The Impact of Shift Length in Policing on Performance, Health, Quality of Life, Sleep, Fatigue, and Extra-Duty Employment

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Abstract

Most law enforcement agencies have traditionally deployed their patrol officers based on a 40-hour workweek in which personnel work five consecutive, 8-hour shifts, followed by two days off. In recent years, however, an increasing number of agencies have moved to some variant of a compressed workweek (CWW) schedule in which officers work four 10-hour shifts per week or three 12-hour shifts (plus a time adjustment to make up the remaining 4 hours of the standard 40-hour workweek). While this trend towards CWWs has been moving apace, there have been few, if any, rigorous scientific studies examining the advantages and disadvantages associated with these work schedules for officers and their agencies.

In this report, we present data on the prevalence of CWWs in American law enforcement in recent years and provide results from the first known comprehensive randomized experiment exploring the effects of shift length (8- vs. 10- vs. 12-hours) on work performance, safety, health, quality of life, sleep, fatigue, off-duty employment, and overtime usage among police officers. We implemented a randomized block experiment in Detroit (MI) and Arlington (TX), in which the blocks include site (i.e., Detroit, Arlington) as well as shift (day, evening, midnight) in order to examine the effects of the three shift lengths on various outcomes. Work performance was measured using both laboratory simulations and departmental data. Health, quality of life, sleep, sleepiness, off-duty employment, and overtime hours were measured via self-report measures including surveys, sleep diaries, and alertness logs. Fatigue was measured using both objective, laboratory-based instruments, and subjective reports of sleepiness.

The results revealed no significant differences between the three shift lengths on work performance, health, or work-family conflict. There were, however, important differences where the other outcomes were concerned. Officers working 10-hour shifts, for example, averaged significantly more sleep and reported experiencing a better quality of work life than did their peers working 8-hour shifts. And officers working 12-hour shifts experienced greater levels of sleepiness (subjective measure of fatigue) and lower levels of alertness at work than those assigned to 8-hour shifts. The results suggest that CWWs are not likely to pose significant health risks or result in worsened performance, and that 10-hour shifts may offer certain benefits not associated with 8-hour shifts, whereas 12-hour shifts may have some disadvantages over 8-hour shifts. Importantly, those on 8-hour shifts averaged significantly less sleep per 24-hour period and worked significantly more overtime hours than those on 10- or 12-hour shifts. As such, a 10-hour shift may be a viable alternative to the traditional 8-hour shift in larger agencies; however, caution is advised when considering 12-hour shifts due to increased levels of self-reported fatigue/sleepiness and lower levels of alertness. Indeed, researchers have noted that individuals tend to underestimate their levels of fatigue, so officers may be more fatigued than they reported while working 12-hour shifts. Additionally, past research has shown increased risks for accidents with increasing numbers of hours worked. It is for these reasons that caution should be exercised when agency leaders consider adopting 12-hour shifts. Finally, the reduced levels of overtime usage for those working 10- and 12-hour shifts suggests the possibility for cost savings for agencies employing compressed schedules. These findings are consistent with many past findings; however, the lack of randomized controlled trials has limited the utility of past studies.

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Police work is a 365-day a year, 24/7 operation. As such, the issue of police scheduling is of utmost importance in achieving appropriate service area coverage at all times on all days. Traditionally, police departments have relied on a 5-day, 8-hour scheduling framework with three standard shifts (day, evening, midnight) in each 24-hour period. Nevertheless, many agencies have adopted alternative work schedules such as compressed schedules/compressed workweeks (CWWs), the type of schedule in which the workweek is shortened and the length of the day is extended. Yet to date, there has been no randomized experiment of the impacts of these shifts in law enforcement.

Nontraditional, compressed schedules in law enforcement are not new; many agencies have initiated pilot programs or employed CWWs over the past several decades. Since the early 1970s, this topic has been the focus of numerous articles in professional publications such as *Police Chief* magazine and *FBI Law Enforcement Bulletin*. For example, in 1970, Huntington Beach, California, instituted a pilot test of the 10-hour shift (Robitaille, 1970). Also, Gavney, Calderwood, and Knowles (1979), in reporting that the Inglewood, California, Police Department had implemented a 4-day workweek in 1976, noted that many law enforcement agencies had established, experimented with, or considered a 4-day workweek. As agencies began to implement compressed schedules in the 1970s, some data began to surface, although most was of little scientific merit. In 1980, the Illinois Department of Law Enforcement, Bureau of Planning & Development (Illinois, 1980), requested information from 10 other law enforcement agencies[1] that had implemented CWWs in order to fully examine the feasibility of such a schedule in their agency. While anecdotal, the agencies reported the advantages and disadvantages of their plans. For example, in Inglewood, California, management surveyed

[1] Data were received from the following seven agencies: 1) Stockton, California; 2) Arlington, Virginia; 3) Inglewood, California; 4) Jacksonville Beach, Florida; 5) Louisiana State Police; 6) Beloit, Wisconsin; and 7) Cook County Sheriff's Office, Illinois.

officers and found that they preferred the 4-day, 10-hour schedules (4/10s). Similarly, the Louisiana State Police (LSP) conducted a pilot program in which they implemented 12-hour shifts, and reported advantages such as reductions in unscheduled overtime, sick leave, and compensatory time accrual, as well as increases in arrest and improved employee morale; however, they also reported concerns about fatigue. Fournet (1983) reported that by 1981 the LSP program had been adopted department-wide, with other agencies requesting information about this shift schedule. In Jacksonville, Florida, where the 10-hour shift schedule was more complicated (i.e., 5 days on, 4 days off; followed by another 5 days on, 4 days off; and then 6 days on, 4 days off), they also reported less use of sick time, less accumulation of overtime, and increased productivity, but did express concerns about case follow-up, supervision during periods of overlap, and the need for more supervisors. Conversely, Arlington, Virginia, reported no impact on leave earned or used when using a 4/10 plan. However, not all such programs were considered successful; after several months on a 4/10 plan, police management in Beloit, Wisconsin, surveyed officers to find that 98% favored the plan, but they dropped the program in part due to "severe disruption in the command of the police force" (Illinois, 1980, p. 6).

Almost 30 years ago, in a National Institute of Justice (NIJ)-funded study of work scheduling, researchers surveyed 160 agencies regarding their practices and reported that almost 25% of departments had implemented 9-, 10-, 11- and even 12-hour schedules for one or more shifts (Stenzel & Buren, 1983). At that time, about 65% of agencies also reported using shift rotation, with about 95% that rotated frequently from weekly to quarterly. While no national data have been reported since that time, recent data generated from 47 Texas agencies revealed the 8-hour shift to be the most widely employed (43%), with 34% of agencies utilizing 10-hour shifts, and 23% operating on 12-hour shifts (DiMambro, 2008). In this report, we will include

the results of two national surveys we conducted with a random sample of law enforcement agencies in 2005 and 2009. The information obtained from these surveys provides a better understanding of the variation and current trends in shift practices nationwide.

Not only is it clear that there is substantial variation in shift scheduling practices, there is also considerable variation in the basis for those practices. According to Stenzel and Buren (1983), some agencies use compressed schedules to overlap personnel at shift changes or during heavy service demand periods, or to provide more time off for officers. Other influences on scheduling practices include union or association contracts or other agreements reached between labor and management that are driven by personnel issues like seniority, labor laws, members' preferences, or other input based on officers' knowledge and/or experiences. And, of course, history and tradition, i.e., "We have always done it this way," often serve as status quo for a variety of scheduling practices. While there may be primary reasons or multiple reasons that agencies adopt compressed schedules, there have been fairly limited scientific data to inform these decisions.

Nevertheless, there is considerable conjecture about the benefits of compressed work schedules in law enforcement, e.g., it will increase employee morale, improve the organization's ability to recruit the best applicants, result in lower costs, and reduce overtime, absenteeism, and turnover. There are, however, limited data to support these claims in law enforcement. For example, with regard to the LSP's change from an 8-hour to a 12-hour schedule, Fournet (1983) concluded that the advantages of 12-hour shifts outweighed the disadvantages. However, while it was predicted that overtime would be reduced by 25%, it actually went up 11%. And the prediction that vehicle-related expenses would be reduced was not substantiated in the study. Officers also reported greater fatigue, but it apparently did not affect their work performance or

attitudes (Fournet, 1983). While arrest rates and morale reportedly did increase, the author's conclusion appears to have been overstated. In the same vein, in a recent union editorial on CWWs in policing, Jacques (2010) reported that the advantages of 12-hour shifts "far" outweigh any disadvantages, noting that advantages of 12-hour shifts include such things as reduction in sick leave, a double-digit increase in total number of arrests, higher job satisfaction and motivation, improved quality of life, etc., even though those findings were based upon a limited amount of information and evidence that was derived primarily from nonscientific sources (internal police department surveys, technical reports, and other un-cited sources). Indeed, Axelsson (2005) noted that while management and employees believe that the advantages of longer work days outweigh the disadvantages, "it could, perhaps, also be argued that the drawbacks of extended work shifts are largely unknown or ignored by these groups" (p. 17).

There has been extensive research on CWWs across a variety of industries dating back to around the early 1970s, although much of it falls short due to less than rigorous scientific designs, methodological issues, and measurement problems. Nevertheless, much of that work has been summarized in various reviews and meta-analyses in order to assess the overall impacts of these schedules on a variety of criteria, such as performance and productivity, safety, job satisfaction, fatigue, sleep, and health. Many have emphasized the need for more research in the area of CWWs, including experimental research (Glueck, 1979) inclusive of more scientifically rigorous, well-designed studies (e.g., Harrington, 1994), as well as research to better address the impact of shift length, overtime, and other related issues (Caruso, Hitchcock, Dick, Russo, & Schmit, 2004). Others have called attention to methodological problems such as small sample sizes and "peculiar" designs (e.g., Axelsson, 2005). Indeed, there has been an overreliance on survey data, often with small samples and the use of cross-sectional and observational designs.

Past research that suffers from these experimental confounds often results in an over interpretation of findings. This is especially true in policing research, where not only is the research less prolific but it has often been based on anecdotal data or data derived from the law enforcement agencies themselves.

Although there are significant policy implications associated with compressed workweeks in law enforcement, there has been little systematic assessment of the impact of shift lengths in policing. To date, there has been no known, comprehensive randomized experiment assessing the impact of CWWs in law enforcement. There is a great need for both an examination of current national practices with regard to CWWs in law enforcement, as well as the impact of such schedules on performance and safety, health, quality of life, sleep, fatigue, and extra-duty employment (i.e., overtime and off-duty work). In this report, we aim to address this gap by providing both the results of the first comprehensive, randomized experiment of the effects of shift length in policing, as well as descriptive data on current shift practices and trends.

Review of Literature

Research on CWW from Non-Law Enforcement Work Domains

In conducting objective research on CWWs, Calvasina and Boxx (1975) noted that during the period of 1969-1974 there was increased media focus on the 4-day workweek but, like much law enforcement research during that same period, it reflected anecdotal information, opinions, or data derived from indirect methods such as opinion surveys like those conducted by the American Management Association (Wheeler, Gurman, & Tarnowieski, 1972) and the joint survey by the American Society for Personnel Management and the Bureau of National Affairs (1972).

Ronen and Primps (1981) reviewed the literature from the 1970s and found 14 studies in which various impacts of CWWs were examined. In reviewing this early work, they found that employee reactions and attitudes toward CWWs were mostly favorable (e.g., Goodale & Aagard, 1975; Nord & Costigan, 1973; Northrup, Wilson, & Rose, 1979; Poor & Steele, 1970). Most workers on compressed schedules had higher job satisfaction (e.g., Hodge & Tellier, 1975; Ivancevich, 1974), reported more leisure time (Goodale & Aagard, 1975), and believed that the compressed schedule had benefited their marriage and/or social life (Goodale & Aagard, 1975). However, fatigue was reportedly higher for those on compressed schedules as well (e.g., Goodale & Aagard, 1975; Hodge & Tellier, 1975; Ivancevich, 1974; Maklan, 1977; Poor & Steele, 1970; Volle, Brisson, Pérusse, Tanaka, & Doyon, 1979).

When examining performance, however, Ronen & Primps (1981) reported mixed results; in a few studies, supervisory ratings of performance improved (e.g., Foster, Latack, & Reindl, 1979; Ivancevich, 1974), whereas objective measures typically remained unchanged (e.g., Calvasina & Boxx, 1975; Goodale & Aagard, 1975). And, in one study, there was reportedly a problem associated with CWWs in terms of lower customer service to internal customers (e.g., Goodale & Aagard, 1975). Yet, others reported that the implementation of CWWs appeared to have resulted in some reduction in absenteeism (e.g., Foster et al., 1979; Goodale & Aagard, 1975; Nord & Costigan, 1973) and overtime (Goodale & Aagard, 1975). Nevertheless, researchers have conducted long-term studies and found that the benefits observed during the initial period reflect a honeymoon effect and they disappear over time (e.g., Ivancevich & Lyon, 1977). But most importantly, there has been wide variation in the methods employed across studies, perhaps accounting for the mixed findings.

Since the 1970s, a growing body of research has accumulated on compressed schedules mainly due to concerns over safety or other important considerations in a variety of industries, with Harrington (1994) noting increasing studies on CWWs in the early 1990s. Research has been conducted across a variety of domains in the last couple of decades. For example, research has been conducted with medical personnel (see e.g., Burke, 2003; Fitzpatrick, While, & Roberts, 1999; McGettrick & O'Neill, 2006; Mills, Arnold, & Wood, 1983); employees in manufacturing or plant settings (see e.g., Duchon, Smith, Keran, & Koehler, 1997; Northrup, 1991; Rosa, 1995); utility and power plant workers (see e.g., Mitchell & Williamson, 2000; Rosa, 1995); and transportation workers such as truck drivers (see Aamodt, 2010), train operators and controllers (Härmä, Sallinen, Ranta, Mutanen & Müller, 2002; Sallinen et al., 2005); and air traffic controllers (Schroder, Rosa, & Witt, 1998). There is additional, albeit limited, research in the areas of information systems personnel (Latack & Foster, 1985), fire operations personnel (Frazier, 1999), and prison guards (Venne, 1993).

Interestingly, Josten, Ng-A-Tham, and Thierry (2003) conducted a review of 15 rigorous studies on the effects of compressed workweeks and noted that positive effects tended to be more frequently reported in studies prior to and including 1982, whereas later studies tended to find more negative effects. And when positive effects of CWWs were found, it appeared that the conclusions were overstated. For example, in a 1977 field survey of 50 chemical and petroleum plants that had adopted 12-hour shifts (from prior 8-hour shifts), all managers reported a significant improvement in morale, without noting any impairments in efficiency, job safety, or workers' health (Northrup et al., 1979). Researchers concluded from this study that when weighing advantages and disadvantages of 12-hour shifts, the "scale tips heavily in favor of the modified schedule" (Northrup et al., 1979, p. 326), yet the information came solely from the

viewpoints of plant managers, and no objective data were obtained. While Josten et al. (2003) conceded that many of the studies on performance had been based upon self-reported data, they also noted that there have been a number of studies from which more objective data has been derived.

Impact on productivity, performance, and safety. In examining research on CWWs, the findings related to performance and productivity, safety, and health have largely been mixed and therefore are inconclusive (e.g., Knauth, 2007; Ronen & Primps, 1981). For example, in a meta-analysis of compressed schedules, researchers examined 25 effect sizes across 12 sub-studies (six of which were coded as high on scientific rigor) and found that for the four studies examining productivity there was no effect, although there was a positive effect for subjective ratings of performance by supervisors (Baltes, Briggs, Huff, Wright, & Neuman, 1999). It is important to note that objective and subjective performance measures are only modestly related and therefore should not be used interchangeably (Bommer, Johnson, Rich, Podsakoff, & MacKenzie, 1995). In addition, some researchers have noted that those on CWWs have increased productivity and improved ability to interact with citizens based on subjective self-reports (e.g., Facer & Wadsworth, 2008; Facer & Wadsworth, 2010). However, as is often the case with self-reported beliefs about performance, these findings are likely to reflect a bias consistent with the desired shift schedule. Interestingly, some have found that CWWs have led to decreased work effort (Duchon et al., 1997) even when the schedule length increment is very small (Josten et al., 2003).

Baltes et al. (1999) concluded that for compressed schedules, regardless of experimental rigor or time since intervention, attitudinal measures were more greatly affected than behavioral outcomes, and supervisory ratings of performance but not actual performance were higher for

those on compressed schedules. For example, nurses working 12-hour shifts reported that they had provided better patient care (McGettrick & O'Neill, 2006) or experienced greater continuity of care with their patients (Campolo, Pugh, Thompson, & Wallace, 1998; Richardson, Dabner, & Curtis, 2003) as compared to their prior 8-hour schedule, even though Stone et al. (2006) reported no differences in patient care among nurses. But even when relying on self-reported measures, some have found negative outcomes associated with CWWs. For example, Burke (2003) found that nurses' reports of errors and injuries to patients (e.g., received more complaints from patients' families, administered incorrect medication or dosage, etc.) increased when hours of work increased.

Importantly, when considering objective data, however, researchers who conducted a recent systematic review concluded that performance deteriorates and injuries increase for those working long hours, especially for very long shifts and when 12-hour shifts are combined with more than 40 hours of work per week (Caruso et al., 2004). Negative impacts of compressed schedules have been documented by Folkard and Tucker (2003) who reported that there was an association between increased work hours and greater industrial accidents and injuries such that accident risk in the twelfth hour of work was more than double that of the first 8 hours. Additionally, Folkard and Lombardi (2004) reported that compared to 8-hour shifts, 10-hour shifts resulted in a 13% increased risk for accidents and injuries, and that rate jumped to 27.5% for 12-hour shifts. However, when considering managers' reports, Northrup (1991) found that the managers in a mini-steel plant reported fewer accidents in general for 12-hour shifts, although it is important to note that there were differential accident rates in some areas; for example, the favorable finding was not true in the melt shop. Hence, it appears that when gathering data on performance and productivity, self-reported measures should be interpreted

with caution because they may reflect biases associated with shift length preferences for various workers.

A significant amount of research has been conducted within the transportation sector, and the largest factor of concern is time since being awake. For example, an analysis by the National Transportation Safety Board (NTSB) indicated that the time since awake was the dominant fatigue-related factor in accidents by domestic air carriers for the period 1978-1990 (NTSB, 1994). When considering shift length, a review of duty period extensions for the Federal Aviation Administration (FAA) indicated that shifts at or above 12 hours are associated with a higher risk of error (Battelle Memorial Institute, 1998). In a study of truck drivers, Hamelin (1987) found that accident risk was quite high after driving for more than 11 hours. Due to safety considerations associated with any increase in daily hours above eight, the National Research Council Panel on Human Factors in Air Traffic Control recommended that the FAA discourage CWWs because they may be associated with "degraded performance" (Wickens, Mavor, & McGee, 1997).

In the medical field, CWWs have been associated with negative outcomes. For example, researchers have found reductions in quality of care by nurses (Bernreuter & Sullivan, 1995; Eaton & Gottselig, 1980; Fitzpatrick et al., 1999; Todd, Reid, & Robinson, 1989) and a 7% drop in direct nursing activities (Reid, Robinson, & Todd, 1993) for those working 12-hour compressed schedules. In addition, Jeanmonod and colleagues (2008) noted that more experienced nurses saw fewer patients when working 12-hour shifts than 9-hour shifts. Similarly, researchers examining emergency room physicians found that those working 8- or 9-hour shifts had greater productivity (number of patients seen per hour) compared to those on 12-hour shifts (Hart & Krall, 2007). On the other hand, McClay (2008) did not find decreases in

productivity of medical residents on 10- or 12-hour shifts, perhaps due to the smaller gap in shift length.

There is also evidence that CWWs are associated with lower cognitive performance (e.g., grammatical reasoning, reaction time, motor abilities) when comparing workers on 12-hour shifts to those on 8-hour shifts (e.g., Duchon, Keran, & Smith, 1994; Rosa & Bonnet, 1993; Rosa & Colligan, 1992). In a longitudinal study of control room operators at a continuous processing plant, workers on 12-hour shifts displayed poorer performance on a series of cognitive, perceptual, and motor skills as compared to those on 8-hour shifts (Breaugh, 1983).

On the other hand, others have not found differences across shift lengths when examining critical thinking skills (e.g., Washburn, 1991; Bernreuter & Sullivan, 1995), or cognitive functioning among nurses (e.g., Campolo et al., 1998; Fields & Loveridge, 1988). When considering the differences between 8- versus 10-hour shifts among air traffic control specialists on cognitive tasks such as reaction time or digit addition, researchers also did not find any significant differences (Schroeder et al.1998)

There is an added complexity when examining the impact of CWWs on performance, namely the point at which performance is measured and the day of the shift. For example, worsened performance has often been present at either the end of the shift (Mitchell & Williamson, 2000), the last day of the 12-hour shift (e.g., Duchon et al., 1994), or both (Rosa & Colligan, 1988). Conversely, while Ugrovics & Wright (1990) also found that those on 12-hour shifts experienced greater fatigue at the end of the shift, they reported it being worst on the first day of the workweek. It is therefore important to examine performance at the end of a shift when considering the impact of longer shifts.

In terms of interpersonal communication, McGettrick and O'Neill (2006) reported poorer communication among medical staff when working CWWs, whereas others have shown improvements in internal communication (Johnson & Sharit, 2001). Other findings have also been mixed. For example, Laundry and Lees (1991) found reductions in minor injuries (cuts, scrapes, and bruises) after introduction of 12-hour shifts, yet higher rates of off-duty injuries including those requiring medical care, thus lending support to the assertion that past findings are equivocal.

Impact on health. One of the greatest areas of concern regarding CWWs is how they may affect the health of workers. Well over a decade ago, the results of a meta-analysis of the impact of work hours and health outcomes demonstrated a small (r = .13) but significant relationship between increasing hours of work and psychological and physiological health symptoms (Sparks, Cooper, Fried, & Shirom, 1997). Yet in a recent systematic review, van der Hulst (2003) noted that "there is evidence of a link between long work hours and ill health, but there is a serious shortage of well-controlled studies that can confirm and strengthen the evidence" (p. 183).

Researchers have identified greater health problems (Sparks et al., 1997), including mental health (Spurgeon, 2003), when total hours worked weekly exceeded 48. In addition, researchers conducting a recent systematic review of 51 studies and one meta-analysis concluded that there have been increased health complaints for those working very long shifts and when 12-hour shifts are combined with more than 40 hours of work per week (Caruso et al., 2004). They also noted that in two studies start times of 6:00 a.m. for those on 12-hour shifts were associated with greater health complaints, most likely due to circadian cycle dips between 4:00 and 6:00 a.m. In a study of 410 truck drivers, Andrusaitis, Oliveira, and Filho (2006) found that increased

number of hours worked was associated with lower-back pain and this difference was apparent with just a one hour difference in work hours from a median of 9.0 to 10.0.

Yet, in the most recent systematic review of 40 studies addressing the impact of CWWs on health, researchers found just five prospective cohort studies using control groups and reported that the results of these provide inconclusive evidence on the health effects of CWWs (Petticrew, Bambra, Whitehead, Sowden, & Akers, 2007). For example, in studies comparing 8- and 12-hour shifts in the nursing field, the results have been inconsistent. Some have found that nurses working more than 8 hours per day were significantly more likely to report having a number of health-related problems, including musculoskeletal problems such as pain, numbness, tingling, aching, stiffness, and burning in the neck, shoulders, and back (Lipscomb, Trinkoff, Geiger-Brown, & Brady, 2002); emotional exhaustion and other psychosomatic symptoms such as headaches, poor appetite, lower back pain, faintness or dizziness (Burke, 2003); and greater anxiety before and after shifts (Ruegg, 1987).[2] Others, however, have reported neutral or more positive results associated with compressed schedules. For example, self-reported physical health of nurses revealed no significant group differences based on shift length (Campolo et al., 1998), and Stone et al. (2006) reported that nurses on 12-hour shifts were less emotionally exhausted than those working 8-hour shifts. Similarly, Eaton and Gottselig (1980) found a significant decrease in subjective symptoms such as cardiovascular complaints and general health complaints, as well as reduced anger-frustration and anxiety-fear states for those on 12-hour compressed schedules in nursing. At the same time, Bambra, Whitehead, Sowden, Akers, & Petticrew (2008) concluded that CWWs may improve work-life balance "with a low risk of adverse health or organizational effects," (p. 764), noting that better designed studies are needed.

[2] Ruegg's (1987) study was based on a change from 8-hour to 12-hour shifts among coronary care nurses.

The findings in other industries have also been inconclusive. A number of researchers have not found significant differences between 8- and 12-hour shifts for general health outcomes (e.g., Cunningham, 1989) or psychological or gastrointestinal health (Tucker, Smith, Macdonald, & Folkard, 1998), although the latter found that those on 12-hour shifts had fewer symptoms of cardiovascular disease and improved eating habits (Tucker et al., 1998). Petticrew et al. (2007) reported improvements in mental health associated with CWWs.

Yet, in an 8-year longitudinal study of health outcomes after a change from an 8- to 12-hour shift in a manufacturing setting, Johnson and Sharit (2001) reported initial positive impacts upon digestive problems (such as heartburn, acid stomach, or diarrhea) and psychological issues (such as feelings of depression or irritability, nervousness, or difficulty concentrating) in the first year; however, these effects did not persist in the 8-year follow-up, suggesting a honeymoon effect. It is also important to note that for many studies where health benefits have been noted for the longer shifts, the findings are tempered by a number of undermining factors. For example, while Mitchell and Williamson (2000) found that workers on 8-hour shifts reported more health complaints than those on 12-hour shifts, they also had a higher proportion of smokers in the 8-hour group. And, when studying 775 workers over two 10-year periods, Lees and Laundry (1989) found that stress-related health issues declined significantly once workers switched to a 12-hour shift. However, they cautioned that these findings may have been the result of increased leisure time and specific to a manufacturing environment.

In their systematic review, Petticrew et al. (2007) note that in many of the 40 studies there were methodological limitations such as small sample sizes, inadequate control groups, and the need for more objective measures. In sum, it appears that many of the mixed findings across

industries may be the result of methodological variation, small sample sizes, or other measurement problems.

Other impacts. The findings related to quality of life issues, sleep, and fatigue are somewhat more consistent. When considering compressed schedules, the findings have suggested that: (a) employees generally favor CWWs (e.g., Armstrong-Stassen, 1998; Axelsson, 2005; Bendak, 2003; Dowd, Oakley, French, Fischer, & Storm, 1994; Duchon et al., 1997; Duchon et al., 1994; Dunham, Pierce, & Castañeda, 1987; Facer & Wadsworth, 2010; Lowden, Kecklund, Axelsson, & Akerstedt, 1998; Pierce & Dunham, 1992; Rosa & Colligan, 1992); (b) there is improvement in home and personal life including increased leisure, personal, and family time or greater satisfaction associated with them (e.g., Armstrong-Stassen, 1998; Knauth, 2007; Lowden et al., 1998; McGettrick & O'Neill, 2006; Mitchell & Williamson, 2000; Facer & Wadsworth, 2010), or reduced work-family conflict (Facer & Wadsworth, 2008; Facer & Wadsworth, 2010); (c) longer days tend to be associated with greater fatigue (e.g., Armstrong-Stassen, 1998; Bendak, 2003; Knauth, 2007); and (d) those on compressed schedules often get more or better sleep than those on traditional, 8-hour schedules (e.g., Axelsson, 2005; Duchon et al., 1997; Mitchell & Williamson, 2000). These findings tended to be consistent regardless of the research designs employed or the scientific rigor of those studies but are perhaps the result of primarily self-reported data.

Unlike the reporting of performance data, it is perhaps more appropriate to obtain self-reported data when considering quality of work and family life, perceptions of fatigue, and data on sleep amount and quality, as these are primarily psychological variables. Importantly, Rosekind and Schwartz (1988) contend that the scientific literature on fatigue and sleepiness suggests that most people underestimate their level of fatigue/sleepiness. As such, when relying

on self-reported or other subjective measures of fatigue, it is likely that the results will be conservative. As such, any indication of fatigue via subjective reports should be taken seriously, as it may represent an underestimate.

Impact on quality of life. Spurgeon (2003) contends that work-hour arrangements can be used to enhance the overall quality of people's lives (p. 126). However, research on shift length has not always demonstrated improvements in quality of life for compressed workweeks.

Quality of personal life. A number of studies on the impact of CWWs on personal life have demonstrated improvements for those working 12-hour schedules as compared to 8-hour schedules (e.g., Johnson & Sharit, 2001), including more time for family, social life, and domestic duties (Knauth, 2007). In examining issues of work-life balance or work-family conflict, again findings have been mixed. Facer and Wadsworth (2008) reported that municipal workers on a 4-day, 10-hour schedule (4/10s) experienced lower levels of work-family conflict than those working all other shifts; however, the findings with regard to job satisfaction, while in the same direction, were not statistically significant.

Whereas the authors of a recent systematic review reported that the introduction of CWWs may "improve the work-life balance of [workers] with few adverse health or organizational effects" (Petticrew et al., 2007, p. 2), others have not obtained significant findings (e.g., Grosswald, 2004; Loudoun, 2008). Furthermore, some have found negative impacts on quality of life for those on CWWs. For example, in a study of pilots in the UK, Bennett (2003) found that those working longer shifts reported a reduction in social activities. Studies with nurses have also sometimes resulted in negative quality of life. For example, nurses on 12-hour shifts in one study reported unfavorable perceptions concerning the benefits of their new shift, e.g., less time to socialize with family and friends, their inability to maintain a routine exercise

schedule, and guilt experienced from feelings of needing to have time away from their patients (Wintle, Pattrin, Crutchfield, Allgeier & Gaston-Johansson, 1995). Similarly, Todd, Robinson, and Reid (1993) examined nurses on compressed schedules who also reported decreased job satisfaction and negative impacts on social and domestic arrangements. Yet, in other nursing studies examining 12-hour compressed schedules, the findings suggest either no differences (e.g., Bernreuter & Sullivan, 1995) or greater job satisfaction (e.g., Stone et al., 2006; Ugrovics & Wright, 1990) as well as improved family and/or social life (e.g., Campolo et al., 1998; Dwyer, Jamieson, Moxham, Austen, & Smith, 2007).

In other industries, the findings also are inconclusive. For example, Dowd et al. (1994) reported that Air Force base workers' attitudes toward 10-hour shifts either did not impact their quality of life or actually improved their quality of life (e.g., family, community, leisure, social, and cultural factors) as compared to 8-hour shifts. And for those on 12-hour shifts, participants in one study reported significantly less disruption to their social lives (Tucker, Barton, & Folkard, 1996). Nevertheless, based on a review of nursing studies from 1970-1993, Bernreuter and Sullivan (1995) indicated that nurses' satisfaction was not improved with 12-hour shifts, but "In fact, job satisfaction may be higher on 8- and 10-hour shifts" (p. 195).

