J Exp Criminol (2018) 14:111–120
DOI 10.1007/s11292-017-9294-2

The impact of work shift and fatigue on police officer response in simulated interactions with citizens

Lois James[1] · **Stephen James**[2] · **Bryan Vila**[3]

Published online: 20 June 2017

Abstract
Purpose This study investigated the impact of work shift and fatigue on officers' responses during simulated interactions with citizens.
Design Using a quasi-experimental design, participants (n = 50) responded to multiple branching scenarios in a laboratory-housed use-of-force simulator. Each scenario had the potential to end peaceably or turn deadly, depending on how the officers responded. Officers who worked across four patrol shifts were tested on two occasions—after five consecutive shifts and again 72 h after completing their last shift.
Findings Day-shift officers were less fatigued (measured using the Psychomotor Vigilance Test) than night-shift officers (f = 44.411; df = 1, 90; $p < 0.001$). Furthermore, officers were more fatigued when they were tested at the end of their work week than after 72 h off-duty (f = 12.030; df = 1, 90; $p < 0.001$). In the simulator, officers from the day shift were more likely to respond in ways that engineered cooperative outcomes (f = 4.81; df = 3, 549; $p < 0.01$).
Implications These findings offer insight into how shift work and fatigue influence police–citizen interactions. Implications for de-escalation and procedural justice in policing are discussed.

✉ Lois James
lois_james@wsu.edu

Stephen James
stevejames@wsu.edu

Bryan Vila
vila@wsu.edu

[1] Sleep and Performance Research Center, Washington State University College of Nursing, P.O. Box 1495, Room 422C, Spokane, WA 99210-1495, USA

[2] Elson S. Floyd College of Medicine, Washington State University Health Sciences, P.O. Box 1495, Spokane, WA 99210-1495, USA

[3] Department of Criminal Justice and Criminology, Washington State University, P.O. Box 1495, Spokane, WA 99210-1495, USA

Keywords Police · Shift work · Fatigue · De-escalation · Procedural justice

Introduction

One of the six critical pillars identified by the President's Task Force on 21st Century Policing was "Building Trust and Legitimacy," underscoring the need for increased focus on de-escalation and procedural justice. Unfortunately, officer fatigue due to shift work, long work hours, and the corrosive nature of their work has the potential to detrimentally affect their interactions with the public (Amendola et al. 2011; Fyfe 1980; Rajaratnam et al. 2011; Vila 2010). As pioneering Stanford University sleep researcher William C. Dement stated:

> [P]olice work is the one profession in which we would want all practitioners to have adequate and healthful sleep to perform their duties at peak alertness levels. Not only is fatigue associated with individual misery, but it can also lead to counterproductive behavior. It is well known that impulsiveness, aggression, irritability and angry outbursts are associated with sleep deprivation. (In Vila 2000, p. xiv).

Humans are naturally nighttime sleepers, making night shift work challenging (Dement and Vaughn 1999). Night-shift workers can suffer from fatigue because their bodies' natural circadian rhythms promote sleep at night and alertness during daylight hours—incongruous with their work schedule. Not surprisingly then, evidence across industries links shift work-related fatigue with errors (Chen et al. 2016; Satterfield and Van Dongen 2013; Waggoner et al. 2012). A related concern is that regions of the brain responsible for executive functions such as moral decision-making and impulse control tend to be affected the quickest by fatigue (Belenky et al. 1998). Arguably, these functions are also the most important for police officers on the street, especially given that society grants police officers the authority to use coercive and deadly force (Bittner 1970, 1980, 1990).

Ample evidence exists that officers suffer from shift work-related fatigue. For example, Vila's "Tired Cops" study found that 14% of officers reported that they were always or usually tired at the *beginning* of their work shifts—results that have since been replicated (e.g., Amendola et al. 2011; Rajaratnam et al. 2011). Research from James and Vila (2015) revealed that night-shift officers had significantly more collisions when tested in a driving simulator compared to day-shift officers. Furthermore, in a survey of 2269 Canadian and U.S. officers, 91% reported being routinely fatigued, 85% reported driving while drowsy, and an alarming 39% reported falling asleep at the wheel (AAA Foundation for Traffic Safety 2004). Less is understood, however, about whether shift work and fatigue affect officers' behavior during encounters with the public. As such, the goal of this paper was to establish whether officers' behaviors in response to video scenarios in use-of-force simulators were influenced by work shift assignment and level of fatigue.

