



SAR Spotlight Forum

The following is an edited version of excerpts from the 2006 edition of *The Textbook for Managing Land Search Operations* by R. Skip Stoffel, et al, Emergency Response International.

While explorations of mathematics and theories help to justify and quantify search operations, a fundamentally sound search also requires successful training and preparation of those who venture into the field to look for clues or the missing person. In this article we explore the connection and possible benefits to probability of detection (POD) through briefing searchers immediately before they enter the field. In addition, we hope to influence the training of those same searchers for increased probability of success in future operations.

The idea for the concepts in this article originated during a presentation given at the Washington State SAR Conference by researcher, Dr. Kenneth Hill, (*Halifax, Nova Scotia*) in 2004. Ken and a number of others in SAR believe search managers and planners can improve searcher POD in the field with specialized training and what is called “priming” during pre-search briefings.

The Briefing/POD Connection

The questions of how or if searchers see and recognize clues, or even the missing subject, defy simple explanation. It is much more than just seeing an item, a clue or the subject. Perception, and judgment based on that perception, combines the complex processes of vision and decision making.

In its simplest and most elementary form, visual search starts with stimulation to the eye. The searcher sees the environment, patterns, and the objects in it. As these objects come into view (*however brief that may be*), neural activity or mental processing occurs. Unconsciously, the searcher makes a comparison between the environment and a personal preconceived standard image (*the mental image of what they are searching for*). Based on this comparison, the brain makes an instantaneous decision to take action, (*declare a find or go investigate*) or to take no action. (*Sounds simple, but it really isn't!*)

Recognition by searchers really involves a relevant interpretation of sensory system stimulus (*sights, sounds, smells, etc.*) to determine a meaningful source and association with what is being searched for. This means that the searcher recognizes a clue as search related or directly related to the subject. We hypothesize a searcher in the field acts as a sensor with a given POD; however, instead of a constant capability this sensor's detection and recognition rate may increase as a result of the right training and experience. This aspect of POD relates to both training before the search and briefings during the search. Briefings constitute a major programming function for searchers on what to look for. To comprehend how all of this fits together in POD we must understand how visual images and mental preconceptions influence and constantly change perception.

Detection and Recognition

In most cases, detection and recognition present vastly different results in search! As an example, a missing person will always leave clues, however the question remains, did the searchers see those clues? Tracking experts estimate a person leaves at least 2000 tracks (or pieces of evidence) in the environment for every mile walked. Unless searchers train to detect **and** recognize those subtle signs, they may see something but fail to recognize its meaning or importance.

Furthermore, without recognition detection gives little value. Ask the crucial question of search planners and managers "Can the searchers that you send to the field recognize what they see as relevant or potentially critical to search success?" i.e. "Are they going to be able to both detect and recognize subtle as well as blatant indications of where the missing person has been, or might be?"

Probability of Detection

From a mathematical perspective, an accurate value of Probability of Detection (POD) must originate with a scientific determination of sensor effectiveness in a given environment under specific conditions. There are essentially four groups of variables affecting POD. (Frost, 1998) They are; the **SENSOR** used in the search, e.g. people, electronics, infrared, etc.; the **SEARCH OBJECT** or what searchers are trying to find; the **ENVIRONMENT**, where and what conditions exist and the size of the area being searched; and the **METHOD of SEARCHING** or tactics used by searchers. Tactics also dictate the level of effort being expended. All of these affect each other, and the ultimate search result, when used in conjunction with one another.

THE SENSOR *(In this discussion we want to focus on the human searcher)*

Searchers utilize the human eye more than any other sensor. While this sensor appears straight forward in its application and utility, human vision includes several shortfalls requiring compensation. Enhancements to vision such as infrared, binoculars and NVGs (*night vision goggles*) provide added capabilities, but a mental component also affects detection capability for searchers.

Memory and Search

Research (*Schneider and Shiffrin - 1977*) shows a division in how human memory operates. Working Memory has limited capacity, is transient, and holds new data or recently refreshed information. Before heading out into the field, searchers place the Search Manager's briefing information into their "mental computer". In essence, they are putting the information from the briefing into what is called Working Memory, analogous to a small floppy disk or thumb drive. In contrast, Reference Memory (the main hard disk) within the brain contains a vast amount of relatively permanent acquired knowledge gained through education and experience. (*With experienced searchers, this includes a great deal of good and bad experience from previous searches.*) People address Working Memory (the floppy disk) through a serial process (*one piece of information at a time like serial numbers in a list*). It is a slower process and takes a lot of time. People access Reference Memory through a parallel process (*multiple pieces at the same time*). This is a much faster and more efficient use of information.

