowest for this measure, the prevalence of fatigue among officers appears fairly consistent. As such, combining the Index scores across all four departments appears to provide a reasonable, if conservative, measure of the prevalence of fatigue-related impairment.

Specifically, at least 6.2 percent of all officers taking the FIT test were highly impaired by fatigue with a certainty of p=0.001 according to this objective measure. If this

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[1] In the validation studies for FIT, a score of 18.5 corresponded with a blood alcohol level of .08%.

probabilistic threshold is lowered to the p=0.01 level, we found that 11.4 percent of officers likely may be impaired. At p=0.05, 19 percent of officers were impaired. These levels of fatigue impairment among police patrol officers are quite high when compared to other occupational groups that have used the FIT test.

For example, in industrial settings such as mining and manufacturing where FIT tests are routinely administered to determine employee fitness for duty, the p=0.001 threshold (Index score ≥18.5) generally is used. According to Krichmar (1997, 1998, 1998; see also Russo et al. 1998; Rowland et al. 1997), only about 1 percent of shift

Table 4.4
Prevalence of High Pupilometry Index Scores Among the Participating Officers

	Portland	*Lowell*	*Polk County*	*Arlington County*	*All Agencies*
Total FIT readings	493	69	2,288	2,424	5,274
Participation rates*	4.5%	1.2%	44.2%	19.4%	15.3%
Average Score	6.90	9.53	6.76	6.82	6.81
Median Score	4.64	3.45	3.99	4.37	4.18
Scores:					
> 18.5	32	9	149	140	329
	6.5%	13%	6.5%	5.8%	6.2%
> 13.3	56	13	267	264	599
	11.4%	18.8%	11.7%	10.9%	11.4%
> 9.5	103	19	425	456	1,002
	20.9%	27.5%	18.6%	18.8%	19%

* Participation rate is the proportion all regular workdays during which participating patrol officers successfully recorded a FIT score.

workers at heavy industry plants fail the FIT test at this level. The highest prevalence of fatigue-related failure Krichmar can recall was 3 percent during a flu epidemic at one plant (1999, personal communication). This is in contrast to the more than 6 percent of participating officers whose Index scores were greater than 18.5 – a state of fatigue that exceeds statutory intoxication in many states (.08 is increasingly common).

Generalizing from the FIT

In all, pupilometry results were calculated for officers on 5,274 out of 34,581 regularly scheduled workdays – about 15 percent of the total possible. Given the significance of the extent of fatigue found, and the variability in participation among and within the agencies, we were concerned about differences that might exist between the FIT tested days and other workdays when pupilometry results are not available. This is important because we can only generalize the pupilometry results to all study participants if there is no significant difference, or if the differences indicate that officers are likely to be more fatigued on days when pupilometry tests were not taken. As such, a comparison of other schedule related data on both tested and other on-duty days is relevant.

Two broad work-hour issues are especially important for estimating officer fatigue: overtime and work-hour regularity. The extent of overtime is relevant both because extended hours of work might logically be expected to increase fatigue and because overtime work disrupts the rhythms of daily life – especially sleep patterns. For this reason, we gathered daily information on officer overtime that we coded according to the disruption each assignment was likely to produce. As such, during each of the 59,459 days for which work-hour and/or pupilometry data were collected, the extent of overtime

worked was scored as either: A (> 7 hours), B (4 to 7 hours), C (>0 to 4 hours), or D (0 hours). The average number of overtime hours worked on FIT versus non-FIT days was then compared for differences.

Work-hour regularity also is likely to be associated with fatigue. As discussed earlier, interruptions in work patterns tend to disrupt sleep and other routine activities that affect officers' ability to recuperate from the challenges of police work. Over the short term, erratic work patterns can add to fatigue and stress. Over the longer term, it seems reasonable to expect that more erratic work patterns will increase the likelihood that officers will develop sleep pathologies and become chronically fatigued. Chronic fatigue can be an important component in a vicious cycle where fatigue impairs job performance, ability to deal with job stress, ability to sustain healthy personal relationships, and ability to recover from the challenges of the job. Each of these, in turn, promotes still more fatigue. Although previous research in sleep laboratories and with other occupational groups has brought attention to this issue (see Bonnet 1985; Broughton and Ogilvie, 1992; Monk 1990; Mitler, Dinges, and Dement 1994), we are aware of no other research that directly measured work-hour regularity among police or other occupational groups. Part of this effort, therefore, was devoted to such measurement.

We relied upon three related measures to examine work-hour regularity on a day-to-day basis: regularity, serial regularity, and smoothed regularity. Each should be inversely related to fatigue. Regularity was calculated as the proportion of the time that an officer's work/time off schedule was uninterrupted by extra work of some sort (perfect Regularity = 1.00). Serial regularity, meanwhile, measured the number of days in a row an officer worked without deviation from his or her usual schedule. Finally, because of the importance of longer-term irregularity as a potential promoter of chronic fatigue, we

also calculated smoothed regularity, a measure of average regularity during the 10 days previous to each observation, to identify general trends in regularity. Later, in the analysis of the effects of fatigue, we will use the variance of serial regularity during the course of each officer's participation in the study as an indicator of chronic fatigue.

As table 4.5 shows, overall overtime and work patterns are quite similar on days where officers provided FIT readings and days where they did not. Of the three agencies where substantial numbers of FIT readings were recorded, only Portland officers tended

Table 4.5
Comparison of FIT vs. non-FIT Tested Workdays

	All Agencies		*Portland*		*Polk County*		*Arlington County*	
	FIT	**No-FIT**	**FIT**	**No-FIT**	**FIT**	**No-FIT**	**FIT**	**No-FIT**
Extent of Overtime:								
> 7 hours	1.7%	2.3%	2.6%	3.0%	2.9%	2.6%	0.2%	0.7%
4 to 7 hrs	2.1	3.8	10.1	5.2	1.0	1.9	1.4	1.8
0 to 4 hrs	6.9	5.5	7.3	3.5	7.7	9.7	6.1	7.1
0 hours	89	88	80	88	88	86	92	90
Average Overtime	.37	.48	.82	.54	.44	.50	.21	.30
Variance	2.1	2.7	3.7	3.0	3.0	3.8	.80	1.3
Regularity:								
Mean	.87	.87	.79	.88	.83	.78	.92	.88
Variance	.11	.11	.17	.11	.14	.17	.07	.11
Serial Regularity:								
Mean	8.8	10.9	6.0	11.0	6.6	6.4	11.3	9.4
Variance	148	306	69	245	87	79	207	166
Smoothed Regularity:								
Mean	.86	.87	.83	.88	.81	.80	.90	.88
Variance	.02	.02	.02	.02	.03	.04	.01	.02
Workdays N=	5,274	54,186	493	17,665	2,288	6,722	2,424	20,062
Percent	8.9	91.1	2.7	97.3	25.4	74.6	10.8	89.2

to have substantially higher levels of overtime during test days. Portland officers also reflected this same pattern for regularity measures. It thus seems possible either that Portland's officers who took the FIT test worked more overtime than their peers or were more likely to take the test during periods in which they worked more overtime. It may also be, however, that the low test rates in Portland – tests were taken on fewer than 3 percent of the possible workdays – have provided unstable results for the department.

The results are far more similar when we include the data from Polk and Arlington Counties, which account for 89 percent of all FIT tests and 53 percent of the overall workday observations during the project. In both of these agencies, FIT test days were similar to non-test days and showed similar regularity patterns. In fact, when all three agencies are considered together, there is little difference between the test and non-test days. What differences do exist favor less, rather than more, fatigue during the FIT test days (average overtime was nearly 30 percent higher on non-FIT days) suggesting that officers were more fatigued on days when pupilometry results were not produced. If so, generalizations about the prevalence and seriousness of fatigue among patrol officers based on this project's data will be conservative and may underestimate the extent of the problem.

Prevalence and Officer Attitudes Summary

Evidence from self-reports, the PSQI, and the pupilometry all point toward substantial fatigue among a significant proportion of officers. According to the PSQI, 41 percent of the surveyed officers had clinical sleep pathologies; the mean global PSQI score for officers was almost double that of the control group that validated the study. Although there was some variation between departments – likely the result of different policies or

procedures to be explored later – no department had fewer than 34 percent of officers with clinical sleep pathologies. Further, no department's mean global PSQI score was less than 190 percent of the control group mean.

Objective measures of officer fatigue also showed that officers were highly impaired (i.e. at a level similar to a blood alcohol concentration > 0.10 percent) on at least 6.2 percent of the 5,274 workdays for which pupilometry tests were taken. The prevalence of highly impaired officers was roughly six times that found among shift workers in industrial settings where the FIT test is administered routinely – a result that was obtained using the most conservative threshold. Further, a comparison of overtime, overtime magnitude, and work-hour regularity between the workdays for which FIT readings were successfully obtained (15% of the total) and the non-FIT test days indicates that the prevalence of fatigue as measured by pupilometry may be generalized with good confidence to all 39,855 work days for which data were collected.

Officers' self-reported attitudes about fatigue showed substantial concern regarding fatigue in co-workers although indirect evidence suggests that they did not believe themselves to be as vulnerable as others. Officers seemed well aware of the negative impact of overtime on family, social, and recreational activities. Despite acknowledging the connection between overtime and fatigue, however, fewer than 18 percent of the responding officers reported that overtime work was detrimental to their own job performance.

Causes and Correlates of Fatigue

As noted, the participating departments varied considerably with regard to the number of officers providing data concerning individual levels of fatigue (the dependent variables).

We began the project's data collection with departments in Portland and Lowell after an agreement with the Santa Ana, California police department became entangled in a dispute between the chief and union representatives on unrelated issues. After our experiences with these initial departments, our procedures for data collection, officer training, and maintenance on the pupilometry equipment were modified to enable the collection of larger, and more complete, data sets from the departments in Polk and Arlington Counties.

