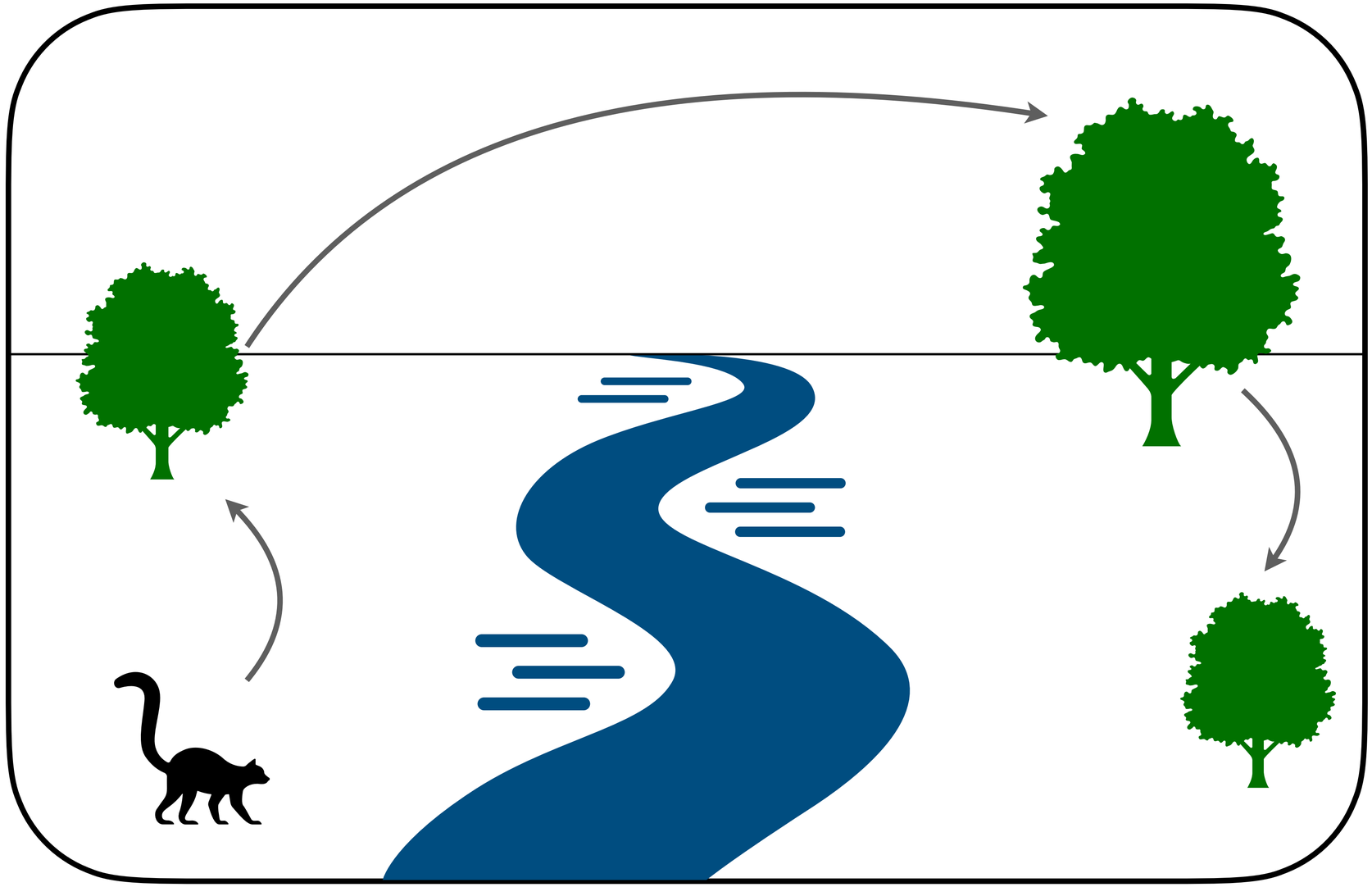
What is the best way to forage?

