Towards a model of fear in Soar*

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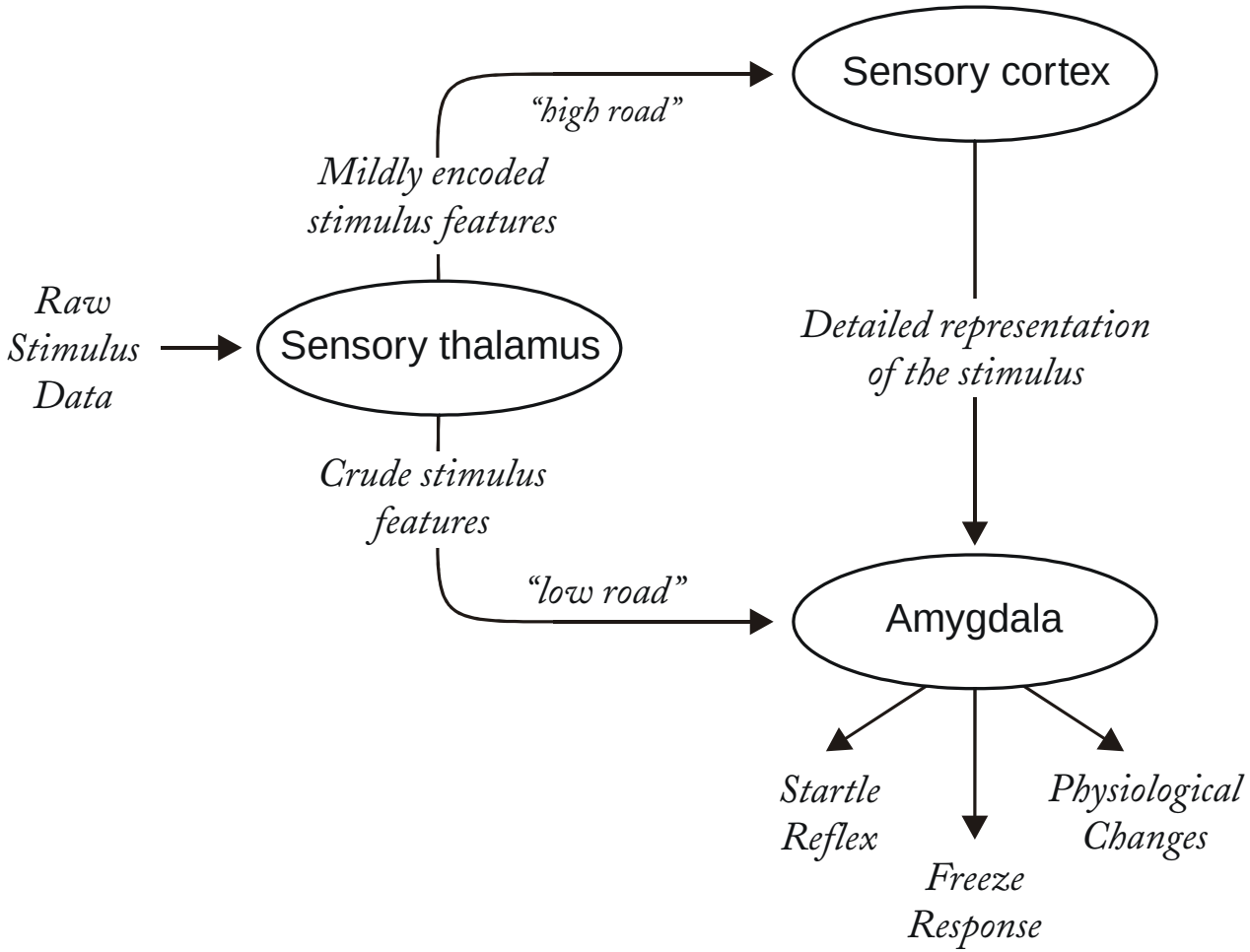
WHY MODEL EMOTIONS?

