ARMY RESEARCH LABORATORY

Tracker Mindset for Explosive Device Emplacement Indicator Detection

by Kristin M. Schweitzer and Alan D. Davison

ARL-TR-6989 **September 2014**

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14. ABSTRACT
While investigating landmine detection training for the AN/PSS-14, we noticed operators were so focused on the detector's auditory output that they were surprisingly unaware of the visual indicators present from the emplacement process and even the landmine itself. We expanded our investigation to explore the possibility that visual detection training might improve landmine and improvised explosive device detection. We interviewed professional individuals who visually search natural environments, identified the methods they used to search an area, and analyzed the cognitive processes they used to interpret the information they perceived. We developed a curriculum based on the consistently successful methods most noted amongst the trackers and their approach to finding spoor. This study was a first step to evaluate the effectiveness of that visual detection curriculum. Our goal was to produce readily deployable training that unit leaders could use to improve their Soldiers' visual detection skills. Each of the 28 Soldier-Engineers we recruited to participate in the study completed a pretraining knowledge test, photograph test, and spoor pit test. They participated in classroom instruction and practical exercises and then retook the three tests. We conclude that the training positively influenced the Soldiers' ability to detect and interpret ground indicators, but we recommend improvements such as more varied and detailed indicators and scenarios before final deployment of the training.

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The project would not have been so successful without their assistance.

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Executive Summary

The goal of this work is to teach visual searchers to use an objective tracker's mindset to automatically sense and become aware of basic improvised explosive device (IED) features, to recognize suspicious areas, and to quickly interpret the traces that remain. Achieving the appropriate mindset should ultimately result in searchers finding an increased number of IED emplacement indicators, whether they are from actual devices or hoaxes. The training we developed for this study details how humans visually detect items; they first must sense the visual stimuli at the physiological level, then become aware of the objects at the conscious level, and finally interpret the implications of the objects at a conscious level. The driving principle is to sensitize searchers to the desired target's appearance. Through consistent, mindful practice a searcher may eventually transition the higher-level, conscious search task for a particular target into an automatic task that requires little to no conscious cognitive effort.

Performance on a knowledge test, a photograph test, and a spoor pit test was recorded for 28 Soldiers before they completed our training and again after our training. All three tests required answers to open-ended questions or a list of the individual's observations. Posttraining performance was superior in all but one case. While better performance was expected, the after action reviews captured the essence of the shift in thinking that many Soldiers began. They saw how light angle affected the visibility of indicators and how human behavior can be inferred from traces on the ground.

We conclude that our training positively influenced the Soldiers' ability to detect and interpret indicators on the ground. It is very difficult to quantify that influence, but Soldiers' comments indicate that their approach to visual detection followed the tracking principles that we introduced. The study focused on dismounted searchers, but the training may also have merit with mounted searchers. Ultimately we believe this training is very valuable to small unit leaders, whether deployed or at a home station, who wish to improve the unit's skills. The materials may be used as is, but several improvements are recommended before final implementation, such as more varied and detailed indicators and scenarios.

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1. Introduction

Terrorists strive to disrupt normal life in any way that might further their cause, and they will use any materials on hand to do so. The result is a mishmash of weapons and tactics that are challenging to fight with generic countermeasures. Arguably the most common and potentially devastating weapon of insurgent choice is an improvised explosive device (IED). An IED is a versatile weapon that can assume almost any appearance, fit into almost any tactical niche, and inflict anywhere from minor to extreme equipment or infrastructure damage. It can also be very deadly. Individuals with any range of experience, from an explosives novice to a war-hardened bomb expert, can construct an IED from readily available materials and tailor its function according to the planned target. With such variability, finding an IED after the terrorist has emplaced it is incredibly difficult.

The majority of IEDs that Soldiers find are detected using unaided vision. Consequently, the Department of Defense has focused intently on improving Soldiers' visual detection performance. Visual detection involves knowing what common IED components look like, what might be anomalies in the visual environment, and what tactical locations are most likely to hold IEDs. To identify individuals who will likely be good IED detectors prior to deployments or missions, researchers have attempted to find correlations between visual IED detection performance and natural abilities ranging from vision to internal motivation. For example, recent Joint IED Defeat Organization-sponsored research has shown that experienced Soldiers quickly process a visual scene using tactical and strategic considerations whereas novices process the scene using a simple search-and-find process (Murphy, 2010). Other studies support the fact that tasks become automatic for individuals as they gain expertise (Fautua, et al., 2010; Mourant & Rockwell, 1972).

This research was designed to evaluate the potential of using fundamental tracking skills to improve an individual's ability to see and interpret spoor—a trace by which the progress of someone or something may be followed (Merriam Webster, 2013)—and as a result be able to better detect IEDs and their indicators.

1.1 Project Background

"Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve as a silent witness against him. Not only his fingerprints or his footprints, but his hair, the fibers from his clothes, the glass he breaks, the tool mark he leaves, the paint he scratches, the blood or semen he deposits or collects. All of these and more, bear mute witness against him.

This is evidence that does not forget. It is not confused by the excitement of the moment. It is not absent because human witnesses are. It is factual evidence. Physical evidence cannot be wrong,

it cannot perjure itself, it cannot be wholly absent. Only human failure to find it, study and understand it, can diminish its value."

Dr. Paul Kirk (1902–1970)
Professor of Criminalistics
University of California, Berkeley

Dr. Edmond Locard (1877–1966), the father of forensic science, observed, "It is impossible for a criminal to act, especially considering the intensity of a crime, without leaving traces of this presence" (Locard, 1923). Restated more concisely, every contact leaves a trace. We know the traces of an IED emplacement must exist. We know an enemy was present and that they disturbed the environment in some way to lay the IED. We know that the enemy departed, leaving not only a device that is now an anomaly in the environment but their own spoor, a trace that follows them like a permanent shadow wherever they go. The question is, how do we find the traces?

1.1.1 How Humans See

Basically speaking, when light from the environment enters the eye, it stimulates the rod and cone photoreceptors on the retina to produce electrical impulses. Those impulses are then transmitted via the optical nerve to the visual cortex in the brain for processing.[*] The eyes constantly move in short, closely spaced fixations called saccades to collect enough images for the brain to build a mosaic of the scene. The brain then fills any gaps in the mosaic with assumed context. However, the brain can only process images at a few degrees per second, so it needs a 2–3 s dwell time at any given spot for good visual recognition. Fortunately, each fixation informs the next, subconsciously preventing people from unintentionally reviewing areas they have just seen and enabling them to search an area with near-optimal efficiency (Najemnik & Geisler, 2005). The whole process is called sensing, where the visual receptors receive or sense visual input.

In addition to informed fixations, the brain uses two basic visual strategies to recognize or perceive appropriate targets. Bottom-up knowledge is the subconscious perception of the basic components of a target and is driven by information from the senses. The saliency or prominence of the target's low-level features is measured by characteristics such as shape, contrast, color, orientation, texture, and motion (Itti & Koch, 1999).

Top-down knowledge is context or goal specific – the searcher knows what he is seeking (e.g., IED indicators) and is therefore more likely to recognize the target when his eyes sense it (Itti & Koch, 1999). Knowledge such as current intelligence or tactics influences the subconsciously perceived cues and contributes to an important memory phenomenon called automaticity.

[*] Rod cells are located around the periphery of the retina and are responsible for peripheral and night vision. Cone cells are centrally located on the retina and are responsible for foveal and (daytime) color vision.

Through consistent exposure to new scenarios and target configurations a searcher will become more sensitive to that target's appearance. He will eventually transition the higher-level, conscious search task for that particular target into a task that requires little to no conscious cognitive effort – the process becomes automatic (Holt & Rainey, 2002).

Why is automaticity important? Automaticity influences several different aspects of visual detection. The most important is that it helps people identify IED emplacement indicators more quickly, which equates to stopping further away from potential IEDs. Standoff distance normally dictates the magnitude of damage a unit might incur, so skills that can increase standoff distance may reasonably increase personnel safety and reduce materiel damage. Automaticity can also reduce or eliminate the sensitivity decrement in vigilance tasks. For example, after the first half hour of a task, operators typically experience a steep decline in vigilance. However, with observers who are so highly practiced that a task has become automatic rather than controlled, the sensitivity decrement to signals or targets is basically eliminated (Holt & Rainey, 2002).

Automaticity affects the way people approach a task. Mourant & Rockwell (1972) conducted a driving study that compared novice drivers' fixations to expert drivers' fixations. The study found that novice drivers would fix their foveal vision on the road and roadsides. They wanted to see each individual component of the task in focus and react in a very controlled manner. The experts on the other hand, used their peripheral vision to monitor the vehicle's path and subconsciously make minor corrections as needed. They viewed the scene holistically and reacted automatically (Mourant & Rockwell, 1972). An everyday example of this is driving while tired. It is not uncommon for an experienced, sleepy driver to arrive at their destination, startled because they did not remember the drive there. Automatic control of the driving task allowed the driver to control the vehicle while their attention was not on the task.

Murphy found similar results involving IED detection. While novice Soldiers would methodically search a photograph scene for individual IED indicators, experienced Soldiers would view the whole scene from strategic and tactical perspectives first, and then focus their conscious search in those areas most likely to contain IEDs (Murphy, 2010). The whole is different from the sum of its parts, and experts and novices were seeing different pictures.

The bottom line is that when the primary search task becomes automatic, more processing power is available for the searcher to analyze target-specific details and environmental conditions. In other words, experts are able to derive more from a scene in a given amount of time than novices are able to. Fortunately, automaticity is a process that can be developed, and can it reduce the load on working memory by 90% (Eudoblox, 2014).

1.1.2 Visual Search Experts: Trackers

When people think of trackers they typically envision a silent loner following what seem to be invisible signs of someone's passage. In reality a tracker is a highly practiced individual who more often works as part of a team rather than alone. The task might be to follow quarry,

backtrack* to a source, or exploit a site, but the clues are readily apparent to those who know how and where to look. To successfully perform these activities, trackers must use all of their senses, intuition, and cognitive abilities. They search for deviations from the baseline environment that might include disturbances on the ground such as a footprint or damaged vegetation, unusual behavior of people, animals, or insects in the area, or circumstances that simply do not make sense for a normal situation. The tracker must note all of the idiosyncrasies he encounters and then assign a value to them according to the situational context and available intelligence—whether it is normal for the situation or not. Even contamination† is useful in that it provides a timeline of activities. A tracker must rebuild an event from the evidence he finds, much as a detective does when forensically examining a crime scene. The interpretation will help the tracker determine whether the quarry is dangerous and might set up an ambush, injured and looking for a place to rest, or lost and oblivious that anyone is following. The more a tracker can anticipate the quarry, the easier and faster he will safely find it.

Figure 1 shows some of the different features and processes that a tracker's skill set contains. The clouds represent relatively stable characteristics and capabilities that drive an individual's cognitive process in general. They include outside information that will influence top-down processing and innate human attributes, some of which may be improved through training. The dashed ovals represent early steps in cognition, some of it subconscious and some of it conscious, where the tracker is beginning to compile the available information. The solid oval is the point at which the tracker is consciously evaluating the indicators, assigning value and context, and deciding on a course of action. The solid rectangle is the final interpretation of the evidence at hand.

*Backtracking is to follow tracks or other sign opposite the direction of travel in order to discover their source.

†Contamination occurs when someone or something comes along after the event of interest and disturbs or destroys the tracks and evidence that were left at the scene.

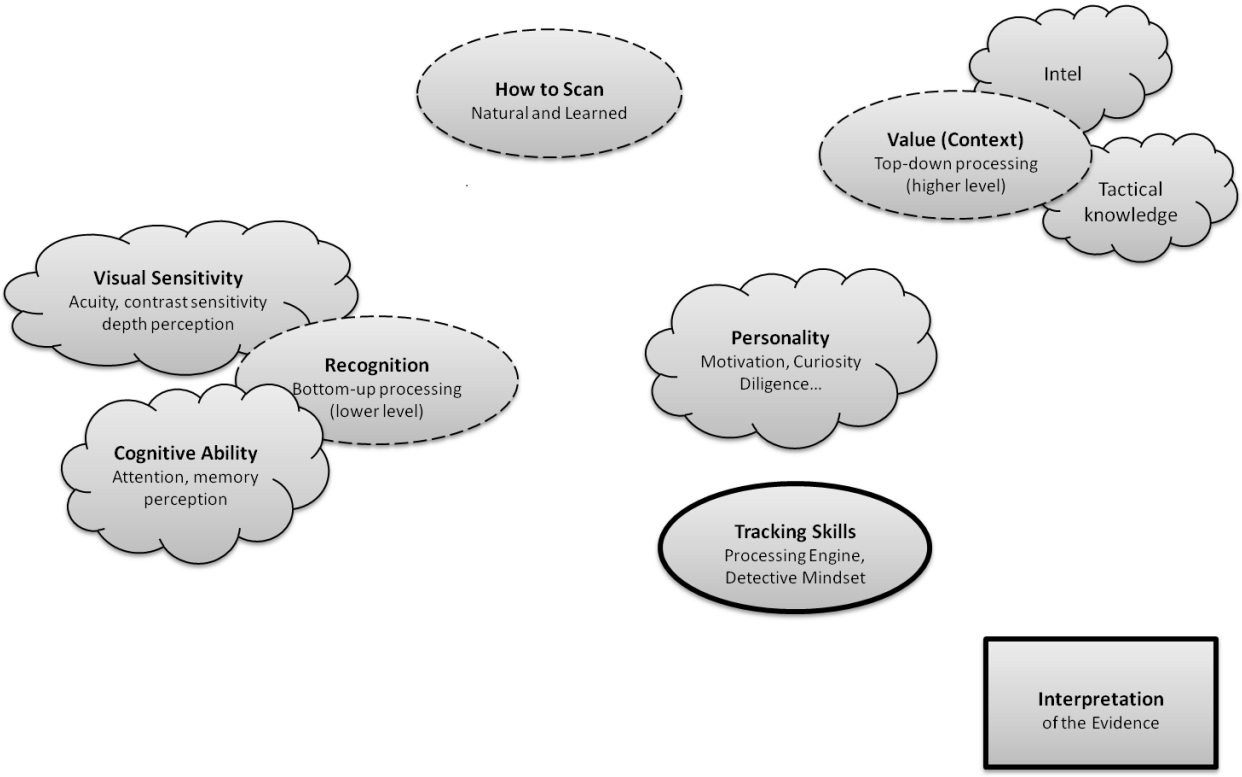

Figure 1. Tracker skill set and cognitive process.

To achieve the objective, a tracker draws on the skills and processes in figure 1 to sense the traces the quarry left, perceive their meaning, and react quickly and decisively enough to close the time-distance gap (i.e., catch up). These skills also form an ideal capability base for tasks such as finding unexploded ordnance, landmines, and IEDs. The process is the same—individuals must first recognize the indicators of an emplacement, either from visually detected traces or from the tactical importance (and thus likelihood) of the site, assign a value to the indicator, and then decide what action to take. The ultimate goal is to identify targets as quickly and accurately as possible by pulling together fragmented knowledge and evidence to holistically analyze a situation and draw actionable conclusions.

The Border Hunter research program sponsored by U.S. Joint Forces Command examined the capabilities and training of combat trackers (as well as profilers and observers) in the context of IED detection. The evaluation found that expert trackers spent more time looking along the trackline (direction of travel) and surrounding area while novice trackers tended to focus on the ground more (Fautua, et al., 2010).

Why the difference between novice and expert trackers? The basics have become automatic, leaving experts free to focus on the larger picture. Additionally, behavioral observations from the Border Hunter exercise noted that most trainees were highly motivated from the start and were able to efficiently connect the dots during scene interpretation. The final technical report concluded that "The ability to develop explanations of cause-and-effect relationships from

evidence collected from the environment proved vital to mission success in both tracking and profiling scenarios" (Fautua, et al., 2010). The tracker mindset, using detective-like skills and a motivated attitude, enables a tracker to interpret scenes hours and sometimes days after the actors have departed—a process and skill set perfectly aligned with visual IED detection.

1.1.3 Motivation

Motivation plays a large role in the successful recognition of targets. It may be extrinsic (seeking an external reward) or intrinsic (content with personal satisfaction), and can empower a person to excel in visual search tasks or completely fail. Commanders in the Israeli Defense Force, who absolutely insist on using trackers to visually inspect all areas for bomb emplacements before any troop movement, continually emphasize motivation when it comes to expert visual search behavior (Schweitzer, 2007). Details from the meetings with Israeli trackers are in appendix A.

The encouraging part about motivation is that it can be improved in tangible ways. It is easy to understand how extrinsic motivation may be increased—simply provide a suitable prize. However, intrinsic motivation is more personal and challenging to influence. For example, Whitehead (1993) found that four basic concepts can facilitate an improvement of intrinsic motivation for sports and exercise: a sense of purpose, the perception of personal control, individual mastery, and fun. It is possible that providing or improving one or more of these four facets could improve an individual's intrinsic motivation for other activities as well. For IED detection, very few people need to grasp a better sense of purpose. The point is clear—find the IEDs or people might die. Nearly every searcher has a strong sense of purpose for the task. However, to increase a person's perception of control and mastery, the person should completely understand the task at hand so that they will choose to learn. Complete understanding enables them to take personal control of the situation by teaching them how they can influence their own performance. As they master the necessary skills, their feeling of control will expand and their motivation to find a target should increase. The fourth facet of fun does not apply appropriately to IED detection and is not addressed here.

1.1.4 What Does It All Mean for IED Detection?

Detecting IEDs is everyone's job. Strictly speaking, combat engineers are the ones who clear routes and must find the IEDs or risk having those behind them hit—a very somber responsibility. However, in practice everyone in the vehicle or on the route helps search for the devices, whether they are engineers, medics, or VIPs (very important persons). How can we improve people's ability to find IEDs without extensive, expensive training setups?

All of the aspects discussed here—sensation, preattention, perception, automaticity, tracker mindset, and motivation—link back to Kirk's (1974) and Locard's (1923) statements that "everyone leaves a trace." Trackers and IED searchers alike must simply find and correctly interpret the traces of interest. To do so, we need to train the brain to prime better, a process that individuals can practice and control. Speed is a weapon, so if we can make the process of

spotting critical strategic emplacement sites automatic instead of a controlled process that the searcher must consciously direct, a significant portion of the search process could be done more quickly and with relatively little effort. It will also free cognitive faculties to better process other information. The searcher must increase their familiarity with the local environment* and with the manner in which targets may appear. Familiarity with the locale enables more accurate recognition of anomalies or deviations from the baseline environment. All clues are contextual, not just for tracks or IED indicators but human and animal behavior, traffic, etc. For example, human behaviors differ depending upon whether the interaction is between family members, friends, coworkers, or complete strangers (Scott-Donelan, 1998).

The goal is to automatically sense and perceive basic IED features, to recognize suspicious areas, and to quickly interpret the traces that remain with an objective tracker's mindset. The embodiment of this is reflected in the behavior of returning route clearance engineers who see potential IEDs everywhere, even though they know logically that IEDs are highly improbable within U.S. borders.

1.2 Objective

The objective of this study was to develop and evaluate a tailorable, squad-level training package that imparts the tracker mindset. The training intent was to improve visual detection capability and the number of finds, thereby directly increasing the number of explosive devices identified before detonation. The end result would be a decrease in the number of casualties due to detonations. The training format was such that noncommissioned officers could readily use the material to conduct their own visual detection skill training with their Soldiers.

1.3 Hypothesis

Soldiers can be taught sufficient fundamental vision and tracker skills in an 8-hour course to significantly improve their ability to visually identify and interpret ground spoor, including IED indicators.

2. Method

2.1 Experimental Design

This study used a within-subjects design to compare pretraining performance to posttraining performance. Training was the independent variable while pre- and posttraining performances on the knowledge test, photo test, and spoor pit tests were the dependent variables. We trained the subjects in two separate groups due to facility and instructor limitations.

*"Local environment" is the area surrounding a searcher within which the searcher can visually distinguish target items from the background.