Satisfaction with shift length. Research has demonstrated that workers often prefer compressed workweek (CWW) schedules and are more satisfied with their schedules (e.g., Dowd et al., 1994; Stone et al., 2006; Facer & Wadsworth, 2010). Nevertheless, in other studies researchers have found the opposite, even when just a slight increase in shift length has been implemented. For example, in a review by Josten et al. (2003), researchers reported that those on 9-hour shifts were less satisfied than those on 8-hour shifts. Despite the fact that Josten et al. (2003) also noted studies of favorable ratings of those on 12-hour shifts, they expressed caution

about the use of extended shifts since many of the studies they reviewed contained methodological flaws.

Impact on fatigue and sleep. Among the most studied factors associated with CWW are fatigue and sleep patterns, yet the findings in this area are also wide-ranging and somewhat inconclusive. For example, when examining cognitive performance in a laboratory setting, researchers found that those with 17 hours of sustained wakefulness performed at the same level as those with blood alcohol counts of 0.05%, the legal limit in many countries, and after 24 hours that number jumped to around 0.10% (Dawson & Reid, 1997). The fact that performing while fatigued can be equated to performing while intoxicated suggests the importance of quality research to determine factors contributing to fatigue and its impact on safety and performance. In fact, Williamson and Feyer (2000) found that sleep-deprived participants performed 50% worse in cognitive functioning than those who were intoxicated. This is further reinforced by data showing that increased fatigue is associated with an increased occurrence of work-related, near-miss injuries (Lilley, Feyer, Kirk, & Gander, 2002) and decreased ability to perform mental and physical tasks (Alberta Human Resources & Employment, 2004).

Fatigue. Numerous studies have demonstrated greater levels of fatigue associated with CWWs and some show related increases in risk. Specifically, many studies have linked 12-hour schedules to increased fatigue, especially when compared to 8-hour schedules (e.g., Bendak, 2003; Garbarino et al., 2002; Macdonald & Bendak, 2000; Rosa & Colligan, 1992; Smith, Folkard, Tucker, & Macdonald, 1998; White & Beswick, 2003). In a report to the Federal Aviation Administration, researchers noted that workers on 12-hour shifts across a number of industries are considerably more fatigued than those on traditional 8- or 10-hour shifts (Battelle Memorial Institute, 1998). In 1997, Akerstedt reported on findings of a review and noted that

"taken together, the results to some extent support the common sense notion of fatigue/sleepiness being a function of the time worked" (p. 109), noting that it may be more pronounced if the days off are used for a secondary job. Also, Rosa and Bonnet (1993) found declines in alertness when moving from an 8- to a 12-hour shift, consistent with findings by others (Daniel & Potasova, 1989; Hamelin, 1987; Volle et al., 1979).

Fatigue has also been associated with errors and other detrimental outcomes. For example, Mitchell and Williamson (2000) found that among power plant workers, there were more errors made at the end of 12-hour shifts. Furthermore, Rogers[3] noted that "… the effects of fatigue can include: difficulty in concentrating, slowed response times, poor decision making and reduced alertness" (Cramer, 2007, p. 1). The more important question is whether longer shifts lead to greater fatigue. In an experimental study with train drivers and railway traffic controllers, Härmä et al. (2002) found that a 3-hour increase in shift length for the participants resulted in a 51% increase in the risk for severe sleepiness, and Sallinen et al. (2005) noted that for each additional hour at work, the odds for severe sleepiness increased by 9%. Furthermore, it appears that safety considerations exist even when the increment of time is much smaller. For example, Cruz, Rocco, and Hackworth (2000) studied air traffic controllers and found that those working 9-hour shifts as opposed to 8-hour shifts were significantly more likely to doze off at work (83% versus 60%, $\chi^2 = 11.64$, $p < .01$). Similarly, even a slight increase in shift length has been shown to be related to increased fatigue among nurses when comparing those on 8- and 9-hour shifts (Josten et al., 2003).

Nevertheless, some researchers have not found significant differences in fatigue based on shift length (Fields & Loveridge, 1988; Tucker et al., 1996; Washburn, 1991). In fact, in a recent

[3] Dr. Naomi Rogers is a sleep expert from the Sleep and Circadian Research Group at the Woolcock Institute of Medical Research.

systematic review of 40 studies on the effects of a CWW on various factors, researchers concluded that CWWs did not seem to have an unfavorable effect on fatigue (Petticrew et al., 2007). However, even the authors note that the lack of negative findings could be related to the popularity of CWW among workers, which may have created a biasing effect. And it is important to reemphasize the finding that individuals underestimate their level of fatigue (Rosekind & Schwartz, 1988).

Clearly, worker preferences for CWWs may temper self-report measures of fatigue, if they believe it will result in a return to (or continuing with) a more traditional 8-hour schedule. Furthermore, Axelsson (2005) has also underscored other methodological concerns that may have led to contradictory or inaccurate findings. These include small sample sizes, "peculiar" designs, and problems with participation. Interestingly, in Axelsson's own studies there were inconsistent findings likely due to variations in research designs. Ultimately, these findings taken as a whole have led several scientists to conclude that just because employees are willing to work CWW schedules or are more satisfied with such shifts, does not mean that their work performance, fatigue, or well-being will be unaffected by longer workdays (Macdonald & Bendak, 2000; Szczurak, Kaminska, & Szpak, 2007). Specifically, Rosa, Colligan, and Lewis noted that "workers seem willing to tolerate greater fatigue and sleep loss for the social/personal gain" but it could be at a cost (1989, p. 31).

Nevertheless, even though fatigue has implications for safety, it does not always translate to field performance. Indeed, in many cases, even when researchers are able to demonstrate increased fatigue and/or reduced alertness associated with longer shifts, they are often unable to find any direct or indirect linkages to various performance measures (e.g., Lilley et al., 2002; Mills et al., 1983).

Smith et al. (1998) examined accumulated evidence comparing 8- and 12-hour shifts in terms of sleep, health, performance, safety, and psychosocial well-being, and concluded that the findings to date had been equivocal; there were few differences in terms of impact on people. Even though Smith et al., (1998) suggested that there may be advantages to 12-hour shifts in terms of lower stress, better physical and psychological well-being, improved durations of off-duty sleep, and improved family relations, they noted that there are still concerns over fatigue and safety. The authors asserted that "fatigue and decreased alertness towards the end of a 12-hour shift can be a real concern and should be borne in mind when such systems are implemented" (Smith et al., 1998, p. 218).

Despite the extensive scientific research suggesting negative impacts of CWWs on fatigue and alertness, there appears to be ongoing anecdotal information lending to more confusion in the field. For example, Circadian, a leading sleep and safety research firm, recently published a report on the advantages and disadvantages of 12-hour shifts, and indicated numerous advantages of 12-hour shifts from both a management and shift worker perspective: increased productivity, reduced errors, higher project completion rates, and more "dedicated" employees on the management side, longer and better quality breaks, twice as many weekends off, improved family and social life, improved morale, more home study time, increased utilization of personal time, little effect on overtime opportunities, and elimination of evening shifts on the worker side (Moore-Ede, Davis, & Sirois, 2007). Yet, while also noting disadvantages, they did not cite any specific studies to support these claims. In any event, they aptly concluded that "the assessment of the merits of 12- vs. 8-hour shift schedules is a complex issue that does not have a simple answer. Clearly there are compelling advantages for 12-hour schedules such as more time off and more weekend days off, but these are balanced by the longer

working days and the questions of mental and physical fatigue" (Moore-Ede, et al., 2007, p. 12). They also contended that 12-hour shifts have "proven to be safe and productive," which seems to be an overstatement based on the scientific evidence to date. Additionally, while they indicated that 12-hour shifts seem to be agreeable to most shift workers (Moore-Ede et al., 2007), other scientists have suggested that mere preference is not a sound basis upon which to adopt 12-hour shifts (Macdonald & Bendak, 2000; Szczurak et al., 2007), without due consideration of the safety and performance issues.

At the same time, there are other issues associated with fatigue that are of particular importance. For example, Ugrovics and Wright (1990) found that those on CWWs reported greater fatigue at the end of the shift, especially on the first day of the workweek, whereas Rosa and Colligan (1988) found that work-related errors increased as the workweek progressed and as the 12-hour day progressed (later in the shift). In sum, while the findings have been mixed, Harrington's (1994) observation seems quite fitting: "Most reviews contend that the 12-hour shift leads to increased fatigue and the potential (at least) for lower productivity and poorer safety records" (p. 702). These findings have led researchers in recent years to caution practitioners about compressed schedules in situations where public safety could be threatened (Armstrong-Stassen, 1998; Knauth, 2007; Macdonald & Bendak, 2000; Rosa, 1995; Scott & Kittaning, 2001). Certainly, policing is one of these public safety domains in which critical incident exposure and risk for potentially devastating consequences are higher than for many other occupations.

Sleep quantity and quality. With regard to sleep quantity, many studies across fields have demonstrated that shift work can adversely affect the sleep quality of workers (Bendak, 2003; Scott & Kittaning, 2001; Garbarino et al., 2002). Hence, it is important to examine

CWWs across all shifts. While there have been mixed findings in the area of sleep associated with CWWs, Duchon et al. (1997) found that those working 12-hour shifts as compared to 8-hour shifts had increased levels of sleep and better sleep quality.

Other impacts. Some researchers have looked at other outcome criteria such as overtime, absenteeism, commuting costs, and other cost factors. This is primarily more recent research and requires replication or further investigation.

Overtime. There has been considerably less research on the impact of shift schedules on overtime and off-duty work. According to Spurgeon (2003), "There are very few safety studies which are concerned specifically with long hours worked as overtime, as opposed to those which are part of long (e.g., 12-hour) shifts" (p. 69). Some, however, have noted decreases in paid overtime (Facer & Wadsworth, 2010), which is consistent with an earlier finding by Foster et al. (1979) who found a 33% reduction in overtime for those on CWWs.

While not the primary focus of our study, it is important to note that some researchers have identified other organizational outcomes associated with compressed schedules, such as reduced costs for commuting (e.g., Price, 1981). For example, State of Utah employees surveyed by Facer and Wadsworth (2010) also reported reduced commuting costs for those on 4/10 schedules, a logical finding given fewer days at work and one that is consistent with assertions made by many who promote such schedules. Sundo and Fujii (2005) reported that commute times may be further reduced on CWWs due to non-peak hour commutes. Facer and Wadsworth (2010) also noted that when the State of Utah examined energy consumption associated with a 4/10 compressed schedule, they noted over a 10% decrease in energy use or an overall statewide reduction of $502,000. Others have reported that the use of CWWs results in decreased leave and absenteeism (Facer & Wadsworth, 2010; Foster et al., 1979). Hung (2006) suggests a

potential cost savings with CWWs but it appears to be based on minimizing staff levels. Although this is not based on 24/7 operations and is hypothetical rather than actual, the author has previously documented savings in commuting costs (Hung, 1996).

On a more negative note, Sundo and Fujii (2005) examined university employees on CWWs and found that a work-day increase of 2 hours led to a reduction in household activities by 1 hour, sleeping by about 20 minutes, and pre-work preparation time by 30 minutes, suggesting some additional impacts on activity patterns.

Summary. Notwithstanding the findings from the research on CWWs, there has been considerable variation in the sample sizes, methodologies, quality, fidelity, and scientific rigor of those studies and, in particular, a lack of studies that included objective outcome measures. Indeed, many have expressed concerns about past research in the area, including the use of small sample sizes, the limited use of control groups and/or matched designs, the limited number of longitudinal designs, the lack of proper controls, potentially confounding factors, preferential biases, and the less than adequate or unknown adequacy of instrumentation (e.g., Bambra et al., 2008; Bernreuter & Sullivan, 1995; Fitzpatrick et al., 1999; Petticrew et al., 2007). For example, some have tested changeovers from 8-hour to 12-hour shifts but have included inconsistent rotational patterns (e.g., Frese & Semmer, 1986; Lowden et al., 1998) such that the independent effects of shift length and shift rotation could not be established. And it is important to note that age has some bearing on preferences: Younger people on 12-hour shifts have more favorable attitudes than older workers (e.g., Dunham & Hawk, 1977), as well as differences in how longer shifts affect them (Reid & Dawson, 2000).

Finally, there has been virtually no research in which individuals have been randomly assigned to different shift lengths; rather, much of the research is cross-sectional or descriptive,

which may be in large part why the findings have not been conclusive. Most importantly, there is a limited body of research examining shift practices in law enforcement. Indeed, Vila, Kenney, Morrison, and Reuland (2000) affirmed that "…little attention has been paid to the ways that police officers' hours of work affect their performance." A summary of the literature in shift practices in law enforcement is provided below.

Research on Compressed Workweeks (CWWs) in Law Enforcement

Lindsey (2007) argued that law enforcement personnel are motivated to work longer hours for a variety of reasons, such as monetary gain, encouragement from the occupational and organizational culture, and the fun of being part of a dangerous, exciting, and stimulating job. Interestingly, due to the widespread knowledge of the impact of fatigue on safety, the federal government regulates work hours of private, for-profit workers—train engineers, truck drivers, commercial pilots, and nuclear power plant operators—but not the police, "the government's most public, sensitive, and routinely controversial service provider" (Vila, Morrison, & Kenney, 2002, p. 7). Similarly, Lindsey (2007) asserted that the hours of firefighters, emergency room doctors, and ship captains are regulated, but the same is not true for law enforcement employees. Indeed, little guidance has been provided to police leaders as to the safety considerations associated with CWWs.

According to Vega and Gilbert (1997), periods of financial strain have led some law enforcement executives to implement CWWs in an effort to improve efficiency. In the current economic climate, law enforcement agencies are faced with the need to do more with less, leading some to consider or implement CWW scheduling (e.g., Oliver, 2005; Sundermeier, 2008). Perhaps not surprisingly, when describing potential advantages and disadvantages of CWWs, law enforcement personnel frequently claim far more advantages than disadvantages.

Over the past four decades, there has been increasing attention paid to the impact of CWWs in law enforcement. Among the many benefits espoused are the ability to (a) increase coverage during peak hours of activity, (b) improve officer job satisfaction and morale, (c) increase performance, (d) reduce response time, (e) reduce crime, (f) reduce costs for officers and agencies (e.g., commuting, overtime, and sick leave), (g) improve teamwork, (h) allow for increased in-service training during periods of overlap, (i) increase days off for personal pursuits/family activities, and (j) reduce accidents as well as complaints against officers (see e.g., Brown, 1974; Cunningham, 1982; Durrett, 1983; Fournet, 1983; Strunk, 1978; Sundermeier, 2008; Vega & Gilbert, 1997; Vila et al., 2000; Weisburd & Buerger, 1986). It certainly sounds like CWWs are a silver bullet for addressing numerous issues. Nevertheless, these purported benefits have not been firmly established in the research literature, nor have they been guided by the result of rigorous scientific investigation. In fact, deCarufel and Schaan (1990) conducted a systematic review in policing and cautioned that there are still many unknown potential impacts of CWWs (1990). Importantly, Vila (2006) referred to research examining optimal shift lengths in policing a "high" priority, noting a need for hard information about the risks and benefits.

Consistent with research in other occupations, scientists conducting studies on compressed schedules in law enforcement often rely on less than optimal research designs and sample sizes, and employ insufficient or subjective outcome measures mainly due to field or practical limitations. Most have not used randomized designs, but instead examine differences after changeovers to CWWs from 8-hour shifts or relied on other observational or cross-sectional research designs. Still others have relied heavily on survey data or case studies (Vega & Gilbert, 1997). Some research of better quality has emerged, but much of it still suffers from methodological, sample size, and measurement issues. For example, while Peacock, Glube,

Miller, and Clune (1983) used a number of highly objective measures (i.e., physiological) in their examination of a changeover from 8- to 12-hour shifts, their study lacked a concrete sample size. Although the overall sample was 75, many of the analyses over time were based on much smaller comparisons. Specifically, Peacock et al. (1983) reported that those on 12-hour shifts had lower blood pressure—a comparison based on just 16 cases—but conceded that this could have been the result of more regular eating and sleeping patterns. Vega and Gilbert (1997) obtained just a 41% response rate to their survey, or a sample of just 34 officers. Also, because they employed a pre-post design for capturing departmental data on response efficiency, the statistically significant findings may not be causal and were so small as to be considered of limited practical import. While others have used innovative methods such as obtaining the attitudes of officers' "wives" (Barter Trenholm, 1997; Gavney et al., 1979) or using chiefs' observations of family relations (Durrett, 1983), these measures are certainly questionable. And some have attempted to assess objective data using self-reported measures that may have inherent biases, e.g., increases in family spending associated with CWWs (Gavney et al., 1979).

Cunningham (1982), while conducting studies on 10- and 12-hour shifts in two Canadian law enforcement agencies, asserted that the studies could not "prove cause and effect, and "the evidence derived from these studies has to be regarded as tentative" (p. 442). Cunningham's studies had some drawbacks such as the limited number of cases (e.g., in Vancouver there were 48 total cases), and an intermingling of shift length with shift rotation in Saanich, Canada, a potential confound. Also, in reviewing the evidence on 12-hour shifts in policing, Cunningham's (1990) assertions were more speculative and could be considered more conjecture than a comprehensive set of findings based on the evidence. Furthermore, Walker and Eisenberg's (1995) study of the changeover to a 12-hour work schedule was confounded by a simultaneous

change to fixed shifts from a prior rotating shift configuration. It also relied on the use of singular agreement items to assess officers' beliefs about their productivity, stress levels, and job commitment, all likely biased by the desire to work the 12-hour shifts. Finally, the Ottawa shift system in Canada involved employing 10-hour shifts on days and afternoons and sticking with 8-hour shifts during the night shift. Again, however, the 8-hour night shifts run continuously for 7 days followed by a 6-day rest period, whereas the 10-hour shifts consist of just three or four shifts followed by 2 days off. Despite the many purported advantages, some have noted a number of potential problems such as patrol car shortages during overlapping shift periods, officer fatigue leading to greater risks, and difficulties in schedule administration (e.g., Stenzel & Buren, 1983). Indeed, the findings of a survey of 104 police departments in California that had implemented the 4-day, 10-hour schedule suggested some potential drawbacks to 10-hour shifts, such as problems with unity of command and supervision, increased costs, lack of personnel to provide sufficient coverage, and the need for more equipment (California Commission on Peace Officers Standards and Training, 1973). Other concerns about CWWs raised by managers in Canadian law enforcement agencies included (a) lessened opportunity for communication with staff, (b) citizen complaints, (c) potential costs, (d) lack of investigative continuity, and (e) lessened identification with the police profession due to time away from the job (Cunningham, 1990). More recently, DiMambro (2008) reported that a number of agencies that had adopted 12-hour shifts also indicated a deleterious effect upon communication among officers or between officers and their supervisors.

Melekian (1999), then police chief in Pasadena, California and now director of the Office of Community Oriented Policing Services of the U.S. Department of Justice, critically examined many issues associated with 12-hour shifts, noting the many arguments made in favor of them.

Among the purported benefits were improved morale, increased quality of life outside law enforcement (e.g., time to attend school or engage with their families), and greater work-family balance. Nevertheless, Melekian also noted the drawbacks such as increased fatigue, reduced communication across shifts, lessened ability to deal with neighborhood problems, and, most importantly, disengagement from the job and reduced ability or time to establish and maintain relationships with the community, thereby detracting from community policing and job involvement. He called for increased research on the impacts of such schedules. Consistent with Melekian's call for more research on CWWs in law enforcement, Vila (2006) noted "…both police executives and officers need hard information about the risks and benefits of such schedules." Similarly, deCarufel and Schaan (1990) noted the importance of increased knowledge of the impacts of CWWs on issues such as court appearances on days off, as well as investigative follow-ups.

Impact on productivity, performance, and safety. Although there are limited data on the impact of CWWs in law enforcement, there has been some work dating back 15-20 years, yet it is not without significant limitations. In a study of the impact of CWWs, Pierce and Dunham (1992) noted that there was no change shown for departmental performance of specific patrol duties, yet coordination of work and meeting the needs of citizens significantly improved. However, whereas in the previous schedule officers worked 7 consecutive 8-hour days, in the changeover to 12-hour shifts officers worked just 4 consecutive days on, followed by 4 off, creating a confound. The former shift allowed for 2 days off after two cycles of seven, 8-hour days, and 3 days off when on the third cycle of seven, 8-hour days, which is a significant deviation from traditional 8-hour schedules where officers work for just 5 consecutive days

before having 2 days off. The comparison of 8-hour and 12-hour shifts then also included a comparison across number of consecutive days worked, seriously limiting the conclusions.

In a study of three Canadian police forces, deCarufel and Schaan (1990) found that while those on 12-hour shifts had more time to close a case before a shift ended, follow-ups were more difficult if the case was not complete by the end of the shift. They, too, had sample size and methodological problems. Their sample represented 25 officers from each of three agencies, one with a 9-hour schedule and two with differing 12-hour shift schedule cycles. Furthermore, the data were obtained from 30-minute interviews, summarized, and then subjected to factor analysis and step-wise regression, both of which are questionable given the sample size. Also, while deCarufel and Schaan (1990) found small but significant effects with regard to increased efficiency (i.e., time spent per call, more calls responded to, and more rapid clearing of calls), they aptly note that the extent of the differences lacked practical significance from an administrative standpoint. Further, because they compared the prior year's data when on traditional schedules to the following year's data after implementation of CWWs (no random assignment to treatment or control), other causal factors occurring over that time period cannot be ruled out.

Similar to research in other occupations, it appears that when there have been reported improvements associated with CWWs, honeymoon effects may also have been present as well. For example, Cunningham (1982) reported an improvement in performance for Canadian officers working 12-hour shifts, but that increase was no longer present in the second year. Also, Weisburd and Buerger (1986) noted that after implementing a compressed schedule[4] in one agency, the chief indicated that while sick leave initially (first 6 months) dropped, it later increased. Consistent with research in other professions, some have also found improvements in

[4] Four, 10.75-hour days followed by 4 days off.

performance and productivity when considering self-reported or supervisory ratings of performance (e.g., Walker & Eisenberg, 1995; Weisburd & Buerger, 1986), but there have been little objective performance data generated to date.

The past studies related to performance, in addition to having design flaws or other limitations, are far from conclusive. Studies by Cunningham (1981; 1982) seemed to suggest greater flexibility in scheduling work activities, like contacts with the community, when officers worked CWWs. The findings related to productivity, however, were mixed. The study in Saanich demonstrated an initial increase in performance, whereas the study in Vancouver showed a slight decrease in self-initiated activities after the 10-hour shifts began. In both cases, however, there was a reduction in absenteeism associated with CWWs.

When examining a change to a 12-hour shift (from an 8-hour shift) in Lincoln, Nebraska, Sundermeier (2008) found that quality of service provided by the department was not negatively affected. Specifically, while there was a slight increase in below-average ratings of officer performance by citizens for those on CWWs, no complaints or disciplinary actions related to the 12-hour shift were noted. Data indicated that the implementation of the 12-hour shift did not result in any negative fiscal impacts; for instance, the amount of overtime paid to complete reports decreased by 51%. While fatigue was reportedly a factor, it did not appear to affect performance. Fatigue, however, was measured only via self-report, which again is likely to have been underreported.

Negative performance outcomes have been identified in some studies. For example, Brown (1974) found that almost half of the agencies he surveyed that had adopted 12-hour shifts reported greater difficulty with cross-shift communication. Similarly, Cunningham (1989) noted

that police managers felt they were more likely to see their officers more regularly when they were assigned to 8-hour shifts as compared to 12-hour shifts.

Impact on health. There is a dearth of research on health outcomes associated strictly with CWWs in law enforcement. Due to the nature of their work, police officers are constantly exposed to stress-inducing situations. As Neylan et al. (2002) stated, "…police officers face pressures from supervisors, attorneys, judges, media, and the public that can lead to stress-related symptoms…" (p. 345). In a study of Australian state police, Davey, Obst, and Sheehan, (2001) found that long work hours led to increased levels of stress ($r = .28$, $p < .001$). However, there have been virtually no studies connecting CWWs to stress or outcomes of stress, other than limited physiological data collected by Peacock et al. (1983). Totterdell and Smith (1992) did identify a significant improvement in psychological well-being for the new shift system, but it is important to note that the 10-hour schedules were only implemented in the day and afternoon shifts in that system (called the Ottawa system).

Impact on quality of life. Many researchers have indicated that there is overwhelming support for CWWs (e.g., Barter Trenholm, 1997; Cunningham 1981; Peacock et al., 1983; Pierce & Dunham 1992). Nevertheless, findings related to quality of life have not always been consistent. In Pierce and Dunham's (1992) study, they reported significant improvement in overall job, leisure time, and life satisfaction among the officers on CWWs. Yet, given the aforementioned confound with number of consecutive days worked, these findings should be interpreted with caution. Past research has also been inconclusive regarding the impact of CWWs on satisfaction with organizational association, amount of work satisfaction (Pierce & Dunham, 1992), and general job satisfaction (deCarufel & Schaan, 1990). The general attitudes of officers related to organizational commitment, job involvement, and intrinsic motivation also

have not been found to be significantly impacted by CWWs (Pierce & Dunham, 1992; deCarufel & Schaan, 1990). According to Cunningham (1981), those officers working 10-hour schedules as compared to 8-hour schedules were more satisfied with their new shift schedule. Again, limitations of these studies must be considered in interpreting these results.

However, Sundermeier (2008) found that officers who switched to a 12-hour shift had more favorable perceptions of the shift and exhibited high morale and job satisfaction, noting that "[t]he 12-hour shifts provided the right balance in their lives and renewed their enthusiasm for police work" (p. 5). In this study, however, only 37 officers participated in the 12-hour shift.

Work-family conflict. Pierce and Dunham (1992) reported a significant decrease in work schedule interference with personal activities; however, as noted above, this may be confounded by the agency's prior schedule of 7 consecutive 8-hour days. Similarly, deCarufel and Schaan (1990) noted that officers on CWWs were overwhelmingly better able to achieve separation between work and non-work activities.

Impact on fatigue, sleep, and alertness. Vega and Gilbert (1997) noted that fatigue and its relation to the compressed workweek is one of the most often cited concerns given by police administrators when considering alternative schedules for their officers. In a study of Canadian police officers in three agencies on 9-hour and 12-hour shifts, researchers found that self-reported fatigue was more of a problem on the 12-hour shifts (deCarufel & Schaan, 1990), even though they only worked four consecutive shifts. However, although officers admitted that fatigue was a concern, it was not a serious enough concern to make them want to return to an 8-hour shift schedule. A similar conclusion was drawn by Sundermeier (2008).

Conversely, others have reported that officers working CWWs were somewhat less fatigued (e.g., Vila et al., 2002). Similarly, Pierce and Dunham (1992) found that stress and

fatigue experienced by officers did significantly decrease after the switch to a 12-hour shift. Others have not identified significant differences comparing 8- to 12-hour shifts (Smith et al., 1998). Again the subjective underreporting of fatigue and potential bias associated with officer preferences for particular schedules may obviate these findings.

Cochrane (2001) stated that that there is "[a] growing concern…over sleep problems related to shift work and the increased liability law enforcement agencies face" (p. 22). Neylan and colleagues (2002) reported police officers get less average total sleep and have significantly worse sleep quality (using subjective measures of sleep and sleep quality) than peer-nominated controls. And in 1983, researchers surveyed officers and found that 53% reported sleeping an average of 6.5 hours or less (Peacock et al., 1983), a finding later confirmed by Vila et al. (2000) who found that the average hours of sleep for officers in their study was 6.6. In one of the most comprehensive studies of law enforcement fatigue, Vila et al. (2002) found that 41% of respondents across four police agencies had such poor sleep quality that clinicians would recommend that they seek medical attention, and that their sleep quality was twice as poor than for those in the general public.

Nevertheless, in at least one study, police officers have reported sleeping more hours when working 12-hour shifts (6.5 hours) as compared to 8-hour shifts (6.2 hours) (Pilcher & Huffcutt, 1996). According to Vila et al. (2000), officers who worked CWWs tended to be somewhat less fatigued although they noted the result was not conclusive due to the number of participants. Totterdell and Smith (1992) also reported that the implementation of the Ottawa system (10-hour compressed schedules for day and afternoon personnel) led to increased sleep when comparing the officers to those in a control agency, but, again, the night shift workers remained on 8-hour schedules.

Sleep deprivation can intensify the stress experienced by officers which, in turn, may result in poor judgment being exercised by an officer. According to Vila et al. (2000), "…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" (p. 88). Also, Cunningham (1990) argued that "the longer hours may affect the police officer's demeanour in meeting the public" (p. 190). It is for this reason that we were interested in examining interpersonal behavior at the end of compressed schedules, as well as performance in use-of-force scenarios.

In addition, the research has shown that fatigue can have potential negative effects on worker performance, safety, and health (Vila 2006). According to Vila (2000), this is certainly true for law enforcement officers as well and may be even more so given the unique nature of their jobs. While Sundermeier (2008) found that fatigue was a factor experienced by officers working 12-hour shifts, the level of fatigue experienced by officers was not enough to affect overall job performance. When considering physiological, psychological, and subjective measures of alertness, researchers in one study found that there were no negative effects of switching to a 12-hour system when compared to the 8-hour system (Peacock et al., 1983).

Impact on overtime and off-duty work. Bayley and Worden (1998) argued that there is considerable variation in overtime across agencies and individuals, but almost no publicly available data. This clearly underscores the importance of examining the amount of overtime associated with CWWs. Vila (2006) asserted that few police departments restrict or monitor off-duty jobs. However, if an agency is considering compressing officers' schedules, they should be

concerned about the additional time they may accumulate in a 24-hour period either commuting to and from work (e.g., Nielsen, 2007), working overtime, and working off-duty, as the combination of these can frequently be excessive.

For the many employees that have compressed workweek schedules, the choice to pick up a second job for extra income becomes very appealing; indeed, Waters and Ussery (2007) noted that agency implementation of CWWs may encourage officers to seek second jobs as opposed to using the time off for rest and recuperation. After all, one of the argued benefits of a CWW is that on the days that the employee has off they will have extra time for rest and recovery from longer than average workdays. Typically, extra work hours and commute time are not factored into the analysis of CWW scheduling, in terms of the potential impacts on health, safety, performance, quality of life, fatigue, or sleep. Nevertheless, there is a dearth of research regarding the role and/or impact of CWWs on off-duty work, overtime, commuting, and other activity patterns. In one study, Cunningham (1981) found that officers assigned to 10-hour shifts had greater court-related overtime compared to those on 8-hour shifts but much less overtime associated with regular workdays (which was reduced by more than half).