Covariation Between Dependent Variables

As expected, the PSQI global scores and the self-reported variable TIRED are significantly correlated at the p=.01 level.[2] In addition, significant relationships between the various thresholds of the FIT test are to be expected since the .05 threshold includes each of the more stringent levels. Interestingly, significant correlations were not found between the FIT results and either the PSQI or the officer self-reports of fatigue. This is so regardless of whether the data are pooled or examined individually by department.

When the fatigue variables are examined by shift, however, considerable variation in the direction and strength of the relationships between the FIT and self-reported TIRED variables are found.[3] For example, as table 4.5 shows, while these relationships are weak in the aggregated data and on day shift, they are relatively strong and positive

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[2] Correlations between dependent variables were calculated using one-tailed Kendall tau-b. List-wise deletion was used for the all-department data; pair-wise deletion was used for the individual-department data in order to alleviate problems with low frequency of FIT tests for some departments. Neither strategy for handling missing cases produced markedly different results in any of the correlational analyses.

[3] Here, two-tailed analyses were used because of inconsistent directionality revealed during comparisons by department. Pair-wise deletion of missing cases was used to maximize comparisons.

(significant at the .05 level in one case) for evening shift and consistently negative for midnight shift (with respective significance levels of .11, .19, and .06 at the FIT05, FIT01, and FIT001 categories). These differences suggest the possibility that responses to TIRED may be influenced by circadian rhythm bias. That is, irrespective of their actual levels of impairment due to fatigue, officers may tend to perceive themselves as being less tired at the beginning of day and evening shifts, when their normal body rhythms are in the "awake" portion of their daily cycles. Conversely, officers coming on duty around midnight are much more likely to feel tired because their bodies are attempting to prepare for sleep rather than work. It is unclear, however, why the strength of the positive correlation between TIRED and FIT in the evenings is so strong. Evening shift officers who had reported being less likely to be tired at the beginning of their shifts than officers on other shifts were more likely to show impairment on daily pupilometry tests – once again, suggesting circadian rhythm bias.

Work-Hour Scheduling, Regularity, and Timing

Our ability to examine longitudinal relationships between fatigue and work-hour scheduling, regularity, and timing is constrained by the fact that officer pupilometry readings are available for only about 15 percent of their regularly-scheduled workdays. However, as previous analyses demonstrated, it is reasonable to generalize our findings from the days in which FIT tests were taken to those in which they were not because the two groups are so similar.

Among the first observations to be made is the extent that the data are drawn from the Polk and Arlington County departments. As noted earlier, this resulted from the lessons learned in the initial project sites (Portland, Santa Ana, and Lowell) that led to

Table 4.5
Correlations Between Fatigue Variables by Shift
(Kendall tau-b)

	PSQI	*TIRED*	*FIT at .05*	*FIT at .01*
		All Departments and Shifts		
TIRED	-.3741**			
FIT at .05	-.0219	.0499		
FIT at .01	.0166	.0010	.6944**	
FIT at .001	.0720	-.0457	.5298**	.6247**
		Day Shift		
TIRED	-.4033**			
FIT at .05	.0000	.0336		
FIT at .01	.0008	.0140	.7173**	
FIT at .001	.0317	-.0040	.5034**	.5996**
		Evening Shift		
TIRED	-.3523**			
FIT at .05	-.2046	.4371*		
FIT at .01	.0000	.2894	.6995**	
FIT at .001	.2677	.1207	.4470*	.6309**
		Midnight Shift		
TIRED	-.3820**			
FIT at .05	.0000	-.2471		
FIT at .01	.0299	-.2012	.7023**	
FIT at .001	-.0674	-.2972	.4781**	.5824**
		Shift Varies		
TIRED	-.5129*			
FIT at .05	.2147	.2542		
FIT at .01	.1179	.0365	.6745**	
FIT at .001	.2147	.1788	.7511**	.6347*

* p = .05 ** p = .01

improved data collection procedures and increased officer participation. As a result, these two departments account for three-fourths of the PSQI and self-reported fatigue (TIRED) observations and 87 percent of the pupilometry readings.

With this qualification in mind, we then applied Kendall's tau-b to measure the correlation of PSQI global scores and self-reported levels of fatigue to the number of overtime hours officers worked, the regularity with which workdays occurred during officers' regularly scheduled work times, the average regularity of officers' work hours during the study period, and the variance of serial regularity of officer work hours. This last variable was intended as a measure of chronic work-hour disruption. While we believe that each of these comparisons is important, as awareness of the project has increased among police officials, the comparison of greatest interest has been an examination of the relationship between fatigue and the number of hours worked per shift, a variable that we measured by calculating the modal number of regular hours each officer worked per day.

Analysis of All Agencies

Examining all departments together reveals consistent correlations between average regularity 1) and the variance of serial regularity, 2) the PSQI measures, and 3) TIRED measures that were significant at the $p = .001$ level. The relationship between modal regular work hours per day and PSQI was significant at the $p = .05$ level; for TIRED it was significant at the $p = .01$ level.

Average regularity describes the proportion of an officer's workdays that was uninterrupted by extra work of some sort. Each day that conformed to the regular work schedule and did not entail overtime work of some sort was counted as a 1. Disrupted

days were counted as 0, then the average score for all days was calculated. Perfect regularity equals 1.0 on this scale. Thus, we would expect average regularity to be inversely related to PSQI global scores to the extent that frequency of work-hour disruption contributes to sleep pathologies. Similarly, we would expect TIRED (self-reported fatigue) to vary with average regularity since higher scores indicate officers feeling tired less frequently at the beginning of their work shifts. Surprisingly, however, what we found was quite the opposite. In fact, one explanation may be that the causal order is actually reversed – officers with lower sleep quality are more often tired at the beginning of their shifts and therefore less likely to work overtime assignments. We will return to this idea in our discussion of age and experience.

Correlations between modal hours of work per day and PSQI and TIRED measures lend support to the contention voiced by officers at each of the departments: fewer, longer workdays per week (such as occur during 'compressed' work schedules) do appear to be significantly related to lower PSQI scores and lower self-reported frequency of being tired at the beginning of shift. It was not possible, however, to determine *how* compressed schedules help diminish fatigue. What is clear is that nearly all of the line officers who worked 10 and 12-hour days, as well as those in Portland who recently had returned from 10-hour to 8-hour schedules just prior to the project start, voiced the belief that compressed schedules provided more time for recuperation and minimized weekly commuting. Some managers and line supervisors also suggested that compressed schedules limited the need for overtime assignments because late arrests and incomplete reports at end of shift were less common.

Neither overtime nor regular hours worked was correlated with any of the dependent variables, and none of the work-hour variables appeared to be correlated with

the proportion of FIT index scores above each of the impairment thresholds.

Analysis of Individual Agencies

The direction of significant correlations found in each department's work-hour data and fatigue measures tended to be consistent with the significant findings when the data from all departments were combined for analysis. The only inconsistency involved the Lowell officers, among whom we found two anomalies: the relationship between TIRED and average regularity was significant and *positive*, as was the relationship between TIRED and variance of seriality. This contrasts with the results from Polk and Arlington Counties, each of which showed significant negative relationships between these variables. These latter findings are consistent with the idea that greater work-hour regularity is associated with officers being less tired at the beginning of work shifts. While we are unable to explain the outcome found in Lowell, the differences may be a result of the far smaller, and less regular, participation from Lowell's officers. As in Polk County, Lowell's officers also showed a significant negative relationship between the magnitude of overtime worked and TIRED. This is consistent with greater self-reported tiredness at the beginning of shift for those who tend to work more overtime.

All departments showed a negative relationship between regular hours and the PSQI index scores, however the relationship was statistically significant only in Arlington County. Since regular hours could easily be deflated by sick time, vacation time, or other sources of days off, this suggests that officers who take more days off may be less likely to have sleep disorders.

We do not include modal hours per day with the departmental data in table 4.6 because there is so little within-department variation for this variable. None of the

Table 4.6
Correlations Between Schedule Length, Work Regularity, and Timing
(two-tailed, pair-wise deletion of missing cases)

	PSQI (tau-b)	*TIRED* (tau-b)	*FIT at .05* (R)	*FIT at .01* (R)	*FIT at .001* (R)
			All Agencies		
OT Hours	-.0064	.0251	-.0364	-.0397	-.0462
Regular Hours	-.0070	-.0298	.0810	.1132	.1075
Avg. Regularity	.1243**	-.1388**	.0286	.0112	.0373
Var. Regularity	.1119**	-.1319**	-.0475	-.0453	-.0744
Mode Hours/Day	-.1047*	.1413**	-.0587	-.0498	-.0680
N =	286	282	149	149	149
			Portland		
OT Hours	-.2397*	.0932	-.2881	-.2699	-.2970
Regular Hours	-.1107	-.0115	.1034	.0960	.0947
Avg. Regularity	-.0016	-.1520	-.1865	-.2433	-.2556
Var. Regularity	-.0399	-.0523	-.0489	-.1403	-.0914
N =	37	35	16	16	16
			Lowell*		
OT Hours	.0374	-.2901*	•	•	•
Regular Hours	-.1194	-.1271	•	•	•
Avg. Regularity	.0728	.3513**	•	•	•
Var. Regularity	-.0215	.3097*	•	•	•
N =	41	37	4	4	4
			Polk County		
OT Hours	-.1553	-.2608*	-.1151	-.1778	-.1694
Regular Hours	-.2031	-.0725	-.0380	-.1218	-.1910
Avg. Regularity	.1719	-.3036**	.0042	.0995	.0706
Var. Regularity	.1870*	-.3095**	-.2032	-.1249	-.1536
N =	55	54	54	54	54
			Arlington County		
OT Hours	-.0364	.1029	.0108	.0680	.0314
Regular Hours	-.1497**	.0347	-.1424	-.0924	-.0368
Avg. Regularity	.1502**	-.1424*	.1467	.0608	-.0075
Var. Regularity	.1255*	-.1226*	.0121	.0242	-.0216
N =	153	156	75	75	75

* Too few officers in this department took the FIT tests with sufficient regularity to make these types of comparisons.

departmental correlations for this variable and any of the dependent variables were significant.

