Critiquing: A Methodology to Extract C2 Expertise

18 June 2003

Dr. Janet E. Miller

Cognitive Systems Engineer

Human Effectiveness Directorate

Air Force Research Laboratory

Problem

- **In-depth understanding of C2 is required for developing accurate, relevant training and support**

- **Extracting tacit knowledge is difficult**
    - **Few experts**
    - **Unpredictability**
    - **Often joint, international positions**

- **Existing knowledge elicitation methods have challenges**
    - **Grounding in context**
    - **Accessibility to experts and relevant tasks**
    - **Laborious and time consuming**
    - **Repeatability**

Understanding the Practitioner

Scratch

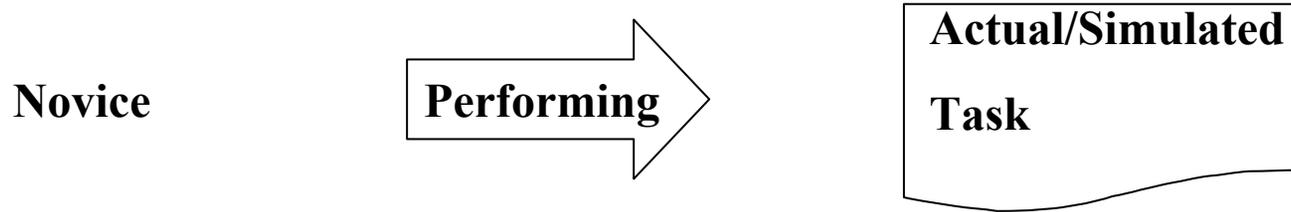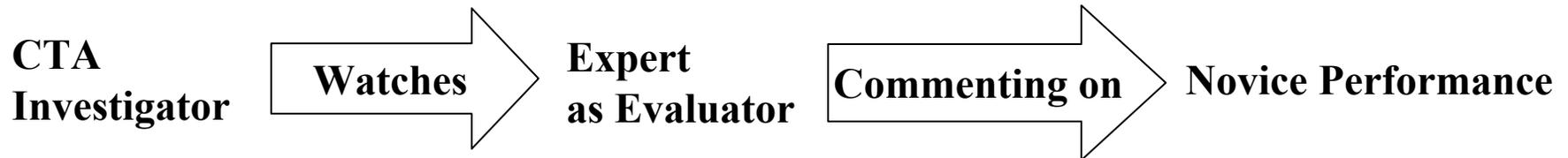CTA Model

