ME 586: **Biology-inspired robotics**

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Goals:
- advice for how to read a scientific paper
- Example paper presentation and discussion lead paper 0: McLeod & Dienes, "Do fielders know where to catch the ball or only how to get there"

how to read a paper

1. read the abstract - 2-5 min

2. look through the figures - 5-10 min

3. read the introduction - 5-20 min

4. read the conclusion - 10 min

5. read the rest of the paper - 1-10 hrs
   (depending on difficulty and detail desired)

since this is a 3 unit course, aim to spend about two hours per review

paper 0 presentation & discussion

Do fielders know where to go to catch the ball or only how to get there

Peter McLeod & Zoltan Dienes
Journal of Experimental Psychology, 1996

Presented by Sawyer Fuller

does this fielder know
where ball will land?

previous work

- Chapman (1968) observed that if a fielder runs at a constant speed such that

$$\frac{d}{dt}\tan(\alpha) = const$$

  she will intercept a parabolic trajectory
- problems:
  - because of air drag, path of ball is far from parabolic
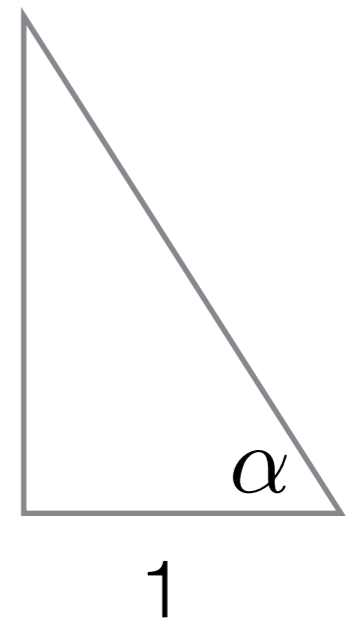 - does not specify how to choose the "constant running speed"

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define: $A \triangleq \tan\alpha$ "slope" of angle
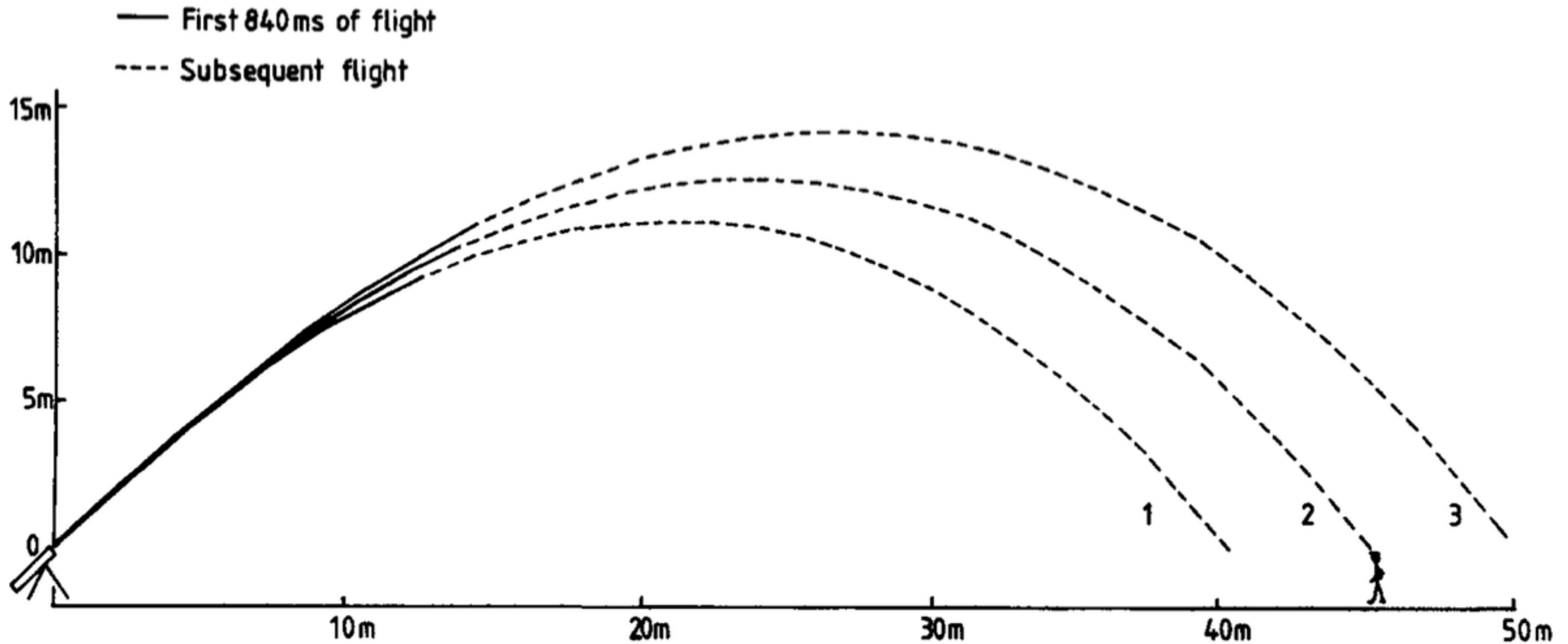
then Chapman's $\dot{A} = const \iff \ddot{A} = 0$

