Impact of the HeartMath Self-Management Skills Program on Physiological and Psychological Stress in Police Officers

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SUMMARY

Police work is often regarded as an extremely stressful occupation, and officers typically suffer a variety of physiological, psychological and behavioral stress effects. It has been argued that particular attention should be given to occupational stress in policing, as its potential negative consequences affect society in more direct and critical ways than stress in most other occupations. Officers operating under severe and chronic stress may well be at greater risk of error, accidents and over-reaction that can compromise their performance, jeopardize public safety and pose significant liability costs to the organization. However, police officers are rarely provided with effective stress management strategies to help alleviate these problems. This study explored the impact on a group of police officers from Santa Clara County, California of the HeartMath® stress and emotional self-management training, which provides practical techniques designed to reduce stress in the moment, improve physiological and emotional balance, increase mental clarity and enhance performance and quality of life.

Areas assessed included: physical health and vitality, emotional well being, coping and interpersonal skills, work performance, workplace effectiveness and climate, family relationships, and physiological and psychological recalibration following acute stress. In addition, physiological measurements were obtained to determine the real-time cardiovascular impact of acutely stressful situations encountered in simulated police calls used in police training, and to identify officers at increased risk of cardiovascular disease and premature mortality.

Results showed that the HeartMath training improved officers' capacity to recognize and manage their stress and negative emotions in both work and personal contexts. Over the course of the study, officers trained in the stress management techniques experienced reductions in stress, negative emotions and physical stress symptoms, as well as increased positive emotion and physical vitality as compared to a control group that did not receive the training. Improvements in family relationships, more effective communication and cooperation within work teams, and enhanced work performance were also noted.

Heart rate and blood pressure measurements taken during simulated police call scenarios showed that acutely stressful circumstances likely to be encountered on the job result in a tremendous degree of physiological activation from which it takes the body a considerable amount of time to recover. The HeartMath techniques learned in this study increased participants' calmness, clarity and focus during these scenarios and enabled them to rapidly and deeply recalibrate, both physiologically and psychologically, after the intense stress was over.

Autonomic nervous system assessment based on heart rate variability analysis of 24-hour ECG recordings revealed that 11% of the officers tested were at high risk for cardiovascular disease and premature mortality. This is more than twice the ratio of at-risk individuals expected to be found in the general population, and is consistent with epidemiological data indicating that police officers as a group have over twice the average incidence of cardiovascular disease.

In conclusion, this study provides evidence that practical stress and emotional self-management techniques can reduce damaging physiological and psychological responses to both acute and chronic stress in police, and positively impact a variety of major life areas in a relatively short period of time. In particular, results show that application of these interventions can produce notable improvements in communication difficulties at work and in strained family relationships, two areas that are well recognized to be major sources of stress for police.

The data suggest that the integration of effective self-management programs in police training could ultimately improve officers' long-term health and emotional well being and increase work effectiveness. Training in emotional self-management could also significantly benefit police organizations by improving judgment and decision making, decreasing the frequency of on-the-job driving accidents and the use of excessive force in high-stress situations. Potential outcomes include fewer citizens' complaints, fewer lawsuits, decreased organizational liabilities and increased community safety. Finally, this study highlights the value of 24-hour HRV analysis as a useful screening tool to identify officers who are at increased risk of developing serious long-term health problems, so that efforts can be made to reverse or prevent the onset of disease in these individuals.

BACKGROUND

The police officer is exposed to stress outside the range of usual human experience. The operational duties of police work, by their nature, may at any time place officers in life-threatening situations, in which the decisions they make can truly mean the difference between life or death for both themselves and others. Many of these situations, such as major disasters or shooting incidents, may well come under the category of traumatic stress. In addition to the intensity of the acute stress experienced in the moment, the feelings that officers carry with them after such emotionally charged incidents represent a more enduring source of stress for many police. Constant exposure to society's interpersonal violence, negative or confrontational interactions with individuals, a sense of personal endangerment, fear of revenge from criminals, and subservience to an ambivalent, watchful public produce negative emotional repercussions that can affect police officers on a chronic basis. [1-5]

In addition to the operational stressors inherent in police work, numerous studies have shown that factors related to organizational structure and climate can be an even greater source of stress for the police officer. [6-8] Shift schedules that disrupt normal sleep patterns and social life, authoritarian management styles, poor interpersonal relationships with supervisors, interdepartmental politics, lack of adequate planning and resources, lack of promotion and transfer opportunities, excessive paperwork, lack of autonomy in performing duties and lack of recognition for work accomplishments are among the organizational stressors faced by members of the police force. [2, 6, 9]

Without effective management, the various acute and chronic stressors of police work impose a significant burden on physical and psychological health, leading to numerous adverse physiological, emotional and behavioral outcomes. [1, 2, 10] Following acutely stressful incidents encountered in the line of duty, bodily systems must recover from an extreme degree of physiological arousal. Over time, repeated stress can lead to the chronic activation or dysregulation of the body's stress response systems, and the eventual exhaustion of the autonomic nervous system. Police officers have been shown to have higher blood pressure and stress hormone levels than clerical workers. [11] In the long term, this physiological strain may have a significant harmful impact on health, leading to the high rates of stress-related illness known to exist in the police profession. [10] Research has shown that police officers are over twice as likely as people in other occupations to develop cardiovascular disease. [12] Police have also been found to die at a higher rate from cancer than the general population. [13]

At the psychological level, the stress of police work may result in chronic negative emotions such as anger, anxiety or depression, which can eventually lead to psychological burnout or emotional

exhaustion. [3, 14, 15] Post-traumatic stress disorder (PTSD) is also a severe consequence of exposure to extremely stressful incidents of violence or major disaster among police officers. [16, 17] The high rates of alcohol use among police are one reflection of unmanaged emotional stress. [10, 18] Other research has confirmed that the mortality rate from suicide is nearly 3 times higher in police than in other municipal employees. [13] Finally, the repercussions of unmanaged stress in police clearly extends to officers' families, where it is reflected in poor relationships with spouses and children and the notably high rates of marital disruption and divorce known to exist within this profession. [10, 19, 20]

The negative physiological and psychological effects of stress may also cause work performance to deteriorate, leading to reduced efficiency and motivation in performing job duties, poor morale, excessive absenteeism and premature retirement. One study conducted in the UK found that in 1990 over 1 million police working days were lost through sickness absence (an average rate of 11 days per officer) and that approximately 25% of these absences could be attributed specifically to stress. [2] The inability to effectively manage stress has its most dangerous consequences in the line of duty. Police work often places officers in situations where reaction speed, coordination and the capacity to make rapid decisions and accurate judgments under pressure is critical, and inefficient mental and emotional responses to stress can significantly impair these abilities. [21] In the extreme, stress can cause officers to lose balance and composure to the degree that they employ inappropriate or excessive force in dealing with subjects. [22] Recent years have seen the wide publicization of incidents of police brutality and homicides committed by individual officers throughout the country. Errors made in the line of duty can have grievous consequences not only on the officers and the particular suspects they encounter, but also on the public's perception of the individual, an entire department and even the entire profession. These consequences can include automobile accidents, injury, death, lawsuits, loss of credibility and even city-wide riots in reaction to officer behavior in highly-charged situations.

It has been argued that special consideration should be given to occupational stress among police forces, as its potential negative consequences affect society in more direct and critical ways than stress in most other occupations. [23, 24] Police officers operating under severe and chronic stress may well be at greater risk of error and over-reaction that can compromise their performance and public safety. However, the police force is perhaps one of the organizations within which the stress experienced by employees receives the least acknowledgment. Some have suggested that police work in a professional environment that encourages emotional detachment from others as well as from their own feelings. [10, 18, 25] The unrealistic expectations imposed by this occupational culture discourage officers from admitting to feeling stress and from openly expressing negative emotions. Thus, while police receive ample training in the theoretical knowledge and technical skills required to perform their jobs and take effective action in an emergency situation, most receive little if any training in the self-management skills needed to help them quickly regain psychological and physiological equilibrium after the intense challenges of their work. Similarly, they are generally not provided with tools to help them manage the emotions they may process internally long after involvement in a traumatic incident. The unusually stringent demands for self-control, compounded by the unavailability of effective strategies for inner self-management becomes an added stressor in its own right for police. [4, 26] It is clear that practical stress management techniques are needed not only to help officers remain more balanced during and after the acute stresses of their jobs, but also to take action to better manage and seek real solutions to the chronic stress related to organizational and family issues.

In this investigation a sample of police officers were provided training in a series of research-based stress and emotional self-management interventions developed by the Institute of HeartMath

(IHM) to help individuals to reduce stress and negative emotions, improve autonomic nervous system balance and overall health, enhance performance and quality of life. The effects of this training on both physiological and psychological recovery from acute stress as well as on sources of chronic stress were explored.

PURPOSE

The aim of the present investigation was multi-fold: 1) to determine the nature and degree of physiological activation produced by different stressful situations and activities likely to be encountered by police in the line of duty, as measured by heart rate and blood pressure changes during simulated scenarios used in police training; 2) to identify officers at increased risk of cardiovascular disease and premature mortality by means of autonomic nervous system assessment; 3) to provide training in practical stress management techniques to a sample of officers and assess the impact of this training on: physiological activation and recalibration following the intense stress of simulated police calls, physical health and vitality, emotional well being, work performance, workplace effectiveness and climate, and family relationships.

METHODS

Participants

A total of 65 participants (64 sworn police officers and one city manager) from seven police agencies in Santa Clara County, California were recruited for this study. The agencies represented were Campbell, Los Altos, Los Gatos, Milpitas, San Jose State University, Santa Clara and Sunnyvale Public Safety. The participants were 55 males and 10 females, with a mean age of 39 (age range: 24-55 years). The group was comprised of 43 patrol officers, 12 detectives and 9 officers currently serving in administrative duties. Of the 64 sworn officers 16 had 1-5 years experience, 20 had 6-15 years experience and 28 had 16-30 years experience serving on the force. The average level of experience for the group was 14.4 years spent serving on the force. Subjects were randomly divided into an experimental group (n = 29) that was to receive the HeartMath self-management training during the study and a waiting control group (n = 36) that was to receive the training once the study was completed. Care was taken to ensure that there was an approximately equal distribution between the two groups of officers of different levels of experience, from different agencies and of both genders. Some adjustments were subsequently made to accommodate scheduling concerns.

Study design

This study took place over a 16-week period. Data collection occurred at three different time points in the study: baseline (at the start of the study), at 5 weeks on the first scenario day (pre-HeartMath training), and at 16 weeks on the second scenario day (post-HeartMath training). Baseline physiological and psychological measurements were collected for all participants at the Santa Clara Police Department at the start of the study. Pre and post physiological and psychological measurements were collected for the subgroup of officers involved in the simulated police call scenario portion of the study at Moffett Airfield, Sunnyvale on the days the scenarios were conducted. For those officers not involved in scenarios, pre and post psychological measurements were collected at the same time points at their respective agencies. Experimental group participants were trained in the HeartMath stress and emotional self-management techniques at the Milpitas Police Department in three separate classroom sessions lasting 4-6 hours each and spaced at approximately equal intervals over a period of one month. The first training session was conducted 3 weeks after the first scenario day, and the last training session was

completed 4 weeks before the second scenario day. The waiting control group received the same training after the study was completed.

A subgroup of the officers (12 experimental group participants and 11 control group participants) participated in the scenario portion of the study. The simulated police call scenarios were conducted at Moffett Airfield, Sunnyvale in conjunction with Sunnyvale Public Safety. A total of three different scenarios were conducted over the course of the study. Two of the simulations (a building search and a high-speed car pursuit) were run on the same day, 5 weeks after baseline measurements were taken and before the experimental group received the HeartMath stress and emotional management training, and one scenario (a domestic violence episode) was conducted 11 weeks later, after the HeartMath training was completed. Physiological and psychological measurements were collected from the participating officers on the days of the scenarios. In addition, participants were asked to rate each simulation according to how stressful it was for them, and training officers from Sunnyvale Public Safety completed an evaluation of the participants' performance in the scenarios.

The scenarios

The scenario portion of the study was run by the Sunnyvale Public Safety, which regularly puts its officers through this type of training at least once a year. The scenarios are designed to simulate as closely as possible real police calls that officers would receive on the job to investigate suspected crimes. In the scenarios, the officers and trained role players carry specially designed fire arms known as "simmunitions." These are the same fire arms that officers use on the job, but have been modified, making it impossible for live rounds to fit in their chambers. They contain special paint cartridges instead of real bullets. The purpose of the scenario training is to give officers exposure to and practice in the types of duties they would be required to perform under the pressure of a real-life police call.

The approximate duration of each simulation in this study was 5-10 minutes, and 3 to 5 trained role players were involved in each scenario. Before each scenario, officers went through a "staging" procedure in which they were briefed on the nature and known details of the suspected crime, as they would be in a real police call. Following each simulation, the officers went through a debriefing session in which they were asked a series of questions about the events that occurred during the scenario. Each scenario was observed by a researcher from the Institute of HeartMath who recorded the timing of events and measured the officers' blood pressure immediately after the scenario ended. A brief description of each of the scenarios follows:

Building search: In this scenario officers receive a call regarding a silent alarm at a warehouse. Officers are required to work with a back-up officer (a trained role player) to search the dimly-lit facility for the suspect. When the suspect is spotted by the officer, he claims to be an employee and reaches inside his jacket for identification. In this scenario the suspect does not have a weapon, and follows the officer's commands. The scenario ends when the officer brings the suspect under control by handcuffing him. This scenario was designed as a low stress trial in which the officers can become familiar with the scenario protocols.