Summary. In sum, compressed workweeks have been implemented in law enforcement since at least as early as the 1970s. The adoption of these alternative schedules may have a considerable impact on employees. To date, there has been no comprehensive, randomized experiment assessing the impact of CWWs on performance, health, safety, quality of life, fatigue, sleep, or extra-duty employment in law enforcement. Nevertheless, there seems to be increasing interest in implementing compressed work schedules in policing for a number of aforementioned reasons.

However, past research across industries has been far from conclusive and informative because of varying degrees of scientific merit and rigor, methodological concerns, and limitations of various measures. This report contains the results of a randomized experiment to assess the impact of CWWs on officer performance, safety, health, quality of life, fatigue, and sleep, as well as other organizational outcomes. In addition, because there are no current national data on shift practices, we wanted to gain an understanding of current scheduling practices to provide context for the experiment. For example, do 8-hour shifts still dominate the landscape of American policing? Are alternative shifts becoming more common, and which shifts are predominant? Do shift practices vary as a function of agency size? In order to answer these questions, we conducted a survey in 300 randomly selected law enforcement agencies nationwide at two points in time, in 2005 and 2009, so that we could examine recent trends in shift scheduling practices. The findings that follow are from the first, multi-site randomized experiment designed to assess the impact of shift length on various outcomes in policing using multiple methods and both objective and self-reported measures.

Current Shift Schedules in American Policing

As part of our examination of shift practices, we conducted a random telephone survey designed to obtain an estimate of the proportion of agencies in which compressed schedules (10-hour or 12-hour shifts) have been implemented or in which the more traditional 8-hour shift schedule is employed. We were also interested in knowing the proportion of agencies that still operate on rotating schedules (those in which agencies require officers to routinely change the time of day at which they work, either from day to evening to midnight or in reverse). Although the U.S. Department of Justice routinely conducts a census of state and local law enforcement agencies and publishes the *Law Enforcement Management and Administrative Statistics*

(LEMAS), data on shift schedules has not heretofore been captured, nor has there been a recent version of LEMAS published. As such, we thought it important to conduct a survey in order to estimate the extent to which local law enforcement agencies in the United States have adopted various shift schedules. The Police Foundation administered this survey to the same 300 agencies at two points in time; the first phase was completed in November 2005 and the second in November 2009. The purpose was to: (a) determine the proportion of agencies that employ 8-, 10-, or 12-hour shifts for their field patrol officers; (b) assess whether these proportions vary by agency size; (c) evaluate the extent to which agencies make use of rotating shifts; and (d) examine trends in these practices over time.

Method

Sampling procedures. A randomly selected sample of 300 local police departments was drawn from the local police portion of the *2000*[5] *Census of State and Local Law Enforcement Agencies* (Reaves, 2002) conducted by the U.S. Department of Justice, Bureau of Justice Statistics. The sample consisted of agencies with 50 or more sworn officers, so that a reasonable distribution could be achieved[6] to include large agencies (more than 201 officers), midsize agencies (101-200 officers), and smaller agencies (50-100 officers). The smallest agencies (< 50 officers) were not sampled because well over 70% of all local law enforcement officers in the United States work in agencies with 50 or more employees (see Reaves, 2007).

By randomly selecting agencies, we were able to generate a sample that was geographically and demographically representative of agencies of those sizes nationwide. In order to assess trends in shift scheduling practices, the same 300 agencies were surveyed four

[5] The 2000 Census was the most recent database we could access.
[6] While almost 90% of law enforcement agencies in the United States have fewer than 50 sworn officers (see Reaves, 2007), these agencies represent only about 25% of all sworn officers. As such, the inclusion of those agencies would present an overrepresentation of the smallest agencies, reducing the number of medium and large agencies at which the vast majority of sworn officers are employed.

years after the initial survey. Participants from each agency were required to answer three brief questions regarding the agency's shift practices (see *Experimental Study, Research Design, Measures* section). To ensure accurate responses from each department, one of the requirements was that the respondent be a patrol supervisor. There were no additional restrictions for the participants.

A total of 300 county, township, and municipal (city, town) police departments with 50 or more sworn members were randomly selected. As shown in Table 1, there were 289 (96%) respondents in Time 1 and 300 (100%) in Time 2. Eleven of the original 300 selected agencies did not respond to repeated phone calls during Time 1. In Time 1, there were two agencies that had fewer than 50 officers due to changes in the number of sworn personnel since the *2000 Census of State and Local Law Enforcement Agencies*, and therefore were not included in the Time 1 results. However, in Time 2, there were 12 agencies that had fewer than 50 officers but had previously (Time 1) reported having 50 or more sworn officers, and as such, were included

Table 1

Distribution of Respondents

Number of Sworn Officers	**Time 1** November 2005	**Time 2** November 2009
< 50	2 (0.69%)	12 (4.00%)
50 to 100	165 (57.09%)	157 (52.33%)
101 to 200	82 (28.37%)	86 (28.66%)
201 +	40 (13.84%)	45 (15.0%)
Total	289[7]	300

[7] No response = 11

in the results as agencies with 50 - 100 sworn (as this was their original status at the study's outset). These staffing reductions were likely due to budgetary issues faced in U.S. law enforcement during the decade of 2000 - 2010. In Time 1, a total of 57% of the respondents were from smaller agencies (between 50 and 100 officers) compared to 52 % in Time 2. There was nearly no change in the number of agencies with 101-200 officers (28% in Time 1 compared to 29.0% in Time 2). Large agencies consisting of more than 200 officers made up 14% of the respondents in Time 1 compared to 15% in Time 2.

Once the 300 agencies were identified, each agency was contacted via phone to complete the short survey. Based on past survey research conducted by the Police Foundation (Amendola, 2004; Amendola, 1996; Weisburd, Greenspan, Hamilton, Bryant, & Williams, 2001; Weisburd, Mastrofski, Greenspan, & Willis, 2004), we expected a response rate of approximately 85% (255 agencies). All researchers who participated in the survey process were given ample training about proper survey and calling techniques. The researcher was required to ask for a patrol supervisor. If a supervisor was not available, the researcher asked for a time at which the supervisor could be reached. There was no payment to respondents for their participation.

Measures. In order to assess the shift schedule of each of the agencies, the Police Foundation created a brief questionnaire in order to obtain important information from the patrol supervisor in a simple and direct format as follows:

1. How many officers do you have on patrol?
2. Do your patrol officers currently work 8-, 10-, or 12-hour shifts?
3. Are they fixed or rotating shifts? If rotating, do they rotate forward or backward?

Because these questions were developed for the sole purpose of this study, there are no reliability or validity data. Also, researchers wrote down any clarifying information, e.g., if a

respondent indicated that the agency was operating on 11-hour schedules, if there was some mixture of schedules worked, and any other information offered by the respondent.

Results

Over the 4-year period, the biggest change was the move away from traditional 8-hour shift schedules. Specific agencies employing 8-hour shifts dropped from 40% in 2005 to 29% in 2009 (see Table 2). There were minor changes in the 10- and 12-hour shifts; the number of agencies employing 10-hour schedules went down from 27% to 22%, whereas the number of agencies employing 12-hour shifts increased slightly from 24% to 26%. Interestingly, the number of agencies employing more than one type of shift length almost doubled from 17 agencies (6%) in 2005 to 32 agencies (11%) in 2009. Furthermore, 9- and 11-hour workdays,

Table 2

Shift Length by Agency Size

	Time 1 November 2005				**Time 2** November 2009			
Number Sworn Officers	**8 HR (%)**	**10 HR (%)**	**12 HR (%)**	**Total**	**8 HR (%)**	**10 HR (%)**	**12 HR (%)**	**Total**
50 to 100 Small	68 (41.2)	37 (22.4)	47 (28.5)	152	54 (32.0)	33 (19.5)	52 (30.8)	139
101 to 200 Medium	34 (41.5)	27 (32.9)	16 (19.5)	77	23 (26.7)	19 (22.1)	22 (25.6)	64
201 + Large	13 (32.5)	14 (35.0)	6 (15.0)	33	11 (24.4)	15 (33.3)	5 (11.1)	31
Totals	115 (40.1)	78 (27.2)	69 (24.0)	262 [a]	88 (29.3)	67 (22.3)	79 (26.3)	234 [b]

[a]For Time 1 there were 5 (1.7%) agencies with 9-hour shifts; 3 (1%) agencies with 11-hour shifts; and 17 (5.9%) agencies that employed multiple shifts. Two agencies had <50 officers.
[b]For Time 2 there were 14 (4.7%) agencies with 9-hour shifts; 16 (5.3%) agencies with 11-hour shifts; 4 (1.3%) with 13-hour shifts; and 32 (10.7%) agencies that employed multiple shifts. 12 agencies had <50 officers.

while very uncommon in 2005 (2.7%), became more common by 2009; a total of 11.3% of agencies had adopted 9-, 11-, and even 13-hour schedules.

There were also differences in shift length based on agency size. For the largest agencies, there appeared to be little change over the 4-year period; indeed, the most common shift for agencies employing more than 200 patrol officers was the 10-hour (35% in Time 1 and 33% in Time 2). Greater changes were observed for the midsized and smaller agencies over the 4-year period. For the medium-size agencies, the most prevalent shift in Time 1 was the 8-hour (42%). By Time 2, there was almost an equal distribution across all three shift lengths due to a 10% drop in the 10-hour shifts and a moderate increase (6%) in the 12-hour shifts for those agencies. Similar to the midsized agencies in Time 1, smaller agencies were also most likely to employ 8-hour shifts (41%).

As shown in Table 3, during the period of the study, there was a significant reduction in agencies with rotating shifts (46% in Time 1 and 25% in Time 2). This may be due to an increasing awareness of research showing that shift rotation can disrupt circadian cycles and result in greater fatigue, insomnia, or other health problems (e.g., Colligan, Frockt, & Tasto, 1979; Czeisler, Moore-Ede, & Coleman, 1982) and worker errors and accidents (e.g., Gold et al., 1992). The result was an increase in the number of agencies employing fixed shifts (from 54% in Time 1 to 75% in Time 2). This trend seems most apparent in the smaller agencies; however, in the medium and large agencies there were also modest increases in fixed tours.

Discussion

The results of this initial descriptive study demonstrate that agencies have been moving away from 8-hour shifts in recent years. Among the largest agencies in the United States, the most common shift configuration was a 10-hour shift schedule, whereas midsized agencies

Table 3

Number of Agencies with Fixed or Rotating Shifts

	Time 1 November 2005			Time 2 November 2009		
Number Sworn Officers	**Fixed Shift (%)**	**Rotating Shift (%)**	**Total (%)**	**Fixed Shift (%)**	**Rotating Shift (%)**	**Total (%)**
50 to 100	79 (47.9)	86 (52.1)	165	122 (74.8)	41 (25.2)	163[a]
101 to 200	48 (58.5)	34 (41.5)	82	59 (73.8)	21 (26.3)	80
201 +	28 (70.0)	12 (30.0)	40	35 (79.5)	9 (20.6)	44
Totals	155 (54.0)	132 (46.0)	287	216 (75.3)	71 (24.7)	287 [b]

[a] This includes the 12 agencies in which there were originally 50 or more officers, but that now have fewer than 50.
[b] In Time 2 there were 13 (4.3%) agencies who had both fixed and rotating shift schedules. In Time 1, none of the agencies reported having both fixed and rotating shifts.

demonstrate a slight, but equal, preference for both 8- and 12-hour shifts above 10-hour tours. Also, among the smaller agencies, there were a decreasing number choosing to continue 8-hour shifts, with 10-hour shifts very uncommon in small agencies. There also seems to be a more recent trend toward employing multiple shift lengths and/or alternative shift configurations like 9-hour or 11-hour shifts.

Finally, while shift rotation was used by just under half the agencies in Time 1, by Time 2 that had dropped substantially to under one-fourth, perhaps indicating increasing knowledge of the fatigue factor associated with fairly frequent shift rotation. In Time 1, shift rotation was much more common in both smaller and midsized agencies than in large agencies, although agencies of all sizes demonstrated movement away from rotating shifts over the 4-year period.

There is a great need for a well-controlled, systematic study of the impacts of CWWs on individual and organizational factors. It appears that past research across a number of occupations has resulted in somewhat mixed findings due to various methodological and

measurement problems (e.g., small sample sizes, lack of randomization, preferential biases, high quality measurement instruments, etc.). In law enforcement, not only has the research been plagued with some of the aforementioned, it also has been sparse. It was the aim of this research to conduct a randomized experiment that would overcome some of these past shortcomings and to provide insight into the benefits and/or detriments associated with CWWs.

Experimental Study

This randomized block experiment was designed to assess the impact of shift length on a variety of measures of law enforcement officer health, safety, performance, sleep, fatigue, quality of life, and extra-duty employment (i.e., overtime and off-duty). This study was conducted in two police departments during the period of January, 2007 through June, 2009. After obtaining volunteers, we randomly assigned officers to one of three conditions: (a) 5 consecutive 8-hour days, (b) 4 consecutive 10-hour days, and (c) 3 consecutive 12-hour days.[8] The agencies agreed to maintain the conditions (shift length, time of day, and district) throughout the course of the 6-month period of the study.

We employed a randomized block design in which shift length was the treatment and the blocks consisted of agency and time of shift (day, evening, midnight). The use of a randomized block design allowed us to take into account variability of the blocking factors, as well as possible interactions between shift length and those factors (see Weisburd & Taxman, 2000). In particular, time of day worked has long been a focus of sleep research, and as such, we felt it important to block by time of shift.

[8] In order to ensure all officers worked 80 hours in each 2-week period, officers assigned to 12-hour shifts worked three consecutive 12-hour shifts in week one, and three consecutive 12-hour shifts followed by a single 8-hour shift in week two, a configuration that is common among agencies operating on 12-hour shifts.

In addition, participants were required to complete live simulation exercises during the last 2.5 to 3 hours of their work shifts. The rationale for completing the simulations at the end of the shifts was based on a report submitted to us from sleep expert Anneke Heitmann, in which she stated, "If testing had to be limited to selected times for each shift, it would be most meaningful to test at the end of the shift in order to capture potential differences caused by time-on-duty" (personal communication, May 1, 2006). This recommendation was also consistent with input of participants in the NIJ Performance, Health, and Safety Meeting in early 2006. While the sleep expert cautioned about various challenges for data interpretations when comparing shift systems and their associated circadian effects, it was believed that blocking by time of day of the shift would control for time of day effects that would have otherwise confounded the findings.

To assess officer health, safety, performance, fatigue, sleep, and quality of life, we collected data from the following three sources: (a) performance simulations we conducted in a laboratory setting in the police agencies, (b) daily statistics from both departments, and (c) surveys and other self-report instruments. We collected data at two points in time—before treatment implementation (the pretest) and at the end of the 6-month[9] study period (the posttest).

Method

Agencies. We selected sites from different regions (the Midwest and the Southwest) and with varying demographic compositions. The two agencies selected for this study were the Detroit, Michigan, Police Department and the Arlington, Texas, Police Department. These agencies were identified because their officers worked the standard five 8-hour duty tours, the agencies' leaders were interested in examining the pros/cons of various schedules, and the

[9] Because it took approximately 2 weeks to administer the performance simulations in each agency (we were able to run 10-12 officers through the exercises per day), the post measure was done as early as 5.5 months after the treatment but no longer than 6 months after.

respective union/association had expressed an interest in switching to a compressed workweek schedule. We also selected these sites because they were sufficiently large enough to ensure minimal impact on regular police operations and to provide a sufficient number of cases for our study. According to the 2007 FBI Uniform Crime Reports (U.S. Department of Justice, 2008), Detroit's population was 860,971 and Arlington's was 372,073. Crime rates for the two sites per 100,000 population varied with violent and property crimes. While Detroit had a higher violent crime rate (266) than Arlington (187), Arlington had a much higher property crime rate (1,523) than Detroit (787).

Participant Characteristics. As of 2007, the Detroit Police Department had 3,049 sworn officers and the Arlington Police Department had 580.[10] Demographic characteristics of officers in our sample and breakdowns by site are presented in Table 4.

Overall Sample. There were more male (77.1%) than female (22.9%) respondents, although the proportions were similar to the composition within the agencies. Although half of the participating officers in Detroit were Black (50.8%), the combined site total of participating officers reveals a higher proportion of White officers (59.3) as compared to Black (31.6%), Hispanic (6.5%), Asian (2.2%), and American Indian (0.4%) officers in the study. The vast majority of the study officers were between the ages of 18 to 34 years old (48.4%), and approximately half of the officers (44.7%) were married compared to (24 %) who indicated they were single, (14.2) having never been married, and 5.5% who were divorced.

Agency-specific. In Detroit, Black officers make up over 65% of the department; however, the proportion participating in our study was somewhat lower (50.8%). In Arlington, Black officers represent 14.7% of the agency, which is almost identical to their representation in

[10] These data are from the *2007 Law Enforcement Management and Administrative Statistics*, Bureau of Justice Statistics (Reaves, personal communication, September 29, 2010).

Table 4

Officer Demographic Characteristics by Site

Characteristics	**Arlington**		**Detroit**		**Total Study Participants**
	Overall N (%)	**Study Participants N (%)**	**Overall N (%)**	**Study Participants N (%)**	**Study Participants N (%)**
Sworn Personnel:	580	147	3,049	128	275
Sex:					
Male	478 (82.4)	117 (79.8)	2,220 (72.8)	95 (74.2)	212 (77.1)
Female	102 (17.6)	30 (20.4)	829 (27.2)	33 (25.8)	63 (22.9)
Total	580 (100)	**147 (100)**	3,049 (100)	**128 (100)**	**275 (100)**
Ethnicity:					
Black	85 (14.7)	22 (15.0)	1,998 (65.5)	65 (50.8)	87 (31.6)
White	397 (68.4)	104 (70.7)	928 (30.4)	59 (46.1)	163 (59.3)
Asian	20 (3.4)	6 (4.1)	10 (< 1)	---	6 (2.2)
Hispanic, any race	69 (11.9)	14 (9.5)	108 (3.5)	4 (3.1)	18 (6.5)
Other (Am. Indian)	9 (1.6)	1 (0.07)	5 (< 1)	---	1 (0.04)
Total	580 (100)	**147 (100)**	3,049 (100)	**128 (100)**	**275 (100)**
Age:					
18-24 years	--	--	--	--	--
25-34 years	--	84 (57.1)	--	49 (38.3)	133 (48.4)
35-44 years	--	41 (27.9)	--	63 (49.2)	104 (37.8)
45-54 years	--	19 (13.0)	--	13 (10.2)	32 (11.6)
55 years or older	--	3 (2.0)	--	3 (2.3)	6 (2.2)
Total	--	**147 (100)**	--	**128 (100)**	**275 (100)**
Marital Status					
Married	--	80 (54.4)	--	46 (35.9)	126 (45.8)
Single	--	54 (36.7)	--	66 (51.6)	120 (43.6)
Unknown	--	13 (8.8)	--	16 (12.5)	29 (10.5)
Total	--	**147 (100)**	--	**128 (100)**	**275 (99.9)**
Years of Service					
2 – 5 years	--	92 (62.6)	--	30 (23.4)	122 (44.4)
6 – 9 years	--	21 (14.3)	--	79 (61.7)	100 (36.4)
10 years +	--	34 (23.1)	--	19 (14.8)	53 (19.3)
Total	--	**147 (100)**	--	**128 (100)**	**275 (100)**

our sample (15%). The majority of participants in Detroit were between the ages of 25 and 44 (87.5%); in Arlington a similar proportion of officers between these ages was found (85%). A

greater number of participating officers in Detroit were single (51.6%) rather than married (35.9%), almost the opposite of Arlington where 36.7% of officers were single and 54.4% were married. The vast majority of officers participating in our study had less than 10 years on the job (85% of Detroit officers and 77% of Arlington officers).

Eligibility. In order to be eligible for the study, the following two criteria were established for officers: 1) must be in the patrol operations division (assigned to respond to calls for service); and 2) must not be working foot patrol or on light or restricted duty. This was to ensure that all participants were performing the same functions so as not to skew the outcome measures.

Sampling Procedures. Officers were recruited for the study on a voluntary basis as is required by federal regulation and consistent with Institutional Review Board (IRB) mandates. Officers were informed that if they volunteered for the study, they were agreeing to be assigned to any one of three shifts (the 8-, 10-, or 12-hour conditions). At the same time, following IRB regulations, officers were given the option to drop out at the outset or at any time during the study, for any reason, although officers were encouraged to stay in the study if at all possible. We attempted to track the reasons for drop outs at the time or in a post exit-interview many weeks later, although many of those officers did not respond to repeated attempts to reach them.

Recruitment. To recruit volunteers for the study, we sought permission from both police departments to make short (about 5 minutes) presentations to officers at different locations and times of day. Because of the large number of officers in Detroit, it was determined that we could make these presentations at roll call meetings (at the beginning of each new shift) in the various districts in order to brief officers about the study. Because not all officers work every day and officers work at various locations and at different times, we spent a number of weeks attending

these meetings at day, evening, and midnight shift changes, as well as during weekdays and weekends to maximize the number of officers that would hear the briefing. In Arlington, we were able to make just three presentations at three locations and at various times in order to accommodate officers who were working day, evening, and midnight shifts. We also created recruitment posters that were hung at district stations and other locations in the police departments (see Appendix A), and individual letters that were sent to all officers in both agencies (see Appendix B for a sample recruitment letter). Also, in both agencies, we provided information and/or training to timekeepers, supervisors, and commanders about the study. In Detroit, the Detroit Police Officers' Association (the union) also printed information in their newspaper, the *Tuebor*.

Procedures. In each study site, we asked interested officers to complete a volunteer sign-up form (see Appendix C) and then created a database of these officers. It should be noted that in the Detroit study site, two officers are assigned to each patrol car for evening and night shifts and for some cars on day shifts. As a consequence, officers also had to be willing to accept a new partner based on the randomly assigned treatment conditions (shift length). All volunteers were randomly assigned to one of the three experimental conditions unless they became ineligible or changed their minds prior to the randomization procedure.

A total of 326 officers across both sites volunteered to participate in the study. These volunteers were randomly assigned to one of three conditions: the 8-hour shift (n = 109), 10-hour shift (n = 109), or 12-hour shift (n = 108).

Incentives. We knew it would not be easy to recruit participants willing to be randomly assigned to a particular shift configuration because this experiment potentially required a major adjustment in the lifestyle of officers. As such, we created some monetary incentives for

officers; first, we provided a $50 cash payment for the completion of the major self-report instrument (see *Experimental Study, Method, Data collection methods and instruments* section for details about surveys), both at Time 1 and Time 2. Therefore, each officer could receive a total of $100 for their participation in the study. In both agencies, we also provided a number of $1,000 cash prizes[11] (one at Time 1 and one at Time 2) via a random drawing from among those officers who completed two specific instruments.[12]

In addition to the monetary incentives, there was an implication but no promise from management that the results of the research may have an influence on subsequent policies or practice. Finally, officers knew that by volunteering they would have a two-in-three chance of being assigned to a compressed workweek for the 6-month period of the study, which was a key motivator for many.

Sample size and power. While we had initially set out to obtain a total of 360 volunteers, our power analysis suggested that a sample of 300 officers would be more than sufficient to ensure a high level of statistical power for detecting small to medium effects (Cohen, 1988, p. 284). For each site, we intended to have 60 officers randomly assigned to each of the three treatment conditions for a total of 180 per site as our goal (see Table 5).

Sample size. Our actual sample size was 128[13] for Detroit and 147 for Arlington, resulting in a total of 275 participants in the study at Time 1. In Time 2, due to attrition, the sample size for Detroit decreased to 88 participants, while in Arlington it went down to 138, resulting in a total sample of 226.

[11] In Detroit, when we were having difficulty getting enough volunteers, we offered four additional $1,000 prizes.
[12] The incentive prize was drawn only from those officers who completed sleep diaries and alertness logs, because this required a few minutes each day during a 2-week period. This was designed to encourage officers to complete this more tedious task.
[13] 179 were randomly assigned, and 51 did not follow through with treatment.

Table 5

Intended and Actual Sample Size

	Time 1		Time 2	
	Intended	Actual	Intended	Actual
Detroit	180	128	128	88
Arlington	180	147	147	138
Total	360	275	275	226

Power. Our power analysis (see Table 6) shows that for our final analysis of 226 cases, still sufficient to detect medium effect sizes, but insufficient to detect smaller effects.

IRB, ethical standards, and safety monitoring. This study design was submitted to the Police Foundation Institutional Review Board who approved the experimental methodology and informed consent procedures. We worked with the selected agencies and our Institutional Review Board to develop a protocol for informed consent (see Appendix D and Appendix E for informed consent documents for Detroit and Arlington, respectively).

Table 6

Power for three group design (N =225, 75 per condition)

Effect Size Cohen's f	***Statistical Power***
.10 (small)	.25
.25 (medium)	.93
.40 (large)	.99

Data collection methods and instruments. We used a variety of methods to obtain data for the study as follows: (a) obtained daily statistics from the departments, (b) administered laboratory-based performance simulations, and (c) gathered data from paper and pencil surveys

and instruments. We collected data for the pre-treatment implementation period as well as the 6-month post-treatment implementation. All three methods of data collection were used to obtain a comprehensive understanding of the officers' behavior, experiences, attitudes, and performance over the course of the experiment in order to compare the three treatment groups consisting of the 8-, 10-, and 12-hour shifts. Due to limitations associated with past studies, our goal was to identify high-quality, reliable, and valid instruments with which to measure the range of outcomes we identified.

Additionally, because the National Institute of Justice was interested in a variety of outcomes, we used a systematic process of identifying specific general constructs to gain a broad-brush understanding of the impacts of CWWs in law enforcement. These constructs included: (a) work performance and safety; (b) health and stress; (c) quality of life; (d) sleep, fatigue, and alertness; and (e) extra-duty employment (overtime and off-duty work). We identified a number of objective and self-report measures to assess these constructs and, to increase power, sometimes created composite measures in order to reduce the number of individual analyses.

Past research has relied on limited, self- or supervisory reports of performance and/or safety. In order to overcome this problem, we used a performance simulation approach to obtaining performance data. This approach mimics that of assessment centers used in hiring and promotional processes across a wide variety of industries, (see e.g. Coulton & Feild, 1995; Hughes, 2006; Krause, Kersting, Heggestad, & Thornton, 2006; Thornton & Gibbons, 2009). The assessment center approach has been demonstrated to be a reliable, valid, and unbiased method for examining work performance (Gaugler, Rosenthal, Thornton, & Bentson, 1987;

Lowry, 1997). While this approach is very time-consuming and costly, it is perhaps the most objective way to obtain performance measures, using a laboratory-based, controlled setting.

This approach allowed us to overcome the problems associated with compiling departmental data on critical incidents as these events typically have very low base rates. At the same time, we were able to obtain more routinely collected agency data on self-initiated activity, although these data can be more indicative of the amount of discretionary time available rather than initiative.

Self-initiated activity. Self-initiated activities of officers were obtained from each of the two participating police departments. We asked each department to provide the following self-initiated activity data for each participant in our study: (a) number of arrests made, (b) number of citations and/or summonses issued, (c) number of reports completed, , and (d) number of self-initiated stops made. Both departments were asked to provide these data for the 6 months prior to the start of the experiment and for the 6 months of the experiment when the different shift lengths were implemented.

Laboratory simulations. Five simulation exercises were administered during the last 2.5 - 3 hours of the officers' shifts in both the pre- and posttest periods. During these sessions, most officers also turned in their self-report data and completed a simulation day survey that included questions related to activities completed during the previous 24-hour period. These simulations were completed in fixed locations in both agencies. In Detroit, the location was at the Detroit Police Department Gaming Unit; in Arlington, it was at the newly-built South District station of the Arlington Police Department. The five simulations, all of which are widely used, include the: (a) Fitness-for-Duty Impairment Screener (FIT)®; (b) Behavioral Personnel Assessment Device (B-PAD)®; (c) STISM® Driving Simulator; (d) Psychomotor Vigilance Test (PVT); and

(e) MILO/Range 3000® Shooting Simulator. Each participant completed the FIT first and the MILO last; however, the order of the other three simulations varied based on the participant's scheduled lab session. Each simulation is described in detail below.

Fitness-for-Duty Impairment Screener (FIT®). The FIT® is a pupil-response test that is short and noninvasive. This assessment tool, developed by PMI, Inc., measures involuntary eye movements and serves as an optical tracker and recording system in order to detect human impairment related to fatigue as well as ingestion of substances (e.g., medications, drugs, or alcohol). Participants were asked to track a series of lights that move from the left to right in the eye's periphery, after which a series of centered lights flashed to measure pupil dilation.

While the FIT® captures four ocular measures, for the purpose of our study we assessed fatigue effects only from low levels of saccadic velocity among the study participants. We took the average of three saccadic velocity readings to serve as the outcome measure.

Behavioral Personnel Assessment Device (B-PAD®). The B-PAD® was designed as a selection tool to assess a potential police officer's interpersonal skills and judgment. The video-based system consists of a series of challenging scenarios to assess how an officer would respond to different situations. Officers are videotaped while watching scenarios and are asked to provide verbal responses to the scenarios. An officer's videotaped response is viewed and scored by a trained, independent rater.[14] Officers were given a score for each of the following: a) task orientation, (b) interpersonal skills, and (c) overall effectiveness.

We used eight different scenarios during the B-PAD® simulation. A different set of scenarios was used during the pre- and posttest sessions; however, we chose scenarios that were similar in content (e.g., two different traffic stop scenarios) in order to make an accurate

[14] In this case, the rater was an experienced law enforcement officer with a PhD, who had received formalized training by personnel from the B-PAD® Group, Inc.

assessment of interpersonal skills and judgment over time. We used equally matched sequences across both administrations (Time 1 and Time 2) in terms of content and response type. The final scenarios for both administrations were comprised of one of the following eight categories: (a) a domestic situation; (b) a police brutality case, (c) an encounter with unruly individuals, (d) an encounter with individuals who had behavioral problems, (e) a workplace conduct scenario, (f) a scenario where an emotional tragedy had occurred, (g) traffic stops with noncompliant citizens, and (h) a social service situation.

The B-PAD® video test focuses on interpersonal competence as measured by two content scales, task orientation and interpersonal skill, and a weighted scale of overall effectiveness. Task orientation reflects the officer's demonstrated ability to assess the situation, develop a plan, follow through on the plan, and bring the situation to closure. Interpersonal skill represents the officer's effort and ability to calm, persuade, induce, or otherwise gain the cooperation of the person with whom he/she is dealing. The overall effectiveness rating denotes a summary judgment of the candidate's competence in meeting the scene objectives and achieving a desired result.