this paper: can we better understand the underlying mechanism?
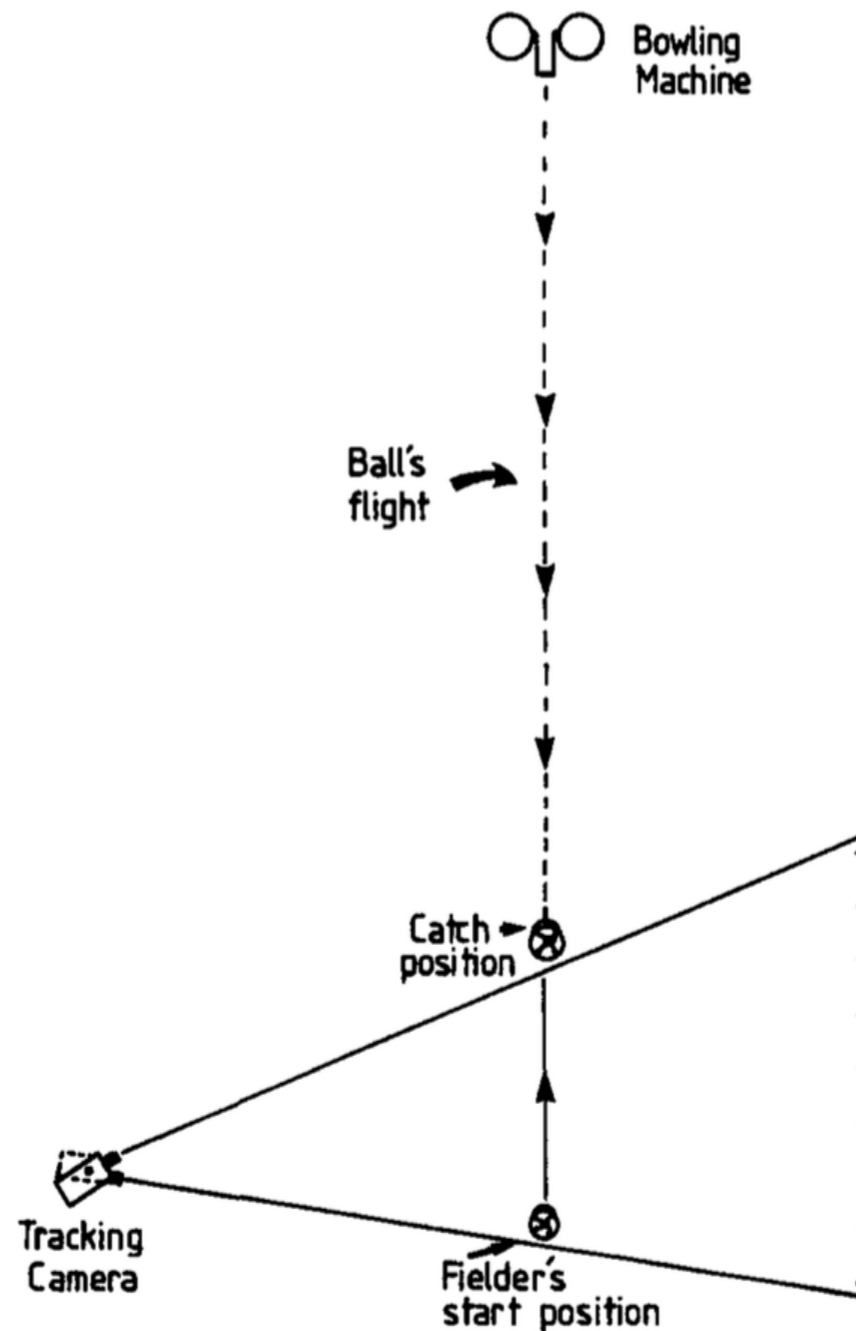
Experimental setup

