

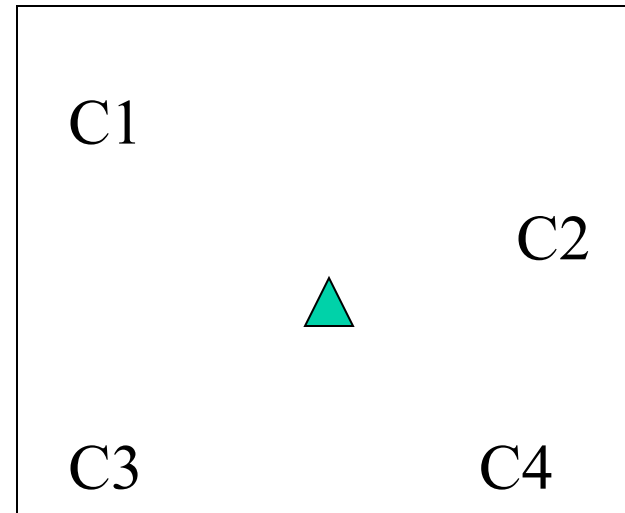
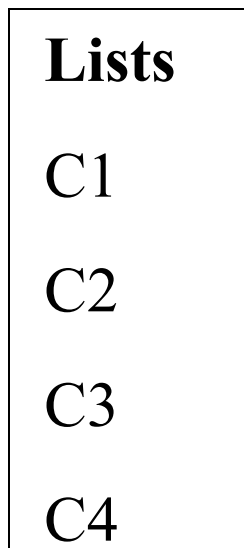
Information Fusion and De-biasing Training

Christopher D. Wickens

Integrating intelligence information from cues (sources) arriving over time is challenging and prone to cognitive biases:

- Anchoring heuristic
- Confirmation bias

Spatial Maps



Cues will differ on a number of attributes: threat level, classification certainty, location certainty, age (= 1-reliability).

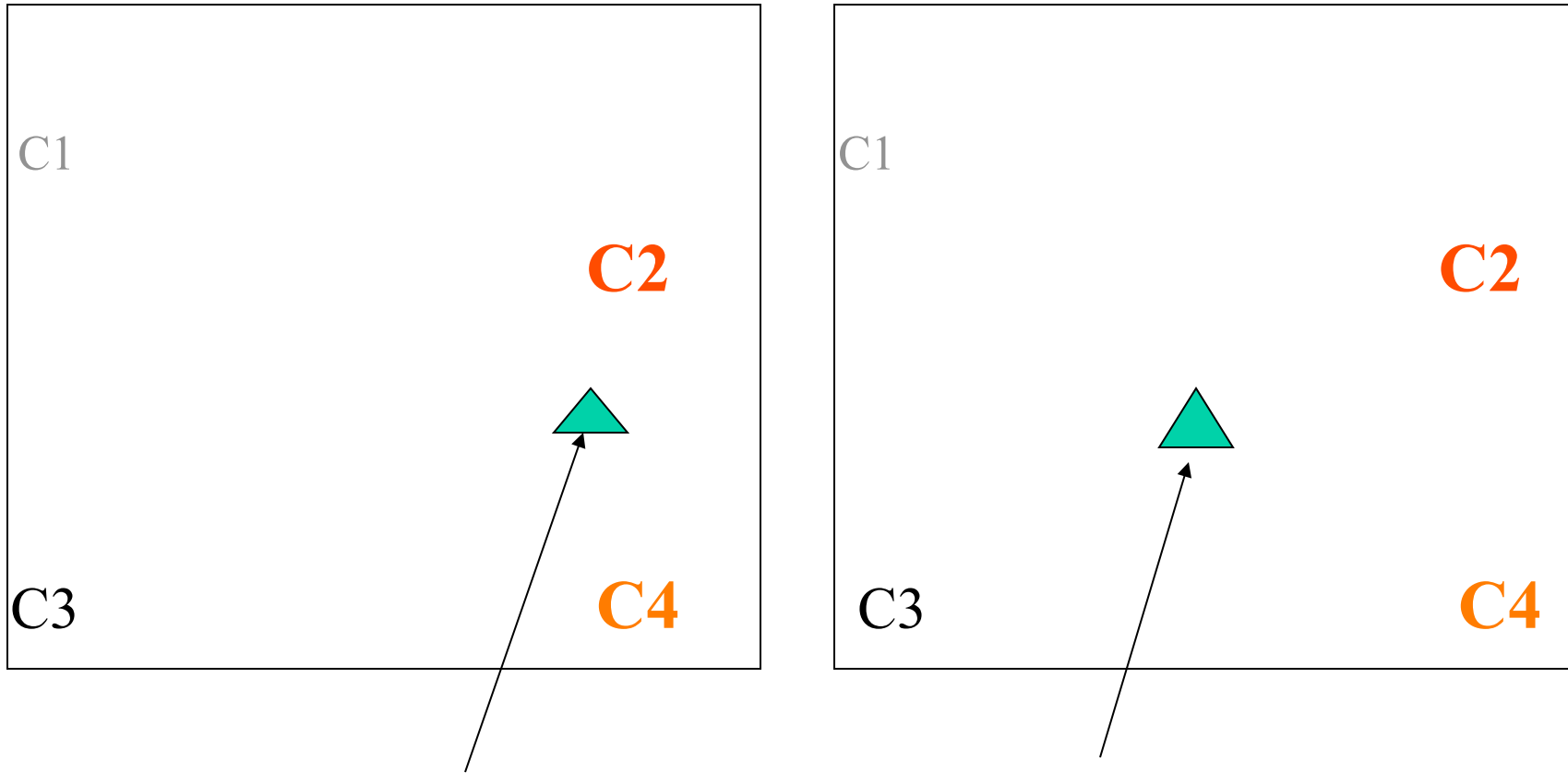
The analyst is interested in establishing a spatial location “target” defined by net effect of cue values, in order to deploy UAV to maximize the net worth of intelligence collected.