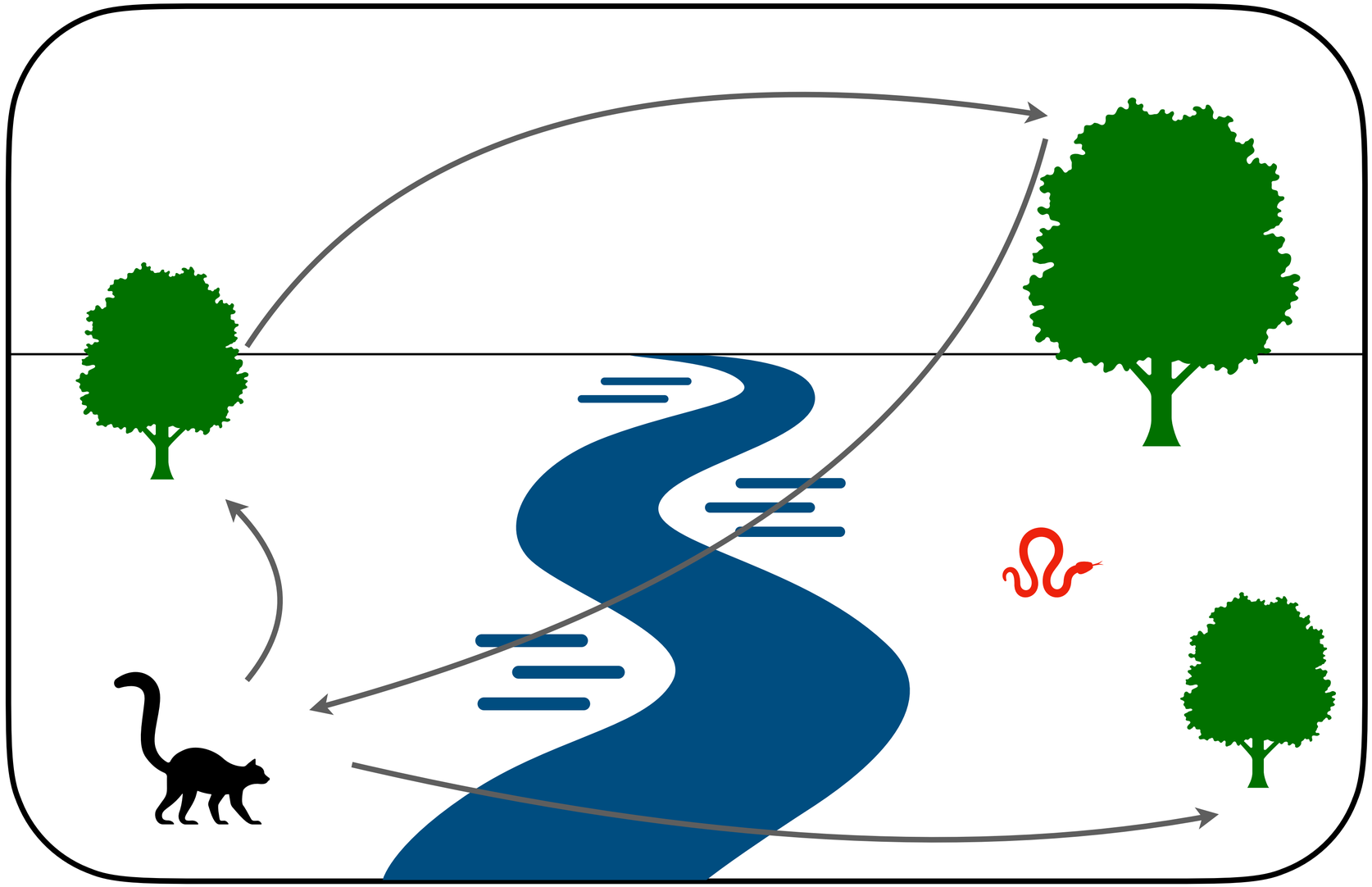
Readings for today

- Charnov, E. L. (1976). Optimal foraging, the marginal value theorem. Theoretical population biology, 9(2), 129-136.
- Pirolli, P., & Card, S. (1999). Information foraging. Psycho- logical review, 106(4), 643.

The foraging problem



The foraging problem



Foraging tasks

Resources

- **Tangible**: Physical resources whose value increased with each unit obtained (e.g., food, water, money).