Analyses of Work Shifts

Findings for work shifts tended to be quite consistent with the combined departmental data. On both day and evening shifts, average regularity again was positively correlated with PSQI Global Index scores, perhaps indicating that officers with more serious sleep disorders were less likely to work overtime assignments. For evening and midnight shifts, officers working compressed schedules were significantly less likely to have higher PSQI global scores or report being tired frequently at the beginning of work shifts. Overtime hours and regular hours per day both were significantly correlated with self-reported fatigue for the 18 individuals who reported that their usual shift varies. Once again, age and experience may be factors here since almost all of the individuals reporting variable shifts had been on the job for less than three years. The midnight shift also showed a significant positive relationship between regular hours per day and percent of FIT tests showing impairment at the .05 level. This, too, warrants a cautious suggestion that taking more days off may enhance fitness.

Department Policies and Practices Regarding Shift Patterns

Apparent relationships between work-hour magnitude, regularity, and timing might well be biased by cross-department variation in policies and practices regarding shift assignments. In particular, if some departments assigned officers to different shifts based on seniority while others made shift assignments based on the assumption that it was desirable to keep a mix of more- and less-experienced officers on each shift, our

shift-based results could be biased by effects associated with age or experience.

We compared the age structure of the four departments using eta^2, a statistical test that describes the proportion of total variability in a dependent variable that can be accounted for by knowing the independent variable (Morusis 994:121). Using eta^2, DEPARTMENT explained only .0180 of the variation in age, a finding that led us to conclude that the age structure of the departments were quite similar. However, when we used the same technique to examine the relationship of age to shift in each of the departments, we found that SHIFT explained a substantial proportion of the variation in age for the Portland and Lowell departments (eta^2=.3320 and .3344 respectively) but little of the age variation in Polk or Arlington County (eta^2=.0874 and .0581 respectively). We believe that the most likely explanation for these differences is that the departments in Portland and Lowell are highly unionized while the other two agencies are not. In our experience, unionization tends to be associated with the allocation of a higher proportion of perquisites by seniority. Moreover, as we discussed earlier, departmental seniority in Arlington County often was not as significant as seniority at a particular assignment with regard to precedence in shift scheduling.

We also collected a number of experience variables to allow us to examine this more closely:

- [YRSOFCR]: cumulative years that an individual had been a police officer for any jurisdiction;
- [YRSPD]: years that an officer had worked for his/her current employer;
- [YRSPTRL]: years than an officer had worked as a patrol officer;
- [YRSPCT]: consecutive years that an officer had been assigned to the current precinct; and
- [YRSSHIFT]: consecutive years that an officer had been assigned to his/her current shift.

As expected, an examination of these variables found that they were highly correlated and clustered into two groups. Correlation coefficients between YRSOFCR, YRSPD, and YRSPTRL ranged from .7390 to .8924, while their correlations with YRSPCT and YRSSHIFT ranged from .2920 to .4379. YRSPCT and YRSSHIFT also were highly correlated with R= .7645.

When we examined associations between experience, DEPARTMENT, and SHIFT, we found a slight difference in experience levels by shift. For example, YRSPD, the best overall indicator of experience, had only .0833 of its variation explained by SHIFT using eta^2. For department, eta^2 was miniscule at .0014. Following the age analyses discussed above, we then examined the three-way relationship between experience, DEPARTMENT and SHIFT for the Portland, Polk County, and Arlington County departments (similar data on officer experience were not available in Lowell). As with the age data, we once again found a substantial difference between the departments. SHIFT explained .3698 (eta^2) of the variation between YRSPD and SHIFT in Portland, but only .0822 for Polk County and .1460 for Arlington County. Given the strong correlation between age and overall police experience indicators (R for YRSOFCR=.7675, YRSPD=.6947, YRSPTRL=.6153), this is not surprising.

Characteristics of Individual Officers

For clarity, our discussion of correlational analyses involving individual characteristics is divided into two sections; personal attributes and those having to do with job experience. Both departmental and shift analyses are included here because of the substantial relationship between age, experience, and shift assignments in the Portland and Lowell

departments. Commute distance was arbitrarily included with the job experience variables.

Personal Attributes. Officer marital status predicted little of the variability in high FIT index scores, something we found surprising since many officers self-reported sleep disruption problems that they associated with family factors – especially the presence and needs of their young children. Given this apparent discrepancy, future research should explore the age and number of officers' children, as well as child care arrangements that may be available during the officers' times for sleeping.

Beyond officers' family arrangements, when data from the four agencies are combined for analysis, officers' age was a highly significant indicator of PSQI Index scores and self-reported fatigue (table 4.7). This is consistent with the literature on sleep disorders (Buysse et al. 1991 and Dement et al. 1982 provide solid reviews of this topic) and suggests that officers may develop more serious sleep disorders over time, that older officers may be less resilient to sleep disruption, or both.

Officer gender also was significantly related to PSQI Index scores when the agency data were combined for analysis. The mean PSQI score for the 31 female officers who completed the instrument was 5.8. This compared to 5.2 for the 264 male officers. Interestingly, however, few women self-reported being fatigued at the beginning of their shifts, a result that may reflect a reluctance of these officers to report weakness of any sort. The lone exceptions were the five women officers in Portland – all but one of whom had unusually high PSQI scores (none reported variable shifts). Unfortunately, however, the rather small number of women officers participating in the project limits the strength of our findings with regard to gender-based differences. As such, future

Table 4.7
Correlations of Personal Attributes and Fatigue Indicators
(by department and shift)

	PSQI	TIRED	FIT at .05	FIT at .01	FIT at .001
			All Agencies		
AGE	.3973**	-.0756*	.0059	.0006	.0017
Marital Status	.2247	.0814	.0105	.0081	.0091
Gender	.3576*	.0609	.0312	.0198	.0065
			Portland		
AGE	.0153	-.0858	.0253	.0484	.1312
Marital Status	.7147	.2351	.2026	.1555	.1231
Gender	.6576	.4623*	.0104	.0040	.0001
			Lowell		
AGE	.0604	.0000	.0954	.0034	.0573
Marital Status	.5560	.3402	.7732	.6034	.6159
Gender	.5631	.1328	•	•	•
			Polk County		
AGE	.0377	-.1426	.0175	.0150	.0268
Marital Status	.4036	.2696	.0128	.0333	.0421
Gender	.4714	.2379	.0033	.0067	.0008
			Arlington County		
AGE	.0585**	-.0656	.0070	.0108	.0212
Marital Status	.3359	.1128	.0477	.0350	.0300
Gender	.4440	1525	.0770	.0592	.0233
			Day Shift		
AGE	.0332	-.0312	.0199	.0000	.0001
Marital Status	.3710	.1388	.0259	.0241	.0122
Gender	.5414	.1566	.1470	.1407	.0913
			Evening Shift		
AGE	.0352	-.1270	.0010	.0007	.0021
Marital Status	.4154	.2184	.0117	.0060	.0335
Gender	.5637*	.2079	.0194	.0001	.0170

		Midnight Shift			
AGE	.0014	-.0756	.0263	.0009	.0003
Marital Status	.4535	.1599	.0008	.0013	.0002
Gender	.4943	.1215	.0001	.0011	.0054
		Shift Varies			
AGE	.0240	.1967	.2322	.2643	.2204
Marital Status	.7071	.5019	.0204	.0171	.0026
Gender	•	•	•	•	•

Note: Although the PSQI is not strictly an interval-level measure, R^2 was used for the AGE: PSQI analyses because the global index is based on a combination of ratio-level data and ordinal rankings on different questions. Cramer's V was used to measure strength of association between the PSQI and TIRED, which are ordinal variables, and the nominal variables since it is a Chi-Square based measure that controls for sample size and facilitates comparison with other analyses. Like Chi-Square, Cramer's V may be interpreted as 0 = no relationship, 1 = complete association.

Kendall's tau-b was used to measure correlations between the ordinal dependent variable TIRED and the ratio-level AGE variable.

R^2 is used to measure strength and significance of association between age and the interval-level dependent variables. Eta is used to measure association between interval-level PMI variables and the nominal independent variables. When squared, eta equals the proportion of total variability of the dependent variable that can be accounted for by knowing the independent variable (Morusis 1994:121).

* p = .05 ** p = .01

research on this subject should oversample female officers to produce a much larger sample for comparisons.

Finally, no personal attributes were significantly associated with the FIT threshold scores.

Job Experience. As we noted earlier, officer age and experience on the job were highly correlated. In addition, experience and shift assignment also are related in the Portland and Lowell agencies. This is consistent with our expectations based on unionization. As a result, we have included both departmental and shift-based data in tables 4.8 and 4.9 below.

PSQI global score was not significantly correlated with any of the variables on officer experience when the data from all departments were combined for analysis. However, a closer examination of the department data indicates that this may be the result of agency-specific differences in shift assignment policies. For example, in Portland the PSQI Index scores had significant *negative* correlations with the number of cumulative years of officer employment (YRSOFCR), years of employment with the current agency (YRSPD), and cumulative years on the current shift (YRSSHIFT). In Arlington County, however, the PSQI scores had significant *positive* correlations with the cumulative years of employment (YRSOFCR) and the number of years an officer had worked in patrol (YRSPTRL). These conflicting findings are consistent with the view discussed earlier of the impact of the officers' union on shift arrangements in Portland. Similarly, other measures of officer experience and the PSQI were consistently negative in Portland and positive in Polk and Arlington Counties (we were unable to obtain experience data for Lowell officers).

Not surprisingly, given their conflicting approaches to officer assignment, the PSQI was not significantly related to officer experience when the agencies' data are combined for analysis.