Big Picture of this Fusion research project:

1. Identify and quantify strategies and biases in intelligence fusion task.
2. Develop empirically based “debiasing” training programs.
3. In a transfer of training design, evaluate bias reduction of these programs, compared to a control group.

Our experimental interest focuses on four **strategies** that could characterize this temporal-spatial integration of abstract information

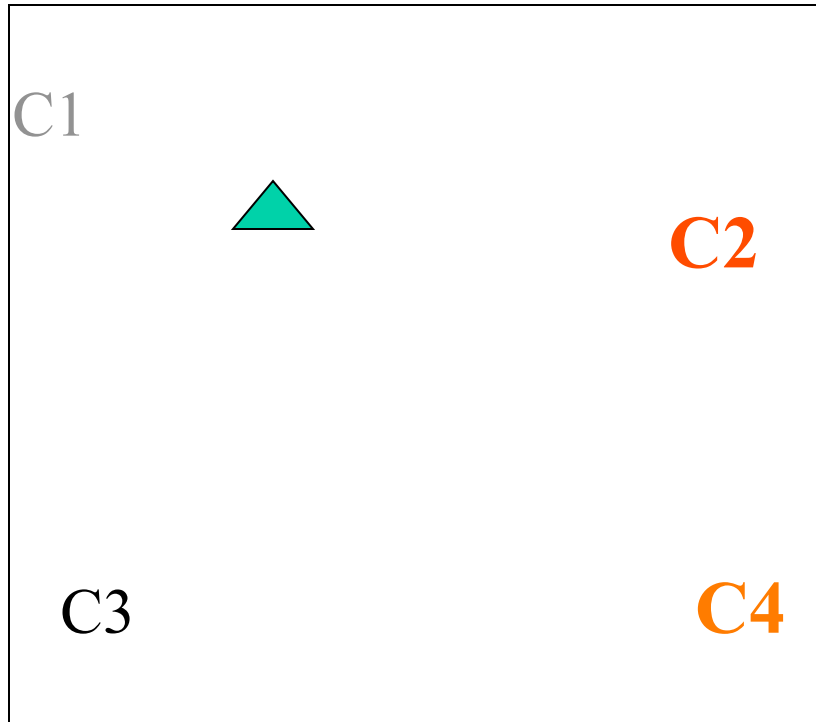
1. **Optimal** (integrates location and threat) 2. **AS-IF** treats all cues “as if” equally important