OR

- **Informational**: Sensory experiences that change or affect internal memory states.

} Patches

Costs

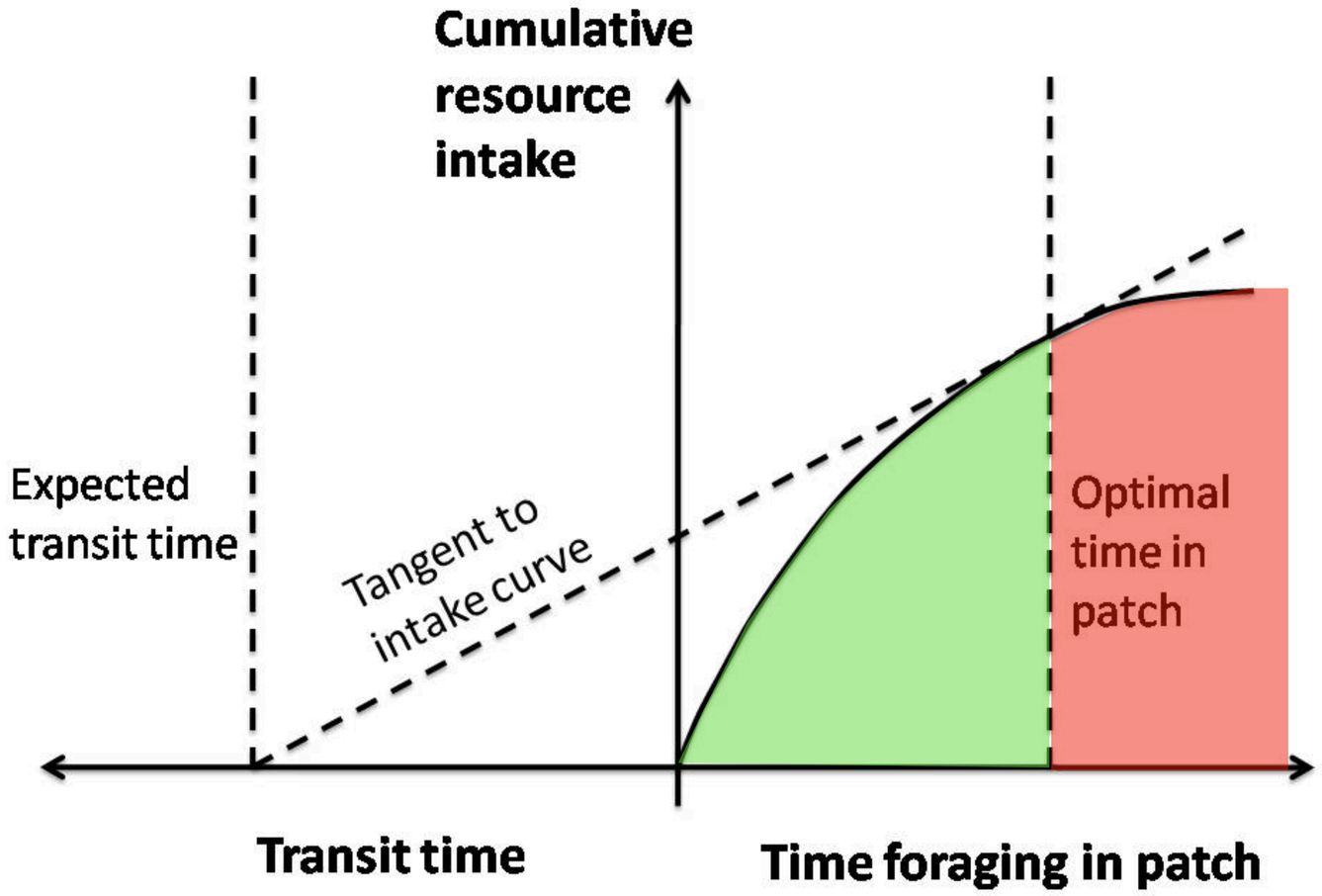
- **Resource costs**: Expenditures of calories, money, etc. that are incurred by the chosen activity.