- fielder catching fly balls

- focus on front-to-back motion, not side-to-side
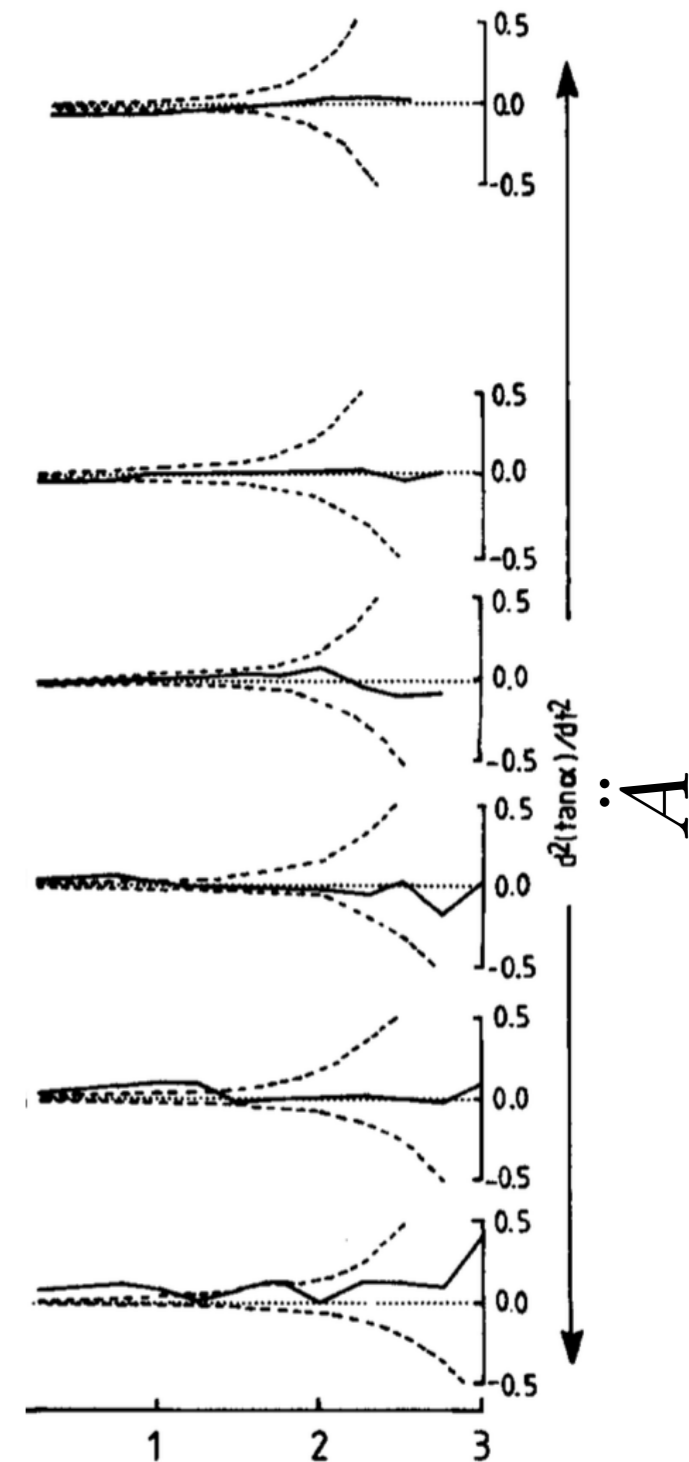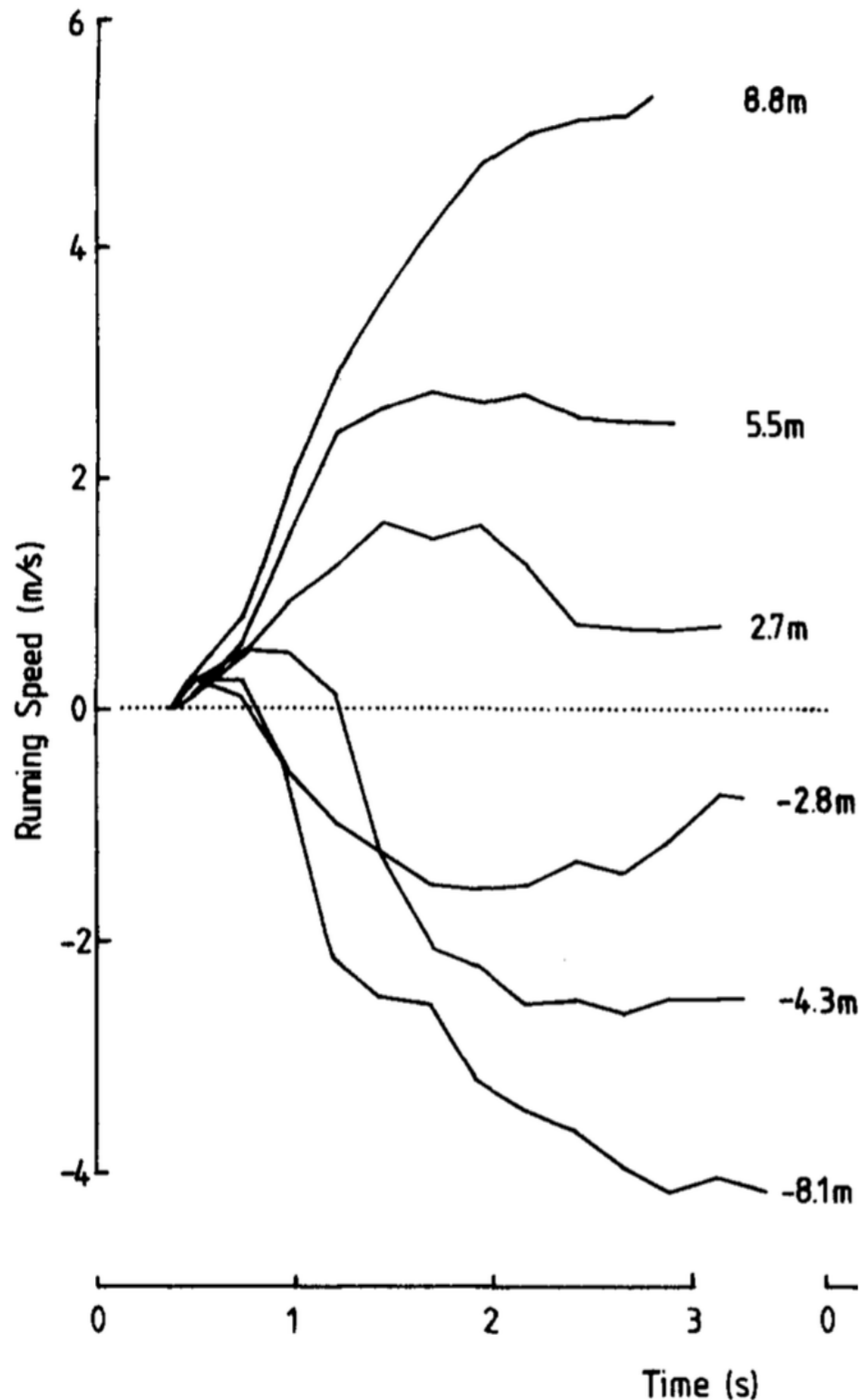
Experimental setup