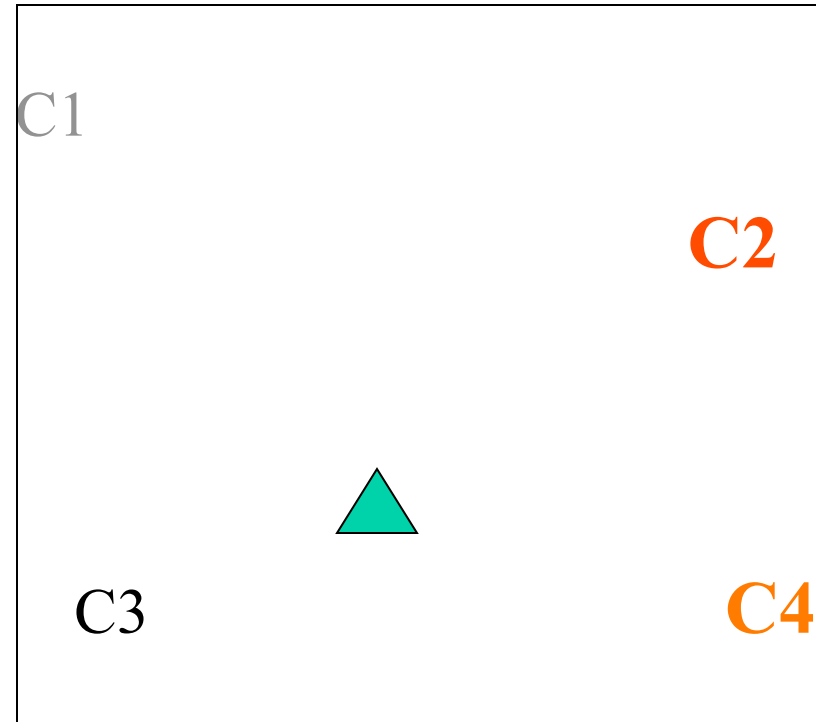
Placement of Intelligence gathering UAV asset