- **More human-like behavior from computer-generated entities.**
  - Increases the efficacy of training
- **Recent wide acceptance of the intrinsic role emotions play in cognition.**
  - LeDoux, J. E. (1996). *The Emotional Brain: The mysterious underpinnings of emotional life*. New York, NY: Touchstone (Simon & Schuster).
  - Ortony, A., Clore, G.L. & Collins, A. (1988). *The cognitive structure of emotions*. Cambridge University Press.
  - Damasio, A. (1994). Descartes' error. New York, NY: Avon Books.
  - *Emotional and Intelligent: The tangled knot of cognition.* Papers from the 1998 AAAI Fall Symposium. Technical report FS-98-03. Menlo Park, CA:AAAI Press.

FEAR: SOME PHENOMENA AND OBSERVATIONS

- Non-volitional freezing at the appearance of a perceived threat
- Perceptual attention is narrowed to the perceived threat
- Responses are biased towards those reducing the level of threat
- Neurologic structures implicated in fear response

NEUROLOGY OF FEAR (LEDOUX)



COGNITIVE STRUCTURE OF EMOTIONS (ORTONY, CLORE & COLLINS)

- **". . . an approach to the study of emotion that explains how people's perceptions of the world—their construals—cause them to experience emotions."**
- **". . . view emotions as *valanced reactions to events, agents, or objects, with their particular nature being determined by the way in which the eliciting situation is construed*."**
- **"A person's appraisal of an emotion-inducing situation is based on three central variables: *desirability, praiseworthiness, and appealingness . . .*"**
- **Several factors affecting the intensity of emotions**
  - Global variables for all emotions: sense of reality, proximity, unexpectedness, arousal
  - Local variables for particular groups of emotions: likelihood, effort, realization, etc.

SOMATIC MARKER HYPOTHESIS (DAMASIO)

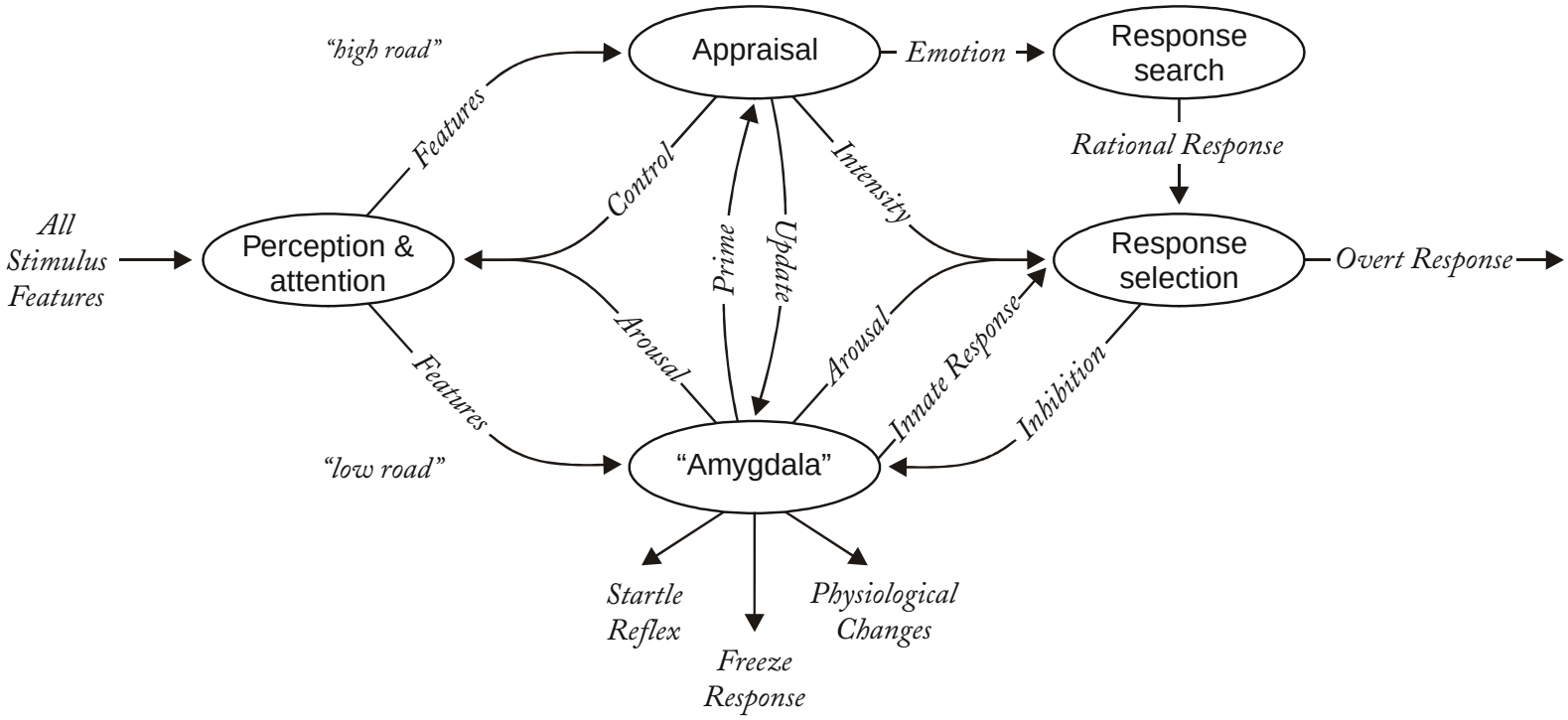
- **"When the bad outcome connected with a given response option *comes into mind*, . . . your experience an unpleasant gut feeling."**