- camera tracks fielder

Figure 2. The experimental setup as viewed from above. A
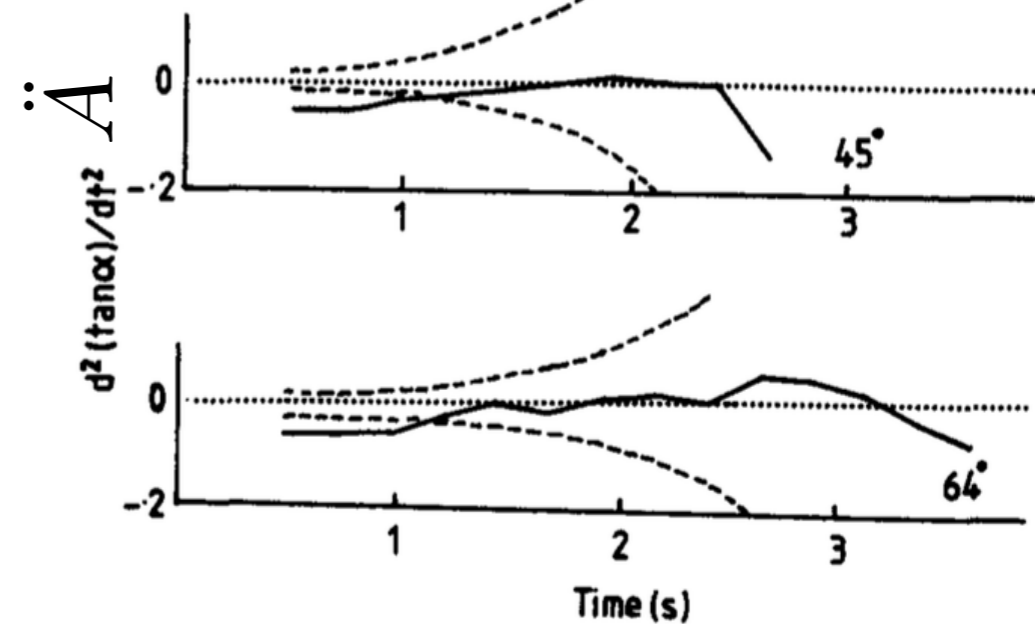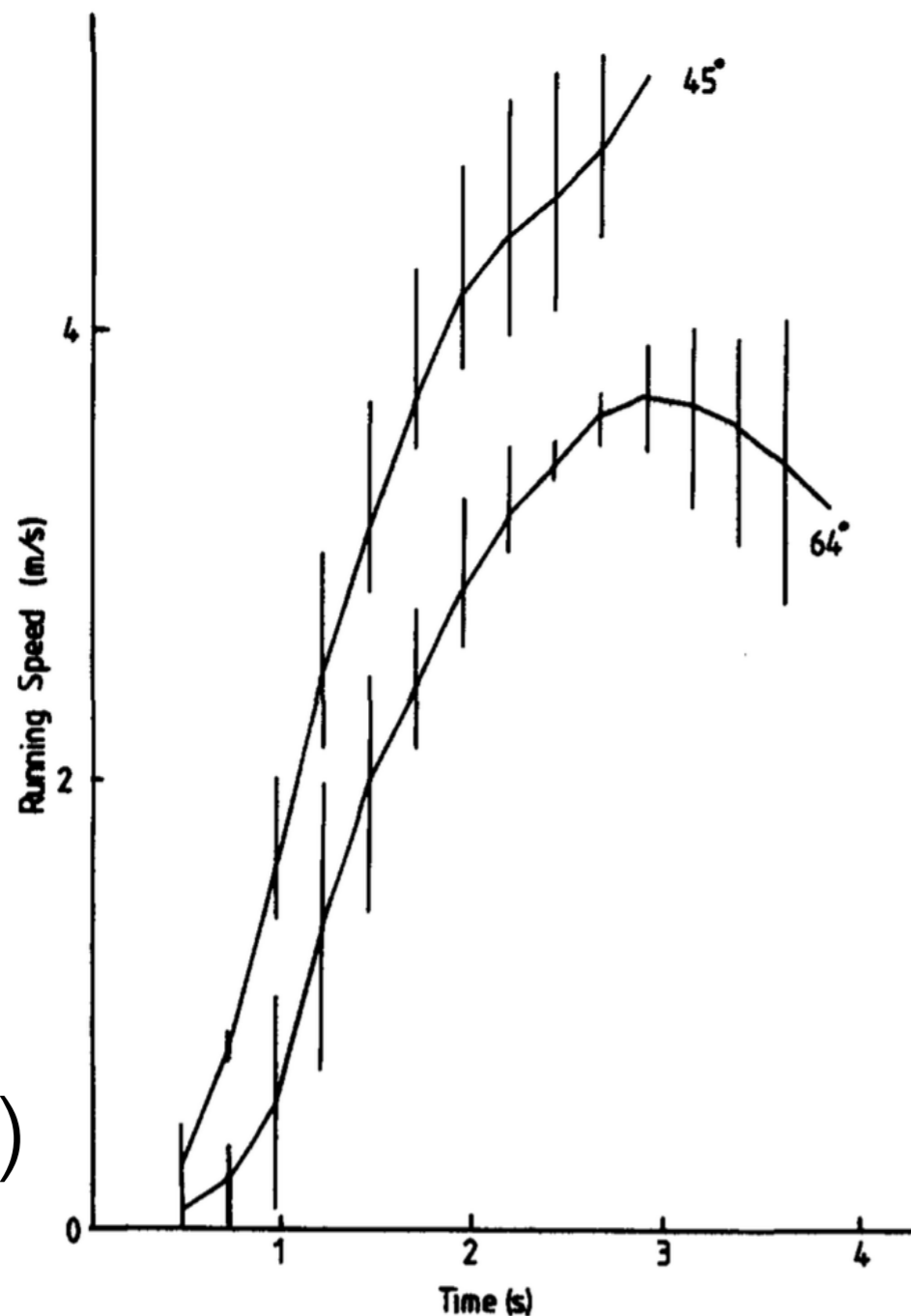
experiment 1: 45deg at different speeds