C1,2,3,4 temporal order. Importance: color: threat level

3. Primacy: Anchoring



4. Recency

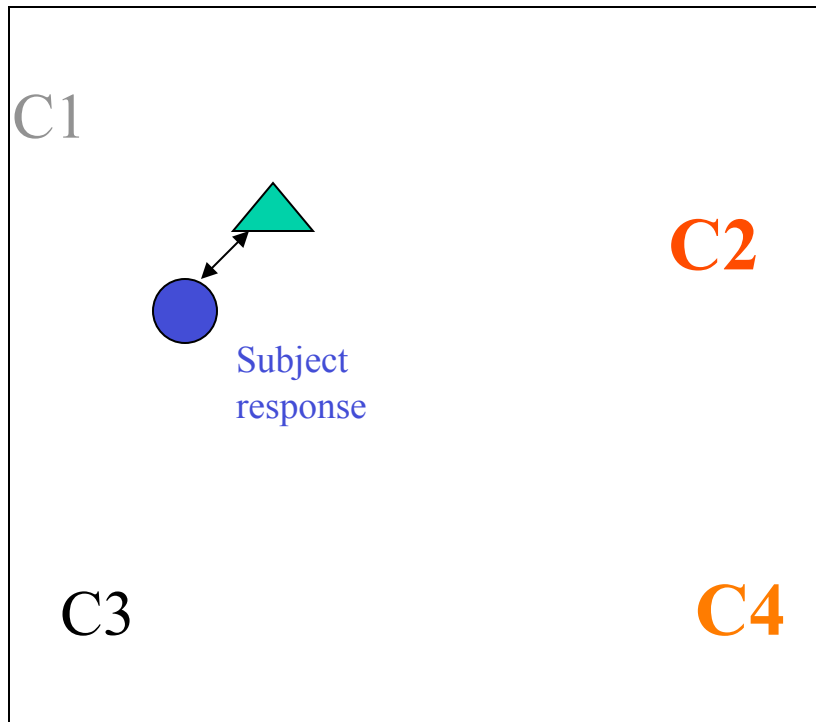


C1,2,3,4 order of importance Color: threat level

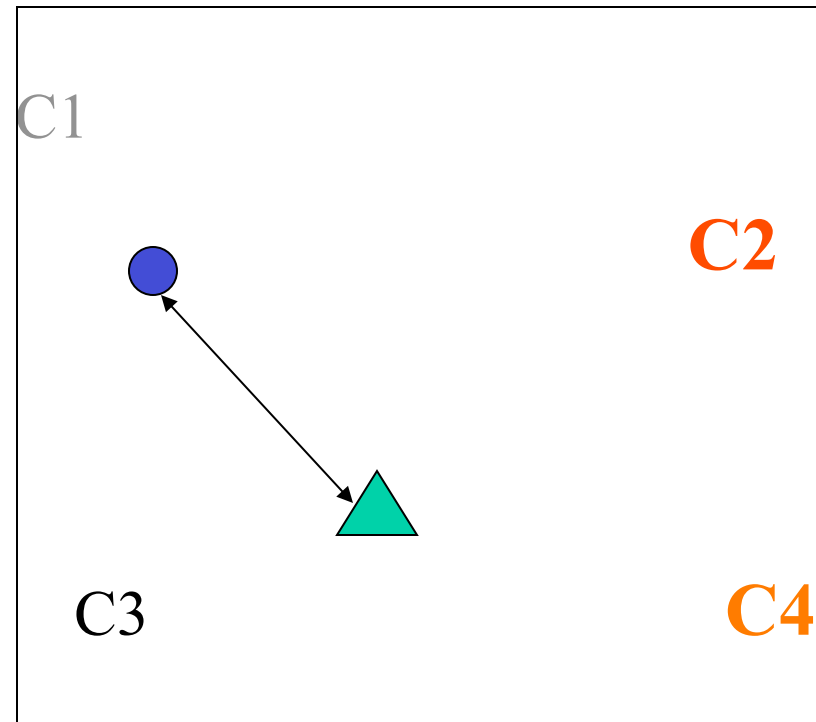
Scoring of strategy chosen by distance of response ● from strategy point ▲

