B. Synchronization
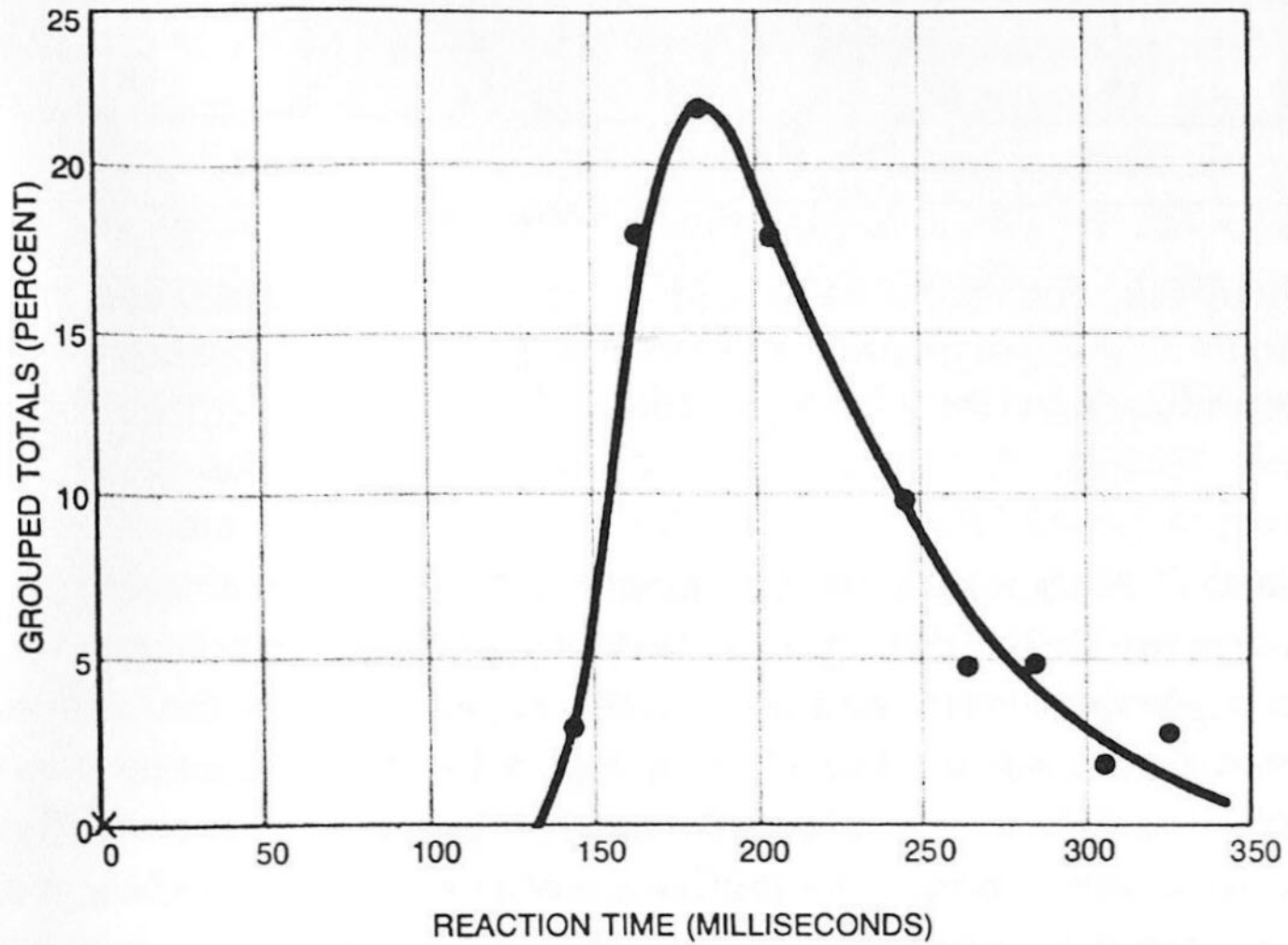
Demonstration:
Human Synchronization
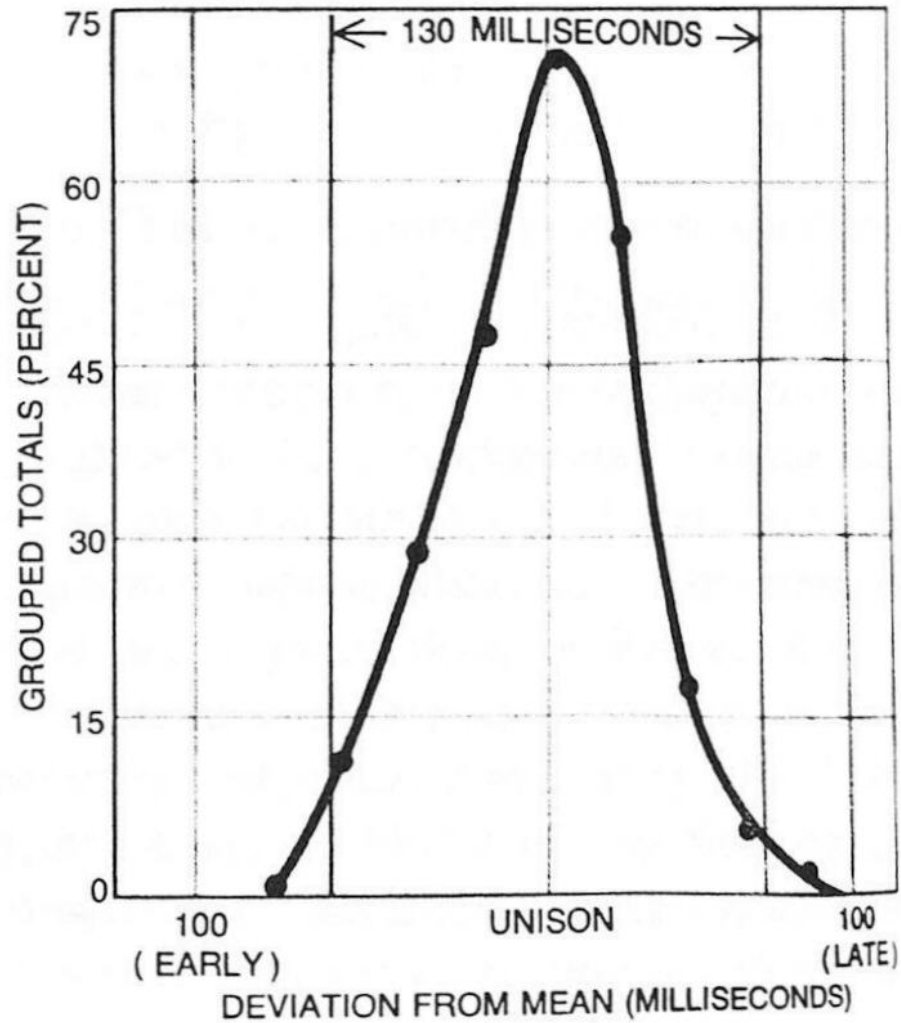
Reaction Time