2.2 Demographics

Twenty-eight Soldiers volunteered to participate in the study and completed all of the activities. Eleven belonged to the first cohort that was trained on days 1 and 2 while 17 belonged to the second cohort on days 3 and 4. The overall average age was 27 years (range: 18–43). Participant ranks were E-2 (n=1), E-3 (n=1), E-4 (n=16), E-5 (n=7), E-6 (n=2), and O-3 (n=1). More than half (n=17) had been in their military occupational specialty for more than 3 years. Overall service time in the Army was distributed fairly evenly across participants by 1–2 years (n=7), 3–4 years (n=5), 4–5 years (n=7), and more than 5 years (n=8). Nine Soldiers had a high school-level education while 16 had some college, one had a bachelor's degree, and one had an advanced degree. Most Soldiers were horizontal construction engineers (n=11), bridge crewmembers (n=6), or combat engineers (n=3), but the remaining participants came from a variety of specialties listed in table 1.

Table 1. Participant military occupational specialties.

Number	Military Occupational Specialty	
3	12B	Combat Engineer
6	12C	Bridge Crewmember
11	12N	Horizontal Construction Engineer
1	12R	Interior Electrician
1	25U	Signal Support Systems Specialist
1	91B	Wheeled Vehicle Mechanic
1	91C	Utilities Equipment Repairer
1	91L	Construction Equipment Repairer
1	92F	Petroleum Supply Specialist
1	94F	Computer Detection Systems Repairer
1	—	Officer

Sixteen participants had spent no time in a route clearance convoy, whereas 10 had spent 6 months or more working route clearance convoys. One Soldier self-reported personal discovery of over 30 IEDs, two reported detecting between 16 and 30, and three reported finding between 1 and 5. The remaining 22 Soldiers reported that they had never personally found any IEDs.

2.3 Apparatus: Training as the Independent Variable

To conduct this study, we created a training curriculum that introduced the basics of human visual perception and tracking in the classroom. We then developed a spoor pit for hands-on demonstrations, practice, and testing.

2.3.1 Training Curriculum: Sensation and Perception

The first part of classroom training focused on the fundamentals of how the eye and brain work in an applied manner. It emphasized the following factors associated with sensation and perception: (1) understanding the capabilities and limitations of the eye, (2) understanding how

to use environmental and artificial factors to increase target visibility, (3) recognizing that the feeling of "something is just not right" likely has a valid source, and (4) understanding why you are more likely to detect what you expect to see. The PowerPoint presentation took about an hour to brief and provided examples of technical concepts applicable to the tactical environment. For example, to put things in a better perspective for the searcher we described the typical 0.5° visual angle for foveal vision as being about 1/2-in. diameter (the size of a dime) at 5 ft, or about a 2-in. circle at 20 ft. Text from the slides we presented is in appendix B.

2.3.2 Training Curriculum: Tracking and Spoor Interpretation

The second part of classroom training introduced the fundamentals of tracking and spoor interpretation. We used photographs to illustrate the subtle soil clues that indicate actions such as direction or speed of movement, and characteristics such as relative load, weathering, and the time-shadow effect. To encourage students to start the interpretive part of tracking, we talked through several photographs, describing the visible impressions and discussing options as to how they might have been made or why they might be located in the position that they were. The goal was for the students to recreate an event from the visible spoor. We described the attributes and skills of a good tracker—the fact that some of the characteristics are inherent and some can be taught but that none are beyond average human capabilities. The most influential characteristics include motivation, patience, visual and aural acuity, common sense, curiosity, endurance (vigilance), tactical awareness, and honesty (Scott-Donelan, 1998). The need for honesty often surprises people, but a tracker must stand by what he knows to be correct and must be willing to admit when he is wrong or unsure. The introductory text for tracking and spoor interpretation slides is also in appendix B.

2.3.3 Training Curriculum: Spoor Pit Exercises

Spoor pit construction. A spoor pit is an area with a ground medium that will hold sharp impressions. The medium is typically soil but could also be materials such as flour or powder. It is especially useful for showing beginners the fine details that a tracker seeks. We typically use an outdoor piece of ground with a fine, loose (but not too loose) surface soil and a firm subsurface soil. For this study we needed an area that was also close to the classroom, big enough to train at least 20 students at a time, had as little shade over the working area as possible, and was unlikely to be disturbed when we were absent. The site we selected was an outdoor sand volleyball court on the edge of a tree line behind the Libby barrack area at Fort Leonard Wood, MO. While the site received some shade in the afternoon and the loose, sandy soil was almost too coarse, it provided the best mix of features that we were able to locate.

Initially, vegetation covered much of the sandy court. We weeded and tilled the surface with a roto-tiller to remove as much vegetation as possible and then raked and smoothed the bare surface by dragging a 2- × 6-in.piece of lumber across the court. The finished surface area still contained a limited amount of vegetation, but it was acceptable for the scope of our training. Blowing leaves and shadows from clouds and adjacent mostly leafless trees provided uncontrolled

variance to the appearance of the ground surface. The loose, sandy soil held reasonably good impressions, though due to the coarseness of the sand particles some spoor yielded less crisp edges than would occur in finer soils. The pit was divided into eight equal sections, approximately 12.5 × 13.5 ft each, with walking lanes set up between the individual sections. Each section or "spoor pit" was used to stage separate events. The purpose of the events was for students to interpret the story told by the observable markings in the soil. The general setup is shown in figure 2.

Figure 2. Spoor pit layout.

Spoor pit activities. Soldiers spent about half of their training time learning by doing "hands-on" activities in the spoor pits. We explained why we see tracks* and created examples. We pointed out the dynamics of a footprint, including the primary impact point, foot roll, heel strike, terminal point, and toe dig. We taught them how to assess multiple steps in terms of stride, pitch angle, straddle, pressure and dwell time, and rhythm and balance. Demonstrations included the type of impressions left by an individual accelerating to a run and compared the length of strides between a runner and a walker. Other examples included the unique indications of hand and finger marks, knee marks, toe digs, the compression of fabric from a person laying

*We see tracks because of edges (outline, recognizable patterns), contrast (shadows, color changes), texture (surface roughness), shine (light reflectance or absorption), and rhythm (spacing or recurrence).

or sitting, and marks from tools and equipment such as shovels, picks, buckets, and rucksacks. We showed Soldiers how to position themselves relative to the light source to optimize the visibility of the spoor, whether the source was natural light from the sun or a signal mirror or artificial light from a flashlight. We also introduced the use of optics in terms of binoculars and colored glasses to illustrate that in some conditions optics can improve the visibility of certain indicators.

Once Soldiers understood the fundamental indicators of human activities and methods to view spoor in the best light, we had them take a break under a pavilion that was out of sight from the spoor pit. We staged a different scenario in each cell and then called the Soldiers back to the pit where we challenged them to interpret what human activity had occurred. Soldiers were encouraged to spend a few minutes interpreting the scene on their own and then to work as a group. We posed questions intended to lead them through an investigative process of identifying impressions and clues and then infer meaning or estimate intent for what had occurred. We concluded the exercises by reenacting the event so the Soldiers could gain a full understanding of the situation.

The final set of "hands-on" instruction was with small groups of Soldiers, two or three, executing a militarily feasible event of their choosing within their designated section of the spoor pit. Each of these events occurred with only the involved Soldier team present. Once each team had laid spoor in their designated areas, the class was challenged to interpret the spoor and describe the event as before, essentially deriving the story told by the spoor. Again, we asked questions to encourage understanding of the scene. Once the class arrived at a feasible description, the responsible team reenacted what had occurred and commented on any missed or incorrect points. This part of the training focused on student involvement and student interaction. Virtually all the Soldiers participated in the interpretation of the spoor.

2.3.4 Second Day Review

On the second day of training we began with the Gratzky quiz, an exercise designed to challenge the student to sort out track contamination, to ease the students back into a tracking-focused frame of mind. Nine sets of unique footprints walk up the side of the paper, and the student is asked to identify the number of people, the first track to pass, the last track to pass, the pronated track, the pigeon-toed track, and the injured walker track. (See the quiz in appendix C.)

We then reviewed the lecture points covered on the previous day. We summarized the visual process, including sensation and perception, the structure of the eye and its visual limitations, and strategies such as artificial light or priming to "see" better. We played a short movie called "Gorillas in Our Midst" to demonstrate one of the consequences of selective attention.*

* "Gorillas in Our Midst" shows six students passing two basketballs. Three students are wearing white shirts and passing one ball to each other while the other three students are wearing black shirts and passing the other ball. The viewer is instructed to count the number of passes the white team makes. Part way through the movie a black-costumed gorilla slowly walks through the middle of the scene, pauses to look at the camera and beat his chest, and then exits on the other side. Most viewers are so focused on counting passes that they never see the gorilla (Simons & Chabris, 1999).

The review included a second set of track photos. We gave the students time to examine the photos that were projected onto a wall screen, asked them what indicators they saw, and then verbally recreated the scene for them.

2.4 Testing: Task Performance as the Dependent Variable

We gave Soldiers three tests prior to the training and the same tests following the training to evaluate how much information believed to be relevant to the application of tracker skills was learned over the period of instruction. We developed a scoring rubric for the photo task and the spoor pit task. This provided a holistic scoring approach, complementing answers from the academic perspective, the art of tracking, and tactical knowledge Soldiers brought from the battlefield. The rubric is in appendix D.

2.4.1 Knowledge Test

We developed a 21-question knowledge-based test to evaluate the Soldier's understanding of human visual sensation and perception, and fundamental tracking techniques and mindset. The premise of the test questions was twofold: (1) an understanding of the visual process would motivate students to search in a more effective manner, and (2) an understanding of expert tracker techniques and way of approaching a situation would improve a student's capability to detect and interpret spoor. Each question was weighted according to its expected value in developing tracking skills. The test is included in appendix D.

2.4.2 Photo Test

For the photo test we projected a picture of ground spoor onto a wall screen for 2 min. During this time we asked the students to provide a written description of the spoor. We displayed five separate photos, one showing two individuals walking single file in the volleyball spoor pit at Fort Leonard Wood and four showing spoor in the finer, more impressionable soil at Fort Huachuca (covering wire, road crossing and loiter, meet and leave, and coming and going). The intent was to expose the Soldiers to different soil types and lighting conditions. The same set of pictures was used in both the pre- and posttraining exams. The annotated photographs used in this test are included in appendix D.

2.4.3 Spoor Pit Test

For the spoor pit test we challenged Soldiers to provide a written description of the event that had occurred in each cell of the spoor pit. They had 2 min to describe the spoor and interpret what might have occurred in the scenario. The test included five separate events, and while pre- and posttraining events were not exactly the same, they were designed to provide very similar scene content. The five scenarios are described in the following paragraphs. Annotated photographs of the spoor pit scenarios used in this test are included in appendix D.

1. Reconnaissance. For the pretraining scenario a single person entered the scene, laid prone and propped on his elbows to hold binoculars, and then retreated from the scene. For the

posttraining scenario the spotter performed the same actions and we added a sniper who entered the scene, laid prone and propped up a rifle on a bipod, and then retreated from the scene.

2. Sit down. For the pretraining scenario a single person entered the scene, sat down in the middle, pulled his heels toward his buttocks and propped his elbows on his knees, and then stood to continue walking out of the scene. For the posttraining scenario the individual again entered the scene, sat down in the middle and pulled his heels toward his buttocks, but this time removed a pack from his back and set it to the side, removed an item from the pack, and replaced it on his back before standing and then walking forward from the scene.
3. Meet and leave. For the pretraining scenario two people entered the scene from opposite directions, met a short distance from one another in the middle, and then retreated from the scene together parallel to the original path. The posttraining scenario was the same except that two individuals entered from one side and one individual met them in the middle. All three left the scene together in the direction from which the single person came.
4. Emplacement. In the pretraining scenario one person entered the scene and stopped at the opposite side of the spoor pit cell, set down a hard-sided container and dug a hole, covered and smoothed the hole, and then walked away. The posttraining scenario again was the same except that two individuals entered the scene. One carried the container and then left while the second person dug the hole and covered a rock in a hasty emplacement before leaving the scene.
5. Drag line. The pretraining scenario shows one person shuffling backward while dragging a hard-sided container. The only differences for the posttraining scenario were that the footprints were not as obvious, and a second, barely visible bag was dragged in addition to the hard-sided container.

2.5 Assumptions

This study occurred in an outdoor environment where conditions such as ambient light and soil moisture were confounds that varied over the course of the day. Given the very applied nature of both IED detection and tracking, we considered the environmental variables acceptable and even desirable. All four days had very similar conditions.

2.6 Analysis

We weighted each question on the knowledge test according to its relevance and importance for successful acquisition of the tracker mindset. We assigned a maximum of 4 points to questions that were critical for developing the tracker mindset to a minimum of 1 point to questions that were relevant but not essential to a tracker's mindset. Scores on the pretraining test questions were summed for each participant and then compared to the corresponding sum of scores on the posttraining knowledge test, using a t-test to check for significant differences.

We counted the number of correct descriptors for the photo task and the spoor pit task to determine whether the Soldiers perceived more indicators after training.

At the end of the two-day research project, we conducted an after action review to solicit Soldier comments on what was good and bad about the project. We were particularly interested in receiving feedback on what Soldiers felt were the most effective and ineffective elements of the training. The review consisted of both a group discussion and individual, written comments. The after action comments are summarized in the following results section and reported in full in appendix E.

2.7 Procedure

Each of two cohorts of Soldiers participated in two consecutive days of training, and testing. The first day started with the administrative procedures, including an explanation of the research project followed by an explanation and completion of the Consent Form. In the classroom, Soldiers then completed the pretraining knowledge test and the pretraining photo test. The next task required Soldiers to travel to the spoor pit where they completed the pretraining spoor pit test. Following the spoor pit test, we released the Soldiers for lunch. Once they returned, they listened to a 1.5 h class on sensation and perception and the techniques and methods of expert trackers. Soldiers then traveled back to the spoor pit for an hour of practical exercises in the spoor pit. This completed the first day of testing and instruction.

The second day started in the classroom. Soldiers were given the Grasky quiz (appendix C) followed by practical examples demonstrating some common fallacies in perception. We reviewed the first day's classroom instruction, and then Soldiers drove to the spoor pit for a series of practical exercises. These exercises involved groups of two or three Soldiers staging predefined events in the pit and their own group-developed event in the pit while the rest of the class remained out of sight. Each event was staged in a separate, discretely marked section. Once each group finished laying their scenario, we challenged the class as a whole to interpret what had occurred in each section. After the class came to a general consensus on what happened, the staging team reenacted the event and the investigators addressed any remaining questions. We released the Soldiers for lunch, brushed the spoor pit clean, and laid the final set of scenarios. Soldiers reconvened after lunch at the spoor pit and completed the posttraining spoor test. Following the posttraining spoor test, Soldiers returned to the classroom and completed the posttraining photo test and the posttraining knowledge test. The two-day research project culminated with an after action review. The second cohort research exercise replicated the first cohort on the following two days.

3. Results

Scoring each of the three tests required careful and sometimes subjective evaluation of the answers. To minimize the subjectivity a scoring rubric was developed for each test. For the knowledge test, one researcher completed all of the scoring. For the photo and spoor pit test, three individuals separately scored the pre- and posttraining answers. Once the scoring was completed, the three scorers met, compared scores, discussed scoring outliers, and then calculated a mean for each of the scores.

3.1 Knowledge Test

Soldier performance on the knowledge test improved by 185% posttraining. A paired t-test assuming unequal variances found significant differences between the pretraining scores (M = 15.3, SD = 10.4) and posttraining scores (M = 43.5, SD = 14.2), t(27) = –8.49, p = 2.96E-11. A perfect score was 92 points.

3.2 Photo Test

Soldier performance on the photo task improved by 35% posttraining. A paired t-test assuming unequal variances found significant differences between the pretraining scores (M = 17.8, SD = 5.5) and posttraining scores (M = 24.0, SD = 5.4), t(27) = –4.21, p = 9.67E-05. A perfect score was 10 points.

3.3 Spoor Pit Test

Soldier performance on the spoor pit task improved by 28% posttraining. A paired t-test assuming unequal variances found significant differences between the pretraining scores (M = 28.2, SD = 8.3) and posttraining scores (M = 36.0, SD = 8.1), t(27) = –3.56, p = 7.88E-04. A perfect score was 15 points.

3.4 After Action Reviews

The two sessions were the first time we had presented the tracker mindset material to students, and we encouraged their feedback on the course structure and content. Overall the students were satisfied with the training. They were particularly happy with the practical exercises that reinforced the lecture points and the opportunity to create their own scenarios for the class to interpret.

Suggestions for improvement included 11 comments emphasizing the need for a longer course with many additional references to the “2 short days” of training, 11 requests to include more IED-specific indicators, 9 comments on needing more dirt time, and 9 comments desiring to see additional tracking mediums and deeper instructional detail such as a better definition of terms, cover and concealment methods and appearance, different angles and light, etc. The photographs

provided some interesting challenges due to lack of depth, and Soldier comments were split over whether we should use more or fewer of them in class. Several Soldiers asked about printed material to support the training, and the appendices of this report will double as curriculum documentation for the students of any future training. All things considered, the fresh perspective on IED detection was welcomed by nearly all the Soldiers. The subsequent verbatim comments were selected to reflect the value that many of the Soldiers expressed, either verbally or in writing.

- "Make this an actual week/40 hr course b/c this is a good tool to have plus some promotion points would encourage people/soldiers to learn it."
- "Really this class was a good introductory course. Two days isn't nearly long enough to get very proficient. It would be nice if there was a follow-up class."
- "Very good training overall. Need more than just two days. Any group or company deploying to do route clearance should attend this training."
- "Course needs to be made into a week long event to get as much as the student can out of it. two days is not enough. But in two days you can get the mindset of the basics of tracking and cover and concealment events."
- "It was a great learning experience. Learned a lot and it should be conducted to every organization."

4. Discussion

To find a target, a searcher must first scan for it (sense it) and then recognize the appropriate visual input as the target of interest (perceive it). The next challenging step is to derive meaning from the object and its context (interpret it). A searcher must know roughly what to expect but must be flexible enough to recognize the unexpected. The searcher must look for behavior patterns and consider likely tactics and avenues of evasion (Scott-Donelan, 1998). The quarry may be erratic, focused, or anywhere in between, so the searcher must use detective-like skills to interpret the evidence he encounters and anticipate the movement of his target.

This training provided Soldiers a set of skills and methods to improve their ability to do all of the previously mentioned tasks. These tools included a better understanding of how to mitigate the limitations of human vision and how to exploit its strengths. Soldiers learned about the story footprints can relate, identification of individuals via print size, estimations of speed and weight, and an awareness of attempts to confuse a tracker. Throughout training Soldiers exhibited a rapidly developing ability to combine the parts of a visual scene into a scenario and to focus on the elements of a visual scene that added relevant information, while discarding other marks that had little meaning.

The results are perhaps not surprising. One would expect individuals to score higher on tests they have seen before, especially when they receive information through the course of two days that help them complete those tests. It is impressive that the students improved their scores on a free form knowledge test and that they identified and articulated more relevant indicators in the photographs and spoor pits posttraining than they did pretraining. The implications are that short, informal training segments can help detection skills in certain cases.

However, the after action reviews indicated that something even more significant might have influenced the measured performance. We introduced a new way of thinking, a new way of approaching the visual detection task. The approach was based on cognition and aspects of human functioning that the individual can influence and/or control. Improvements to the underlying cognitive process are difficult, if not impossible to truly quantify, but the thoughts that Soldiers shared indicated that they began to see the search for IED indicators in a different manner. One comment even mentioned how fun the training was—fun being one of the four pillars for improving intrinsic motivation for some tasks. This change in mindset, adopting a tracker's mindset for visual detection, was what we hoped to achieve with the curriculum. Additional testing might aim to isolate and examine whether particular variables were solely or symbiotically responsible for detection performance improvements after tracker mindset training.

5. Conclusions

The purpose of this research project was to develop a training package that could be used by noncommissioned officers at the squad level to significantly improve Soldier's capability to visually detect indicators of IEDs while keeping the training sufficiently brief to fit into limited available training time. The authors recognize that performance was not measured against actual IED detection but believe that the fundamental skills that enable detection and interpretation of spoor can generalize to indicators of IEDs and various other tactical information of importance.

The roughly 8 h of instruction time used in this research was only enough to cover the very basic fundamentals of the skills that trackers employ. Most tracking courses last from 40 to 80 h, and even then instructors recognize that only the fundamental skills are taught. Real skill is only gained through many hours of practice in the field.