Primacy: Anchoring

Recency

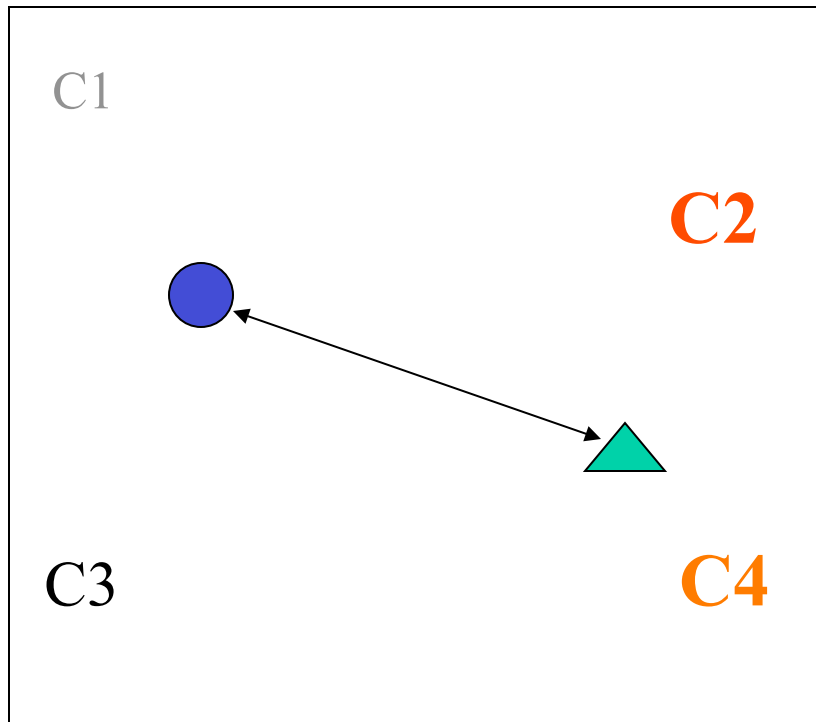


High primacy score

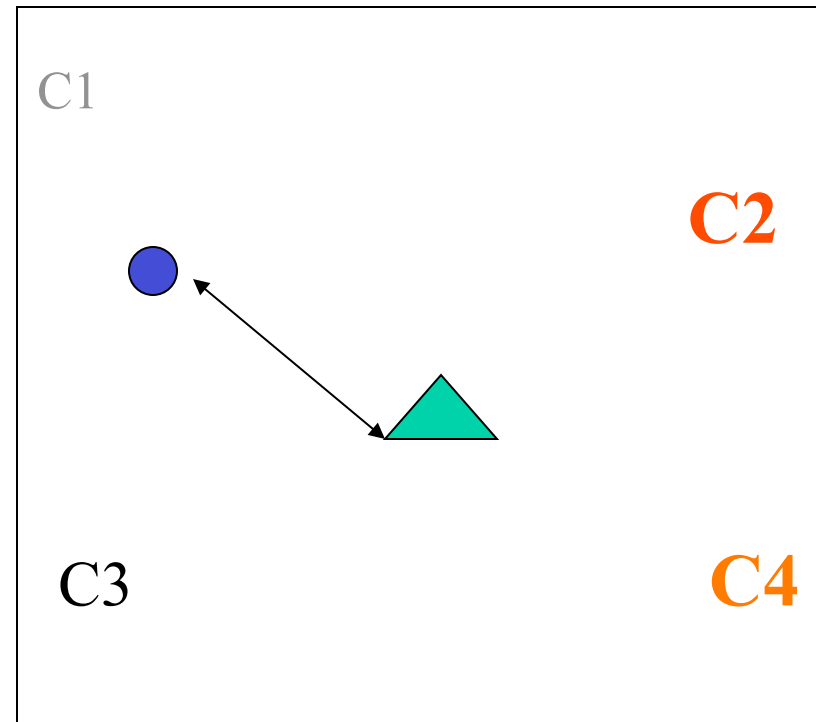


Medium recency score

Optimal (integrates location and threat) AS-IF treats all cues “as if” equally important



Low optimality score



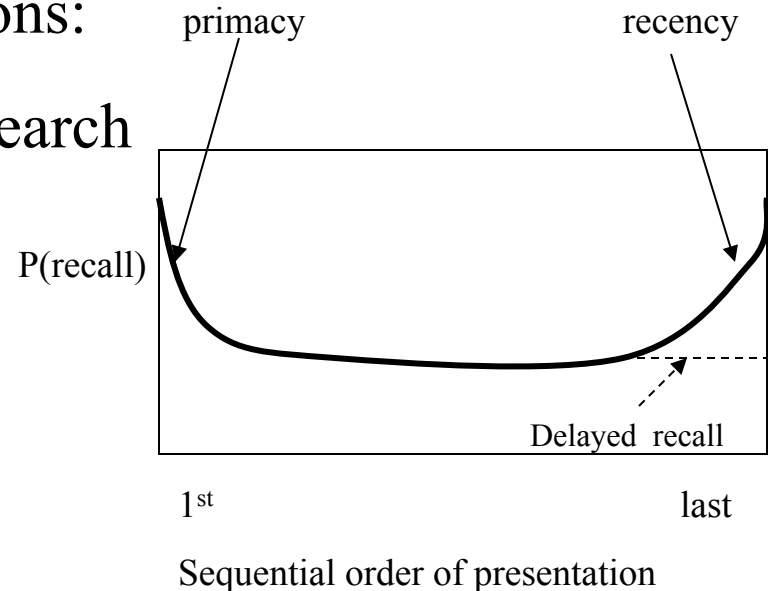
Medium “as if” score

So, each target placement yields four distance strategy scores.
Optimality score is the best measure of “good” performance

Primacy and Recency:

Of particular importance for three reasons:

- 1 Well-established bias in memory research
- 2 Primacy: well established heuristic in decision research: **Anchoring.**



- 3 The “age” of information: In intelligence, the earlier collected evidence is often less reliable, because more time has passed between collection and evaluation. The longer lag, the more likely things have changed. Thus this factor dictates that recency is more optimal, and primacy (anchoring) is **less** optimal. Yet primacy and anchoring are dominant observations.

The Paradigm (Expt 5)

7 cues showing
here temporal
order.