Self-reports of how often officers are TIRED at the beginning of their shifts likewise are not significant for any of the experience variables in the departmental comparisons. However, it is worth noting that the direction of all but the marginal relationships are consistently positive in Portland and negative in Polk and Arlington Counties – just the opposite of relationships between experience and fatigue as measured by PSQI. This further supports our conclusions about the impact of seniority-based assignment policies on officer fatigue, because the PSQI is a positive measure of

fatigue while TIRED is a negative measure.

The shift-based analyses for TIRED were very similar to those for PSQI with the exception of a strong negative association between TIRED and years in patrol (YRSPTRL) for the midnight shift and a strong *positive* association between TIRED and consecutive years on the current shift (YRSSHIFT) in the small variable-shift group. A negative relationship between TIRED and years on patrol (YRSPTRL) would be consistent with the idea that officers tend to become more chronically fatigued as they accrue more street experience. As was discussed earlier, the number of consecutive years of assignment to the same shift (YRSSHIFT) and current precinct (YRSPCT) are much less highly correlated with age than the other experience variables; they might be tracking a different concept. We hesitate to speculate about this anomalous relationship, however, due to the low number of observations. Taken together, however, these findings suggest the importance of further examination on the impact of seniority on agency personnel.

Table 4.8
Correlations Between Officer Fatigue, Experience, and Daily Commutes (by department)

	PSQI (tau-b)	N PSQI	TIRED (tau-b)	N TIRED	FIT .05 (R)	FIT .01 (R)	FIT .001 (R)	N FIT
				All Agencies				
Commute	.1028*	288	-.1059*	284	.0328	.0490	.0866	136
Yrs. Ofc.	.1026	136	-.0998	133	.1163	.1049	.1523	97
Yrs. Pct.	.0352	136	-.0543	133	.0257	.0457	.1325	97
Yrs. PD.	.0677	136	-.0691	133	.1421	.1394	.0057	97
Yrs. Patrol	.1115	135	-.1186	132	.0027	.0057	.0560	96
Yrs. Shift	.0002	134	-.0683	131	.0932	.1088	.1853	97

				Portland				
Commute	-.0596	288	-.0197	40	-.3775	-.4334	-.3115	11
Yrs. Ofc.	-.2472*	136	.0307	35	-.0185	.0152	.1293	16
Yrs. Pct.	-.1963	37	.1814	35	.0384	-.0095	.0310	16
Yrs. PD.	-.2594*	37	.0673	35	.0694	.1237	.2776	16
Yrs. Patrol	.2377	37	.1100	35	.1501	.1794	.3342	16
Yrs. Shift	-.3169*	37	.2596	35	.0384	-.0095	.0310	16
				Lowell				
Commute	.0920	41	.0940	36	-.5285	-.6619	-.4763	4
				Polk County				
Commute	.0190	54	-.0774	54	-.2220	-.2173	-.1592	52
Yrs. Ofc.	.1527	55	-.1460	54	.1957	.1957	.2242	54
Yrs. Pct.	-.0199	55	-.0778	54	.0551	.0479	.1464	54
Yrs. PD.	.1081	55	-.1469	54	.2038	.2201	.2255	54
Yrs. Patrol	.1178	54	-.1723	53	-.1152	-.0861	-.0432	53
Yrs. Shift	.0128	55	.0215	54	.1354	.1457	.2284	54
				Arlington County				
Commute	.1662**	151	-.1111	154	.0328	.0490*	.0866*	69
Yrs. Ofc.	.2311*	44	-.0699	44	.1616	.0951	.1456	27
Yrs. Pct.	.0959	44	.0122	44	.0252	.1761	.3481	27
Yrs. PD.	.1842	44	.0040	44	.2458	.1865	.2278	27
Yrs. Patrol	.2492*	44	-.0547	44	.2406	.2038	.2929	27
Yrs. Shift	.0541	42	-09.48	42	.0845	.1996	.3534	27

* p = .05 ** p = .01

Experience also appears to have a positive correlation with fatigue-related impairment as measured through pupilometry when the data from all four agencies are combined for analysis. Once again, this appears consistent with the idea that officers

become more chronically fatigued with increasing experience and age, are less resilient to sleep disruption, and are therefore more likely to be seriously impaired due to fatigue. However, a closer examination of the data suggests that there may be shift-based differences between experience and FIT score relationships. For all indicators of experience, non-marginal correlation scores tend to show a positive, though generally non-significant, relationship for day and midnight shifts and a negative relationship for the evening shift. In sum, there appears to be a significant positive relationship between experience and fatigue, but it likely is mediated by organizational policies and shift based differences.

One-Way Commuting Time. In the combined analysis of departments, significant relationships were found between length of an officer's COMMUTE, his or her PSQI Index score, and self-reported fatigue (TIRED). This finding supports our initial assumption that officers with longer commutes experience more fatigue. A similar, nearly significant relationship (p=.07) was found between day-shift commuting, PSQI, and TIRED. As would be expected since commute time tends to diminish for people working other than day shift, the strength of these associations dwindled substantially for evening shift workers and was almost non-existent for midnight shift.

Commuting also shows a significant positive correlation with the two higher FIT thresholds for officers in Arlington County. However, in the other departments the signs of the substantial but non-significant associations were negative. The evening shift data also showed a significant positive correlation between the lower FIT threshold and COMMUTE, but day and midnight shifts showed negative, if much less significant, relationships (p~.30).

Table 4.9
Correlations Between Officer Fatigue, Experience, and Daily Commutes (by shift)

	PSQI (tau-b)	N PSQI	TIRED (tau-b)	N TIRED	FIT .05 (R)	FIT .01 (R)	FIT .001 (R)	N FIT
				Day Shift				
Commute	.1037	96	-.1802*	91	-.1339	-.1304	-.0756	59
Yrs. Ofc.	.1183	49	.0192	46	.2734	.2905	.3419*	36
Yrs. Pct.	.0009	49	-.0835	46	.1350	.1414	.2142	36
Yrs. PD.	.0873	49	-.0263	46	.3200	.3727*	.3939*	36
Yrs. Patrol	.0295	48	.1074	45	.1826	.1843	.2132	35
Yrs. Shift	-.1291	49	.0692	46	.2378	.2253	.3191	36
				Evening Shift				
Commute	.1450	95	-.1278	93	.3584	.4506*	.3715	26
Yrs. Ofc.	.0227	31	-.1803	31	.2310	-.1524	-.5184	13
Yrs. Pct.	-.0806	31	.1884	31	-.5149	-.4783	-.2487	13
Yrs. PD.	.0686	31	-.1276	31	.2829	-.1265	-.5431	13
Yrs. Patrol	.0971	31	-.0717	31	.3479	.0320	-.1486	13
Yrs. Shift	-.1307	31	.1224	31	-.2760	-.3168	-.1078	13
				Midnight Shift				
Commute	-.0093	73	-.0416	73	-.1850	-.2158	-.1970	26
Yrs. Ofc.	-.0394	44	-.0408	44	.0439	.0019	.0677	13
Yrs. Pct.	.0314	44	-.0918	44	.0676	.0412	.1659	13
Yrs. PD.	-.0921	44	-.0303	44	.0438	.0114	.0594	13
Yrs. Patrol	.0865	44	-.3413**	44	-.1847	-.1204	-.0266	13
Yrs. Shift	.0826	43	-.1487	43	.1303	.1434	.2247	13
				Shift Varies				
Commute	.0468	14	.1470	17	.2276	.3096	.4253	13
Yrs. Ofc.	-.3706	8	.1375	8	-.3875	-.5042	-.4167	8
Yrs. Pct.	-.3846	8	.4281	8	-.0705	-.0742	.1198	8

Yrs. PD.	-.2642	8	.0934	8	-.3749	-.4587	-.3195	8
Yrs. Patrol	-.1482	8	.0458	8	-.3805	-.4597	-.3178	8
Yrs. Shift	-.3397	8	.7935*	8	-.3320	-.1467	.0520	8

* p = .05

A note of caution is appropriate, however, since our analyses of commute effects may be confounded in part by Polk County, where deputies effectively have no commute because each officer drives his or her patrol vehicle home. In effect, each deputy is on duty the moment he or she leaves home for work – a commuting time of zero regardless of the time required to travel from home to the district station for roll-call briefing.

The Effects of Fatigue

An initial goal of the project was to explore the effects of fatigue on officer performance by comparing both aggregated individual data and daily data for two groups of officers: those who were involved in accidents and/or were injured while on duty, and those who were not. These approaches were supplemented with qualitative data from the family focus groups and our discussions with officers, supervisors, and managers at the four study sites.

In addition to accident and safety data, our goal also was to capture departmental information regarding citizen complaints and officer commendations so that the relationship between fatigue and the indicators of officer performance that are particularly important for community policing could be explored. Unfortunately, despite early commitments, when it came time to assemble these personnel data only two agencies were willing to provide access. Further, in most instances where such data were

available, what was provided was the date that the commendation or complaint was issued rather than the day that the incident occurred. As such, these data were of limited analytical use.

Fatigue and Accidents, Injuries, Sick Time, and Performance

As discussed earlier, it is logical to expect that fatigue increases the likelihood of officers becoming involved in accidents, being injured on the job, and becoming ill. To explore this question, we took two approaches. The first approach used summary data on individual officers to determine if those who were involved in accidents or who suffered on-duty injuries had higher PSQI Index scores, levels of self-reported fatigue, average FIT readings, or a higher percentage of FIT readings above the three impairment thresholds described earlier. We also tested the utility of work-hour measures that one logically would expect to be associated with job-related fatigue as predictors or correlates of these kinds of incidents. The second approach explored daily data regarding these same variables. Instead of comparing summary measures for officers, however, individual incidents were compared to the daily measures of fatigue taken around the time of reported accidents or injuries. Levels of fatigue and sick time taken by officers were compared as well.