Still, even with the limited amount of training, results of each of the knowledge, photo, and spoor pit testing showed statistically significant improvement in performance. The fact that such improvement becomes apparent in such a limited amount of time speaks well for the power of even a brief training course in how to perceive and interpret spoor. The results are practically significant as well. Many of the Soldiers who participated in this research commented that they found the training different from any they had experienced in previous military training, and several stated that it provided them with a new tool to use in the tactical environment.

The limited classroom training was important so that Soldiers could learn and experience certain capabilities and limitations of sensation and perception that are not intuitively understood. For example, most people have no understanding of how little detail humans can perceive in a visual scene, or some of the tricks our visual system can play on our perception. Most of the training was very hands-on. For example, Soldiers saw how impressions and targets appear or disappear based upon the tracker's position relative to the sun (or artificial light). Actually experimenting with how the light angle affected their ability to see or not see the shadows that define a target was a powerful learning tool.

Based on the results and the feedback from the Soldiers, we conclude that the training is worth conducting. In the absence of commitment to formal training, this "hip pocket" training may improve the students' approach to finding visual IED indicators. The authors are willing to work with any organization that would like assistance in implementing this type of training.

Recommendations

- Modify the curriculum to include more IED-related indicators and a wider array of other indicators. Add visualization facilitators such as flour and artificial light. Subjects such as terminology, the time-shadow effect, viewing angle, and aging should be covered more thoroughly.
- Present a wider variety of photographs and scenarios for the photo and spoor pit tasks.
- Examine the utility of introducing footprint diagrams, techniques for recording footprints, the Erikson technique for determining the chronology of events, and binocular use for detail awareness.

Overall—practice!

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Appendix A. Strangers in Israel: Trip Report

This appendix appears in its original form, without editorial change.

Date: 21-31 July 2007

Location: Israel

Purpose: To meet with Israel Defence Forces, Israel Border Police, and Israel Police personnel to understand how Israel uses tracking to find terrorists and how they find improvised explosive devices.

Introduction

Terrorist groups such as Hizbullah and Hamas have used religious justification to direct guerrilla attacks on Israel, and Israel has had to adjust its military and police responses accordingly. Today the borders with Syria and Jordan are relatively quiet, but terrorist and smuggling activities are problematic on the Lebanese and Egyptian borders.

The author traveled with a world renowned, expert tracker to Israel to see how Israel has been as successful as it has in fighting terrorists. The specific purposes were to learn how Israel is employing trackers and how Israel might select and/or train people to visually detect bombs (i.e. improvised explosive devices). The input received is the focus of this report. Individual names have been changed to protect privacy.

Input

Ben was our guide for the entire week. For 5 years he headed the Police and Security in the Old City of Jerusalem. His knowledge of history, geography, and security was invaluable.

Day 1 (M): Ben gave us lectures on the current borders, geography, and war/security history of Israel in the morning. After the lectures, Ben drove us around different Jewish and Muslim neighborhoods to familiarize us with the differences between the cultures, took us to see the new security fence with all its sensors and cameras (which they call a “clever fence”), and explained the areas where sniper walls had to be erected. In the evening, Edan gave us lectures on Muslim fundamentalism, how they are trying to indoctrinate others, and the ramifications for non-Muslims.

Day 2 (T): Ben introduced us to Eliav (well-versed in Arabic) and we first drove out to a monastery of St. George (about 20 km from Jerusalem in the Wadi Qilt). Eliav described how trackers are used, in combination with tracking and explosives dogs (off-leash), to track in the local terrain. He said that the tracking and explosives dogs used in conjunction with the trackers are also trained to attack. Every unit goes out with at least one tracker from the operational area and every commander has one senior tracker from the operational area to advise him on missions. Next we drove up to visit a retired officer who was a Bedouin tracker and commander on the Lebanon border. He thinks anyone (city/country born, male/female) can be trained to be a tracker if the desire is present – motivation is of primary importance. On the successful use of trackers, he insists that total acceptance by and integration with command is the only way tracking will work effectively. (He learned this through experience with his initially uncooperative command.)

Once we left the officer's house, we stopped at an IDF border post and discussed tracking with the Soldiers who were on duty. We saw the drag road and the vehicle used to take the trackers out to search for spoor. The Soldiers maintain that *nothing* happens without trackers going first.

Day 3 (W): We picked up a retired army officer in Tel Aviv and drove out to the Negev. The officer specializes in survival in the desert, but was also a commander for 5 years in the South. While not a tracker himself, he commanded trackers and used them very effectively. He insists that the key to tracking is to know and understand the terrain – know what routes are possible, which ones are actually used, how long they take to travel, what sorts of things travelers will seek (e.g. water), where best to intercept the trail, etc. To be a good tracker the officer insists that the person must love the job. If the person has no love for the job, his or her background will not make him a good tracker. He emphasized that we must know the people and their customs, mannerisms, and taboos, and use them to our advantage in order to avoid hostile confrontation whenever possible. [E.g. The COL's story about tracking the men into the Sheik's camp, asking the Sheik about the hypothetical camel footprints coming in but not going out, and keeping his rifle on his lap and loaded during tea because he did not feel "safe".] Knowing how to survive teaches you what to seek and where to search (e.g. Roman road area).

In the evening we sat with Eliav and the officer to discuss Bomb Detector selection – what would it take to select an individual that will be good at finding bombs? When the officer selects people to go through tracking training he interviews them by giving them scenarios and listening to how they would handle the situation and what information they would derive. He looks for interest in and compatibility with nature, and an ability to think and reason well in different situations – like a detective. Eliav said when his unit selects people to go through tracking training they have an interview process, personality-type tests, and a physical test…the unit has a psychologist who administers the tests. Eliav and the officer both believe that trackers and bomb detectors cannot be separate. Motivation and drive are very important, and knowledge of the terrain, its people, and the climatic environment are essential.

Example scenarios from the officer: (1) See water deep in a well, but have no rope or bucket – how do you get water? (2) How do you change a tire in the desert when you have no jack? (3) Father rides the camel to market but does not return when expected – what clues does the herder use to know that it was he that passed and when?

Day 4 (R): We drove with Ben and the officer to the Egyptian border. The Border Police had closed the road we wanted to take due to intelligence reports, and we had to wait for an escort. By chance we met Oded, who used to work under Ben in the Old City, and we were able to go into the border post to speak with him on how he employs trackers and to speak with two of the Bedouin trackers. Most of the infiltrators in that area are smugglers who do not shoot at the Police and do not lay bombs, mines, or booby traps. They employ many antitracking techniques, but are basically nonviolent.

Day 5 (F): We drove with Ben to the Hagoshrim Kibbutz in Upper Galilee to meet Ze'ev, a former officer from a South Lebanese Army (SLA) bomb disposal unit who fought and lived among Hizbullah terrorists for 25 years. The SLA used trackers to clear the way, employing the least number of Soldiers as possible and positioning them as far apart as reasonable to avoid multiple casualties if one detonated a bomb.

After 1990 (and the collapse of the Soviet Union) SLA saw a change in Hizbullah tactics – they transitioned from rudimentary tactics and bombs to something more sophisticated. As a result, Lebanon was no longer stronger and had to follow and learn (much like the United States is doing now). Most often each terrorist knows only what he is supposed to do, nothing more about the network, making it extremely difficult to glean intelligence from captives.

Ze'ev insisted that we must stay out of the cities, villages, markets, and stores – draw the terrorist away from the population to us so we can maintain control. He stated that we must change the people's mindset (which has been indoctrinated since birth) that we (the non-Muslims) are the enemy by helping them. We need a professional Soldier that will become a part of the people – he must stay in the same area of operations. The Soldier needs to use binoculars from the high ground to observe an area from many different angles and heights – working from the outside to the inside, from the top to the bottom (all the way into the water/sewer tunnels), visually clearing the area before entering. Ze'ev recommended always video recording in order to learn from mistakes, to take photos before any bombs are disturbed, and to make models after neutralization so that others may learn what has been done. He said we need to fight in the same manner as the enemy, but the main difficulty is that we fight to live and they fight to die – we must see the terrorists as trained Soldiers. In regards to trash: SLA cleared the sides of the road (with D-9 bulldozers) and covered them with a layer of different colored sand so that any disturbances were obviously a different color.

Day 6 (S): The lessons to be learned from Ze'ev are that (1) We must learn and understand the enemy before we can destroy him; (2) We must *always* be in control of the area; and (3) We must maintain good relations with the people. The officer in charge must be able to employ people in their best capacity – keep Soldiers engaged and rotate them for experience. The Soldiers must have the heart and information and motivation to do a proficient job.

Ben spoke with us on security in the Old City. We discussed the tensions, manpower, camera systems, catalysts, and how few really want trouble.

Day 7 (S): Walked around the Old City of Jerusalem and discussed the tensions, security, and the riots that resulted a few days after Ariel Sharon's visit to the Dome of the Rock. We visited the Old City Police command center where they monitor ~350 security camera feeds (the 35 most sensitive areas stay onscreen constantly, while the others are monitored on a rotational basis). Police command, private security (for the Jewish families living in the Muslim Quarter), and intelligence are all collocated and information was well shared among them.

We visited the Jerusalem Police Bomb Disposal officer in charge, but he said their expertise did not lie with what we wanted to know. He suggested that we contact the trackers, as their mission aligned more closely with detection.

Thoughts

Several responses recurred with each Israeli commander we met. One of the most important keys to defeating the enemy was to know and understand the terrain and climate and normalcy of an area. The other key was to know and understand the people and customs of an area. These factors require

someone who is intimately familiar with the area – he must know common avenues of access, stopping points, and information points. He must also be familiar with seasonal elements which influence land accessibility and human activity. Regarding people and customs, the Israelis we met can, for the most part, look at an individual and tell you whether s/he is Jewish or Muslim, which provides a wealth of information on the individual's habits, mindset, and tendencies. For outsiders, this is a challenging, if not impossible task. While some amount of instruction such as our visits to the different neighborhoods is essential, it takes time and exposure to really learn the people.

How much time is needed to become familiar enough with the land and the people to operate effectively? No one is sure. The only certainty is that foreigners stick out badly in a place where history, traditions, and family connections are very strong.

I repeatedly inquired as to the qualities needed for a good bomb detector, distinct from those of trackers. None of the commanders we met thought that tracking and bomb detection could be separated. They believe that the same skill sets are needed for both tasks and that the same qualities are necessary and prevalent in people who are good at the tasks. Considering that in Israeli operations the trackers always move into an area first, trackers will usually be the first to encounter any bombs as well, making it imperative that they be well aware of where to search and what to seek. Explosives dogs are often employed successfully along with trackers to detect bombs (which would seem especially useful in cities).

Though not well reflected in the daily input above, Israel demonstrates an extraordinary amount of cooperation among her agencies, which enables an excellent intelligence network that is essential for driving operations. The agency offices are very often collocated and information is freely shared.

Conclusions

The driving question was: What is Israel doing to ensure success against terrorism that the United States is not doing? A limited answer is: tracking and interagency cooperation. Many of the responses we received suggest that the U.S. might need to take a step back to scrutinize procedures and policies before selection and/or training can be truly effective.

We learned that the primary quality some Israeli commanders consider necessary for an individual to be a good tracker (i.e. bomb detector) is motivation. The selection process includes interviews to gauge knowledge and desire and tests to determine cognitive abilities, but the person must also have an intimate knowledge of his area of operation (terrain and climate) and the people (their characteristics, tendencies, and customs). The best illustration of how important it is to know the land and the people is the way Ze'ev always referred to bombs as Strangers, because they are out of place and do not belong. We also learned that to be truly effective, tracking must be integrated and fully accepted at the *command* level or else trackers will be wasted.

The Israel trip confirms many suspicions – that motivation might be more predictive of ability than inherent traits or training, and that tracking and bomb detection skills are not just similar, but the same. The question of what, exactly, tracking ability imparts that is so valuable for anomaly and change detection still remains. Is it continuous training to find minutiae that do not belong? Is it being able to

put clues together like a detective? Is it intensively thinking like the enemy in order to predict him? Further investigation of individuals before and after tracking training might lead to some answers, which would be directly applicable to the selection and/or training of people for bomb detection. (Better yet would be to interview a tracking unit in theater.)

Speaking with commanders, soldiers, and police that deal with the threat of bombs and terrorists every day in their home country was very sobering. This trip has led me to believe that training lane fidelity is not as important as completely immersing one's self in how the enemy thinks, seeing where he will go, and noticing what changes are apparent in the people when he is or has been near. These things focus the "where to search" and are not effectively done from the confines of a vehicle. Training lanes would teach the macro details of "what to seek", but the finer details will vary with each operational area and would be most easily honed on foot in the area itself.

Note of Interest

The Ben Gurion International Airport in Tel Aviv had regular obvious security, but they rely heavily on profiling, which has been extremely effective in identifying bombers. Once we began paying attention, we could see that there were multiple layers of security personnel watching, beginning as we first drove into the airport and continuing as we exited the vehicle, stood in the initial security screening line, and made our way through multiple ID checks.

Appendix B. Training Curriculum: Classroom Lecture With Notes

This appendix appears in its original form, without editorial change.

The authors will happily share the classroom lecture slides, notes, and practical examples and activities upon request. Below are text excerpts from the full presentation.

Training Objectives

Enhance your capability to visually detect targets

- Understand the human factors in the art of detection
- Understand the capabilities and limitations of the eye
- Understand how to use factors that increase target visibility
- Realize that we naturally tend to see objects as part of a group
- Understand that you are more likely to detect what you expect to see
- Recognized that the feeling "that something is just not right" likely has meaning

The Art of Detection

Sensation – physiological ability of your eyes

- At or above visual threshold
- Resulting in registering a signal on the retina
- Signal must be of sufficient strength to be transferred to the brain

Perception – the result of a long complex process in which we interpret that which is sensed

- The process relies on the senses, situational context, past experiences, and personal judgment
- Image is meaningless until it is recognized, identified, and interpreted
- A person's actions are not based on sensations, but on perception of sensations.
- Perception is "not a high fidelity reproduction of stimuli impinging on the receptors, but is a reproduction of the objects which these stimuli suggest".
- Our perception of an object may trigger thoughts about the object, and our memories of objects we have seen in the past may influence our perception of the object.

For example, if a person does not know what a bomb looks like, then a bomb painted fluorescent orange, with the fuse smoking, laying on the edge of the road would provide no perception of danger.

Activity: Hold up a modified church key and then a quarter. Students are unlikely to recognize the church key but most will recognize the quarter. Given context, interpretation of the Rat-Man pictures

LESSON: Being able to see something with your eyes is not enough to consciously know what you saw.

Visual Capabilities

Accommodation – ability of the lens to focus the light rays on the retina

Visual Acuity – ability to discriminate fine detail is limited to a very small area in our vision

- Due to the small area on our retina that has a high concentration of cone cells
- Only objects with a visual angle of about 0.5° or less fall completely on the fovea
    - At 5 feet distance, you see detail in an area about the size of a dime
    - At 10 feet distance, you see detail in an area of about a 1 inch circle
    - At 20 feet distance, you see detail in an area of about a 2 inch circle

LESSON: To detect fine detail in an area, you will likely have to make several different eye fixations

Night Blind Spot: 5° to 10° because cones populate the central portion of your retina and cones require light to function

- At 5' away the blind spot is a 5" to 10" circle.
- At 10' away the blind spot is a 10" to 20" circle.
- At 20'away the blind spot is a 20" to 40" circle.

LESSON: Since the night blind spot is in your foveal (central) field of view, you are not capable of discriminating fine detail at night.

Day Blind Spot: 5.5° to 7.5° because of the optic nerve (no cones or rods)

- At 5' away, you are blind to an area of about a 7" circle.
- At 10' away, you are blind to an area of about a 14" circle.
- At 20' away, you are blind to an area of about a 28" circle.

Activity – Day Blind Spot Demonstration: Close the right eye. With the left eye, focus on a specific object straight ahead. To the left of the focal point, slowly move an object such as your finger or a pencil from in front of you to the left side until it becomes invisible. If you use your index finger, typically only the top of your finger will disappear for only a few degrees, not far from your focal point.

Visual acuity defines only a small portion of our ability to resolve details. Environmental stimuli provide a wide range of spatial frequencies and physical contrasts that affect what we can perceive. Also consider that "older" observers require three times more contrast to see wide (low frequency) gratings.

LESSON: Understand the capabilities and limitations of your "personal" equipment.

Saccades and Fixations

Saccades

- A rapid and abrupt jump, about 1/20 of a second, made by the eye as it moves from one fixation to another
- Typically 1 to 3 saccades per second
- Vision is impaired during these movements
- Generally of an involuntary nature driven by information gathered during the previous fixation
- Can be reflexive

Fixations

- Each fixation provides information about a small area, and our perception of the whole object or scene occurs when we combine the information from a number of fixations
- Our perception of a whole object is constructed from information taken in from smaller parts

For example, consider "busy" pictures, the ones where so many items are crammed into one scene that it is difficult to see anything at all. The longer you look at the picture, the more crazy things you see in them, and seemingly every time you look at them you will see something new.

For another example, consider situations such as when you are driving through town. You might drive mindlessly home on auto-pilot and "see" very little, or you might drive mindfully while searching for a particular address and see all sorts of "hidden" businesses or features.

LESSON: Since saccades move fixations based on information, knowledge of what to look for is a key contributor to detection.

Contrast Sensitivity

- Light Level
- Luminance (light) Contrast
- Color Contrast
- Exposure Time

LESSON: Correct positioning of a light source can make contours or edges more visible.

Intuition

Can targets, in some way, be detected at a level below conscious awareness? Can stimulation, of which the observer is unaware, still exert a measurable influence on certain response outcomes?

Probably!

Priming - You need to know what you are looking for and what the target looks like.

Intentionally increase time viewing potential target areas.

Examples:

1. Subjects were asked to state the meaning of a word presented to them subliminally (below the conscious level). The word "cook" was flashed on a screen so rapidly that observers were not aware of what was presented. This was followed by the presentation of two words, "bake" and "view", both of which could be clearly seen (and consciously perceived). Subjects were then asked which of the two words was most like the subliminally-flashed word. Results were that the word "bake" was selected significantly more often than would have occurred by chance.

2. From page 25 of David Scott-Donelan's tracking manual, regarding the sixth sense: "One must never ignore what is called the "Sixth Sense". The "sixth sense" is merely subtle, unconscious, sensory inputs which have not yet been processed by the brain into conscious, recognizable, logical thought. It is not foolish to act upon one's "hunches" while tracking the quarry because ignoring these hunches may place the team in great jeopardy." (Scott-Donelan, 1998)

3. Often Soldiers report to us that they just had a feeling that something was there, prior to finding an IED, or something is just not right, before and an attack began.

LESSON: Heed the feeling of something not being quite right. Spend extra time viewing the area.

Groups and Likelihood

We perceive objects based perceptual groupings – similar things tend to be grouped together.

Our perception of parts of a stimulus depends on the overall stimulus configuration – the whole is different from the sum of its parts

We perceive the object that is most likely to be caused by our sensory stimulation. For example, if a number of possible objects could have caused a particular pattern of light and dark on the retina, we will perceive the object that is most likely to occur in that particular situation

For example, consider a comparison between regular and high definition TV. If you only watch a football or baseball game on regular TV, you tend to think it is okay. Then you switch to HD and realize how much detail you were missing. When you first flip back to regular TV you wonder how you could watch such poor resolution, but in a few minutes the picture seems relatively normal again. Your brain fills in much of the missing information, based on your expectations.

So what?

LESSON: Recognize that you tend to view a scene as a whole, but that you may need to take it apart to perceive the target. Knowledge about the target improves the likelihood of detecting it.

Figure-Ground Segregation

- A figure appears more "thing-like" and is seen in front of the ground.
- The ground appears as unformed material.
- Any contour separating the figure from the ground appears to belong to the figure.

Activity: Try to read the license plate, first when it is upside down, and then when it is right side up.
The Rubin vase/profile illusion is an ambiguous figure/ground illusion.
Stanford psychologist Roger Shepard's drawing of the woman and the candlestick
The Gestalt perceptual drawing in which one may perceive either an old woman or a young woman

LESSON: You are much more likely to perceive something that you expect.

Why do we see things?