Methods

We used a within-subject, between-groups design to test 50 police patrol officers' responses to video scenarios depicting police–citizen encounters in use-of-force

Table 1 Participant demographics (age, gender, race/ethnicity, years of experience) by shift assignment

	Full sample (n = 50)		Day 06:00–16:40 (n = 12)		Swing 10:00–20:40 (n = 14)		Power 16:00–02:40 (n = 9)		Grave 20:00–06:40 (n = 15)	
Age	42.7	(8.0)	49.4	(5.1)	45.2	(7.4)	37.3	(6.0)	37.4	(6.3)
Sex										
Male	45	90%	9	75%	13	93%	8	89%	15	100%
Female	5	10%	3	25%	1	7%	1	11%		
Race/ethnicity										
White	48	96%	12	100%	14	100%	7	78%	15	100%
Black	1	2%					1	11%		
Hispanic	1	2%					1	11%		
Years sworn	16.5	(7.5)	23.2	(4.9)	18.1	(5.5)	12.2	(8.3)	11.8	(6.3)

Data shown as mean (SD) or count %

simulators. These scenarios each had multiple branching options and had three potential outcomes: cooperative, neutral, or deadly. The branching of scenarios and outcomes was determined using an evidence-based logic model, developed for scoring officer behavior in real time (James et al. 2017; Vila et al. 2016). Using this design, we were able to determine whether officers interacted with people in ways that either escalated or de-escalated encounters, and whether that differed based on the officer's work shift and level of fatigue.

Participants

Subjects were 50 sworn, full-time police officers with more than two years of service who were assigned for at least one year to field patrol work in a mid-size metropolitan police department. As Table 1 shows, officers in the study were, on average, 42.7 years old [standard deviation (SD) = 8.0] and had 16.5 years of experience (SD = 7.5). Of the 50 participants, 45 were male and 48 were White. Volunteers were reimbursed for each hour they participated in the study. Officers were selected at random from a list of qualified volunteers from the patrol division and screened for suitability; primary inclusion criteria were "fit for duty" and working patrol.

Materials

This experiment was conducted in the Simulated Hazardous Operational Tasks laboratory at Washington State University, which is equipped with two high-definition use-of-force simulators (James et al. 2013, 2014, 2016). The scenarios[1] featured in the simulators depicted: (1) vehicle stops; (2) welfare checks; (3) investigations of suspicious circumstances; (4) disturbances of the peace; and (5) community meetings. The scenarios were approximately 3 min in length and had three potential outcomes: cooperative (where the onscreen individual complies and also indicates their

[1] Sixty scenarios were filmed, six of each encounter type. Individuals in the scenarios were White, Black, and Hispanic, and were all male.

willingness to cooperate and their confidence in police),[2] neutral (where the onscreen individual complies but does not give any positive feedback), or deadly (where the onscreen individual becomes enraged, and rapidly presents a weapon and starts shooting at the camera view).[3] The logic model used to determine scenario branching consisted of several decision points. The first was "positive" or "negative" track, and was determined based on whether the officer did at least three of the following five things:

1. Greeted the individual
2. Introduced him-/herself to the individual
3. Explained the purpose of the encounter
4. Demonstrated concern/offered to help the individual
5. Reassured the individual

If the scenario was branched positive, the next decision point was "cooperative" or "neutral" outcome, with cooperative selected if the officer did any of the following things:

1. Thanked the individual for compliance
2. Apologized for inconvenience
3. Showed natural human emotion (e.g., laughs, jokes)
4. Offered to help the individual

If the scenario was branched negative, the next decision point was the "escalate" or "de-escalate" track, with de-escalate selected if the officer did any of the following things:

1. Acknowledged that the individual is getting upset
2. Apologized for inconvenience
3. Tried to calm the individual[4]
4. Offered to help the individual

If the de-escalate track was selected, the officer was put back to the "cooperative" or "neutral" outcome decision point. If the escalate track was selected, the scenario automatically went to "deadly" outcome. Prior to the study, research assistants were trained on the use of the logic model until all were consistent in their branching decisions and timing.[5]

[2] For example, by saying "If I ever see anything suspicious going on around here I'll let you guys know, I know you have a tough job and I appreciate everything you do".