STISIM® Drive. The STISIM®, developed by System Technology, Inc., is a PC-based, high-fidelity, fully interactive driving simulator that provides auditory and visual feedback (Allen, Stein, Aponso, Rosenthal, & Hogue, 1990; Rosenthal, Parseghian, Allen, & Stein, 1995). It is an interactive program designed to simulate various driving conditions and environments. These driving environments vary from city to rural and include conditions that require attention and response to different stimuli such as stops signs, pedestrians walking out onto the street, bicyclists, etc. The STISIM® requires the participant to follow directions on a computerized

driving course while monitoring radio calls from a dispatcher, in order to assess driver performance realistically represented driving situations.

In order to assess safety, we examined a variety of driving errors using the STISIM® driving simulator. According to experts, research has made a strong case for the claim that people's behavior on a simulator is similar to their behavior on the road (Bédard, Parkkari, Weaver, Riendeau, & Dahlquist, 2010). As such, we created a composite index of driving performance using a number of driving behaviors captured by this simulator: (a) off-road accidents, (b) collisions, (c) pedestrians hit, (d) speed exceedances, (e) traffic light tickets, and (f) illegal turns. While we needed a somewhat global measure of driving performance due to the number of outcomes being captured in this study, the reliability coefficient was low ($\alpha = .58$), most likely indicating that various driving behaviors are unrelated to others. Indeed, according to one expert, driving is not considered to be a unitary construct (E. Stern, personal communication, July 8, 2010).

Psychomotor Vigilance Test (PVT). We used the PVT (Dinges & Powell, 1985) to assess reaction time for each participant. For ease of administration, we used an adapted version that was developed by researchers at the Walter Reed Army Institute of Research for use on a hand-held PDA (Thorne et al., 2005). The PVT measures the participant's ability to sustain attention and respond in a timely manner to salient signals (the random appearance of a graphic target/bulls-eye). The PVT allowed for the collection of objective performance data rather than simply relying on subjective estimates. Reaction time is likely to decrease with an increase in sleepiness or fatigue, and the PVT illustrates the degree of reaction capability in participants' ability or failure to react to stimuli in a timely manner (e.g., Dinges & Kribbs, 1991; Dinges, 1992; Dinges et al., 1997; Kribbs & Dinges, 1994).

We performed a detailed analysis of the objective performance data collected on the PVT to derive five key parameters from each PVT trial (Dinges & Powell, 1985; Kribbs & Dinges, 1994). These primary variables include: (a) mean reaction time (RT); (b) frequency of lapses (number of times the subject fails to respond to the signal); (c) duration of lapse domain (shifts in lapse duration calculated from the reciprocal of the 10% slowest RTs); (d) optimum response times (the average of the 10% fastest RTs); and (e) false response frequency, or what we refer to as false starts (responses that were initiated when no stimulus was present) (Dinges & Powell, 1985).

MILO®/RANGE 3000® shooting simulator. The shooting simulator is produced by IES Interactive Training, located in Ann Arbor, Michigan, and is primarily used for training. The system uses video and interactive technology to simulate a variety of environments and situations. It is designed to provide the individual user the opportunity to practice judgmental shooting while experiencing realistic situations, but also includes fixed targets to gauge accuracy at various distances. IES has released various versions of this simulator. In the Arlington, Texas, police department, they were using the version called the RANGE 3000®, which is functionally equivalent to the newer simulator called the MILO® that we used in Detroit (provided by IES for the purposes of the study).

The simulator allows for recording and analyzing data from officer responses including whether, where, and when shots are fired, as well as officer interactions via videotapes of their performance. There are also a number of fixed-target practices, which were used to detect shooting accuracy. Using these recorded data, we were able to obtain the following measures: (a) judgment, (b) command presence, (c) accuracy/weapon skills, and (d) target accuracy. In the shooting scenarios, judgment was assessed by examining the degree to which the officer properly

assessed the threat, adapted his/her behavior, made appropriate decisions, utilized environmental cues, requested help, etc. Command presence refers to the way in which officers took control of the situation vis-à-vis verbalizations, tone, interview stance, and authority. Shooting accuracy is the extent to which a shot hits the target squarely, whereas weapon skills involve the extent to which an officer took aim, assumed the appropriate shooting stance, and controlled the weapon prior to firing. It is important to note that these dimensions are not part of the shooting simulator itself but were developed through an iterative process involving law enforcement officers and conducted by the study team.[15]

Accuracy was measured by the "course of fire"[16] target shooting simulation, as well as active shooter simulation, whereas the other dimensions were measured solely in the active shooter simulations. Officers participated in three active-shooter scenarios. We selected from a bank of simulated exercises not already used by the agencies participating in the study to minimize practice effects associated with knowledge of particular scenarios. To further minimize practice effects, we provided a different set of scenarios to the officers for Time 1 and Time 2.

Self-report instruments. In addition to the simulations, each participant was asked to complete a series of surveys and other instruments including: (a) an in-lab survey that was completed the day of the laboratory simulations; (b) a sleep diary and alertness log that were completed for a 2-week period prior to the laboratory simulations; and (c) a Scantron® booklet survey entitled the *Law Enforcement Officer Survey of Work Attitudes, Personal Characteristics,*

[15]The subject matter experts had a discussion about shooting training and standard practices for firearms use in law enforcement. From that, they identified a number of dimensions that relate to proper weapon skills and shooting accuracy. These dimensions were first defined, and then indicators of poor to excellent weapon skills were generated. A group then assigned ratings to each indicator and those obtaining the highest levels of inter-rater reliability were used to anchor a 4-point Likert rating scale. For instance, an officer who does not draw his/her weapon in response to a threat would be anchored low on the scale of judgment (a score of 1), while behaviors such as giving appropriate commands would be anchored high on the scale of command presence (a score of 3 or 4).

[16] The course of fire was made up of fixed-target shooting from different distances.

Health, Safety, and Quality of Life (hereafter referred to as the "law enforcement officer survey") that was generally completed in advance of the simulations or the same day.

In-Lab Survey. The in-lab survey consisted of questions pertaining to current shift schedule such as shift start time, amount of caffeine ingested in the past 24 hours, etc. Additionally, we asked a series of questions related to health, which were only administered at Time 2 so as not to interfere with treatment. For example, we used the Berlin Sleep Apnea scale (Netzer, Stoohs, Netzer, Clark, & Strohl, 1999) to assess sleep patterns associated with sleep apnea. Sleep apnea refers to a cessation of breathing for at least a 10 second duration during sleep (Alvi & Lee, 2005). In the event that participant responses indicated a high risk of sleep apnea, a letter was sent to officers advising that they consult with their physician regarding sleep apnea (see Appendix G). Had these individuals completed this instrument in Time 1, the potential that the individual would see a doctor who may have prescribed a treatment would have created an experimental confound. As administered, it was only detected in Time 2, after the final measures had been obtained. We also included a measure of insomnia, as well as Costa's gastrointestinal and cardiovascular health (Barton et al., 1995) scales. Again, because these questions were included to capture officer health information for which we would be obligated to disclose any indicated problems, to prevent a confound we included them only in the second laboratory survey.

Sleep Diary. The sleep diary was developed by the Police Foundation under the direction of Dr. Anneke Heitmann, a sleep and fatigue expert (see Appendix I for full sleep diary). This booklet was completed by officers during the 2-week period prior to the administration of performance measures at Time 1 and Time 2. Officers recorded their sleep periods in a 24-hour period, including primary and secondary (naps) periods, so that we could capture total sleep

during the 2-week period. The sleep diary also allowed us to capture ratings of sleep quality ranging from *very poor* to *very good* for each of the sleep periods recorded, and where officers spent their time over the course of each day (e.g., working at department, working elsewhere, sleeping, awake-not working, and commuting to and from work). Sleep diaries have been commonly used in numerous studies of sleep patterns.

Alertness Log. The alertness log was a booklet that was also developed by the Police Foundation under the direction of Dr. Anneke Heitmann (see Appendix J for full alertness log). The log captured alertness levels during each hour of an officer's shift over the same 2-week period in which the sleep diaries were completed, but only on the days in which the officer was working, also at both Time 1 and Time 2. Alertness logs have been used successfully in sleep and fatigue research. The standardized response scale, the Karolinska Sleepiness Scale (Akerstedt & Gillberg, 1990), ranges from 1 = *very sleepy* to 9 = *extremely alert.*

Law enforcement officer survey. In addition to the above surveys, we created a survey booklet using a Scantron format in order to assess various psychological, work-related, and demographic questions. This survey consisted of numerous measures that had been previously established as reliable and valid indicators. The measures ranged from quality of life, stress, job satisfaction, and sleepiness. The survey consisted of a total of 456 questions, a few of which were adapted from other studies. We sent the survey to each participant prior to their scheduled laboratory simulations in order that they would have ample time for its completion prior to the day of the performance measures. Please refer to Appendix F for a complete list of each measure included in the law enforcement officer survey and the corresponding psychometric properties. Most of these measures were included in the analysis and are described further in the *Experimental Study, Research Design, Measures* section.

Research Design

Multicenter trial. While we had two sites for our research, we implemented one tightly controlled experiment in order to pool data across sites. This type of approach is a special type of replication study in which the sites are not replications per se, but rather part of the overall design (e.g., Fleiss, 1982; Weisburd & Taxman, 2000). In order for multicenter trials to be valid, the researchers must maintain consistency in research protocols, something we were able to control by using the same researchers across sites and employing standardized protocols for treatment and measurement. Nevertheless, the fact that sites may have important differences requires a way to control for the study site in the analysis. As such, we employed a randomized block design.

Randomized block design. In order to evaluate the impact of different shift lengths on officer performance, health, quality of life, sleep, fatigue, and extra-duty employment, we used a randomized block experimental design. The use of a randomized block design allowed us to take into account variability of the blocking factors, as well as possible interactions between shift length and those factors (see Weisburd & Taxman, 2000). In our study, we used two blocks as statistical controls: the first was site (Arlington or Detroit); and the other was shift schedule/time of day (i.e., day, evening, and midnight shifts). The design was balanced across the shifts, although generally speaking the number of personnel assigned during these time periods is not equivalent; evening shifts tend to have the most officers working. Including both study sites, our anticipated random block design was intended to resemble that shown in Table 7. However, because there are more personnel typically working evening shifts, the distribution did not result in even numbers in each of the cells. As shown in Table 8, the distribution we achieved was different.

Table 7

Randomized Block Research Design

		Detroit, Michigan (N = 117)				Arlington, Texas (N = 135)			
Length ↓	Schedule →	*Day*	*Evening*	*Midnight*	*Total*	*Day*	*Evening*	*Midnight*	*Total*
8 Hour Shift		13	13	13	39	15	15	15	45
10 Hour Shift		13	13	13	39	15	15	15	45
12 Hour Shift		13	13	13	39	15	15	15	45
		39	39	39	117	45	45	45	135

Table 8

Actual Distribution per Cell

		Detroit, Michigan (N = 88)				Arlington, Texas (N = 138)			
Length ↓	Schedule →	*Day*	*Evening*	*Midnight*	*Total*	*Day*	*Evening*	*Midnight*	*Total*
8 Hour Shift		7	8	7	22	8	24	13	45
10 Hour Shift		13	10	10	33	14	19	15	48
12 Hour Shift		8	16	9	33	9	21	15	45
		28	34	26	88	31	64	43	138

Random assignment. In each study site, we obtained a complete list of officers who were willing to volunteer for the study. Officers willing to participate were told that they may be assigned to a different shift, which would be assigned randomly (i.e., not based on seniority or preference). All officers on the volunteer lists were stratified by their respective assigned patrol district (six districts in Detroit and four districts in Arlington) and shift schedule (day, evening, and midnight) prior to the random assignment sequence. We conducted separate randomization procedures within each block (agency and time of shift). Also, in order to minimize disruptions

to departmental operations, we distributed the participants equally across patrol districts by randomly assigning within each district, so as not to overburden any particular district(s).

To conduct the random assignment sequence, we used a computer generated random number for each individual officer within his or her respective district and shift schedule (e.g., five volunteer officers in District 1 who were scheduled on the day shift). Once the random number had been generated, the group of volunteer officers was arranged in ascending order based on the total number of officers within that particular district and shift schedule. Next, we used a computer program to generate a table of random permutations for the total number of officers within the particular district and shift schedule to assign the sequence in which they would be listed for assignment to the experimental conditions. Finally, we used a computer program to randomly generate a list of the experimental conditions (8-, 10-, and 12-hour) for assigning the officers to the treatment condition based on the sequential order of the random permutation. The random assignment sequence enabled us to assign almost an equal proportion of officers per experimental treatment condition (8-hour, $n = 109$; 10-hour, $n = 109$; and 12-hour, $n = 108$) prior to participant attrition. The random assignment process was conducted in-house by Police Foundation staff members.

Concealment. The randomization sequence was concealed from each department; however, departments were made aware that assignment to the shifts was completely random and officers would not be able to choose their shift or switch shifts. Even so, many officers wanted to select their own shift or felt that assignment to shifts should be based on seniority, and a few supervisors wanted to change their officers' schedules; however, we informed them that this would interfere with the scientific integrity of the study. Once random assignment was completed, each officer was made aware of their assigned shift (a few weeks prior to the start of

the 6-month period) in order to make adjustments as needed (family schedules, daycare, etc.). Finally, the department was made aware of each officer's assigned shift, as this information was needed for scheduling purposes, arranging leave, and accounting and payroll purposes.

Measures. The selection of measures to employ in our study was based on a number of factors including past reliability and/or validity, fidelity, ease of administration, and, to a lesser extent, cost. Our study focused on five primary constructs, each of which serves as an overarching theme under which various measures are organized: (a) work performance and safety; (b) health and stress; (c) quality of life; (d) sleep, fatigue, and alertness; and (e) extra-duty employment. The constructs, instruments used to measure each, and the sources are provided in Table 9. In the following sections, each construct and its associated measures are explained in detail including the specific operational definitions (measures) used in each, as well as associated psychometric properties (established reliability and validity data) of these measures. Where appropriate, we also include our obtained coefficients of reliability for these measures in separate tables.

Work performance and safety. The first construct, work performance and safety, was broken down into two broader categories: laboratory simulations of performance and departmental data. Simulated performance consisted of three composite measures: (a) interpersonal skills, (b) driving safety, and (c) shooting performance. Departmental data consisted of various types of self-initiated activities. Table 10 shows the reliability coefficients for the work performance and safety measures.

Interpersonal skills. While shift work and nonstandard schedules in 24/7 operations have been shown to be related to ability to communicate and interact socially in other domains (e.g., Bell, Davidson, & Sefcik, 2002; Bonnet & Arand, 2003), there has been no research on the

Table 9

Constructs, Instruments, and Sources

CONSTRUCTS & INSTRUMENTS	Measuring	Author(s) of Measure, Year
Work Performance & Safety		
●Interpersonal Behavior	Performance	Composite of existing measures
-8 B-PAD® vignettes		The B-PAD Group, Inc., 1994, 1999, 2010
-Lost temper frequency		Czeisler et al. 2005
●Driving (STISIM®)	Safety	Rosenthal et al. 1995, Systems Technology, Inc.
●Shooting (MILO/Range3000®)	Performance	IES Interactive Training
●Self-Initiated Activities	Performance	Composite of department data
-Arrests, citations, reports, and stops		
Health & Stress		
●Cardiovascular, Gastrointestinal Health	Health	Barton et al. 1995 (Costa subscale)
●Stress	Stress	Composite of existing measures
-Police Stress Questionnaire		McCreary and Thompson 2004
-Work Environment Inventory		Liberman et al. 2002
-Police Daily Hassles Scale		Hart, Wearing, and Headey 1994
●Sick Leave	Health	Department data
Quality of Life		
●Quality of Work Life (QWL)	QWL	Composite of existing measures
-Job Satisfaction (MSQ)		Weiss, Dawis, England, and Lofquist 1967
-Schedule Satisfaction		Tucker, Smith, Macdonald, and Folkard 1998
-Organization Commitment		Allen & Meyer 1990
-Job Involvement Scale		Kanungo 1982
●Quality of Personal Life (QPL)	QPL	Composite of existing measures
-Work-Family Conflict I		Carlson, Kacmar, and Williams 2000
-Work-Family Conflict II		Netemeyer, Boles, and McMurrian 1996
Sleep & Fatigue		
●Sleep Amount, Quality (Sleep Diary)	Sleep Amount	Heitmann 2006 (unpublished)
●Sleepiness Composite (subjective fatigue)	Sleepiness	Composite of existing measures
-Sleep Assessment		Czeisler et al. 2005; Heitmann 2006 (unpub.)
-Epworth Sleepiness Scale		Johns 1991, 1992
●Alertness (Alertness Log)[a]	Alertness	Heitmann 2006 (Karolinska scale)
●Fatigue (objective, physiological)	Fatigue	Composite of existing measures
-Saccadic Velocity (FIT®)		PMI, Inc.
-Psychomotor Vigilance Test		Dinges and Powell 1985; Thorne et al. 2005
●Sleep Disorders	Sleep Disorders	Composite of existing measures
-Berlin Sleep Apnea (*adapted*)		Netzer et al. 1999
-Insomnia		Heitmann 2006
-Sleep Disorders		Czeisler et al. 2005
Extra-Duty (sleep diary)		
●Off-Duty Employment and Overtime[b]	Total Hours	

[a]The average daily alertness level on days worked was computed based on the fourteen-day period.[17]
[b]Overtime was calculated as the amount of departmental hours worked in excess of 80 hours per two-week period.[18]

[17]While it is likely that alertness levels may decrease as the shift goes on, we were interested in the overall alertness across groups for the entire shift. Additional analysis may reveal differences towards the end of the shift.

impact of such schedules on interpersonal behavior in law enforcement. Officers' interpersonal skills were assessed using a composite consisting of eight scenarios from the Behavior Personnel Assessment Device (B-PAD®) and a singular item related to losing one's temper. As described earlier, the B-PAD® is a video-based simulation that assesses interpersonal skills and judgment by examining how an officer would respond to a series of different situations. According to the publishers, "the B-PAD is a 'high fidelity' test that uses realistic representations of task situations and provides applicants with an opportunity to resolve situations" (the B-PAD® Group, 2010). The B-PAD® allows us to measure officers' task orientation (ability to assess the situation), interpersonal skills, and overall effectiveness. In one study, internal consistency of the two rating scales (Form A) with the overall effectiveness rating yielded coefficients ranging from .80 to .93 (Doerner & Nowell, 1999). In a concurrent validity study, Rand (1987) obtained a coefficient of .72 when comparing B-PAD® scores to supervisory ratings. In addition to the B-PAD®, we included a question about interpersonal skills in the law enforcement officer survey. The question, "How frequently do you lose your temper?," was adapted from the Harvard Work Hours, Health, and Safety Study (Czeisler et al., 2005). After combining these two measures, we obtained a reliability coefficient of .79.

Driving safety. Driving safety was assessed using the STISIM® simulator. As mentioned previously, the STISM® is a computerized program designed to simulate various driving conditions and environments that require attention and response to different stimuli such as stops signs, pedestrians walking out onto the street, bicyclists, etc. The STISIM® provides a number of outcome measures and those that we used are listed below. Studies show that the STISIM® performance is positively correlated with real on-road driving performance and associated with

[18]In instances when the hours did not total eighty hours due to the officer being on vacation, sick, or absent, overtime was assumed to equal zero for that particular officer's data.

the number of real-life traffic violations (Bowens, 2004). Since driving is not considered to be a unitary construct (E. Stern, personal communication, July 8, 2010), we created a composite made up of the aspects of driving we found most important for a study of officer driving safety. This composite measure consisted of the following driving behaviors/outcomes: (a) number of off-road accidents, (b) number of collisions, (c) number of pedestrians hit, (d) number of speed exceedances, (e) number of traffic light tickets, and (f) number of illegal turns. Previous assessments of the driving simulator demonstrated an alpha coefficient of .82 (Lee, Drake, & Cameron, 2002), while our reliability analysis resulted in an alpha coefficient of just .58, most likely due to the lack of a unitary operational definition of driving performance.

Shooting performance. Shooting performance was assessed using the MILO®/Range 3000® shooting simulator. Three measures of shooting performance were obtained from this simulation: (a) command presence, (b) accuracy, and (c) judgment, as previously described. Our analysis of the reliability of shooting performance resulted in an alpha coefficient of .43, perhaps indicating that various aspects of shooting performance are distinct.

Self-initiated activities. Departmental data were used because they are among the most available indices of performance and used by police departments and researchers alike, although their validity as indicators of good or poor performance is debatable. Self-initiated activity was a composite of a number of departmental datasets, including number of (a) arrests made, (b) citations and/or summonses issued, (c) reports completed, and (d) traffic stops made. These data were obtained from each department and covered a 12-month period (6 months prior to the start of the study, and the 6-month period during which officers were assigned to one of three

shifts).[19] No previous reliability estimate has been captured for this set of measures; however, our analysis resulted in an alpha coefficient of .78.

Table 10

Reliability Coefficients of Work Performance and Safety Measures

Work Performance & Safety	Performance Measure	Reliability (Cronbach's Alpha)
Interpersonal Skills	B-PAD® + 1 question	.79
Driving Safety	STISIM®	.58
Shooting Performance	MILO®/Range 3000®	.43
Self-Initiated Activity	Departmental Data	.78

Health and Stress. An assessment of officer health and stress, the second construct, was comprised of cardiovascular health, gastrointestinal problems, and work stress. The reliability coefficients we obtained in this study are listed in Table 11.

Cardiovascular Health. Questions of cardiovascular health were included in the in-lab survey completed during the participants' appointed laboratory session. These questions were obtained from Costa's health subscale of the *Standard Shift Work Index* (Barton et al., 1995). The scale was comprised of eight items, consisting of a 4-point Likert scale ranging from "almost never" to "almost always". Participants were asked questions such as, "How often do you suffer from heart palpitations?" and "How often do you suffer from shortness of breath when climbing the stairs normally?" Prior existing reliability data for these questions are not available; however, we obtained a Cronbach's alpha of .81.

[19] The number of days for each 6-month period was equal so as not to bias a reporting period.

Gastrointestinal Problems. Questions related to gastrointestinal problems were included in the in-lab surveys given to participants on the day of their simulations. These questions were obtained from Costa's health subscale of the *Standard Shift Work Index* (Barton et al., 1995). The scale was comprised of eight items, consisting of a 4-point Likert scale ranging from *almost never* to *almost always*. Participants were asked questions such as, "How often do you complain of digestive difficulties?" and "How often do you feel nauseous?" Prior existing reliability data for these questions are not available; however, we obtained a Cronbach's alpha of .80.

Work Stress. Work stress was assessed using three independent instruments included in our law enforcement officer survey: (a) the *Police Stress Questionnaire*, (b) the *Police Daily Hassles scale*, and (c) the *Work Environment Inventory*, which were combined to create a composite measure of stress.

The *Police Stress Questionnaire* (PSQ) is an instrument used to assess job stressors specific to a police officer (McCreary & Thompson, 2004). The scale consists of items related to organizational stressors (e.g., "Please indicate how much stress has been caused over the past 6 months as a result of excessive administrative duties") and operational stressors (e.g., "Please indicate how much stress has been caused over the past 6 months as a result of occupation-related health issues."). The reliability of the PSQ has been previously demonstrated at .92 (McCreary & Thompson, 2004).

The *Police Daily Hassles Scale* (PDH) (Hart, Wearing & Headey, 1994) was adapted from the original *Daily Hassles and Uplifts Scale* (Kanner, Coyne, Schaefer, & Lazarus, 1981) to assess ongoing stressors specific to law enforcement. Two categories of daily hassles are used in this survey: organizational hassles (e.g., "not receiving recognition for a job well done") and operational (e.g., "departmental handling of complaints"). Past reliability coefficients for the

PDH have ranged between .72 and .94, and factor analyses of each category of daily hassles loaded above .60 (Hart, Wearing, & Heady, 1994).

The *Work Environment Inventory* (WEI) is a 68-item questionnaire that assesses exposure to routine occupational stressors, excluding duty-related critical incidents such as being attacked (Liberman et al., 2002). Examples include, "My supervisors and I respect and trust each other" and "I do not let my neighbors know what I do for a living." The authors reported reliability coefficients ranging from .92 to .97 (Liberman et al., 2002); however, we were not able to identify any subsequent studies regarding the reliability or validity of the WEI. Our analysis of the composite (inclusive of the PSQ, PDH, and WEI) resulted in a Cronbach's alpha of .92 for work stress.

Sick Leave. Departmental data on days and hours of sick time taken were obtained.

Table 11

Reliability Coefficients of Health Measures

Health	Measure	Reliability (Cronbach's Alpha)
Cardiovascular Health	Standard Shift Work Index	.81
Gastrointestinal Problems	Standard Shift Work Index	.80
Work Stress	Police Stress Questionnaire Police Daily Hassles Scale Work Environment Inventory	.92

Quality of life. An assessment of officer quality of life, the third construct, was comprised of quality of personal life and quality of work life. The reliability coefficients for these measures are included in Table 12.

Quality of Personal Life. This composite includes two measures of work-family conflict (Work-Family Conflict I and Work-Family Conflict II), which were included in the law enforcement officer survey. The scores on the scales were computed and then transformed to *z*-scores in order to create this composite measure of quality of personal life.

The first measure of work-family conflict assesses the impact of an individual's job on his/her family life (Carlson, Kacmar, & Williams, 2000). The scale was adapted from prior work-family conflict measures (Frone, Russell, & Cooper, 1992; Gutek, Searle, & Klepa, 1991), and designed to address limitations of previous instruments by taking a multidimensional approach to capturing the nature of work-family conflict. Three domains of work-family conflict are assessed with this measure: (a) time-based (when time devoted to one role makes it difficult to participate in another role), (b) strain-based (when strain experienced in one role intrudes into and interferes with participation in another role), and (c) behavior-based (when specific behaviors required in one role are incompatible with behavioral expectations in another role). Examples of questions include, "My work keeps me from my family activities more than I would like," and "When I get home from work I am often too frazzled to participate in family activities or responsibilities." The alpha coefficients for the three domains were .87 (time-based), .85 (strain-based), and .78 (behavior-based) (Carlson et al., 2000). Validity was assessed using a content-oriented approach as described below. The Carlson work-family conflict scale has shown high validity as well. Specifically, strain-based "work interference with family" (WIF) was predictive of family satisfaction, -.25, $p < .05$, and life satisfaction, -.24, $p<.05$, as was behavior-based WIF (family satisfaction, -.39, $p < .05$ and life satisfaction, -.36, $p < .05$) (Carlson et al., 2000).

The second work-family conflict measure reflects the impact of work on family life (Netemeyer, Boles, & McMurrian, 1996). Although this scale does not include various dimensions of work-family conflict (Carlson et al., 2000), it does provide an additional measure of commonly agreed upon aspects of work-family conflict. Examples of questions include, "Due to work-related duties, I have to make changes to my plans for family activities," and "In most ways my life is close to ideal." Previous reliability assessments resulted in alpha coefficients ranging from .82 to .90 (Netemeyer et al., 1996). The completely standardized within-factor item loadings ranged from .60 to .89 across samples. Discriminant validity coefficients ranged from .83 to .89 (Netemeyer et al., 1996). We conducted an analysis of the reliability of the quality of personal life construct (inclusive of the two work-family conflict scales) and obtained a Cronbach's alpha of .88.

Quality of Work Life. Quality of work life was measured using a composite of five assessment instruments that were included in our law enforcement officer survey. These instruments included: (a) the *Minnesota Satisfaction Questionnaire (MSQ,* (b) satisfaction with schedule (SS, (c) the *Organizational Commitment Questionnaire (OCQ,* and (d) the *Job Involvement Scales (JIS)*. Each scale score was transformed to a *z*-score in order to combine measures into a single composite score of quality of work life.

The *Minnesota Satisfaction Questionnaire (MSQ)* (Weiss, Dawis, England, & Lofquist, 1967) measures job satisfaction using a variety of scales, including achievement, independence, social status, recognition, supervision, and working conditions. Examples of questions from the scale include, "[How satisfied are you with]" … "the competence of my supervisor in making decisions?" or "the chances for advancement on this job?" The reliability and validity of this instrument has been well documented over time. The data suggest that in general the MSQ

scales have adequate internal consistency coefficients ranging from .59 to .97 (Weiss et al., 1967). Test-retest alphas were conducted separated by one week resulting in coefficients from .66 to .89. Content validity of the MSQ was derived from a factor analysis resulting in two scales: extrinsic (55% of variance accounted for) and intrinsic satisfaction (58% of variance accounted for) in initial studies by Weiss et al. (1967).

Schedule satisfaction (SS). Because research has demonstrated that those working compressed schedules report greater satisfaction with their shift schedules (Baltes et al., 1999), we included four items related to satisfaction with shift schedule and length. We adapted the first item, "Do you feel that the overall advantages of your shift schedule outweigh the disadvantages?" (Barton, et al., 1995) to address advantages of the shift length. The remaining two items were generic shift schedule and shift length items that we developed for this research.

The *Organizational Commitment Questionnaire (OCQ)* (Allen & Meyer, 1990) aims to address the degree to which employees feel committed to their organization across three categories of commitment: (a) affective commitment (an individual's identification with, attachment to, and involvement in a particular organization); (b) continuance commitment (the costs that an employee associates with leaving the organization); and (c) normative commitment (an employee's feeling of obligation to remain with the organization). The OCQ is a 15-item scale that has been used extensively in research. Examples of the questions include, "I do not feel like 'part of the family' at my organization," and "Too much in my life will be disrupted if I decided I wanted to leave my organization now." Past evidence of the OCQ's reliability has been strong with reliability coefficients of .87 (affective commitment), .75 (continuance commitment), and .79 (normative commitment). There is evidence for the convergent and discriminant validity of the subscales (Allen & Meyer, 1990).

The *Job Involvement (JI) Scales* assess an individual's perspective of the importance of his or her job (Kanungo, 1982). These scales examine one's psychological identification with a particular job and the extent to which it meets his or her needs. Some examples of questions include, "Usually I feel detached from my job," and "I live, eat, and breathe my job." The established reliability of the JI scales range from .67 to .89 (Kanungo, 1982), suggesting that both the reliability of repeated measurements and internal consistency of items were sufficient. Intercorrelations among the three job involvement scales were statistically significant, suggesting convergent validity of the scales, with a coefficient s ranging from -.12 with work involvement questionnaire, to .80 for job involvement using the graphic rating scale.