- Shape – Recognizable shape of familiar things
- Shine – Reflected light from shiny objects
- Shadow – Changes contrast
- Silhouette – Contrasting colors and breaking the skyline
- Surface – Wide, single color surfaces
- Spacing – Regular spacing, out of balance with natural environment
- Movement – Moving objects which attract attention
- Sensors – Infrared / thermal, magnetic, movement or seismic sensors
- Smell – out of place in natural environment
- Noise – Unnatural, out of place noises or vibrations
- Intuition – Sixth sense or unprocessed data inputs

Key elements that are often indicators of an IED

- Foot prints
- Knee prints
- Hand prints
- Tool prints
- Indicators of a hole and its shape
- Relative positions of digging indicators
- Global indicators of target areas

Subliminal Perception

If the presentation of an object is too brief for identification, it is subliminal in that subjects cannot identify it, and therefore they are unaware of the name. At the same time, however, they might be aware of other aspects of the object, such as orientation or texture. In that sense, awareness is a set of dimensions on which a threshold may be defined.

A person is often unaware of the specific cues and clues to which he is reacting not because the stimulus is insufficient to cross the threshold into consciousness but because the effort to be fully aware of all the cues all the time would create too great a cognitive strain. However, recognition thresholds vary tremendously, not only among individuals, but also in the same individual from one time to another, in accordance with his physical situation, his physiological condition, and above all the degree to which he is psychologically attuned to the particular content of the message.

Can expert knowledge increase sensitivity to subliminal information or enhance the potential that subliminal perceptions will cross the threshold to conscious awareness?

Yes!

For example, when you buy a new car you become an “expert” at finding that car – in the parking lot, waiting for someone driving it to pick you up, etc. You begin seeing the same model car everywhere, even if you are driving yours and have no need to search for it. You are subconsciously seeking and finding “your” car. The same principle may be applied to finding any object. The more often you search for it, the more likely you are to find it and the more automatic the process becomes. Consider the times when you are driving a rental car and you find yourself in the parking lot trying to open a stranger’s vehicle because it looks just like yours at home!

Bottom Line: Just being able to sense something is not enough to consciously know that you saw it. Tactical knowledge, correct expectations of targets, memory, and experiences along with knowledge about the capability and limitations of your eyes are all key to your ability to quickly and accurately detect targets.

Description of a foot print in the Fort Leonard Wood volleyball sand pit

Figure B-1. Foot print.

The primary impact point is distinct at the heel with a small plume of sand at the toe, indicating forward travel. The lengthy shadow suggests a deep print in soft, “fluffy” sand. Given the apparent coarseness of the surrounding soil, the detail of the print indicates that the sand must be somewhat moist. Soil color differences, most apparent at the toe plume and in the parallel lines along the bottom of the picture (rake marks), indicate that the soil is likely drying in the morning sun. The darker toe plume means the print is fresh – the subsurface soil is still moist while the surrounding soil is drier. The rake marks show paler (and drier) mounds and slightly darker furrows, suggesting the area may have been raked not long before the foot print was made.

Appendix C. Grasky Quiz

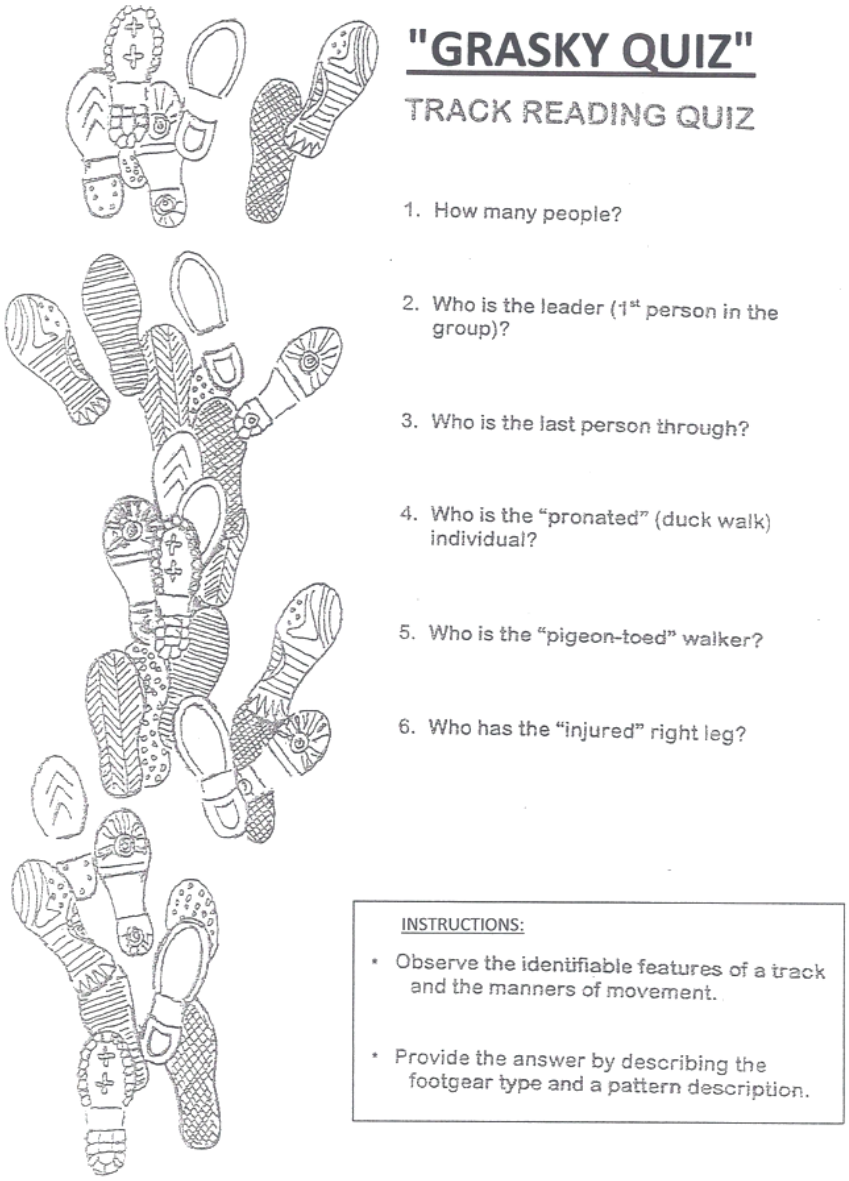

Figure C-1. Grasky Quiz.

Grasky's Track Reading Quiz Answers

1. **How many people?**
   Nine – one of the authors named the tracks Pebbles, Crosses, Swoosh, Outline, Sunburst, Mesh, Furrows, Tire Tracks, and Knob-heel (with the chevron soles).

2. **Who is the leader (1st person in the group)?**
   Pebbles was first – all other tracks are on top of Pebbles.

3. **Who is the last person through?**
   Crosses was last – Crosses is on top of all other tracks.

4. **Who is the "pronated (duck walk) individual?**
   Swoosh is pronated – both of Swoosh's prints (left and right) are pitched outward.

5. **Who is the "pigeon-toed" walker?**
   Outline is pigeon-toed – both of Outline's prints (left and right) are pitched inward.

6. **Who has the "injured" right leg?**
   Sunburst is injured – Sunburst's right print has a significant outward pitch while the left print has a normal pitch.

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Appendix D. Knowledge Test, Photo Test, Spoor Pit Test, Scoring

This appendix appears in its original form, without editorial change.

✓ Knowledge test and scoring rubric

✓ Photo task with annotations for (i) two individuals walking single file, (ii) covered wire, (iii) road crossing and loiter, (iv) meet and leave, and (v) coming and going.

✓ Pre-training spoor pit test – annotated photographs and scoring for (i) reconnaissance (spotter only), (ii) sit down, (iii) meet and leave involving two people, (iv) emplacement by one person, and (v) drag line with one container.

✓ Post-training spoor pit test – annotated photographs and scoring for (i) spotter and sniper, (ii) sit down and check pack, (iii) meet and leave involving three people, (iv) emplacement by two people, and (v) drag line with two containers.

Knowledge Test and Scoring Rubric

Tracker Mindset for Explosive Device Emplacement Detection – Knowledge Test ID Number _____

The scoring approach was to provide a value to each question based on its relative importance to understand the topic and then identify the correct answers. Given the open-ended nature of the questions, scorers awarded points to participant answers that were reasonably correct, or could be correct with a different interpretation of the question, even if the answer was not listed in the rubric.

Physiology & Psychology

1. List or briefly describe three methods or techniques you can use to improve your chance of seeing visual cues on the ground. (6 points possible)
    - Use central vision, foveal vision
    - Increase the stare time at an area (dwell time)
    - Place the target between yourself and the lateral direction of the sun
    - Search right to left
    - Use enhanced viewing optics such as colored glasses or binoculars (2 pts)
    - Look for shape or colors that don't fit (2 pts)
    - Change perspective, angle of viewing, closeness (2 pts)
    - Look at a smaller group and then put the scenario together (2 pts)
    - Use mirror to reflect light for shadow (2 pts)
    - Use flashlight (2 pts)
    - Smell – scents may give cue (1 pt)

2. If you are looking at the ground 10 feet away from you, how big of an area on the ground can you see with the most possible detail? (2 points possible)

    About the size of a quarter or a 1-inch circle

3. If you are searching for an IED, why is it important in terms of eye movement that you have an idea of what the visual indicators should look like? (6 points possible)

    Our eyes search an area with a series of movements (saccades) followed by fixations. Most fixations are very short, 1 to 3 per second. Information gained during a fixation guides the location of the following fixation. If you have knowledge of what you are looking for, then the fixations are driven by useful information as opposed to random information.

4. Can feelings that "something is just not right" be worthy of further consideration? If so why, if not, why not? (6 points possible)

    Yes, we may see something that does not reach the level in the brain where we perceive it. That is, what we see may not reach the threshold of conscious recognition.

Knowledge Test and Scoring Rubric

5. Why is it difficult to see detail in very low light level conditions? (2 points possible)
    - Cone cells provide the capability to see detail but do not function in low light conditions
    - Light creates the shadow to indicate edges (1 pt)
    - Rods do not provide good acuity (2 pts)
    - The eyes cannot see color as well at night (1 pt)
    - No shadows (1 pt)
    - Light contrasts the prints (1 pt)
    - Cones shut down and rods do not see color (1 pt)

6. How do novices and experts typically analyze a scene differently? (4 points possible)
   Novices look at the parts, experts look at the sum of the parts (whole picture)
    - Novice sees everything but does not know how to interpret the data gathered. The expert knows how to put the information together. (4 pts)
    - Experts put things together like a puzzle thinking like a detective (4 pts)
    - Experts know more clues, understand the patterns to recognize, and how to obtain more info from the clues (4 pts)
    - Experts know what to look for and where to look (3 pts)
    - Experts pick up the fine detail (2 pts)

7. How long should your attention dwell in one spot so that the brain has time to process what the eye sees? (2 points possible)
   2-3 seconds

8. What psychological process allows us to process information faster? (4 points possible)
   Automaticity

9. How can the process in #8 be improved? (4 points possible)
   Practice; experience

Tracking Basics

10. What is spoor? (4 points possible)
    Indicators of a person's passage (4 pts)

11. What is a track trap? (4 points possible)
    An area of ground that holds impressions especially well

12. What two features of a track enables us to see it? (6 points possible)
    - Shadows; color changes
    - Depth (2 pts)
    - Impression (2 pts)
    - Pressure and light (2 pts)
    - Patterns and contrast (4 pts)
    - Color, contrast (4 pts)

13. How should the tracker be positioned so that he sees the best tracks? (6 points possible)
    Facing the sun, with the track between the tracker and the sun

14. What is the most significant, unpredictable influence on the visual appearance of spoor? (4 points possible)
    - Weather/aging; contamination
    - Humans and weather (6 pts)

Tracker Mindset & Situational Awareness

15. What indicators does a tracker note? (6 points possible)
    - Deviations from the natural state… any changes (6 pts)
    - Target behavior – carrying load, limping, running, jumping, sitting, etc. (6 pts)
    - Anything out of place (6 pts)
    - Types of indicators; size, depth, clarity, color (3 pts)
    - How many people, direction, what they are doing (2 pts)
    - Depth, which way the track is going (1 pt)
    - Shadows and shine (4 pts)
    - Direction, activities (4 pts)

16. How does a tracker anticipate his quarry? (6 points possible)
    - Likely avenues; intelligence (external), including movement behaviors
    - Guess needs or wants (4 pts)
    - Past behavior (4 pts)
    - Typical behavior (4 pts)
    - Think like they think (6 pts)
    - Building a profile based on previous tracks (6 pts)
    - Try to figure out where he is going (3 pts)
    - Thinking about what they are doing and may be headed (6 pts)

17. What are the characteristics of the tracker's mindset? (6 points possible)
    - Think like a detective; consider the scene as a whole; automatically note deviations
    - Focus and situationally aware (2 pts)
    - Aware, alert, observant (3 pts)
    - Methodic, analytical, recognizes patterns, experienced (4 pts)
    - Know what quarry is likely to do (2 pts)
    - That of a hunter (4 pts)
    - Mindset of a detective, more aware of detail and surroundings (4 pts)
    - Who, what, when and why to find out what went on (4 pts)
    - Knows what to look for (1 pt)
    - Detail oriented, groups concepts to build profiles (4 pts)
    - Think like a detective (4 pts)
    - Looking for details (2 pts)

18. What makes a tracker more aware of his surroundings? (6 points possible)
    - Vulnerability; possibility of ambush; understanding of what is normal for an area; different perspective (boots on the ground)
    - Knowing what to look for and recognizing things out of place (4 pts)
    - Being familiar with conditions (3 pts)
    - Knowing what indicators are and what they mean (3 pts)
    - Practice (2 pts)
    - Knowledge of the area (3 pts)
    - Ability to use only the info the really need (3 pts)
    - Time and skill (2 pts)
    - Visual mindset of what to look at or for (3 pts)
    - The bigger picture of things (2 pts)
    - Possibly getting ambushed (3 pts)
    - Knowing people might hurt him if and when he gets to a certain spot (3 pts)
    - Training and practice (2 pts)
    - Know how to look for stuff that doesn't belong. (3 pts)

19. How does a tracker's situational awareness transfer to IED detection? (4 points possible)
    - Tactical significance of emplacement sites (ambush); change detection (deviations from the natural state – environmental and behavioral)
    - Indicator can be found (2 pts)
    - Can help to locate what transpired (1 pt)
    - IEDs out of place, dirt different color (2 pts)
    - Enable tracking of planters (1 pt)
    - Picks up on cues quicker and knows where to look for next cue (2 pts)
    - Gives indicator of where people were and what they were doing (2 pts)
    - So you can see indicators before you come upon it (2 pts)
    - Being aware of surroundings and not becoming complacent (2 pts)
    - More focus, dealing with IEDs, they will tend to be more aware (2 pts)
    - Always scanning, always alert (2 pts)
    - Know what to look for (3 pts)
    - Can see a spot on the trail for good IED placement (4 pts)
    - Training eye and mind to detect unnatural occurrences (2 pts)
    - Able to notice slight change in surroundings (2 pts)
    - Pays attention to finer details (2 pts)
    - Soils, tracks, misplace objects, etc. (2 pts)
    - Can tell when an area has been disturbed (2 pts)
    - Knows what wrong looks like (2 pts)

20. How can you improve your awareness? (4 points possible)
    - Consider different perspectives; approach with an open mind; practice constantly!
    - Slow down and take more time (2 pts)
    - More tracking class (2 pts)
    - Practice (2 pts)
    - Pay attention to detail (2 pts)
    - Set up own spoor pit and test (3 pts)
    - Practice, employ, education (3 pts)
    - Take time to observe (2 pts)
    - Work on it everyday (2 pts)
    - Learn indicators and gain experience (2 pts)

Photograph Test and Scoring Rubric

Tracker Mindset for Explosive Device Emplacement Detection – Photo Test

The first photo in each section (or for Photo 1, the only photo) is the unmarked picture that participants saw for the test. The second photo in each section contains annotations that label each indicator.

Impressions from Photo 1 – Two individuals walking single file (10 points possible)

Figure D-1. Two individuals walking single file.

- Two individuals traveled in the same direction in single file. Cannot say who walked first, as no tracks appear to overlap another.
- Travel was from R to L, as evidenced by the toe drags that are characteristic of forward travel. (Backward travel would have heel drags.)
- Travel was mission-focused, as evidenced by the regular stride and straight line of travel.
- The pace was slow to moderate, as demonstrated by the stride length.
- Individuals likely carried no load, as the prints have no significant toe dig.
- The larger print is a boot-patterned sole with a separate heel, likely (but not definitively) made by a male because it is bigger.
- The smaller print appears to have a relatively smooth sole with a separate heel, likely (but not definitively) made by a female or juvenile because it is shorter and narrower.

General

- Soil on the bottom R is wet, as suggested by the darker color and supported by the well-defined sole patterns and edges.
- Soil on the top L is dry sand, as determined from the lighter color and ill-defined sole patterns and edges.
- Parallel lines in the sand indicate the ground was swept or raked before the tracks were laid.

Photograph Test and Scoring Rubric

- The photograph is aimed toward the sun, which significantly improves the visibility of the shadows that accentuate the prints.

Impressions from Photo 2 – Covered wire (10 points possible)

Figure D-2. Covered wire (original).

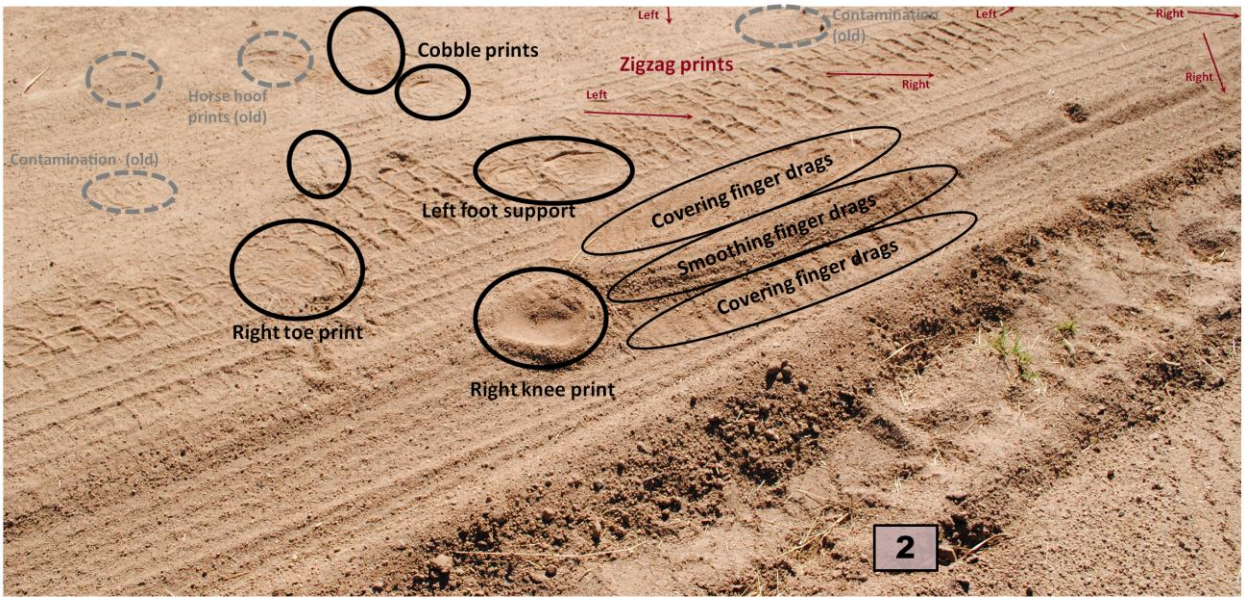


Figure D-3. Covered wire (annotated).

Photograph Test and Scoring Rubric

Børn boot prints (with a separate heel), called "Cobble" for the cobblestone-like sole pattern

- Most prominent in the scene is the smoothed area in the center from a right knee print.
- The accompanying toe print from the right foot appears to the L and just above the knee print.
- A well-defined print from the left support foot appears in the fine soil of a tire track directly above the knee print. Some soil is mounded on the outside edge of the print, indicating that extra weight was likely distributed on the outside of the foot (as might occur when reaching from a kneeling position).
- The chevron-like marks are finger drags, like those made when brushing soil together to cover something. The long parallel marks down the middle of the chevrons are also finger drags, as one might make when smoothing a surface.
- Interpretation: it appears that Cobble entered the scene from the left, knelt on the right knee and covered something long and narrow in the road, and then backed away from the scene at the top L.

