

The Forensic Force® Series: Psychophysiological Responses to TASER®-ECD Influence

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Background

One of the most pressing problems within the law enforcement and use-of-force instructor communities is the reconciliation of force deployments with subject noncompliance and resistance. With the advent of more sophisticated and effective Electronic Control Devices (ECD), most notably produced by TASER® International, many officers have elected to use this quantum of force in place of oleoresin capsicum (OC) sprays, impact weapons, and physical control techniques.

There have been a number of controversial ECD deployments upon noncompliant or physically resistive and combative subjects, including a number of incidents involving in-custody deaths in which ECDs were used. As a result, the media, the public, and the courts have significantly increased their scrutiny of ECD use by law enforcement.

A new decision by the U.S. Court of Appeals for the 9th Circuit in *Bryan v. McPherson* (2010), discussing the appropriateness of a TASER® ECD as a “non-lethal, but intermediate quantum of force,” has joined the historically more notable federal force guideline cases. These cases provide use-of-force instructors and officer end users with force consideration and management parameters. Law enforcement officers are reminded that the Fourth Amendment which addresses aspects of search and seizure and our use of force, requires that we are obligated to balance “the nature and quality of the intrusion (quantum of force used) against the countervailing governmental interests at stake (the need for that level of force)” (*Graham v. Connor*, 1989).

As the 9th Circuit Court recognized in *Bryan* and the 8th Circuit Court in *Brown v. City of Golden Valley* (2009), and as use-of-force instructors and officers know, while ECDs have been described as capable of delivering a 50,000 volt charge, this does not accurately describe the electrical impulse actually experienced by an ECD-influenced subject. Depending upon a number of unique circumstances, the full 50,000 volts do not enter the subject’s body but are sometimes needed to ensure that the electrical current can complete a circuit through the air or the subject’s clothing. In fact, and again depending upon each unique set of circumstances, TASER’s® X-26 model ECD normally delivers a peak voltage of only 1,200 volts to the body.

There is much discussion within the law enforcement, legal, media, and ECD manufacturing communities as to what the actual physiological effects of ECD

influence—referred to as *load*—are upon the body. Much of the research that has been published has been manufacturer driven and is obviously open to interpretation, scrutiny, and speculation. While there have been some independent studies of the physiological effects of ECDs, to our knowledge there have been no studies on the psychological effects of a subject who is under an ECD load.

The investigators wished to conduct a limited, independent research experiment on the psychophysiological effects of an ECD load upon test subjects. This project was funded by Martinelli & Associates: Justice & Forensic Consultants, Inc. of Temecula, California. This forensic and law enforcement consulting and training firm conducts independent use-of-force research and forensic investigations and has no financial ties or professional relationship whatsoever to any ECD manufacturer. Both investigators do provide forensic investigations and expert witness services in criminal prosecution and civil rights litigation in the areas of police/corrections practices and use of force/excessive force involving ECDs.

Test Hypothesis, Tasks, and Determinations

1. It is known that a strong electrical current acutely introduced into the body will hyperstimulate the Central Nervous System (CNS), the Sensory Nervous System, and the Motor Nervous System.

Task and Determination – Investigate the likelihood that a subject suddenly influenced by a strong electrical current will experience immediate sensory deprivation consisting of a loss of hearing and an inability to physically respond to and/or complete commands to perform one simple physical skill—to place their hands behind their back.

2. It is known that some subjects experiencing an acute and prolonged phobic stimulus may enter into a psychological state of panic, freezing, and confusion referred to as *hypervigilance*. It is hypothesized that the sudden introduction of a prolonged and extremely painful electrical stimulus as generated by an ECD through electrical probe injection or a “drive stun” nonprobe exposure will be sufficient to create hypervigilance in certain individuals. It is also hypothesized that this level of ECD load stimulus will be sufficient to cause panic, confusion, and disorientation within some subjects at a level that will obstruct/prevent them from comprehending or complying with any orders given by the involved officer.

Task and Determination – Investigate the likelihood of this occurrence.

3. It is known that subjects under the influence of directed pain will move away from the direction of that pain rather than move towards it. ECD electrical current within the body can be perceived as multidirectional by the person under load. It is hypothesized that certain individuals when acutely influenced by a strong ECD electrical current will experience a level of hypervigilance that will cause them to suddenly panic, become confused, and involuntarily attempt to physically escape away from the point of influence. This phenomenon will be referred to as *Pain/Panic Escape Response* (PER).