High-speed pursuit: In this scenario officers engage in a high-speed car chase. The course was set up on a runway at Moffett Field and was designed to approximate a city area (*i.e.* the street widths and corners were the same as in a typical city district). While driving, officers receive a radio call and are given specific information regarding the crime and suspect. While chasing the suspect's vehicle with siren on, officers are in continual communication over the radio with the dispatcher. The suspect (a trained role player) engages in various maneuvers, including jumping out of his car at one point and running towards the officer's vehicle, with a gun pointed at the officer's car. The

scenario ends when the suspect's car pulls over and the officer orders him to get out of his vehicle. In the debriefing session, officers are asked questions which require them to remember the information they were given by the dispatcher and to assess the safety of their driving during the scenario.

Domestic violence: In this scenario officers receive a call regarding a disturbance at a domestic address. With a back-up officer (a trained role player) they are required to investigate. At the scene (a civilian household) officers encounter an injured woman who is crying continuously and holding a bloody towel to her head. When questioned, she claims she has fallen and hurt herself. Officers then encounter the suspect (the woman's husband) who has a weapon at his side which is not visible to the officer. As the suspect is being questioned by the officer, he pulls out his weapon in clear sight and points it at his wife. The suspect does not comply with the officer's commands to put down the weapon. After approximately 30 seconds the suspect points the weapon at the officer and fires, if the officer does not shoot him first. If the officers fire first and hit the suspect, they complete the scenario by handcuffing him. If the officer is shot, the scenario ends at that point.

The HeartMath stress and emotional self management training

The HeartMath stress and emotional self-management program[27] provides individuals with practical, easy-to-learn techniques that can be used to recognize and transform inefficient mental and emotional responses to stress in the moment. These interventions have been shown in organizational settings to reduce stress, tension, negative emotion and fatigue, while enhancing positive emotion, communication and job satisfaction. [28-32] Practice of the HeartMath techniques has also been demonstrated to have significant physiological benefits, including reducing inappropriate autonomic nervous system activation,[33] improving autonomic balance,[33, 34] facilitating entrainment of physiological systems, [33, 35] reducing stress hormone levels, [36] boosting the immune system, [37, 38] and enhancing cardiovascular efficiency. [33] In addition, a growing number of case histories demonstrate that practice of the techniques can reduce symptomatology and improve clinical status in diverse patient populations. [39, 40] Notably, the techniques have been shown to restore blood pressure to normal values in hypertensive individuals without the aid of medication. [28]

Through the training provided during this study, officers learned to identify and recognize the specific issues, attitudes and experiences that contribute to their stress, and to make perceptual and attitudinal shifts to transform inefficient reactions to potential stressors. Brief descriptions of several of the core techniques officers learned in the training follow:

Freeze-Frame®[41]: The Freeze-Frame technique is designed specifically to enable individuals to intervene in the moment that stress is experienced. In essence, the technique instructs people to consciously disengage from negative mental and emotional reactions as they occur by shifting their attention to the area of the heart, then self-generating a positive or neutral feeling state. This prevents or reverses the body's normal destructive stress response and changes the bodily feedback sent to the brain, [33, 35] thus arresting physiological and psychological wear and tear. As a result of Freeze-Frame, one can think more clearly and often transform an inefficient, emotionally draining response to a proactive, creative one. With practice, this tool can be used effectively in less than one minute. In this study, officers were encouraged to use the Freeze-Frame technique before entering the scenarios to center themselves in a state of inner balance and clarity, and after the scenarios to achieve rapid physiological and psychological recalibration from stress.

Coherent Communication[29]**:** Lack of effective communication between people is a major source of stress and inner turmoil. Often it is difficult to hear others because we are preoccupied by our own internal thought processes. At work, ineffective communication among coworkers or between supervisors and the work force can lead to feelings of hostility, mistrust and separation between team members and has a negative impact on productivity and teamwork. At home, poor communication with family members or loved ones is a major factor underlying strained personal relationships. The Coherent Communication technique facilitates the sharing of ideas and information with greater sincerity and effectiveness. Individuals learn to communicate more openly and honestly and to stop internal dialog in order to listen to others more deeply. This communication technique enables people to more readily understand the essence of a conversation and often to perceive additional levels of subtlety within the information being communicated.

Heart Lock-In®[27]**:** The Heart Lock-In technique enables people to "lock in" to a physiologically coherent state associated with improved cardiovascular function, reduced fatigue, heightened inner calm and mental clarity. With practice of the technique, individuals can effectively retrain their physiological systems to sustain longer periods of balanced, coherent function. The technique involves focusing one's attention on the area of the heart and experiencing a sincere positive feeling state such as appreciation while listening to music specifically designed to facilitate stress reduction and promote physical, mental and emotional regeneration. [42, 43] Practice of this tool promotes entrainment of physiological systems and helps to balance heart rhythms, emotional states, hormonal and autonomic function. [36]

In addition to the above techniques, other tools covered in the program help participants apply the key concepts and techniques learned to actively address work and personal stressors and actualize more of their core values both at work and in their personal lives. Also incorporated in the program were several real-time demonstrations of the participants' heart rate variability, including one which illustrated heart rhythm entrainment during a Heart Lock-In.

MEASURES

Psychological measures

Personal and Organizational Quality Assessment (POQA) survey: This 80-item validated and normed assessment tool provides a broad overview of the individual's emotional stressors and social attitudes, vitality and physical symptoms of stress, as well as measures of workplace effectiveness. All participants in the study (n = 65) completed the POQA survey at three time points: baseline, pre-HeartMath training (5 weeks after baseline) and post-HeartMath training (16 weeks after baseline).

Program Impact Assessment: This semi-structured interview was administered by a clinical psychologist to the subgroup of experimental (n = 12) and control group (n = 11) participants who took part in the scenarios. The interview was conducted on the day of the final scenario, four weeks after the completion of the HeartMath training program. This assessment was designed to determine the impact of the HeartMath training on four major life areas: coping skills, family relationships, work performance and interpersonal skills. Officers were asked to rate to what extent they noted an improvement over the previous six weeks in 32 specific aspects of psychosocial functioning pertaining to these major areas (*e.g.* insight into my psychological well-being; ability to manage my moods; tendency to assert my opinions, feelings and desires with family members; tendency to respond to those I am close to with empathy versus criticism; ability to adapt to changing work environments and schedules; ability to stay calm and clear when faced

with the unknown; feeling accepted and supported by supervisors; extent to which I attempt to resolve work conflicts constructively, etc.) Those officers who had been trained in the HeartMath stress management techniques were asked to rate to what extent they attributed observed changes to their integration of the techniques in their day-to-day lives. In addition, they were asked to openly discuss changes in their ability to cope with emotional distress; in home life and relationships; in their work performance; and in their interpersonal relationships at work that they attributed to having received the HeartMath training. The approximate duration of the interview was 10-15 minutes.

Scenario stress levels: Following each scenario, participating officers were asked to rate the intensity of the stress they felt during the simulation on a scale of 1 to 10 (10 = maximum stress). They were also asked to state what was the most stressful part of the scenario to them and why.

Physiological measures

Heart rate variability: Participants' autonomic function was assessed by the analysis of heart rate variability (HRV). The normal resting heart rate in healthy individuals varies dynamically from moment to moment. Heart rate variability, which is derived from the electrocardiogram (ECG), is a measure of these naturally-occurring beat-to-beat changes in heart rate and is an important indicator of health and fitness. HRV is influenced by a variety of factors, including physical movement, sleep and mental activity, and is particularly responsive to stress and changes in emotional state. [34] The analysis of HRV can provide important information relative to the function and balance of the autonomic nervous system, and decreased HRV is a powerful predictor of future heart disease, increased risk of sudden death, as well as all-cause mortality. [44-46] In this regard, HRV is becoming increasingly used as a non-invasive screening tool to identify at-risk individuals. [39] In this study, heart rate variability analysis was performed for three main purposes: (1) to compare average heart rate during the officers' daily activities versus during the intense stress of the scenarios; (2) to obtain a detailed, real-time record of the beat-to-beat changes in officers' heart rates as they occurred in response to different activities performed and emotions experienced during the scenarios; and (3) to analyze officers' autonomic nervous system function and balance and determine if there were individuals in the group who were at risk of disease or premature mortality.

Analysis of heart rate variability was performed from 24-hour ambulatory ECG (Holter) recordings on a subgroup of 27 officers. Three-channel Holter recorders (Del Mar Avionics, Irvine, California) which incorporate a time-lock control circuit to ensure accurate HRV analysis were used for the data collection. Officers wore the recorders for 24 hours at all three time points in the study (baseline, first scenario day/pre-HeartMath training, and second scenario day/post-HeartMath training). The recorders were fitted when the officers arrived at the baseline data collection or scenario training site. At that time, participants were given a log in which they were asked to record the times of major activities in which they engaged and any significant changes in emotional state they experienced throughout the day and night. During the scenarios, officers' activities were observed and logged by an experimenter. All analysis was carried out at the HeartMath Research Center using DADiSP/32 digital signal processing software. Autonomic function was assessed in keeping with the recently published International Task Force Report which standardized the nomenclature, analysis methods and definitions of the physiological and pathological correlates of heart rate variability measures. [47]

Blood pressure: Blood pressure was measured at baseline for all study participants, as well as before and immediately after each scenario. For the baseline and pre-scenario measures, three left arm readings were obtained at intervals of two minutes and the average of the last two readings

was used as the reported value. For the post-scenario measure, one reading was obtained as soon as the scenario ended.

Performance measures

Scenario evaluations: Following each scenario, an evaluation of the participants' performance in the simulation was completed by the training officer. For all three scenarios, participants were rated on a five-point scale ranging from "poor" to "excellent" in the following four general categories: ability to maintain focus during scenario; ability to make appropriate decisions; ability to communicate clearly during the de-briefing; and ability to regain composure/balance after the scenario. Additionally, for the high-speed pursuit scenario, officers answered a series of questions which assessed their ability to remember relevant information communicated to them by the dispatcher during the simulation and required them to self-assess their driving performance and safety. For the domestic violence scenario, participants were evaluated by the training officer using a five-point scale ranging from "poor" to "excellent" in nine additional categories pertaining specifically to that scenario. These were: approach; contact/information collection; use of contact and cover officers; use of cover; use of triangulation; positioning of involved parties; appropriate escalation of force; appropriate weapons used; and arrest and control. The training officer also provided a written evaluation of each participant's performance for this scenario.

Scenario Impact Assessment: Following the domestic violence scenario, participants entered a brief semi-structured interview with an experimenter in which they were asked to self-assess changes in their performance in and responses to the scenarios that they had experienced over the course of the study. Areas covered were: quality of job performance during the simulation; feeling centered throughout the simulation; concern about evaluations of those observing the simulation; quickness with which they felt they were returning to how they normally feel after the simulation; and quickness with which they felt they were returning to how they normally feel after the current simulation compared to the last one they encountered. Participants who had been trained in the HeartMath techniques were asked to rate to what extent they attributed changes in these areas to their integration of the interventions. They were also asked to openly comment on specific changes they were aware of in their response to the simulation that they attributed to having received the HeartMath training. The interview lasted approximately 5 minutes.

RESULTS

Due to personal or work-related circumstances, seven of the 65 original participants could not complete the study. Therefore, the final analysis was carried out on 28 experimental group participants and 31 control group participants. The subgroup involved in the scenario portion of the study was comprised of 12 officers in the experimental group and 11 in the control group.

Program Impact Assessment Results: *Coping skills, family relationships, work performance and interpersonal skills*

Responses to the Program Impact Assessment interview were analyzed using T-tests for independent samples. Results indicated marked improvements in coping skills, family relationships, work performance and interpersonal skills in the trained participants as compared to the control group (Figure 1). At the end of the study period, in comparison to the control group, officers trained in the HeartMath techniques were significantly more likely to interact with their families with greater patience and understanding; to find themselves spending more time with those that they care about; and to stay calm and clear when faced with the unknown in their jobs.

Participants' comments in the interviews indicated that using the HeartMath techniques gave them greater conscious awareness of their stress and emotions and a greater understanding that their

own stress or well-being is truly a product of their perceptions. They also found they had a greater capacity to deal with stressful situations in a more balanced way rather than becoming overwhelmed by them. Using the techniques, they were able to take a time out to gain perspective on a problem or issue before reacting emotionally, and to more easily make inner perceptual and attitudinal shifts. Many of the officers felt that these improved coping skills reduced their stress and increased the effectiveness with which they were able to perform their jobs. Trained participants also noted that using the techniques resulted in less competition and greater cooperation within their work teams, improved listening and more effective communication among team members. These improved listening skills also extended to the officers' interactions with their families, enabling them to manifest greater care and compassion for their loved ones. One commuting officer commented that practicing the Freeze-Frame and Heart Lock-In techniques in the car enabled this individual both to arrive at work in a better frame of mind and go home in a better frame of mind to spend quality time with spouse.