Moccasin prints, called "Zigzag" for the distinctive sole pattern

- Entered the scene at top center, turned L and walked to the R along the fine soil tire track, and then exited at top R (only three clear foot prints are visible).
- Interpretation: Zigzag does not appear to loiter, but strides purposefully out of the scene along the tire track, suggesting that the individual was not connected to Cobble. However, it is curious why Zigzag would suddenly change direction.

General

- All foot prints are fresher than the tire tracks, as all foot prints lie on top of the tire tracks.
- One tire track appears to have heavier, mud-type tires.
- The hoof print was made when the ground was soft (i.e. wet).
- The photograph is aimed toward the sun, which significantly improves the visibility of the shadows that accentuate the prints.

Photograph Test and Scoring Rubric

Impressions from Photo 3 – Road crossing and loiter (10 points possible)

Figure D-4. Road crossing and loiter (original).

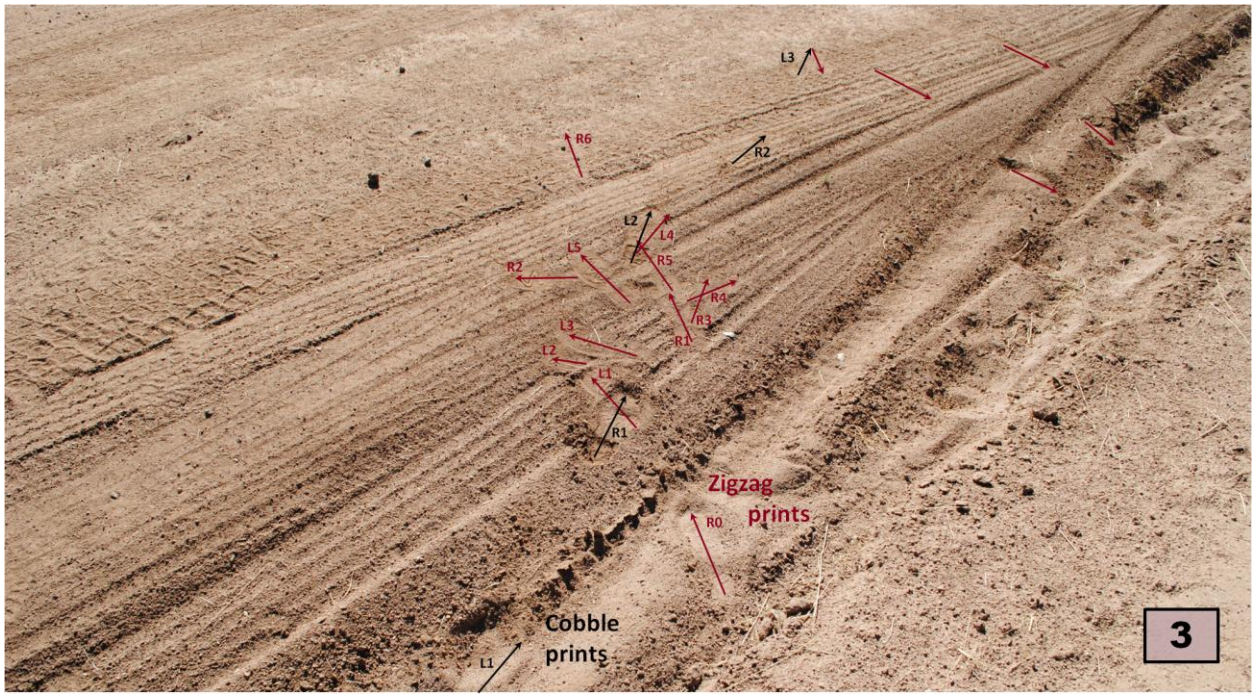


Figure D-5. Road crossing and loiter (annotated).

Photograph Test and Scoring Rubric

Moccasin prints, called "Zigzag" for the distinctive sole pattern

- Entered the scene at bottom, just L of center. Right foot (R0) stepped on the pale, soft shoulder sand and left foot stepped onto the hard roadbed.
- Loitered on the roadside for a short time, as evidenced by the parallel, overlaid prints about shoulder width apart. First faced perpendicular to the road (L1 & R1), turned to the left (L2 & R2), turned to the right (L3-4 & R3-4), and then faced perpendicular once again (L5 & R5). [Note: The left Cobble print completely obscures the L4 print in this photo. Check the pre-Cobble photo on slide 6 to see the complete set of Zigzag prints.]
- Continued across the road, stepping with the right foot first (R6).
- Close examination reveals return prints with a short stride and wide straddle at the top R of the scene.
- Interpretation: Zigzag stepped onto the roadside, possibly checked each direction for traffic or for clear fields of view, and then crossed the road away from the observer. Either before or after the initial roadside loiter, Zigzag crossed the road toward the observer's right.

Børn boot prints (with a separate heel), called "Cobble" for the cobblestone-like sole pattern

- Entered the scene at bottom L in the very soft, sandy shoulder with the left foot (L1).
- The next step (R1) is on top of the Zigzag prints, indicating a later passing. The right print appears deeper than the others with a significant toe dig.
- The next left heel print (L2) appears slightly deeper than normal. The following right (R2) and left (L3) prints appear normal.
- Interpretation: Cobble made a slight hop across the subtle depression between the soft shoulder and the firm roadbed, leaving two slightly deeper prints, and then continued at a brisk pace to angle across the road.

Before Cobble entered the scene…

- Zigzag entered the scene at bottom, just L of center. Right foot stepped on the pale, soft shoulder sand and left foot stepped onto the hard roadbed.
- Loitered on the roadside for a short time, as evidenced by the parallel, overlaid prints about shoulder width apart. First faced perpendicular to the road, turned to the left, turned to the right, and then faced perpendicular once again.
- Continued across the road, stepping with the right foot first.
- Close examination reveals return prints with a short stride and wide straddle at the top R of the scene.
- Interpretation: Zigzag stepped onto the roadside, possibly checked each direction for traffic or for clear fields of view, and then crossed the road away from the observer. Either before or after the initial roadside loiter, Zigzag crossed the road toward the observer's right.

General

- Interpretation: the two tracks are seemingly not associated, as Cobble strides purposefully over the Zigzag loiter point without hesitation.
- All foot prints are fresher than the tire tracks, as all foot prints lie on top of the tire tracks.
- The photograph is aimed toward the sun, which significantly improves the visibility of the shadows that accentuate the prints.

Impressions for Photo 4 – Meet and leave (10 points possible)

Figure D-6. Meet and leave (original).

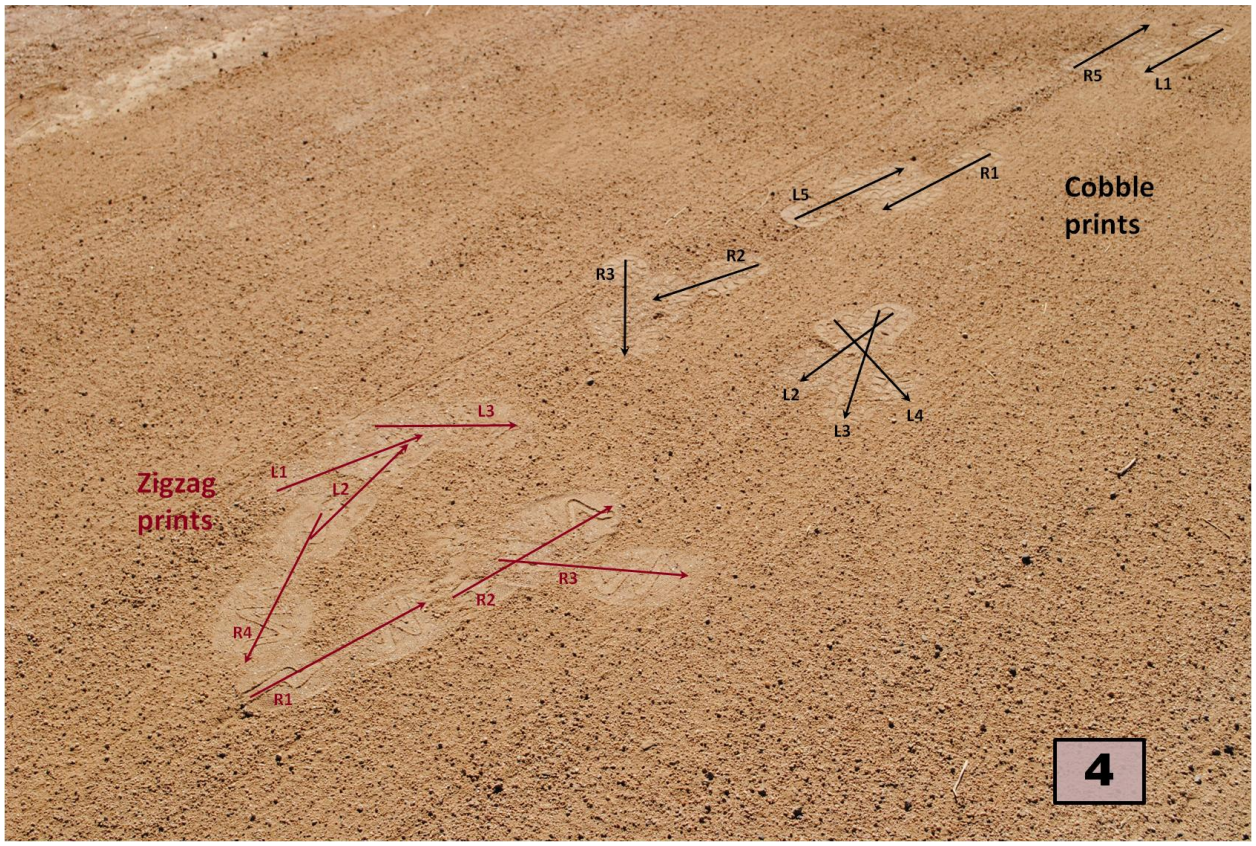


Figure D-7. Meet and leave (annotated).

Moccasin prints, called "Zigzag" for the distinctive sole pattern

- Entered the scene at bottom L.
- Walked a couple of steps (R1 & L1) and then loitered for a short time, as evidenced by the parallel, overlaid prints about shoulder width apart (R2-3 & L2-3).
- Retraced original path (R4).

Børn boot prints (with a separate heel), called "Cobble" for the cobblestone-like sole pattern

- Entered the scene at top R.
- Walked a few steps (L1-2 & R1-2) and then loitered for a short time, as evidenced by the parallel, overlaid prints about shoulder width apart (L3-4 & R3).
- Retraced original path (L5 & R5).

General

- Interpretation: Zigzag and Cobble walked toward one another and stopped within handshake distance (personal space), indicating some familiarity with each other. [Note: Close familiarity or non-American cultures may move closer to hugging distance or to stand within smaller personal bubbles. Individuals hostile with each other would likely stop further apart.] The two possibly looked to the right, as suggested by the right-facing tracks. Both individuals turned around and retreated in the direction from whence they came.
- The photograph is aimed toward the sun, which significantly improves the visibility of the shadows that accentuate the prints.

Impressions for Photo 5 – Coming and going (10 points possible)

Figure D-8. Coming and going (original).

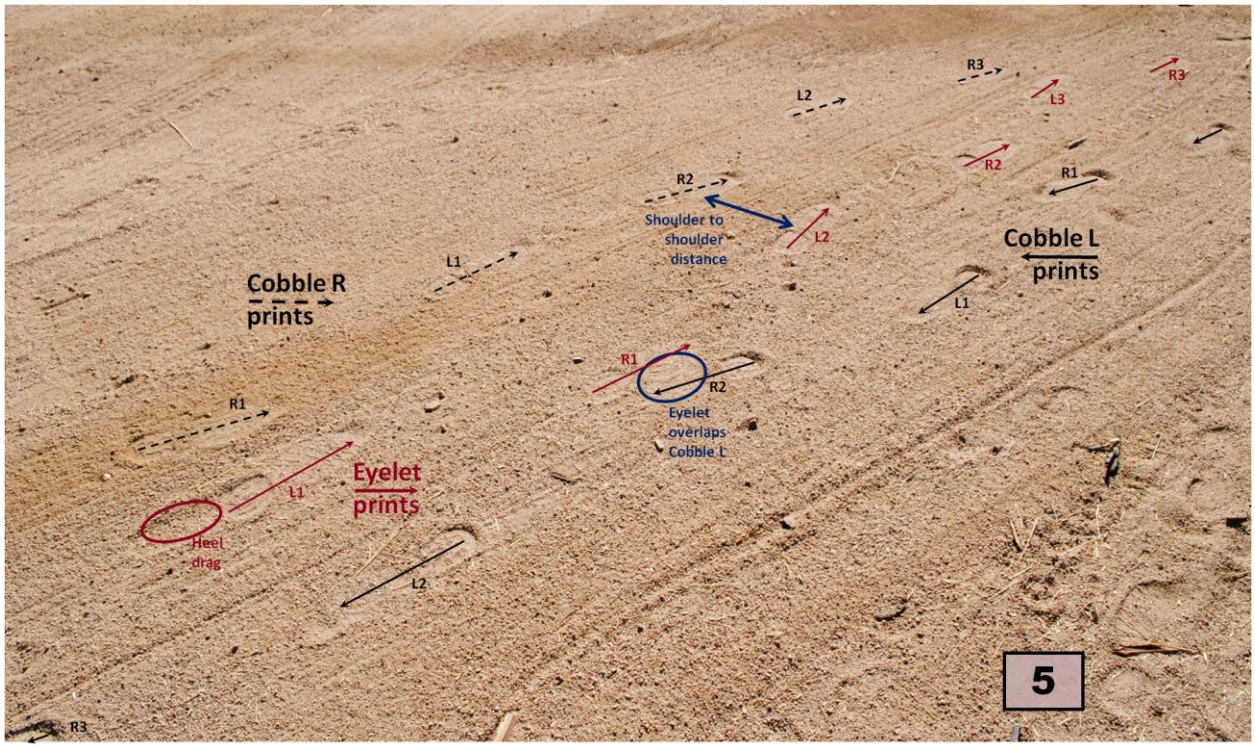


Figure D-9. Coming and going (annotated).

Photograph Test and Scoring Rubric

Børn boot prints (with a separate heel), called "Cobble L" for the cobblestone-like sole pattern traveling left

- First tracks on the scene entered at top R and traveled to bottom L. The heel strike shadows are fairly pronounced.

"Cobble R" (Cobble traveling right) and boat shoe prints, called "Eyelet" for the horizontal circles-on-lines sole pattern

- Both Cobble R and Eyelet entered the scene at L. Their track lines are close together, but never overlap – either prints on prints or single file alignment.
- Eyelet passed this location after Cobble L passed, as evidenced by Eyelet's print overlaid on Cobble L's print in the center.
- Eyelet's first print on the L has a long heel drag.

General

- Interpretation: Cobble passed this point first, and then returned with Eyelet. The regular distance between and closeness of Cobble's and Eyelet's prints suggest that they may have walked side by side and were familiar with one another. [Note: Non-American cultures may move within smaller personal bubbles, regardless of close familiarity. Individuals unfamiliar or hostile with each other would likely walk further apart.]
- All foot prints are fresher than the tire tracks, as all foot prints lie on top of the tire tracks.
- Two roads merge, as evidenced from the general direction of tire tracks at the top and L.
- Drag line along the bottom R of the scene.
- The photograph is aimed toward the sun, which significantly improves the visibility of the shadows that accentuate the prints.

Pre-Training Spoor Pit Test and Scoring Rubric

Tracker Mindset for Explosive Device Emplacement Detection – Pre-training Spoor Pit Test

The authors conducted the spoor pit task 13-16 Nov 2012 at Fort Leonard Wood, MO in a sand volleyball court. They photographed the pre-training spoor pit scenarios on Monday, 12 Nov 2012 in the late morning. What follows is only a small sample of the photos needed to provide a thorough description of the impressions. The authors will happily supply a full set of original and annotated photographs upon request. The first photo in each section that follows is an unmarked picture of the spoor pit's natural appearance. The second photo in each section contains annotations that label each indicator.

Pre-training spoor pit 1 – reconnaissance, spotter only

(15 points possible, up to 5 for each spoor identified and up to 10 for correct scene interpretation.)

Figure D-10. Reconnaissance, spotter only (original).

Pre-Training Spoor Pit Test and Scoring Rubric

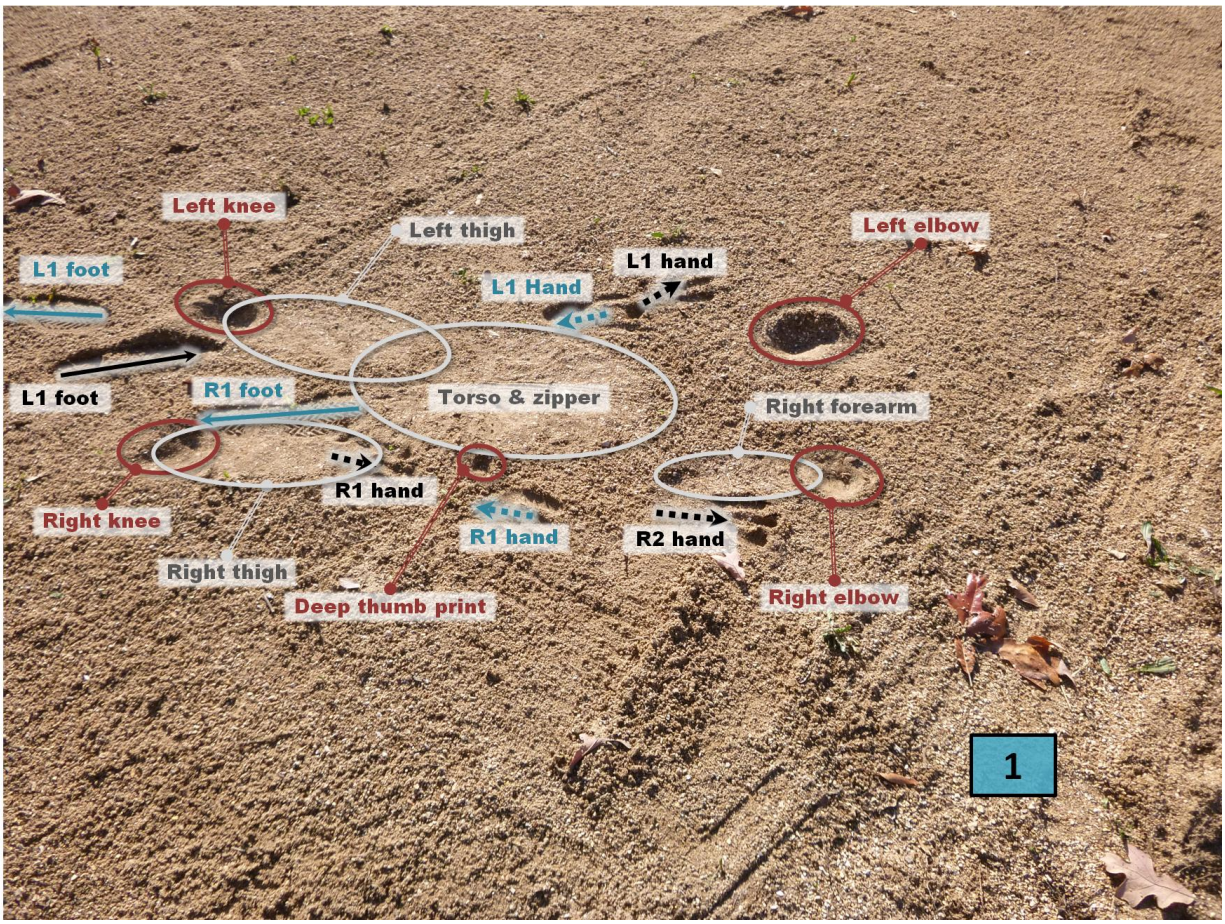


Figure D-11. Reconnaissance, spotter only (annotated).

General

- The photograph is aimed toward the sun, which significantly improves the visibility of the shadows that accentuate the prints.
- The "seam" running parallel to the upper left foot path resulted from sweeping half of the pit from the foot paths on either side of the pit (right path not visible).