Task and Determination – Investigate the likelihood of this occurrence.

4. It has been well-documented that ECD electrical current flowing through the body negatively affects muscles and joints by stiffening and locking them up. Under this condition, subjects find it difficult or impossible to move. It is hypothesized that most subjects under the influence of an ECD load would be obstructed/prevented from completing any ordered physical tasks such as placing their hands behind their backs.

Task and Determination – Investigate the likelihood of this occurrence.

Methodology

Volunteers for this research project were recruited from three primary sources: (1) police officers attending TASER® ECD instructor certification courses for the first time, (2) recruits attending the Basic Police Academy program, and (3) officers attending TASER® ECD end-user certification courses (N = 100). In each case, the test subjects understood on some level, through lecture and videos of subjects under ECD influence, the dynamics of ECDs, with the specific ECD systems being either the TASER® model X-26 or X-3.

The test subjects were told that they were participating in a study to determine certain aspects of ECD load exposure. They also understood that the reason for the research was to attempt to improve the overall use-of-force training process.

Test Subject Profile

The test subjects ranged in age from 22 to 50 years of age with the average age being 30.15 years old. The test group included a cross section of genders and ethnicities of varying heights and weights. All test subjects were relatively healthy adults who were sober and without reported serious medical issues. There were no obvious differences in reactions to ECD exposure due to age, ethnic background, height, or weight.

Based upon Mr. Staton's professional experience in exposing thousands of officers to ECD loads and as is typical in similar exposures, some of the test subjects presented with a higher level of anxiety than others prior to exposure. However, the test subjects' anxiety level did not appear to have any affect on their ability to comply with verbal directions prior to exposure.

The method of ECD load exposure was to deploy either TASER® model X-26 or X-3 probes into the back of the volunteers while the subjects were lying in a prone (face down) position from a standard distance of six feet, with the probes positioned in approximately the same location for each subject. Prior to being exposed, the test subjects were not told what was expected of them except that after the exposure they would be required to complete a short questionnaire about what they had experienced during their ECD exposure. The test subjects were not aware that they were going to be given an order to perform a physical task. The test subjects were not allowed in the room where the exposure tests were being conducted until it was their turn to be tested. After being exposed, the test subjects were told to remain in the test room so as to avoid contact with other test subjects who were waiting to be exposed.

As soon as the probes were deployed and the ECD load had commenced, the test subjects were given three clear and loud verbal orders to "Place your hands

behind your back!” The investigators then made observations on the test subjects’ psychophysiological responses to the ECD electrical stimuli. Each test subject received only one automatic five-second cycle of electrical current from the ECD.

Results of the Study

This study resulted in a number of important findings for use-of-force instructors and end-user officers of ECDs, specifically those using an ECD manufactured by TASER® International. One interesting and confirmed finding was a new psychophysiological phenomenon identified by Dr. Martinelli as Pain/Panic Escape Response.

Pain/Panic Escape Response

The results of this study indicates that ECD neuromuscular incapacitation (NMI) appears to be so acute and painful as to overwhelm the sensory systems of many subjects to a point where they seek to physically escape from “custody” in order to avoid the painful effects of ECD NMI.

Fifty-four percent of the subjects tested reported experiencing a Pain/Panic Escape Response (PER) during which they wanted to physically escape from the location of the intense pain of the ECD load. This response appears to confirm a concept that many use-of-force arrest and control tactics instructors understand, which is that subjects most often move away from the direction of pain. However, when an ECD is involved, this involuntarily generated response appears to be significantly heightened as a direct result of the intensity and multidirectional nature of the electrical stimuli.

A new concern, as postulated by Dr. Martinelli and confirmed by the videos and questionnaire made in this study, is that subjects under ECD influence may experience an involuntary PER wherein the brain engages its automatic survival mechanism and orders the body to escape from the intense, acute pain of the ECD. This PER may be misinterpreted by involved officers as “resistance” to orders and commands while the subject is under load, which, in turn, may cause the officer to active the TASER® on the affected subject again or repeatedly to force his or her compliance.