Analysis of the Aggregated Data

Below, we compare the PSQI global index scores and self-reported fatigue responses for officers who were involved in accidents and/or injured on duty with those who were not. In addition, similar comparisons are made with FIT Index threshold levels, work-hour regularity, individual sick day practices, individual officer characteristics, and finally for

officers with commendations or complaints during the study period.

As table 4.10 shows, a much larger proportion of officers who later were involved in on-duty accidents and/or injuries during the study period scored in the higher ranges of the PSQI during the first few weeks of the study. Although a slightly larger proportion of non-accident officers scored in the 5 to 9 range (5 being the threshold for diagnosing clinical sleep disorders), those having accidents or injuries were substantially more likely

Table 4.10
Comparisons of PSQI and TIRED Indicators for Officers with Accidents or Injuries

	Officers with:	
	No Accidents/Injuries	*Accidents or Injuries*
PSQI Global Score		
<= 5	58%	61%
> 5	42	39
> 7	23	26
> 9	8	11
> 11	3	8
> 13	2	5
Average score	5.22	5.41
n	233	55
TIRED at Start of Shift		
Never	1%	5%
Seldom	29	19
Sometimes	53	56
Usually	10	14
Always	3	4
n	236	55

to have global scores above 9. The self-reported fatigue (TIRED) question also was administered early in the study. When compared with non-accident officers, the proportion of officers with accidents or injuries who reported being tired at the beginning of their work shifts was consistently higher for each affirmative category than non-accident officers.

Although officers with accidents and injuries tended to take the FIT test about 50 percent less often than those with no accidents, the proportion of their scores above each impairment threshold was consistently higher than their peers (table 4.11). Although we cannot draw meaningful conclusions from only eight cases, these objective indicators of fatigue follow the same pattern observed with the PSQI and TIRED self-reports. Given the fact that both subjective and objective indicators of fatigue follow the same pattern, it does appear that greater fatigue is associated with more accidents.

Work hour regularity measures, however, do not appear to be correlated with the occurrence of either accidents or injuries for these officers. Comparisons of sick hours

Table 4.11
FIT Index Scores for Officers With and Without Accidents and Injuries
(Number and Percent Impaired)

	N	*FIT > .05*	*FIT > .01*	*FIT > .001*
With Accident/Injuries	6	2 (33%)	1 (17%)	1 (17%)
Without Accident/Injuries	5,268	100 (19%)	599 (11%)	329 (6%)

Note: Categories show cumulative percent; FIT > .05 includes FIT > .01 and FIT > .001

taken by officers appear to indicate that those experiencing accidents or injuries are much more likely to take sick time than their peers. Interpreting these results requires caution, however, since some officers who are injured on duty may take sick time while workers' compensation claims are being reviewed.

Highly correlated age and experience variables reveal the same patterns – on average, officers with accidents are two years younger and two years less experienced than their non-accident peers. While we cannot explain these differences with any certainty, it seems plausible that older, more experienced officers are injured less often because of their experience, greater caution, and preference for less risky assignments. Future research should examine this more closely.

Finally, we examined the limited commendation and complaint information we were able to gather – only the Portland and Polk County departments provided these data. Still, officers with accidents appear to have nearly double the complaint rate of those without either accidents or injuries. That they also have slightly higher commendation rates, however, suggests that these are not merely problem officers. In fact, our group discussions with officers and supervisors at the participating departments suggest that both problem officers and those who pursue their jobs with the most vigor are more likely to be involved in accidents or injured on the job.

A Few Final Thoughts on Fatigue, Accidents, Injuries, and the Use of Sick Time

Because accidents and injuries are low base-rate phenomena, our ability to evaluate causal relationships with fatigue using the data gathered in this project is limited. Nonetheless, the limited data available do suggest a connection between fatigue-related impairment (as measured by pupilometry) and accidents and injuries. In fact, the

proportion of accidents where fatigue was present (50%) is nearly identical to that found by the National Transportation Safety Board's investigation of fatal interstate trucking accidents (NTSB 1990).

As table 4.12 shows, work-hour data were collected over a four- to six-month period (depending upon departmental resources) for 379 patrol officers in the four participating agencies. Out of 59,461 workdays possible, 19,158 were regular days off; 5,722 were paid days off due to sick leave, vacation, or administrative leave; and 34,581 were regularly scheduled workdays. Pupilometry tests were taken on 5,274 (15%) of the workdays.

Out of 94 accidents and/or injuries recorded among participating officers, only six (6%) occurred on a day when pupilometry results for the officers involved were available. Of those six, one officer's results reported fatigue impairment at the 0.05 level, while a second officer was impaired at the .001 level. Recall that this result suggests a level of impairment equivalent to either a blood alcohol level of more than 0.08 percent (Rafal and Cornsweet 1994) or the level of impairment associated with being awake for more than 24 hours straight (Dawson and Reid 1997). Using lagged measures that included pupilometry results from the day prior to the accident or injury incident added two additional cases. Of these eight, three officers were fatigue-impaired at the 0.05 level and one at the 0.001 level.

Clearly, we cannot draw meaningful conclusions from only eight cases. Regardless, the finding that 50 percent of the individuals who had accidents or were injured on the job and also had provided pupilometer readings on one of the two days preceding the incident were fatigue-impaired is at least suggestive, especially when we

Table 4.12
Comparison of FIT Index Scores for Officer Workdays With Accidents or Injuries

	N	Percent of Total
Total Workdays	35,634	100%
Accident or Injury Days	94	0.26
	N	**Total Accident Days With FIT**
Accident Days with FIT Results on Same Day	6	
Accident Days with FIT Results on Prior Day	2	8
FIT Results .05 or Above	4	50%

recall that only 19 percent of the officers collectively produced similar FIT results (6.2 percent were rated impaired at the 0.001 level).

Beyond accidents and injuries, our analysis also was concerned with the impact of fatigue on officers' use of sick time. In this case, however, somewhat more data is available.

As table 4.13 shows, of the 35,634 regularly scheduled workdays during the project period, participating officers reported sick and away from work 1,053 times. On 38 of those days (3.6%), pupilometry readings were available from the day prior to the day of absence for illness. Of those 38, seven officers (18%) were fatigue-impaired at the 0.05 level or higher, a result that is comparable to the fatigue levels of officers generally (19%).

Table 4.13
Comparison of FIT Index Scores for Officer Sick Days

	N	Percent of Total
Total Workdays	35,634	100%
Days Absent for Illness	1,053	2.96
	N	**Sick Days With FIT**
Sick Days with FIT Results on Prior Day	38	3.61%
FIT Results .05 or Above	7	18

Regularity of Work Hours

The analysis of project data also focused on associations between accidents and injuries and work-hour variables. To do so, we examined the extent of overtime as a categorical variable collapsed into four groupings: working no overtime, working less than four hours, working between four and seven hours, or working seven or more hours of overtime.

As table 4.14 shows, 17 percent of accidents or on-duty injuries occurred on days where the involved officers were working overtime. Conversely, slightly less than 12 percent of the workdays for the non-accident/non-injury group were overtime days. On the days officers were in accidents or injured while on duty, they also were somewhat more likely to have worked full overtime days, somewhat less likely to have worked half-days, and almost twice as likely to have worked smaller amounts of overtime than officers working on non-injury or accident days.

Table 4.14
Extent of Officer Overtime and Accidents or On-Duty Injuries

	All Officers		*Officers With No Accidents or Injuries*		*Officers With Accidents or Injuries*	
> 7 Hours OT	1,356	2.3%	1,351	2.3%	3	3.4%
4 to 7 Hours OT	2,145	3.6	2,141	3.7	2	2.3
< 4 Hours OT	3,328	5.6	3,297	5.6	10	11.4
No Overtime	52,630	88.5	51,530	88.4	73	83
TOTAL	59,459		58,319		88	

We also examined the proximate effects of work-hour regularity on accidents and injuries. This was done by comparing several measures. For example, **daily regularity** was treated as a dichotomous variable describing whether a workday followed the officer's usual schedule. **Serial regularity** was an interval-level variable that described how many days in a row an officer had worked without deviation from his or her usual schedule at the time of an accident or injury. It was calculated by adding one to the tally for each successive regular day. When an officer worked overtime or otherwise had his or her schedule disrupted, serial regularity returned to zero, then began increasing again if the regular shift was followed. At the end of the study period, we calculated the variance of serial regularity as a measure of chronic disruption. Finally, because of the importance of intermediate-term irregularity as a potential promoter of chronic fatigue, we also calculated **smoothed regularity**, the mean regularity for the 10 days previous to an observation or incident. Perfect smoothed regularity would result in a score of 1.0.

There were 94 accidents or on-duty injuries reported by participants in this project during the period for which work-hour data were collected. Six of these were both

accidents and injuries, leaving a total of 88 accident or injury incidents. At the time of these incidents, nearly 23 percent of the officers involved were working irregular schedules. This contrasts sharply with the 13 percent of officers working irregular work schedules who were neither injured nor involved in accidents. On average, serial regularity was substantially lower for the accident/injury group than for non-accident/non-injury officers: 7.8 versus 10.7 respectively. Smoothed regularity was similar for both groups, suggesting that the effects of fatigue on the likelihood of an officer experiencing an accident or injury while on-duty may result more from proximate, rather than recent-past work-hour regularity.

Table 4.15
Proximate Relationship Between Work-Hour Regularity and On-Duty Accidents or Injuries

	All Officers	*Officers With No Accidents or Injuries*	*Officers With Accidents or Injuries*
Mean Serial Regularity	10.75	10.66	7.77
Variance Serial Regularity	292.01	284.63	87.52
Mean Smoothed Regularity	0.87	0.87	0.892
Regular Days	51,589	50,528	68

Finally, the variance of serial regularity is much smaller for the group of 68 officers who were involved in accidents or injured than for their peers who were not. This is a proxy for chronic fatigue because it captures the long-term disruption of an officer's

schedule – lower variance indicates *more* disruption because the cumulative serial regularity scores upon which it is based are smaller. This suggests that chronic effects also may be important, a finding that is consistent with previous research on fatigue and sleep among other occupational groups and in the general public.