Table 12

Reliability Coefficients of Quality of Personal and Work Life Composites

Quality of Life	**Measure**	**Reliability (Cronbach's Alpha)**
Quality of Personal Life	Work-Family Conflict I Work-Family Conflict II	.85
Quality of Work Life	Minnesota Satisfaction Questionnaire Satisfaction w/ Schedule Organizational Commitment Job Involvement	.88

Sleep, fatigue, and alertness. The fourth construct was comprised of amount of sleep, sleep quality, sleepiness and fatigue, and sleep disorders. The reliabilities for measures in this category are provided in Table 13.

Sleep amount and quality. Sleep amount was derived from the Scantron survey and the sleep diary. Two questions assessing the amount of sleep in the Scantron survey included, "How many hours of sleep per 24-hour period are you actually getting, on average, when you work your current fixed shift?" and "How many hours of sleep per 24-hour period are you actually getting, on average, during days off?" Additionally, the sleep diary provided information on the average amount of sleep over a 2-week period for each officer. Because each entry is an independent assessment for that particular day, we did not compute a reliability coefficient.

Sleep quality was derived solely from the sleep diary. When completing the sleep diary, participants were asked to indicate the quality of their sleep during any sleep period (full night of sleep and naps) over a 2-week period. Again, each day's sleep quality is an independent measure for that particular day, so we did not compute a reliability coefficient.

Sleepiness. This measure consisted of questions used in the Scantron survey, which included questions from the Epworth Sleepiness Scale (Johns, 1991), the Harvard Study Scale (Czeisler et al., 2005), and questions recommended by a sleep expert. The Epworth Sleepiness Scale is an 8-item measure of fatigue and sleepiness that asks participants to indicate the degree to which they would doze during various activities. Example activities include, "sitting quietly after lunch without alcohol" or "as a passenger in a car for an hour without a break." The Epworth Sleep Scale has been positively associated with self-reported problems of sleepiness (Chervin & Aldrich, 1999). Past reliabilities of the Epworth Sleep Scale demonstrate test-retest reliabilities of .82 (Johns, 1992) and .86[20] (Knutson, Rathouz, Yan, Liu, & Lauderdale, 2006), as well as Cronbach's alphas of .73 and .88 (Johns, 1992). In addition to the Epworth Sleep Scale, we asked one question taken from the Harvard Sleep Study ("[How often] during your waking hours [do I] feel tired, fatigued, or not up to par?") and three questions recommended by a sleep

[20] Based on an intraclass correlation coefficient (Knutson et al., 2006).

consultant (e.g., "During the past month, how would you rate your level of sleepiness during the time you were awake?" and "Were you fighting sleep at all during your current shift?"). These questions have no previous documented reliability or validity coefficients. Our overall analysis of the reliability of our composite measure of sleepiness resulted in a Cronbach's alpha of .82.

Sleep disorders. This measure consists of several questions taken from the Berlin Questionnaire to assess sleep apnea (Netzer et al., 1999), and was completed by participants as part of the in-lab survey. Sleep apnea refers to a pause in breathing during sleep that lasts at least 10 seconds (Alvi & Lee, 2005). These questions assess snoring behavior, wake-time sleepiness and drowsiness, and history of high-blood pressure or a high-body mass index, in order to assess one's risk of sleep apnea syndrome. Questions included in the in-lab survey were, "Do you snore frequently?" and "Do you snore loudly?" The Berlin Questionnaire has been shown to be a reliable indicator of risk of sleep apnea (Begany, 1999), and has a previously reported reliability of .63 to .92 (Netzer et al., 1999). A Cronbach's alpha of .80 was obtained for sleep disorder questions in our study.

Fatigue. We used two independent physiological measures to assess fatigue (and/or impairment). As indicated previously, we used the Fitness-for-Duty Impairment Screener (FIT®) in order to detect impairment related to medications, drugs, alcohol, and/or fatigue. Participants were asked to track a series of lights that moved from the left to right in the eye's periphery, after which a series of centered lights flashed to measure pupil dilation. While four measures can be derived from the FIT®, we used the primary indicator of fatigue, saccadic velocity. Recent research has shown saccadic velocity to be the most sensitive measure of fatigue and it was most relevant to our analyses. It also has been shown to be sensitive to sleep deprivation (e.g., Russo et al., 2003; Rowland et al., 2005) and significantly correlates to other measures of sleepiness

such as the sleep latency test and Stanford Sleepiness Scale (Rowland et al., 2005). Additional scientific validation has been performed by several organizations (see Addiction Research Center of NIH/Johns Hopkins, Walter Reed Army Institute of Research, Vermont Alcohol Research Center, and Institute for Circadian Physiology). Our analysis of the FIT® resulted in an alpha coefficient of .82.

We also used the Psychomotor Vigilance Test (PVT) to assess reaction time for each of the participants. Performance data from the PVT included the following parameters: (a) mean reaction time, (b) false starts (responses that were initiated when no stimulus was present), and (c) frequency of lapses (number of times the subject fails to respond to the signal). PVT performance has been demonstrated to be highly sensitive to changes in alertness/drowsiness associated with circadian phase (Dinges & Kribbs, 1991; Wyatt et al., 1997); acute total sleep deprivation (Dinges et al., 1994); cumulative partial sleep loss (Dinges et al., 1997; Rowland et al., 2005); and shift work/jet lag (Rosekind et al., 1994). Our analysis of the PVT reliability resulted in an alpha coefficient of .77.

Table 13

Reliability Coefficients of Sleep, Fatigue, and Alertness Composite

Sleep, Fatigue, and Alertness	Measure	Reliability (Cronbach's Alpha)
Sleepiness	Sleep Consultant Harvard Study Epworth Sleepiness Scale	.82
Sleep Disorders	Berlin Sleep Apnea Scale	.80
Fatigue	Fitness Impairment Tester	.82
Fatigue (reaction time)	Psychomotor Vigilance Test	.77

Alertness. Alertness was assessed using the alertness logs that each officer completed. The average alertness levels were calculated over a 14-day period, on a daily basis, in order to obtain an average daily alertness level.[21] See *Experimental Study, Method, Data collection methods and instruments* section for more information regarding the alertness log. Because each indication of alertness is a singular account for each hour of one's shift, it would not be appropriate to assess reliability of the scale, as actual variations would be expected.

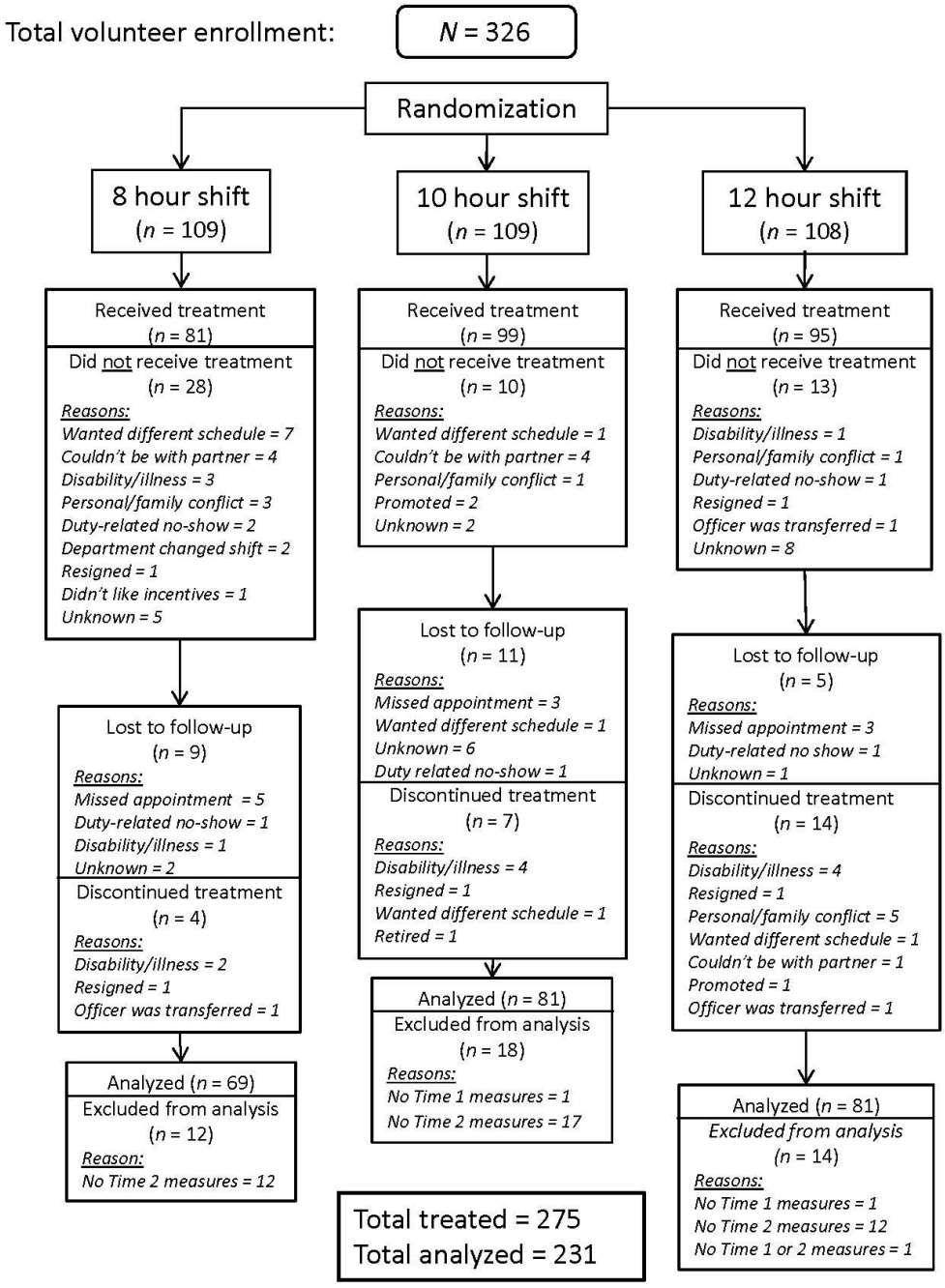
Extra-duty employment. Our final construct, extra-duty employment, consists of hours of departmental overtime, as well as work at a secondary job (whether coordinated by the police department or the officer him/herself). Overtime and off-duty employment hours were taken from the sleep diary officers completed for a 2-week period. Specifically, we asked participants to list the number of hours per 24-hour period that they had worked at the department, number of hours worked elsewhere, and other activities. Overtime[22] was the amount of hours worked at the department in a 2-week period in excess of 80 hours.

Results

Flow of participants. In Figure 1, we present the flow of participants through the experiment from randomization through the outcome measures. There was crossover in three cases due to operational reasons in the department. In Detroit, two officers are assigned to one car, generally speaking. As a result, some operational issues arose, which required two individuals to be switched to a different condition by their supervisors. While this was highly discouraged, it was necessary from an operational standpoint. In two districts, on a particular shift, there were an uneven number of officers assigned to 12-hour shifts. In order to keep the

[21] While it is likely that alertness levels may decrease as the shift goes on, we were interested in the overall alertness across groups for the entire shift. Other analysis may reveal differences towards the end of the shift.
[22]Overtime was calculated as the total number of hours in excess of 80 hours in a 2-week period. In instances when the hours did not total 80 hours due to the officer being on vacation, sick, or absent, then overtime was assumed to equal zero for that particular officer's data.

Figure 1. Flow of Participants through Stages of the Experiment



extra officer in the 12-hour condition, we allowed a person on the 8-hour to be reassigned to the 12-hour condition. In another district, an officer applied to work alone and because the officer's request was accommodated, he had to be moved out of the 12-hour shift and on to the 8-hour shift.[23]

In the present study, there were barriers to some officers' continued participation in the treatment groups, such as family conflicts, promotions, and transfers of assignments (i.e. no longer on patrol). As such, there was both voluntary and involuntary attrition in our study. Voluntary attrition occurred when officers chose to drop out of the study at the outset, or discontinued participation at some stage of the study. Involuntary attrition occurred when officers were discontinued from the treatment or excluded from the analysis for any of the following reasons: (a) the officer resigned or retired from the agency; (b) the officer became disabled or ill; (c) the officer was unable to complete outcome measures because of a duty-related reason (at court, on departmental leave, at a hot call, could not be rescheduled); or (d) the department either promoted the officer, transferred the officer to a non-patrol assignment, or changed their shift schedule (day, evening, or midnight).

Attrition

Voluntary attrition – Time 1. Once officers were informed of the treatment condition to which they were assigned, 37 of the 326 chose not to participate in the study (11.3%), and the greatest number of those were in the 8-hour condition (n = 20), compared to the 10-hour condition (n = 8), and the 12-hour condition (n = 9). The lower level of participation in the 8-hour shifts is most likely because all officers across sites were working 8-hour shifts prior to the study's implementation, and this condition did not constitute a change for them; indeed, most indicated

[21]In Detroit, after dark, departmental policy requires two officers per vehicle. Because of the time of year and start time of this officer's shift, it was not possible for this officer to work the 12-hour tour because he would be working alone after dark.

that they wanted a different shift (n = 7), wanted to remain with their partner (n = 4),[24] or had a family conflict (n = 3). We were not concerned with any bias based on greater voluntary attrition for the 8-hour group because it operated as a control condition and, as such, can be seen as a reaction of disappointment to not getting a treatment.

Voluntary attrition – Time 2. While 275 officers received treatment, 29 (10.5%) did not participate in the follow-up stage due to: (a) a missed appointment (n = 11), (b) a personal or family conflict (n = 5), (c) the officer's desire to return to his/her original schedule and/or partner (n = 4), or (d) an undetermined reason (n = 9). There did not appear to be meaningful differences across treatment conditions; 11 each were lost in both the 10- and 12-hour shifts, and 7 in the 8-hour condition. We do not consider the lower attrition for the 8-hour condition as a bias because, again, the 8-hour shift served as a control, and there was higher attrition for the officers on 8-hour shifts in Time 1.

Therefore, overall voluntary attrition across Time 1 and Time 2 was fairly equally distributed across treatment groups: 8-hour (n = 27), 10-hour (n = 19), 12-hour (n = 20). The fact that there was about a third greater attrition in the control condition is not that concerning as it most likely reflects a disincentive to participation, in that it would result in no change in the current situation.

Involuntary attrition – Time 1. We also experienced attrition due to reasons uncorrelated with the treatment (involuntary attrition). In Time 1, there were 14 officers (4.3%) who chose to be in the study but could not due to: (a) a promotion or re-assignment to a non-patrol function or different schedule (n = 5), (b) a disability or illness (n = 4), (c) a duty-related reason (n = 3), or (d) resignation (n = 2).

[24] This was only the case in Detroit, where officers work two to a car.

Involuntary attrition – Time 2. In the follow-up, there were 21 officers (7.6%) lost for reasons unrelated to treatment because of: (a) a promotion or reassignment (n = 3), (b) an illness or disability (n = 11), (c) a duty-related reason (n = 3), and (d) resignation or retirement (n = 4).

Attrition Analysis. As is common in most experimental designs, attrition of the original sample can occur when data are collected over two points in time. In the present study, there were barriers to some of the officers' continued participation in the treatment groups, such as family conflicts, promotions, and transferred assignments (i.e., no longer on patrol). As a result, attrition from the original sample can represent a potential threat of bias (may affect both the internal and external validity of the study) if those officers who dropped out from the study are significantly different from those who remained in the study, particularly when considering treatment attrition (i.e., those choosing not to accept or remain in the treatment, in this case due to knowledge of the specific treatment, e.g., 10-hour shift, etc.).

In our assessment of applicant flow data, it is important to note that some of our attrition was due to involuntary reasons (e.g., being transferred to a different assignment, becoming disabled, or being promoted). As an indirect test for bias from subsequent attrition, we compared the differences in the demographic characteristics (sex, race, age, marital status, and years of service) between those officers who dropped voluntarily[25] and those who remained in the study. We conducted a logistical regression analysis by creating a dichotomous dependent variable in which 1 represented those who remained and 0 was for those who dropped from the study, with the demographic characteristics[26] as the independent variables. A statistically significant coefficient on any of the independent variables would indicate attrition bias.

[25]Ineligible participants were excluded from the analysis.
[26] Because of a significant amount of missing data, marital status was excluded from the regression analysis. We did, however, examine marital status by performing a cross tabulation for which the Chi-square was not statistically significant.

Based on the regression analysis, the only significant finding was the race of the officer; of the 37 Black officers assigned to the 8-hour shifts, 17 (46%) voluntarily dropped from the study whereas just 12 (22%) of the 54 White officers assigned to 8-hour shifts dropped. Upon further investigation, we observed that this finding mostly resulted from the higher overall rate of attrition in Detroit and the fact that Detroit had a higher proportion of Black officers. In Arlington, just five Black officers were assigned to 8-hour shifts. In fact, in Detroit, there were a higher proportion of drops among White officers (61.1%) as compared to Black officers (53.1%).

Demographic Analysis. We conducted an analysis of demographic characteristics by shift assignment to examine if there was systematic variability across treatment and control groups. The descriptive data are presented in Table 14. It is important to note that the groups did not significantly differ at the outset, most likely due to random assignment to the treatment and control groups. As a result, we did not use demographic data as a covariate in our model.

Data analysis. Our study employed a randomized block experimental design to assess the impact of various shift schedules on a number of health, safety, performance, and quality of life outcomes. Irrespective of the form of the outcome variable, the estimated models have four types of parameters: (a) treatment (shift length—8-, 10-, and 12-hour); (b) time of day of the shift (day, evening, and midnight) as a blocking factor; (c) site of the study (Detroit and Arlington) as a blocking factor; and (d) treatment by block interactions for time of day or the site of the study. This approach allows for the examination of the overall mean effect of being on an 8-, 10-, or 12-hour shift schedule. The use of the interaction terms will enable us to examine the extent to which the effect of shift length is affected by the time of day of the shift or the site of the study. More important, the blocking factors will provide a more efficient estimate of the statistical significance of the treatment by reducing the overall error variance associated with a statistical test. If the

Table 14

Demographic Characteristics of Treatment and Control Groups

Demographics	**8-Hour**	**10-Hour**	**12-Hour**	**Total**
Sex:	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Female	21 (21.4))	22 (21.6)	22 (23.9)	65 (22.3)
Male	77 (78.6)	80 (78.4)	70 (76.1)	227 (77.7)
Total	98 (33.6)	102 (34.9)	92 (31.5)	292 (100.0)
Age:	*n* (%)	*n* (%)	*n* (%)	*n* (%)
25-34 years	43 (43.9)	53 (52.0)	49 (43.5)	136 (46.6))
35-44 years	42 (42.9)	38 (37.3)	38 (41.3)	118 (40.4)
45-54 years	13 (13.3)	10 (9.8)	9 (9.8)	32 (11.0)
55 years and over	--	1 (1.0)	5 (5.4)	6 (2.1)
Total	98 (33.6)	102 (34.9)	92 (31.5)	292 (100.0)
Marital Status:	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Married	36 (53.7)	37 (43.0)	41 (52.6)	114 (49.4)
Separated	--	3 (3.5)	2 (2.6)	5 (2.2)
Divorced	7 (10.4)	14 (16.3)	12 (15.4)	33 (14.3)
Never Married	24 (35.8)	32 (37.2)	23 (29.5)	79 (34.2)
Total	67 (29.0)	86 (37.2)	78 (33.8)	231 (100.0)
Race:	*n* (%)	*n* (%)	*n* (%)	*n* (%)
Black	37 (37.8)	29 (28.4)	30 (32.6)	96 (32.9)
White	54 (55.1)	69 (67.6)	56 (60.9)	179 (61.3)
Other	7 (7.1)	4 (3.9)	6 (6.5)	17 (5.7)
Total	98 (33.6)	102 (34.9)	92 (31.5)	292 (100.0)
Years of Service:	Mean (*n*)	Mean (*n*)	Mean (*n*)	Mean (*n*)
Mean Years	7.285 (98)	6.197 (102)	7.629 (92)	292 (7.014)

Note. Chi-square analyses for sex, age, marital status, and race were not significant. The *t*-tests for mean years of service also were not significant at the $p < .05$ level

block by treatment interactions did not achieve statistical significance at the .05 level, we excluded them from the analyses (see Fleiss, 1982).[27]

Analysis plan. The results presented in this study are based primarily on comparisons of means for the three treatment conditions (8-, 10-, and 12-hour shift lengths) and statistical tests to indicate the probability of obtaining a difference between the three groups. Our alpha level for rejection of the null hypothesis was set at $p < .05$. Since there were virtually no rigorous past experimental designs testing the impact of shift length, our hypotheses were nondirectional and, as

[27] Fleiss (1982) actually suggests a more conservative alpha level of $p < .01$.

such, we employed two-tailed tests. Missing data were excluded from the analysis on a case-by-case basis, so our *n* for any of our statistical tests includes all of the valid cases in the dataset.

In light of the imbalance in sample sizes among the treatment conditions, General Linear Model (GLM) analyses were conducted. GLM provides a more conservative analytical approach than ANOVA as the approach does not assume equal cell sizes among all groups. Importantly, since we employed a pretest/posttest design, we followed the analytical approach suggested by Huck and McLean (1975) in which the baseline pretest measures were used as a covariate to control for initial group differences in conjunction with the posttest measures to examine treatment effects. Using an analysis of covariance "will result in a more sensitive test of possible differences among treatments" (Huck & McLean, 1975, p. 516). The purpose for the inclusion of covariates in the model is twofold: (a) to reduce the within-group error variance to allow for a more accurate assessment of the effects of the treatment conditions, and (b) to remove the bias from a possible confounding variable that may influence the outcome variable.

Effect Size. Throughout our discussion of the results of the present study, we present Cohen's *f* (Cohen, 1988) effect size index[28] to measure the influence of the intervention (i.e., length of shift) that is being investigated by taking the ratio of the magnitude of the differences between the means of the experimental groups divided by the pooled standard deviations of those groups (see Cohen, 1988). As noted by Weisburd, Petrosino, and Mason (1993), an effect size "…is thus dependent on the size of the impact of a treatment, taking into account how much individuals in the sample vary in the outcomes measured" (p. 343). Nonetheless, scholars have noted that the reporting of effect sizes remains inconsistent and, more important, often lead to

[28] Cohen's effect size *f* index formula is the square root of the eta squared (η^2) divided by 1 minus η^2. (Cohen, 1988, p. 280-288). η^2 is calculated as the ratio of the effect variance (SS_{effect}) to the total variance (SS_{total})-- $\eta^2 = SS_{effect} / SS_{total}$. The value for the SS_{total} in the formula includes the SS for each of the effects and the error term, but does not include the SS for the intercept in the GLM models. Note the η^2column in one version of SPSS provided only partial η^2output. As such, η^2 was manually calculated.

difficulties in their interpretation—determination of *how much* of a difference the intervention made (see Ferguson 2009; Lipsey 2000; Weisburd, Lum, & Yang, 2003). As eloquently stated by Ferguson (2009) regarding the interpretation of effect sizes, "There is no agreement on what magnitude of effect is necessary to establish practical significance" (p. 532).

Cohen (1988) attempted to address the issue of interpreting effect size estimates relative to other effect sizes. Using the Cohen's *f* estimated (as presented in our results), he suggested some general definitions for small (*f* = .10), medium (*f* = .25), and large (*f* = .40) effect sizes for use in the social sciences. Unfortunately, those estimates were chosen to reflect the typical effect sizes in behavioral sciences as a whole; "effect sizes in behavioral science are generally small, and, in terms of *f*, will generally be found in the .00-.40 range" (Cohen, 1988, p. 284). As a consequence, Cohen cautioned researchers against using his labels to interpret relationship magnitudes and, instead, offered those estimates as a "frame of reference" (Cohen, 1988, p. 284) for the effect size index. In his discussion of the specific values of *f* conventions (i.e., small, medium, and large), Cohen (1988) notes that "…these qualitative adjectives are relative, and, in general, may not be reasonably descriptive in any specific area. Thus, what a sociologist may consider as a small effect size may well be appraised as medium by a clinical psychologist" (p. 285).

In an effort to provide a generally interpretable sense of the magnitude or practical meaning of effect size estimates in crime and justice studies, Lipsey argues that effect size values of .10 and larger "could easily be of practical significance" (2000, p. 109) and thus provide for a meaningful effect. Based on Lipsey's suggested criterion for a meaningful effect and for the purpose of the present study, we interpret every effect size (Cohen's *f* index) that is equal to or greater than .10 as a meaningful effect. While perhaps considered small when using Cohen's

labels, such effects in the randomized experiment are representative of meaningful differences on the associated outcome measures.

Dependent variables. We used several outcome criteria in the current set of analyses. Specifically, we identified five constructs including: (a) work performance and safety; (b) health and stress; (c) quality of life; (d) sleep, fatigue, and alertness; and (e) extra-duty employment. Please refer to the *Experimental Study, Research Design, Measures* section for the specific construct composition and the resulting reliabilities. Detailed descriptions of the measures making up each of these constructs are provided in Appendices A and B. The summary statistics for all of the outcome variables examined for the complete sample are provided in Table 15.

In creating specific scaled outcome measures, common metrics for combining measures were developed by first creating *z*-scores for each of the individual variables and then combining them to create a composite score. In order to increase reliability and limit systematic variability of both of our outcomes relying on rated performance (interpersonal performance using the B-PAD® and shooting performance using the MILO/Range 3000®), rater training was provided for the two separate individuals for the two exercises. Those individuals rated both Time 1 and Time 2 performance across all participants so as to maintain rating consistency and limit rater biases. We assessed the reliability of scales we used via Cronbach's alpha, a coefficient of internal consistency that indicates how well items within a scale measure a single latent construct. Alpha levels .70 and above are generally considered as strong scales and alpha levels between .60 and .70 are, in most cases, considered acceptable (Cascio, 1991; Ary, Jacobs, & Razavieh, 1985). The majority of our outcome measures demonstrated internal consistency with Cronbach's alpha

Table 15

Descriptive Statistics for Outcome Variables by Construct

Construct	Variable	Measure	N	Min	Max	Mean
Work Performance & Safety	Driving	# off-road accidents	228	0.00	3.00	0.07
		# of collisions	228	0.00	3.00	0.38
		# of pedestrians hit	228	0.00	3.00	0.54
		# speed exceedances	228	0.00	16.00	7.76
		# traffic light tickets	228	0.00	4.00	0.40
		# illegal turns	228	0.00	2.00	0.06
	Shooting[a]	-judgment	143	-1.85	2.06	0.00
		-command presence	143	-3.27	0.91	0.00
		-accuracy	143	-2.68	1.19	0.00
	Self-initiated Activity	-arrests	218	-1.31	3.53	0.14
		-citations	218	-0.86	7.96	0.05
		-reports completed	218	-1.94	3.32	0.11
		-stops made	218	-1.02	6.17	0.01
	Interpersonal Skills	-task orientation	190	-2.55	1.28	0.02
		-interpersonal skills	190	-2.53	1.30	0.02
		-overall effectiveness	190	-2.56	1.29	0.02
		-lost temper frequency	190	-4.34	0.90	-0.02
Health	Cardiovascular Problems		208	-2.50	2.06	0.00
	Gastrointestinal Problems		208	-2.97	2.51	0.03
	Work Stress	-PSQ	208	-2.89	2.12	0.01
		-PDH	208	-2.58	2.78	-0.00
		-WEI	208	4.17	2.80	0.03

[a]In *z*-score units (mean = 0, standard deviation = 1)

Table 15 (continued)

Descriptive Statistics for Outcome Variables by Construct

Construct	Variable	Measure	N	Min	Max	Mean
Sleep, Alertness, Fatigue	Sleep Amount	-average hours sleep	193	3.67	11.43	7.56
	Sleep Quality	-average sleep quality	193	-3.09	2.66	0.00
	Sleepiness	-feel tired	203	-1.54	1.94	-0.01
		-sleepiness	203	-1.96	3.35	-0.01
		-likely to doze	203	-3.15	2.96	-0.00
		-fighting sleep	203	-0.44	2.25	-0.04
		-nodding off	203	-0.68	3.30	-0.00
	Alertness	-alertness log	142	0.00	8.39	6.45
	Sleep Disorders	-insomnia	228	-0.72	2.89	0.01
		-sleep disorders	228	-1.47	7.04	0.03
		-sleep apnea	228	-1.63	3.59	0.00
	Fatigue	-saccadic velocity	233	53.41	97.27	74.38
		-reaction time (PVT)	233	-0.96	12.69	0.00
		-anticipations (PVT)	233	-0.54	7.57	-0.00
		-lapses (PVT)	233	-0.55	7.56	0.00
Quality of Life	Quality of Work Life	-job satisfaction	175	-6.69	6.51	0.04
		-shift schedule	175	-2.11	0.47	0.01
		-satisfied – shift	175	-1.86	0.53	-0.00
		-shift length	175	-1.41	0.70	0.00
		-satisfied – shift length	175	-1.37	0.72	-0.01
		-satisfied with job	175	-2.87	0.34	0.01
		-job involvement (JIS)	175	-1.94	2.53	-0.01
	Quality of Personal	Work Family Conflict I	198	-2.39	2.72	0.01
	Life	Work Family Conflict	198	-1.68	2.34	0.01
Extra-Duty Employment	Overtime	Sleep Diary	193	0.00	88.00	3.41
(2-week period)	Off-duty	Sleep Diary	193	0.00	59.00	7.26

coefficients over .75[29] for the latent constructs we used as outcome variables (see *Experimental Study, Method, Data collection methods and instruments* section).

It is important to note that since many of the outcome measures were derived from self-reported items that assessed officers' personality, temperament, and demeanor, we examined whether officers were responding to the items honestly or whether they were attempting to present themselves in a more favorable way. Our survey included a 33-item scale developed by Crowne and Marlowe (1960) to identify the extent to which officers exhibited this social desirability bias, allowing us to pinpoint any outlying participants and remove them from our analysis. Past reports of the scale's internal consistency resulted in alpha coefficients ranging from .73 to .78 (Nordholm, 1974; Holden & Fekken, 1989, respectively), and a test-retest reliability of .86 (Crino, Svoboda, Rubenfeld, & White, 1983). In our sample, the scores ranged from 4 to 29 with a mean of 19.1 and a standard deviation of 5.0. While we were not overly concerned with low social desirability (i.e., exceptionally honest responses), we were concerned with a response pattern of highly socially desirable responses (exceptionally dishonest responses) so we set a criterion of ≥ to 2 standard deviations above the mean to identify any officers whose data should be excluded from the analyses. All of the participating officers fell within the selected criteria and, as a result, none of the participants' data were excluded on the basis of a social desirability bias in responding to the survey items. This is not surprising considering our sample consisted of police officers whose jobs are in jeopardy if they are dishonest.