- **Somatic markers "force attention on the negative [positive] outcome to which a given action may lead, and functions as an automated alarm signal . . . [that] may lead you to reject [accept], *immediately*, the negative [positive] course of action . . . and then allows you to *choose from among fewer alternatives*."**

- **How are they acquired? "When the choice of option X, which leads to bad outcome Y, is followed by punishment and thus painful body states, [a somatic marker is acquired.] Re-exposure . . . to option X, or thoughts about the outcome of Y, will now have the power to reenact the painful body state and thus serve as an automated reminder of bad consequences to come."**

EMOTION/FEAR MODEL (AS OF 05/19/99 @ 2:33PM)

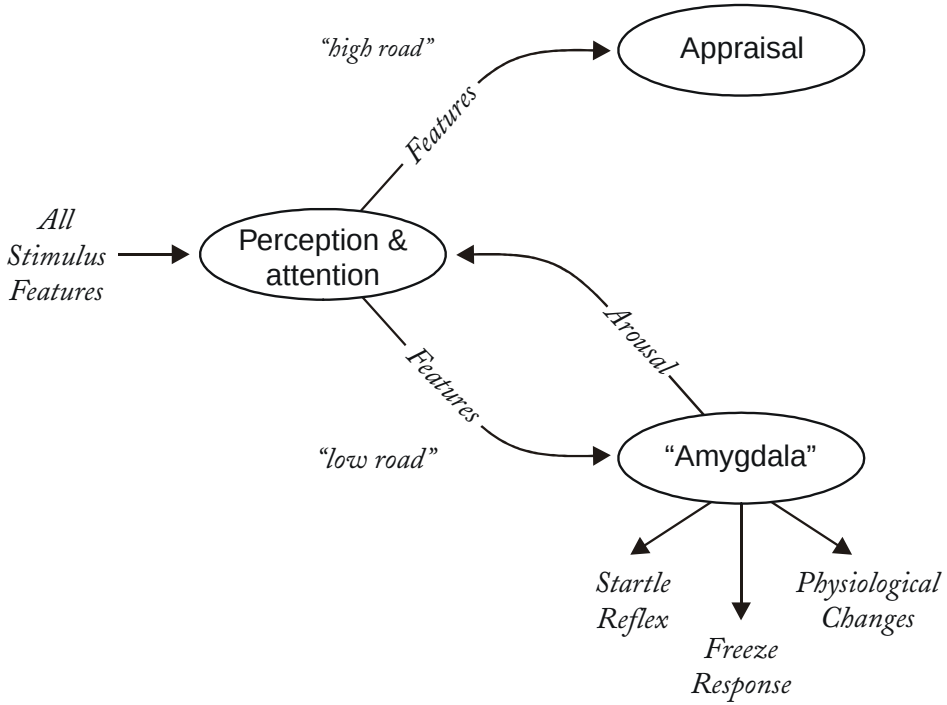
- **"Paper" model is inspired by LeDoux, Ortony, Damasio, Sherer and others.**
- **Still very much under development**