Repeated activations may, in turn, create or exacerbate psychological hypervigilance during which the affected subject presents with panic, confusion, and loss of all rational thought and cognizant processing. It is notable that 13% of the subjects in this study reported presenting with hypervigilance consisting of panic, confusion, and “being too stressed to do anything.” Loss of forebrain cognitive processing, transitioning to midbrain automatic survival escape mechanisms, may completely preclude any possibility of the subject complying with orders to stop “resisting.” It is also believed that loss of forebrain cognitive processing would be exacerbated in those individuals already presenting with psychosis, mental illnesses involving slower or confused thinking, and/or those who are under the influence of alcohol and illicit drugs.

Although not scientifically confirmed, it may be possible in some rare instances for officers to create or exacerbate a preexisting psychophysiological “negative spiral” in psychotic and/or drug influenced subjects under an ECD load during prolonged or repeated exposure events. It is hypothesized by Dr. Martinelli that repeatedly

exposing this profile of subject to acute electrically induced NMI may increase the subject's basal metabolic rate (BMR) and psychological hypervigilance, thereby increasing the risk of Agitated-Excited Delirium Syndrome (AED/S). It has been well-documented that the medical phenomenon of AED/S has historically been linked to sudden in-custody death incidents. However, this same condition could occur as a result of other force options being used, which frequently prolong attempts to capture, control, and physically restrain a violent and combative subject with the same presentations.

ECD Influence Negatively Affects Hearing and Comprehension

Prior research has confirmed and use-of-force instructors, psychologists, and physiologists understand that when an individual experiences a phobic scale response (fear) due to a sudden threat, the brain immediately prepares the body to respond by involuntarily infusing itself with stimulants such as adrenalin and epinephrine, and pain blockers such as endorphins and dopamine (Grossman, 1996; Martinelli, 2010; Settle) While these "survival chemicals" stimulate the body to allow for faster and stronger defensive responses with limited to no sense of pain, they also create obstructions to normal survival mechanisms such as perceptual narrowing ("tunnel vision"), myopic vision, loss of depth perception, and auditory occlusion resulting in diminished or total loss of hearing.

As discovered from past psychophysiological studies, a combination of an acute and prolonged phobic scale response coupled with the sudden involuntary introduction of stimulants causes a sudden rise in the affected subject's BMR. The BMR is measured by heart rate, blood pressure, and respiration.

Numerous studies in psychophysiology confirm that while an individual's optimal performance "zone" lies somewhere between 90 to 150 BPM (beats per minute), a BMR in which heart rates climb to levels exceeding 200 BPM creates a circumstance where comprehension and cognitive processing, which occur in the forebrain, begin to rapidly deteriorate. A transition then takes place during which normal survival protocols or the "defense hierarchy" rapidly move from the forebrain into the midbrain where trained defensive "automatic" memories are ingrained and such instinctual survival responses such as "fight or flight" are found. The stress-inoculated subject will most likely enter into a state of psychological hypervigilance in which the subject may present with such symptoms as increased agitation, panic, confusion, incoherence, psychological "freezing," or PER.

It is critical that use-of-force instructors teach and ECD end-user officers understand that absolutely no cognitive processing or rational thought takes place in the midbrain. Therefore, no amount of screamed, repeated orders or uses of an ECD for "pain compliance" induced via probes or "drive stuns" will be effective in forcing comprehension and compliance of some subjects who are under an ECD load. In fact, repeated TASER® exposures of the subject may create quite the opposite effect by generating an involuntary PER.

This study documented that 80% of our test subjects indicated that they could hear the instructor officer's directions clearly, and 13% reported that they could hear only a portion of the directions. Seven percent of our test subjects reported that while they could hear some yelling, they could not decipher what was being said.

This finding is of significant importance since officers who have not been properly trained in basic human psychophysiology and its relationship to the use of force expect that every time they issue loud orders or commands to a noncompliant or resistive subject, that subject is fully able to comprehend and comply with those orders. Our research indicates that this is not necessarily the case. Further, it appears likely that officers who give orders to subjects while at the same time influencing them with an ECD may actually be hampering or totally obstructing that subject's ability to comprehend and comply with the officer's orders. Use-of-force instructors, especially those certifying or updating officers in the use of ECDs, including the TASER[®], need to be aware of and impart this important information to their students.

The hearing problems experienced by our test subjects are consistent with auditory occlusion/exclusion that frequently occurs during high stress situations when the body pools blood and fluids away from the auditory canals and toward the center of the brain as a survival mechanism.