Overall, the trained officers indicated that the HeartMath training benefited them most by increasing their ability to manage their moods (83%); improving their capacity to listen patiently to family members and be understanding of their concerns (75%); and enabling them to gain greater insight into their own psychological well-being (58%). The specific areas in which the training had the least impact were: the ability to integrate intuition into actions at work (8%); the tendency to discuss personal life matters with co-workers (8%); and the tendency to discuss with co-workers emotionally difficult situations encountered on the job (17%).

Personal and Organizational Quality Assessment Results: *Stress, emotions and physical stress symptoms*

Analysis of covariance (ANCOVA) was used to compare the responses to the Personal and Organizational Quality Assessment (POQA) survey for the two groups. Results showed that as compared to the control group, participants trained in the HeartMath techniques exhibited considerable reductions in stress, negative emotions, depression and fatigue, and increases in positive emotions, peacefulness and vitality over the sixteen-week study period (Figure 2). Trained participants also showed reductions in a number of the physical stress symptoms measured, particularly sleeplessness, indigestion and anxiety (Figure 3). Notably, over the sixteen weeks, stress dropped by 20% in the trained officers while it declined only 1% in the control group. Depression declined 13% among the trained officers while it increased by 17% in the control group in the same time period. There was an 18% reduction in fatigue in the trained participants, whereas those not trained in HeartMath showed a decline of only 1%. Sleeplessness dropped by 17% in the trained group while it increased in the control group by 6%. Further, the control group showed a decline in all the positive scales measured (positive emotions, peacefulness and vitality), while these measures increased over the course of the study in the group trained in the HeartMath techniques. The means and standard deviations of the results for all participants are provided in Table 1.

The POQA survey results were also analyzed to determine whether there were significant differences among officers in the items measured due to level of experience, shift work or gender. Only a few items varied significantly among these groupings. The only significant difference based on experience level was in mental clarity. Officers with 16-30 years experience had significantly higher levels of mental clarity than those who had served 1-5 years or 6-15 years on the force. The only significant difference between officers working a night shift versus those working a day shift was in job satisfaction. The night shift officers reported lower levels of job satisfaction than the day shift officers. Two variables were significantly different between genders. Female officers reported a higher level of sleeplessness than males, while male officers had higher levels of anger.

Scenario stress levels

Participants rated the domestic violence scenario as the most stressful, followed by the high-speed pursuit scenario, and finally the building search as the least stressful of the scenarios (Figure 4).

Scenario performance evaluations

Figure 5 summarizes the average scenario evaluation results for experimental and control group participants in the four general areas that were evaluated for all three scenarios: ability to maintain focus during scenario; ability to make appropriate decisions; ability to communicate clearly during the de-briefing; and ability to regain composure/balance after the scenario. It is of note that the experimental group tended to score lower in these areas than the control group in the two scenarios that were conducted prior to the HeartMath training (the building search and high-speed pursuit); however, after they received training in the HeartMath techniques, this trend reversed: the experimental group scored higher than the control group in all key areas in the final scenario (domestic violence), which participants reported to be the most stressful.

Figure 6 shows evaluation results for all subjects for the specific questions participants were required to answer after the high-speed pursuit scenario. Thirty percent of the officers remembered the suspect's name that they were told by the dispatcher, 78% remembered the name of the business at which the suspect worked, 86% felt they drove with due regard during the scenario, and 74% answered that they drove within the limitations of the vehicle or their own driving ability.

Figure 7 shows evaluation results for all subjects for the nine specific areas assessed in the domestic violence scenario. Participants scored highest on average in the use of appropriate weapons and contact/information collection. The poorest average performance was seen in the positioning of involved parties, use of cover and use of triangulation. In most of the skills evaluated, there was a fairly wide range of ability demonstrated among the different participants, which most likely reflects their widely differing levels of experience in this type of scenario training.

Effects of the HeartMath techniques on coping performance

Of the officers trained in the HeartMath techniques who underwent the final (domestic violence) scenario, 83% noted in their interview that they saw clear improvements in their coping performance that they attributed to their use of the techniques. Of this group, 80% felt that using the Freeze-Frame technique immediately after the scenario enabled them to recalibrate from the high stress and return to how they normally feel significantly more quickly as compared to in the previous scenarios before they had been trained in the HeartMath tools. (In contrast, only 36% of the control group noted any improvement in how quickly they were able to recalibrate after the final scenario as compared to the previous ones). Several of the officers indicated that they also planned to use the technique on the way home from the scenario, to gain an even deeper level of inner balance. Sixty percent also used Freeze-Frame before (50%) or during (10%) the scenario, and 60% commented that they felt more centered throughout the scenario as a result of their integration of the HeartMath techniques. Overall, participating officers' comments indicated that using the Freeze-Frame technique before entering the scenario helped them feel more calm, focused, confident and better able to adjust to stress, while using the technique after the scenario enabled them to more rapidly and deeply recover, both physiologically and psychologically, from the intense stress they experienced.

Physiological results

Figures 8 - 18 provide a summary of the physiological data collected from the participants. The heart rate and blood pressure results clearly indicate that all the scenarios resulted in a considerable degree of physiological stress and activation.

Heart rate

A primary indicator of stress and autonomic nervous system activation is increases in heart rate. Figure 8 shows the average increase in heart rate of all the officers during each of the scenarios. The stress and activity of the scenarios produced profound elevations in heart rate, with the average heart rates ranging from 128-143 bpm, which is between 40 to 55 bpm above the officers' normal average daytime heart rates. The normal average daytime heart rate is indicated by the horizontal line in Figure 8. The largest increases in heart rate were seen in the domestic violence scenario, with an average increase of 55 bpm above the daytime average. This was closely followed by the building search scenario, with a mean increase of 52 bpm above the normal daytime average, and then the high speed pursuit with an increase of 40 bpm above the daytime average. Figure 9 illustrates an example of the heart rate increases experienced by a single officer during the different scenarios. During the peak action of all three scenarios, this officer's heart was beating faster than 3 beats per second.

In addition to the average heart rate analysis, the ambulatory ECG recordings allowed us to monitor the beat-to-beat changes in heart rate that occurred in response to the different activities in which officers engaged during the scenarios. Figures 10 - 12 provide typical examples of the heart rate variability (the beat-to-beat changes in heart rate) in individual officers during each of the three scenarios. The times at which different activities or events occurred are clearly marked on the graphs. In all three simulations, a large and very rapid increase in heart rate is evident as the officer shifts from a preparatory mode (staging) to the actual action of the scenario. Further increases are seen as the scenarios reach their most stressful peak. Although heart rate begins to decrease rapidly as soon as the simulations are over, in the building search and domestic violence scenario examples it remains substantially elevated relative to baseline for some time after the scenarios have ended. Analysis of the 24-hour ECG recordings revealed that it took an average of 1 hour and 5 minutes after the scenarios ended for officers' heart rates to return to their normal baseline values. In several cases, heart rate did not recalibrate to baseline for over 2 hours afterwards.

Figure 13 shows an example of the change in heart rate experienced by one officer who used the Freeze-Frame technique to help recalibrate after the intense stress of the domestic violence scenario. When the scenario was over the participant's heart rate began to drop, but initially stabilized at a value above its normal baseline range. As the participant Freeze-Framed, there was an immediate, further reduction in heart rate back to baseline.

Blood pressure

Figure 14 shows the average changes in systolic and diastolic blood pressure for all the participants before and after the scenarios. Baseline average blood pressure values taken on a day on which the officers were not involved in scenarios were 124/76 mmHg. Significant increases in blood pressure were observed in the scenarios. The officers' average blood pressure was 166/98 mmHg after the building search, 145/96 mmHg following the high speed pursuit and 175/95 mmHg after the domestic violence scenario, indicating average rises of 40 mmHg for systolic and 20 mmHg for diastolic pressure. Figure 15 shows an example of the blood pressure changes experienced by one officer during the three scenarios.

The most extreme increases in systolic blood pressure were seen in the domestic violence scenario. Figure 16 details the individual changes in each officer's systolic pressure during this scenario. There was considerable variation in the degree of blood pressure increases among the individual participants. In five of the officers, systolic blood pressure rose to over 200 mmHg, indicating

increases in the range of 80-120 mmHg above their starting values. The largest increase in systolic pressure was from 122 to 243 mmHg (an increase of 121 mmHg). The smallest change measured was from 137 to 152 mmHg (an increase of 15 mmHg),

In general, there was little difference in the physiological measures between the trained participants and the control group, as was expected. However, analyses of the blood pressure results revealed one notable trend. As shown in Figure 17, during the two scenarios conducted prior to the HeartMath training, (the building search and high-speed pursuit), the experimental group had a higher average increase in systolic blood pressure than the control group. However, after they received training in the HeartMath techniques, this trend reversed: the experimental group had a lower average systolic blood pressure than the control group in the final scenario (domestic violence), which participants reported to be the most stressful. The average increase in diastolic blood pressure was also lower in the trained group during the final scenario.

Risk assessment

From the heart rate variability analysis of each participant's baseline 24-hour electrocardiogram, six key measures of autonomic nervous system function and balance commonly used in risk assessment were calculated. For a more detailed explanation of these measures and their clinical relevance, see reference 39. Of the 27 officers whose HRV was analyzed, three (11%) were found to have low HRV and are therefore considered to be at high risk for cardiovascular disease and premature mortality. Figure 18 illustrates the scatter plots showing all participants' values for each of the six measures analyzed. Average values for normal healthy individuals according to age are indicated by the center dotted line on each graph, and normal reference ranges (95% confidence intervals) are delineated by the two solid lines. Note that for several of the measures (very low frequency, low frequency and high frequency power) three of the officers' values fall outside the normal reference range for their age groups.

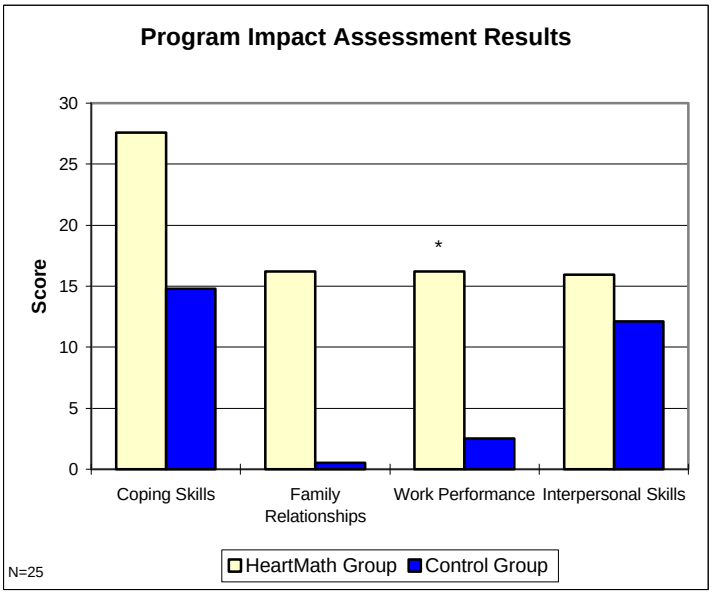

Figure 1. Improvements in major life areas following the HeartMath training. Coping skills, family relationships, work performance and interpersonal skills were assessed by means of a semi-structured interview conducted 4 weeks after the completion of the HeartMath stress and emotional self-management training. Officers trained in the HeartMath techniques showed improvements in all areas as compared to a control group that did not receive the training. The * symbol shows statistical significance, indicating a p value of less than .05.

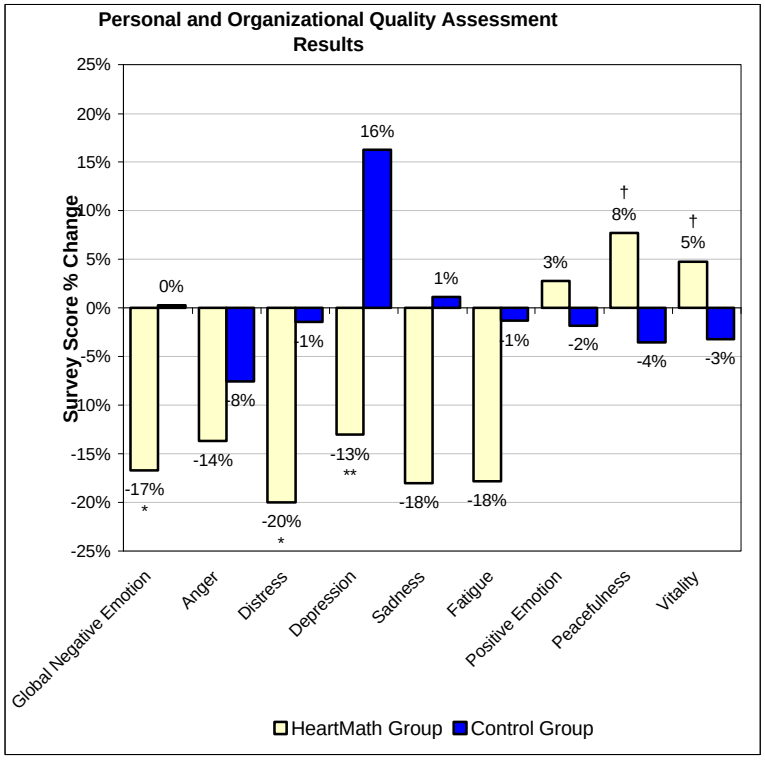

Figure 2. Improvements in stress and emotional well being following the HeartMath training. Compares the differences between the average pre- and post-training scores for each psychological variable measured by the POQA survey. The "global negative emotion" score is the overall average of the individual scores for the anger, distress, depression and sadness constructs. Participants were assessed at the start of the study and 16 weeks later (4 weeks after the completion of the HeartMath training). As compared to a control group, participants trained in the HeartMath techniques exhibited considerable reductions in distress, depression, anger, sadness, fatigue and overall negative emotion, and increases in positive emotions, peacefulness and vitality over the study period. Note that the control group not trained in the techniques experienced a marked rise in depression over the same time period. †$p < .1$, *$p < .05$, **$p < .01$.