SCENARIO A

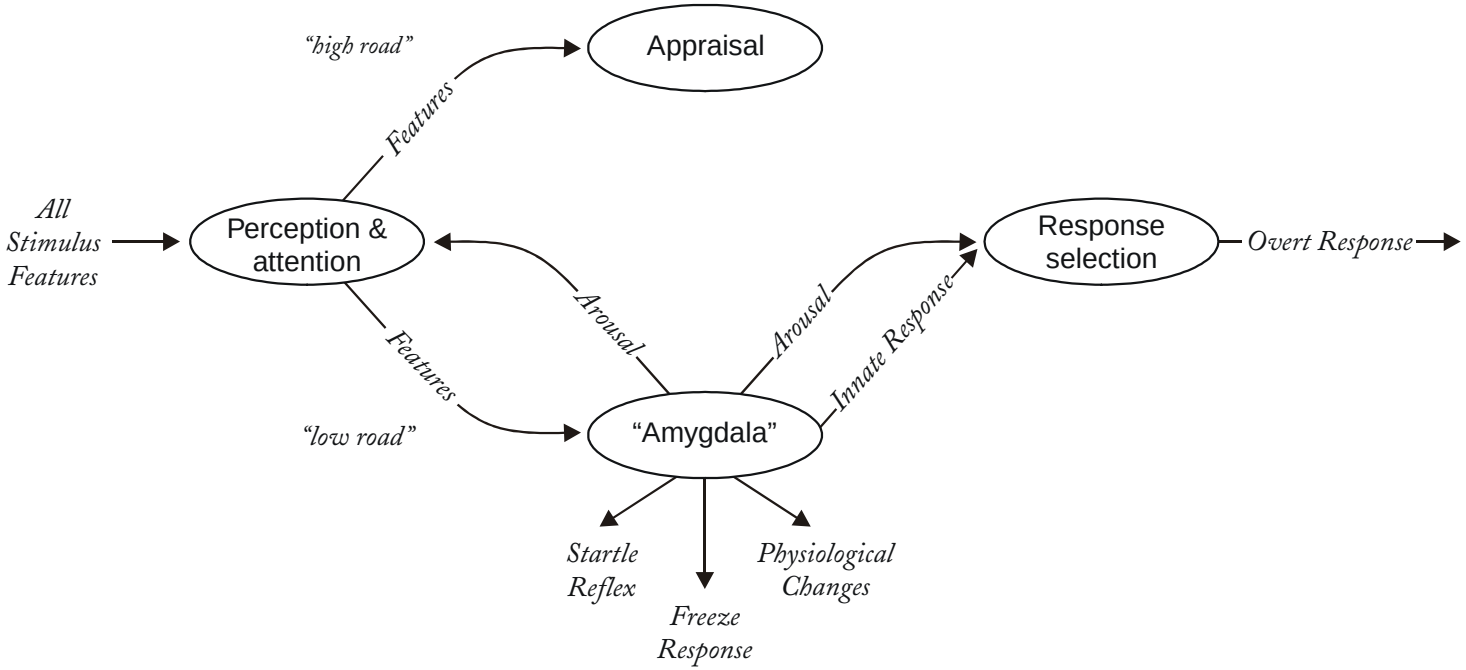
- A person is walking through the woods and comes to a large log across the path. He bends down to roll the log out of the way, and while doing so, uncovers and glimpses a long, slender, curvy object.