Officers learn in use-of-force classes that comprehension of directions and orders given to noncompliant or physically resistive subjects is critical in achieving compliant behavior. In the U.S. Supreme Court decision *Tennessee v. Garner* (1985), the Court stated that, whenever possible, officers are required to provide the noncompliant or resistive subject with reasonable orders prior to the deployment of force. Reasonable warnings given prior to deployment of an ECD allow the resistive subjects to consider the consequences of further resistance and provide them with an opportunity to comply with the officer's orders. However, what happens when an officer's orders to a resisting subject to stop resisting and place his or her hands behind his or her back are given while the subject is under an ECD load?

ECD Influence Impairs or Obstructs the Ability to Physically Complete Tasks

One finding of our study was that an ECD load may impair or obstruct a noncompliant or physically resistive subject's ability to complete a physical task as ordered by an officer. As use-of-force ECD instructors and officers familiar with ECD dynamics understand, an ECD load creates neuromuscular incapacitation (NMI) that in most cases involuntarily and physically locks up muscles and joints in the body. Contemporary ECD training advises officers to handcuff and/or establish physical control while the resistive subject is under an ECD load.

A problem arises when untrained, improperly trained, and/or overly excited end-user officers repeatedly influence subjects who they believe to be continuously resistive but who, in fact, may be unable to physically complete orders to place their hands behind their backs because they are obstructed from doing so due to an ECD NMI. Dr. Martinelli has found this exact fact pattern to be prevalent in a number of civil litigation cases, including in-custody deaths he has reviewed as a forensic criminologist and police/corrections expert.

This study found that 87% of the subjects tested either experienced some difficulty or were totally unable to complete the physical task of placing their hands behind their backs when ordered by the instructor while under ECD NMI. Of the 87% who reported difficulty or an inability to complete the ordered task, 58% of the

test subjects stated their reasons for this were motor problems with a difficulty or inability to move hands and arms. Only about 13% of the entire test subject sample reported having little to no difficulty completing the task as directed while under ECD influence. Test investigators observing these individuals note that while they did move the hand on the unaffected side of the body to the back, they were not able to move the affected side hand or were only able to move it slightly. So even the ones who thought they complied did so in part but not totally.

The problem of officers unnecessarily and repeatedly influencing subjects with ECDs under the aforementioned circumstances can be easily remedied by training officers in basic psychophysiology and subject responses to ECD influence. Use-of-force and ECD instructors need to train officers in *submission recognition* and encourage the ECD end-user officer to take time to assess a subject's responses following initial ECD influence in order to determine whether or not the subject can comprehend and physically respond to their commands before deciding whether or not they should re-influence the subject. For this reason, instructors also need to reemphasize forcibly restraining and handcuffing resistive subjects while they are under an ECD load whenever it is safe to do so.

Officers attempting to control and restrain subjects also need to constantly evaluate the totality of rapidly evolving circumstances, including special circumstances in which it is known that the subject has a weapon but may have their hands/arms tucked underneath their body since repeated use of an ECD might be justifiable to secure a concealed weapon.

Study's Psychophysiological Findings and Conclusions

- This study has identified and defined a psychophysiological dynamic now referred to as the Pain/Panic Escape Response (PER) associated with ECD NMI. PER appears to occur involuntarily in some subjects when NMI becomes so acute as to overwhelm the subjects' sensory systems to a point where they seek to physically escape from custody in order to avoid the painful effects of the ECD NMI.
- PER may be misinterpreted by involved officers as resistance to orders and commands while the subject is under an ECD load. This perception, in turn, may cause the officer to activate the ECD on the affected subject again or repeatedly to force compliance.
- ECD NMI may cause a loss of forebrain cognitive processing and a transitioning to midbrain automatic survival escape mode. This, in turn, may preclude the ability of the subject to comply with orders to stop resisting. It is believed that loss of forebrain cognitive processing may be exacerbated in those individuals already presenting with psychosis, mental illnesses involving slower or confused thinking, Agitated-Excited Delirium Syndrome, and/or those who are under the influence of alcohol or illicit drugs.
- It may be possible in some rare instances involving the aforementioned subject profile that repeatedly exposing the subject to acute electrically induced NMI may increase their BMR and psychological hypervigilance to a point where the risk of AED/S is also increased.

- This study has documented that a significant number of test subjects exposed to an ECD load experienced hearing and comprehension problems with simple directions issued during exposure. The study also confirmed that an ECD load that creates NMI impairs or obstructs an initially noncompliant or physically resistive subject's ability to complete a physical task as ordered by an officer in a significant number of tested subjects.