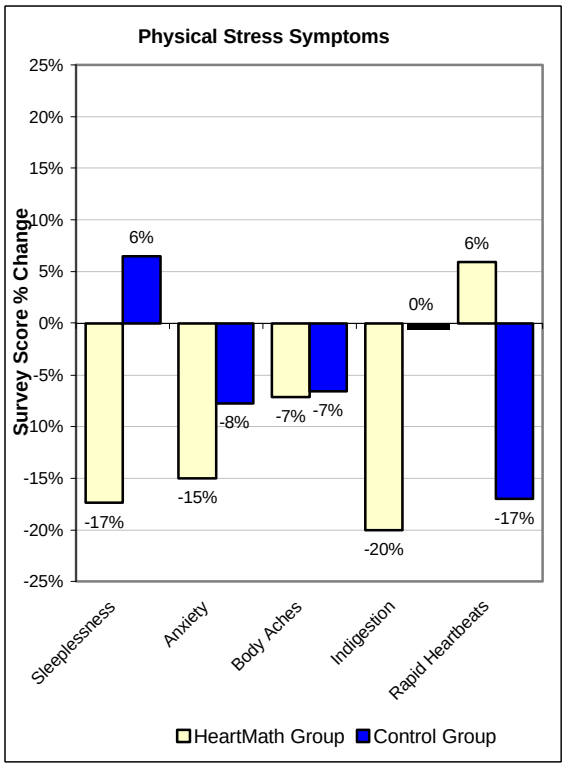

Figure 3. Changes in physical stress symptoms following the HeartMath training. Illustrates changes in five physical symptoms of stress as assessed for all participants at the start of the study and 16 weeks later (4 weeks after the completion of the HeartMath training). There was a reduction in sleeplessness, anxiety and indigestion in the HeartMath group. The HeartMath group also reported more rapid heartbeats than the control group, which may be due to an increased awareness of their heartbeats after the training program.

Table 1. Personal and Organizational Quality Survey Means and Standard Deviations

	HeartMath Group			Control Group		
	Baseline	5 weeks	16 weeks	Baseline	5 weeks	16 weeks
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Global Negative Emotion	2.13 ± .50	2.00 ± .59	1.78 ± .49	1.96 ± .47	1.93 ± .54	1.97 ± .69
Anger	2.44 ± .74	2.25 ± .72	2.11 ± .70	2.42 ± .66	2.33 ± .68	2.24 ± .82
Distress	2.56 ± .57	2.44 ± .66	2.05 ± .64	2.26 ± .59	2.26 ± .72	2.23 ± .82
Depression	1.46 ± .51	1.37 ± .57	1.27 ± .36	1.32 ± .38	1.33 ± .47	1.54 ± .65
Sadness	2.05 ± .76	1.93 ± .78	1.68 ± .63	1.84 ± .74	1.80 ± .69	1.86 ± .81
Fatigue	2.94 ± .90	2.81 ± .78	2.42 ± .85	2.48 ± .58	2.44 ± .57	2.45 ± .81
Positive Emotion	4.08 ± .46	4.06 ± .50	4.19 ± .43	4.28 ± .54	4.12 ± .61	4.21 ± .67
Peacefulness	3.77 ± .69	3.82 ± .74	4.06 ± .49	3.97 ± .64	3.87 ± .75	3.83 ± .88
Vitality	3.99 ± .58	4.07 ± .70	4.18 ± .53	4.19 ± .52	4.12 ± .63	4.06 ± .74
Social Support	4.35 ± .52	4.21 ± .60	4.31 ± .50	4.29 ± .57	4.18 ± .68	4.10 ± .78
Mental Clarity	4.43 ± .45	4.32 ± .48	4.35 ± .44	4.41 ± .46	4.24 ± .66	4.13 ± .65
Job Satisfaction	4.52 ± .59	4.44 ± .64	4.29 ± .67	4.44 ± .60	4.37 ± .65	4.34 ± .89
Goal Clarity	3.96 ± .84	4.08 ± .71	4.06 ± .67	4.10 ± .70	4.10 ± .68	4.20 ± .71
Productivity	4.57 ± .41	4.52 ± .52	4.39 ± .44	4.40 ± .51	4.39 ± .52	4.40 ± .60
Communication Effectiveness	3.64 ± .53	3.73 ± .60	3.68 ± .68	3.81 ± .66	3.77 ± .72	3.92 ± .78
Sleeplessness	2.46 ± 1.10	2.50 ± 1.14	2.04 ± .84	2.00 ± 1.13	1.94 ± 1.00	2.13 ± .92
Anxiety	2.86 ± .85	2.79 ± .88	2.43 ± .74	2.48 ± .85	2.42 ± .76	2.29 ± .97
Body Aches	2.50 ± 1.11	2.46 ± 1.00	2.32 ± .90	2.45 ± .96	2.19 ± 1.08	2.29 ± 1.01
Indigestion	2.32 ± 1.06	1.96 ± 1.04	1.86 ± .89	1.77 ± .92	1.61 ± .84	1.77 ± .92
Rapid Heartbeats	1.82 ± .94	2.00 ± .98	1.93 ± .90	1.71 ± .74	1.42 ± .62	1.42 ± .62

Experimental group N=28

Control group N=31

Analysis of covariance (ANCOVA)

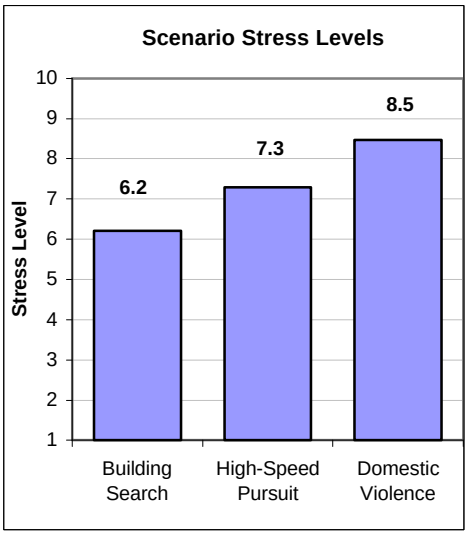

Figure 4. Scenario stress levels. Shows the officers' ratings of the three scenarios according to how stressful they perceived each to be. The domestic violence scenario was rated as the most stressful, followed by the high-speed pursuit, and the building search was the least stressful to participants.

General scenario evaluation results: Group Comparison

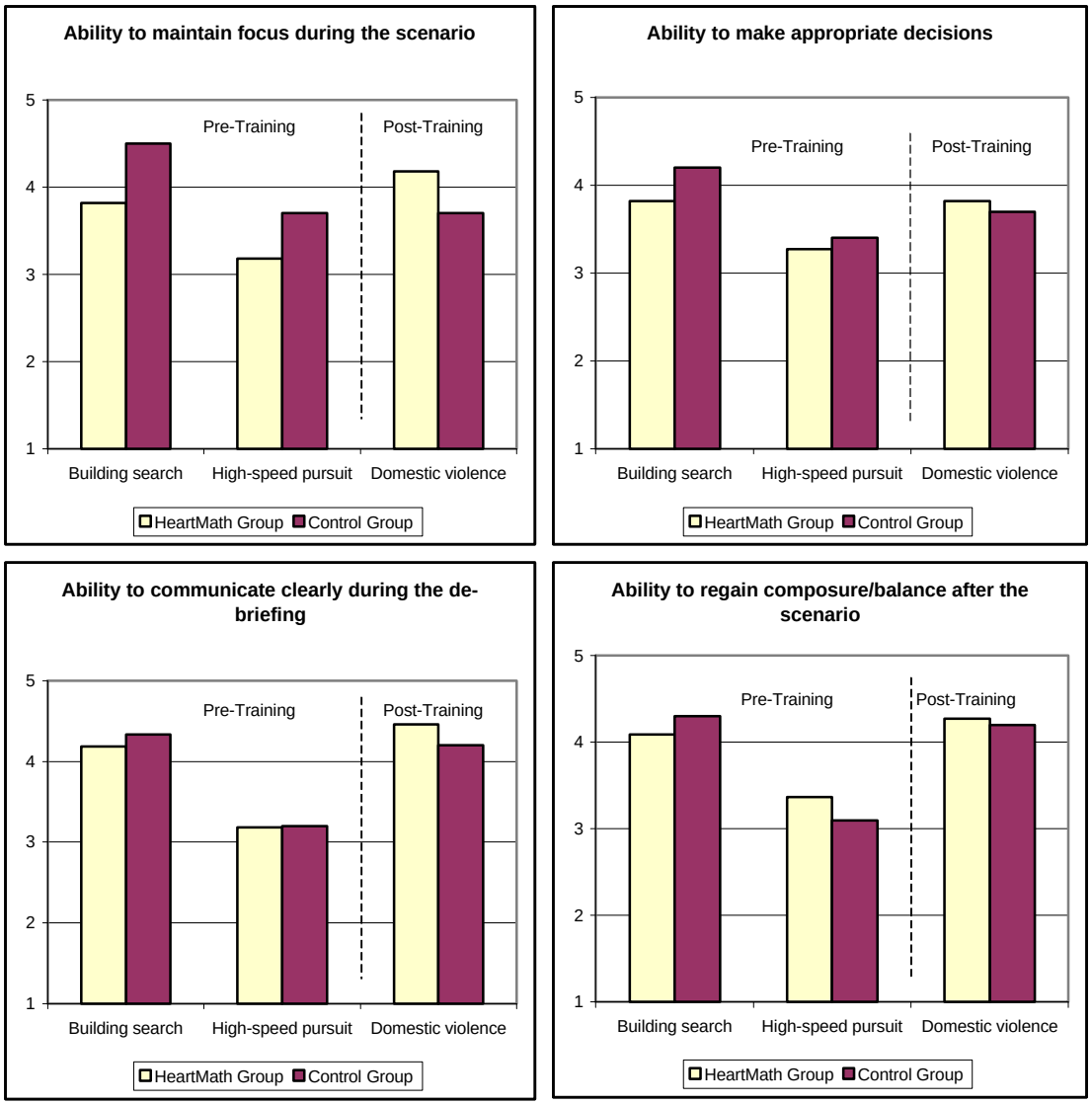

Figure 5. General scenario evaluation results: HeartMath group vs. control group. This set of graphs summarizes the average scenario evaluation results for experimental and control group participants in the four general areas that were evaluated for all three scenarios (results for each key area evaluated are displayed as a separate graph). Note that the experimental group tended to score lower than the control group in the two scenarios that were conducted prior to the HeartMath training (the building search and high-speed pursuit); however, after they received training in the HeartMath techniques, this trend reversed: the experimental group scored higher than the control group in all key areas in the final scenario (domestic violence), which participants reported to be the most stressful.

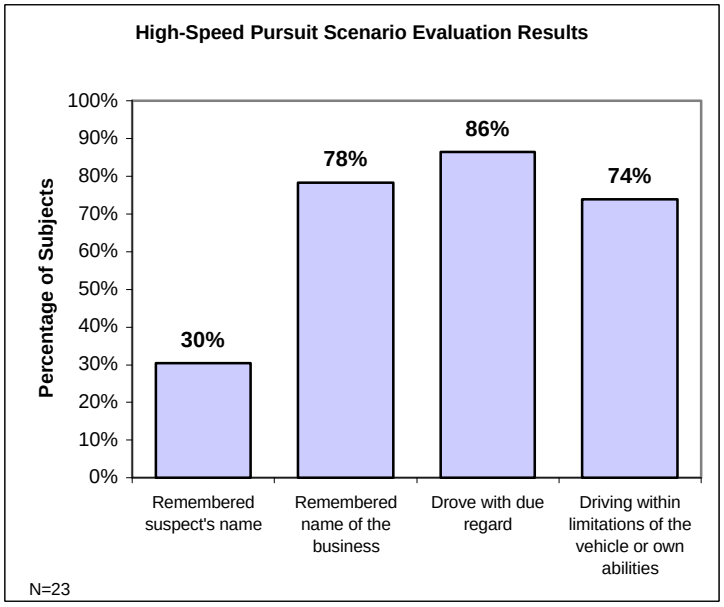

Figure 6. High-speed pursuit scenario evaluation results. Quantifies all participants' responses to the specific questions answered after the high-speed pursuit scenario.

