Chapter 6 – PHOTOSIMULATION EXPERIMENTS

The evaluation of photographs by observers in a laboratory setting is called photosimulation. Slides (analog images) of the target and its surroundings are shown to groups of observers and their observations form the basis for the evaluation. The method repeats to some extent, indoors, what takes place in the field during a field trial. One can claim that instead of taking the observers to the field, one records an image of the scene to be evaluated and takes it to the observers for display on a screen. Compared with field observations, photosimulation adds extra media, namely the optics of camera, projector and film. This contributes to the fact that so far it has not been possible to reproduce the detection range of a field trial from a corresponding photosimulation experiment. However, photosimulation is still a good method for *ranking* the camouflage measures, not *determining absolute detection ranges*. The photosimulation experiment includes exactly the same independent variables as the field trial since the photographer will collect the imagery during the field trial. Observer evaluation of the imagery can be accomplished by a variety of techniques. The most well known technique is analog photosimulation using 35 mm slides [4, 5]. Advances in image collection technology now offer digital alternatives. Following are two procedures, analog and digital, that have been successful in prior experiments. Tools with additional features are available, such as POSE and SAFARI [6, 7, 8], that provide for automatic recording of observer responses, as well as other features, that are further described in the SCI-095 final report [9].

6.1 TRADITIONAL ANALOG PHOTOSIMULATION

In a traditional photosimulation trial, analog images recorded in the field are projected as color slides to observers under controlled (laboratory) conditions. The field trial should be set-up to accommodate the intended photosimulation evaluation and to allow extraction of the desired information. Additional information can be found in Reference 10.

6.1.1 Design of the Experiment

The photosimulation is performed in a darkened room ensuring enough space for the appropriate installation of the projector, projection screen and observers, and that is free from distractions. The light in the room should be such that it does not influence viewing of the screen. Slides are viewed by an observer from a fixed, predetermined distance, a2, calculated by:

$$a2 = (a1 \times f1) / f2$$

where al = distance projector – screen
a2 = distance observer – screen
f1 = focal length of camera
f2 = focal length of projector

An observation chair is positioned in the calculated spot and is attached to the floor to keep its position fixed throughout the photosimulation.

A standard commercial 35 mm slide projector can be used to project the slides. The projector should be positioned directly behind and above the observer to present a centered unobstructed image. The distance of the projector from the screen should be adjusted to project an image on the screen that is 2.0 m wide. The slide

projector should be set to automatic, changing slides at a preset time interval, which is determined from a test run. Typically this would be 15 seconds.

Two data recorders sit behind and to the side of the observer's chair. The data recorders should be positioned so that they can easily hear any comments from the observer and see the target locations identified by the observer. The use of two data recorders allow results to be confirmed/validated and ensure a more complete and accurate experiment. It is best if at least one of the data recorders conducts the data analysis.

After the room has been set-up, the photosimulation supervisor organizes one or more test runs in order to check the procedure and to ensure optimal conditions. A typical viewing room set-up is shown in Figure 3.