Each cue:
XY position, threat
level, order



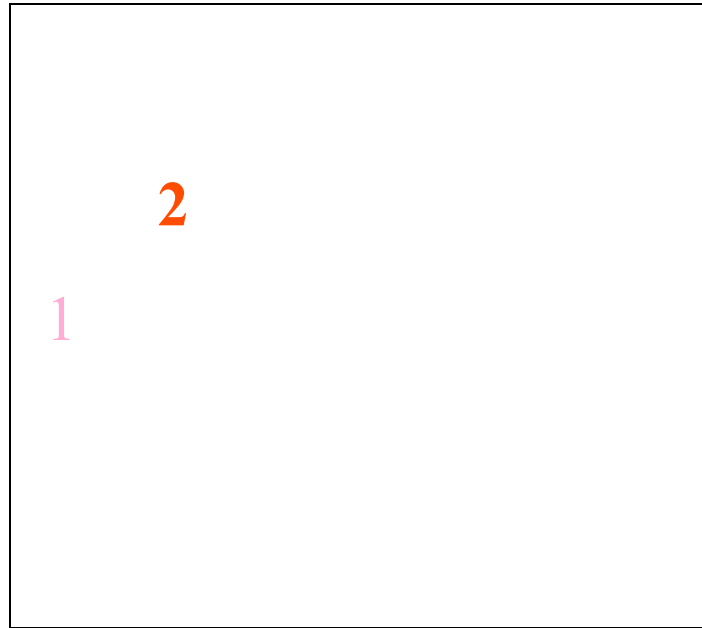
Subject responds after final cue: “...Thus the best location for the UAV should take into account gaining more information about greater threats, while still gaining as much information as possible about all threats.”

We evaluated XY distance of response from the location dictated by each of the four strategies.

The Paradigm (Expt 5)

7 cues showing
here temporal
order.

Each cue:
XY position, threat
level, order



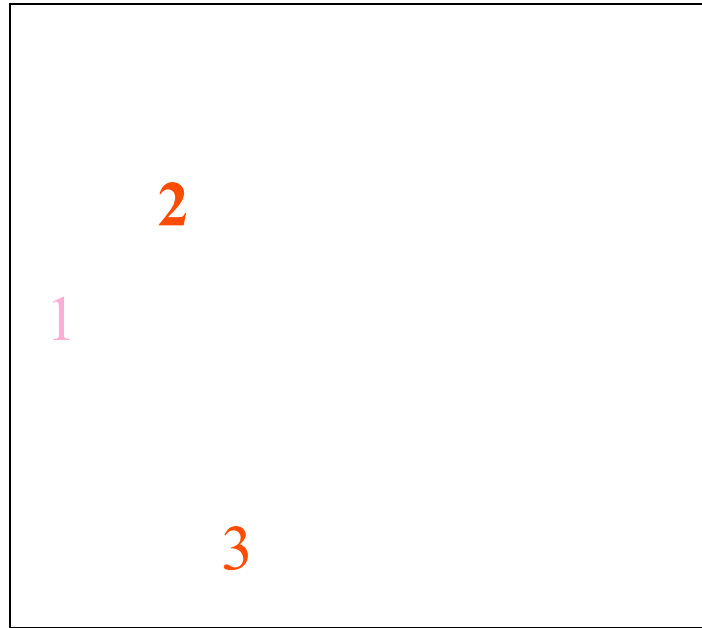
Subject responds after final cue: “...Thus the best location for the UAV should take into account gaining more information about greater threats, while still gaining as much information as possible about all threats.”

We evaluated XY distance of response from the location dictated by each of the four strategies.

The Paradigm (Expt 5)

7 cues showing
here temporal
order.

Each cue:
XY position, threat
level, order



Subject responds after final cue: “...Thus the best location for the UAV should take into account gaining more information about greater threats, while still gaining as much information as possible about all threats.”

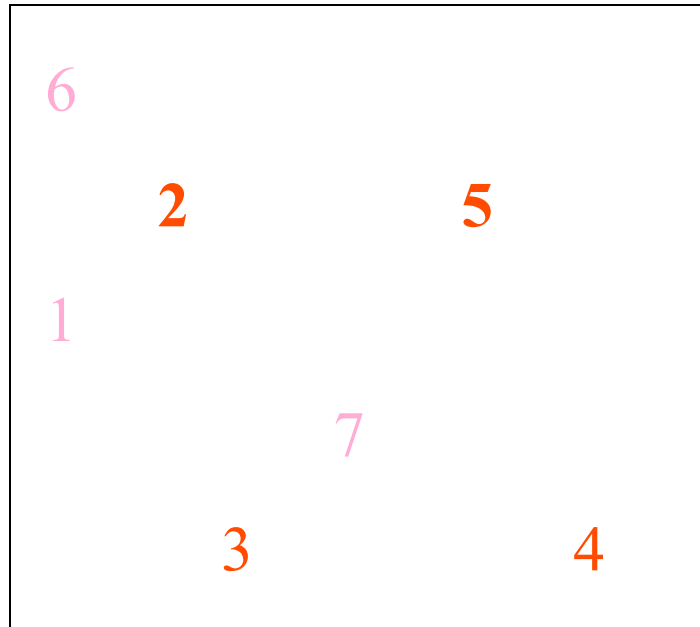
We evaluated XY distance of response from the location dictated by each of the four strategies.