[29] While we recognize that the Cronbach's alpha levels for the shooting performance and driving simulator were low (.43 and .58, respectively), we felt that the items used in each measure were an accurate reflection of the dependent variable of interest in the study. The low alphas on the two scales may be attributed to the sample's homogeneity and the results may be justified for use in the analyses (see Bernardi, 1994).

Findings. As previously mentioned, the specific objectives of this study were to examine the extent to which shift schedules impact measures of performance and safety, health, quality of life, sleep, fatigue, and extra-duty employment among law enforcement officers. A thorough examination of the key findings is reported in the sections below. In the results tables, significant effects are listed in bold.

Work performance and safety. The results of the GLM models for the four outcome measures we used to assess officers' work performance and safety are presented in Table 16. There were no significant differences between the shift length groups in terms of any of our measures of performance and safety after taking into consideration the Time 1 scores. While the effect size for our composite measure of interpersonal performance was small (f = .12), all of the others were very small and of little consequence.

Because Cronbach's alpha for the items comprising driving safety (off-road accidents, collisions, pedestrians hit, speed exceedances, traffic light violations, and illegal turns) was lower than the acceptable level (.58) for analysis, these results should be viewed with caution. It is possible that finer tuned analysis of individual aspects of driving performance would reveal impacts of shift length. Indeed, various components of driving performance may be differentially affected by various conditions (e.g., Wood, Chaparro, & Hickson, 2009).

Also, because Cronbach's alpha for the items comprising shooting performance was lower than the acceptable level (.43) for analysis, the results should be viewed with reservation. It is possible that the three aspects of shooting performance we measured (command presence, judgment, and accuracy) are unique dimensions of performance. In terms of departmentally collected data, our composite measure of self-initiated activity revealed no significant differences among shift lengths.

Table 16

Work Performance/Safety GLM Estimates

Outcome Measure	***F* (df)[a]**	***P***	***Cohen's f***
Interpersonal Skills			
Shift Length	1.73 (2,214)	.180	.12
Driving Simulator			
Shift Length	.264 (2,214)	.768	.04
Shooting Performance			
Shift Length	.481 (2,111)	.619	.08
Self-initiated Activity			
Shift Length	1.22 (2,252)	.298	.07

[a]The *F* was calculated taking into account the pretest measure, site of study and time of day. See Appendix H for the full model.

Health. Three categories of data were used to assess the impact of shift length on officers' health: (a) cardiovascular problems using the Health subscale of the Standard Shift Work Index; (b) gastrointestinal problems using the Health subscale of the Standard Shift Work Index; (c) work stress using a composite based on scores from the *Police Stress Questionnaire* (PSQ), the *Police Daily Hassles (PDH) Scale,* and the *Work Environment Inventory (WEI)*; and (d) sick leave taken. Shown in Table 17 are the results of the GLM models for the three outcome measures that were used to assess the health of officers in the study.

Cardiovascular health and gastrointestinal problems. The analysis of each of the scales revealed no significant differences across the groups for shift length. These findings are not surprising when considering the physical demands of police work, which require officers to be in good physical health as a prerequisite for becoming a police officer. This is particularly true for officers in the Arlington Police Department who are required to pass an annual physical test as a condition for their continued employment with the department.

Work Stress. A *z*-score composite was created combining the three measures of work stress (PSQ, PDH, and WEI) to obtain an average score. We did not find significant differences in stress levels across the shifts.

Sick Leave. There were no significant differences across groups with regard to the amount of sick leave taken. Sick leave was reported by the police agencies and was in number of days and hours.

Table 17

Officer Health GLM Estimates

Outcome Measure	***F* (df)[a]**	***P***	***Cohen's f***
Cardiovascular Health			
Shift Length	.007 (2,222)	.993	.01
Gastrointestinal Problems			
Shift Length	.809 (2,202)	.447	.08
Work Stress			
Shift Length	.319 (2,197)	.727	.03

[a]The *F* for the Work Stress variable was calculated taking into account the pretest measure, site of study and time of day. Gastrointestinal and cardiovascular problems were not measured during the pretest. See Appendix H for the full model.

Quality of Life. Several officer self-report scales were used as measures of their perceived quality of personal life and quality of work life in an attempt to assess the impact on shift length on quality of life issues.

Quality of personal life. The measure for quality of personal life contained two instruments that were used to assess work and family conflict: (a) Work Family Conflict I, and (b) Work Family Conflict II. Scores from both scales were combined and converted to *z*-scores. The analysis of our

composite measure of quality of personal life resulted in no significant differences between the groups for shift length (see Table 18), and a very small effect size.

Quality of work life. To examine the quality of work life (QWL), we included a number of instruments measuring job satisfaction (MSQ), organizational commitment (OCQ), job involvement (JIS), and the 4-item schedule satisfaction (SS) scale. We created standardized *z*-scores for each of the measures and combined them into a composite measure. The results from our analysis revealed a significant effect of shift length, $F(2,197) = 3.94$, $p = .021$, on QWL after controlling for the effect of the pretest measure for quality of work life, although this translates to a small to medium effect ($f = .16$). A pairwise comparison of the adjusted group means revealed that the QWL for those on 10-hour shifts was significantly higher (mean = 0.93) than for those on 8-hour shifts (mean = -1.29), whereas the same was not true for those on 12-hour shifts (mean = 0.03).

Table 18

Quality of Personal and Work Life GLM Estimates

Outcome Measure	***F* (df)[a]**	***P***	***Cohen's f***
Quality of Personal Life			
Shift Length	.303 (2,192)	.739	.04
Quality of Work Life Composite			
Shift length	**3.94 (2,197)**	**.021**	**.16**
Shift Length * Site	**4.76 (2,197)**	**.010**	**.19**

[a] The *F* was calculated taking into account the pretest measure, site of study and time of day. See Appendix H for the full model.

For QWL, there was also a significant interaction between shift length and site, $F(2,197) = 4.76$, $p = .010$. In an effort to better understand which comparisons were accounting for the interaction effect between treatment and quality of work life, we examined within site main effects (see Table 19). In Detroit, while there were no statistically significant differences, the effect size

was small to medium (f = .19); those on the 8-hour shifts had the lowest mean level of QWL. In Arlington, the main effect of shift length was $F(2,125) = 8.49$, p = .000, which translates to an effect size of f = .31 (medium). As shown in Table 20, the 10-hour group reported a significantly higher quality of work life (mean = 3.08) as compared to those in the 8-hour (mean = -0.63, p = .001) and 12-hour (mean = -0.13, p = .004) groups. It is important to note that those participants working 8-hour shifts in both sites reported the lowest quality of work life.

Table 19

Within Site QWL GLM Estimates

QWL	***F* (df)[a]**	***Significance***	***Cohen's f***
DETROIT			
Shift Length	$F(2,69)= 1.75$	p = .181	.19
ARLINGTON			
Shift Length	**$F(2,125) = 8.49$**	**p = .000**	**.31**

[a] The F was calculated taking into account the pretest measure, site of study and time of day. See Appendix H for the full model.

Table 20

Within Site Means for QWL

QWL	***8-hour***	***10-hour***	***12-hour***
DETROIT			
Mean	-2.3	-1.52	-0.05
ARLINGTON			
Mean	-0.63	3.08	-0.13

Sleep, fatigue, and alertness. Several outcome indicators were used to assess the impact of shift length on amount and quality of sleep, sleepiness, fatigue, sleep disorders, and alertness.

Sleep amount. The analysis of the average hours of sleep showed a significant effect among groups with respect to length of shift, $F(2,147) = 3.23$, $p = .043$, after controlling for the effect of the average number of hours of sleep in the pretest (see Table 21). The strength of association of the effect on shift length using the Cohen's *f* effect size index indicated a small to medium effect (*f* = .19). A pairwise comparison test of the adjusted group means revealed that the average hours of sleep for officers in the 10-hour shift were significantly greater (mean = 7.86) than the average hours of sleep among officers on the 8-hour shift (mean = 7.27, $p = .036$), but that was not the case for the 12-hour group (mean = 7.63, p = ns).

Table 21

Sleep/Fatigue/Alertness GLM Estimates

Outcome Measure	***F* (df)[a]**	***p* value**	***Cohen's f***
Average Sleep Amount			
Shift Length	**3.23 (2,147)**	**.043**	**.19**
Average Quality of Sleep			
Shift Length	.865 (2,147)	.423	.09
Sleepiness			
Shift Length	**5.75 (2,222)**	**.004**	**.20**
Fatigue (FIT®)			
Shift Length	.098 (2,201)	.906	.02
Fatigue (PVT)			
Shift Length	1.49 (2,214)	.228	.11
Sleep Disorders			
Shift Length	.208 (2,224)	.812	.04
Alertness			
Shift Length	**4.42 (2,132)**	**.014**	**.21**
Length*Site	**6.01 (2,132)**	**.003**	**.30**

[a] The *F* was calculated taking into account the pretest measure, site of study and time of day. The Sleep Disorder variable did not have a pretest measure. See Appendix H for the full model.

Sleep quality. While significant differences were found in the average amount of sleep across different shift lengths, the same effect was not present in our examination of the quality of sleep. No statistically significant differences were found among the groups with respect to shift length (Cohen's $f = .09$); all participants indicated their average quality of sleep as "good" with little variation.

Sleepiness. To assess sleepiness, we included items from the Harvard Study of Work Hours (Czeisler et al., 2005) and our sleep consultant, as well as the entire Epworth Sleepiness Scale, transformed to *z*-scores and combined for a composite measure of sleepiness. There was a significant effect of shift length on the sleepiness composite, $F(2,222) = 5.75$, $p = .004$. Testing the magnitude of the sleepiness construct resulted in a small to medium effect ($f = .20$) for shift length. A pairwise comparison test of the adjusted group means revealed that the average level of sleepiness for officers in the 12-hour shift (mean = 0.77) was significantly higher than for those on the 8-hour shift (mean = -0.72, $p = .003$).

Fatigue. We assessed objective fatigue using the Fitness-for-Duty Impairment Screener (FIT®) and the Psychomotor Vigilance Test (PVT). While the FIT® captures three ocular measures, for the purpose of our study we assessed fatigue effects *only* from reductions in saccadic velocity among the study participants. We took the average from the three saccadic velocity readings to serve as the outcome measure. We did not find a significant impact of shift length on fatigue based on the measurement of saccadic velocity (FIT®) or the PVT composite (reaction time, lapses, and false starts), although there was a small effect size for the PVT measure ($f = .11$).

Sleep disorders. To assess the presence of sleep disorders among participants, we relied on self-reported questionnaire items from the Harvard Work Hours Study (Czeisler et al., 2005), our sleep consultant, and an adapted version of the Berlin Sleep Apnea Questionnaire during the

posttest phase of the study. A composite measure was created using averaged *z*-scores. There were no significant differences among the shift length groups with respect to sleep disorders.

Alertness. We measured alertness via alertness logs, where officers indicated their level of alertness during each hour of their shift. The average level of alertness per shift over the 2-week period served as our outcome measure for alertness. For this measure, there was a significant effect, $F(2,132) = 4.42$, $p = .014$, representing a small to medium effect size ($f = .21$). Significant differences among the groups were found for the length of shift with respect to the average levels of alertness after controlling for the effect of the pretest measure of level of alertness. A pairwise comparison test of the adjusted group means revealed that the average level of alertness for officers in the 12-hour shift was significantly lower (mean = 6.11) than the average alertness levels among officers on the 8-hour (mean = 6.74, $p = .012$), but not the 10-hour (mean = 6.31, p = ns) shift.

There was also a very significant treatment by site interaction for level of alertness, $F(2,132) = 6.01$, $p = .003$. In an effort to better understand which comparisons were accounting for the interaction effect between treatment and level of alertness, we examined within site main effects (see Table 22). In Detroit, there was a medium to large effect size ($f = .34$), but the comparison did not reach statistical significance. The limited sample size in Detroit makes this finding hard to interpret. However, it appears that those working 8-hour shifts in Detroit are more alert than either those on 10s or 12s, suggesting decrements in alertness for compressed schedules. On the other hand, in Arlington, the main effect of shift length was $F(2,91) = 8.47$, $p = .000$, with an effect size of $f = .29$ (medium). As shown in Table 23, those on 12-hour shifts were significantly less alert (mean = 6.10 hours) than those on the 10-hour (mean = 6.74, $p = .000$) and 8-hour shifts (mean = 6.53, $p = .037$), showing a clear disadvantage for those working 12-hour shifts, but not for 10-hour shifts.

Table 22

Within Site Alertness Levels GLM Estimates

Alertness	***F* (df)[a]**	***Significance***	***Cohen's f***
DETROIT			
Shift Length	$F(2,44)= 2.53$	$p = .093$	.34
ARLINGTON			
Shift Length	**$F(2,91) = 8.47$**	**$p = .000$**	**.29**

[a] The *F* was calculated taking into account the pretest measure, site of study and time of day. See Appendix H for the full model.

Table 23

Within Site Mean Alertness Levels

Alertness	***8-hour***	***10-hour***	***12-hour***
DETROIT	6.89	5.85	6.22
ARLINGTON	6.53	6.74	6.10

Extra-duty employment. Concurrent with our analysis of the possible risks of shift lengths on officers' health, safety, performance, and quality of life issues, this study further investigated the extent to which off-duty employment and overtime are influenced by differences in shift length. Specifically, we wanted to evaluate whether there were differences among the groups with respect to the amount of off-duty employment and departmental overtime amassed during a 2-two week period. The results of the analysis for off-duty employment and departmental overtime are presented in Table 24.

Off-duty employment. We examined the extent to which shift length impacts on the total number of hours an officer worked outside the department. While the officers on 10-hour shifts worked the least amount of off-duty work, the differences across groups were not statistically

significant, and the effect size was very small (f = .05). The following are the means for each group: 8-hour = 6.83; 10-hour = 5.32; and 12-hour = 7.53).

Overtime. The amount of overtime hours taken by officers was significantly different among the groups for shift length $F(2,145) = 15.42$, $p = .000$. The strength of the effect for length of shift using the Cohen's f effect size index indicated a large effect (f = .42). An examination of the group means adjusted for the effect of the pretest overtime hours revealed that the average amount of overtime among officers in the 8-hour shift (5.75 hours) was significantly higher than the average hours for officers in the 10-hour (mean = 0.97 hours, p = .000) and 12-hour (mean = 1.89 hours, p = .000).

Table 24

Extra-Duty Employment GLM Estimates

Outcome Measure	***F* (df)[a]**	***Significance***	***Cohen's f***
Off-duty Employment			
Shift Length	.241 (2,146)	.786	.05
Overtime			
Shift Length	**15.42 (2,145)**	**.000**	**.42**
Length * Site Interaction	**5.86 (2,145)**	**.004**	**.24**

[a] The F was calculated taking into account the pretest measure, site of study and time of day. See Appendix H for the full model.

There was also a significant interaction effect for shift length by study site when considering amount of overtime, $F(2,145) = 5.86$, p = .004. The analysis revealed that while officers on 8-hour shifts in both sites worked the most amount of overtime, those in Detroit worked considerably more (mean = 8.76[30]) than those in Arlington (mean = 2.74 hours). In an effort to better understand which comparisons were accounting for the interaction effects, we examined within site main

[30] Adjusted for pretest overtime hours.

effects of the treatment. Indeed, in both sites, there was a significant difference across groups (see Table 25). In Detroit, the main effect of shift length was $F(2,44) = 7.39$, $p = .002$, which translates to an effect size of $f = .53$ (large). As shown in Table 26, the 8-hour group had significantly more overtime (mean = 9.01 hours) than both the 10-hour group (mean = 1.49, $p = .002$) and 12-hour group (mean = 3.02, $p = .013$), indicating that either type of compressed schedule in Detroit results in less overtime than for 8-hour shifts. And it is quite clear that those in the 10-hour group worked substantially less overtime than those on 8-hour shifts in Detroit.

Table 25

Within Site Overtime Hours GLM Estimates

Overtime	***F* (df)[a]**	***Significance***	***Cohen's f***
DETROIT			
Shift Length	**7.39 (2,44)**	**.002**	**.53**
ARLINGTON			
Shift Length	**3.03 (2,104)**	**.053**	**.25**

Table 26

Within Site Mean Overtime Hours

Overtime	***8-hour***	***10-hour***	***12-hour***
DETROIT	**9.01**	**1.49**	**3.02**
ARLINGTON	**2.54**	**.75**	**1.04**

In Arlington, the main effect of shift length was $F(2,104) = 3.03$, $p = .053$[31], which translates to a medium effect size ($f = .25$). Whereas the 8-hour group had more overtime (mean = 2.54 hours) than those on the 10-hour shift (mean = 0.75, $p = .064$), and 12-hour group (mean = 1.04 hours, p = ns), the first comparison approached statistical significance and the latter was not statistically significant.

Discussion

Since at least as early as the 1970s, compressed workweeks have been implemented in a variety of employment settings and for a variety of reasons. There has been considerable research to examine the impacts of such shifts, particularly in 24/7 operations (e.g., hospitals, production and power plants, utilities, and transportation), due to concerns over safety, fatigue, performance, and quality of life. Nevertheless, to date there has been considerably less research in the area of public safety, partially because public safety is not regulated by the federal government, but rather is a state and local function. In this research, we sought to more comprehensively examine the impact of the two most typical compressed work schedules (4/10s and 3/12s) in law enforcement on performance and safety, health, quality of life, sleep and fatigue, as well as off-duty employment and overtime usage.

Consistent with past research in other occupations, compressed schedules (10- and 12-hour) did not seem to have a significant impact on our measures of performance. This is consistent with results of a meta-analysis by Baltes et al. (1999) in which researchers identified just four studies in which performance was used as a dependent variable. In those studies, there was no impact of shift length on objective performance or productivity measures. While Baltes et al. (1999) did identify some studies indicating significant impacts of shift length on work performance, the majority of those were based on subjective performance measures (i.e., supervisory ratings of performance),

[31] Just reaching statistical significance.

which have typically not been found to correlate with objective performance measures (e.g., Alexander & Wilkins, 1982; Bommer et al., 1995). In addition, Coutts and Schneider (2004) have identified problems with subjective performance ratings in law enforcement, and therefore we chose not to rely on subjective measures in our experiment.

In policing, quantification of objective performance is made more difficult due to the lack of agreement regarding what constitutes good performance, especially when considering individual performance. Nevertheless, when objective measures have been identified for research, most studies have not demonstrated an impact of shift length on performance (e.g., Cunningham, 1982; deCarufel & Schaan, 1990; Pierce & Dunham, 1992; Smith et al., 1998; Sundermeier, 2008). As such, we selected primarily objective, police-specific measures of work performance (e.g., interpersonal performance, driving safety, shooting performance, and self-initiated activity) and found no effect of shift length.

There has been a limited amount of research on the impact of CWWs on aspects of interpersonal performance across industries, and those findings have been mixed. For example, some have found lower levels of customer service associated with CWWs (e.g., Goodale & Aagard, 1975), and reduced quality of care of nurses (e.g., Bernreuter & Sullivan, 1995), whereas others have reported improved patient care among nurses (e.g., McGettrick & O'Neill, 2006; Compolo et al., 1998), but those findings have typically been based on self reports. As such, we used a more objective measure of interpersonal performance, which, although based on rated performance, is rated by a stranger trained to reliably rate various performance dimensions without bias. Yet, when using this more objective measure, we found no significant group differences associated with shift length.

With regard to driving safety, there have not been systematic studies of the impact of shift length on officer driving outcomes. However, in conducting a cross-industry review of the

literature, Knauth (2007) reported a greater number of studies finding an association with longer work hours and various types of accidents. Although considering the fact that a few found no effects and others reported fewer accidents for those on CWWs, the impact of shift length on accidents is, at best, equivocal. Furthermore, our driving measure consisted of various risky driving behaviors besides accidents. While we found no significant differences in driving performance based on shift length, this result should be interpreted with caution given the fact that we used a composite index of a number of risky driving behaviors. Some have more recently found that different aspects of driving performance tap different cognitive resources (e.g. Trick, Toxopeus, & Wilson, 2010) or that different driving outcomes can be differentially affected by various conditions (e.g., Wood, et al., 2009). Given the breadth of our study and the number of outcome variables, we did not conduct analysis of individual driving behaviors, due to potential reductions in statistical power.

We could not identify any past studies of CWWs in which shooting performance was used as a performance criterion. In our use of a high-fidelity simulator, we did not observe any significant differences. Because this was the first examination of this outcome, it is possible that future examinations may reveal differences based on shift length. Since we used a composite measure of shooting, it is not clear whether analysis by each independent dimension (command presence, accuracy, and judgment), would be differentially affected by fatigue and/or shift length, something that should be explored in future investigations.

Finally, with regard to self-initiated activity, a few past studies in nursing have shown that those on 12-hour shifts had a reduced work effort (e.g., Duchon, et al., 1997), a decrease in activities (e.g., Reid, et al., 1993), and saw fewer patients (Jeanmonod et al., 2008). In our study examining several types of self-initiated activities (traffic stops, reports completed, etc.), we found no impact of shift length.

We also found no negative or positive impacts of shift length on our measures of health (cardiovascular health, gastrointestinal problems, and work stress). Past researchers examining CWWs across industries have reported results that are equivocal (Knauth, 2007), with some finding a negative impact of increased shift length on health (e.g., Smith et al., 1998) and others finding an improvement in health (e.g., Lees & Laundry, 1989; Williamson, Gower, & Clarke, 1994) with CWWs. Yet, as previously reported, past research across industries has been plagued with methodological, design, and measurement problems, and the research in policing is no exception. Nevertheless, some studies from policing seem to demonstrate positive health outcomes for CWWs, contrary to our findings. For example, Peacock et al. (1983) found reductions in cardiovascular strain after a stress test, although this was based on just 16 participants' data. Also, Pierce and Dunham (1992) found a significant decrease in stress and fatigue, although it should be noted that they used an interrupted time series design and had no control group.

Nevertheless, our findings suggest that while 8-hour shifts are the most commonly implemented schedules, they have some disadvantages over 10-hour shifts, without demonstrating any unique advantages. In our research, those officers working the 10-hour shifts got more sleep per night than those on 8-hour shifts (greater than four hours more per week). However, the perceived quality of sleep did not significantly differ across groups. Furthermore, those officers assigned to 8-hour shifts worked significantly more overtime than did those on 10- or 12-hour shifts (more than 5 times as much as those on 10-hour shifts, and more than 3 times as much as those on 12-hour shifts). While there was an interaction effect with site, this simply reflected that the magnitude of the difference was much greater in Detroit than in Arlington. Whereas the differences in Arlington were in the same direction as those in Detroit, the paired comparisons within Arlington did not reach statistical significance, although there was a moderate effect size. In both cases the 10-hour shift workers had the lowest reported amount of overtime.

Also, our findings regarding quality of work life demonstrated that those working 10-hour shifts had a significantly higher quality of work life than those on the 8-hour shifts. This finding is consistent with most of the past research across work domains indicating that those on compressed schedules tend to rate them favorably or have increased job involvement or satisfaction (e.g., Armstrong-Stassen, 1998; Axelsson, 2005; Bendak, 2003; Dowd et al., 1994; Duchon et al., 1997; Dunham et al., 1987; Facer & Wadsworth, 2010; Lowden et al., 1998; Pierce & Dunham, 1992; Rosa & Colligan, 1992). On the other hand, while much of the past research on CWWs has found a positive impact on personal life (Armstrong-Stassen, 1998; Knauth, 2007; Lowden et al., 1998; McGettrick & O'Neill, 2006; Mitchell & Williamson, 2000; Facer & Wadsworth, 2010) or reduced work-family conflict (Facer & Wadsworth, 2008; Facer & Wadsworth, 2010), our study did not result in any significant findings for quality of personal life (operationalized as work-family conflict). While officers on 10-hour shifts (as compared to those on 8-hour shifts) had a higher quality of work life, this did not translate to lower levels of work-family conflict.

Perhaps most interesting and surprising was our finding that officers working 10-hour shifts averaged significantly less overtime per 2-week period than those on 8- and 12-hour shifts. While there was a significant interaction with site as previously noted, this simply reflected a much stronger effect in Detroit. This result suggests a potential cost savings for agencies that implement CWWs, especially 10-hour shifts. While we did not examine the particular scheduling strategies and efficiency of such practices, it is yet to be determined whether there may be efficiency losses or increased personnel costs when implementing 10-hour shifts. Both 8- and 12-hour shifts can be equally distributed across the 24-hour spectrum, whereas the same is not true of 10-hour shifts. Nevertheless, the gains in quality of work life, increased sleep, and overtime savings associated with 10-hour tours may result in a net benefit to law enforcement agencies.

Although it may be expected that some advantages associated with 10-hour shifts would inure to those on 12-hour shifts, we did not find that in this study. For example, those on 10-hour shifts had a higher reported quality of work life than those on 8-hour shifts, but those on 12-hour shifts did not. Also, while those on 10-hour shifts had significantly more sleep than those on 8-hour shifts, the same was not true for those on 12-hour shifts.[32] In addition, there were some disadvantages related to 12-hour shifts, including greater reported levels of sleepiness and lower levels of alertness while at work as compared to those on 8-hour shifts. Because past researchers have indicated that people underestimate their fatigue levels (e.g., Rosekind & Schwartz, 1988), this finding should be reason for further concern. The fact that the benefits associated with 10-hour shifts—better quality of work life and greater average sleep amount—did not extend to 12-hour shifts indicates a nonlinear effect. Indeed, the lower levels of alertness and higher levels of sleepiness for those on 12-hour shifts suggest diminishing returns for the 12-hour shift configuration, although in one site alertness was diminished for the 10-hour shift as well.

Nevertheless, consistent with findings by Axelsson (2005), the 12-hour schedules were less detrimental in our study than may have been anticipated. However, Axelsson's findings that long working hours should not include monotonous tasks, physically hard work, or solitary work should be considered carefully since these activities may be more common in law enforcement. In addition, given the prior warnings by researchers related to fatigue in positions of public security, agencies should be concerned with managing fatigue in extended shifts, particularly those of 12-hours or more, inclusive of overtime work.

Finally, it is important to note that unlike other study designs, the use of a randomized control trial limited biasing factors since officers assigned to each did not have the capacity to artificially inflate their ratings in relation to those in other groups, as they would not have

[32] Although the mean level of sleep for those on 12-hour shifts was higher than for those on 8-hour shifts, these differences did not reach statistical significance.

knowledge of how others responded to questions. In most previous studies where there was an entire agency changeover from one schedule to a more compressed schedule, officers could report improvements over their prior shifts retrospectively. Also in our study, participants in both agencies were told that they would not be guaranteed any change to a new shift regardless of the study's results.

There were some limitations to this study. For example, while our attrition analysis does not indicate systematic bias, the rate of attrition in Detroit was higher than that in Arlington, and it was greatest for the 8-hour shift. However, because this shift could be considered the control condition in that both agencies were operating on 8-hour shifts prior to the study, and was the shift to which all non-study officers were assigned, we do not have reason to believe that this led to inaccurate conclusions or over-interpretation of findings. Indeed, while a greater number of officers on 8-hour shifts withdrew from the study initially, it was mostly due to dissatisfaction with not obtaining entry into a treatment condition, indicating a less favorable attitude toward 8-hour shifts. The fact that those with less favorable attitudes dropped out of that condition suggests that the negative findings related to quality of work life for those on 8-hour shifts may mean that had those individuals participated, that may have resulted in an even lower quality of work life, or possibly a significant effect of greater work-family conflict. Therefore, because those remaining in the study were more likely content with that shift than those who withdrew, we may expect that a bias in shift preference would lead the remaining officers to report being more, not less, satisfied as we found. Also, it is important to note that there were few cases in which individuals in 10- or 12-hour treatment conditions withdrew because of the difficulty of that shift.

While we had hoped for a greater number of participants than we obtained, we had a sufficient number to ensure the ability to detect medium effects as per Cohen. The fact that we detected smaller effects is likely due to the increased power of our randomized block design and,

given the previous discussion of effect size interpretation, when we did identify small effects (as per Cohen), they were nevertheless quite meaningful. In addition, the sample size we had is substantially higher than those of most previous studies, many of which used observational or cross-sectional designs.

While numerous studies have found performance and safety problems associated with longer shifts, we were not able to provide evidence to support any potential performance decrements. Given the greater levels of sleepiness and lowered alertness for those on 12-hour shifts,[33] caution should still be exercised by agencies planning on implementing those shifts, as we did not consider all potential forms of performance, nor did we examine individual driving behaviors.

Based on past research, it is plausible that the discrepant past or current findings may have to do with the time at which performance measures were taken. For example, researchers have noted that fatigue and other performance effects tend to be most pronounced at the end of a long shift (Rosa & Bonnet, 1993; Rosa, 1995; Ugrovics & Wright, 1990; Hart & Krall, 2007), which is why we captured all laboratory measures at the end of the shifts. And because past studies have shown negative outcomes for various times of day (e.g., Härmä et al., 2002; Heselgrave, Rhodes, & Gill 2000), we used time of day as a blocking factor, but found no significant interactions with shift length for those comparisons in which shift length was significant. Indeed, many sleep experts do caution against confounding various start and end times of shifts with periods of circadian dips. Yet, in spite of the start and end times, and using the time of day as a blocking factor, we found no significant shift length impacts and no interactions with time of day of the shift. Because our study was not intended to test for main effects of time of day, we did not conduct analysis of this variable independently.

[33] And possibly lowered alertness for those on 10-hour shifts.

While this study has provided considerable information about the impacts of CWWs on performance, health, quality of life, sleep, fatigue, and extra-duty employment, it also suggests the need for additional research. For example, while we found significant advantages of 10-hour shifts, we did not examine how to most efficiently implement those schedules. In addition, there appeared to be wide variation in overtime hours (ranging up to 88 hours per 2-week period[34]). Considering prior research indicating that fatigue and long work hours can have serious safety consequences (e.g., Burke, 2003; Caruso et al., 2004; Folkard & Lombardi, 2004; Vila, 2000), extra caution should be exercised when adopting 12-hour shifts due to increased risks at the end of those shifts.

It is also important that future research focus on the extent to which law enforcement agencies have implemented overtime policies, and whether they monitor and assess excessive overtime or off-duty work. As some have argued, it is possible that there are a variety of individual difference variables such as age or health conditions that may influence resiliency and coping with longer work hours, as well as differences in how longer shifts affect them (e.g., Calvasina & Box, 1975; Dunham & Hawk, 1977; Reid & Dawson, 2000). As such, there is a need for more research on individual characteristics that may interact with shift lengths in producing varied outcomes. Finally, a study of managerial decision making in the public sector revealed that managers are much more likely to implement alternative work schedules on the basis of organizational issues (i.e., productivity, ease of supervision, economics, costs and benefits, and administrative demands) rather than employee issues (Duxbury & Haines, 1991), which is why we focused on both performance and overtime issues, as well as health and quality of life issues. Indeed, we examined sleep, fatigue, and safety as issues that may impact both employer and employee. Nevertheless, there is an ongoing need for research that examines the cost-benefit ratios of balancing worker and employer issues in implementation of alternative work arrangements, especially CWWs in law enforcement,

[34] The extreme outlier was removed from our analysis so as not to bias the results.

especially in light of the current economically challenged environment in which public organizations operate.