Design Seeds
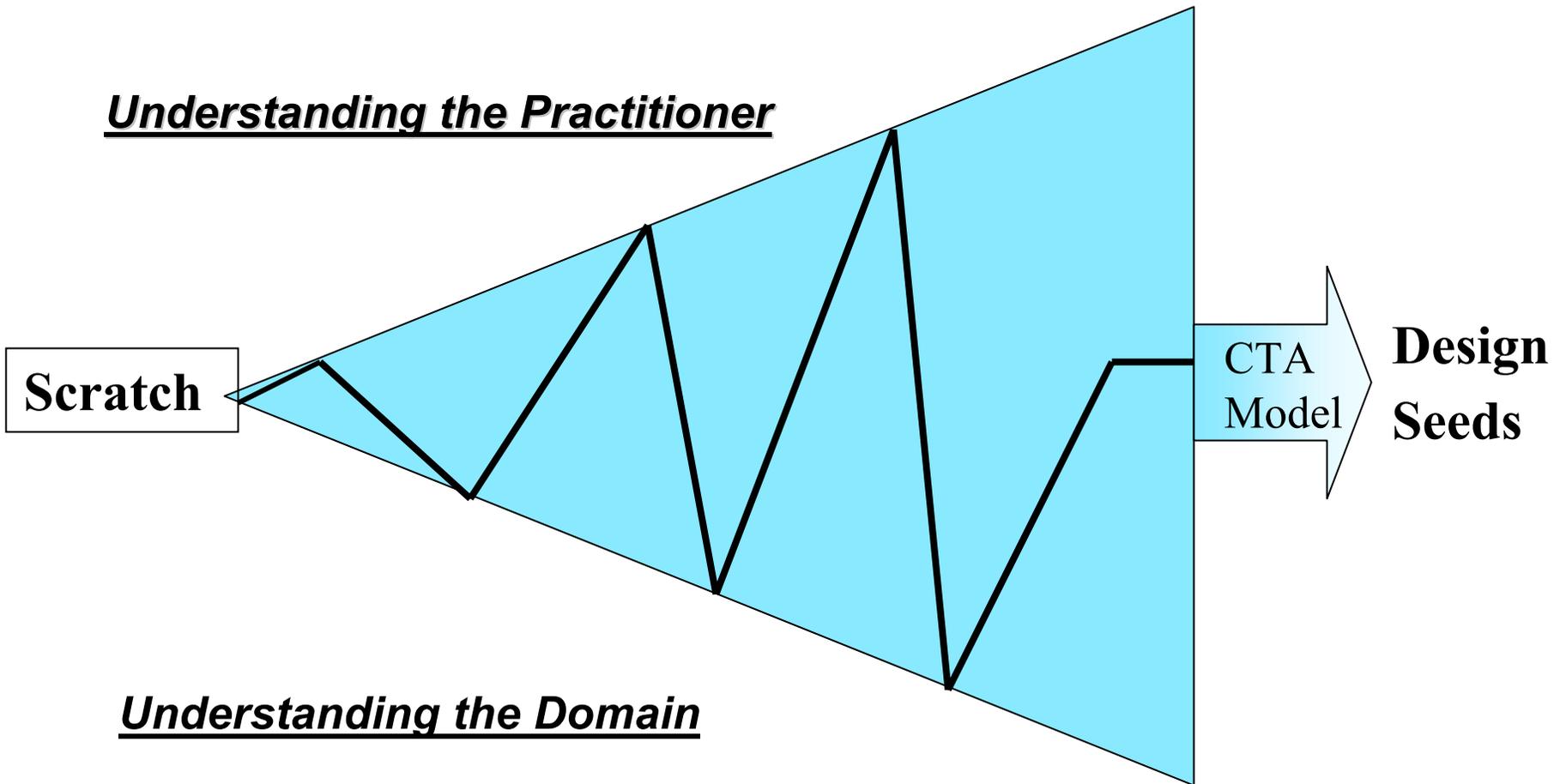
Understanding the Domain

Exploring the current world → Exploring the future world

Process of Expert Performing Critiquing Task

Novice → **Performing** → Actual/Simulated Task

Process of Novice Performing Domain Task

CTA Investigator → **Watches** → Expert as Evaluator → **Commenting on** → Novice Performance

EXERCISE EXERCISE EXERCISE EXERCISE

In 1996, the European Space Agency lost a satellite during the first qualification launch of a new rocket design. Give a short briefing about the basic facts of the incident: when it was, why it occurred, and what the immediate impacts were.

EXERCISE EXERCISE EXERCISE EXERCISE

Ariane 5 --> replacing
Launcher   A.4.

flight
--> Ariane 501

Russian Rocket dead - Same Week

In 1996, the [European Space Agency] lost a satellite during the first qualification launch of a new rocket design. Give a short briefing about the basic facts of the incident: when it was, why it occurred, and what the immediate impacts were.

5 Jun 1996

over-confidence

SW failure Blow up

exclusively

did not carry out tests on IRS
--> could have found problem

Ariane 5 --> SW failure ?
Blew up

errors in inertial reference system (IRS, backup failed,too)

Loss of guidance
30 secs > L.O.
Got bad info, thought it was
(2.5 miles. Self destruct)

No Expected Problem

Sunstorm [-prevent EM storms on sun

Inquiry Board ---> ESA
CNES (French)

implemented

IRS should be turned
·off immediately after lift off
·[test facility]☆ --> more thorough testing program for entire launcher

w/as much real equipment as technically feasible

·More transparent work/w Ariane 5 partner
·384$ recovery from failure

Next flight mid April 1997

get well program   unplanned

Lost year

fill in w/old tech

what they did:
·rewritten sw
--> in light of lessons

Made better testbed analyzed all SW

--> used A-4 SW

when
-5 Jun 1996, Ariane 5 program, replacing Ariane 4 program

why   (backup failed, too)   lost its guidance
SW failure-IRS system malfunction(wrong system:for A-4 program
        didn't expect problems
        --> did not test
        --> could have prevented

fill in Ariane 4 rocket

Impacts--> $384 blunder, lost year of program
                    unplanned flight