- Assumptions: He is not a accustomed to the sight of snakes, is not actively searching for snakes, and does not have an expectation of finding snakes. Upon seeing the object, he will initially exhibit a startle response of a magnitude proportional to his personal disposition towards and experience with snakes.



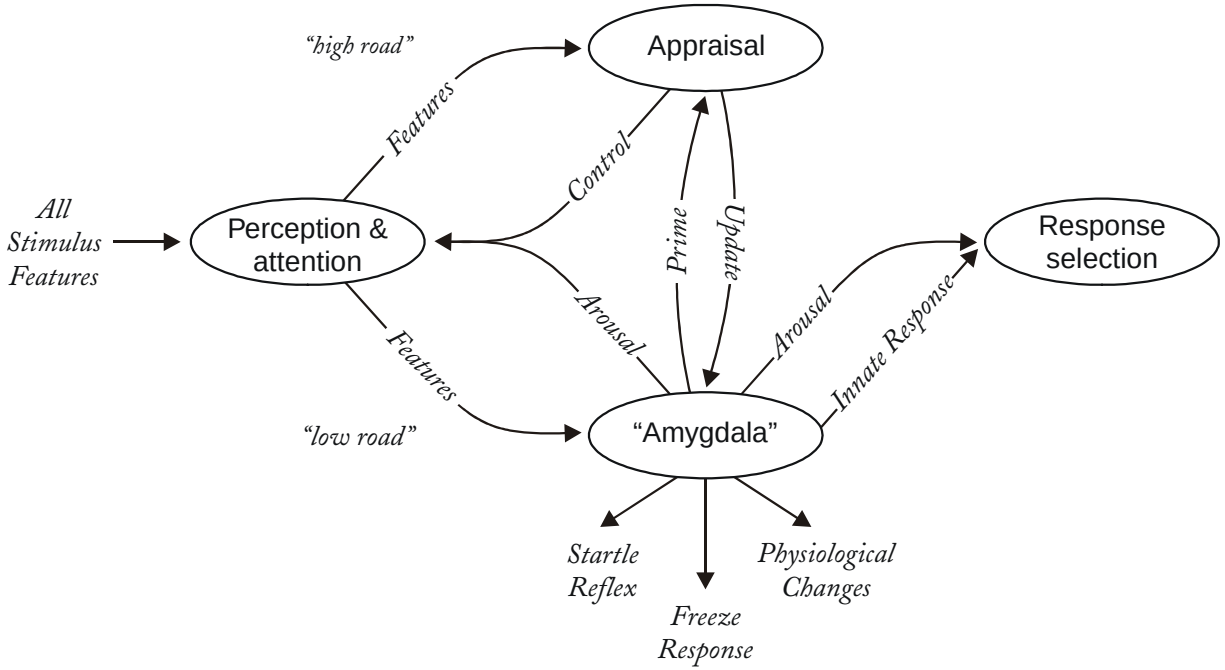
SCENARIO A, CONT'D

- **Response 1: He immediately runs away.**



SCENARIO A, CONT'D

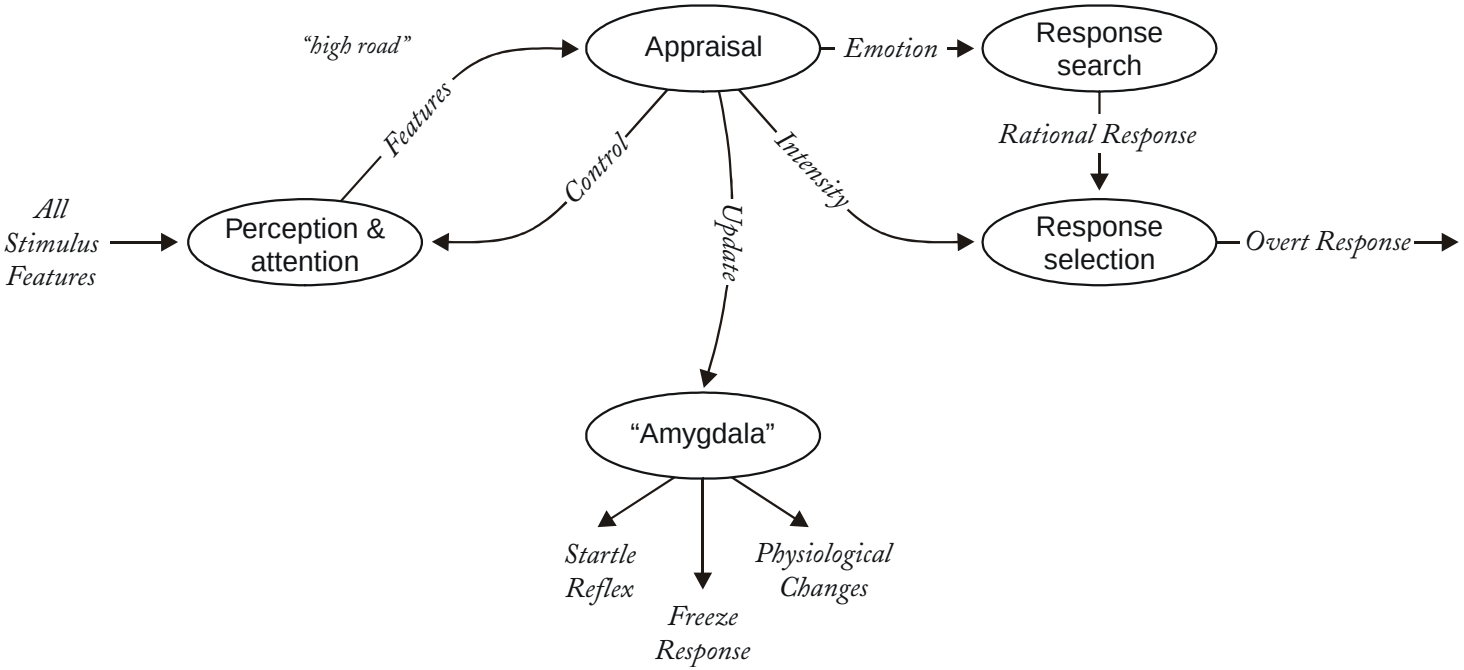
- **Response 2: He freezes, recognizes that the object is a stick, and resumes his walk**