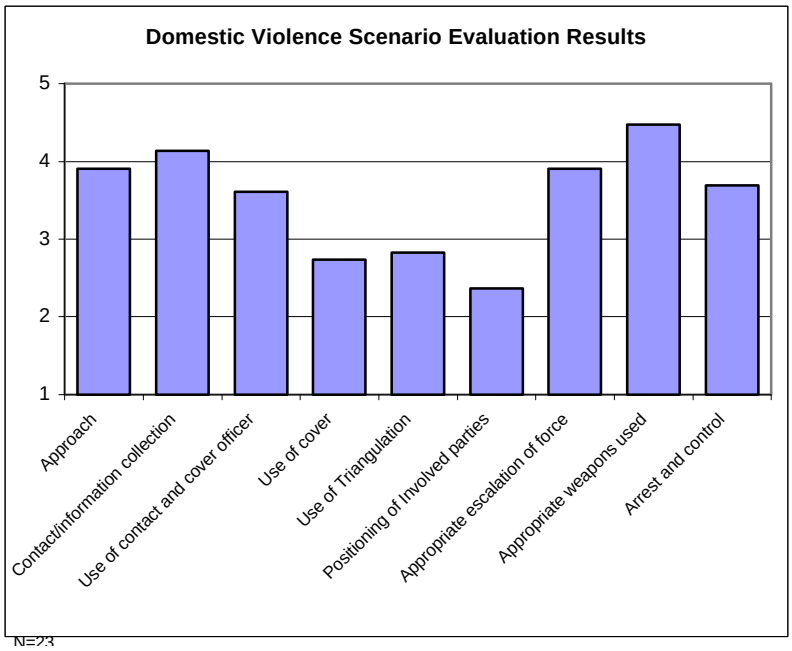

Figure 7. Domestic violence scenario evaluation results. Shows average evaluation scores for all participants for the nine specific areas assessed in the domestic violence scenario. Participants scored highest on average in the use of appropriate weapons and contact/information collection, while the poorest average performance was seen in the positioning of involved parties, use of cover and use of triangulation.

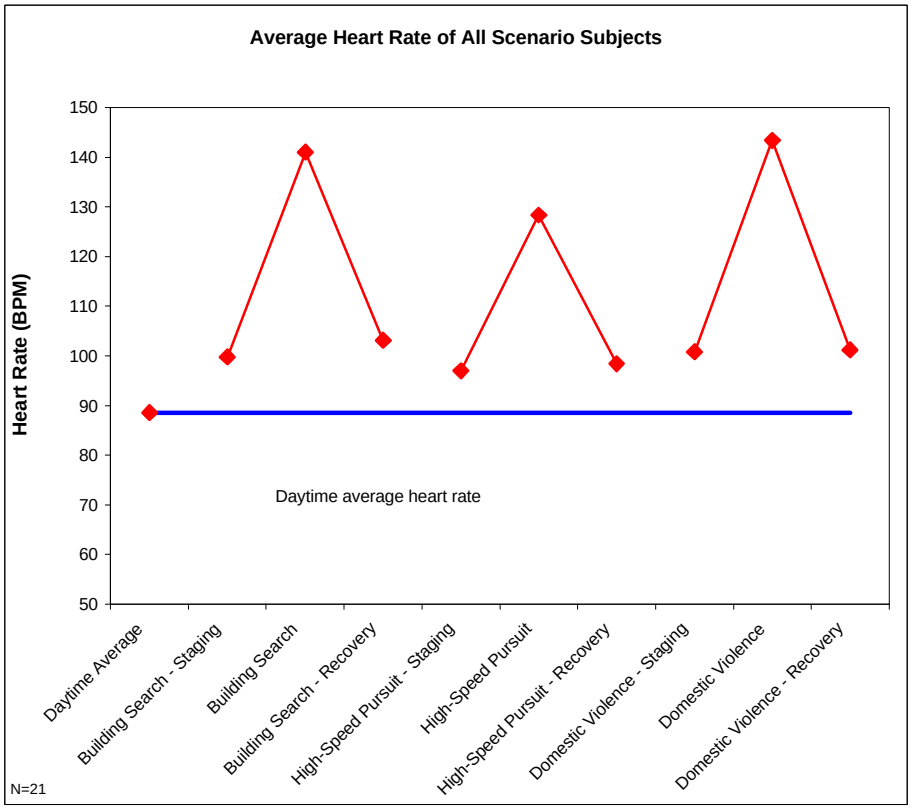

Figure 8. Average increases in heart rate during the scenarios. Plots average heart rate for all officers before (staging), during, and after (recovery) each scenario. The stress and activity of the scenarios produced profound elevations in officers' heart rates. The average heart rate was 140 bpm during the building search scenario, 128 bpm during the high-speed pursuit, and 143 bpm during the domestic violence scenario. These values represent increases of 40 to 55 bpm above the officers' normal average daytime heart rate of 88 bpm, which is indicated on the graph by the horizontal line.

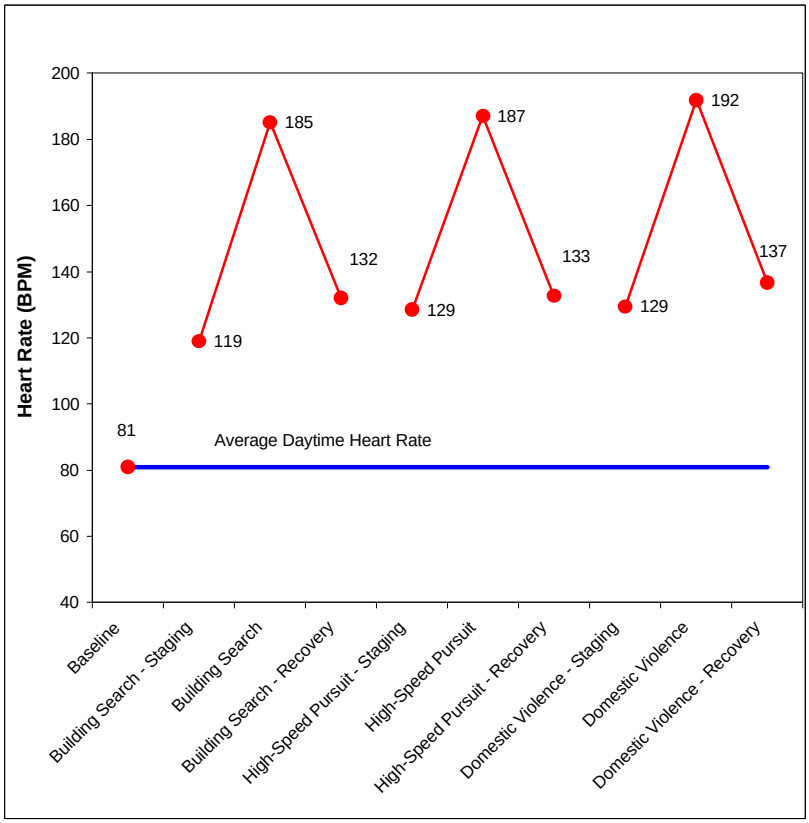

Figure 9. Heart rate changes in one officer during the scenarios. This graph provides an example of the increases in heart rate experienced by one participant during the three scenarios. During the peak action of all three scenarios, this officer's heart was beating faster than 3 beats per second. The largest increase occurred in the domestic violence scenario, with heart rate rising to 192 bpm. The officer's normal average daytime heart rate (81 bpm) is indicated by the horizontal line on the graph.

Heart Rhythm of One Officer During the Building Search Scenario

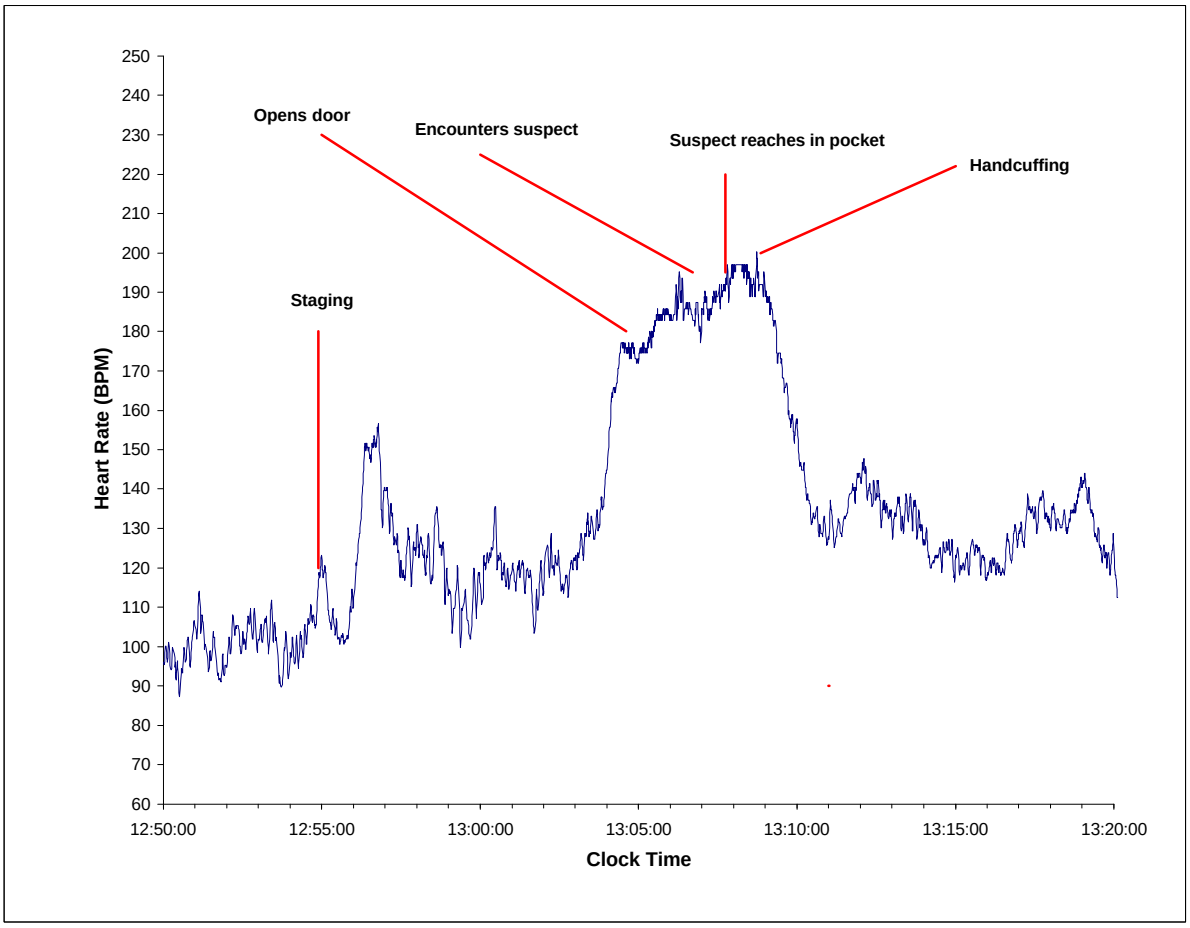

Figure 10. Heart rhythm of one officer during the building search scenario. This graph provides a typical example of an officer's heart rate variability (beat-to-beat changes in heart rate) during the building search scenario. Changes in heart rate are an important physiological indicator of stress and autonomic nervous system activation. Note the sharp and pronounced increase in heart rate as the officer prepares to enter the building. There is a further increase in heart rate as the officer encounters and interacts with the suspect. Although heart rate drops once the scenario has ended, it still remains considerably elevated, compared to baseline, for some time afterwards.