The Paradigm (Expt 5)

7 cues showing here
temporal order.

Each cue: XY
position, threat level

(4 levels color coded),
temporal order



Subject responds with single target location after final cue:

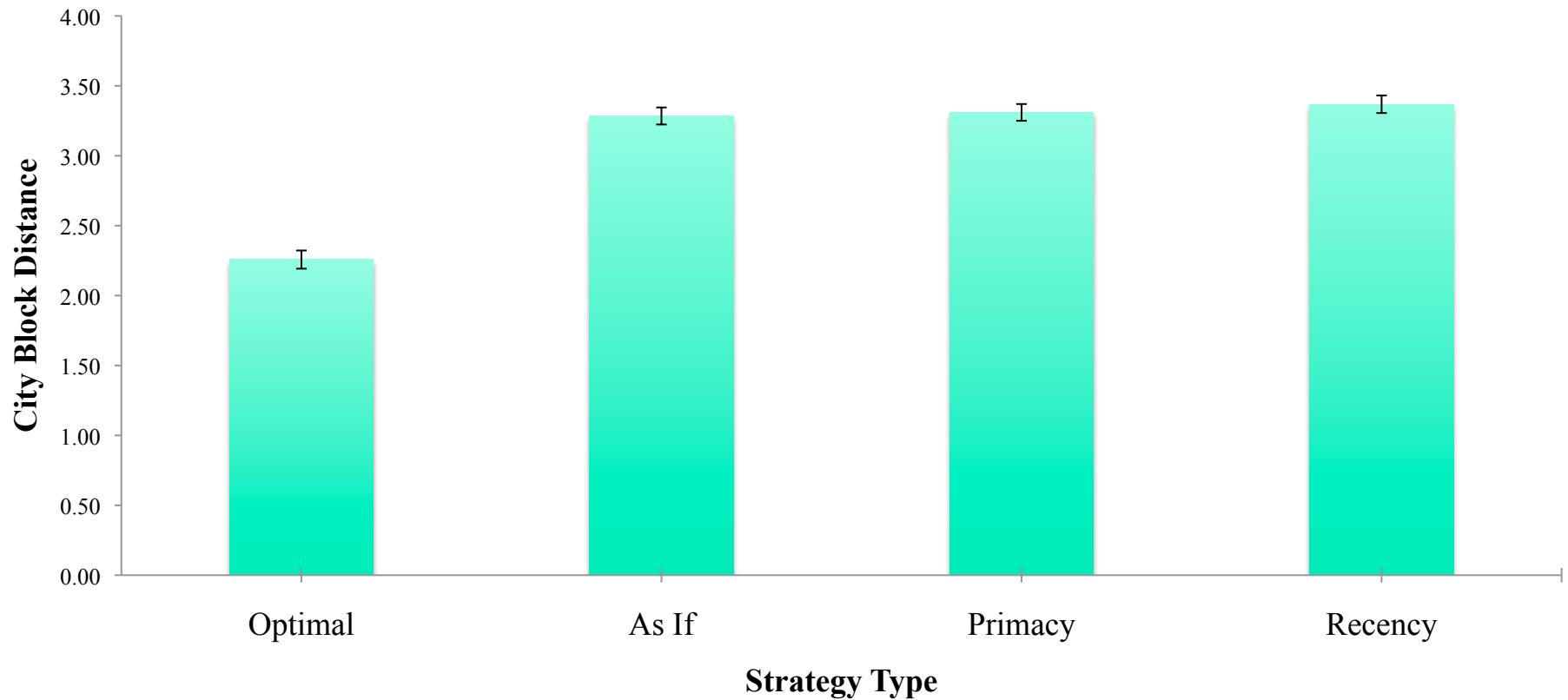
“...Thus the best location for the UAV should take into account gaining more information about greater threats, while still gaining as much information as possible about all threats.”

We evaluated XY distance of target response from the location dictated by each of the four strategies.