As agencies strive to implement policies and practices that are more efficient and effective, it is important that they implement evidence-based strategies and policies. In our experimental study, we sought to identify advantages and disadvantages of various shift lengths and compressed workweeks, without an expectation of finding a "best shift." Of course, decisions about what practices to employ best lay with police executives who are challenged with balancing employee considerations with operational responsibilities. Nevertheless, in the past, many of these decisions were made without the benefit of scientific data because such information in law enforcement was limited. In recent years, agency leaders have been receiving increased pressure from police associations and unions, while also experiencing increasing competition for the best personnel and limited resources. These factors, coupled with a rapidly increasing trend away from 8-hour shifts, have led some executives to make swift decisions about alternative shift schedules without solid evidence or comprehensive examination of the advantages and disadvantages. It seems that when it comes to shift practices, opinions, preferences, or beliefs stemming from nonscientific information have driven the decisions, most likely due to a lack of solid research findings.

It is hoped that the findings of this study will provide important information for law enforcement leaders (management and union), as well as other policy makers, to consider when examining the most efficient and effective practices in their agencies, while also allowing them to maximize safety and quality of life among their personnel, as well as that of the public they serve.

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Appendix A
Recruitment Documents

Want to make $100?

Want to work 4 10-hour days?
3 12-hour days?*

BONUS: $1,000 Prize Drawing!

The Police Foundation in Washington, D.C. is working with the Detroit Police Department and Detroit Police Officers' Association to examine the feasibility of 4 10-hour shifts and 3 12-hour shifts*. In order to proceed, we need volunteers. The study will assess how 5/8s, 4/10s, and 3/12s* affect officers' health, safety, performance, and quality of life.

Who can participate?

- All patrol officers from Platoons I, II, and III assigned to respond to calls for service.
- A total of 270 officers will be selected, with priority given based on seniority.

What do you have to do?

Before beginning the assigned shifts, and again 6 months later, you will:

- Complete 3 ½ hours of tactical games/simulations while on-duty.
- Complete a survey off-duty.
- Keep track of your sleep patterns and level of alertness during a 2-week period.

What do you get out of it?

- A chance to work different hours – participants will be **RANDOMLY ASSIGNED** to either 4/10s, 3/12s*, or remain on their same shift **(YOU CAN'T CHOOSE A SHIFT)**
- A chance to make some extra money – all participants will receive two $50 stipends to compensate for off-duty time spent completing the survey.
- Two chances to win one of two **$1,000 cash prize drawings**.

Representatives from the Police Foundation will conduct informational sessions and sign-ups during shift changes at the districts—[Districts 1-3: **11/7 – 11/10**] [District 4: **11/7 – 11/9 and 11/11**], and [Districts 5 and 6: **11/9 – 11/12**]. To volunteer ahead of time email Kzinsser@policefoundation.org or call toll free **1-866-697-7290.**

Further information and a volunteer form has/will be distributed to your department mailbox. Volunteering does not guarantee that you will be selected for the study, as there is limited space available. All information you supply will be kept confidential.

***3 12-hour shifts in week #1 and in week #2, 3 12s plus an 8 hour day.**

There's Still Time....

Shift Work Study SIGN-UPS being accepted until Friday, December 8th

Check out the new Tuebor for more details!

For more information or to sign up, call the Police Foundation toll free at (866) 697-7290
OR
call Commander John Autrey at the Northeastern District
(313) 596-1110

Want to work fewer days?
Four 10-hour shifts?
Three 12-hour shifts?*

The Police Foundation in Washington, D.C. is working with the Arlington Police Department to examine the feasibility of compressed work schedules (4 10-hour shifts and 3 12-hour shifts*). The study will assess how various shifts affect officers' health, safety, performance, and quality of life.

In order for the Arlington Police Department to consider compressed work schedules, there must be enough volunteers to complete the study so that the advantages and disadvantages of each schedule are properly considered.

Participants will be **RANDOMLY ASSIGNED** to either 4-10s, 3-12s*, or remain on their same shift **(YOU CAN'T CHOOSE A SHIFT LENGTH)** for the period January through June. **The random assignment WILL NOT CHANGE the shifts you selected in the bid process.** Extra day(s) off will be assigned directly before/after the days off you selected in the bid.

Who can participate?

- All current patrol officers EXCEPT those working front desk, HEAT, foot patrol, store front, those on light duty or medical leave, new recruits still in field training, and those scheduled to retire or be deployed overseas in the upcoming months.

What do you get out of it?

- A chance to work different hours starting in January!!
- A chance to make some extra money – all participants will receive two $50 stipends to compensate for off-duty time spent completing the survey.

What do you have to do?

This fall and next June, you will:

- Complete 2 ½ hours of tactical games/simulations while on-duty.
- Complete surveys off-duty.
- Keep track of your sleep patterns and level of alertness during a 2-week period.

BONUS: $100!

SIGN UP NOW!
(Your lieutenant and district commander have the forms)

CUT OFF DATE: TUESDAY, September 30th!!!

***3 12-hour shifts in week one, and 3 12-hour shifts PLUS an 8-hour day in week two.**

Appendix B
Sample Recruitment Letter

November 1, 2006

Dear Officer _____:

Are you interested in working either 4/10-hour shifts or 3/12-hour shifts? The Police Foundation in Washington, DC has been awarded a federal grant to conduct a study of shift work that will assess the feasibility of these compressed work schedules. As such, the Detroit Police Department and the Detroit Police Officer's Association have collaborated with the foundation and agreed to be a key site for this research project which will have national impact. The study will examine how 5/8s, 4/10s, and 3/12s affect fatigue and officers' health, safety, performance, and quality of life. As a volunteer, you would be contributing greatly to this effort. However, if you volunteer it is possible that for the 6 months of the study you would be assigned to 4/10s, stay on 5/8s, or be assigned to 3/12s*.

WHO'S ELIGIBLE?
All active-duty officers from Platoons I, II, and III who are assigned to respond to calls for service.

BENEFITS
- If you are selected to participate you will receive a stipend of $100 ($50 in the first and last months of the study). The payment is to compensate you for the time you spend off-duty completing the survey and to thank you for participating.
- You will also have two chances to win one of two $1,000 prizes. Participants who complete all exercises in each phase of the study will be entered in the prize drawings (one the first month and one the last month).
- Your participation will aid in the development of policing practices designed to improve the health, safety, performance, and quality of life of police officers nationwide, and help the Detroit PD assess the advantages and disadvantages of each shift schedule.

WHAT'S REQUIRED?
Participation in the study involves 2 basic activities over two periods of time (before the start of the assigned shift and 6 months later):
- A practical/tactical session completed during the last 2 hours of a two consecutive (if possible) work shifts that will include a shooting simulator, a driving simulator, a video simulation, and other practical/tactical exercises.
- Surveys completed off-duty.

HOW TO GET INVOLVED
There are a limited number of spaces available in this study. Researchers will be on-site from November 7th through November 12th conducting information sessions and sign ups during roll-call briefings (we will be in each district for 3 consecutive days—dates to be posted at your district shortly). If you are interested please volunteer as soon as possible, but no later than November 16th. Your participation in this study will be strictly voluntary, but volunteering does not guarantee that you will be selected to participate as there are only 270 spaces available. If more than 270 officers volunteer, priority will be given based on seniority. All simulations and surveys will be completed in early December and new shift assignments will take effect on ***January 2, 2007 and continue through June 30, 2007***.

To volunteer:
- Complete the attached volunteer form and informed consent
- **Bring** your completed forms to roll call on one of the days we will be on site (we will have extra forms there as well), OR
- **Fax** the forms to (202) 296-2012, OR
- Send an **email** with the same information as on the attached form to Kzinsser@policefoundation.org, OR
- **Call** the Research Coordinator Kate Zinsser at (202) 721-9787 to get any questions answered before signing up.

All information collected during this study will be kept confidential. If you have any questions, concerns, feel free to contact either of the people listed below during regular business hours

Dr. Karen L. Amendola, Principal Investigator
1201 Connecticut Ave., NW, Suite 200
Washington, D.C. 20036
(202) 833-1460

Commander John Autrey
Detroit Police Department
(313) 218-3374

*3/12s will be operationally defined as working 3 consecutive, 12-hour shifts in week #1, and in week #2, 3 consecutive 12-hour shifts plus a fourth day of 8 hours (total of 80 hours every two weeks, or an average of 40 hours per week).

Appendix C
Volunteer Form

SHIFT WORK STUDY
VOLUNTEER FORM AND INFORMED CONSENT

In order to be included you MUST SIGN AND RETURN NO LATER THAN (*DATE*) as follows:

1) BY MAIL IN PRE-ADDRESSED, STAMPED ENVELOPE
OR
2) BY FAX TO (202) 296-xxxx

SIGNATURE Required:

I have read and understand the information in the Shift Work Study Informed Consent document, and I have had all questions answered to my satisfaction. I voluntarily agree to participate in this research.

_____ _____
Print Name **Signature**

Today's Date: _____

We will send your materials, including the initial surveys, to you at home to ensure your confidentiality. Please provide the following information so we can be in touch with you:

Home Address: _____

_____

City: _____ State:_____ ZIP: _____

Personal Email: _____@_____

Work Email: _____@_____

Home Phone: ( ) _____ - _____Best time: _____

Work Phone: ( ) _____ - _____Best time: _____

Cell Phone: ( ) _____ - _____Best time: _____

FAX: ( ) _____ - _____Is this work/home? _____

If any of the responses I provided are indicative of an underlying sleep disorder, the best way for the researcher to notify me is: _____by mail at home _____other, list

_____

Thank you!

Appendix D
Informed Consent – Detroit

INFORMED CONSENT

Shift Work Study

Conducted by:
Karen L. Amendola, PhD and other researchers
Police Foundation

The Detroit Police Department and the Detroit Police Officers' Association have agreed to participate in a research study being conducted by the Police Foundation under a grant from the National Institute of Justice that is examining the advantages and disadvantages associated with various shift schedules. This study is entitled "The Impact of Law Enforcement Shift Practices and Extra-Duty Employment on Various Health, Safety, Performance, and Quality of Life Outcomes."

I understand that if I volunteer to participate, the researchers will randomly assign me to work a schedule of either four 10-hour days, three 12[*]-hour days, or my current schedule of five 8-hour days for a period of 6 months beginning January 15th, 2007. If I am assigned to work the same schedule that I am already working, I understand that my participation will still include completing the same steps as will be done by officers assigned to different schedules, as this "control group" is necessary to examine differences in schedules. If I am assigned to a new schedule, I understand that the officers I regularly interact with may not be the same officers I interact with currently, and that I may report to more than one supervisor during my tour, based on my new schedule.[**] I understand that there are only 270 participant spaces available in the study and if more than 270 officers volunteer selections will be made by district and seniority, so there is a chance I will not be chosen to participate even if I volunteer.

I certify that I am currently an active duty officer from Platoon I, II, or III who is assigned to respond to calls for service. I am not on restricted duty and expect to stay on patrol for the next 7-8 months. I understand that if I find out that my status on street patrol will change (i.e. promotion, reassignment, disability, pregnancy, etc.), that I will become ineligible for continued participation at that point in time and agree to inform the study's principal investigator. I also understand that the Detroit Police Department reserves the right to remove me from the study for operational or other reasons.

This study is not designed to prove or disprove any prior position or belief about which schedule is best or worst, but to examine the impact of shift practices, overtime, and off-duty employment on a variety of officer health, safety, performance, and quality of life issues. In fact, the researchers hypothesize that there will be some pros and cons associated with every shift schedule.

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[*] 3/12s will be operationally defined as working 3 consecutive 12-hour shifts in week #1 and in week #2, 3 consecutive 12-hour shifts plus a fourth day of 8 hours (total of 80 hours every two weeks, or an average of 40 hours per week).

[**] The Detroit Police Department will assign days off to participants. Participants will not be required to work an entire weekend for the 6 month period of the study.

I understand that in order to receive the results of this study I must contact Kate Zinsser via email at kzinsser@policefoundation.org or call (202) 721-9787.

Overview of the Study

The research study involves a survey and a practical/tactical simulation component. The survey component will be done on my own time, but with a small monetary incentive. The practical/tactical simulation will be completed during work hours at the department. I understand that the researchers will be gathering this information at two (2) different points in time. First, this information will be completed in month preceding the start of the new shift schedules. At the end of the study (before the end of the 6th month), I will be asked to complete the process again. The next section outlines the specific steps required of me (on a volunteer basis), if I agree to participate.

Steps Involved if I Participate

a. ***Complete some self-report measures*** as detailed below;
   a. *Sleep diary*—booklet to be completed for 2 weeks at each of two study phases (prior to starting the study and at the end of 6 months). It is estimated that this will take about 5 minutes per day.
   b. *Alertness log*—booklet to be completed only on the days that I work for the department during the same 2 week periods when I complete the sleep diaries. It is estimated that this will take between 5 and 10 minutes per day during these brief time periods.
   c. *Complete a comprehensive survey*—this survey asks about work attitudes, job satisfaction, personal habits, health, safety, quality of life, and job stress, as well as some related questions and demographics. It is expected that this will take between one and a half and three hours to complete. This will also be given prior to the start of the study and during the last month of the study.

b. ***Participate in practical/tactical simulations*** at the training academy prior to beginning the study and during the sixth month of the study. These sessions will be conducted during the last three hours of my shift on a day that I am working in the department. The exercises consist of a brief meeting with a researcher, completion of five simulations and a very brief survey. I understand that these sessions will consist of the following:

   a. *Meeting with a researcher* for the purpose of:
      i. delivering my completed survey.
      ii. bringing in my sleep diary and alertness log for a researcher to check and ensure I have no questions about how to complete it accurately.
   b. *Answering a brief survey* (approximately 10 minutes).
   c. *Completing five (5) simulation exercises*.
      i. A driving simulator (approximately 30 minutes)
      ii. A response time game (called “psychomotor vigilance”) on a hand-held personal data assistant (approximately 30 minutes)
      iii. Responding to a series of videotaped situations on a television for which we will videotape your response (approximately 30 minutes)
      iv. The MILO shooting simulation (approximately 30 minutes)
      v. The FIT pupil reaction test on a machine that tests for fatigue level (approximately 20 minutes).

3) ***Authorize review of relevant departmental performance data.*** I understand that the City may provide basic information to the Police Foundation regarding sick/injury leave, complaints, accidents, arrests made, and stops, all for group comparison purposes. This will allow them to assess whether the shift length, time of day, or schedule affects these factors differently.

I understand that by participating in the study, my personal liability coverage provided by the police department will not be altered regardless of the shift schedule to which I am assigned. I understand that there are advantages and potential disadvantages associated with my participation in the research. If I participate, I will receive a ***stipend of $50*** after completion of the practical/tactical simulations ***for a total possible payment of $100***, provided I attend my scheduled practical/tactical simulation (or call to change my appointment if it is impossible for me to keep the commitment) and bring in my completed survey (although I am not required to answer any question that I am not comfortable answering) and complete the sessions that day. The payment is a thank you to me for taking my time off-duty to complete the survey and my willingness to participate in the study overall. I understand that even if I decide later to drop out of the study for any reason (even though the researchers hope I won't), I may keep any stipend I have already received. I further accept the fact that I will not receive an additional benefit for completing the simulation exercises as these will be done **<u>on-duty</u>**, *time for which I am already being paid by the police department*.

There is also an additional potential benefit associated with completing a sleep diary and alertness log during a two-week period in each of the two study phases. By fully completing these two logs, **my name will be entered into a drawing** with the other participants in my agency (about 270) and one person will **receive a prize of $1,000 at each of the two measurement periods (prior to beginning the experiment and during the last month of the study).** As such, I understand that **I have two separate chances to win $1,000**, provided I fully complete the logs during each of the two study phases. A total of $2,000 ($1,000 each to two people) will definitely be awarded in my police department to the people that are selected at random from the pool of those who have fully completed the logs and diaries.

I understand that there are some potential disadvantages of participation as well. The study does require a commitment of time and a willingness to provide honest and complete information whenever possible. I am aware that some of the questions are of a personal nature and the researchers promise to protect my confidentiality by not connecting any of my responses to my name or personal identity. I am assured that my responses to any personal questions are directly related to the study's purposes. I also understand that answers to some questions being asked toward the end of the study may be indicative of an underlying sleep disorder and that if this is the case, it may be suggested that I seek a medical diagnosis by a general physician or sleep laboratory. NOTE: Indicate below the manner in which you would like to be informed if your self-reported symptoms suggest this need.

I understand that the researchers will only present aggregate data or a summary of results based on groups large enough so that no person can be individually identified. The collection of my information will only be attached to an ID number that I will be assigned for the study. Only the research team from the Police Foundation (and **<u>not</u>** the police department) will be able to associate my name with my ID number in order to connect my data from each of the two phases of the study. I understand that when the study is complete, the researchers will destroy the list that links participant names with identification numbers. All information I provide to the researchers from the Police Foundation during the study will be kept in the strictest confidence. I understand that my responses will never be revealed in a way that can personally identify me, nor will any information

about me personally be provided to the police department, **EXCEPT** if I make a direct threat or express an intention to harm myself or someone else.

If I agree to participate in the research study, I understand that I may withdraw at any time, and the department will have the authority to return me to my prior schedule. If I choose to withdraw, I understand that I will not be required to complete any more surveys or simulations. I realize that there will be no penalties or negative consequences to me if I decide to skip any questions or stop participating altogether.

If I have any questions, concerns, or complaints, I am free to contact any of the people listed below during regular business hours. Below is my signature indicating my consent to begin participating in this study.

CONTACTS

Karen L. Amendola, PhD
Principal Investigator
Police Foundation
1201 Connecticut Ave,
NW Suite 200
Washington, DC 20036

Professor Dick Bennett*
Chairman of Institutional Review Board
& Professor at American University
c/o Police Foundation

[Also had department contact here]

I have read and understand the information in the Shift Work Study Informed Consent document, and I have had all questions answered to my satisfaction. I voluntarily agree to participate in this research.

_____ _____
Print Name **Signature**

Today's Date: _____ Researcher Initials: _____

District:_____ Current Shift:* [___ 12am - 8am] [___ 8am - 4pm] [___4pm- 12am]
Platoon I Platoon II Platoon III

Current Days (check each you are regularly scheduled to be on patrol duty):

___Mon ___Tues ___Wed ___Thurs ___Fri ___Sat ___Sun

If you are selected we will send your survey and other participant information to you via department mail. If we need to contact you with more information, how would you prefer that we do so? (please complete AT LEAST ONE of the following):

Private Email: _____@_____

Work Email: _____@_____

Home Phone: ( ) _____ - _____Best time: _____

Work Phone: ( ) _____ - _____Best time: _____

Cell Phone: ( ) _____ - _____Best time: _____

FAX: ( ) _____ - _____Is this work/home? _____

If any symptoms I report may be indicative of an underlying sleep disorder, the best way to notify is:

____by mail at work ____by mail at home ____other

Provide address:

_____

*Note: Officers working on Platoon IV are ineligible for this study.

Appendix E
Informed Consent – Arlington

INFORMED CONSENT

Shift Work Study

Keep this for your records.

Conducted by:
Karen L. Amendola, PhD and other researchers
Police Foundation

The Arlington Police Department has agreed to participate in a research study being conducted by the Police Foundation under a grant from the National Institute of Justice that is examining the advantages and disadvantages associated with various shift schedules. This study is entitled, "The Impact of Law Enforcement Shift Practices and Extra-Duty Employment on Various Health, Safety, Performance, and Quality of Life Outcomes."

I understand that if I volunteer to participate in the study, the researchers will **randomly assign me to work a schedule of either four 10-hour days, three 12*-hour days, or my current schedule of five 8-hour days for a period of 6 months beginning in January. The random assignment will not change the shift schedule I selected in the bid process. However, if I get assigned to work ten-hour shifts or 12-hour shifts, my additional day(s) off will be assigned either immediately prior to or after my scheduled days off so that my days off will run sequentially.** If I am assigned to work the same schedule that I am already working, I understand that my participation will still include completing the same process as will be done by officers assigned to different schedules, as this "control group" is necessary to examine differences in schedules. If I am assigned to a new schedule, I understand that the officers I regularly interact with may not be the same officers I interact with currently and that I may report to more than one supervisor during my tour based on my new schedule.

I certify that I am currently a full-time patrol officer who is assigned to respond to calls for service and not a recent recruit still in field training. I am not/will not be working front desk, HEAT, foot patrol, store front, on light duty or medical leave, and I do not plan to retire or be called to active duty military service in the upcoming six months. I understand that if I find out that my status on street patrol will change (i.e. promotion, reassignment to one of the above duties, disability, pregnancy, etc.), I will become ineligible for continued participation at that point in time and agree to inform the study's principal investigator.

This study is not designed to prove or disprove any prior position or belief about which schedule is best or worst, but to examine the impact of shift practices, overtime, and off-duty employment on a variety of officer health, safety, performance, and quality of life issues. In fact, the researchers hypothesize that there will be some pros and cons associated with every shift schedule.

* Three 12-hour days will be operationally defined as working 3 consecutive 12-hour shifts in week #1 and then in week #2, working 3 consecutive 12-hour shifts PLUS a fourth day of 8 hours (total of 80 hours every two weeks, or an average of 40 hours per week).

Overview of the Study

The research study involves surveys and a practical/tactical simulation component. The survey component will be done on my own time but with a small monetary incentive. The practical/tactical simulation will be completed during work hours at the department. I understand that the researchers will be gathering this information at two (2) different points in time. First, this information will be completed this fall prior to the shift change in January. At the end of the study (before the end of the 6th month), I will be asked to complete the process again. The next section outlines the specific steps required of me (on a voluntary basis), if I agree to participate.

Steps Involved if I Participate

1) ***Complete some self-report measures*** as detailed below:

   c. *Complete a comprehensive survey*—this survey asks about work attitudes, job satisfaction, personal habits, health, safety, quality of life, and job stress, as well as some related questions and demographics. It is expected that this will take between one and a half and three hours to complete. This will also be given prior to the start of the study and during the last month of the study.
   d. *Sleep diary*—booklet to be completed for 2 weeks at each of two study phases (prior to the start of the new schedules). It is estimated that this will take about 5 minutes per day during those 2 weeks.
   e. *Alertness log*—booklet to be completed only on the days that I work for the department during the same 2 week periods when I complete the sleep diaries. It is estimated that this will take between 5 and 10 minutes per day during these brief time periods.

2) ***Participate in practical/tactical simulations*** to be held at the new **South district station** prior to beginning the study and during the sixth month of the study. These sessions will be conducted during the last three hours of my shift on a day that I am working in the department. The exercises consist of a brief meeting with a researcher, completion of five simulations, and a very brief survey. I understand that these sessions will consist of the following:

   a. *Meeting with a researcher* for the purpose of:
      i. turning in my completed survey and receiving $50 payment
      ii. receiving instructions about the simulations.
   b. *Answering a brief survey* (approximately 10 minutes).
   c. *Completing five (5) simulation exercises*.
      i. A driving simulator (approximately 30 minutes).
      ii. A response time game (called “psychomotor vigilance”) on a hand-held personal data assistant (approximately 15 minutes).
      iii. Responding to a series of videotaped scenarios on a television for which we will videotape your response (approximately 30 minutes).
      iv. The MILO shooting simulation (approximately 30 minutes).
      v. The FIT pupil reaction test on a machine that tests for fatigue level (approximately 20 minutes).

3) ***Authorize review of relevant departmental performance data.*** I understand that the city may provide basic information to the Police Foundation regarding sick/injury leave, complaints, accidents, arrests, and stops made, for group comparison purposes. This

will allow them to assess whether the shift length, time of day, or schedule affects these factors differently.

I understand that….

… there are advantages and potential disadvantages associated with my participation in the research. If I participate, I will receive a ***stipend of $50*** after completion of the practical/tactical simulations ***for a total possible payment of $100***, provided I attend my scheduled practical/tactical simulation (or call to change my appointment if it is impossible for me to keep the commitment) and bring in my completed survey (although I am not required to answer any question that I am not comfortable answering) and complete the sessions that day. The payment is a 'thank you' for taking time off-duty to complete the survey and my willingness to participate in the study overall. I understand that even if I decide later to drop out of the study for any reason (even though the researchers hope I won't), I may keep any stipend I have already received. I further accept the fact that I will not receive an additional benefit for completing the simulation exercises as these will be done **on-duty**, *time for which I am already being paid by the police department*.

…there are some potential disadvantages of participation as well. The study does require a commitment of time and a willingness to provide honest and complete information whenever possible. I am aware that some of the questions are of a personal nature, and the researchers promise to protect my confidentiality by not connecting any of my responses to my name or personal identity. I am assured that my responses to any personal questions are directly related to the study's purposes. I also understand that answers to some questions being asked toward the end of the study may be indicative of an underlying sleep disorder and that if this is the case, it may be suggested that I seek a medical diagnosis by a general physician or sleep laboratory. NOTE: Indicate on the volunteer form the manner in which you would like to be informed if your self-reported symptoms suggest this need.

…the researchers will only present aggregate data or a summary of results based on groups large enough so that no person can be individually identified. The collection of my information will only be attached to an ID number that I will be assigned for the study. Only the research team from the Police Foundation (and **not** the police department) will be able to associate my name with my ID number in order to connect my data from each of the two phases of the study. I understand that when the study is complete, the researchers will destroy the list that links participant names with identification numbers. All information I provide to the researchers from the Police Foundation during the study will be kept in the strictest confidence. I understand that my responses will never be revealed in a way that can personally identify me, nor will any information about me personally be provided to the police department, **EXCEPT** if I make a direct threat or express an intention to harm myself or someone else.

…if I agree to participate in the research study, I may withdraw at any time, and the department will have the authority to return me to my prior schedule. If I choose to withdraw, I understand that I will not be required to complete any more surveys or simulations. I realize that there will be no penalties or negative consequences to me if I decide to skip any questions or stop participating altogether. I understand that in order to receive the results of this study I must contact Kristin Williams via email at kwilliams@policefoundation.org or call (202) 721-9787.

If I have any questions, concerns, or complaints, I am free to contact any of the people listed below during regular business hours. I have provided my signature indicating my consent to begin participating in this study on the volunteer and informed consent form.

CONTACTS

Karen L. Amendola, PhD
Principal Investigator
Police Foundation
1201 Connecticut Ave, NW Suite 200
Washington, DC 20036

Dick Bennett, PhD*
Chairman of Institutional Review Board
& Professor at American University
c/o Police Foundation

[Also had departmental contacts here]

Appendix F

Past and Current Psychometric Properties of Measures[35]

Shaded rows are dependent variables (n = 16). **n/a** = not applicable because it is (a) part of a composite we created, (b) a composite we created, or (c) a construct without measures. **u/a** = unavailable (no past coefficients identified)

CONSTRUCTS (n = 7) Instrument/Measure	Total Items	Reliability (past)	Validity (past)	Reliability α obtained	Author(s) of Measure, Year
WORK PERFORMANCE	n/a	n/a	n/a	n/a	n/a
Interpersonal Behavior	n/a	n/a	n/a	.79	*Composite of existing measures*
-8 B-PAD® vignettes	n/a	.84 to .94[a]	.72[b]	n/a	-B-PAD Group 1994, 1999, 2010
-Lost temper frequency	1	u/a	u/a	n/a	-Czeisler et al. 2005
Driving-STISIM Drive®	n/a	.82	u/a	.58[c]	Systems Technology, Inc.
Shooting-MILO/Range 3000®	n/a	u/a	u/a	.43[c]	IES Interactive Training
Self-initiated activities	n/a	n/a	n/a	.78	*Composite of officer activities*
HEALTH	n/a	n/a	n/a	n/a	n/a
Cardiovascular Health	8	u/a	u/a	.81	Barton et al. 1995 (Costa subscale)
Gastrointestinal Health	8	u/a	u/a	.80	Barton et al. 1995 (Costa subscale)
STRESS	194	n/a	n/a	.92	*Composite of existing measures*
-Police Stress Questionnaire	40	.92 to .93	u/a	n/a	McCreary and Thompson 2004
-Work Environment Inventory	68	.92 to .97	u/a	n/a	Liberman et al. 2002
-Police Daily Hassles Scale	86	.72 to .94	.60	n/a	Hart, Wearing, and Headey 1994
QUALITY-WORK LIFE	65	n/a	n/a	.88	*Composite of existing measures*
-Job Satisfaction (MSQ)	20	.59 to .97	.47 to .70	n/a	Weiss et al. 1967
-Schedule Satisfaction	4	u/a	u/a	n/a	Tucker et al. 1998
-Organizational Commitment	24	.75 to .87	.21 to .77	n/a	Allen and Meyer 1990
-Job Involvement Scale	16	.62 to .89	-.12 to .80	n/a	Kanungo 1982
QUALITY-PERSONAL LIFE	14	n/a	n/a	.85	*Composite of existing measures*
-Work-Family Conflict I	9	.78 to .87	-.24, -.39	n/a	Carlson et al., 2000
-Work-Family Conflict II	5	.82 to .90	.83 to .89	n/a	Netemeyer et al. 1996
SLEEP & FATIGUE[c]	n/a	n/a	n/a	n/a	n/a
Sleepiness Composite	12	n/a	n/a-	.82	*Composite of existing measures*
-Sleep Assessment	54	u/a	u/a	n/a	Czeisler et al. 2005; Heitmann 2006
-Epworth Sleepiness Scale	8	.73 to .88	u/a	n/a	Johns 1991, 1992
Alertness (Alertness Log)	n/a	n/a	n/a	n/a	Used Karolinska Rating Scale
Fatigue	n/a	n/a	n/a	n/a	n/a
Saccadic Velocity (FIT®)	n/a	u/a	-.97, -.99	.82	PMI, Inc.
Psychomotor Vigilance Test	n/a	u/a	u/a	.77	Dinges and Powell 1985
Sleep Disorders Composite	14	n/a	n/a	.80	*Composite of existing measures*
Berlin Sleep Apnea (*adapted*)	7	.63 to .92	u/a	n/a	Netzer et al. 1999
Insomnia	1	u/a	u/a	n/a	Heitmann 2006[d]
Sleep Disorders	6	u/a	u/a	n/a	Czeisler et al. 2005
EXTRA-DUTY (sleep diary)	n/a	n/a	n/a	n/a	Composite includes commute time
Overtime	n/a	n/a	n/a	n/a	# of hours in excess of 80 per 2 weeks
Off-Duty	n/a	n/a	n/a	n/a	# of hours per 2 weeks

[a] Doerner and Nowell 1999.
[b] Rand 1987.
[c] Our reliability estimates provide evidence that various aspects of driving and shooting are unique.
[d] Personal communication, April 23, 2006.