Heart Rhythm of One Officer During the High-Speed Pursuit Scenario

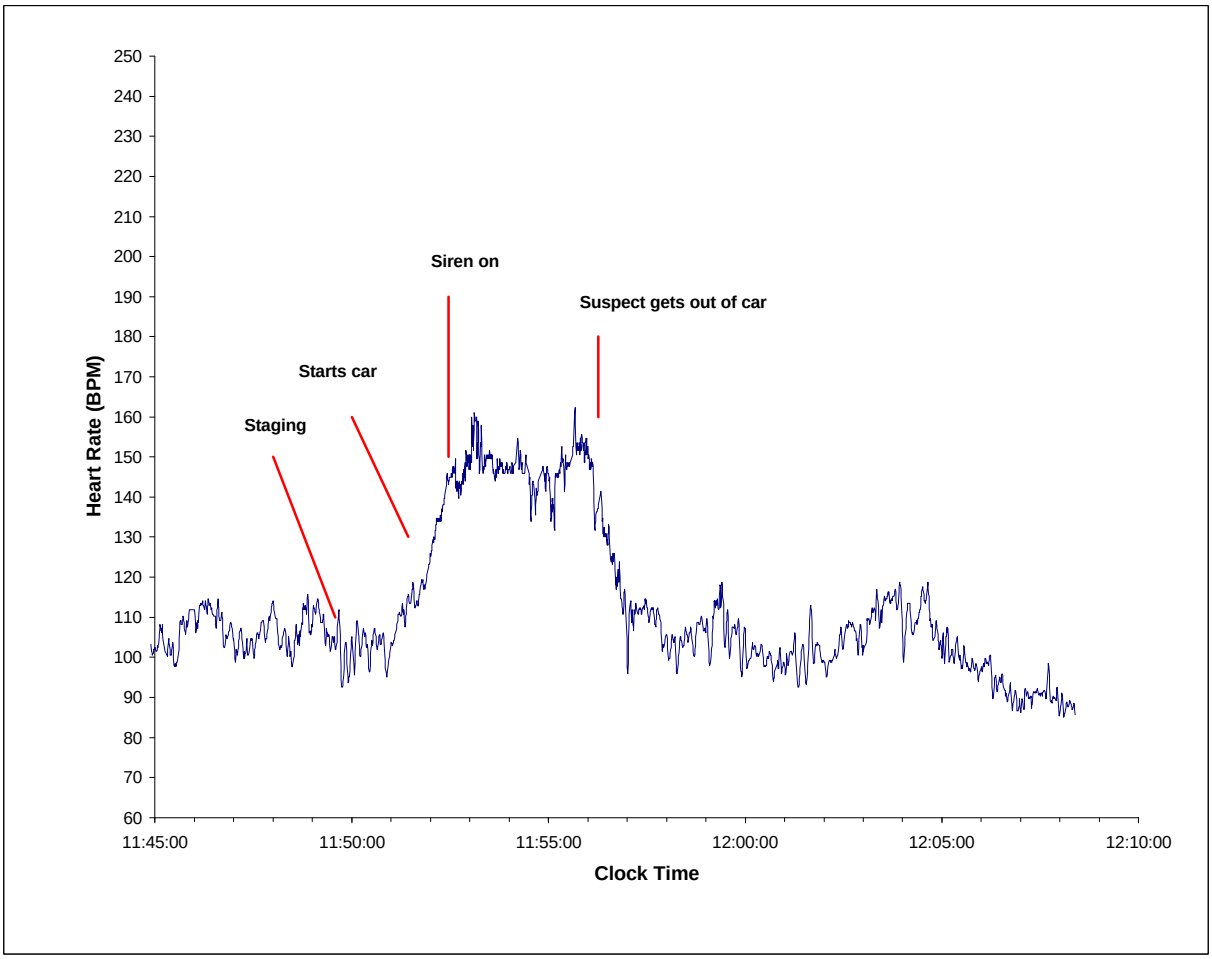

Figure 11. Heart rhythm of one officer during the high-speed pursuit scenario. This graph provides a typical example of an officer's heart rate variability (beat-to-beat changes in heart rate) during the high-speed pursuit scenario. The stress and physiological arousal experienced by the participant is reflected in the large and rapid increase in heart rate that occurs as the officer prepares to begin the chase. This elevated heart rate is maintained for the duration of the scenario.

Heart Rhythm of One Officer During the Domestic Violence Scenario

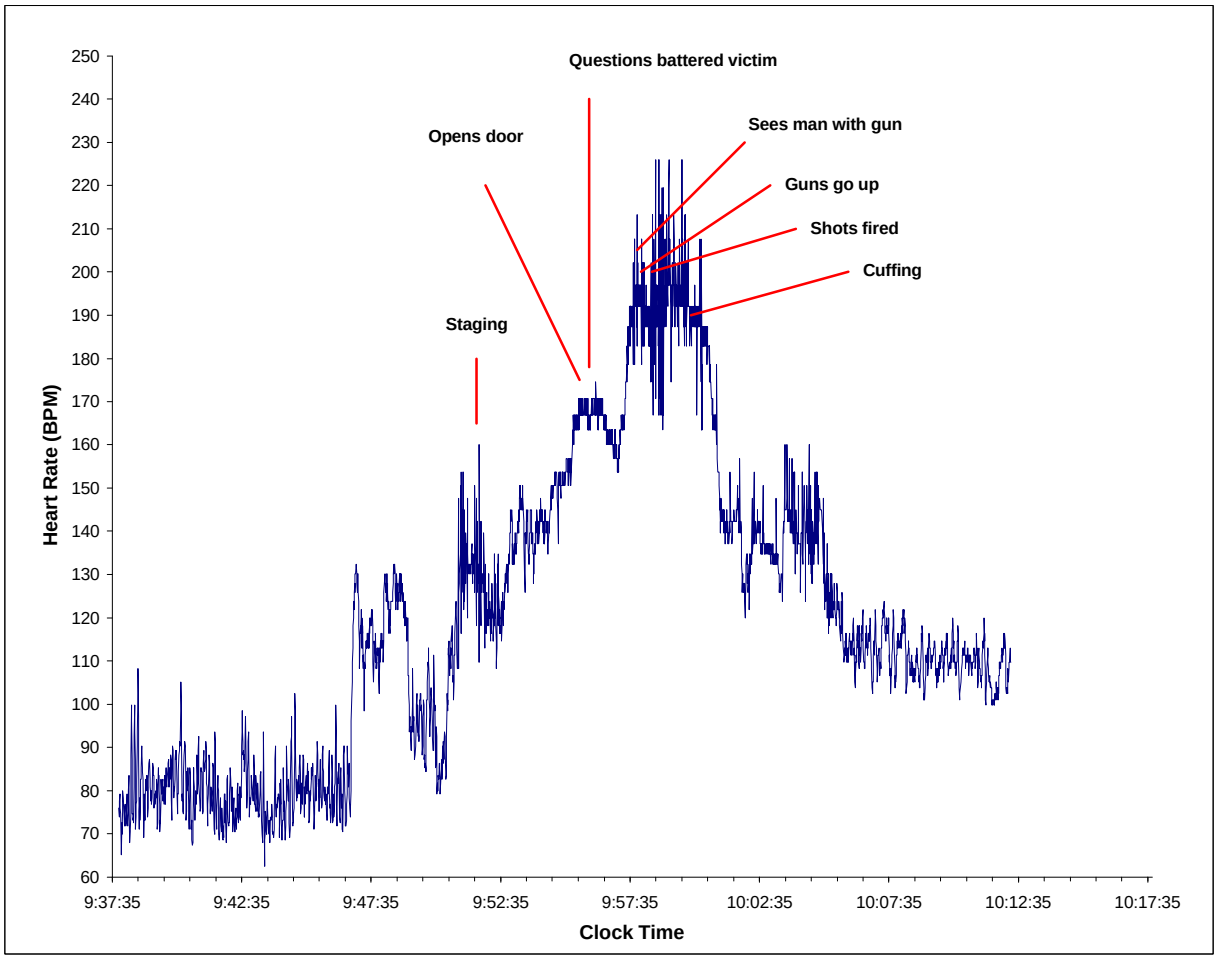

Figure 12. Heart rhythm of one officer during the domestic violence scenario. This graph provides a typical example of an officer's heart rate variability (beat-to-beat changes in heart rate) during the domestic violence scenario. Heart rate begins to rise as the officer prepares to enter the residence. There is then an extremely sharp, further increase in heart rate as the participant spots the armed suspect. During the peak stress of the scenario, as gun shots are fired between the officer and suspect, the officer's heart is beating at over 200 beats per minute -- faster than 3 beats per second. Heart rate begins to decrease once the scenario has ended, but still remains elevated at a level substantially above baseline. In this particular participant, it took over 2 hours after the scenario for heart rate to return to normal.

Heart Rhythm of One Officer Using Freeze-Frame
After the Domestic Violence Scenario

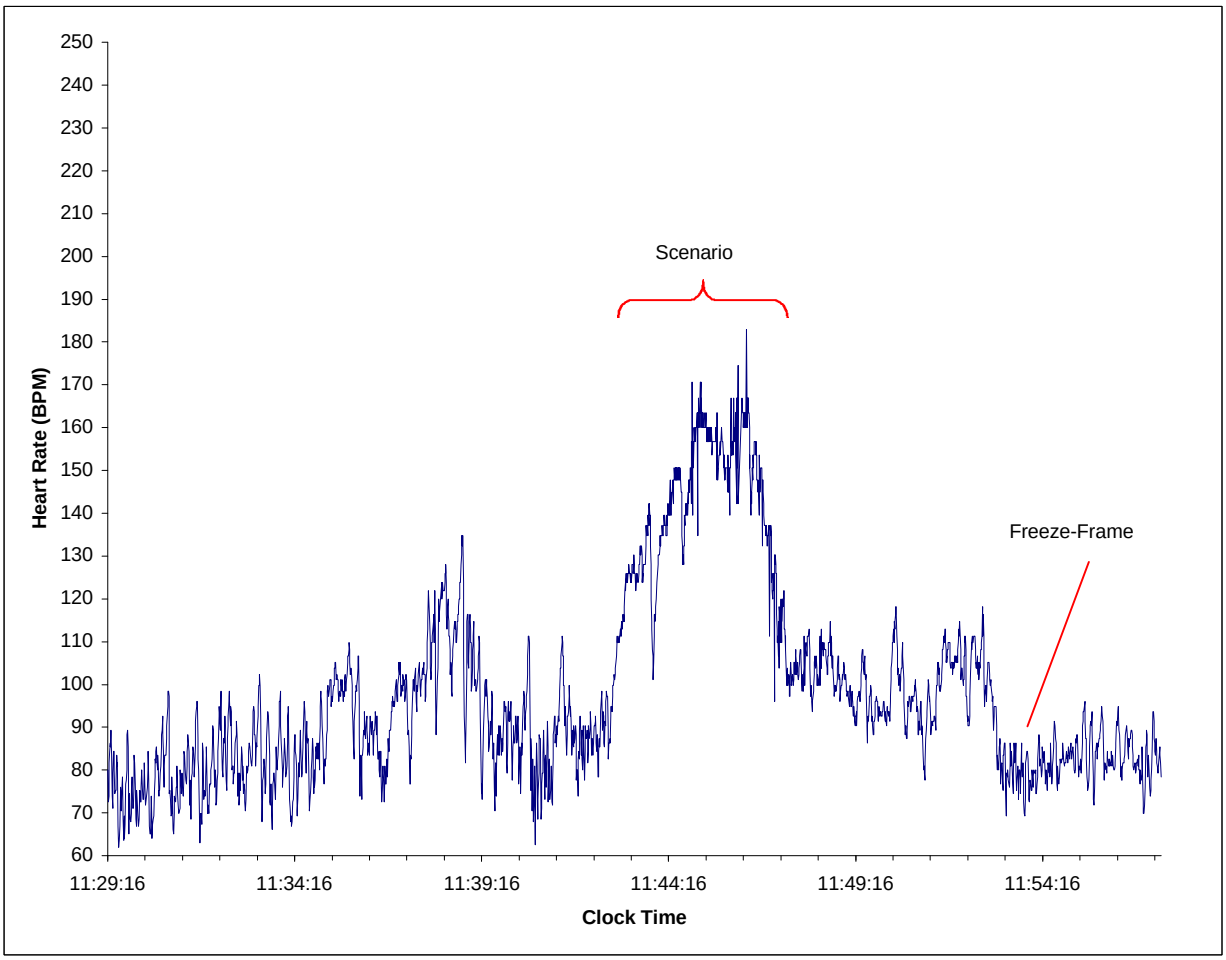

Figure 13. Heart rhythm of one officer using Freeze-Frame after the domestic violence scenario. This graph provides an example of the change in heart rate experienced by one officer who used the Freeze-Frame technique to help recalibrate after the stress of the domestic violence scenario. Note that when the scenario ends, the participant's heart rate begins to drop, but remains elevated in a range above its normal baseline range. As the officer uses the Freeze-Frame technique, there is an immediate, further reduction in heart rate back to baseline.

Average Blood Pressure During the Scenarios

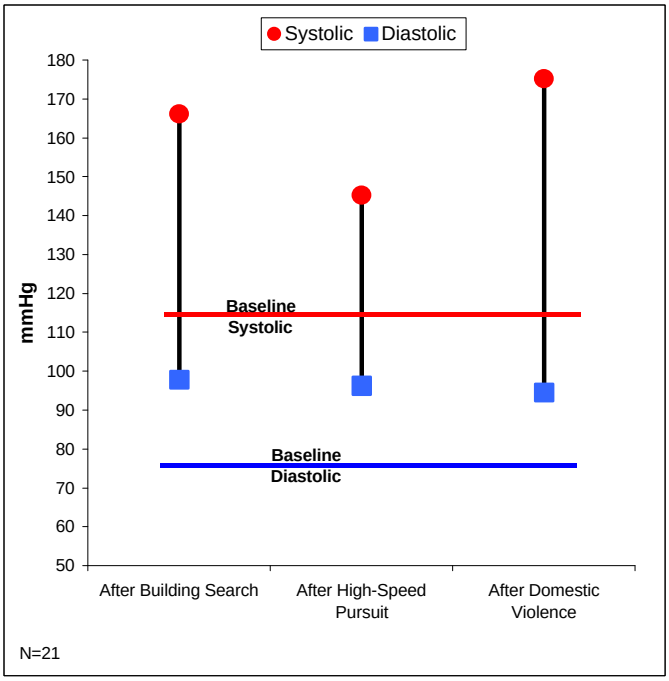

Figure 14. Average blood pressure during the scenarios. This graph shows the average systolic and diastolic blood pressure for all participants during each of the scenarios, as compared to a baseline reading taken on a normal workday on which the officers were not involved in the scenarios. For each reading, systolic pressure values are indicated by a dot, diastolic values are marked by a square, and the two values are connected by a vertical line. Baseline systolic and diastolic pressure values are indicated by the two horizontal lines on the graph. The stress and activity of all three scenarios produced significant elevations in blood pressure. The officers' average blood pressure was 166/98 mmHg after the building search, 145/96 mmHg following the high speed pursuit and 175/95 mmHg after the domestic violence scenario, indicating average rises of 40 mmHg for systolic and 20 mmHg for diastolic pressure.