Study's Training Recommendations

- Use-of-force ECD instructors must familiarize themselves with basic human psychophysiological and stress performance concepts sufficient to impart this knowledge to end-user officers during initial and periodic update training in the use of ECDs.
- ECD instructors need to incorporate submission recognition training, including role-playing scenarios, into all initial and periodic ECD training courses so that end-user officers can learn to recognize the difference between resistance and psychophysiological impairment of ECD exposed subjects.
- The use of any mechanized, technical ECD is a "perishable skill." Therefore, instructors need to do a thorough job of incorporating a variety of reality-based role-playing scenarios into each ECD training session. ECD training, including participation in scenarios, should take place every year.
- ECD training practicals, especially for the new and overly complicated TASER® X-3 model, should take place under simulated stress-induced conditions that involve darkness, excitement, loud noises, and other distractions to evaluate the end-user officer's ability to manipulate the ECD and make appropriate force decisions.
- ECD instructors should train and encourage end users to cuff under ECD load whenever it is safe to do so. Training scenarios should incorporate this tactic.
- Weapon retention training should be incorporated into every ECD course.
- All ECD end users should be exposed to an ECD load before being certified to carry and use the device. You cannot possibly hope to convince the general public and/or a plaintiff attorney that an ECD is a safe and effective defensive force or capture and control tool when you refuse to be exposed yourself.
- Since there are occasional malfunctions of ECDs, use-of-force ECD instructors should always incorporate alternate weapon transition training into every ECD course.
- ECD instructors should have enough equipment (ECDs, cartridges) for all end users in class as soon as budgets allow.

Study's Administrative Recommendations

- Agencies need to objectively evaluate products and not rely exclusively on a manufacturer's representations. Is the training impacted by a desire to increase sales? Is the content overly influenced by a manufacturer's efforts to avoid

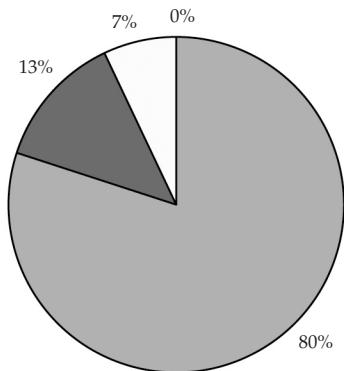
product liability? Does a manufacturer's course's lack of officer safety and capture and control tactics training expose agencies to liability? If this is the case, then agencies should have their own use-of-force instructors sent away for product training and then return home to develop ECD training courses that meet their agency's unique needs.

- Agencies should develop an ECD policy that can be accepted by that agency's general population. This policy should provide discretion to the end-user officer without giving them "free reign."
- Agencies employing an ECD should have a use-of-force tracking system in place that tracks ECD use so that the agency and community can monitor and evaluate the benefits and/or identify problems with ECD deployments.
- Agencies should be transparent with all use-of-force investigations involving ECDs so that the public can see what is being done to correct any deficiencies or problems in their agency's use-of-force program.

**TASER®-ECD Psychophysiological Response Experiment Statistics
(Researchers: Dr. Ron Martinelli and Jerry Staton)**

1. Grade your ability to HEAR directions while under the influence of ECD NMI (A-C-D-F).

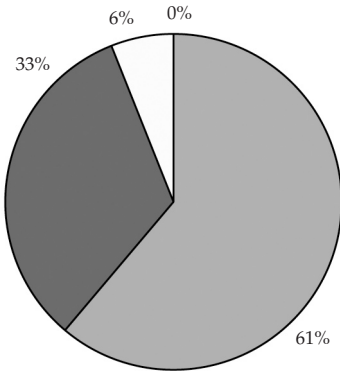
A	C	D	F	%
"I could hear the directions perfectly."	"I could not hear all of the directions. I could only hear a portion of the directions."	"I could hear someone speaking/yelling at me but could not tell what was being said."	"I experienced complete auditory exclusion. I could not hear anything that was being said."	
80%	13%	7%	0%	100%



- Could hear the directions perfectly
- Could not hear all the directions
- Could hear someone speaking/yelling but not what was being said
- Complete auditory exclusion