SCENARIO B

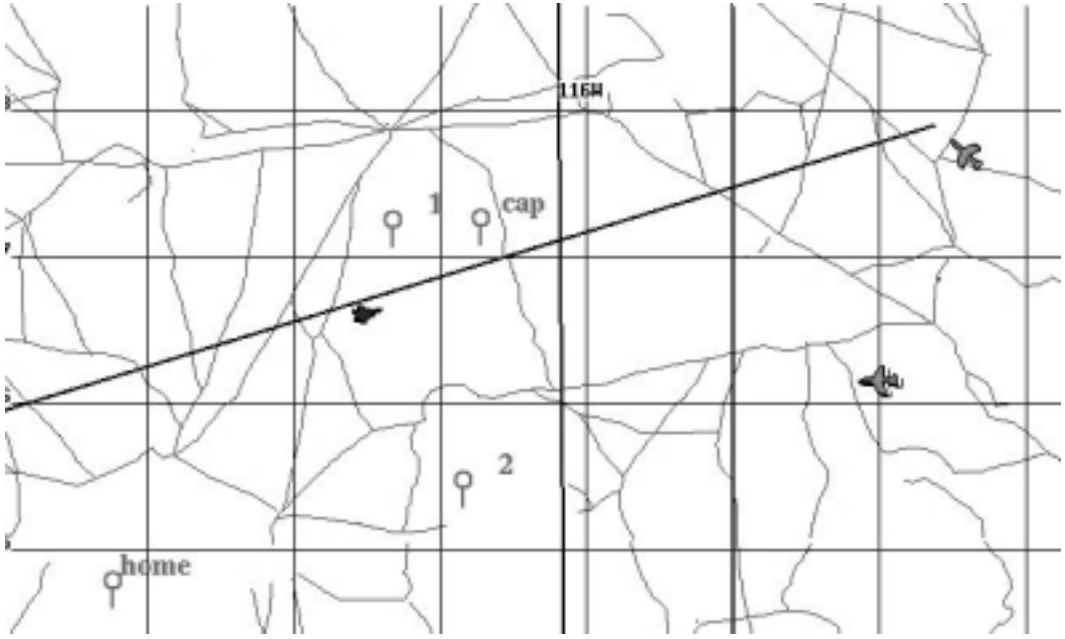
- **A husband has prepared a late dinner for himself and his wife. Thirty minutes ago, she called to say that she was leaving the office. She has yet to arrive, although her office is a leisurely five-minute walk across campus from home.**

- **Assumptions: The husband cares for his wife and her tardiness is anomalous.**



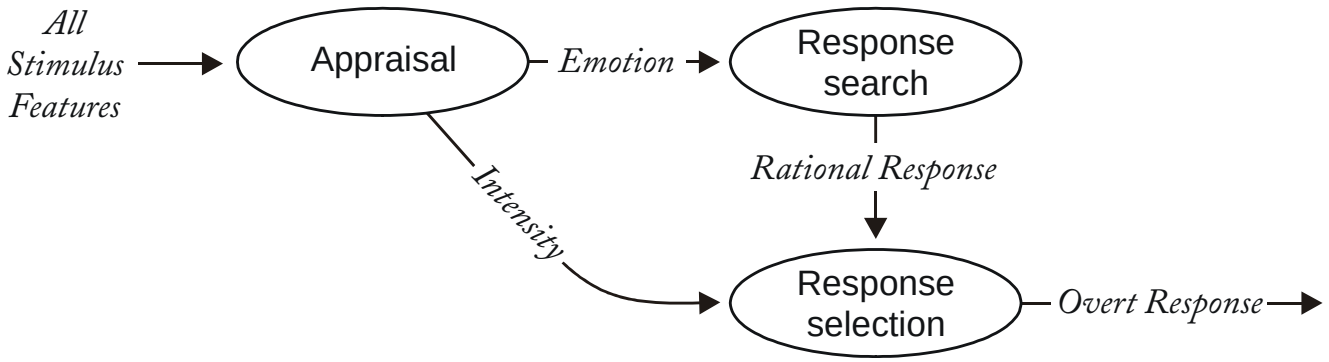
PROOF-OF-PRINCIPLE DEMONSTRATION

- **A scenario in TacAir-Soar that would be expected to cause fear in a pilot: 1 v. 4.**
- **The allied fighter, approaching from the west, is flying a CAP mission and will eventually confront the four enemy planes approaching from the east.**