Example of Blood Pressure Changes From One Officer

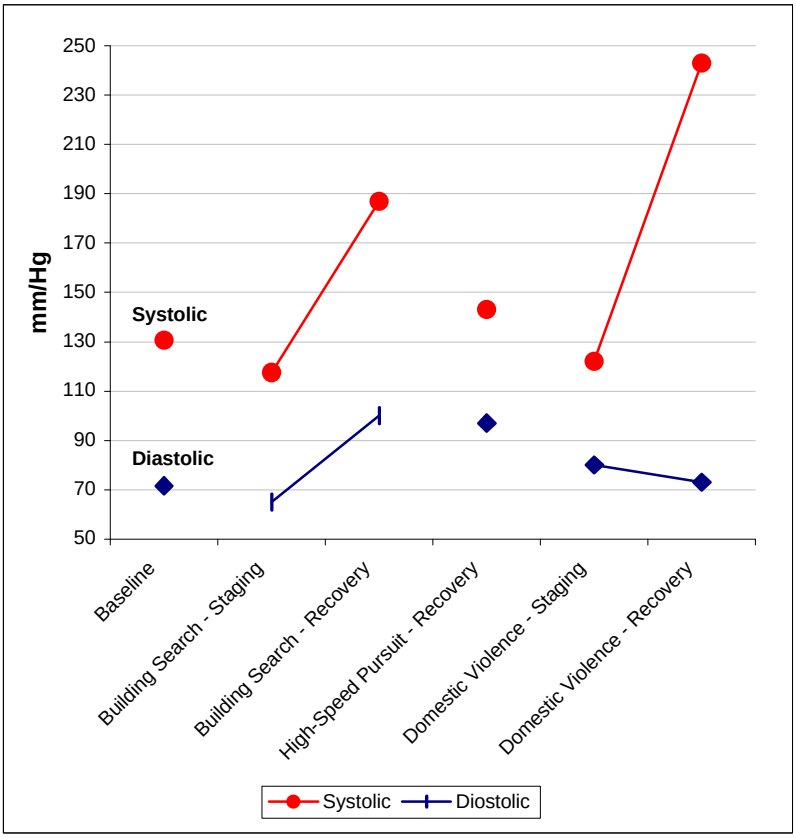

Figure 15. Blood pressure changes in one officer during the scenarios. This graph provides an example of the blood pressure elevations experienced by one participant during each of the scenarios, as compared to a baseline reading taken on a normal workday on which the officer was not involved in the scenarios. This officer experiences the largest increase in systolic pressure during the domestic violence scenario, with his systolic reading jumping from 122 mmHg before the simulations to 243 mmHg by the time the scenario has ended.

Systolic Blood Pressure in All Subjects Before and After the Domestic Violence Scenario

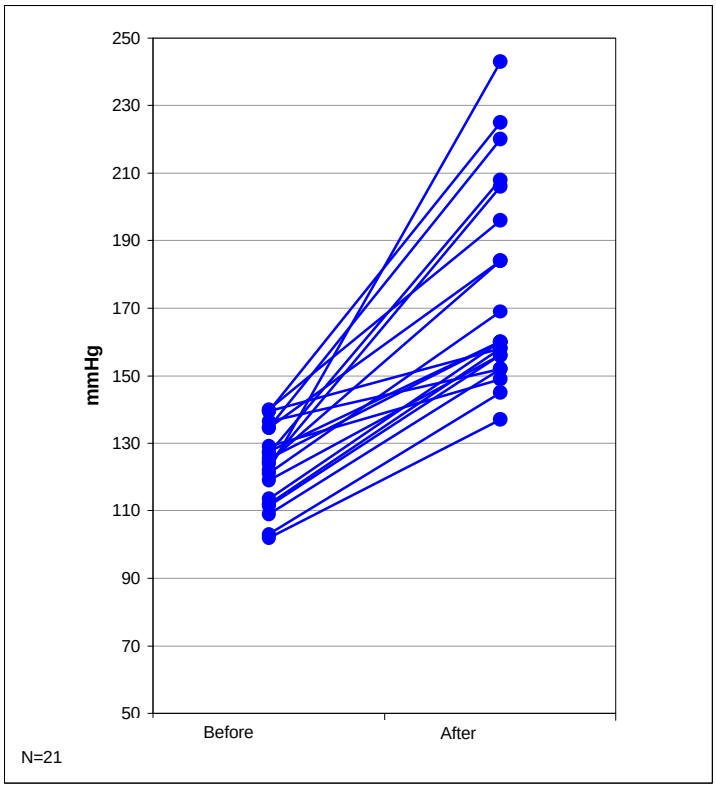

Figure 16. Systolic blood pressure increases in all officers during the domestic violence scenario. This graph details the individual changes in each officer's systolic blood pressure during the domestic violence scenario. There was substantial variation in the blood pressure responses among the different officers. In five of the officers, systolic blood pressure rose to over 200 mmHg during the scenario, indicating increases in the range of 80-120 mmHg above their starting values. The largest elevation in systolic pressure was from 122 to 243 mmHg (an increase of 121 mmHg). The smallest change measured was from 137 to 152 mmHg (an increase of 15 mmHg).

Average Increases in Blood Pressure: Group Comparison

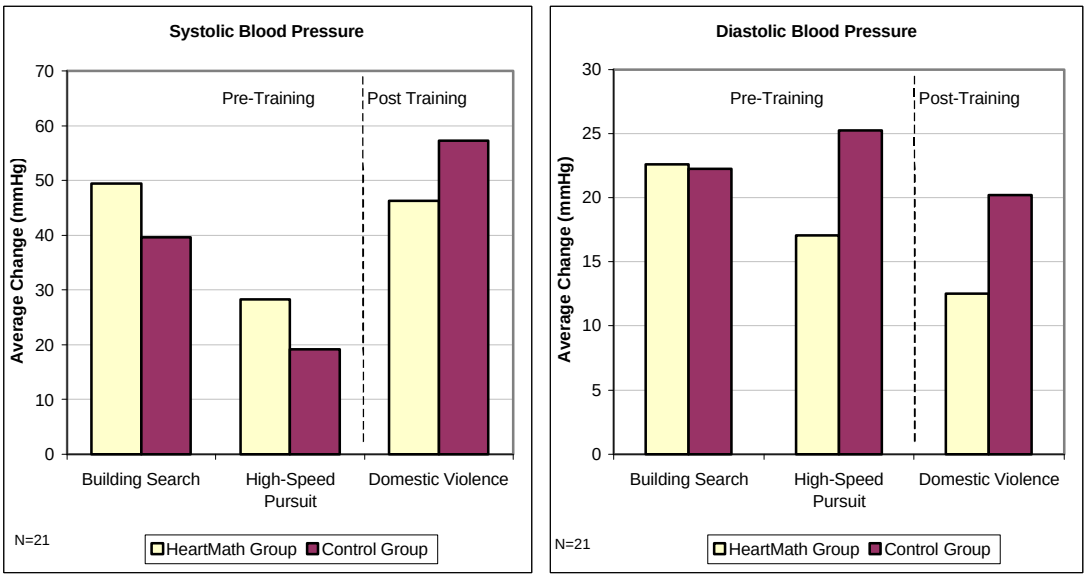

Figure 17. Average increases in blood pressure during the scenarios: HeartMath group vs. control group. These graphs compare the average amount of increase in systolic and diastolic blood pressure experienced during the scenarios in HeartMath group vs. control group participants. (Values shown represent the mean difference between the blood pressure readings taken before the scenarios and those taken immediately afterwards.) It can be seen that during the two scenarios conducted prior to the HeartMath training, (the building search and high-speed pursuit), the experimental group had a higher average increase in systolic blood pressure than the control group. However, after they were trained in the HeartMath techniques, this trend reversed: the experimental group had a lower average systolic blood pressure than the control group in the final scenario (domestic violence), which participants reported to be the most stressful. The average increase in diastolic blood pressure was also lower in the HeartMath group during the final scenario.

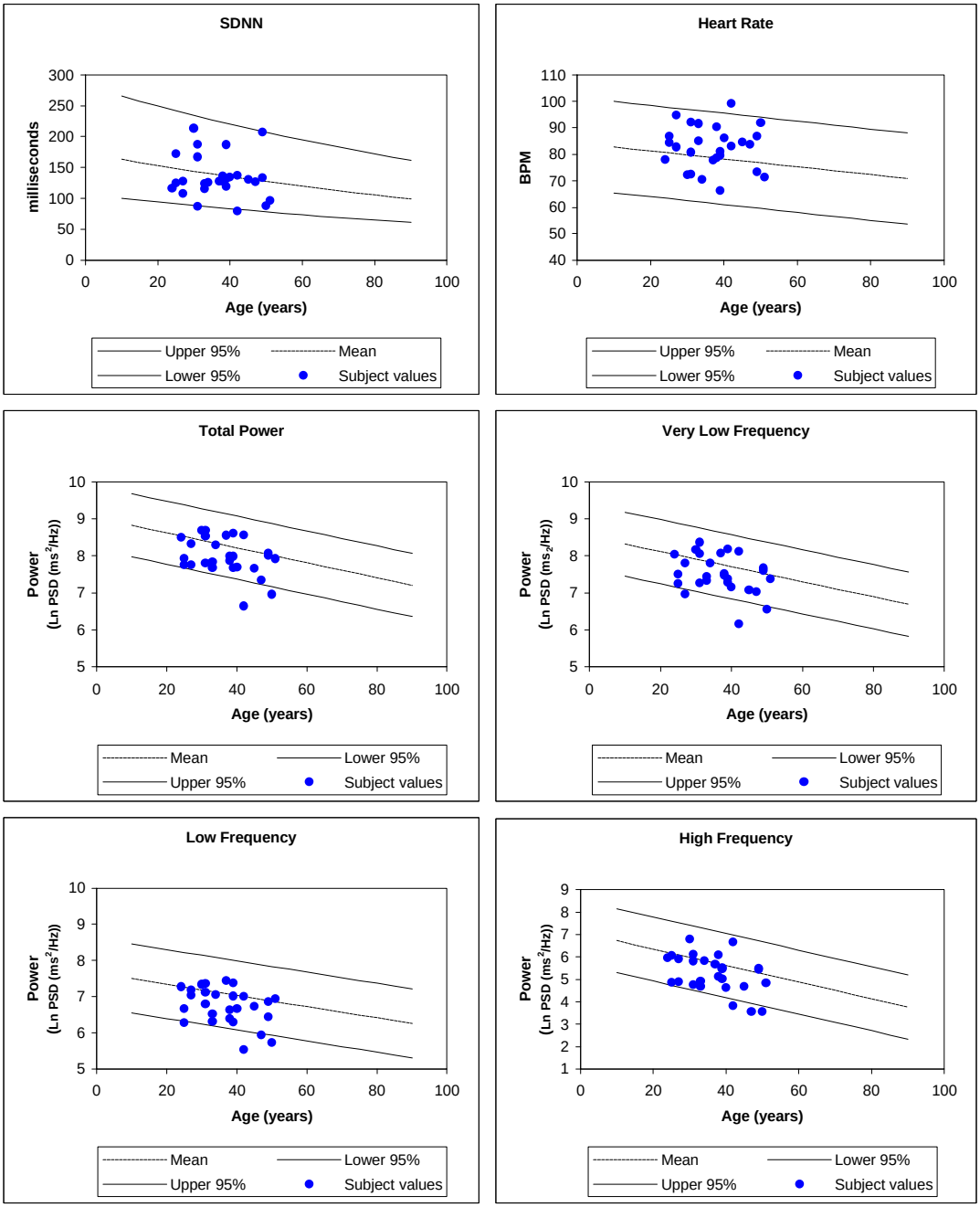

Figure 18. Risk assessment. This set of graphs summarizes risk assessment results for all officers analyzed. From the heart rate variability analysis of officers' baseline 24-hour electrocardiograms, six key measures of autonomic nervous system function and balance commonly used in risk assessment were calculated. The scatter plots show values for all participants analyzed for each of these measures. Power is plotted on the vertical axis and age is plotted on the horizontal axis. The descending diagonal lines on the graphs indicate the natural decline in heart rate variability that occurs with increasing age. Average values for normal healthy individuals according to age are indicated by the center dotted line on each graph, and normal reference ranges (95% confidence intervals) are delineated by the two solid lines. Note that for several of the measures (very low frequency, low frequency and high frequency power) three of the officers' values fall below the normal reference range for their age groups. This abnormally low heart rate variability places these individuals at increased risk of cardiovascular disease, sudden death and premature mortality from all causes. In this sample of police officers, 11% were found to be at high risk, which is over twice the ratio expected to be seen in a typical sample of the general population. This figure is consistent with results of epidemiological studies which reveal that police officers as a group have greater than double the average incidence of cardiovascular disease found in the general population.

DISCUSSION

The data collected in this investigation clearly illustrate the extreme degree of physiological arousal elicited by the acutely stressful circumstances to which police can be exposed in their work. It should be emphasized that the heart rate and blood pressure changes measured in this study occurred in response to scenarios that the officers knew were only simulations; thus it is highly likely that the degree of physiological activation officers undergo when exposed to real danger is even more profound. Of the different types of police calls simulated in this study, the domestic violence scenario was rated as the most stressful by the participants and also produced the greatest rises in heart rate and systolic blood pressure.