variable running speed but $\ddot{A} \approx 0$

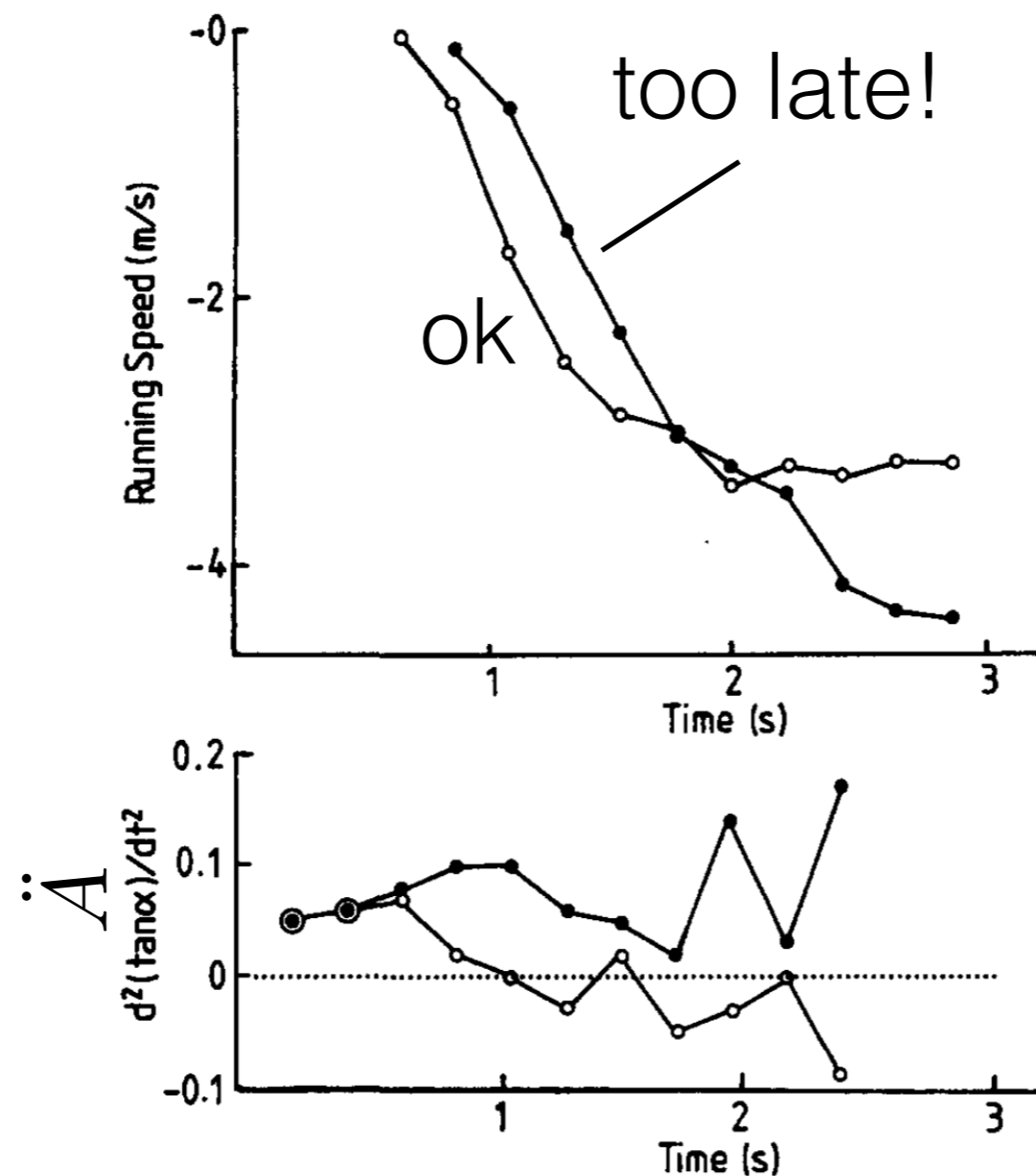# experiment 2: change launch angle
(try 45 and 64 deg)