[3] Less than lethal force options such as Taser, pepper spray, baton, or hands-on tactics were not employed in the current study.

[4] Note that rapid-fire "Calm down! Calm down! Calm down!" did not count as trying to calm the individual. A genuine empathetic attempt to calm the individual (e.g., "It's ok, you are not in trouble, you do not need to worry") was required.

[5] Timing to initiate a scenario branch or outcome was either immediately upon evidence of the participant satisfying the logic model or within 5 s of the branching point if the participant did not satisfy the logic model.

Officer fatigue was measured using a 10-min Psychomotor Vigilance Test (PVT, Pulsar model 2.0.5.9, Philadelphia, PA). The PVT is a well-validated and simple reaction-time task with high stimulus density. It measures participants' ability to sustain attention (Lim and Dinges 2008), and is the most widely used objective measure of fatigue.

Procedures

Participants were asked to maintain their usual daily routine during the study, but were instructed not to accept overtime assignments during the 72 h prior to the rest condition. The shift schedule within this department for patrol officers is five consecutive 10:40 h shifts, followed by four consecutive days off. Every third rotation of the shift schedule is five consecutive 10:40 h shifts, followed by five consecutive days off, resulting in 160 h worked every 28 days, which averages out to a 40-h work week. This shift schedule sits between the predominant 10-h and 12-h shift schedules common in law enforcement. Prior to the study, scenarios were randomized without replacement from the pool of 60 using Microsoft Excel. Upon entering the laboratory for testing, officers donned a gun belt and holstered a Glock model 22 that had been modified for use in the simulators.[6] Officers were given a standardized briefing to prepare them for the upcoming scenario, which gave specific details about the type of encounter they were about to face. It was stressed to officers that they respond as they would on the street, that they interact with people on the screen, attempt to resolve problems peaceably, and de-escalate where possible. Participants responded to six scenarios per study day, with a 2-min break between each scenario, during which they remained in the simulator.

Study variables, research hypotheses, and analytical models

The predictor variables for this study were:

1. Work shift assignment[7]: day shift—06:00–16:40; swing shift—10:00–20:40; power shift—16:00–02:40; grave shift—20:00–06:40;
2. Testing condition: "end of work week"—they arrived at the laboratory immediately after completing their final shift (10:40 h) in a five-shift work week and "end of days off"—they arrived at the laboratory at the same time of day during their third consecutive day off (i.e., 72 h after their last work shift);
3. Level of fatigue: measured using the PVT.

The outcome variables of interest were the three potential scenario outcomes (or "endings") presented as dummy variables (cooperative = yes/no, neutral = yes/no, deadly = yes/no). Control variables included were officer age and years of experience.[8] Our research hypotheses were as follows:

[6] The holsters used in the experiment were the same type as those used by the agency from which participants were recruited, to ensure familiarity with the holster.
[7] Shift assignment was determined by the department and not manipulated by the researchers.
[8] Officer race and gender were not included as control variables due to the limited diversity of the sample.

H_1: Officers who work during the day (i.e., day and swing shifts) will be less fatigued (as measured by the PVT) than officers assigned to night shifts (i.e., power and grave shifts).

H_2: Officers will be less fatigued (as measured by the PVT) when they are at the end of their days off compared to when they are at the end of their work week.

H_3: Officers who work during the day will be more likely to treat people in ways that engineer a cooperative outcome than officers working night shifts.

H_4: Officers will be more likely to treat people in ways that engineer a cooperative outcome when they are at the end of their days off compared to when they are at the end of their work week.

H_5: Officers who are more fatigued (as measured by the PVT) will be *less* likely to treat people in ways that engineer a cooperative outcome.

Given that each participant responded to multiple scenarios (up to 12), our data potentially violated the assumption that observations were independent. As such, generalized linear multilevel modeling (MLM) was used to analyze the data. This analytical technique accounts for the clustering of observations around participants and partitions variance accordingly, reducing the risk of type I errors. IBM SPSS (v.24.0.0.0, New York, NY) was used for the statistical analysis.