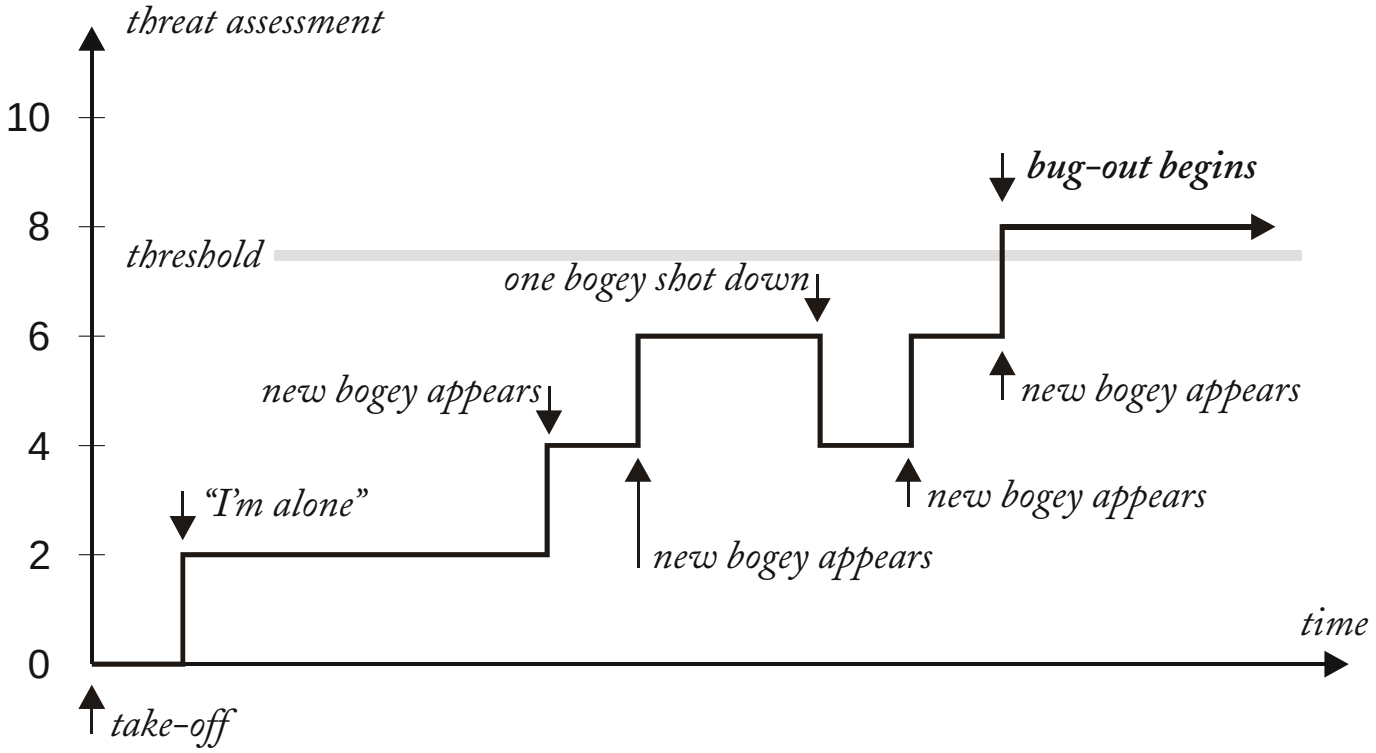
PROOF-OF-PRINCIPLE DEMONSTRATION, CONT'D

- **Built a very simplified fear model**
- **Very simple threat assessment**
  - Am I alone?
  - Are there enemy present?
  - Am I/Are we outnumbered?



PROOF-OF-PRINCIPLE DEMONSTRATION, CONT'D

- **In this scenario, the allied fighter will "bug-out" when the threat assessment exceeds a threshold.**



ISSUES

- **A knowledge-level implementation**
- **Does not address how fear affects the way we perceive, think or plan**
- **True threat assessment would be based on the following factors**
  - What the likelihood of harm?
  - What is the expected harm?
  - How long to I have before I must act?
  - How effective could my actions be?

FUTURE WORK

- **GET PHASE 2 FUNDING!!**
- **Complete implementation of fear with a consideration of Ortony's work**
- **Explore an implementation of arousal**
- **Develop a perceptual attention mechanism**
- **Implement the emotion of anger**
  - How offended are you at someone due to their actions?
  - How undesirable are the consequences of their actions?
- **Look for and implement architectural changes**
- **Use a domain relevant to the Army**
- **Get Phase 3 funding**