[35] For more information about past reliability and validity, see the full technical report of this experiment, *The Impact of Shift Length in Policing on Performance, Health, Quality of Life, Sleep, Fatigue, and Extra-Duty Employment: Final Report* (Amendola, et al. 2011), at www.policefoundation.org/docs/library.html or www.ncjrs.gov .

Appendix G
Sleep Apnea Letter

September 25, 2009

«FIRST» «LAST»
«STREET»
«CITY_ST» «ZIP»

Dear Officer «LAST»:

Thank you again for participating in the shift work study in the Arlington Police Department. This study was supported with funds from the National Institute of Justice. As part of the study, we examined sleep patterns and other factors.

Based on information you provided to us in the process, we have identified that you have some of the indicators of a sleep disorder known as "sleep apnea." We used an instrument known as the Berlin Questionnaire (for sleep apnea). The purpose of our study was not to diagnose any disorders, nor are we qualified medical experts. However, given the information you provided, we recommend that you contact your physician and/or a sleep laboratory so that you can be formally evaluated for the presence of this disorder.

In the attached report, we present the sleep apnea instrument and other factors (height and weight to assess body mass index) upon which we have made this assessment, along with the criteria for high risk for sleep apnea. Feel free to share this information with your physician and/or sleep laboratory. It is important that you know that this disorder can be serious, so we encourage you to follow up on this as soon as possible.

Again, thanks for participating in the shift work study. A full feedback report will be provided to you within the next month or so.

If you have any questions, feel free to contact me at (202) 833-1460.

Sincerely,

Karen L. Amendola, Ph.D.

Detroit Police Department
Shift Work Study

Assessment of Risk for Sleep Apnea

As part of the study on shift work, the Police Foundation examined sleep patterns, fatigue, and other characteristics potentially related to performance. During July of 2007, you completed a survey instrument while at the gaming unit to participate in the shift work simulation exercises. As part of that survey, we included items from the "Berlin Questionnaire," an instrument that measures the presence and frequency of snoring behavior and waketime sleepiness or fatigue, which can be indicators of sleep apnea.

"The obstructive sleep apnea-hypopnea syndrome is a potentially disabling condition characterized by excessive daytime sleepiness, disruptive snoring, repeated episodes of upper airway obstruction during sleep, and nocturnal hypoxemia. Epidemiologic surveys indicate associations among snoring, sleep apnea, and cardiovascular disease." (Netzer, Stoohs, Netzer, Clark, and Strohl, 1999).

The Berlin Questionnaire was an outcome of the Conference on Sleep in Primary Care attended by 120 U.S. and German physicians in 1996 in Berlin. At the conference, the physicians proposed risk groupings to simplify the recognition of sleep apnea.

There are three symptom categories as follow: 1) snoring behavior; 2) waketime sleepiness and/or drowsy driving; and 3) history of high blood pressure or body mass index more than 30. To be considered a HIGH RISK, you have to have symptoms in 2 of the 3 symptom categories.

Symptom Categories:

Category 1: To be assessed a HIGH RISK, you would have had to have persistent symptoms (greater than 3 to 4 times per week) in TWO or more questions about snoring.

Category 2: To be assessed a HIGH RISK, you had to have reported persistent waketime sleepiness (greater than 3 to 4 times per week) or drowsy driving*.

Category 3*: To be assessed a HIGH RISK, you had to have reported a history of high blood pressure or a body mass index of more than 30 (See Attachment).

*Please note that we excluded items from the Berlin Questionnaire for drowsy driving, history of high blood pressure, or weight changes. Instead we used other items similar to these that were captured in other parts of the survey. These included height, weight, history of high blood pressure, and our own question about drowsy driving "during the past month how often have you found yourself fighting sleep or briefly nodding off while driving to/from work?" If you answered several times per week, then we considered you high for drowsy driving.

Report from the Berlin Questionnaire indicating High Risk for Sleep Apnea

There are three categories of scoring for this instrument. A certain score generated from the questions on each category result in a "positive" for risk in the category (at risk). You must be at risk in TWO CATEGORIES to be considered at "High Risk" for sleep apnea.

Below, we show the categories in which you were positive. Please note that in category three, you are positive if you have high blood pressure (whether being treated or not), a body mass index over 30 kilograms per meter squared (we converted from your report of height and weight in pounds), OR BOTH.

Category 1:	Category 2:	Category 3:
___At risk	___At risk	___ At risk
___ NOT at risk	___ NOT at risk	___ NOT at risk

You have been identified as ***high risk for sleep apnea*** based on your being at risk in two or three categories above. Again, this is simply a self-report measure, and therefore, can only indicate the risk, not actual presence of this disorder. Therefore, we highly recommend that you speak with your physician or be assessed by a sleep laboratory in order to diagnose this condition.

For More Information:

http://en.wikipedia.org/wiki/Sleep_apnea
http://www.sleepapnea.org/
http://www.nhlbi.nih.gov/health/dci/Diseases/SleepApnea/SleepApnea_WhatIs.html
http://www.mayoclinic.com/health/sleep-apnea/DS00148
http://www.webmd.com/sleep-disorders/sleep-apnea/sleep-apnea

Appendix H
General Linear Model

Driving Simulator GLM

Tests of Between-Subjects Effects

Dependent Variable: post stism composite

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	71.189[b]	6	11.865	1.002	.425	.027	6.012	.392
Intercept	.764	1	.764	.065	.800	.000	.065	.057
STISM1	49.710	1	49.710	4.198	.042	.019	4.198	.532
LENGTH2	6.255	2	3.128	.264	.768	.002	.528	.091
SITE	.361	1	.361	.031	.862	.000	.031	.053
SHIFT3	11.675	2	5.837	.493	.612	.005	.986	.130
Error	2534.083	214	11.842					
Total	2605.367	221						
Corrected Total	2605.272	220						

a. Computed using alpha = .05

b. R Squared = .027 (Adjusted R Squared = .000)

Shooting Simulation GLM

Tests of Between-Subjects Effects

Dependent Variable: post shooting composite

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	63.528[b]	8	7.941	2.126	.039	.133	17.007	.826
Intercept	1.266	1	1.266	.339	.562	.003	.339	.089
ZSHOOT1	45.980	1	45.980	12.309	.001	.100	12.309	.935
LENGTH2	3.597	2	1.799	.481	.619	.009	.963	.127
SITE	.226	1	.226	.061	.806	.001	.061	.057
SHIFT3	8.588	2	4.294	1.150	.321	.020	2.299	.248
LENGTH2 * SITE	5.227	2	2.613	.700	.499	.012	1.399	.166
Error	414.622	111	3.735					
Total	478.217	120						
Corrected Total	478.151	119						

a. Computed using alpha = .05

b. R Squared = .133 (Adjusted R Squared = .070)

Self-Initiated Activity Composite GLM

Tests of Between-Subjects Effects

Dependent Variable: post wrk productivity composite

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	1180.508[b]	8	147.563	36.314	.000	.535	290.508	1.000
Intercept	4.647	1	4.647	1.144	.286	.005	1.144	.187
WRKPD1	484.190	1	484.190	119.153	.000	.321	119.153	1.000
LENGTH2	9.896	2	4.948	1.218	.298	.010	2.435	.265
SITE	152.459	1	152.459	37.518	.000	.130	37.518	1.000
SHIFT3	35.136	2	17.568	4.323	.014	.033	8.647	.748
LENGTH2 * SITE	1.087	2	.543	.134	.875	.001	.267	.070
Error	1024.026	252	4.064					
Total	2205.298	261						
Corrected Total	2204.534	260						

a. Computed using alpha = .05

b. R Squared = .535 (Adjusted R Squared = .521)

Interpersonal Skills GLM

Tests of Between-Subjects Effects

Dependent Variable: post bpad reverse code

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	128.734[b]	8	16.092	2.038	.043	.071	16.303	.822
Intercept	9.489	1	9.489	1.202	.274	.006	1.202	.194
NBPAD1	63.215	1	63.215	8.005	.005	.036	8.005	.804
LENGTH2	27.320	2	13.660	1.730	.180	.016	3.460	.361
SITE	1.267	1	1.267	.160	.689	.001	.160	.068
SHIFT3	20.453	2	10.227	1.295	.276	.012	2.590	.279
LENGTH2 * SITE	20.856	2	10.428	1.321	.269	.012	2.641	.284
Error	1689.851	214	7.896					
Total	1825.764	223						
Corrected Total	1818.584	222						

a. Computed using alpha = .05

b. R Squared = .071 (Adjusted R Squared = .036)

Cardiovascular Scale GLM

Tests of Between-Subjects Effects

Dependent Variable: Zscore: cardiovascular scale

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	3.941[b]	5	.788	.779	.566	.017	3.895	.278
Intercept	2.208E-02	1	2.208E-02	.022	.883	.000	.022	.052
LENGTH2	1.347E-02	2	6.733E-03	.007	.993	.000	.013	.051
SITE	1.971	1	1.971	1.948	.164	.009	1.948	.285
SHIFT3	2.184	2	1.092	1.079	.342	.010	2.159	.238
Error	224.606	222	1.012					
Total	228.547	228						
Corrected Total	228.546	227						

a. Computed using alpha = .05

b. R Squared = .017 (Adjusted R Squared = -.005)

Gastrointestinal Scale GLM

Tests of Between-Subjects Effects

Dependent Variable: Zscore(GASTRO)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	3.687[b]	5	.737	.730	.602	.018	3.651	.260
Intercept	2.997E-02	1	2.997E-02	.030	.863	.000	.030	.053
LENGTH2	1.633	2	.817	.809	.447	.008	1.618	.187
SITE	1.297	1	1.297	1.284	.258	.006	1.284	.204
SHIFT3	.816	2	.408	.404	.668	.004	.808	.115
Error	203.990	202	1.010					
Total	207.682	208						
Corrected Total	207.676	207						

a. Computed using alpha = .05

b. R Squared = .018 (Adjusted R Squared = -.007)

Work Stress Composite GLM

Tests of Between-Subjects Effects

Dependent Variable: post work stress composite

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	660.322[b]	8	82.540	25.240	.000	.506	201.923	1.000
Intercept	6.918	1	6.918	2.115	.147	.011	2.115	.304
NWRKSTR1	537.649	1	537.649	164.410	.000	.455	164.410	1.000
LENGTH2	2.086	2	1.043	.319	.727	.003	.638	.100
SITE	2.608E-02	1	2.608E-02	.008	.929	.000	.008	.051
SHIFT3	3.522	2	1.761	.539	.584	.005	1.077	.138
LENGTH2 * SITE	12.682	2	6.341	1.939	.147	.019	3.878	.399
Error	644.223	197	3.270					
Total	1304.547	206						
Corrected Total	1304.546	205						

a. Computed using alpha = .05

b. R Squared = .506 (Adjusted R Squared = .486)

Quality of Personal Life GLM

Tests of Between-Subjects Effects

Dependent Variable: post quality personal life

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	602.544[b]	8	75.318	10.501	.000	.304	84.004	1.000
Intercept	1.920	1	1.920	.268	.605	.001	.268	.081
PERLF1	569.596	1	569.596	79.411	.000	.293	79.411	1.000
LENGTH2	4.348	2	2.174	.303	.739	.003	.606	.098
SITE	6.180	1	6.180	.862	.354	.004	.862	.152
SHIFT3	7.381	2	3.691	.515	.599	.005	1.029	.134
LENGTH2 * SITE	9.426	2	4.713	.657	.520	.007	1.314	.159
Error	1377.178	192	7.173					
Total	1979.729	201						
Corrected Total	1979.722	200						

a. Computed using alpha = .05

b. R Squared = .304 (Adjusted R Squared = .275)

Quality of Work Life

Tests of Between-Subjects Effects

Dependent Variable: post quality work life

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	2037.820[b]	8	254.728	13.427	.000	.353	107.417	1.000
Intercept	11.541	1	11.541	.608	.436	.003	.608	.121
NQLIF1	1410.459	1	1410.459	74.348	.000	.274	74.348	1.000
LENGTH2	149.596	2	74.798	3.943	.021	.038	7.885	.704
SITE	53.268	1	53.268	2.808	.095	.014	2.808	.385
SHIFT3	71.002	2	35.501	1.871	.157	.019	3.743	.386
LENGTH2 * SITE	180.612	2	90.306	4.760	.010	.046	9.520	.788
Error	3737.308	197	18.971					
Total	5775.138	206						
Corrected Total	5775.128	205						

a. Computed using alpha = .05

b. R Squared = .353 (Adjusted R Squared = .327)

Average Sleep Amount GLM

Tests of Between-Subjects Effects

Dependent Variable: post avg sleep hours

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	39.970[b]	8	4.996	4.537	.000	.198	36.296	.996
Intercept	41.431	1	41.431	37.623	.000	.204	37.623	1.000
BSLEEP	19.072	1	19.072	17.319	.000	.105	17.319	.985
LENGTH2	7.105	2	3.553	3.226	.043	.042	6.452	.608
SITE	.913	1	.913	.829	.364	.006	.829	.148
SHIFT3	2.717	2	1.358	1.234	.294	.017	2.467	.266
LENGTH2 * SITE	4.581	2	2.290	2.080	.129	.028	4.160	.422
Error	161.881	147	1.101					
Total	9224.841	156						
Corrected Total	201.851	155						

a. Computed using alpha = .05

b. R Squared = .198 (Adjusted R Squared = .154)

Average Quality of Sleep GLM

Tests of Between-Subjects Effects

Dependent Variable: post avg sleep quality

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	13.382[b]	8	1.673	8.867	.000	.326	70.940	1.000
Intercept	10.627	1	10.627	56.333	.000	.277	56.333	1.000
BSLEEPQ	11.052	1	11.052	58.588	.000	.285	58.588	1.000
LENGTH2	.327	2	.163	.865	.423	.012	1.731	.197
SITE	.420	1	.420	2.225	.138	.015	2.225	.317
SHIFT3	.921	2	.461	2.442	.091	.032	4.884	.485
LENGTH2 * SITE	.657	2	.329	1.742	.179	.023	3.483	.361
Error	27.730	147	.189					
Total	2061.228	156						
Corrected Total	41.112	155						

a. Computed using alpha = .05

b. R Squared = .326 (Adjusted R Squared = .289)

Sleepiness Composite GLM

Tests of Between-Subjects Effects

Dependent Variable: new post fatigue composite

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	746.325[b]	8	93.291	13.178	.000	.322	105.420	1.000
Intercept	.504	1	.504	.071	.790	.000	.071	.058
NFATGU1	500.059	1	500.059	70.635	.000	.241	70.635	1.000
LENGTH2	81.356	2	40.678	5.746	.004	.049	11.492	.864
SITE	.393	1	.393	.055	.814	.000	.055	.056
SHIFT3	28.034	2	14.017	1.980	.141	.018	3.960	.407
LENGTH2 * SITE	15.308	2	7.654	1.081	.341	.010	2.162	.238
Error	1571.653	222	7.080					
Total	2318.440	231						
Corrected Total	2317.978	230						

a. Computed using alpha = .05

b. R Squared = .322 (Adjusted R Squared = .298)

Fatigue (FIT)

Tests of Between-Subjects Effects

Dependent Variable: AvgOfVelocity

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	7732.545[b]	8	966.568	51.091	.000	.670	408.732	1.000
Intercept	255.110	1	255.110	13.485	.000	.063	13.485	.955
T1VELCTY	7077.894	1	7077.894	374.128	.000	.651	374.128	1.000
LENGTH2	3.720	2	1.860	.098	.906	.001	.197	.065
SITE	78.404	1	78.404	4.144	.043	.020	4.144	.526
SHIFT3	79.145	2	39.573	2.092	.126	.020	4.184	.427
LENGTH2 * SITE	54.608	2	27.304	1.443	.239	.014	2.887	.307
Error	3802.594	201	18.918					
Total	1178037	210						
Corrected Total	11535.139	209						

a. Computed using alpha = .05

b. R Squared = .670 (Adjusted R Squared = .657)

Psychomotor Vigilance Test GLM

Tests of Between-Subjects Effects

Dependent Variable: post PVT composite

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	207.893[b]	8	25.987	4.612	.000	.147	36.897	.997
Intercept	1.411	1	1.411	.250	.617	.001	.250	.079
PVT1	186.741	1	186.741	33.143	.000	.134	33.143	1.000
LENGTH2	16.763	2	8.381	1.488	.228	.014	2.975	.315
SITE	3.882	1	3.882	.689	.407	.003	.689	.131
SHIFT3	3.197	2	1.599	.284	.753	.003	.567	.095
LENGTH2 * SITE	2.715	2	1.357	.241	.786	.002	.482	.088
Error	1205.776	214	5.634					
Total	1413.709	223						
Corrected Total	1413.669	222						

a. Computed using alpha = .05

b. R Squared = .147 (Adjusted R Squared = .115)

Sleep Disorder GLM

Tests of Between-Subjects Effects

Dependent Variable: sleep disorder composite

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	31.701[b]	5	6.340	.980	.431	.021	4.898	.347
Intercept	3.564	1	3.564	.551	.459	.002	.551	.115
LENGTH2	2.691	2	1.346	.208	.812	.002	.416	.082
SITE	16.716	1	16.716	2.583	.109	.011	2.583	.360
SHIFT3	9.281	2	4.640	.717	.489	.006	1.434	.170
Error	1449.690	224	6.472					
Total	1481.598	230						
Corrected Total	1481.392	229						

a. Computed using alpha = .05

b. R Squared = .021 (Adjusted R Squared = .000)

Alertness GLM

Tests of Between-Subjects Effects

Dependent Variable: post alertmess means

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	66.982[b]	8	8.373	10.104	.000	.380	80.835	1.000
Intercept	55.033	1	55.033	66.415	.000	.335	66.415	1.000
BMEAN	33.949	1	33.949	40.970	.000	.237	40.970	1.000
LENGTH2	7.331	2	3.665	4.423	.014	.063	8.847	.753
SITE	6.734E-02	1	6.734E-02	.081	.776	.001	.081	.059
SHIFT3	14.455	2	7.227	8.722	.000	.117	17.444	.967
LENGTH2 * SITE	9.962	2	4.981	6.011	.003	.083	12.022	.876
Error	109.379	132	.829					
Total	6068.529	141						
Corrected Total	176.360	140						

a. Computed using alpha = .05

b. R Squared = .380 (Adjusted R Squared = .342)

Overtime GLM

Tests of Between-Subjects Effects

Dependent Variable: post overtime

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	988.185[b]	8	123.523	7.740	.000	.299	61.918	1.000
Intercept	588.305	1	588.305	36.862	.000	.203	36.862	1.000
NTIME1	158.655	1	158.655	9.941	.002	.064	9.941	.879
LENGTH2	492.171	2	246.086	15.419	.000	.175	30.839	.999
SITE	186.224	1	186.224	11.669	.001	.074	11.669	.924
SHIFT3	1.249	2	.624	.039	.962	.001	.078	.056
LENGTH2 * SITE	187.032	2	93.516	5.860	.004	.075	11.719	.868
Error	2314.130	145	15.960					
Total	4043.063	154						
Corrected Total	3302.315	153						

a. Computed using alpha = .05

b. R Squared = .299 (Adjusted R Squared = .261)

Off-Duty Employment GLM

Tests of Between-Subjects Effects

Dependent Variable: post off duty hours

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	5214.644[b]	8	651.830	4.487	.000	.197	35.899	.996
Intercept	1755.267	1	1755.267	12.084	.001	.076	12.084	.932
OFFDUTY1	2423.269	1	2423.269	16.683	.000	.103	16.683	.982
LENGTH2	70.019	2	35.010	.241	.786	.003	.482	.087
SITE	1002.016	1	1002.016	6.898	.010	.045	6.898	.742
SHIFT3	794.249	2	397.125	2.734	.068	.036	5.468	.533
LENGTH2 * SITE	58.437	2	29.218	.201	.818	.003	.402	.081
Error	21207.520	146	145.257					
Total	33108.125	155						
Corrected Total	26422.164	154						

a. Computed using alpha = .05

b. R Squared = .197 (Adjusted R Squared = .153)

Appendix I
Sleep Diary

For any questions, please contact a member of the research team:

Cell phones while on site:

Midnights

(202) 352-2982

Evenings

(202) 352- 8803

Days

(202) 352 - 8265

SLEEP DIARY

Shift Work Study

Conducted by:

Police Foundation
Washington, DC

Participant ID #: _____

Agency: Detroit Police Department

Sleep Diary Instructions:

For today and each of the next 13 days, please complete each of the pages in sequence.

For the purposes of this log, each day will count as beginning at 0001 hours (12:01 am). There are six (6) activities listed on each day as follows:

1. Working at your regular police job (including overtime)
2. Working at a different job or home business
3. Driving to/from any job
4. Sleeping (your main sleep period)
5. Taking nap(s)
6. Any other waking hours

For each activity, list the total number of hours of each between 0001 and midnight of that day. That should always total 24 total hours. Partial hours should be rounded down or up to the closest whole number.

Finally, for each period of sleep list the sleep times and rate the overall quality of that sleep by checking the appropriate box for very poor, poor, fair, good, or very good. If you took more than two naps, just indicate that with a written note at the bottom of the page.

Sleep Diary
NOTES (continued)

Sleep Diary
NOTES

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Sleep Diary **EXAMPLE**

I worked an 8 hour shift with 2 hours of overtime from midnight to 10am. Then I drove home (30 minutes), grabbed a quick snack and went right to bed (30 minutes later). I slept from 11am until 5pm. Stayed awake until 8pm and then took a 1 hour nap before driving (15 minutes) to my other job where I worked for 2 hours and then commuted (15 minutes) to the department for my regularly scheduled shift at midnight.

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 1

Date: 1/28/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 14

Date: 2/10/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 13

Date: 2/9/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 2

Date: 1/29/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 3

Date: 1/30/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 12

Date: 2/8/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 11

Date: 2/7/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 4

Date: 1/31/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 5

Date: 2/1/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 10

Date: 2/6/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 9

Date: 2/5/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 6

Date: 2/2/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department _____

Working elsewhere _____

Commuting to and from work _____

Awake-not working _____

Sleeping (including naps) _____

Total = **24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 7

Date: 2/3/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department	_____
Working elsewhere	_____
Commuting to and from work	_____
Awake-not working	_____
Sleeping (including naps)	_____
Total =	**24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Sleep Diary

Day 8

Date: 2/4/07

*For this 24 hour period beginning at 0001 and ending at 2400, please list the total number of hours you spent doing each of the following (**total must = 24 hours**):*

Working at department	_____
Working elsewhere	_____
Commuting to and from work	_____
Awake-not working	_____
Sleeping (including naps)	_____
Total =	**24**

SLEEP TIMES AND QUALITY: Please list sleep start and end times and check (√) sleep quality for each sleep period.

	Start	End	Very Poor	Poor	Fair	Good	Very Good
Sleep 1							
Sleep 2 *(if applicable)*							
Sleep 3 *(if applicable)*							

Appendix J
Alertness Log

For any questions, please contact a member of the research team:

Cell phones while on site:

Midnights

(202) 352-2982

Evenings

(202) 352- 8803

Days

(202) 352 - 8265

Complete on Work Days Only

ALERTNESS LOG

Shift Work Study

Conducted by:

Police Foundation
Washington, DC

Participant ID #: _____

Agency: Detroit Police Department

Alertness Log Instructions:

For the period beginning 1/28/07 and ending on 2/11/07, please complete one page of the alertness log for any of the days in which you ***are working***. It is very important that you enter the date on each page so that we know which days you are actually working, and then fill in the time you start and finish work. The ***date is the day on which your shift began*** (even if it was at 2300 hours, and continued until the next day).

Place an X in the "rating" column of the table for each hour you were ***not working*** at the police department. Then, for each hour ***you actually worked*** at the police department (including overtime), enter the number in the "rating" column that corresponds to your alertness level. Use the following scale:

1 = Very sleepy, great effort to keep awake, fighting sleep
2 = Sleepy, some effort to stay awake
3 = Sleepy, no effort to stay awake
4 = Some signs of sleepiness
5 = Neither alert nor sleepy
6 = Rather alert
7 = Alert
8 = Very alert
9 = Extremely alert

Please fill in your regularly scheduled shift start and end times
Use military time

Start time: __ __ __ __ (ex. 0700, 0730)

End time: __ __ __ __ (ex. 1500, 1530)

Alertness Log
NOTES (continued)

Alertness Log
NOTES

EXAMPLE

Today is the 24th of December and I worked my regularly scheduled shift from 11:00 p.m. last night until 9:00 a.m. this morning (I am on a 10 hour shift). However, it is now 11:00 a.m. and I have just finished two hours of overtime. I started off feeling very alert, but got really tired around 3:00 a.m. and started to perk up a bit around 5:00. While I was very alert between 6:00 and 8:00 a.m., I was becoming increasingly tired after that.

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

Time you started & ended your shift today (include overtime).

Start time: __ __ __ __ (ex. 0700, 0730)
End time: __ __ __ __ (ex. 1500, 1530)

1 = Very sleepy, great effort to keep awake, fighting sleep
2 = Sleepy, some effort to stay awake
3 = Sleepy, no effort to stay awake
4 = Some signs of sleepiness
5 = Neither alert nor sleepy
6 = Rather alert
7 = Alert
8 = Very alert
9 = Extremely alert

Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

Alertness Log
(Use for Work Day Only)

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

Time you started & ended your shift today (include overtime).

Start time: __ __ __ __ (ex. 0700, 0730)

End time: __ __ __ __ (ex. 1500, 1530)

Use the following scale to rate your alertness level:

1 = Very sleepy, great effort to keep awake, fighting sleep
2 = Sleepy, some effort to stay awake
3 = Sleepy, no effort to stay awake
4 = Some signs of sleepiness
5 = Neither alert nor sleepy
6 = Rather alert
7 = Alert
8 = Very alert
9 = Extremely alert

Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

1

Alertness Log
(Use for Work Day Only)

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

Time you started & ended your shift today (include overtime).

Start time: __ __ __ __ (ex. 0700, 0730)

End time: __ __ __ __ (ex. 1500, 1530)

Use the following scale to rate your alertness level:

1 = Very sleepy, great effort to keep awake, fighting sleep
2 = Sleepy, some effort to stay awake
3 = Sleepy, no effort to stay awake
4 = Some signs of sleepiness
5 = Neither alert nor sleepy
6 = Rather alert
7 = Alert
8 = Very alert
9 = Extremely alert

Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

10

Alertness Log
(Use for Work Day Only)

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

Time you started & ended your shift today (include overtime).

Start time: __ __ __ __ (ex. 0700, 0730)

End time: __ __ __ __ (ex. 1500, 1530)

Use the following scale to rate your alertness level:

1 = Very sleepy, great effort to keep awake, fighting sleep
2 = Sleepy, some effort to stay awake
3 = Sleepy, no effort to stay awake
4 = Some signs of sleepiness
5 = Neither alert nor sleepy
6 = Rather alert
7 = Alert
8 = Very alert
9 = Extremely alert

Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

9

Alertness Log
(Use for Work Day Only)

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

Time you started & ended your shift today (include overtime).

Start time: __ __ __ __ (ex. 0700, 0730)

End time: __ __ __ __ (ex. 1500, 1530)

Use the following scale to rate your alertness level:

1 = Very sleepy, great effort to keep awake, fighting sleep
2 = Sleepy, some effort to stay awake
3 = Sleepy, no effort to stay awake
4 = Some signs of sleepiness
5 = Neither alert nor sleepy
6 = Rather alert
7 = Alert
8 = Very alert
9 = Extremely alert

Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

2

Alertness Log
(Use for Work Day Only)

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

Time you started & ended your shift today (include overtime).

Start time: __ __ __ __ (ex. 0700, 0730)

End time: __ __ __ __ (ex. 1500, 1530)

Use the following scale to rate your alertness level:

1 = Very sleepy, great effort to keep awake, fighting sleep
2 = Sleepy, some effort to stay awake
3 = Sleepy, no effort to stay awake
4 = Some signs of sleepiness
5 = Neither alert nor sleepy
6 = Rather alert
7 = Alert
8 = Very alert
9 = Extremely alert

Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

3

Alertness Log
(Use for Work Day Only)

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

Time you started & ended your shift today (include overtime).

Start time: __ __ __ __ (ex. 0700, 0730)

End time: __ __ __ __ (ex. 1500, 1530)

Use the following scale to rate your alertness level:

1 = Very sleepy, great effort to keep awake, fighting sleep
2 = Sleepy, some effort to stay awake
3 = Sleepy, no effort to stay awake
4 = Some signs of sleepiness
5 = Neither alert nor sleepy
6 = Rather alert
7 = Alert
8 = Very alert
9 = Extremely alert

Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

8

Alertness Log
(Use for Work Day Only)

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

Time you started & ended your shift today (include overtime).

Start time: __ __ __ __ (ex. 0700, 0730)

End time: __ __ __ __ (ex. 1500, 1530)

Use the following scale to rate your alertness level:

1 = Very sleepy, great effort to keep awake, fighting sleep
2 = Sleepy, some effort to stay awake
3 = Sleepy, no effort to stay awake
4 = Some signs of sleepiness
5 = Neither alert nor sleepy
6 = Rather alert
7 = Alert
8 = Very alert
9 = Extremely alert

Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

7

Alertness Log
(Use for Work Day Only)

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

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Start time: __ __ __ __ (ex. 0700, 0730)

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Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

4

Alertness Log
(Use for Work Day Only)

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

Time you started & ended your shift today (include overtime).

Start time: __ __ __ __ (ex. 0700, 0730)

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Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

5

Alertness Log
(Use for Work Day Only)

Date (month/day/year) _____/_____/_____
(If your shift goes through midnight, use date of shift start)

Circle one:

Mon Tue Wed Thur Fri Sat Sun

Time you started & ended your shift today (include overtime).

Start time: __ __ __ __ (ex. 0700, 0730)

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Use the following scale to rate your alertness level:

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Hour of Shift	*Rating*	*Hour of Shift*	*Rating*	*Hour of Shift*	*Rating*
0001		0800		1600	
0100		0900		1700	
0200		1000		1800	
0300		1100		1900	
0400		1200		2000	
0500		1300		2100	
0600		1400		2200	
0700		1500		2300	

6