Each Subject:

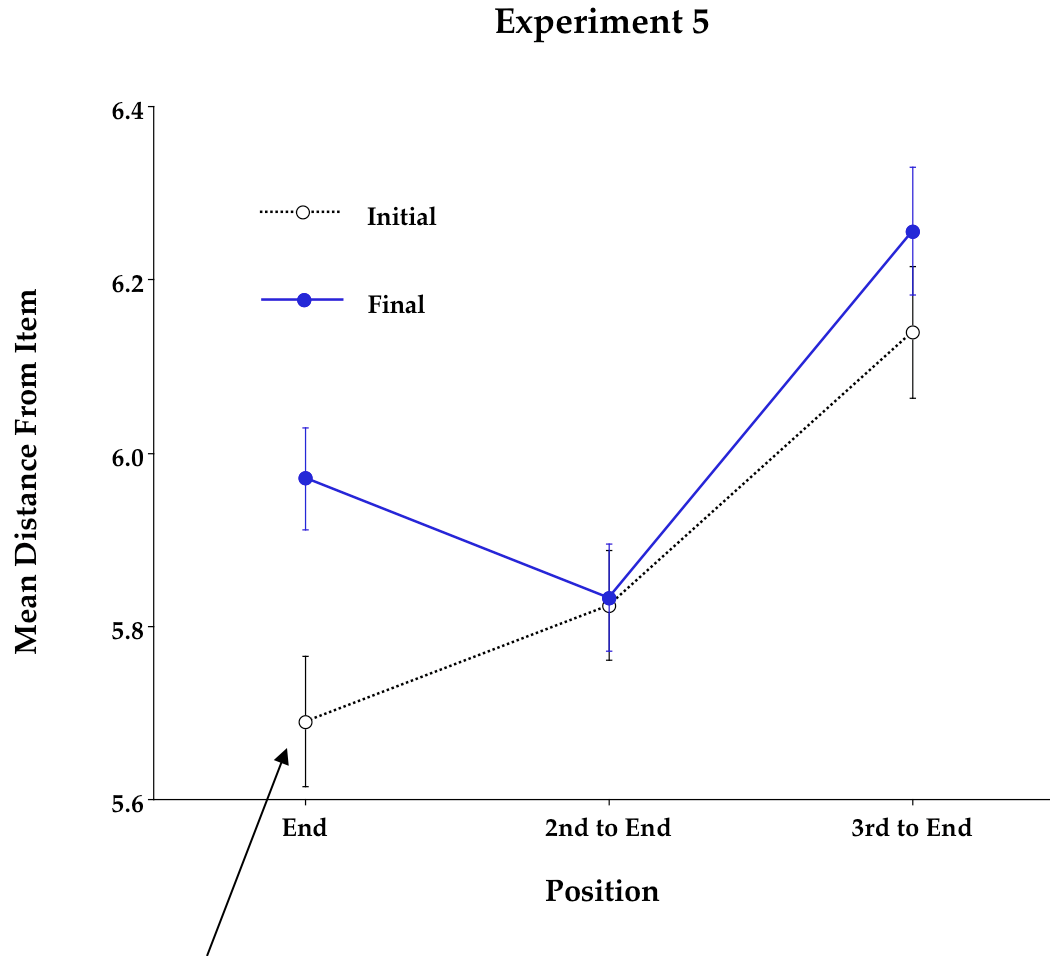
- 48 scenarios. (1st 24 practice with feedback)
- Counterbalanced.
- Scenarios designed so that the four different strategy points were dispersed from each other.
- Response given by a mouse click on the subject-judged optimal location.

Results: Distance of response from strategy point



$F(3,105)=61.01, p<.01$, Some degree of optimality (optimal is closer than “as if”). Primacy (Anchoring) and recency are equally present.

Influence on subject's choice of 3 cues early in the order (primacy) vs later in the order (recency). Lower value → closer, greater influence.



Primacy, anchoring, dominates: This is **not** appropriate when earlier information is less reliable.

Big Picture of this Fusion research project:

1. Identify and quantify strategies and biases in intelligence fusion task.
2. Increase demand level of paradigm by introducing a fourth attribute (to position, temporal order, threat level), which is: **Reliability** of sensor information:
 - Uncorrelated with temporal order.
 - Correlated with temporal order (age of information).
3. Develop empirically based “debiasing” training programs.
4. In transfer of training design, evaluate bias reduction of programs, compared to control group.