Taken together, these findings support the idea that overtime work may cost departments and communities more than just time-and-a-half pay because of increased risk of accidents and injuries (see Vila 1996:69-73).

Section 5:
Conclusions: Preliminary Findings About Police Fatigue and Its Measurement

One of the project's initial goals was to explore the methods available for studying police fatigue. Another was to obtain a preliminary estimate of the prevalence of fatigue among police patrol officers and its effects on them. This section describes what we have learned about studying police fatigue and our preliminary findings.

The Utility of Pupilometry

Data collection began with well-established methods including officer self-reports and the use of the *Pittsburgh Sleep Quality Index* (PSQI). These were supplemented with the *FIT™ Workplace Safety Screener*, a pupilometry device developed by PMI, Inc. to detect fatigue-related performance risks. Since the device measures involuntary eye responses, it provided an objective measure of officers' fatigue. While we encountered far more difficulties with data collection (of various types) than initially expected, we have concluded that the pupilometry device has considerable potential for ferreting out workplace fatigue.

Physically, the screener is robust, enclosed in a heavy steel-plate case that protects its internal instruments. While several machines generally are required for a single site to expedite testing at the beginning of each work shift, they all can be networked to a single hub computer that records test results. We found the reliability of the equipment to be similar to most computer-based systems that are run around-the-clock. However, unlike most desktop computers, which are relatively independent, any

malfunction in one device can incapacitate the others. Once the source of the malfunction (e.g., power outage, software crash, etc.) is located, the system must be manually rebooted before testing can resume. As a consequence, data collection at the first two sites (Portland and Lowell) often was disrupted due to system failure – a problem that appears to have had an impact on participation rates when officers became discouraged with the equipment.

Beyond these technical concerns, we also learned quickly (but well into the data collection process) that it was important for the FIT screeners to be placed on a solid and vibration-free surface at a standardized height. If not, some officers had difficulty properly aligning their eyes with the device. Similarly, we initially underestimated the extent of training and practice that some officers require for the machine's use. For example, in both Portland and Lowell, we assumed that a single five-minute supervised practice session would be sufficient. When officers had difficulty completing subsequent tests, however, no one was immediately available to correct their errors. This, of course, increased frustration, causing numerous officers to stop participating altogether.

Unfortunately, we failed to anticipate each of these issues. As a result, in both Portland and Lowell inadequate preparation and training in the equipment's use and regular maintenance occurred in the first few months of data collection. This (and two organizational issues discussed below), may have been sufficient to suppress officer interest and willingness to participate. For example, a number of officers told project staff that "the machine is always down" despite the relative infrequency of malfunctions. In future efforts, we recommend more rigorous training in the use of the instrument for participating officers. It also is important to use considerable caution with regard to where and how the machine is placed. Further, a staff person with sufficient rank and stature to

encourage officers and audit their participation should monitor the screener's performance daily.

Summary of Preliminary Findings

Community policing places additional demands on personnel resources that often are met through the use of overtime and extra duty assignments despite the awareness that such administrative practices add to officers' fatigue both by increasing the amount of work they perform and by disrupting their sleep patterns. When added to other job-related stressors such as the need for off-duty court appearances, regular changes in the shifts worked, the demands for additional training and education for officers, and many officers' need for outside employment, the effects of officer fatigue could be significant.

While there has been little focus on the police, considerable research on the effects of fatigue has been developed over the last century in a variety of other fields including industrial and safety engineering, management, medicine, psychology, and sociology. As a result, we know that the effects of excessive fatigue can include decreased alertness, impaired performance, and negative effects on one's mood (Bonnet 1985; Broughton and Ogilvie 1992; Mitler et al. 1994).

For the police, officer fatigue may be especially troubling. Mentally and emotionally, fatigue reduces the abstractive and integrative frames of reference that support and give perspective to our thoughts, activities, and perceptions. Because it narrows perspective, fatigue also tends to increase anxiety and fearfulness, while lowering an officer's ability to deal appropriately with complex stressful situations. This, in turn, increases the likelihood of stress-related illness (e.g., Brown and Campbell 1994; Kroes 1985:147-148; Monk 1990). Tired people also are more irritable and prone to

anger (e.g., Thayer 1989:110-136), which can be a significant problem for agencies attempting to improve police/community relations.

In addition, because fatigue tends to increase irritability and fearfulness while diminishing the capacity of officers to make sound decisions, it also is likely to increase the probability of officer misconduct, especially misconduct associated with the use of excessive force. Even the best officers who are impaired by fatigue or chronic fatigue will likely, on occasion, overreach in threatening situations, lose their tempers, and make bad decisions.

Finally, the link between fatigue and accidents in other occupational groups has been well established. During periods of low activity, fatigue tends to increase accident-proneness, because tired people tend to be less attentive, slower to react to impending hazards, and more likely to respond inappropriately (Dwyer 1991; Lauber and Kayten 1988). Worse yet, the effects of fatigue are both cumulative and synergistic since overwork, boredom, and high anxiety each impact sleep and sleep patterns. This, of course, further increases fatigue and the rate at which it accumulates. The net effect of these multiple stressors then spills over into leisure time, making recuperation all but impossible (Gardell 1987:65-66). The result is a vicious cycle where fatigue diminishes the ability to cope with other job stressors in a healthy manner. This, in turn, further disrupts sleep and sleep patterns, increasing the fatigue being felt. In time, this process can only be expected to accelerate and erode an officer's ability to function effectively.

Until now, the problem of officer fatigue – and the potential for developing strategies to solve it – has been all but overlooked by researchers, policy-makers, and police managers. We believe that the present project has advanced our knowledge by using a comprehensive set of research strategies to:

- Collect and analyze data on police work hours, work-hour policies and procedures, accidents, injuries, illnesses, misconduct, and citizen complaints;
- Use self-report surveys and focus group discussions with officers and officers' families to gather information about their subjective experience of fatigue and impressions about its effects on their professional performance, physical and emotional well-being, and personal lives; and
- Conduct objective tests on the extent of officer fatigue using noninvasive eye reaction and computer-based tests of readiness for duty.

The Prevalence of Fatigue

The results of this preliminary research reveal that police are more fatigued than other occupational groups. For example, officers in the four agencies studied reported that they routinely worked more consecutive hours per one-day, two-day, or seven-day period than would be legal if they were nuclear power plant operators or truck drivers. A substantial number of officers in this study exceeded those standards more than 10 percent of the time. More specifically, at least 6.2 percent of officers taking the well-validated and objective FIT pupilometry test were highly impaired with a certainty of p=.001. This is the impairment equivalent of a .10 blood alcohol concentration – a rate six times the usual failure rate for shift workers in industrial and mining jobs. Anecdotally, this is more than double the highest rate experienced pupilometry researchers recall observing in other settings. At the p=.01 level, 11 percent of officers failed and at the p=.05 level, 19 percent of officers were impaired.

In addition to the pupilometry results, 41 percent of all officers completing the well-validated Pittsburgh Sleep Quality Index had clinical sleep pathologies. The mean global scores for officers in each department were roughly double the mean global score for the instrument's validation control group. Even given the prevalence of low quality sleep, only

41 percent of officers reported averaging seven or more hours of sleep per day. As a group, officers reported receiving an average of only 6.6 hours of sleep per day; 4 percent report averaging fewer than five hours. Not surprisingly, more than one officer in seven self-reported problems with fatigue during the previous month:

- 14% reported "always" or "usually" being tired at the beginning of their work shifts;
- 18% reported that keeping up enough enthusiasm to get things done had been either "somewhat of a problem" or "a big problem;" and
- 16% reported that they had trouble more than once a week staying awake while driving, eating meals, or engaging in a social activity.

Officers also voiced substantial concern about fatigue in their co-workers. More than half said they would be "concerned" or "very concerned" if another officer on their shift was very tired. A similar proportion characterized overtime work as "somewhat harmful" or "very harmful" to social and recreational activities that help people recover from job stress and fatigue, and to the family and personal relationships that help keep officers grounded emotionally. Ironically, relatively few officers (18%) thought that overtime work was detrimental to their own job performance.

The Causes and Correlates of Fatigue

Relationships between self-reported fatigue and objectively measured fatigue appear to vary from shift to shift, indicating that self-perceptions may be biased by circadian rhythms. Officers on the evening shift, for example, self-reported being least likely to feel tired at the beginning of their work shift. They were consistently *more* likely, however, to show impairment on daily pupilometry tests.

In addition to when the shift occurs, the use of compressed work schedules merits additional study. Correlations between modal hours of work per day (i.e., normal shift length), sleep quality tests, and self-reported tiredness suggest that fewer, longer days may be associated with less fatigue – as many officers have contended. There does not appear to be a relationship between fatigue as measured by pupilometry and the likelihood that on officer will call in sick. However, there are tentative indications that officers who take more days off tend to be less likely to be impaired by fatigue. This suggests a recuperation effect. Further, a significant relationship between experience and fatigue appears to exist; however, that relationship is complex and likely mediated by organizational policies. For example, an agency's policies and practices regarding seniority and shift assignment may have a substantial influence on overall levels of fatigue within a given department. There are some indications that departments in which it is easier for older, more experienced officers to work shifts that are less likely to interfere with sleep hygiene may have lower overall levels of fatigue. Finally, officers with longer commutes appear to experience significantly more fatigue as measured by self-reports and the PSQI. As may be expected, commuting distance has the greatest effect on day shift officers. We believe that this topic requires additional study.

The Impacts of Officer Fatigue

A much higher proportion of officers who later were involved in on-duty accidents and/or injuries during the project's study period scored in the higher ranges of the PSQI during the first few weeks of the study. These same officers were substantially more likely to have reported "always" or "usually" being tired at the beginning of their work shifts.