Results

Officer fatigue

To determine whether night-shift officers tend to be more fatigued than day-shift officers, we analyzed differences in the PVT scores across shift. The results revealed a significant between-shift effect on fatigue ($f = 44.411$; $df = 1, 90$; $p < 0.001$). Day-shift officers had an average PVT reaction time of 305 ms (SD = 95), swing-shift officers had an average PVT reaction time of 297 ms (SD = 71), power-shift officers had an average PVT reaction time of 376 ms (SD = 114), and grave-shift officers had an average PVT reaction time of 342 ms (SD = 92). Thus, power- and grave-shift officers (who sleep during the day) were significantly more fatigued than day- and swing-shift officers (who sleep at night), supporting our first research hypothesis. Although the difference in milliseconds might not seem meaningful, the same difference resulted in significant and severe degradation in driving skill (James and Vila 2015).

Next, to investigate whether our condition variable did, in fact, reflect differences in fatigue, we looked at differences in the PVT scores in the same officers tested at the end of their work week and again at the end of their days off. The results revealed that officers were significantly more fatigued when they were tested immediately following five consecutive 10:40 h shifts than when they were tested after 72 h off-duty ($f = 12.030$; $df = 1, 90$; $p < 0.001$). During the "end of work week" condition, the average PVT reaction time was 333 ms (SD = 89),[9] while during the "end of days off"

[9] The standard deviations reported appear large in comparison to the difference in means. This is due to the strong individual differences between subjects—the use of MLM controls for these differences.

condition, the average PVT reaction time was 316 ms (SD = 99). This provides support for our second research hypothesis.

Scenario outcomes

Our final three research hypotheses concern the impact of shift, condition, and fatigue on officers' behavior in the simulator. The descriptive statistics revealed that 24% (133) of scenario observations resulted in cooperative outcomes, 19% (107) resulted in neutral outcomes, and 57% (319) resulted in deadly outcomes. Day-shift officers were more likely to have scenarios end cooperatively ($f = 4.81$; $df = 3, 549$; $p < 0.01$) than officers assigned to other shifts. To explain this finding, officers assigned to the day shift were able to *prevent* a deadly outcome a majority (56%) of the time, compared to swing (35%), power (45%), and grave shift (39%) officers. This finding provides partial support for our third research hypothesis that day-shift officers (day and swing) would outperform night-shift officers (power and grave).

Neither testing condition ($f = 0.30$; $df = 2, 585$; $p = 0.59$) nor fatigue ($f = 0.43$; $df = 2, 544$; $p = 0.52$) significantly predicted scenario outcome. Officers were no more likely to treat people in ways that encouraged cooperation when they were tested at the end of their days off than when they were tested at the end of their work week. They also did not appear to be affected by fatigue (as measured by the PVT) in how they treated people. Thus, we do not provide support for our fourth and fifth research hypotheses.

Finally, years of experience did not predict scenario outcome ($f = 0.46$; $df = 1, 549$; $p = 0.5$). However, officer age was related to scenario outcome ($f = 5.05$; $df = 1, 549$; $p = 0.03$), indicating that older officers were better at treating people in ways that fostered a willingness to cooperate.

Discussion

The associations between work shift, fatigue, and officer response in encounters with citizens appear complex. Several findings emerge from this study that require interpretation. First, our study found that, although night-shift officers and officers at the end of their work week were significantly more fatigued, neither the time that officers were tested (end of work week or end of time off) nor the PVT score affected whether scenarios ended in cooperative or deadly outcomes. Rather, officers who worked during the day were more likely than night-shift workers to interact with on-screen citizens in ways that produced a cooperative outcome. This suggests the that substantive natures of day- versus night-shift police work may affect officers' responses in citizen interactions. For example, officers who work during the day may have more opportunities to interact with citizens in less threatening and more cooperative situations, and, therefore, have increased opportunities to hone these skills.

Furthermore, while years of police service was not associated with scenario outcome, officer age predicted cooperative outcomes. This finding suggests that life experience, rather than police experience, may teach police officers to adopt more peaceful and cooperative solutions. For example, older officers may have acquired various interpersonal techniques in their work and personal lives, or may simply be more mature in their social interactions. On the other hand, older officers may be less

inclined to become involved in a physical encounter and, therefore, these officers may be more willing to take their time and employ numerous alternative force options. Officer age may also be partially responsible for our finding that day-shift officers are more likely to produce cooperative solutions, since senior officers tend to work the daytime shifts (see Table 1). It is also possible, however, that the habitual circadian misalignment experienced by officers working night shifts may have resulted in chronic fatigue that underlies day-to-day fluctuations in tiredness (evidenced by changes in the PVT scores or testing condition). It is, therefore, difficult to tease apart the superior skill of the day-shift officers from potential chronic fatigue of the night-shift officers.