The heart rate recordings show that it takes the body a considerable amount of time to recalibrate from such intense levels of stress. In this group of officers, results showed that on average, heart rate remained elevated well above baseline for more than one hour after the scenario debriefing process had ended. Consideration of the intense physiological arousal that police officers endure in response to acute stress is of significance given the high rates of stress-related illness, particularly cardiovascular disease, in police. [10, 12] Police are known to have over twice the incidence of cardiovascular disease as the general population, and one study determined that being employed in law enforcement places one at a greater risk of developing cardiovascular disease than having high blood pressure, diabetes, being overweight or smoking. [12] In recent years, emotional stress has become increasingly recognized as a critical risk factor in cardiovascular morbidity and mortality. [48-50] While the body has built-in homeostatic feedback systems that enable it to recalibrate from stress-induced physiological responses, it has been shown using animal models that emotional responses to stress, if repeated consistently over time, can be sufficiently powerful to override the body's feedback systems and lead to chronic disease. In this way, initially reversible physiological adjustments to stress can eventually lead to exaggerated and persistent activity of the sympathetic nervous system and irreversible structural changes to the cardiovascular system, resulting in chronic hypertension or other pathophysiological conditions. [51-53] Chronic sympathetic activation can also result in eventual exhaustion of the autonomic nervous system, which has a body-wide impact, predisposing one to illness and increasing the risk of premature mortality. [40, 54]

Along these lines, the results of the heart rate variability (HRV) analysis revealed that three of the 27 officers tested fell below the normal ranges for their age groups in several key measures of autonomic nervous system function and balance, placing them at increased risk of cardiovascular disease, sudden death and premature mortality from all causes. The number of high-risk individuals identified in this study equaled approximately 11% of the sample, which is 2.2 times the ratio that would be expected to be found in an average population. This is remarkably consistent with the epidemiological findings indicating that police officers have 2.3 times the risk of cardiovascular disease as compared to the general population. [12] This study's findings therefore suggest that 24-hour HRV analysis can be a useful screening tool to identify at-risk individuals in organizational settings. Our work indicates that low HRV, often accompanied by fatigue, is frequently found in individuals who suffer prolonged or chronic stress. Encouragingly, a growing number of case histories show that consistent practice of the HeartMath techniques can help increase HRV and restore healthy autonomic function and balance in individuals who are at risk. [39, 40] We therefore recommend that once at-risk individuals are identified, they be given intensive training in these techniques to help them reduce stress and improve their health.

Heart rate variability is also a marker of the efficiency of the body's neural feedback mechanisms and reflects the individual's capacity to effectively organize physiological and behavioral resources in response to environmental demands. As with many of the body's regulatory systems, the greater the range of variability, the healthier the individual and the greater one's physiological and behavioral flexibility in response to external challenges. Thus, individuals with low heart rate variability have reduced capacity to adjust rapidly and respond effectively to stressful stimuli. [55] This is particularly relevant, as police officers are continually confronted in their work with numerous and diverse challenges, often occurring within a short time span, which require a wide range of behavioral responses. Quick adaptability and flexibility under stress determines an officer's capacity to respond efficiently and effectively to these external demands. The greater officers' response potential or possible range of behavior, the more likely they are to be able to deal efficiently and effectively with the challenges inherent in their work. By helping restore natural physiological variability in officers with low HRV, practice of the HeartMath tools can increase the behavioral flexibility that is crucial to optimal performance.

Overall, this study's findings point to the importance of achieving quick and deep recalibration following intense stress. This recalibration is also of prime importance at the psychological level, as stress hormones released during the "fight-or-flight" stress response are now known to suppress the function of higher brain centers concerned with concentration, inhibition of inappropriate responses or distractions, effective planning, decision making and other forms of rational thought. [21] There is also evidence that cortisol, the principal glucocorticoid hormone released under stress, inhibits memory retrieval. [56] For the police officer, the ability to think rationally under stress, to concentrate, plan ahead, remember and organize crucial information, make effective decisions and control inappropriate emotion-triggered reactions, is critically important, and in some cases can determine the difference between life and death for oneself and other parties.

This study's findings are encouraging, as the results of the interviews with the officers involved in the scenarios provide initial evidence that use of the self-management interventions learned in the study enabled the majority to recalibrate more quickly and deeply to a state of increased physiological and psychological balance following the simulations. Officers who used the Freeze-Frame technique before the scenarios also noted that it helped them feel more centered, balanced and confident in the midst of these stressful situations. These benefits are also reflected in the evaluations completed by the scenario training officers. The trends showed that in the two scenarios conducted prior to the HeartMath training, the experimental group scored lower on average than the control group in their ability to maintain focus, make appropriate decisions, communicate clearly during the de-briefing and regain balance after the scenarios. In contrast, in the domestic violence scenario, which was conducted after the HeartMath training, the experimental group scored higher than the control group in all these categories. This is also of consequence, as the domestic violence simulation was considered by participants to be the most stressful of the scenarios. Notably, a similar pattern was observed in the blood pressure trends, which showed that the experimental group had a higher average systolic blood pressure than the control group during the scenarios that occurred prior to the HeartMath training, but a lower average systolic blood pressure in the final scenario that was conducted after the HeartMath training. Diastolic blood pressure values for the experimental group were also lowest during the final simulation as compared to the scenarios that were conducted before the self-management training.

Human responses to acute stress are readily felt and generate strong feedback in our systems, driving us to regain physiological and psychological balance through both automatic bodily mechanisms and conscious actions. In contrast, life's chronic stressors, including job pressures, strained interpersonal relationships, communication difficulties and unmanaged negative thought and emotional patterns, can be more insidious and ultimately even more harmful, as they can

sustain a background level of emotional imbalance that causes a low-grade stress response to be chronically activated. With time, the body and psyche "adapt" to this less-than-optimal functional state, which continually drains energy, obscures mental clarity, causes performance to deteriorate, and produces wear and tear on our internal systems, promoting physiological responses that accelerate aging and disease progression. [57] It is therefore particularly encouraging that the techniques in this study had a measurable effect on participants' ability to effectively manage the chronic stress in their lives. Results revealed significant reductions in global negative emotion, stress and depression as well as increases in peacefulness and vitality over the six weeks of the study. Anger, sadness and anxiety were also reduced, as were several physical stress symptoms.

One of most prominent effects of the integration of the HeartMath techniques among the trained officers in this study was greatly improved listening and communication. The program assessment interviews indicated that these improved communication skills had a significant impact both within work teams and in officers' relationships with their spouses and families -- two key areas in which a typical lack of effective communication is a significant and well-recognized source of stress in the lives of many police officers. [2, 10] In this study, results indicated that the officers' increased ability to listen more effectively to one another resulted in less competition, greater cooperation and team cohesiveness, and increased work efficiency. In particular, officers in supervisory positions expressed a greater readiness and capacity to listen with greater sincerity and care to their staff members, and noted how this created an improved work environment and greater cooperation from employees. It is a likely possibility that these benefits contributed to the significant increase in overall work performance seen over the course of the study. Officers' implementation of their improved communication skills at home also produced significant benefits, with 75% of the participants noting an improvement over the course of the study in their capacity to listen patiently to family members and to be understanding of their concerns. Officers' comments suggest that sincerely applying this increased care and sensitivity in their personal relationships could help dissipate a significant amount of the underlying stress in this key area of their lives.

The greatest and, in our view, most important effect of the self-management training was seen in the participants' increased ability to manage their moods. Eighty-three percent of the participants noted an improvement in this area. This is of particular significance, as research on human stress has clearly shown that it is really our unmanaged internal mental and emotional *reactions* to situations and events that are the most fundamental *source* of the "stress" we experience. Notably, in a recent study of job stress in police officers, individuals' confidence in their ability to manage their negative emotions was shown to effectively buffer the negative physiological and psychological effects of occupational stress. [58] Officers who believed they could not control the negative emotions they experienced proved to be more vulnerable to the negative consequences of occupational stressors, and reported increasingly severe distress as the frequency of occupational stressors rose. On the other hand, officers who were confident in their own ability to manage their negative moods were less likely to experience physiological and psychological distress, even if they were exposed to high levels of potential stressors.

The HeartMath interventions are specifically designed to target stress at its source by helping individuals reduce or transform negative mental and emotional responses as they are experienced. In this study, providing officers with practical, easy-to-use tools to recognize and eliminate stress in the moment significantly increased participants' awareness of their stress, as well as their confidence in their own ability to effectively manage or transform stressful emotional reactions. Results suggest that the application of these improved coping or emotional management skills reduced the stress officers felt in a variety of areas of their lives, including significant relationships and interactions at work and at home, as well as helping them to achieve deeper levels of internal

balance during and after acutely stressful situations. For a summary of the key benefits of the HeartMath training gained by police officers in this study, see Box 1.

Box 1. Key Benefits of the HeartMath Training for Santa Clara County Police Officers

- Increased awareness and self-management of stress reactions
- Reduced distress, anger, sadness and fatigue
- Reduced sleeplessness and physical stress symptoms
- Increased peacefulness and vitality
- Reduced competition, improved communication and greater cooperation within work teams
- Improved work performance
- Greater confidence, balance and clarity under acute stress
- Quicker recalibration following acute stress
- Improved listening and relationships with family

One advantage of the Freeze-Frame technique learned by participants in this study is that, in contrast to many relaxation or exercise stress management protocols, the technique does not require an extended block of time or separate space outside the normal workplace environment to practice. Rather, it is specifically intended for use in the midst of stressful situations, when it is most needed. This benefit is particularly relevant for police, whose jobs often demand that they be constantly vigilant and able to maintain inner balance and clarity in the midst of performing their duties, frequently under highly stressful circumstances. Further, our experience with numerous individuals indicates that with practice, the self-management skills facilitated by the HeartMath techniques become essentially "automatic" and can therefore be effectively implemented in moments of crisis without any time lost. An additional advantage of the techniques used in this study is that they are quickly and easily learned, and can yield immediate benefits if used sincerely. It is of note that significant improvements in several areas that are commonly recognized as major sources of stress in police were achieved in this study in as little as one month's time after the completion of the HeartMath training. This also presents the possibility that additional improvement could be achieved with continued practice of the techniques over a longer time period.

CONCLUSIONS AND FUTURE DIRECTIONS

Police officers as an occupational group endure particularly high levels of stress. The physiological, psychological and behavioral effects of stress in police can be severe, and include extremely high rates of suicide, alcohol use, cardiovascular diseases and other stress-related illnesses. Chronic

anxiety, depression, psychological burnout and disrupted family relationships are other common manifestations of prolonged unmanaged stress in police officers. In the line of duty, the inability to effectively manage one's stress responses can significantly impair judgment and decision making abilities and in the extreme can result in the inappropriate application of force, driving accidents, injury and death. These consequences severely compromise public safety and can lead to citizen unrest, lawsuits and high liability costs to police agencies. The numerous and severe effects of stress in the police profession clearly point to the need for effective stress management strategies for this population.

The results of this investigation provide convincing evidence that the application of practical stress and emotional management techniques can reduce damaging physiological and psychological responses to both acute and chronic stress in police, and positively impact a variety of major life areas in a relatively short period of time. Officers who practiced the HeartMath techniques during this study experienced marked reductions in negative emotions, fatigue and physical stress symptoms as well as increased peacefulness, physical vitality and improved work performance. In particular, significant improvements occurred in communication difficulties at work and in strained family relationships, two prominent sources of stress for police. Results suggest that the techniques provided in this study were effective in reducing the most fundamental source of participants' stress by giving them greater ability to manage and transform stress-producing perceptions and negative emotional reactive patterns.

This study also provides important insight into the physiological impact of acute on-the-job stress as experienced in real time by police officers, as measured by cardiovascular responses to simulated police call scenarios. The acute stress of the scenarios produced rapid and pronounced increases in heart rate and blood pressure, from which it took officers a considerable amount of time to recover. The HeartMath interventions helped officers maintain greater clarity and inner balance under the pressure of these high-stress situations and also enabled them to recalibrate more quickly afterwards, both psychologically and physiologically. In addition, this study points to 24-hour HRV analysis as a useful screening tool to identify officers who are at increased risk of developing serious long-term health problems, so that efforts can be made to reverse or prevent the onset of disease in these individuals. Intensive training in stress management interventions known to increase HRV and improve autonomic nervous system balance can be of particular benefit for officers who are at-risk.

While additional research is clearly needed to explore the longer-term effects of the interventions employed in this study, the results of this initial investigation suggest that in the long-term, gaining increased levels of emotional self-management could potentially benefit police officers in a wide range of capacities. These potential benefits include: enhanced work/life balance; a reduction in the high rate of domestic problems, particularly divorce; improved work climate and organizational effectiveness; reduced cardiovascular morbidity and improved overall health; and reduced early retirement for stress-related causes. In addition, providing training in practical self-management strategies could help alleviate some of the major organizational burdens faced by police forces. For example, officers with competence in self-management skills are likely to make better decisions when confronted with challenges in the line of duty, resulting in reduced use of inappropriate or excessive force, fewer accidents, fewer citizens' complaints, fewer lawsuits, and reduced liability costs at the individual agency level.

The continued and accelerated rise of stress and unrest in today's societies is likely to mean an increasing workload for police in the future. The need for officers to maintain internal balance through these unbalanced times will likely generate an increased emphasis on training in stress and self-management for those employed in law enforcement. The integration in police training of programs providing officers with practical and effective self-management techniques has

enormous potential to result in more comprehensive training for officers in skills enabling them to perform their jobs with greater effectiveness and ultimately provide better protection to the citizens whom they serve.

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