Impressions – one individual with a running "w" sole pattern foot print

- This scene contains impressions from many different body parts, mostly located R of center – toe digs, knee prints, thigh prints, body print, hand prints, arm prints, elbow prints. Notice the gently wrinkled effect from fabric and the sharp parallel lines from the front zipper. [Note: Sometimes we saw the slanted impressions from Army uniform name tags or the square rank tags, but not in this particular scenario.]
- It appears that one elbow (the left) pressed more deeply into the sand with no accompanying arm impression while the right elbow impression is more shallow and lies at the end of a fabric impression. It also appears that the left knee impression is deeper than the right, and that the right toe dig is deeper than the left toe dig.

Pre-Training Spoor Pit Test and Scoring Rubric

- Two sets of foot prints were made by the same shoe, both facing the same direction. The individual entered the scene walking forward from L to R, and then exited the scene walking backward from R to L.
- The distant photos do not show enough detail to determine which direction the individual was traveling, so we looked at a close-up photo (not shown here) of the two print sets to establish sequence.
    - The most prominent indicator is the toe plume on the bottom center print (R1) showing that the toe drug some sand forward as the individual lifted his foot for the next step. The same can be seen on the toe print (left foot) that is just visible on the left edge of the photo.
    - The top set of prints most prominently shows a leaf drag (ending at L2 toe), indicating backward travel. A subtle heel plume appears on R1 showing that the heel drug some sand backward as the individual lifted his foot for the next step. (There is no tell-tale toe plume.) The irregular stride length (distance from left heel to right heel) is often an indicator of backward travel as well.

Sequence of Impressions - The individual entered along the bottom track, laid prone and created the toe digs in the process, and then rose and exited backward along the top track.

- Black L1 foot is the left support foot as the individual knelt onto his right knee first. The track is quite distorted from the person shifting weight and drawing the foot back to lay down.
- Black R1 hand is the first support hand placed on the ground. It is partially smudged by the right thigh print, causing the palm portion of R1 to be indistinct and indicating it was laid before the thigh print.
- Black L1 hand and then black R2 hand are the next prints made as the person laid his body prone.
- The left elbow and the right forearm prints would have come next, followed by the right elbow print. (The edge of the right elbow print appears to overlay the right forearm print.)
- To rise the person rolled slightly to the left, causing deeper impressions along that side of the body (elbow and knee) and used the right hand (blue R1 hand) to push back onto his knees. This left a deep impression from the thumb. Blue L1 hand came next to provide balance, overlaying the palm of black L1 hand.
- The person used his right foot (blue R1 foot) to stand and then departed backward, stepping first with blue L1 foot.

Interpretation: The individual walked forward into the scene (L to R) and knelt down, left knee first. He used his empty hands to “walk” his body into a prone position (right hand first) and propped himself on his left elbow first while resting his right forearm on the ground (long sleeves, right hand off the ground). He adjusted his body to prop on both elbows, ideal for a pose holding binoculars. He then rolled slightly to the left to push himself back to standing, stepping up from kneeling with the right foot first, and then walked backward out of the scene (R to L).

Pre-Training Spoor Pit Test and Scoring Rubric

Visual Points

1. Right elbow
2. Right forearm
3. R2 hand
4. R1 hand
5. Deep right hand thumb print
6. R1 hand
7. Right thigh
8. Right knee
9. R1 foot
10. Left elbow
11. L1 hand
12. L1 Hand
13. Torso and zipper
14. Left thigh
15. Left knee
16. L1 foot
17. Series of footprints walking into and out of position.

Pre-training spoor pit 2 – sit down

(15 points possible, up to 5 for each spoor identified and up to 10 for correct scene interpretation.)

Figure D-12. Sit down (original).

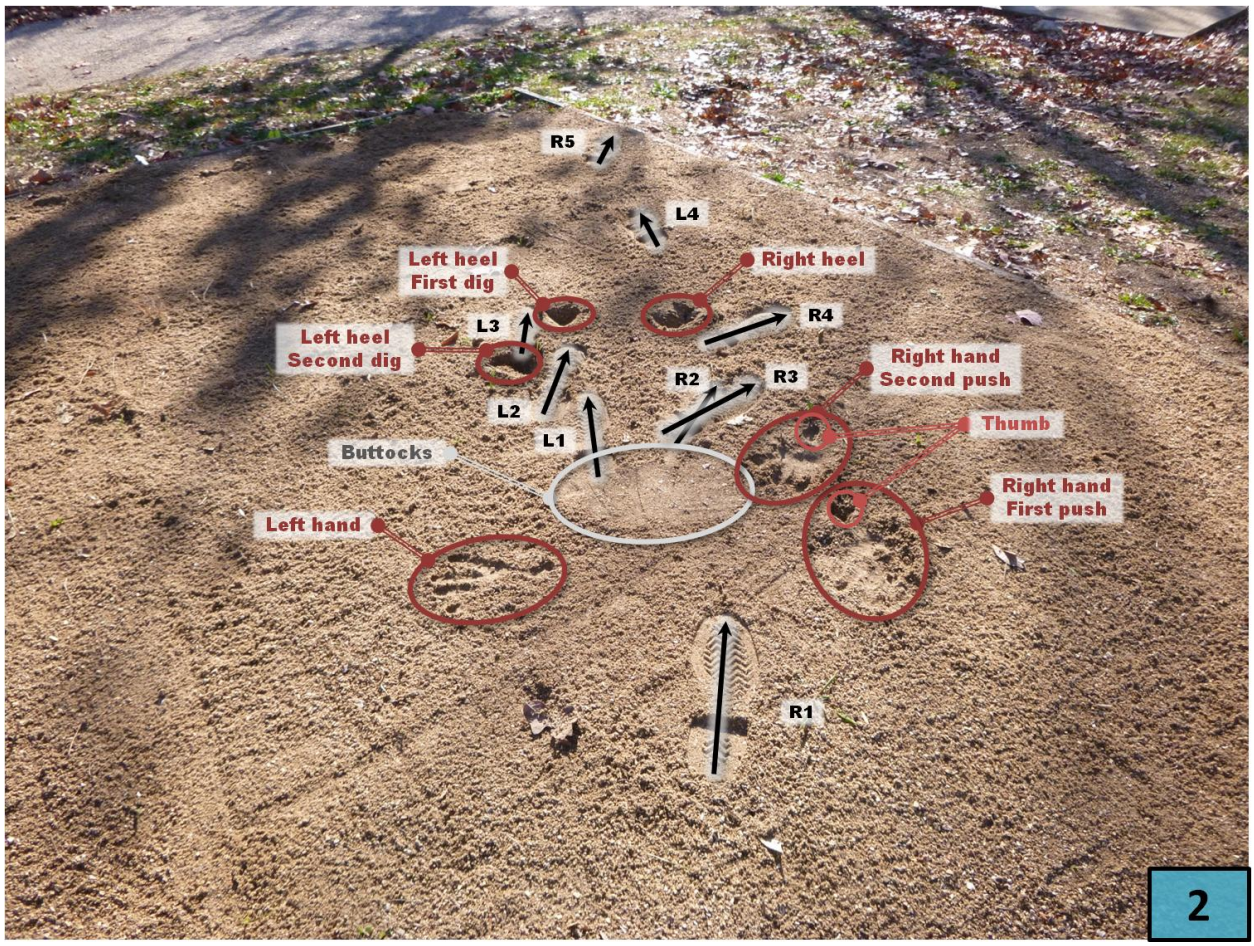


Figure D-13. Sit down (annotated).

Impressions – one individual with a running "w" sole pattern foot print

- Individual entered the scene from bottom center with the right foot.
- The flattened area in the center of the scene contains wrinkled impressions akin to what fabric would leave.
- Hand prints, one on the left and two on the right, are located on either side of the flattened area. The orientation of the right hand prints are more of a load bearing position, and the depth and detail of the second impression especially indicate significant weight was placed on the hand.
- Two of the three divots above the fabric are shaped appropriately for heel prints, with a crescent back (in sunshine) and sloping front (in shadow). The third divot (left heel, second dig) is shaped differently, but the plume of sand covering the adjacent foot print suggests that the heel may have been twisted before being lifted right-ward, wallowing the original crescent-shaped divot and dragging sand in the direction of movement.
- The orientation of the right foot prints and the tilt (i.e. roll) of the impressions indicate that the individual shifted weight to the right.

- The roll of the departing foot prints indicate that the person was slightly off-balance, appearing to leave with a right and then a left foot step when actually the foot steps were left and then right.

Interpretation: The person walked to the center of the scene and sat down using the left hand for balance. He sat with knees bent upward, as one would when propping elbows, causing his heels to dig into the ground. He adjusted his position to pull is left heel toward his body, causing the second (lower) heel dig and the light foot impression. When he rose he rolled his weight to the right side, as indicated by the right-facing foot prints, and used his right hand twice to push himself up. In the process of rising, his left heel dug into the ground a bit, rounding the divot. Once standing he was slightly off-balance and his left foot rolled to the outside. He took a final step (right foot) and exited the scene.

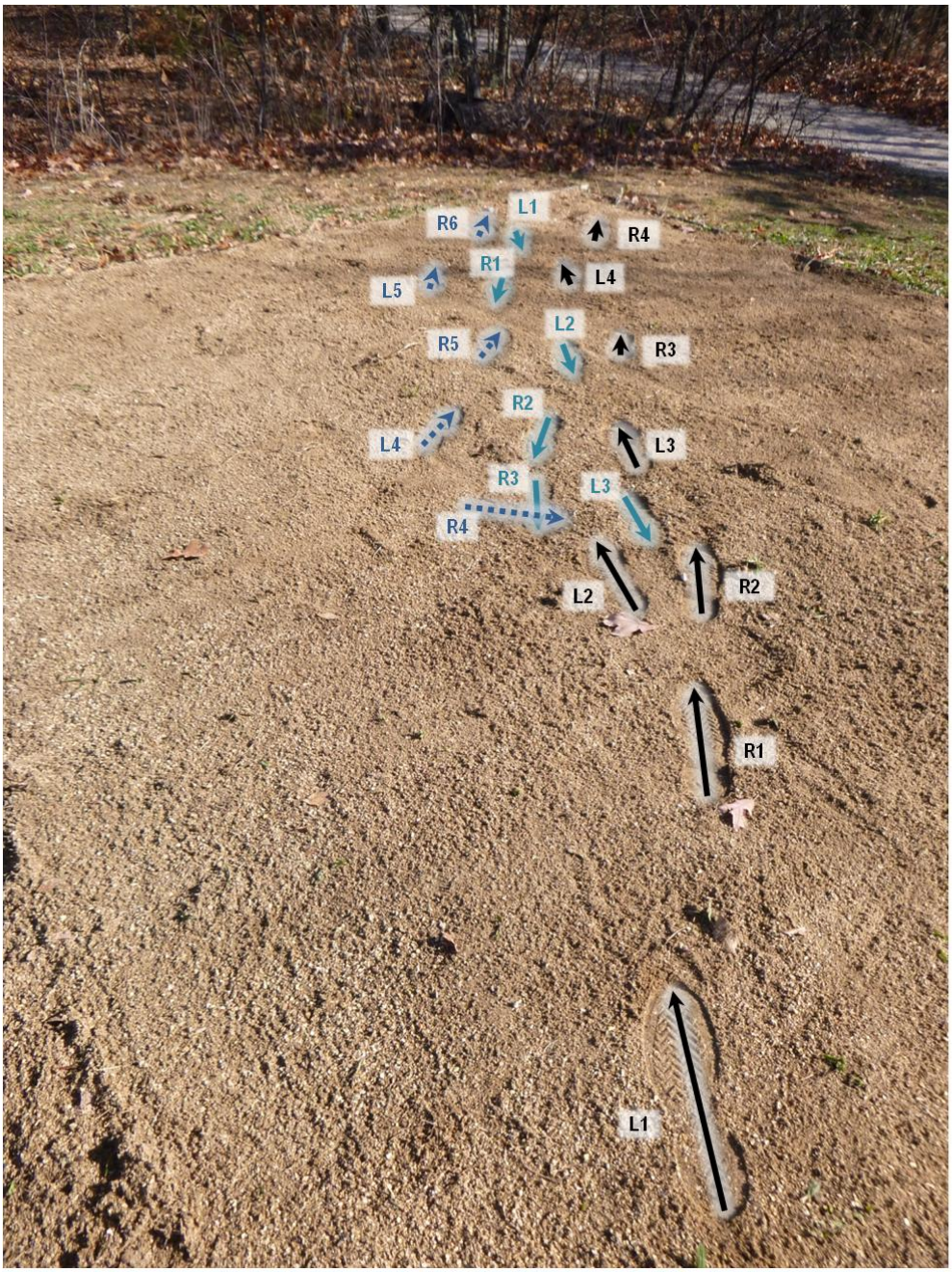
Visual Points

1. R1 foot print
2. Right hand first push
3. Thumb
4. Right hand second push
5. R2-4 foot prints
6. Right heel
7. Left hand
8. Left 1-3 foot print
9. Left heel dig (first)
10. Left heel dig (second)
11. Buttocks
12. L4 foot print
13. R5 foot print

Pre-Training Spoor Pit Test and Scoring Rubric

Pre-training spoor pit 3 – meet and leave involving two people
(15 points possible, up to 5 for each spoor identified and up to 10 for correct scene interpretation.)

Figure D-14. Meet and leave involving two people (original).



3

Figure D-15. Meet and leave involving two people (annotated).

Impressions – two sets of tracks – one has a running "w" sole pattern and one has an indistinct hiking boot sole pattern.

- The "W" print entered the scene from the bottom – left-right-left foot steps, and then the right foot stepped to parallel with the left as the individual stopped.
- W's stop was likely short, as no overlapping prints that typically accompany weight shifts or sight-seeing are present.
- W continued in his original direction of travel.

Pre-Training Spoor Pit Test and Scoring Rubric

- The Hiker print entered the scene from the top – left-right-left-right-left foot steps, and then the right foot stepped to parallel with the left as the individual stopped within cheek-kiss distance of W's prints.
- It is likely that Hiker did not stop for long either, as the only overlapping prints seem to be from his change in direction.
- Hiker turned to the left, overlapping several of his original prints, and returned the way he came.
- Given the manner in which W's and Hiker's converging prints align and the consistent spacing between their retreating tracks, it is likely they were present in this scene at the same time.

Interpretation: Two individuals met, greeted one another in a familiar manner, and then walked away together.

Visual Points

1. L1 W foot print (entering from bottom)
2. R1 W foot print
3. L2 W foot print
4. R2 W foot print – side by side of W L2 foot print (stopped position)
5. Hiker (H) L1 foot print (entering from top)
6. H R1 foot print
7. H L2 foot print
8. H R2 footprint
9. H L3 foot print
10. H R3 foot print side by side of H L3 foot print and in front of W R2 and L2 foot prints
11. H R4 (reverse turn to exit back out top of picture and to L of W
12. H L4 foot print
13. H R5 foot print
14. H L5 foot print
15. 15.H R6 foot print (departs top of picture and pit with W to his R.

Pre-Training Spoor Pit Test and Scoring Rubric

Pre-training spoor pit 4 – emplacement by one person
(15 points possible, up to 5 for each spoor identified and up to 10 for correct scene interpretation.)

Figure D-16. Emplacement by one person (original).

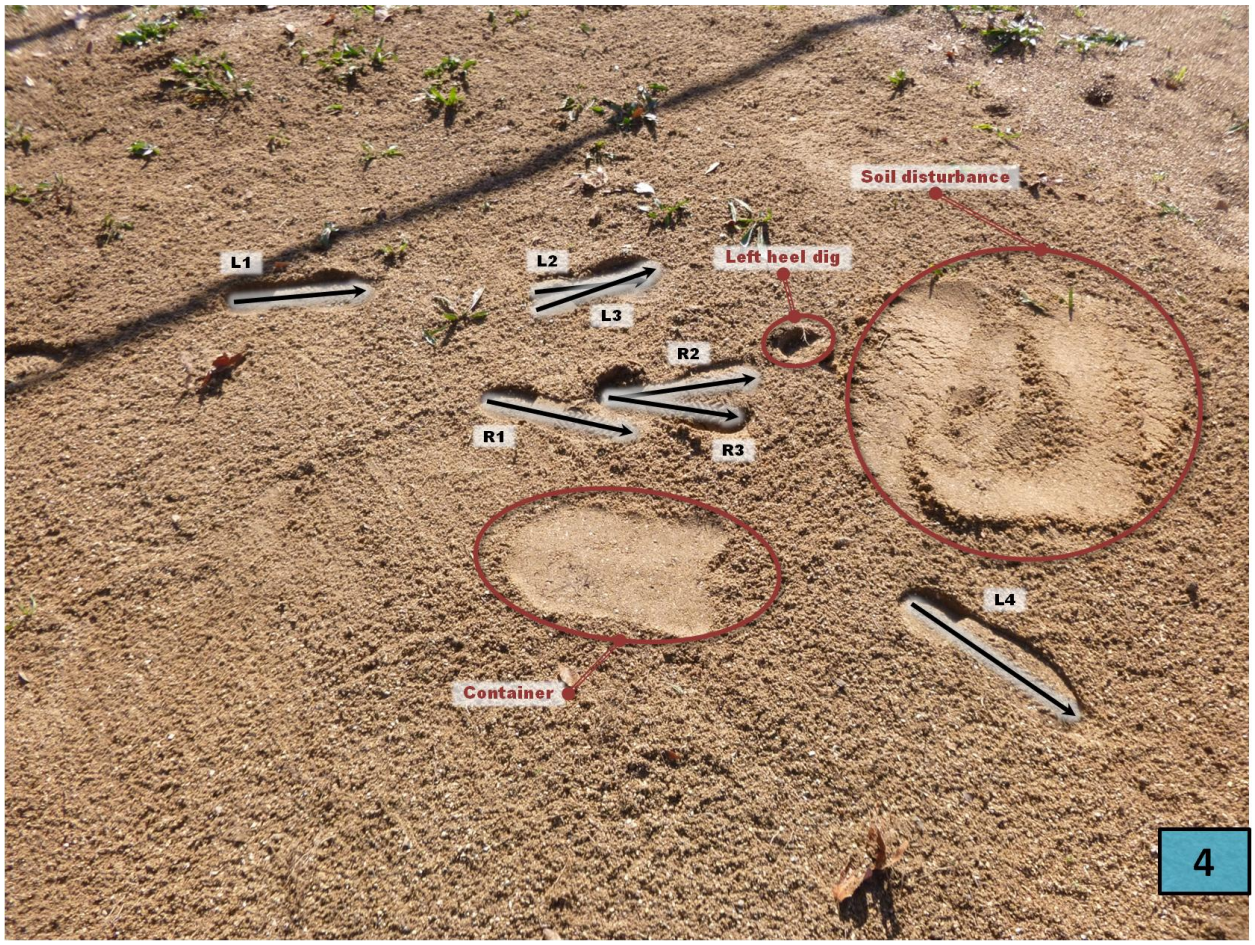


Figure D-17. Emplacement by one person (annotated).

Impressions – one individual with a running "w" sole pattern foot print

- One individual entered the scene right-left-right from the left and then stopped in the center, stepping the left foot parallel with the right.
- The feet were shifted slightly, marring the precise outline of the shoe. The left standing print shows a double heel where the foot was pivoted counterclockwise a smidge.
- There is a divot in front of the right foot print.
- The smoothed area on the right appears to have been compressed all at once, indicating some object was placed on the ground.
- The smoothed area at the top is rough, indicating an uneven smoothing action with something like a hand or tool.
- The individual exited the scene at the bottom right, stepping left and then right.

Interpretation: The individual walked into the scene and set down a container that was in his right hand. He pushed a tool (most likely a shovel, given the circumstances) with his left foot to disturb the soil, leaving a heel divot as the tool either sank into the ground or slipped along the surface. He then smoothed the soil, picked up the container (unless he buried it), and walked around the disturbance and out of the scene.