- runner runs slower if ball takes longer, rather than running full speed and arriving early

(figure 4)

missing the ball

- happens if running too slowly so that $\ddot{A}$ never goes to zero

too late!

ok

Figure 5. Velocity and d²(tan α)/dt², as in Figure 3, for two

alternative hypotheses
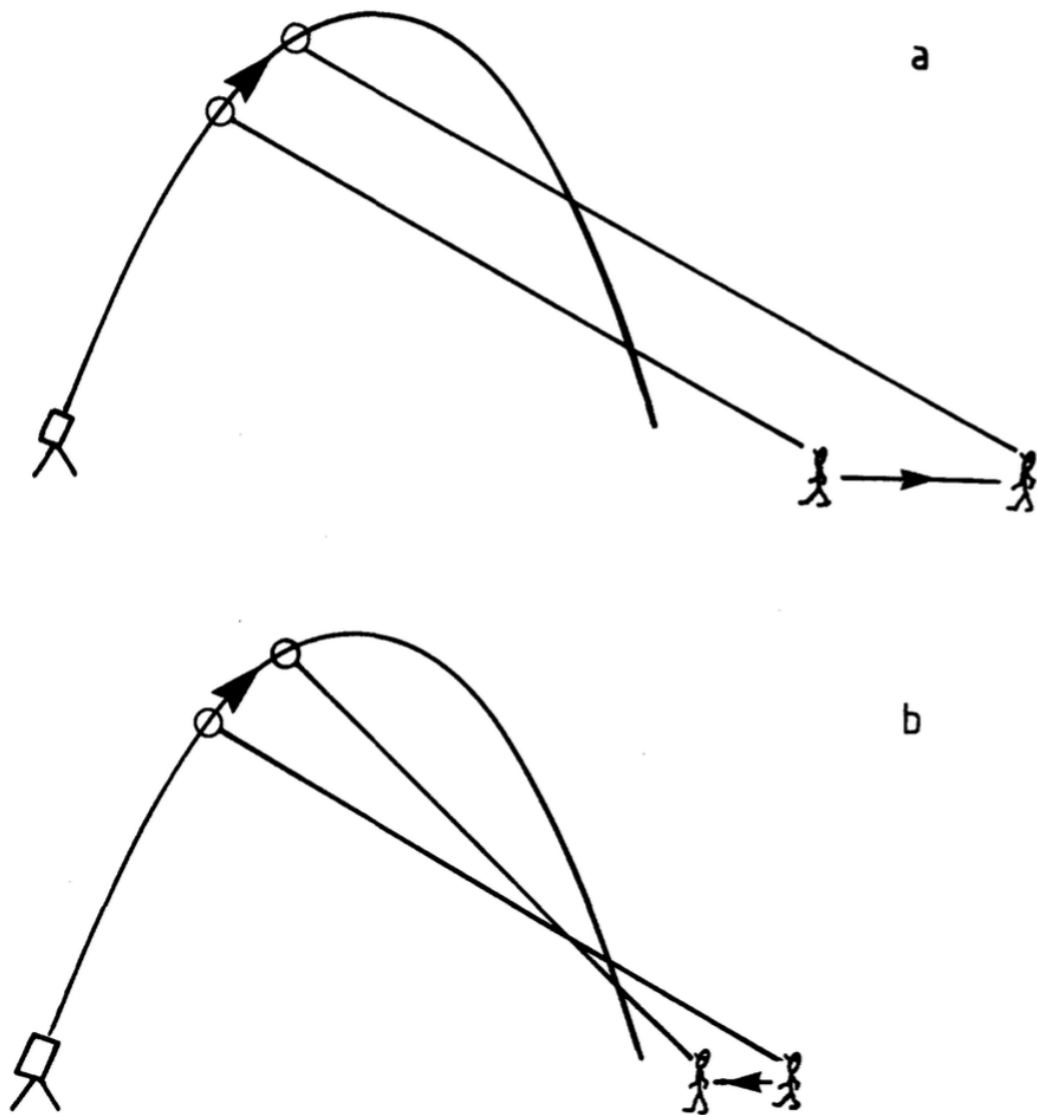
- rejected: keeping alpha constant