Fig, from Buck & Buck (1976)

Synchronization

Fig, from Buck & Buck (1976)

Flashing Among Fireflies

Synchronous Flashing

- In only two places enormous numbers of fireflies gather in trees and flash in synchrony
  - SE Asia (India, Philippines, New Guinea)
  - Elkmont in the Smoky Mountains!
- A group of trees spread over 1/10 mile may flash in synchrony
- Only males do synchronous flashing
- Had been unexplained for 300 years
- Early 1900s: claimed to be an illusion because no explanation could be imagined

Why Do They Do It?

- Females identify males of their own species by flashing rate
  - difficult to do if they flash chaotically
  - i.e., enhanced discrimination
- Allows males to detect (unsynchronized flashing of nearby females)
  - i.e., enhanced detection
- Allows small groups of males to attract larger numbers of females
 - i.e., signal enhancement

How Do They Do It?

- "innate individual rhythmicity with phase-dependent sensitivity to mutual influences"
- Natural flashing period: 965±90 msec (≈ 1 sec)
- Flash from firefly *A* will reset the clock of nearby firefly *B*
  - thereby shifting the *phase* of *B*'s clock
- If *A* flashes in first 840 ms of *B*'s cycle, will inhibit *B*'s next flash & delay until 1 sec after stimulus (i.e. retarded so it is in sync with *A*)