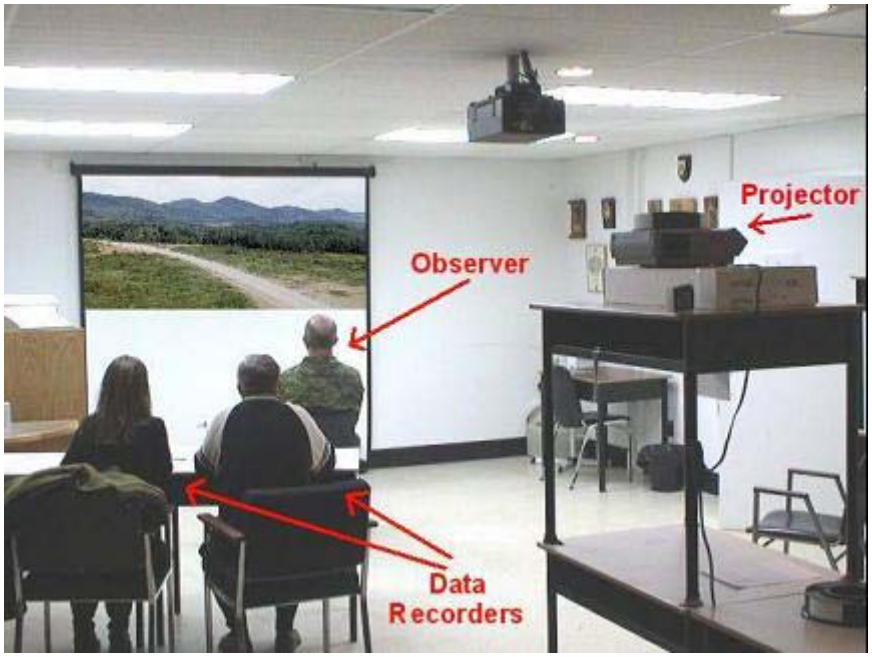

Figure 3: Typical Viewing Room Set-up.

Prior to initiation of the photosimulation test, the observers are given an introductory briefing in a separate room describing the goals of the photosimulation and what each observer is required to do. For best results, the briefing should be conducted from a printed script so that each observer group is given exactly the same background information. A typical briefing is at Annex A.3. Ideally the observers should be soldiers and be trained for the specific observation task used in the photosimulation. Following the briefing, each observer should be given a questionnaire to complete. This questionnaire collects background information on the individual: military occupation, age, gender, visual acuity and previous training in vehicle detection or photosimulation trials. A copy of a sample questionnaire is contained in Annex A.4.

Observers should enter the viewing room one at a time and sit in the designated chair in front of the projection screen. The observer is again briefly instructed on how the trial will be conducted and what actions are required. The observer is provided with a laser pointer (or similar device) and instructed to use the pointer to indicate the location of any targets he/she detects in the projected slide. The observer is asked to familiarize himself/herself with the operation of the laser pointer. While this activity is taking place, the completed

questionnaire for the observer is reviewed by the data recorder and any ambiguous information clarified. If the observer indicated on the questionnaire that he required corrective lenses, the test supervisor should confirm that they are being worn. The observer is then shown two series of slides presented in the same manner, one as practice and one the test series.

Directly thereafter the photosimulation with the test series can begin, starting with the slide at the longest associated range to the target. As each slide is shown to the observer, the data recorders capture the observer's comments and record the slide number at which the target was detected, recognized or identified. Corresponding ranges are derived from the associated slide numbers. The supervisor controls the experiment including briefing and handling of the slide projector. After finishing the run, the observer leaves the room and is reminded not to discuss the trial with anyone until the end of the trial. The next observer enters the room and the procedure is repeated.

Typically, 15 to 20 observers are required to obtain a statistically relevant result. However, in order to avoid learning effects the observer should not view more than two series of slides, each of a different background. The use of a practice imagery series is very important in a photosimulation trial. It overcomes any potential learning effect on observers, allowing unbiased results to be obtained for the imagery of interest. Consistent use of the same warm-up imagery provides a mechanism to confirm that different trials have been conducted in the same consistent manner and that it is valid to compare detection results between these trials that may have been conducted at different times and/or in different geographic regions. Use of the Coyote imagery series, described here, has yielded a median detection range of 950 meters with a 95 percent confidence interval of 850 – 1067 meters for fifteen observers. Future photosimulation trials employing this imagery series should expect to obtain similar results.

6.1.2 Example Photosimulation Experiment

At CFB Valcartier (Quebec, Canada) training area, imagery of an uncamouflaged and camouflaged Coyote, LAV-III, was collected from a helicopter platform. Views of the terrain area and the target vehicle are shown in Figures 4 and 5, respectively. The observer was shown two series of projected 35 mm slides. The first series of slides was a practice set. It was explained that the imagery (terrain) in the second set would be very different from the first set of slides viewed, but the observer's task remained the same: to detect military targets, point out where they were located and describe the class of vehicle detected. Each series of imagery consisted of 16 slides and was shown to the observer in succession beginning with the slide with the longest associated range to the target. Each successive slide decreased in range and was presented to the observer for 14 seconds before the next one was displayed.

Figure 4: Coyote Target Area.

Figure 5: Close-up of Coyote Target Vehicle.