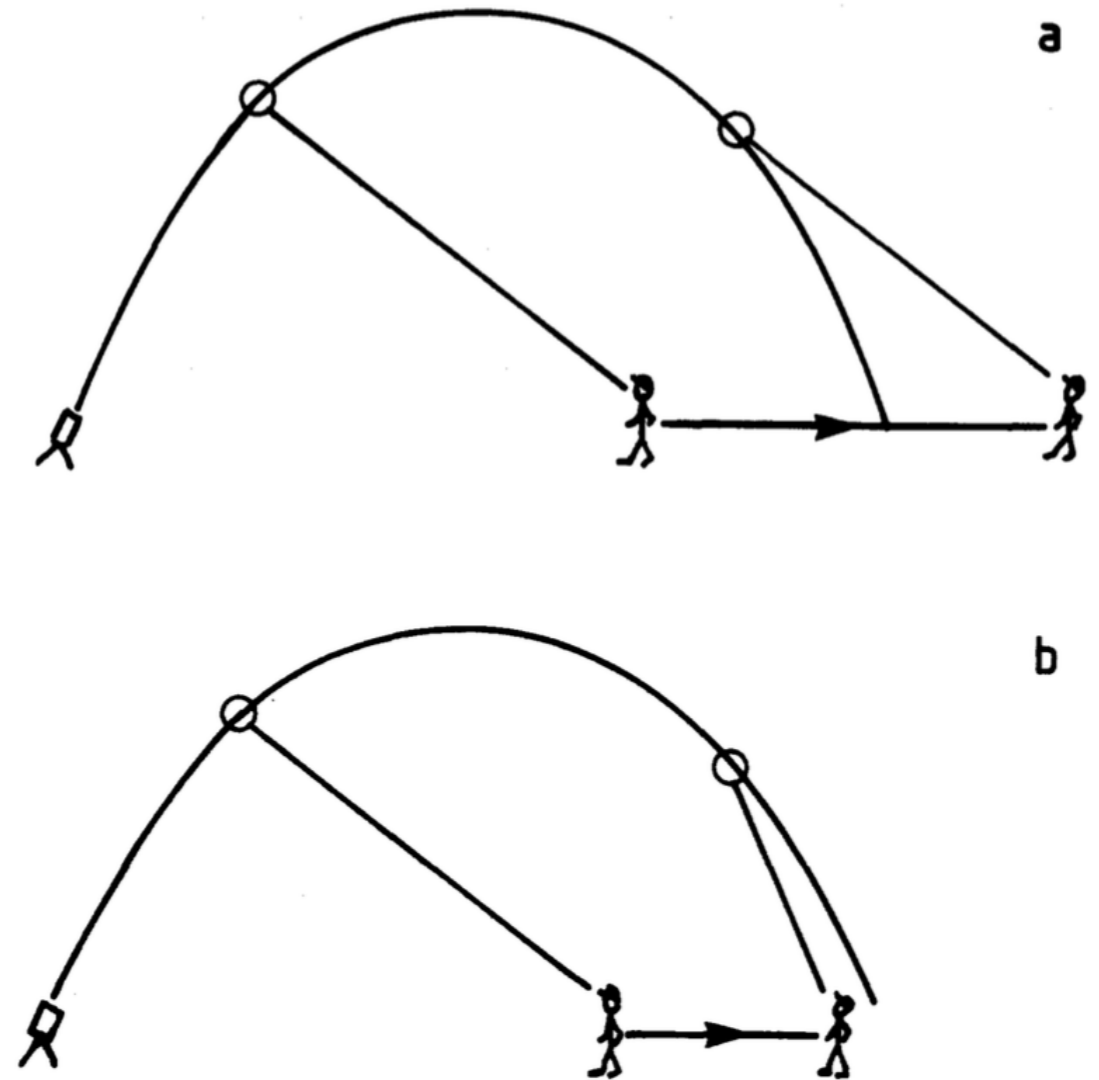*Figure 8.* Two strategies for interception when the fielder should run forward. (a) Keeping the
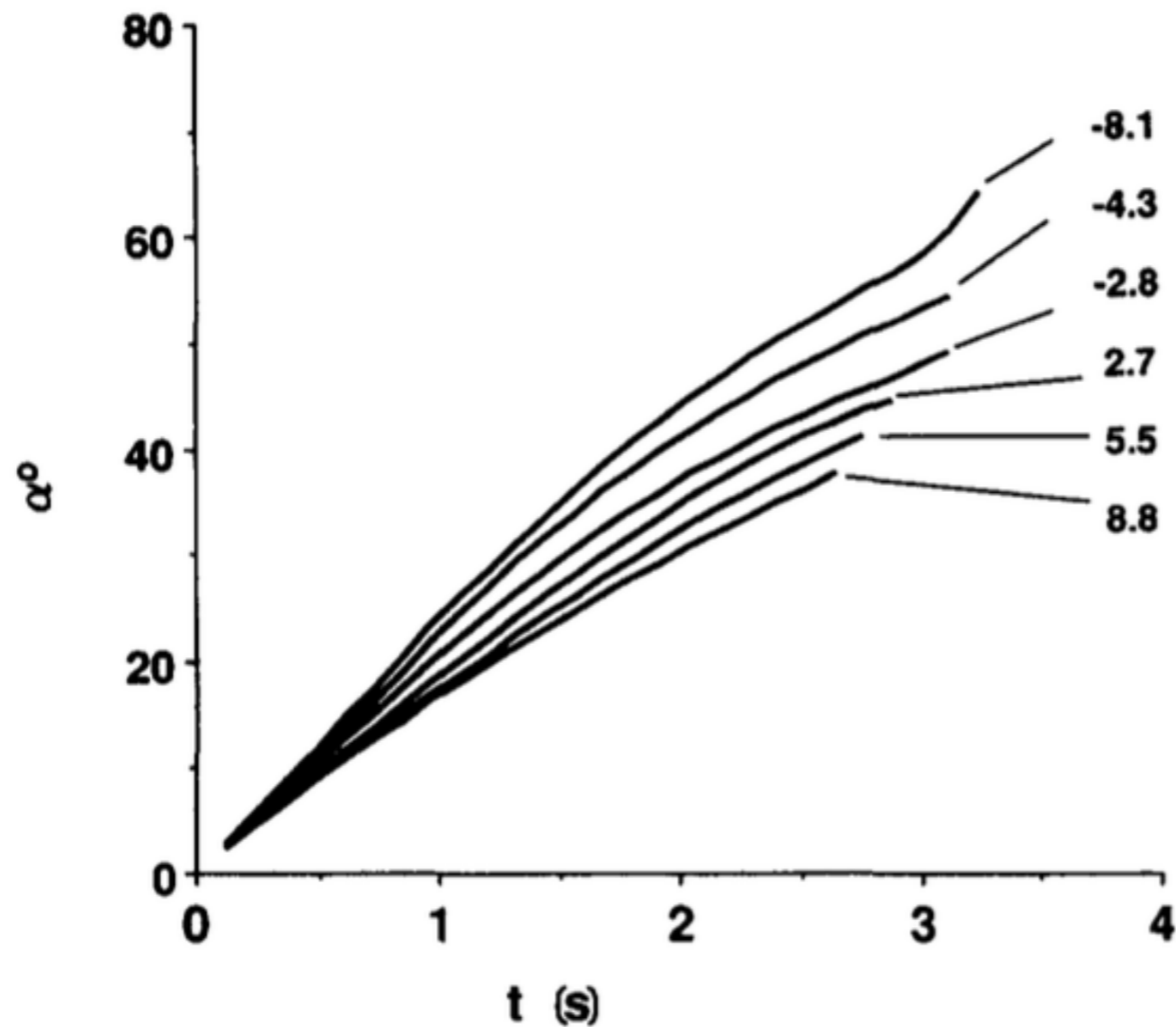
Figure 9. Two strategies for interception when the fielder is running backward. (a) Keeping the

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alternative hypotheses

- rejected: $\ddot{\alpha} = 0$ (because lines not straight)

paper's conclusion:

runner implements a *feedback* controller ("servo"):

dv/dt = K d²tanα/dt²

$$\dot{v} = -K\ddot{A}$$

summary

- fielders are not running at constant speed to ball

- consistently, they are running at the moment they intercept it

- they didn't use spare time to run to where the ball would fall

  - this suggests they don't know where that will be

- dynamic behavior suggests a simple *feedback law*

Reminder for when you are presenting a paper

- In addition to presenting, you will also lead the discussion of the paper

- don't write a review

- Instead, make a blank post so you can read other reviews. Then, skim through the reviews and come prepared to bring up their questions and comments

discussion comments

- Is this really general? Can we learn more if we try extremely non-ballistic balls like waffle balls?

- calculating a second derivative is noisy

- "good players often stop and wait for the ball to land"

- what about lateral motion?

- great thing to test with a simulation!

- next question: how is this learned?

- Disney research video: catching a ball in virtual reality