get well program
re-analyze all sw (IRS), made more realistic sw

Progressive Novice Note Sheets

Progressive Novice Note Sheets

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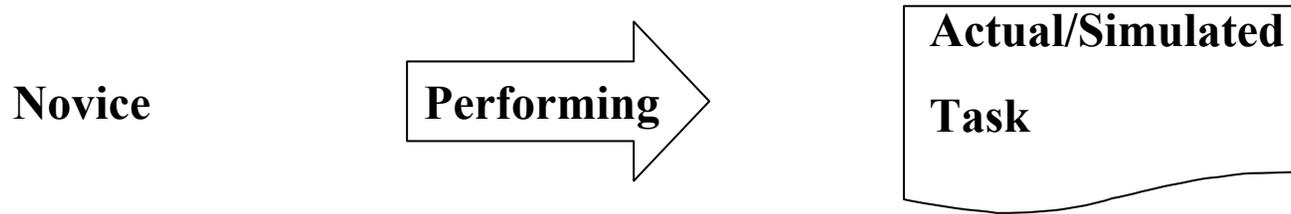Sunstorm
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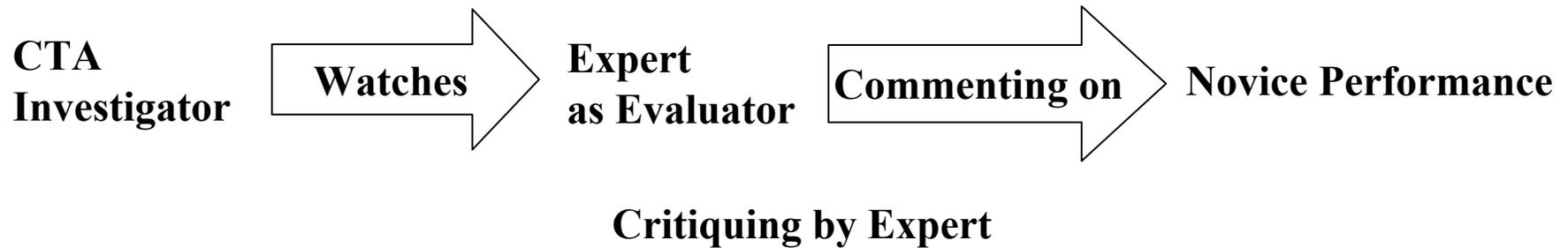
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Experts' Comments about Study

- **E5 – No prior knowledge:** I felt uncomfortable

- **E6 – No prior knowledge:** I was a little uncomfortable.

- **E8 – Partial prior knowledge:** I'm glad I was prepared. I was able to draw my own conclusions.
- **E9 – Partial prior knowledge:** I would not have been comfortable without at least reading the articles, seeing what data set he's working with. If you don't know what data set they have, you can't critique, it's not valid.

- **E7 – Full prior knowledge:** I was comfortable in the way data was presented. You might tell them (novices) but they have to do it themselves. This is good for training as they do the work and not just memorize.
- **E10– Full prior knowledge:** I had fun. I found it intriguing.

Process of Expert Performing Critiquing Task

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Critiquing by Expert

Discussion

- **Remember: Any method shapes the conditions of observation.**

- **Relationship to C2**
  - **Can be used in conjunction with Modeling & Simulation**
  - **Provides strong cue to focus**

  - **Participatory role**

Conclusion

- **Existing knowledge elicitation methods have challenges**
    - **Grounding in context**
    - **Accessibility to experts and relevant tasks**
    - **Laborious and time consuming**
    - **Repeatability**

- **Critiquing used to get an in-depth understanding of the C2 domain required for developing accurate, relevant training and support**