Pre-Training Spoor Pit Test and Scoring Rubric

Visual Points

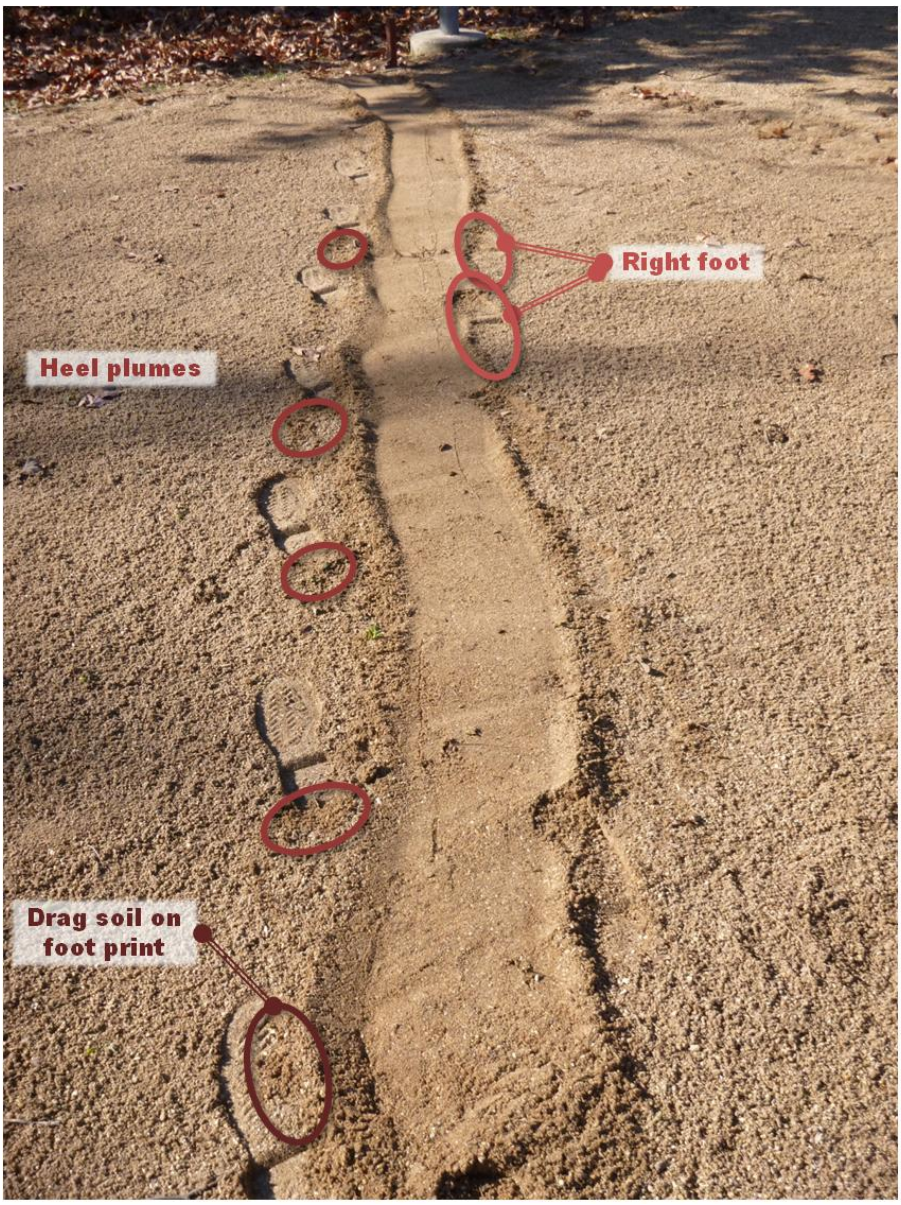
1. R1 (person enters scene from bottom)
2. L1
3. R2
4. L2 (besides R2) shows double heel mark
5. R3 & R4 partially overlap just in front of R2
6. L heel dig to front of R3 and just L of Soil disturbance
7. Container print just below R2 & R4

Pre-Training Spoor Pit Test and Scoring Rubric

Pre-training spoor pit 5 – drag line with one container
(15 points possible, up to 5 for each spoor identified and up to 10 for correct scene interpretation.)

5

Figure D-18. Drag line with one container (original).



5

Figure D-19. Drag line with one container (annotated).

Impressions – one individual with a running "w" sole pattern foot print

- One set of tracks with only the left foot print visible. Though the two right foot prints are not readily visible in this photo, the next photo from a different angle will show them more clearly.
- The individual was walking backwards, as evidenced by the heel plumes.
- The object left a smooth drag line, suggesting the material was rigid rather than flexible. Its passing knocked loose sand on top of the foot prints, indicating the person passed before the object.
- The jags in the drag line are consistent with the person's stride.

Interpretation: It appears that the individual was bent over pulling something along, as the pitch of the foot is outward and the heel strike is deep.

Pre-Training Spoor Pit Test and Scoring Rubric

Visual Points

1. Impression of object drug through the length of the picture
2. Seven or more distinct left W footprints are visible to the left of the slide
3. Heel plumes at back of left footprint indicates that person is walking backwards
4. Drag soil on footprint, bottom left indicates drag followed footprint
5. Two right footprints are visible ¾ way to top of picture and just right of drag

Post-Training Spoor Pit Test and Scoring Rubric

Tracker Mindset for Explosive Device Emplacement Detection – Post-training Spoor Pit Test

The authors conducted the spoor pit task 13-16 Nov 2012 at Fort Leonard Wood, MO in a sand volleyball court. They photographed the pre-training spoor pit scenarios on Tuesday, 13 Nov 2012 in the late afternoon. What follows is only a small sample of the photos needed to provide a thorough description of the impressions. The authors will happily supply a full set of original and annotated photographs upon request. The first photo in each section that follows is an unmarked picture of the spoor pit's natural appearance. The second photo in each section contains annotations that label each indicator.

Post-training spoor pit 1 – spotter and sniper

(15 points possible, up to 5 for each spoor identified and up to 10 for correct scene interpretation.)

Figure D-20. Spotter and sniper (original).

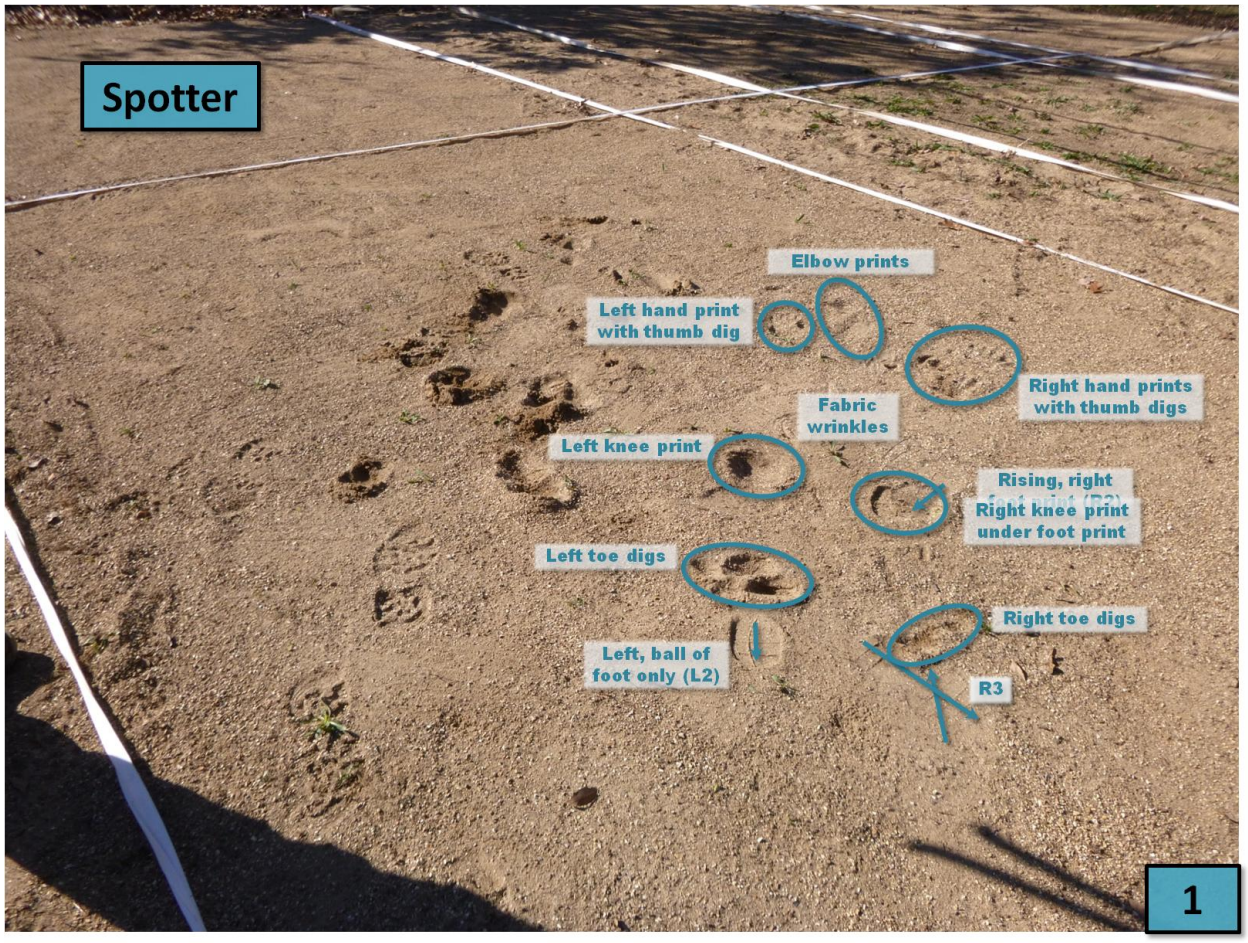


Figure D-21. Spotter and sniper (original).

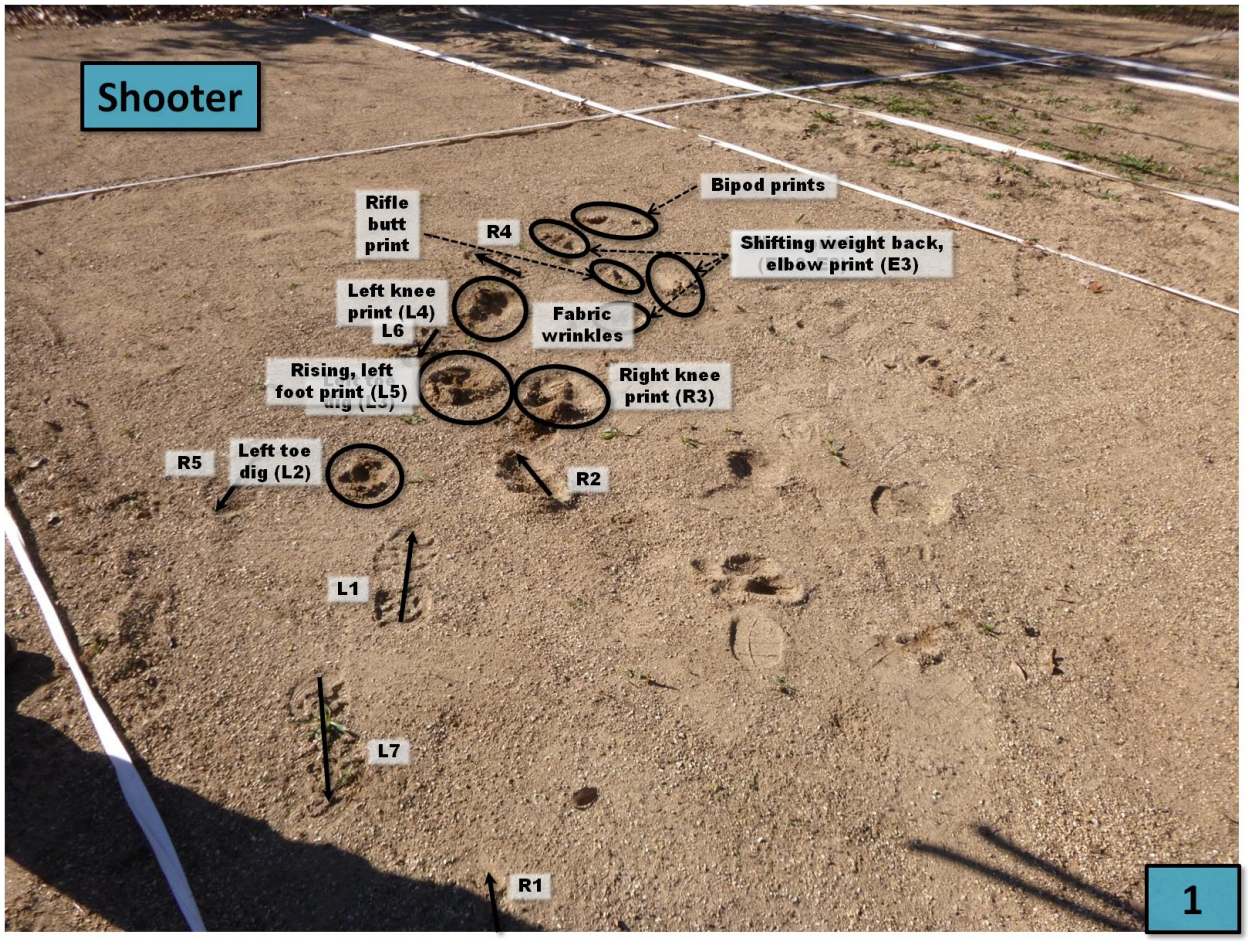


Figure D-22. Spotter and sniper (sniper annotated).

General

The sun is to the cameraman's left in these photos, which makes it more difficult to see the hand prints and fabric wrinkles.

Impressions – two individuals, one with a hiking boot sole pattern on the left and one with lines for the sole pattern on the right

For both individuals, the smoothed area central to the toe, knee, and elbow prints contains wrinkles that are characteristic of fabric, presumably a prone individual's clothing, which can give indicators of his identity. For example, canted rectangular impressions at the breast pocket level might indicate a name tag for a uniform. A straight line up the middle suggests a fastening jacket rather than a pullover (which may favor a civilian rather than military subject).

Shooter impressions – the Hiker sole pattern

- Hiker entered the scene from the bottom left with his right foot (R1, only forward half of the print is visible).
- The second right foot impression (R2) is toed-in in preparation for the individual to lower himself to the ground, suggesting that he knelt with the right knee (R3) on the ground first.

- The first left toe dig (L2) was for balance until the individual settled into a prone position with the left knee hiked up (L3 toe dig and L4 knee print, R3 right knee print). The soil at L4 is pushed up significantly, indicating the knee was scooted forward rather than placed into position.
- No hand impressions are visible, suggesting the individual was holding something and had to use his elbows for prone movement.
- The elbow impressions are fairly widely spaced – ideal for balance. They are aligned with three other impressions that are consistent with a bipod and rifle butt, indicating that perhaps the individual was in a prone shooting position.
- The significant soil disturbances at the L3 and R3 locations indicate foot movement without a clear, weighted step.
- The clear exit prints show balanced, purposeful movement.

Spotter impressions – the Lines sole pattern

- Lines entered the scene from the bottom right with the right foot (R1). The print is not visible in this photo due to the overlaying exit print (R3), but the preceding lead-in prints outside the bottom boundary of the photo indicate that the right foot entered the scene there.
- The deeper knee and toe impressions on the left side suggest that the individual lowered himself to the left knee first.
- The deeper hand and thumb prints on the right suggest that the individual rolled left to rise, enabling him to pull his right foot (R2) up first to stand.
- Since the first exit foot print for the left foot (L2) has distinct (sharp) detail and no heel impression, it is likely that weight was shifted promptly from the ball of the left foot back to the full right foot (R3). The uneven weight distribution could be the result of an injury or loss of balance (or both), or simply a characteristic way of moving.
- The elbow impressions are fairly close together – not ideal for balance, indicating that perhaps the individual was holding something that required two hands, such as binoculars.

Post-Training Spoor Pit Test and Scoring Rubric

Visual Points

Hiker (shooter):

1. R1 foot print
2. L1 foot print
3. R2 foot print
4. L2 left toe dig
5. R3 right knee print
6. L3 left toe dig
7. R4 foot print
8. L4 foot print
9. Fabric wrinkles
10. E3 two separate elbow prints (R & L)
11. Rifle butt print
12. L5 rising left foot print
13. R5 right foot print
14. L6 left foot print
15. L7 departing left foot print

Lines (spotter):

1. R3 right foot print
2. Right toe digs
3. L2 left ball of foot
4. Right toe digs
5. Left toe digs
6. Right knee print
7. R2 rising right foot print
8. Left knee print
9. Fabric wrinkles
10. Right hand prints with thumb digs
11. Left hand print with thumb dig

Post-Training Spoor Pit Test and Scoring Rubric

Post-training spoor pit 2 – sit down and check pack
(15 points possible, up to 5 for each spoor identified and up to 10 for correct scene interpretation.)

Figure D-23. Sit down and check pack (original).

Figure D-24. Sit down and check pack (annotated).

Impressions – one individual with a lined heel sole pattern foot print

- Lined Heel enters from bottom center (L1) and walks (R1, L2, R2, L3) to the center of the scene.
- A rear-pointing right hand print is visible. The print has no significant thumb dig, suggesting that weight was evenly applied (i.e. perhaps the individual was using the hand support to sit down rather than rise).
- The smoothed area in the center has wrinkle impressions, such as those observed with fabric. It is likely that the individual sat down, shifting the right foot (R3) in the process.
- Two digs (L4, R4) resemble the shape, depth, and angle consistent with heel digs from a seated position.
- To the left of the wrinkle impressions is a significant soil disturbance. It is hard to definitively describe what caused the disturbance, but indicators such as wrinkle impressions, hard lines, and location might suggest something like a backpack.
- The “tool” prints to the right of the wrinkle impressions are shaped like a rifle butt. However, no supporting indicators are visible. The upper tool print is deeper than the lower tool print, indicating that more pressure was applied, possibly as a crutch to assist the person in rising from the ground.
- Foot prints lead away from the scene, indicating the individual rose (L5, R5) and left (R6).

Post-Training Spoor Pit Test and Scoring Rubric

Visual Points

1. L1 left foot print
2. R1 right foot print
3. Right hand print
4. L2 left foot print
5. Wrinkled fabric
6. Disturbance
7. Tool marks (2 each)
8. R2 & R3 foot prints
9. L3 foot print
10. R4 right heel dig
11. L3 left foot print
12. L4 left heel dig
13. L5 left foot print / heel dig
14. R5 right foot print / heel dig
15. R6 right foot print moving on

Post-training spoor pit 3 – meet and leave involving three people
(15 points possible, up to 5 for each spoor identified and up to 10 for correct scene interpretation.)

Figure D-25. Meet and leave involving three people (original).

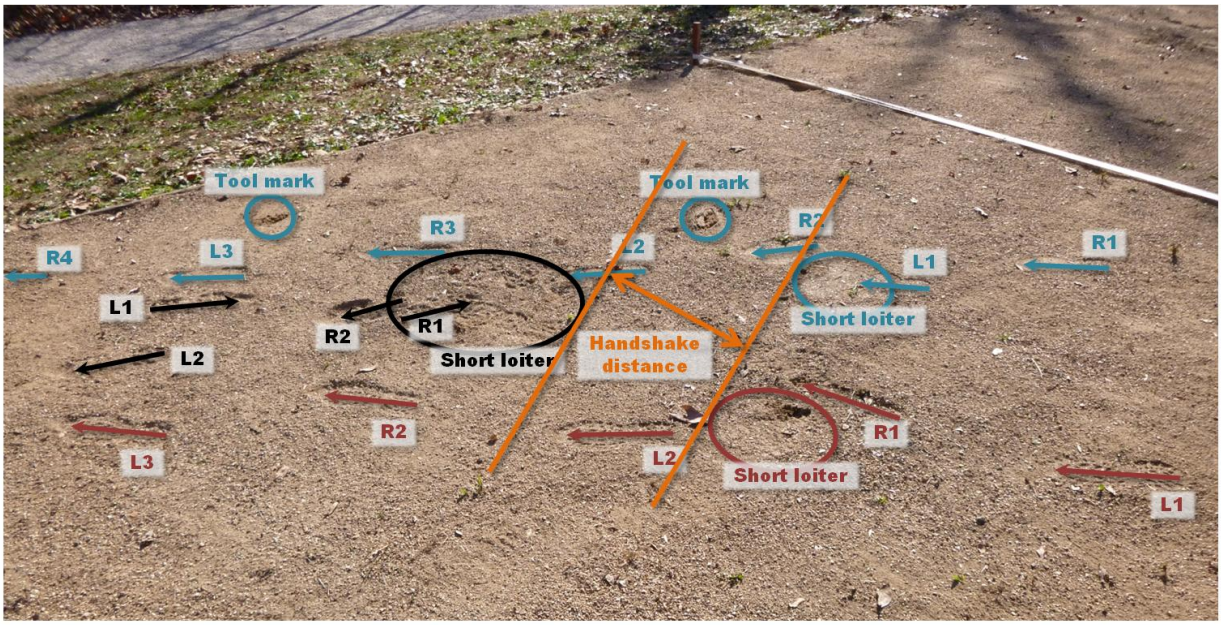


Figure D-26. Meet and leave involving three people (annotated).