As for the objective measures, the proportion of pupilometry scores above each of

the impairment thresholds was consistently higher for officers who were involved in accidents or injured on duty. However, these findings must be viewed with caution because only eight of 94 people in the accident/injury group had taken the pupilometry test the day of their accident/injury or the day before. On average, officers involved in accidents or who were injured on duty were two years younger and two years less experienced than officers who were not. The reason for this pattern is unclear, however. For example, it might be that younger officers are less skilled or prudent, that they are more enthusiastic, or that they are both. Data from citizen complaints from the two departments – Portland and Polk County – indicated that officers who were injured and/or had accidents on the job had almost double the number of complaints filed against them as their peers without injuries or accidents. Still, the fact that they also had slightly higher commendation rates suggests that they are more than simply problem officers.

Unfortunately, we found only eight cases where officers involved in accidents or injured on the job also took pupilometry tests on the day of or the day before an incident. Half of these officers were impaired at the .05 level; one officer was impaired at the .001 level. Overtime days also tend to be associated with accidents and injuries. On average, non-injury/non-accident officers worked overtime 12 percent of the time. By comparison, 17 percent of accidents and/or injuries occurred on days in which overtime was worked. Accident/injury days also were somewhat more likely to have occurred on full days of overtime work as compared with partial overtime days.

Finally, regularity of work hours appears to be important. At the time of accidents and/or injuries, 23 percent of officers were working irregular work schedules. This compares with 13 percent irregular work hours for non-injury/accident days.

Concluding Thoughts on Managing Fatigue

Results from any pilot study such as this should be viewed with caution. Still, it hardly seems prudent for managers to ignore what are striking findings with regard to the prevalence of fatigue – especially when those results are consistent with the common sense observations of police officers, managers, and researchers. As such, we have made a number of recommendations for future research that we think are warranted before it is possible to make informed decisions about factors such as

- how many hours officers should work per day or week;
- how we assess officers' fitness for duty, or
- what work schedules are most useful for minimizing fatigue in what environments.

Until such standards can be developed, we suggest the following general guidelines to minimize officer fatigue.

Officer Education

Officers should be taught the importance of good sleep hygiene (see Monk and Folkard 1992; Moore-Ede 1993) as well as how to manage fatigue through diet, exercise, and personal habits. This also involves learning to think about fatigue as a safety, health, and performance issue.

Department Policy

Police managers should develop work-hour policies that place concrete limits on the number of hours officers are allowed to work per day, week, and month except in emergency situations. These limits should include regular duty, overtime, special details,

and off-duty work. In the absence of specific research results, we recommend that these standards be developed on a department-by-department basis with the cooperation of employee organizations, community groups, and local governments. Wherever possible, managers should work out arrangements with local courts to minimize court-related overtime.

With regard to compressed shift arrangements for police, it seems clear that in some environments they have the potential to limit fatigue – perhaps by providing more opportunities for recuperation and more flexibility for balancing family and social responsibilities. But many other variables beyond shift length also are relevant. Examples include shift regularity, commuting conditions, shift selection processes, off-duty employment policies, and usual overtime demands. We believe that the best approach at present is for managers to work with their officers to develop comprehensive fatigue-management plans that treat shift length as one of many important variables.

Employee Participation

Each of the previous recommendations specifically included employee involvement. We think that this is critical for the success of any fatigue-control program. The hours an officer is assigned to work fundamentally affect almost every aspect of his or her personal, social, family, and professional life. Officers who see themselves as powerless with regard to such a basic issue undoubtedly will experience more stress (see Brown and Campbell 1994). Stress diminishes an officer's ability to deal with fatigue which, in turn, promotes more stress and more fatigue. The best way to avoid this vicious cycle is to provide officers with as much power in setting work-hour policies – and their own work hours – as is possible.

Until additional research enables us to develop work-hour standards for police officers, we believe that these general guidelines should help managers limit the damage done by fatigue.

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Appendix A:

Data Forms for Officers

PATROL OFFICER DEMOGRAPHIC DATA

1. **ID #:** _ _ _ _

2. **Agency:** 1 = Portland, Oregon Police Bureau
   3 = Lowell, Massachusetts Police Department
   4 = Polk County Sheriff's Department
   5 = Arlington County Police Department

3. **Age at onset of study:** _____ years

4. **Sex:** 1 = M
   2 = F

5. **Race/ethnicity:** _____
   1 = White/caucasian
   2 = African-American
   3 = American Indian
   4 = Latino
   5 = Other, please describe _____

6. **Marital status**: _____
   1 = Single
   2 = Married
   3 = Divorced
   4 = Co-habitant
   5 = Widowed

7. **Approximate round-trip commuting time from residence:** _____ minutes

8. **Years as a police officer:** _____ years and/or _____ months

9. **Years with current employer:** _____ years and/or _____ months

10. **Years assigned to uniformed patrol at current agency:** _____ years and/or ____ months

11. **Years assigned to present precinct or district:** _____ years and/or _____ months

12. **Years on current watch (i.e., morning, day, evening) :** _____ years and/or _____ months

13. **Latest performance evaluation:** 1 = above average 2 = average 3 = below average

SLEEP QUALITY AND WORKING CONDITIONS QUESTIONNAIRE

The first half of this questionnaire relates to your usual sleep habits during the past month only, so your answers should indicate the most accurate reply for the *majority* of days and nights in the past month. The second half of this questionnaire addresses working conditions and a variety of other factors. Please be sure to answer all questions.

1. **What is your:** ***Age?*** ____; ***Sex?*** M___ F___; ***Marital status?*** Single ___ Married___ Divorced___ Widowed___

2. **During the past month, what time have you usually gone to bed at night?**

   Bedtime _____

3. **During the past month, how long (in minutes) has it usually taken you to fall asleep each night?**

   Number of minutes _____

4. **During the past month, what time have you usually gotten up in the morning?**

   Getting up time _____

5. **During the past month, how many hours of actual sleep did you get at night?** (This might be different than the number of hours you spent in bed.)

   Hours of sleep per night _____

NOTE: For questions #6-11, check the one best response. Please answer all questions.

During the past month, how often have you had trouble sleeping because you...

6. **Cannot get to sleep within 30 minutes**

   Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

7. **Wake up in the middle of the night or early morning**

   Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

8. **Have to get up to use the bathroom**

   Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

9. **Cannot breathe comfortably**

   Not during the | Less than | Once or twice | Three or more

past month _____	once a week _____	a week_____	times a week_____

10. Cough or snore loudly

Not during the past month _____	Less than once a week _____	Once or twice a week_____	Three or more times a week_____

11. Feel too cold

Not during the past month _____	Less than once a week _____	Once or twice a week_____	Three or more times a week_____

12. Feel too hot

Not during the past month _____	Less than once a week _____	Once or twice a week_____	Three or more times a week_____

13. Had bad dreams

Not during the past month _____	Less than once a week _____	Once or twice a week_____	Three or more times a week_____

14. Have pain

Not during the past month _____	Less than once a week _____	Once or twice a week_____	Three or more times a week_____

Other reason(s), please describe

_____

_____

16. How often during the past month have you had trouble sleeping because of this?

Not during the past month _____	Less than once a week _____	Once or twice a week_____	Three or more times a week_____

17. During the past month, how would you rate your sleep quality overall?

Very good _____	Fairly good _____	Fairly bad _____	Very bad _____

18. During the past month, how often have you taken prescribed or "over-the-counter" medicine to help you sleep?

Not during the past month _____	Less than once a week _____	Once or twice a week_____	Three or more times a week_____

19. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month _____	Less than once a week _____	Once or twice a week_____	Three or more times a week_____

20. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

No problem at all _____	Only a very slight problem _____	Somewhat of a problem _____	A very big problem _____

21. Do you have a bed partner or roommate?

No bed partner or roommate _____	Partner/roommate in other room _____	Partner in same room, but not same bed _____	Partner in same bed _____

22. Which shift have you usually worked during the past year?

Days __; Evenings ___; Midnight ___; Varies__

23. How long is your round-trip commute from home to your primary duty assignment?

_____ *round-trip minutes*

24. During the past year, what do you estimate to be the *MAXIMUM* total number of hours you worked during *each* of these time periods? (Fill in the blank with a **number** in the range given that reflects both regular & overtime work.)

Any 1 day period? _____ (possible range from 8-24 hours)

Any 2 day period? _____ (possible range from 16-48 hours)

Any 7 day period? _____ (possible range from 40-168 hours)

Any 30 day period? _____ (possible range from 168-720 hours)

25. How concerned would you be if another patrol officer on your shift was very tired? (Circle one)

very concerned concerned somewhat concerned slightly concerned not concerned at all

26. Roughly what percent of the overtime you worked during the past year do you think was associated with each of the following activities? (Fill in each blank with a **number**; the numbers should add up to 100%.)

_____% Off-duty court appearances

_____% Extra shift assignment to fill in for someone who was sick, on vacation, disabled, etc.

_____% Arrests made late in the shift or report writing

_____% Special events such as crowd control, missing children, parades, etc.

_____% Other (give examples) _____

100% *TOTAL*

27. How does overtime work affect the following aspects of your life? (Check one for **each** category.)

	very helpful	*somewhat helpful*	*almost no effect*	*somewhat harmful*	*very harmful*
Family & personal relationships					

Social & recreational activities					
Physical fitness & health					
Income					
Job performance					

28. How often do you feel tired at the beginning of your work shift? (Circle one)

always usually sometimes seldom never

29. When you feel tired at the beginning of your work shift, how often is each of the following responsible? (Check one for **each** category.)

	always	*usually*	*sometimes*	*seldom*	*never*
Lack of sleep					
Attending school					
Family commitments					
Social & recreational activities					
Outside employment					
Overtime assignments					
Other (specify):_____					

Police Fatigue Study ID#_____

PUPILOMETRY QUESTIONNAIRE

Date: _____

Please circle the <u>one</u> best answer to each question.