Backups

Designing Tools for People

Abstract

Patterns in Cognitive Systems   *Abstracted Patterns*

Generative   **Linking Understanding and Usefulness**   **Authentic**

Prototypes As Tools for Discovery

Design Seeds: Reusable Concepts And Techniques

Participative

Adapted from D. Woods, 2001

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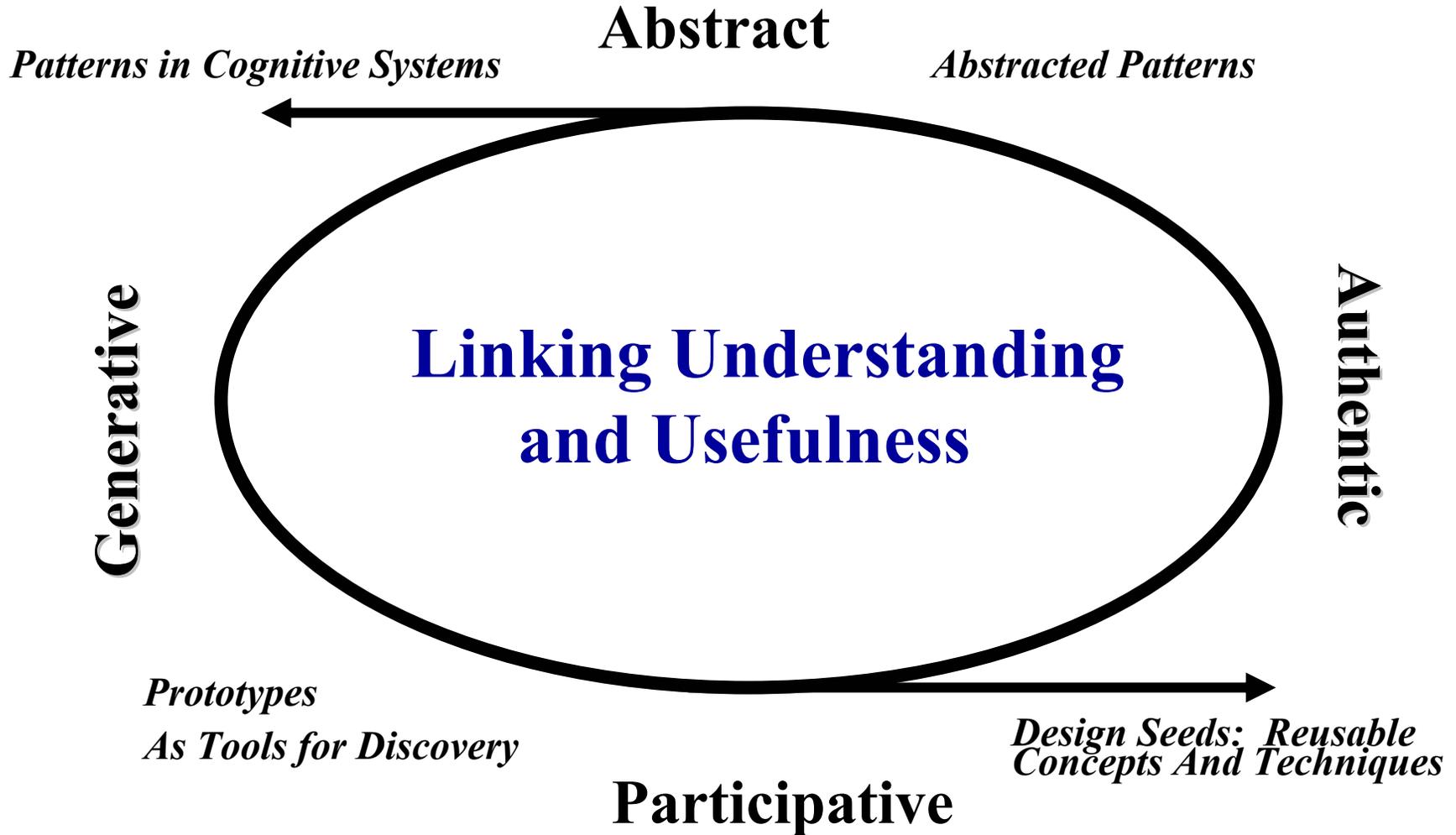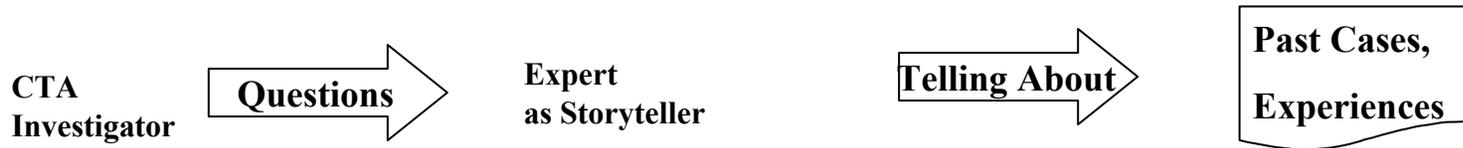
Method Breakdowns

Families:

- **Structured Interview/Elicitation**
- **Performance/Observation**
- **Mapping Semantic Space**
- **Functional Domain Modeling**
- **Functional Task Modeling**
- **Computational Modeling Methods**
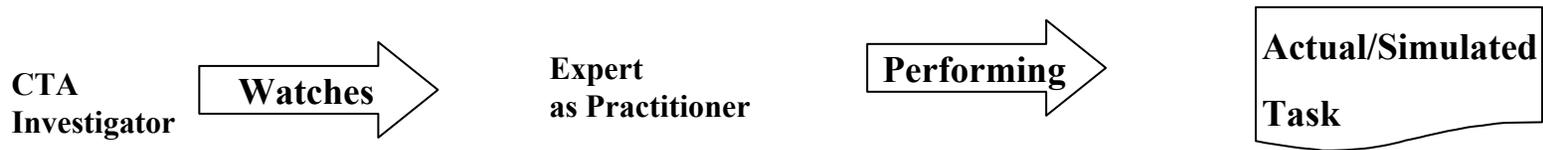- **Participatory Design Methods**

Elicitation by Interview

CTA Investigator → **Questions** → Expert as Storyteller → **Telling About** → Past Cases, Experiences

Elicitation by Observation

CTA Investigator → **Watches** → Expert as Practitioner → **Performing** → Actual/Simulated Task

Elicitation by Critiquing

CTA Investigator → **Watches** → Expert as Evaluator → **Commenting on** → Novice → **Performing** → Actual/Simulated Task
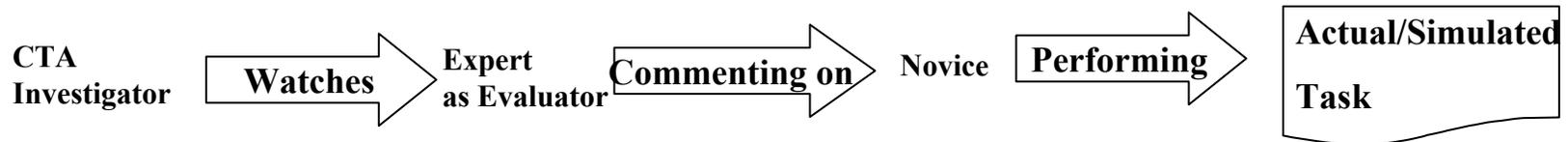
•Information Selection:
-Understand what the question really is
-Have a goal in mind
-Need to check intell sources not just open course

•Corroborate/Resolution:
-Be aware of directed sources
-Need multiple sources to confirm data
-Talk to other people
-Reports 6 months or so after an event probably more accurate
-Take open source with a grain of salt
-Human sources have to have direct knowledge

• Story Construct:
-Get familiar before formulating
- Need to know the audience
- Senior people want pictures, graphs
- Include basics if audience might not be fully informed
- Admit what you don't know
- You have to be right with what you say
- Never contradict yourself

•Information Selection:
-Understand the problem
-Keep full task in mind as you read
-Look for patterns in the title list
-Don't build results on one search.

•Corroborate/Resolution:
-Talk to other analysts to see to discuss the problem
-What source information comes from is very important, loses validity if 2nd or 3rd hand information
-It's necessary to corroborate information, might not use if only in one source

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•**Information Selection:**
-Can get wrong focus if don't correctly define
-Go back to the person asking question to resolve ambiguity
-If using on-screen views of title list, make sure window is large enough to notice patterns of large part of data set
-Read titles to get a feel for the data set
-Value of data dependent upon source
-Use meta data in title list, that is, for example, the fact one name shows up a multitude of times

•**Corroborate/Resolution:**
-Ask other analysts for opinions
-Will have to evaluate data, not just read it
-Language can be considered a high level determinant during data evaluation
-Watch for biased reporting
-Be aware of information that is actually only repeating another source
-Don't base assessment on only a few documents
-Be aware complete details might intentionally not be revealed
-Be aware information might not be directly stated

• **Story Construct:**
-Look for patterns
-Sometimes setting down a timeline helps
-Use external memory, if necessary, to jog memory
-Diagram the info if possible
-Include implications in assessment
-Have list of sources to support assessment
-Accept that time and resource constraints affect the possible result

Analyst E10 on Novice 2

•**<u>Information Selection:</u>**
-Do more than one search
-Look for implications
-Use information in titles but don't fully judge documents with that
-Keep focused on task
-Look for information over time

•**<u>Corroborate/Resolution:</u>**
-Compare information over time to look for changes.
-Always have to evaluate sources.
-Use several sources
-Look for independent reviews

• **<u>Story Construct:</u>**
-Be prepared for in-depth questions
-Include implications.