The high number of scenarios (57% overall) resulting in deadly outcomes most likely reflects the study design and the nature of the recorded scenarios. That is, the results do not imply that 57% of police–citizen encounters will result in deadly force—the Bureau of Justice Statistics estimates this percentage to be less than 1%. Rather, in the current study, 57% reflects the percentage of scenarios in which the officer's natural response was *not* to automatically employ common procedural justice techniques; for example, they did not greet the individual, introduce themselves, or explain the reasons for police response. Further, once the scenario began to deteriorate, officers tended not to employ de-escalation techniques that would have resulted in a cooperative outcome. The idea that individuals will be more willing to cooperate with the police if they feel they are being treated in a fair and just manner is a central component of procedural justice theory (Sunshine and Tyler 2003). However, our finding reflects that, over half of the time, procedural justice and other forms of de-escalation were not officers' first natural response. The importance of this finding cannot be understated. While some have argued that police officers are already well trained in de-escalation tactics, our finding supports the 21st Century Policing Task Force's recommendation that de-escalation and procedural justice need to become more central to American police training, policy, and practice.

It is important to note that the scenarios themselves could be frustrating to an officer, since the videos are pre-recorded and, therefore, do not always reflect what would naturally occur in a real-life situation. Moreover, in some scenarios, the citizen's behavior may indicate non-compliance. As examples, the citizen may not respond appropriately (or at all) to the officer's questions, or may not comply if the officer commands the person to step out of the car. However, officers tend to be familiar with these types of police encounter simulators,[10] and be able to suspend their disbelief when the occasional disconnect occurs. This disconnect reflects one of the limitations to the study of police behavior using a simulation-based approach. Additional limitations include the fact that study participants were limited to verbal communication or deadly force options. In real-life situations, officers have multiple less lethal options available to them. In addition, simulation removes the potential life or death consequences from the equation; officers are not motivated by desperation or fear to employ alternative force methods (Terrill 2016). Finally, the agency from which officers were recruited is highly homogenous; as such, our study sample suffers from a lack of diversity that precludes external generalization.

In conclusion, these findings do not diminish the importance of addressing police fatigue; rather, they suggest that the impact of fatigue on officers' day-to-day

[10] This particular agency uses the VirTra simulator in their academy.

interactions may be nuanced and dependent on other variables, such as officer skill at de-escalation and the type of calls they experience while on shift. It appears that day-shift officers have something valuable to teach officers on other shifts, given that, in the majority of scenarios (56%), their go-to tactic reflected core components of procedural justice and de-escalation. Whether this is due to their age, the types of situations they typically encounter, the fact that their sleep aligns with their bodies' natural circadian rhythms, their feelings of fatigue, or other variables requires future investigation to inform police policy and practice.

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Dr. Lois James' published research focuses on the relationship between sleep, health, and performance in elite populations such as police officers, combat medics, military personnel, nurses, and top-tier athletes. She is particularly interested in how sleep and circadian disruption due to shift work lead to negative health outcomes and performance deficits. Through understanding the prevalence and impact of sleep deprivation and circadian disruption within these populations, Dr. James creates fatigue management strategies to help build resilience and reduce the risk of performance deficits and chronic health issues.

Dr. Stephen James is the manager of the Simulated Hazardous Operational Tasks laboratory at WSU. His role is to develop the capabilities of the laboratory to allow data collection, design and create the simulation tasks, manage data collection, lead data analysis, and prepare technical reports. His research focus is aimed at understanding the dynamics of police–citizen encounters and evaluating simulation technology used by law enforcement personnel for such encounters. This understanding leads to more effective—and more cost-effective—training.

Dr. Bryan Vila is a world-renowned expert on police fatigue. A former police officer and executive with 17 years' experience in local, national, and international agencies, Dr. Vila pioneered the study of the impact of workplace fatigue on officers' safety, performance, and health more than 35 years ago. He has published one book and more than 40 peer-reviewed research articles and book chapters on the topic. He has given more than 100 invited workshops and talks on the topic to police officers, executives, and policy-makers in the USA, UK, and Canada. Dr. Vila has received 13 competitive research grants and contracts on police fatigue and related issues.