

Situation awareness measurement: A review of applicability for C4i environments

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Introduction

- The purpose of this paper is to make an analysis of the C4i situation using existing Situational Awareness (SA) techniques
- C4i: Command, Control, Communication, Computers, and Intelligence
 - Emergency Response
 - Gold/Silver/Bronze (Fixed/Mobile/Field)

SA-y What?

- Multiple Competing definitions
 - Three-Level Model
 - Perceptual Cycle Model
 - Activity Theory Model
- Three Level Model
 - "The perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" (Endsley)
 - Most popular and widely cited (and therefore used in this paper)
 - Useful because it involves the human decision making process affect on SA

Team SA: Getting the job done

- Reflects the coordinated awareness that the team possesses as a whole unit
- The degree to which every member in the team has the same understanding of the environment
- "The active construction of a model of a situation partly shared and partly distributed between two or more agents, from which one can anticipate important future states in the near future." (Artman and Garbis)
- Extremely important in the C4i environment

And what of Reliability?

- Measures SA and does not measure other processes or factors
- Possesses the required level of sensitivity
 - technique can accurately detect changes in SA due to novel technologies and programs
- Does not alter SA during the measurement procedure

The Crux of the matter: C4i

- Technique should be capable of measuring SA simultaneously at different geographical locations
 - Each agent involved should be simultaneously assessed for SA
- Technique should be capable of measuring both individual and team/shared SA
 - Individuals possess unique goals, models, and SA: they need to maintain individual SA and a team SA
- Measure SA in real time
 - Simulations are increasingly difficult, and in-field measurements would be necessary

Do what now?

- 17 possible applicable methods for C4i
 - Freeze probe techniques
 - Real-time probe techniques
 - Self-rating techniques
 - Observer-rating techniques
 - Performance measures
 - Process Indices (Eye Tracker)

Freeze-Probe techniques

- Administration of SA queries during freezes in simulation
 - SAGAT
 - SART
 - SALSAs
 - SACRI
 - Situation Awareness Control Room Inventory

Real-Time Techniques

- Administration of SA queries while the task is in progress
 - SPAM
 - Situation Present Assessment Method
 - SASHA
 - SASHA_L
 - SASHA_Q
 - SART?

Self-Rating Techniques

- Administration of SA queries at the end of a simulation
 - SART
 - SARS
 - Situation Awareness Rating Scales
 - CARS
 - Crew Awareness Rating Scale
 - MARS
 - Mission Awareness Rating Scale
 - QUASA
 - QUAntitative Analysis of Situational Awareness
 - C-SAS
 - Cranfield - Situation Awareness Scale

Other: The Less-Fortunate

- Observer-Rating Techniques
 - Administration of SA query through a third-party to the task
 - SABRARS
 - Situation Awareness Behavioral Rating Scale
- Performance Measures
 - Indirect assessment of SA by the measurement of performance
 - "kills", "hits", mission success, etc
- Process Indices
 - Monitor the process that subjects use to get SA during the task
 - Eye-tracker devices
 - VPA
 - Verbal Protocol Analysis (thinking aloud)

Analysis

- Freeze Probe
 - offer a direct measurement of operator SA
 - SAGAT and SART are widely validated
 - Cant use them effectively in the field
 - freezes interrupt natural task-flow
- Real-Time Probe
 - Removes the task-freezes of Freeze Probe
 - can still intrude upon primary task
 - unpredictable nature of C4i ruins effectiveness

Analysis Too

- Self-Rating
 - Quick, Easy, non-intrusive (post-trial), no training
 - Useful for assessing team SA, critical analysis of team members
 - Self-rating techniques are generic and not used for team SA
 - C4i participants are prone to forgetting periods of low SA
 - rating one's own SA is always questionable
- Observer-Rating
 - Seemingly Most suited to the C4i environment
 - Observer is not a good judge of actual individual SA
 - participants knowing they are observed change their behavior

And Yet More Analysis

- Performance Measures
 - VERY simple and non-intrusive, maybe too much so
 - is performance affected by SA alone?
- Process Indices
 - judged by fixation on appropriate task objects
 - eye-tracking in the field is impossible
 - "look-but-fail-to-see" phenomenon

Finally, In Conclusion

- Existing SA methods are a poor fit for C4i
- Aside from SAGAT and SART, most techniques have limited validation
- Final Final (Final) Analysis:
 - Need to develop a unique solution to the C4i environment
 - Develop a toolkit using current solutions