1. How would you describe your current state of alertness?
   very sleepy *somewhat sleepy* *neither particularly alert nor sleepy* *somewhat alert* *very alert*

2. How would you describe current weather conditions?
   sunny *mostly sunny* *mostly cloudy* *heavy overcast* *raining*

3. How much sleep did you get during the past 24 hours?
   fewer than 2 hours *2 to 4 hours* *4 to 6 hours* *6 to 8 hours* *8 to 10 hours* *10 or more*
   This amount is *more* (or) *less* than normal.

4. Compared to your normal sleep patterns, how have you slept during the past four nights?
   better than normal *about the same as normal* *difficulty getting to sleep* *sleep interrupted*

5. Do you have any of the following symptoms at the present time?
   fever *chills* *nausea* *aches* *headache* *dizziness* other:_____

6. Any changes in vision? (please describe)_____

7. Have you used prescription or "over-the-counter" medications (such as for allergies or colds) during the past 24 hours?
   No
   Yes (please describe): _____

8. Is a recent event or ongoing situation causing you an unusual amount of stress?
   No
   Yes (please describe in general terms)_____

Police Fatigue Study ID#_____

PUPILOMETRY QUESTIONNAIRE Date:_____

Please circle the <u>one</u> best answer to each question.

1. How would you describe your current state of alertness?
   very sleepy *somewhat sleepy* *neither particularly alert nor sleepy* *somewhat alert* *very alert*

2. How would you describe current weather conditions?
   sunny *mostly sunny* *mostly cloudy* *heavy overcast* *raining*

3. How much sleep did you get during the past 24 hours?
   fewer than 2 hours *2 to 4 hours* *4 to 6 hours* *6 to 8 hours* *8 to 10 hours* *10 or more*
   This amount is *more* (or) *less* than normal.

4. Compared to your normal sleep patterns, how have you slept during the past four nights?
   better than normal *about the same as normal* *difficulty getting to sleep* *sleep interrupted*

5. Do you have any of the following symptoms at the present time?
   fever *chills* *nausea* *aches* *headache* *dizziness* other:_____

6. Any changes in vision? (please describe)_____

7. Have you used prescription or "over-the-counter" medications (such as for allergies or colds) during the past 24 hours?
   No
   Yes (please describe): _____

8. Is a recent event or ongoing situation causing you an unusual amount of stress?
   No
   Yes (please describe in general terms) _____

POLICE FATIGUE STUDY ID #_____

INSTRUCTIONS:
As a roommate or bed partner of a police officer participating in a study of fatigue, please consider how often in the past month this person has exhibited the following. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. Loud snoring

Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

2. Long pauses between breaths while asleep

Not during the past month _____ | Less than once a week_____ | Once or twice a week_____ | Three or more times a week_____

3. Legs twitching or jerking while you sleep

Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

4. Episodes of disorientation or confusion during sleep

Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

5. Other restlessness while you sleep; please describe _____

Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

POLICE FATIGUE STUDY ID #_____

INSTRUCTIONS:
As a roommate or bed partner of a police officer participating in a study of fatigue, please consider how often in the past month this person has exhibited the following. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. Loud snoring

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Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

3. Legs twitching or jerking while you sleep

Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

4. Episodes of disorientation or confusion during sleep

Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

5. Other restlessness while you sleep; please describe _____

Not during the past month _____ | Less than once a week _____ | Once or twice a week_____ | Three or more times a week_____

Appendix B:

Pupilometer Instructions

POLICE FATIGUE STUDY

Conducted by:

Police Executive Research Forum
Washington, DC

Funded by:

National Institute of Justice
U.S. Department of Justice

Please Remember That When Using the Pupilometer at the Beginning of Each Shift:

- This pupilometry reading lasts approximately 30 seconds.
- Use just one eye and be sure to use the same eye each time.
- If your head is properly positioned, your "sight picture" should be a round—as opposed to oval—green light.
- When your eye is positioned, press either of the square green buttons located on the wings of the head piece.
- Holding your head still, follow the greet light with your *eye* as it moves from side to side, and do your best to avoid blinking.
- After the light comes to rest in the center of the viewing port, there will be approximately a 10-second pause; you may blink during this pause.
- Continue looking at the green light as it flashes several times. There will be around two seconds between flashes, and do your best to avoid blinking.
- When the pupilometer beeps, your daily test is done.
- Before walking away, be sure to check the small screen located above the keyboard for a message. If you have been randomly selected by the pupilometer to fill out the short survey, please take one from the holder, complete it, and then drop it in the lock-box.

THANKS FOR YOUR HELP! This project is important
for the health and safety of police officers around the country.

IF YOU HAVE ANY QUESTIONS OR SUGGESTIONS ABOUT THIS STUDY, OR THERE ARE PROBLEMS WITH THE MACHINES, PLEASE CONTACT EITHER:

Dr. Greg Morrison
Western Oregon University
360-297-2047 or 503-838-8853

OR

Dr. Bryan Vila
University of Wyoming
307-766-2177

Appendix C:

Administrative Data Forms and Focus Group Protocols

) #: _ _ _ _ _ 1b. Type of Day: 1 = Paid Day On 2 = Paid Day Off 3 = Unpaid Day Off

D#: _ _/_ _/_ _ 3. Shift: 1 = Day 2 = Evening 3 = Midnight/Night 4. Time on: _ _:_ _ 5. Time off: _ _:_ _

Shift hours worked: _ _ 7. Overtime Hours worked: _ _

ourt time? 1 = Yes 9. If yes, number court hours worked: _ _

Detail hours worked: _ _ 11. Detail time on: _ _:_ _ 12. Detail time off: _ _:_ _

: Officer sick: 1 = Yes 14. Hours sick: _ _

Traffic accident: 1 = Yes 16: At fault?: 1 = Yes 2 = No 17. Accident type: _ _

Describe: _____

Complaint: 1 = Yes 19: Complaint status: _ 20. Nature of complaint: _ _

Describe: _____

2.. Commendation: 1 = Yes 22. Nature of commendation: _ _

Describe: _____

23: Officer injured on the job: 1 = Yes 24: Nature of injury: _ _

Describe: _____

ID #: _ _ _ _ _ 1b. Type of Day: 1 = Paid Day On 2 = Paid Day Off 3 = Unpaid Day Off

. Date: _ _/_ _/_ _ 3. Shift: 1 = Day 2 = Evening 3 = Midnight/Night 4. Time on: _ _:_ _ 5. Time off: _ _:_ _

6. Shift hours worked: _ _ 7. Overtime Hours worked: _ _

Court time? 1 = Yes 9. If yes, number court hours worked: _ _

10. Detail hours worked: _ _ 11. Detail time on: _ _:_ _ 12. Detail time off: _ _:_ _

. Officer sick: 1 = Yes 14. Hours sick: _ _

15. Traffic accident: 1 = Yes 16: At fault?: 1 = Yes 2 = No 17. Accident type: _ _

Describe: _____

. Complaint: 1 = Yes 19: Complaint status: _ 20. Nature of complaint: _ _

Describe: _____

. Commendation: 1 = Yes 22: Nature of commendation: _ _

Describe: _____

23: Officer injured on the job: 1 = Yes 24: Nature of injury: _ _

Describe: _____

FATIGUE STUDY FOCUS GROUPS

Focus Group Populations, Size, and Selection Criteria:

1. A convenience sample of officers interested in discussing officer fatigue will be obtained following various shifts at each of the study sites. Group size is expected to vary from four to eight officers.

2. A volunteer sample of officers' spouses and significant others will be obtained at each study site by sending notices home with officers after making role call announcements. Group meetings will be scheduled to meet volunteers' needs. Group size is expected to vary from four to twelve individuals.

Goals:

1. Obtain impressions about work-hour induced fatigue and its effects upon the health, safety and performance (HSP) of patrol officers.

2. Obtain information about officers' sleep patterns and quality of sleep.

3. Obtain information about the affect of work-hour related fatigue on officers' families and quality of family life.

4. Identify issues that officers and their significant others believe are important with regard to Goals 1, 2 and 3 that have not previously been addressed by the research team.

5. Obtain information regarding the importance of overtime and moonlighting as sources of fatigue and as sources of income for officers and their families.

6. Obtain information about primary causes of police officer fatigue and impressions regarding their relative importance.

Focus topic 1: General impressions about factors possibly influencing work-hour induced fatigue, e.g.:

- How long in patrol and what shift typically worked?
- If other than day shift, has adjusting to different sleep cycle been successful?
- Getting enough good quality sleep (i.e., not perpetually tired)?
- Young children present in the home (any early morning criers)?
- Any major on-going life changes (marriage, divorce, death, etc.)?
- Any regular social activities (clubs, events, etc.)?

Focus topic 2: What relationships might there be between work-hour induced fatigue, patrol officer HSP, and the following professional matters?

- Patrol staffing levels (Portland, for example, is well under its authorized staffing level and officers seems to work quite a few extra shifts.)
- Off-shift court time frequent (i.e., overtime opportunity, but schedule disruption)
- Additional/collateral community-policing responsibilities
- Off-duty work opportunities (departmentally sanctioned AWA non-police status)
- Sick time (low morale leading to casual use of sick time leading to working or off-shift officers being offered or called in on overtime)
- "Low" productivity (disinterest in work; just putting in time; lack of excitement)
- Off-shift training requirements

Focus topic 3: What relationships might there be between work-hour induced fatigue, patrol officer HSP, and the following personal matters?

- Ability to establish and/or maintain quality personal relationships
- Ability to honor general family responsibilities
- Vacation and recuperative/restorative opportunities
- Routine, weekend-length recreational activities
- Social engagements
- Continuing education

Focus topic 4: Other fatigue-related topics which arise during the course of discussions?