2. Grade your ability to COMPREHEND/PROCESS what was being said to you while under the influence of ECD NMI (A-C-D-F).

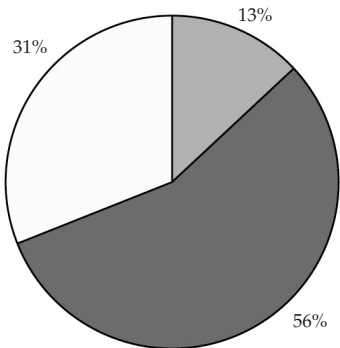
A	C	D	F	%
"I was able to completely understand and process what was being said to me."	"I could hear what was being said but had difficulty comprehending processing what was expected of me."	"I could hear someone speaking/ yelling at me but could not tell what was being said."	"I experienced complete auditory exclusion. I could not hear anything that was being said."	
61%	33%	6%	0%	100%



- Able to completely understand and process
- Could hear but had difficulty understanding
- Could hear yelling but could not tell what was being said
- Complete auditory exclusion

3. Grade your ability to COMPLETE THE PHYSICAL TASKS that you were being directed to do while under the influence of ECD NMI (A-C-F).

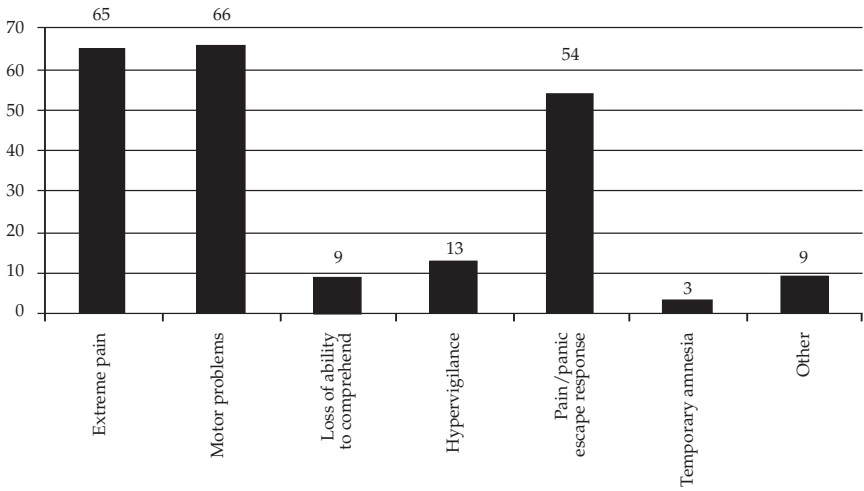
A	C	F	%
"I was able to physically complete the tasks as directed without difficulty."	"I experienced some physical difficulty completing the tasks as directed."	"I was unable to complete any of the physical tasks as directed."	
13%	56%	31%	100%



- Able to complete tasks: no difficulty
- Able to complete tasks: some difficulty
- Unable to complete any of the tasks as directed

4. Please list any psychophysiological symptoms you experienced while under the influence. (Multiple responses allowed. Total number of responses: 219.)

1	2	3	4	5	6	7
Extreme pain	Motor problems; difficulty or inability to physically move hands and arms.	Loss of ability to comprehend/process spoken directions.	Hypervigilance: feelings of panic, confusion, freezing; too stressed to be able to do anything.	Pain/Panic Escape Response: "I just wanted the pain to stop, and I wanted to escape from there."	Temporary amnesia while under ECD influence: "I don't recall what happened."	Other Wrote in other psychophysiological responses not covered.
65	66	9	13	54	3	9



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- Bryan v. McPherson*, 590 F.3d 767 (9th Cir. 2010).
- Chew v. Gates*, 27 F.3d 1057, 1061 (9th Cir. 2003).
- Deorle v. Rutherford*, 272 F.3d 1272, 1279 (9th Cir. 2001).
- Draper v. Reynolds*, 369 F.3d 1270, 1273 n.3 (11th Cir. 2004).
- Graham v. Connor*, 490 U.S. 386 (1989).
- Headwaters Forest Def. v. County of Humboldt*, 240 F.3d 1185, 1199 (9th Cir. 2000).
- Hickey v. Reeder*, 12 F.3d 754, 757 (8th Cir. 1993).
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- Mateyko v. Felix*, 924 F.2d 1473 (9th Cir. 1991).
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- Sancier v. Katz*, 553 U.S. 194, 201 (2001).
- Scott v. Harris*, 550 U.S. 372, 386, 394 (1989).
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