In every search effort the searchers learn the distinction between targets and distracters for the new environment. The briefer bridges the gap between previous targets and distractions and those present on the current search. Research (*Shiffrin, R. W. & Schneider W., 1977*) indicates that practice brings about changes in the way the brain transfers multiple memory items from working to reference memory (*multiple pieces at the same time*). In other words, practice looking for specific items in differing environments pre-loads the more rapidly accessible and efficient reference memory.

Attention

Attention refers to our allocation of mental processing resources. It describes an ability to focus on a task or to concentrate on a specific item. Unfortunately, a searcher's ability to pay attention has its limits just like any other mental process. When the brain pays attention, some stimuli get more processing than others, and this processing opens the door to conscious perception and memory. Relating to search, the question is, **“What grabs and keeps searcher attention while they search?”**

Visual Attention

Humans pay attention visually in three different ways: Selective, divided, and automatic. Most people find difficulty in paying attention to more than one thing at a time with any degree of efficiency. Attending to one task over another requires selective attention. Humans automatically carry out some attention processes, such as reading, while others occur unconsciously, such as attention driven by fear or anxiety. In divided attention only one cognitive process occurs efficiently at a time. Something gets full processing and something else gets only limited attention. As an example, think about a searcher in a dangerous environment such as rough, steep, rocky terrain. Self preservation or safety attention naturally takes precedence over clue consciousness.

As another example, think about faces in the last class you attended. At first everyone essentially is non-descript and looks like everyone else. Then someone talks to you or asks a question. *(Now we paid attention to detail and can differentiate a particular face.)* As humans we remember what it was that we paid attention to.

Automatic visual attention does not require focus. A good example occurs while driving a car and reading road signs with a glance. Even stepping out into the street and glancing both ways is an attention function that occurs automatically. Attention is not focused, we perceive broadly, but not in detail.

Reading presents a great example of the automatic attention function:

Amzanig ?
I cdnuolt blveiee taht I cluod aulacrty uesdnatnrd waht I was rdgnieg
THE PAOMNNEHAL PWEOR OF THE HMUAN MNID
Prtety Amzanig huh?

People focus their attention on complex visual stimuli to synthesize it into a meaningful pattern or a recognizable feature.

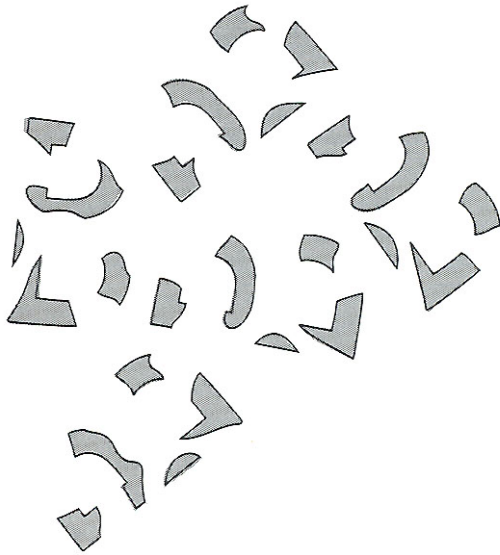
Feature Integration Theory

The brain codes different visual features in parallel to what can be called “feature maps.” People (*searchers*) easily distinguish single features visually. The brain recognizes the feature almost instantaneously – requiring no attention. Finding a blue circle among red circles is a parallel process. However, when multiple features enter the problem (*this is processing conjunctions or groups of features*) with a confusing background, the process reverts to serial and slows down dramatically. Searching for multiple features in a complex setting or area forces the brain into a serial processing mode.