As each slide was shown to the observer, two data recorders captured the observer's target Initial Detection, Recognition and Identification results. The range associated with the slide when the observer first pointed to the target location was recorded as the initial detection range. The range associated with the displayed slide when the observer was able to describe the general characteristics of the target vehicle was recorded as the recognition range. The observer was deemed to have recognized the target in the practice set when he/she stated that it was a light armored vehicle or wheeled armored vehicle or wheeled personnel carrier. The observer identified the vehicle by declaring that the target was a LAV or Coyote vehicle. Again, the range associated with the slide shown when the observer first identified the vehicle was recorded. During the photosimulation trial two data recorders completed separate data sheets to record the results for each observer and slide set. An example of a data sheet used for the Coyote series of slides is shown in Annex A.5.

False targets were also recorded. A false target was taken to be any object/area pointed to on the slide that was not the target vehicle. When this occurred, the range associated with the slide was recorded along with any comments made by the observer. This information was recorded for possible future analysis. (Note: No analysis of the false target information is planned or performed in this guidebook.)

After having viewed the practice series and one of the experimental slide series, the observer was informed that their participation in the trial was complete. The observer was thanked and reminded not to discuss the trial.

6.2 DIGITAL PHOTOSIMULATION

Recognizing that current digital technology is fast approaching the quality of photographic slides, SCI-095 used digital imagery in a classical photosimulation. An initial approach was to digitize the slides available and use a computer and monitor instead of a projector and screen. However, the group does not recommend digitizing slides. If a digital photosimulation is planned, image collection in the field should be done with a good quality digital camera.

Presenting the images on a computer monitor offers possibilities for simplifying data collection. Image presentation can be partly or fully automatic; observer response can be recorded by the computer. Good results have been obtained by using laptop computers and commercial software. Alternative, more sophisticated and costly methods are also available but are not addressed in these guidelines (see Reference 9).

6.2.1 Design of the Experiment

Imagery can be presented to the subjects using a computer in the same manner as in the classical photosimulation experiment. Because of the lower resolution of the computer monitor compared to slide projections, observer distance to the image does not need to be controlled as in the classical experiment. As a result, each observer can determine an individual viewing distance from the monitor. An introductory briefing should be provided to the observers describing the task and what is required of them and demographic information should be obtained. A sample briefing is shown at Annex A.6. Imagery should be presented in a manner that automatically advances the image after 14 seconds. The test coordinator collects the observer's responses as before and a sample data collection sheet is shown at Annex A.7.

Using the off-the-shelf equipment described below, reasonable agreement with analog photosimulation results has been achieved. Use of other types of hardware and software may have unknown influence on the results.

6.2.2 Example Laptop Photosimulation

The laptop photosimulation is a variation on the basic photosimulation technique. The procedure used during an Italian photosimulation trial conducted in June 2003 is described here.

Observers viewed each image for a fixed time while sitting in a chair placed in front of the laptop used for the trial. The laptop screen was 15" in size, with a width of 29.5 cm and a resolution of 1024 x 768 pixels. The chair was positioned in a way that the distance from observer's eyes and the screen was approximately 30 cm. The observers were free to slightly adjust their distance from the screen and its inclination in the way they felt most comfortable. The images were shown through a commercial presentation software package for convenience (PowerPoint), in which the first image was viewed for an indefinite time, while the remaining images had a fixed viewing time and advanced automatically. The viewing time for each image was fixed to 14 seconds, see [10] for considerations about this choice. The images were imported into the presentation so that the image filled the entire screen.

The observers came into the viewing room one at a time and sat in front of the laptop. Trial procedures were briefed in detail, and the observer was given a pointer (a pencil) for use during the trial. An alternative method is to include the observer briefing as the first slide in the presentation. Two or three sets of digitized slides were shown. The first set was always the practice series as used in the traditional photosimulation described earlier in this chapter.

The observers were instructed to point out any potential military target they saw in the images with the pointer and, whenever possible, identify the target. The range associated with the image on which the observer first correctly pointed at the target was recorded as initial detection range. Recognition range was defined as the range associated with the image on which the observer first correctly recognized the type of military vehicle.