AND

- **Opportunity costs**: Benefits that could be gained by engaging in other activities, but are forfeited by engaging in the chosen activity.

(Charnov 1976; Pirolli & Card 1999)

Marginal value theorem



https://en.wikipedia.org/wiki/Marginal_value_theorem

The optimal strategy for foraging is one that maximizes gain per unit time when resources, as well as rate of returns, decrease with time.

(Charnov 1976)

Information foraging theory

The application of MVT to situations requiring information gathering and sense making (i.e., allocation of attention), and where agents can mold the environment to fit available strategies (i.e. enrichment)

Rewards → Information

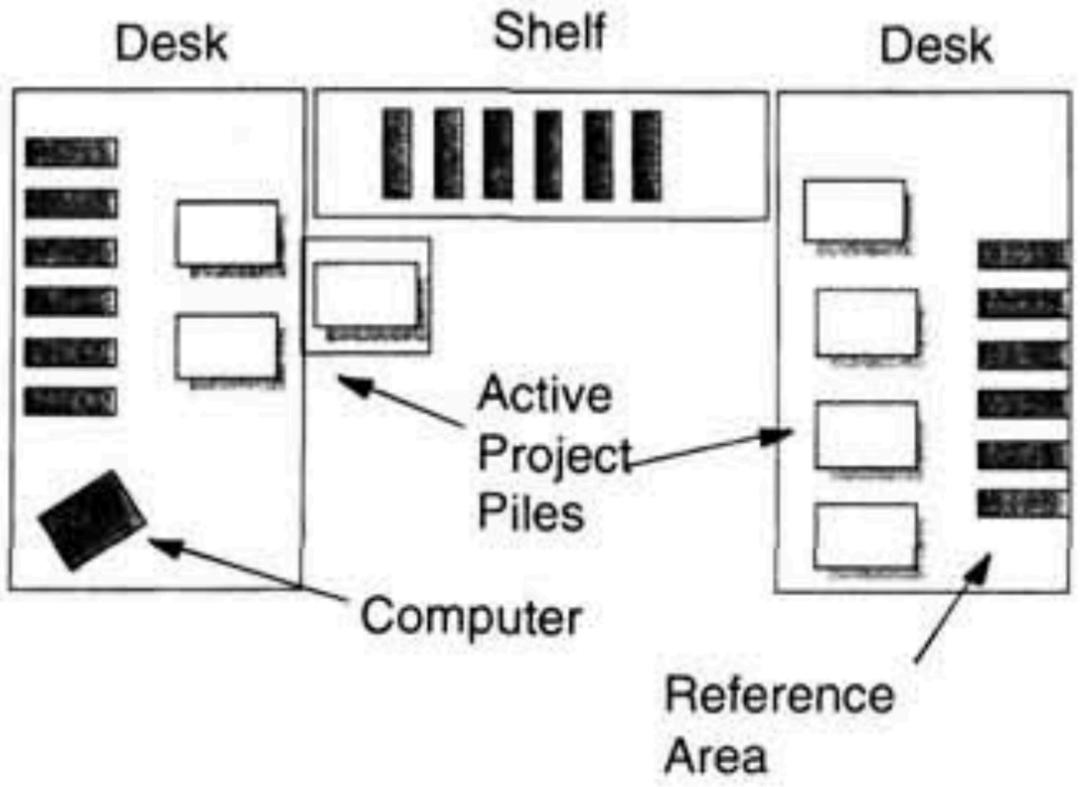
Physical effort → Attention

(Pirolli & Card 1999)