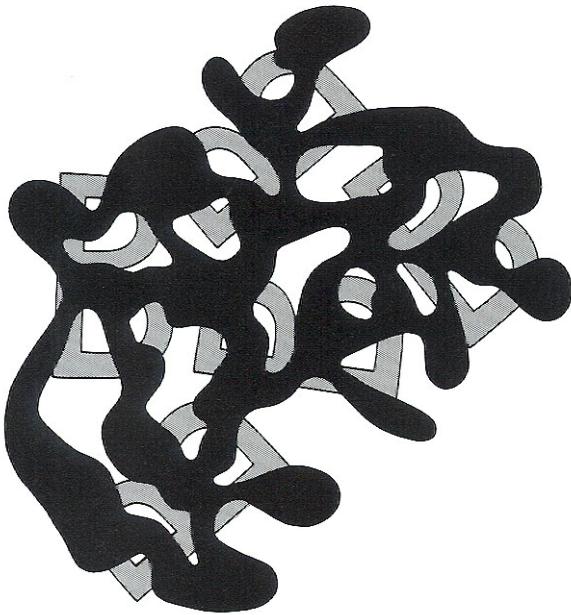
Form recognition occurs when mentally grouping elements of the retinal image. The principle called “good continuation”, uncovered in 1923, refers to our tendency to group together in a single structure things appearing aligned in directional continuation of form. A searcher sees what appears to be a foot sticking out from behind a tree. Even though no other part of the

missing person's body is immediately visible, the searchers eyes automatically shift to the other side of the tree to look for continuation of the person's body.

Proximity and similarity also play into our perception of form. With all other things equal, humans tend to organize objects close together as parts of an overall whole. They also tend to group similar objects. This similarity can be in terms of color, lightness, size, or even texture. Intervening objects, vegetation or substances like snow occlude form but also fill in the gaps for seemingly disconnected parts. The following example demonstrates how this works. How can we visually combine the disconnected pieces in this illustration?



Answer: Superimpose an object over the top of the pieces. The next illustration shows how this can be done. Now the brain sees Bs.



When searchers go to the field, they create a mental picture of the target(s) (*missing person or clues*) that they seek. That target or search image develops through perceptual experience (*participated in a previous search*) or will occur based on how briefers tell them to look. This image guides the visual search conducted by these people and directly affects POD.

Searcher's Expectations have a tremendous impact on their subjective assessment for probability of detecting a clue or the missing person. (*Does the person really have a clear image of what it is that they are looking for?*) This directly affects the scanning rate and frequently is used by a person to return visually for "follow-up" inspections. In other words, expectations affect dwell time and the tendency to "take a second look."

Searching for multiple clues or targets presents a more difficult task than searching for a single target. That means processing more than one image during any visual snapshot. However, searchers usually improve with practice, and with what is called "priming." For lack of better analogies, we need to "prime" the visual pump. This time we define the parameters of perceptual recognition through a mental process called canonical perspective.

Canonical Perspective

Canonical Perspective concerns the authoritative or accepted view of any object. With no additional input or description (*hat, key, cup, glove, etc.*), we tend to accept the canonical perspective or "standard identifying view" of what an object looks like. Unfortunately, this perspective often gives a view different from what searchers see. For example, envision a "baseball cap" type hat turned upside down and smashed into the grass or other vegetation. This description of a baseball cap falls outside of the canonical perspective. The searcher sees the hat without that image in his mind, so even though he or she sees the object, it fails to register as recognizable and there is no "find." In many cases, this explains why searchers failed to find the crucial glaringly apparent clue until later in the search. Objects, clues and missing persons that fall outside the canonical perspective and therefore require a lot more time of focus and attention relate to **dwell time** (*the time of focused attention*).

Visual "Sweep searching" fails to detect form or shape as opposed to "taking visual snapshots" which does. This is a technique long used in searching from aircraft by aerial observers.

As stated earlier, questions of how or if searchers see clues, or even the missing subject, defy simple explanation. Perceptual judgment along with the complex processes of vision and decision making most definitely affect POD. Managers and planners may have much more of a role in determining POD than previously thought. At this juncture what is needed is some expanded efforts at very controlled experimentation to determine the full benefit of "priming" searchers through both the briefing process and specific training. Existing research tells us very clearly that just seeing (*stimulation of the eye*) is not necessarily detecting. Searchers must make a personal comparison between what they are seeing and a preconceived image. The question is "Can a briefer, manager, or planner make a difference in that preconceived image?" We think they can!

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