Impressions – two individuals with a hiker boot sole pattern foot print and one individual with a mesh sole pattern foot print

- Black Hiker entered the scene from the left and walked to center (L1, R1).
- Blue Mesh and Red Hiker entered the scene from the right and walked to center (L1, R1).
- All three individuals stopped approximately handshake distance from one another and loitered for a short time, as evidenced by only a few overlapping prints rather than many.
- Black Hiker returned in the direction from which he came (R2, L2). Blue Mesh and Red Hiker continued their original line of travel (R2, L2, R3, L3, R4). In this picture, none of the exiting prints from the three individuals overlay one another in this scene, so it is impossible to prove the sequence of passing. However, given the distance between the track lines, it is reasonable to assume that Black Hiker walked before Blue Mesh, giving him room to travel the same direction. Red Hiker was far enough away from the other tracks that it is not reasonable to estimate his place in the sequence.
- The tool marks could be made by anything from a walking stick to a shovel. The term “tool” is only meant to indicate an unknown item separate from the human.
- In a separate photo (not shown), one can see Red Hiker’s prints overlaying Black Hiker’s – clear evidence that Red Hiker’s track line was laid after Black Hiker’s track line. One may deduce that Black Hiker turned and led while Blue Mesh and Red Hiker followed.

Post-Training Spoor Pit Test and Scoring Rubric

Visual Points

Black Hiker: Entered scene from left and walked to the center, then turned about and walked out in same direction entered the scene.

1. L1 foot print (going in)
2. R1 foot print (going in)
3. Loitered
4. R2 foot print (headed back)
5. L2 foot print (headed back)

Blue Mesh: Entered scene from right and walked to the center, loitered, then continued in same direction.

1. R1 foot print
2. L1 foot print
3. R2 foot print
4. Loiter –within handshake distance of Black Hiker
5. Tool mark
6. L2 foot print
7. R3 foot print
8. Tool mark
9. L3 foot print
10. R4 foot print

Red Hiker: Entered scene from right and walked to the center, loitered, then continued in same direction.

1. L1 foot print
2. R1 foot print
3. Short loiter
4. L2 foot print
5. R2 foot print
6. L3 foot print

Post-Training Spoor Pit Test and Scoring Rubric

Post-training spoor pit 4 – emplacement by two people
(15 points possible, up to 5 for each spoor identified and up to 10 for correct scene interpretation.)

Figure D-27. Emplacement by two people (original).

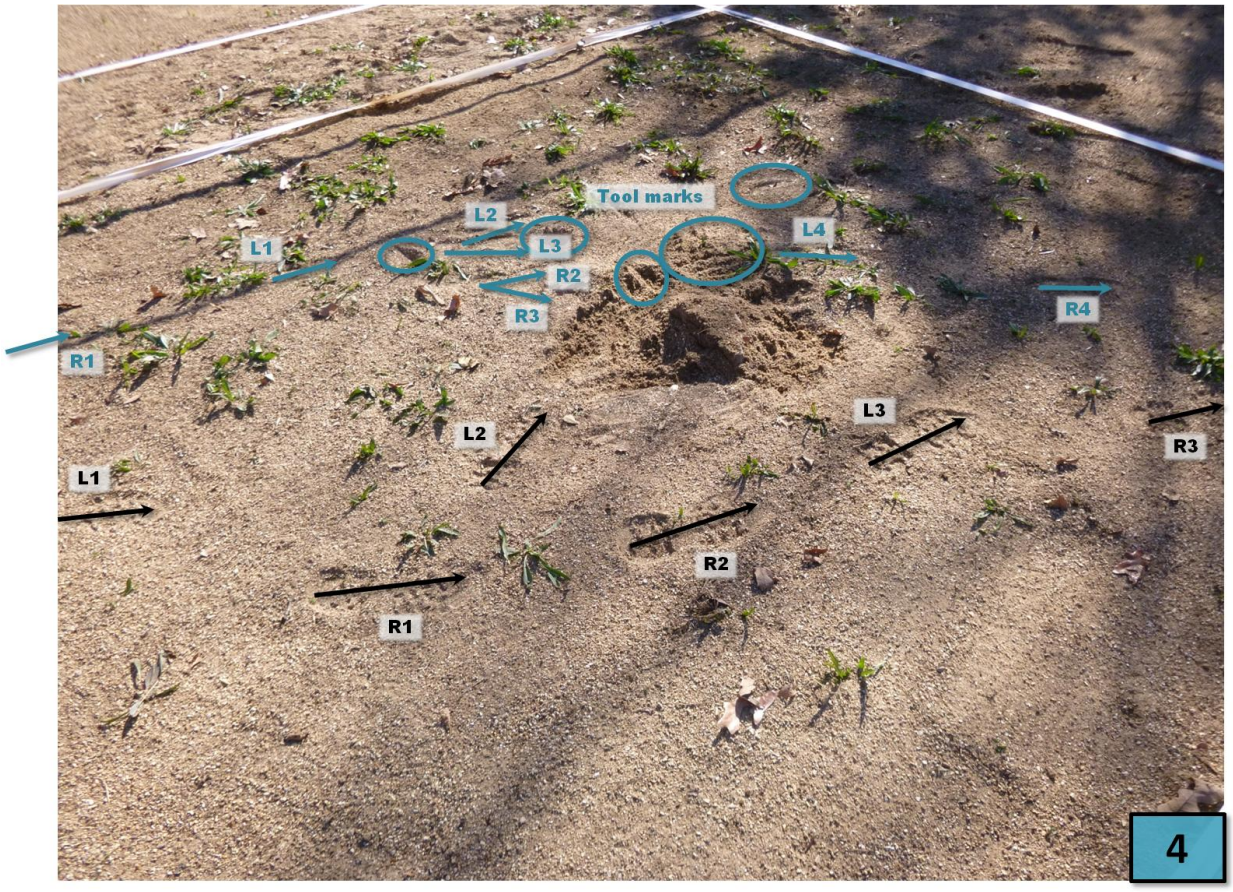


Figure D-28. Emplacement by two people (annotated).

Impressions – one individual with a hiker boot sole pattern foot print and one individual with a smooth sole pattern foot print

- Hiker (black) enters the scene from bottom center and exits the scene top center.
- Hiker's L2 print orientation suggests acknowledgement of the ground disturbance or some activity in that area. The gait appears otherwise regular and unhurried.
- Smooth Sole (blue) enters the scene from the bottom left and appears to loiter a short time near the ground disturbance (R2, L2, R3, L3). Several impressions are visible, possibly tool marks. Two look like the grooves on the back of a shovel and 3 look like slice marks from the shovel blade.
- Smooth Sole continues around the ground disturbance and exits the scene near top center.
- The spacing between the two track lines as they enter the scene indicates that the two individuals could have been walking side by side. No overlapping prints indicate a sequence of passing. However, the direction of travel for Smooth Sole (blue) as he exits the scene would cross Hiker's path, suggesting that they left the scene a different times.

Interpretation: Combined with the location of the tool marks and the assumption that the semi-buried object was carried into the scene, the interpretation is that Smooth Sole carried a shovel to the emplacement site and dug the hole. Hiker walked roughly alongside Smooth Sole, placed the object in

the hole, and walked away. Smooth Sole roughly/hastily covered the object and walked around the object to depart.

Visual Points

Hiker (black)

1. R1 right foot print
2. L1 left foot print
3. R2 right foot print
4. L2 left foot print (angled to the left)
5. R3 right foot print – departing scene
6. L3 left foot print – departing scene
7. R4 right foot print- departing scene

Smooth Sole (blue)

1. R1 right foot print
2. L1 left foot print
3. R3 right foot print
4. L2 & L3 left foot prints very close
5. Loiter indications
6. Possible tool marks
7. Obvious ground disturbance (hole)
8. L4 left foot print
9. R4 right foot print

Post-training spoor pit 5 – drag line with two containers
(15 points possible, up to 5 for each spoor identified and up to 10 for correct scene interpretation.)

Figure D-29. Drag line with two containers (original).

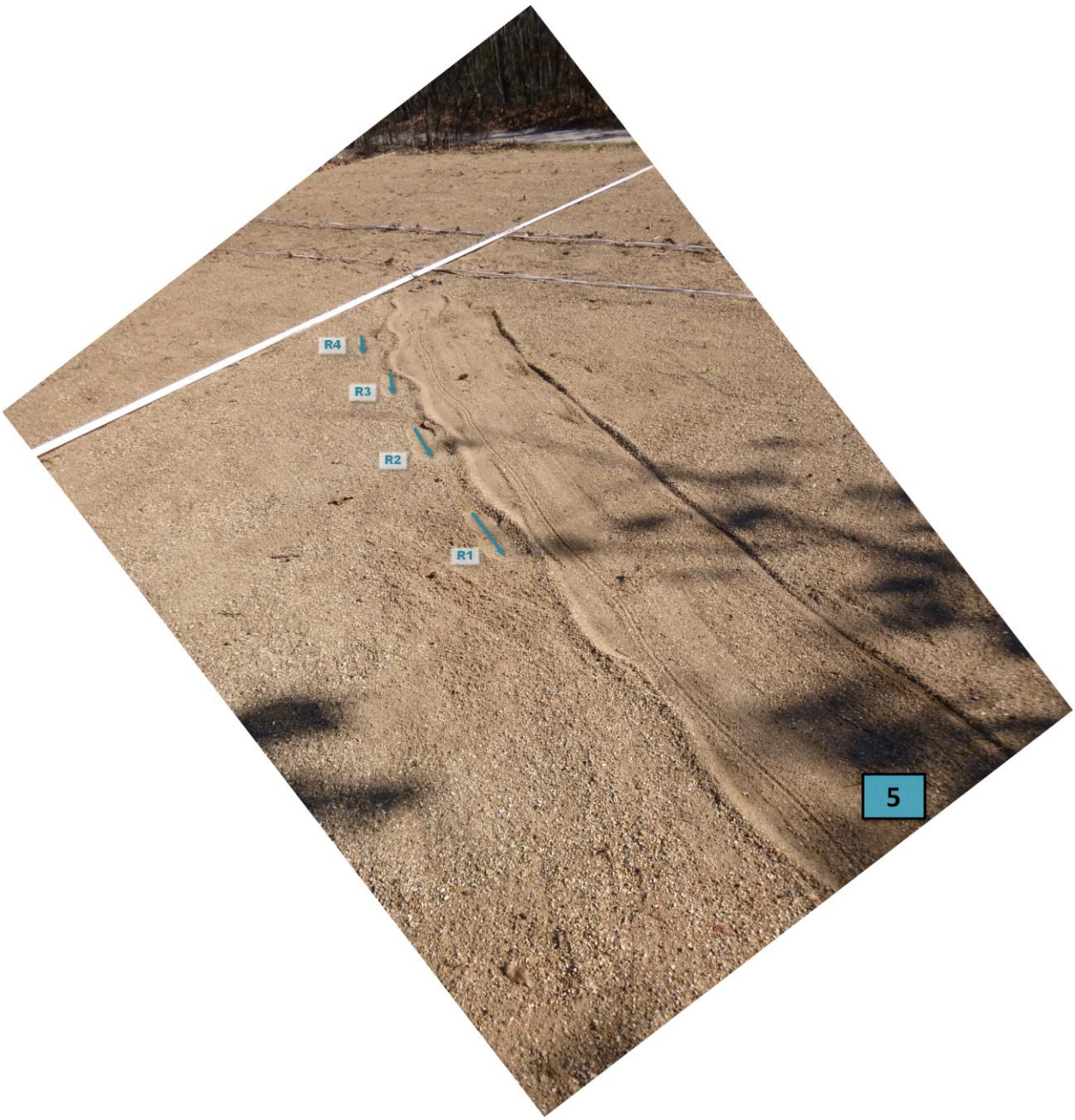


Figure D-30. Drag line with two containers (annotated).

Impressions – one individual with a smooth sole pattern foot print

- A smoothed area crosses the scene diagonally from bottom right to top center. The area has two components – a grooved segment and a very smooth segment. The terminal point at top center shows the grooved segment ending first, revealing that the smoothed section is much wider than was apparent from the rest of the impression line.
- The smoothed area spills over the R3 print, indicating the foot print was laid first.
- Interpretation: one individual was walking backward, dragging two items – possibly a rigid container, as evidenced by the regular grooves along the entire impression line and a soft

container such as a bag, given the smooth wavy impression line. The soft container passed before the rigid container.

Interpretation: one individual was walking backward, dragging two items – possibly a rigid container, as evidenced by the regular grooves along the entire impression line and a soft container such as a bag, given the smooth wavy impression line. The soft container passed before the rigid container.

Visual Points:

1. R1 right foot print (walking backwards)
2. R2 right foot print (walking backwards)
3. R3 right foot print (walking backwards)
4. R4 right foot print (walking backwards)
5. Left foot prints were covered over by the dragging action

Appendix E. After Action Review Comments

This appendix appears in its original form, without editorial change.

Comments from the AAR

Husky can find pressure plates for about 2 months, then they disappear (to the Husky)
Took off panels and replaced with rakes (many in theater)
Off road with Husky was gold.

Comments

ID	*1. What things did you like most about the training?*	*2. What things did you like least about the training?*	*3. What would you do differently (add / delete / change) if you had only 8 hours to conduct this training?*	*4. What additional comments would you like to make?*
2	There was scientific backing for what was taught; instructors have a good knowledge of tracking techniques	The photos are a good introduction, but field time is the best way to look a scenarios	Add more spoor pit time in larger areas; have a culminating event at the end of the 8 hours; add how to work in team size elements; add tracking over a distance	Adding IED components to the areas and imprints for Soldiers to get an idea for objects they would encounter again.
3	Hands on; explanation on everything was really good	We just did dirt, I would like to see grass, gravel, clay, different terrain.	Take away death by PowerPoint	Instructors were awesome. They knew their information and followed through very well.
4	It was new information with a fresh perspective on an old problem (finding IEDs). It was very informative.	Probably the photo guessing. Not because it didn't contribute, more because it was frustrating. It was more difficult and you couldn't get different angles.	Having slides dedicated to specific clues (after the initial testing).	Really this class was a good introductory course. 2 days isn't nearly long enough to get very proficient. It would be nice if there was a follow-up class.
5	Informative; good pace	I wanted more samples of different actions and what the tracks look like. Also, what spoor looks like in different terrain (gravel, pavement, wooded area, etc)	More feedback on spoor	I'd like to attend a longer version of this, one where we actually track someone instead of interpret spoor in a volleyball court.
6	Not knowing anything I liked the subject in general. I feel it is a very large subject to cover in 2 days, but is a great introduction.	I felt like it was too much information for 2 days. This is a subject that needs more time even for an intro to it.	Better organization could get more information out.	

ID	1. What things did you like most about the training?	2. What things did you like least about the training?	3. What would you do differently (add / delete / change) if you had only 8 hours to conduct this training?	4. What additional comments would you like to make?
7	Hands on going outside to get the full effect of the training	That there are indicators when in theater or during a deployment there are none	Put command wire in the training	None
8	There was a lot of hands on training	Not being able to know the answers till the end	Add different training areas maybe mud, pavement	Good class learned a lot
10	Teaching your eye to see more with different light or tech. Location was nice with sand pit.	Really there was nothing I didn't like, but could have been better with lones [?] while walking through the woods around building show actual events situations.	No delete, but would change or put actual IED so our eye could train on that for war time.	Good job. I'm walking away with more than I came in with.
11	Instructor's knowledge on the topic; the visual aids; hands on experience	Lanes were small; class was only 2 days; need more hands on; better definition of terms	Split the time up 4 hr class rm/4 hour field or 6x2.	
12	Learning to read a spoor	Nothing	I would add training IEDs so you can learn to pick up the indicators of the PP & CD IEDs, i.e. stick lanes	Very good training overall. Need more than just two days. Any group or company deploying to do route clearance should attend this training.
13	The information on how to save my life and battle buddies	___ [?] we ___[?] more about IED	Make the training longer. 2 days was not enough.	Overall it was a good class; new information giving out.
21	I liked the sand pits.	There wasn't and like creators like make creator [crater?] with tracks around it like 3 meters off	I would put more training with IEDs placing them making tracks.	Training was good I know a lot more than I came here with
22	The class teaches you the 1st step to reading tracks, how to properly look at them, how to read them, basics for a beginner.	Class needs to be longer, a week course to cover as much material as possible in regards to IED. Cover and concealment How to detect as much as you can.	[Circled "add"] Booklet for students to take with them for their own personal use for in the field.	Course needs to be made into a week long event to get as much as the student can out of it. 2 days is not enough. But in 2 days you can get the mind set of the basics of tracking and cover and concealment events.
23	I liked that it not only involved classroom but had an outside hands-on look on the subject as well.	I thought that having IED simulators or some sort of visual IED to train on would have been more realistic.	I would change the different pits on the classroom side and move it to complete outdoors hands-on	I thought it was a good base for a class and could be helpful and effective

ID	1. What things did you like most about the training?	2. What things did you like least about the training?	3. What would you do differently (add / delete / change) if you had only 8 hours to conduct this training?	4. What additional comments would you like to make?
24	The check on learning. Hands on. Actually making a scene	Changing of classrooms	More hands on training	It was a great learning experience Learned a lot and it should be conducted to every organization
25	Some the information about tracking and soil marks	Not enough examples with actual IED in spoor	Make sure that the class is more understand because not all troops have had classes on types of IED	Make sure to have several different soil type for spoors
26	Identifying prints and have an idea on what they were doing. Instructors were very informative.	Distance between classroom and spoor site		
27	The way it taught me how to look more into detail about tracks, and how to interpret them.	I didn't care for the slides of the spoor pit as much as I did being outside and getting different angles and views	Do away with some of the slides and spend more time identifying different scenarios	Instructors were very knowledgeable and helpful. The class was a big eye opener to tracking skills.
28	Practical exercises made the classroom portion understandable	Not enough field practice	Remove some of the soldier concept scenarios at the spoor pit on Day 1, add more IED specific tracking techniques.	I feel the class was misrepresented as an IED class. I do realize that this is a juvenile program, however, little if any time was spent on IED specifics. Perhaps adding command wire burying, debris removal, and or placement.
29	Very different training than had before, a new set of skills	For different scenes in the spoor pit, have a little more analyzing time to get all details	Add in possible woods/forest tracking	
30	New training Hands on	Back and forth to training	More in depth classroom time	This is a good class but could be longer and more information added.
31	Hands on training actually making a scene helped understand	Angles and light were limited by weather Made hard to understand and determine what was going on	+ more hands on actually make scenario and go out and let the class crawl around and figure out the scene	Good training and very knowledgeable instructors

ID	1. What things did you like most about the training?	2. What things did you like least about the training?	3. What would you do differently (add / delete / change) if you had only 8 hours to conduct this training?	4. What additional comments would you like to make?
32	It was good to know b/c not only is this gonna help me hunt in my off time but survive down range.	Paperwork honestly.	Make this an actual week/40 hr course b/c this **IS** a good tool to have plus some promotion points would encourage people/soldiers to learn it.	Maybe a longer lunch say 2 hrs b/c slides are a good form of sleep therapy.
33	The field training at spoor pit was good.	Overall I felt the training was well presented	I would have liked to have spent more time with print reading.	I think a better spoor pit would help increase teaching. Maybe having one built specifically for training would be great.
34	Knowledgeable instructors, hands on training and snacks		Keep it the same.	Great class and I did walk away with more knowledge than I had before.
	It was new learning and it was fun trying to figure out what happened in each situation.	Pictures were kind of hard to distinguish things at times	Maybe have a little more time in the sand pit.	
36	I liked that we learned a different skill to help with identifying IEDs and IED identifiers.	There wasn't anything I didn't like about the training. Except I wasn't aware of what I was doing before I got into the class.	I would add a small portion of IED training. Mainly the ones most used in Afghanistan.	It was a great class. I learned a bunch in the short 2 days.
37	The pics and the information put out by the trainers	The repetitive scenarios	Terrain, weather like stuff, like weather, grass etc More props for exercise	More pics and different type scenarios but overall good info and keep up the good work. Thank you

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