Information foraging example

Resources

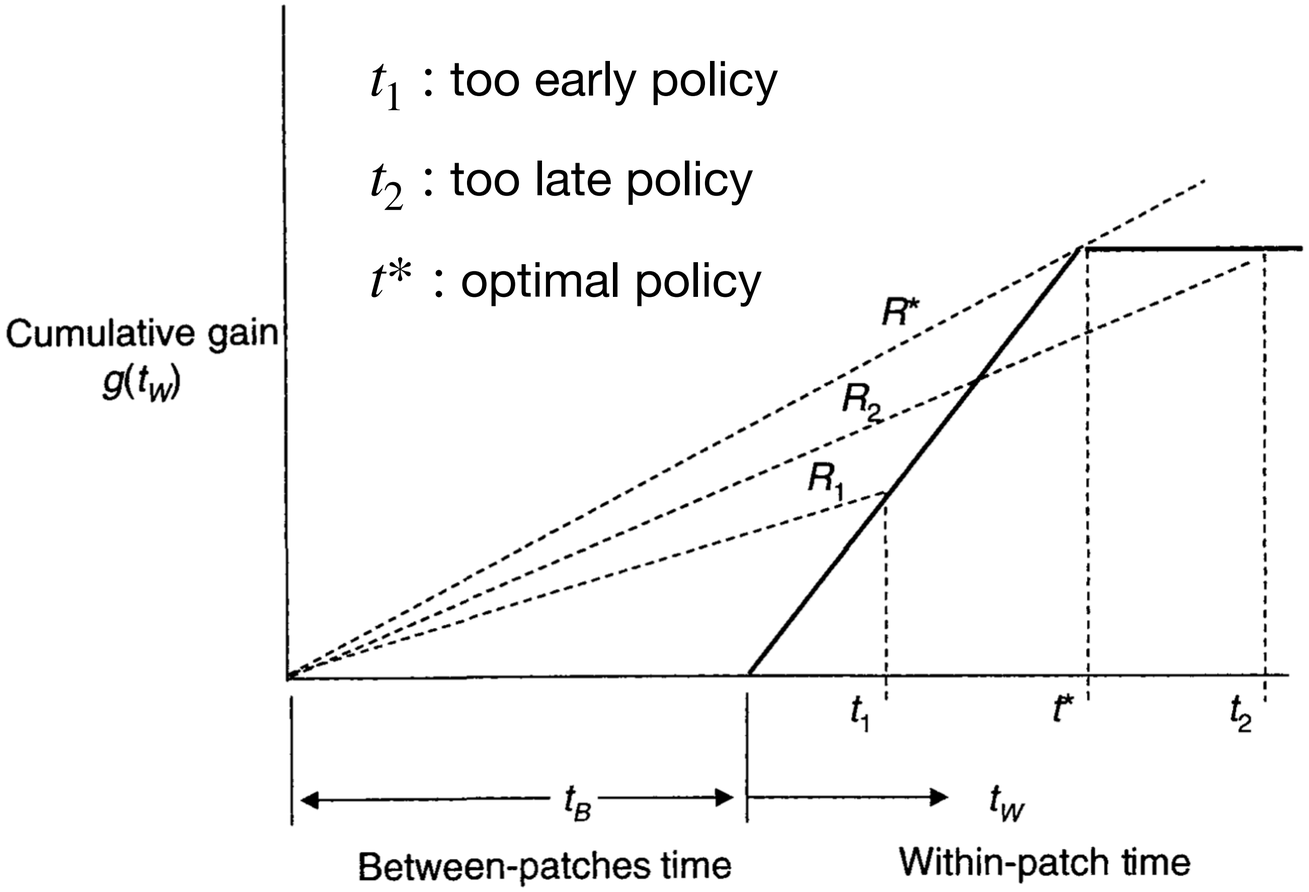
1. The arrangement of task-related information into physically localized clusters reduces the overall costs of accessing items when engaged in relevant tasks.
2. Clusters of task-related information seem to be arranged such that those with higher frequency of access are placed in areas that have lower costs of access.



How does the analyst move around from source to source when gathering information?

(Pirolli & Card 1999)

Information patch foraging



$$R = \frac{G}{T_B + T_W}$$

Resources gained

Between patch effort (time)

Within patch effort (time)

(Charnov 1976; Pirolli & Card 1999)

Information patch foraging

Resources gained

$$R = \frac{G}{T_B + T_W}$$

Between patch effort (time)

Within patch effort (time)