- If A flashes in last 160 ms, *B*'s next flash occurs normally, but subsequent flash will be advanced to be in sync with *A*
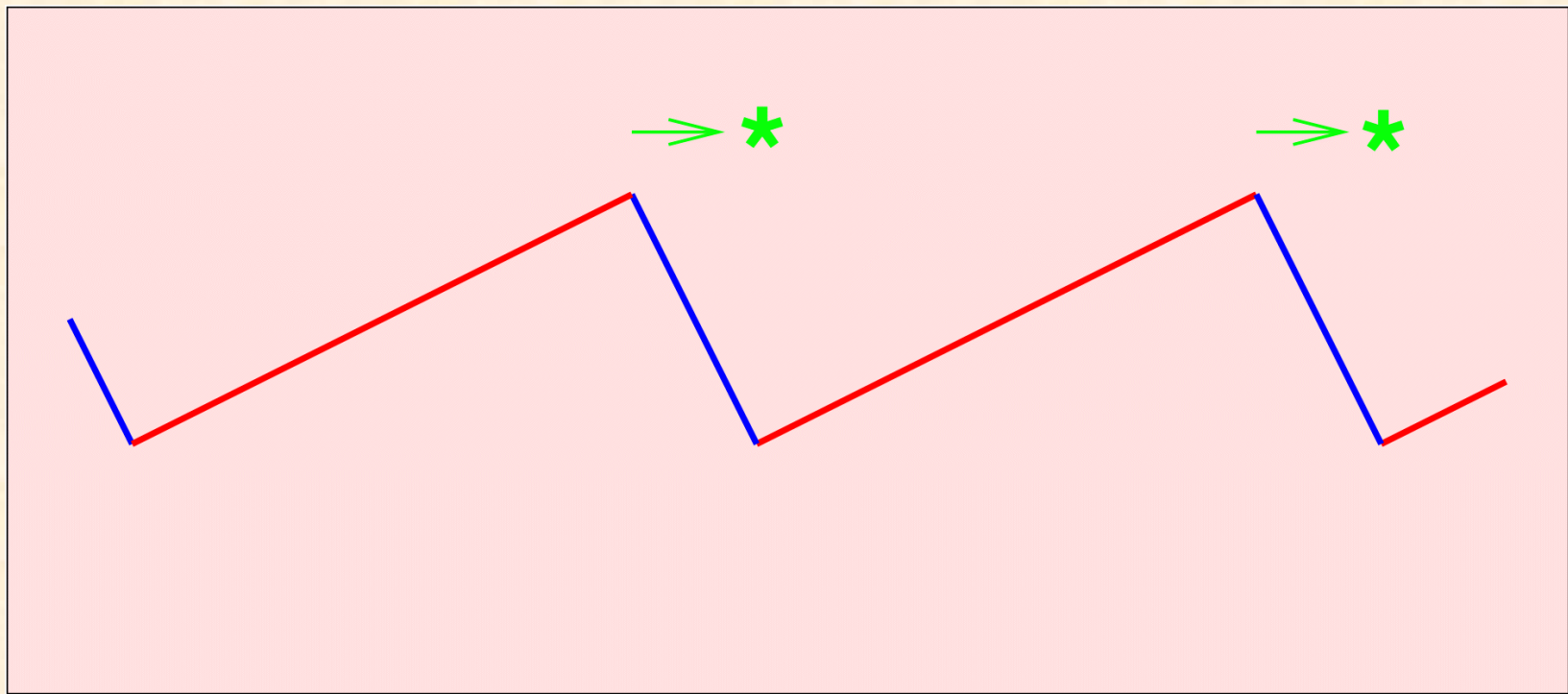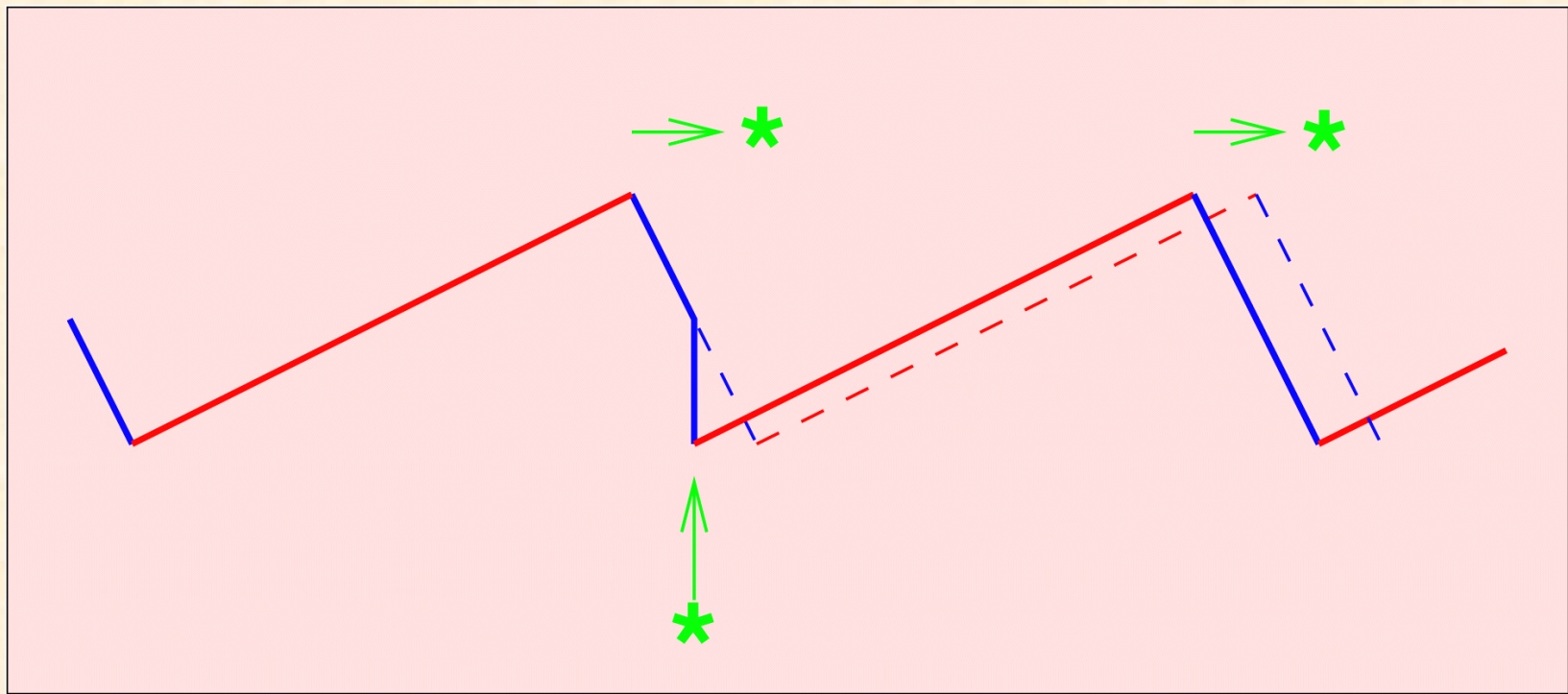
Free-running Flashing
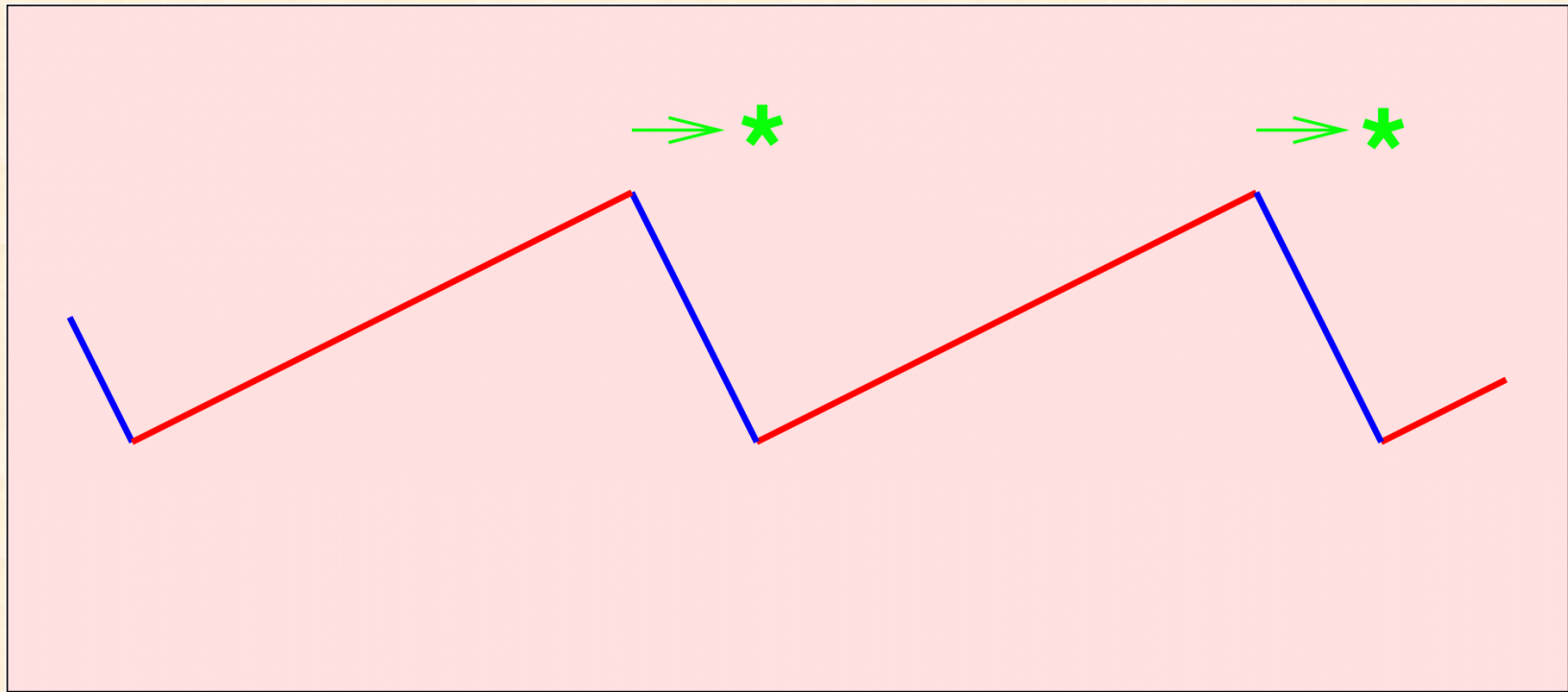
Stimulus in first 840 msec
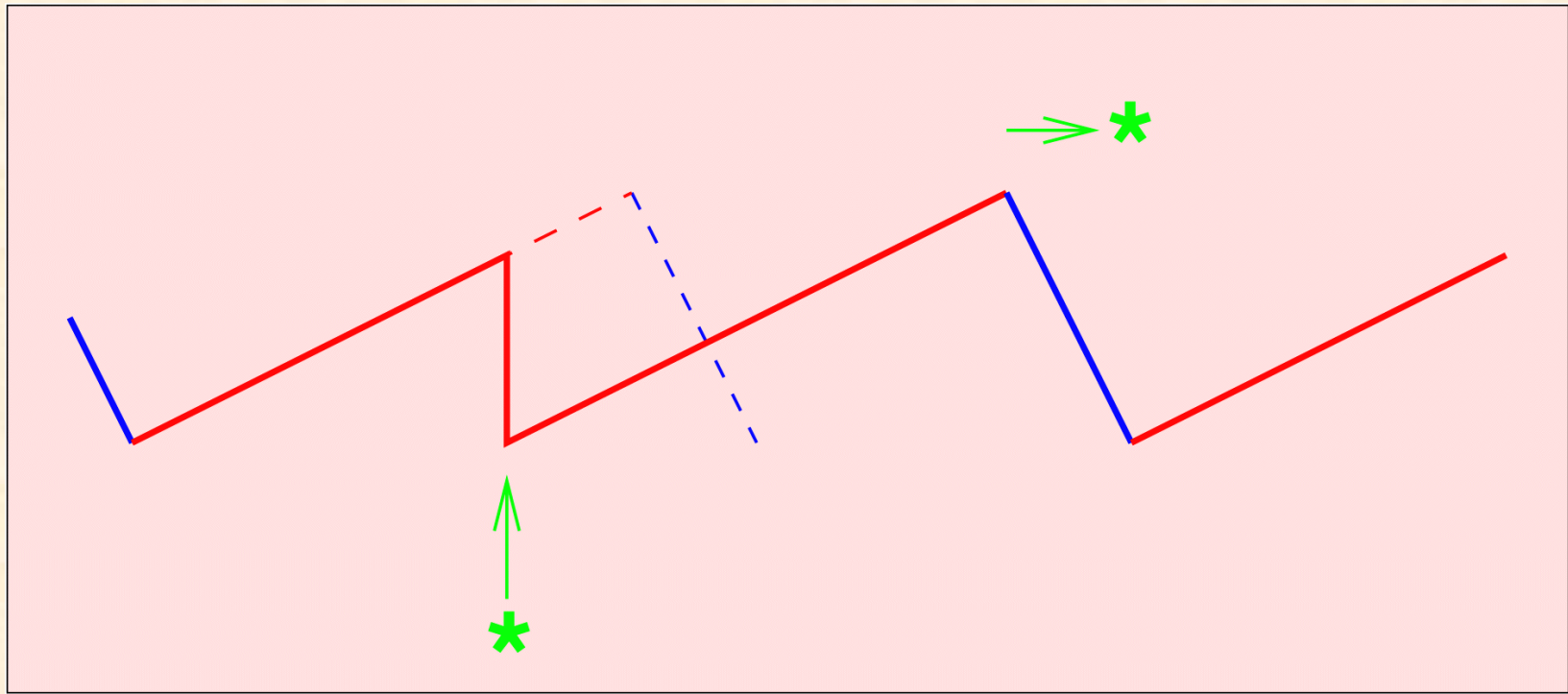
Free-running Flashing (again)

Stimulus in last 120 msec

Camazine's Model of Firefly Synchronization

Run Firefly.nlogo Simulation

Wilensky's Model of Firefly Synchronization

Run Fireflies-mobile.nlogo Simulation

Part VIII