Rate of encountering patch i

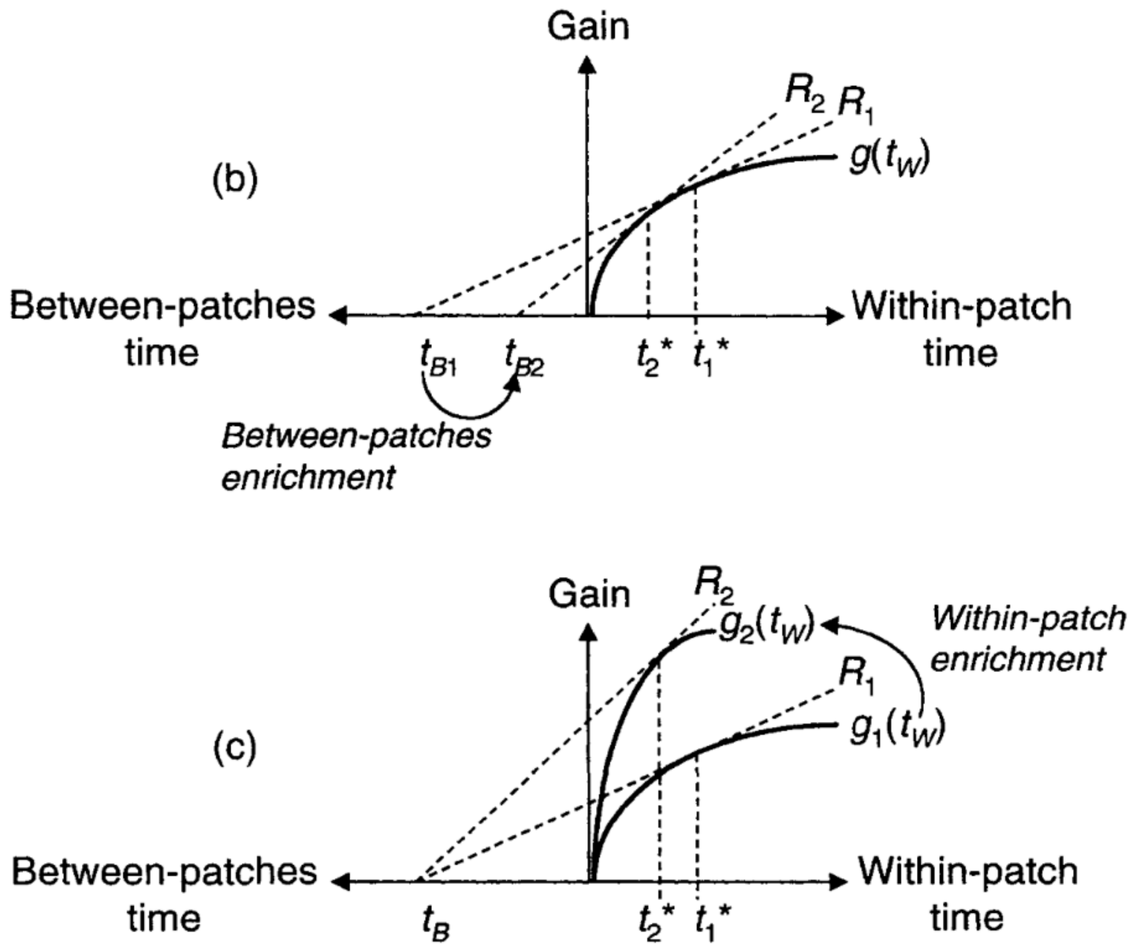
Resources gained in patch i

$$R = \frac{\sum_{i=1}^{P} \lambda_i g_i(t_{Wi})}{1 + \sum_{i=1}^{P} \lambda_i t_{Wi}}$$

Time in patch i

(Pirolli & Card 1999)

What's special about information foraging?



Enrichment allows for a change in the gain rate or effort expenditures, modifying the optimal foraging patterns.

(Pirolli & Card 1999)

Let’s get forage!

Task: Collect as many stones in 60 seconds as possible from 4 patches at varying distances

Rules:

- Pick a single forager from your group.
- Plan the foragers route as a group.
- Forager can only *walk* as a moderate pace. *No running.*
- Forager can only pick up one stone at a time with tongs provided. No more than one stone at a time.
- Forager has to return to the start for the points to count.

Hint: Think of the two types of effort from the MVT when planning your route & strategy

Map