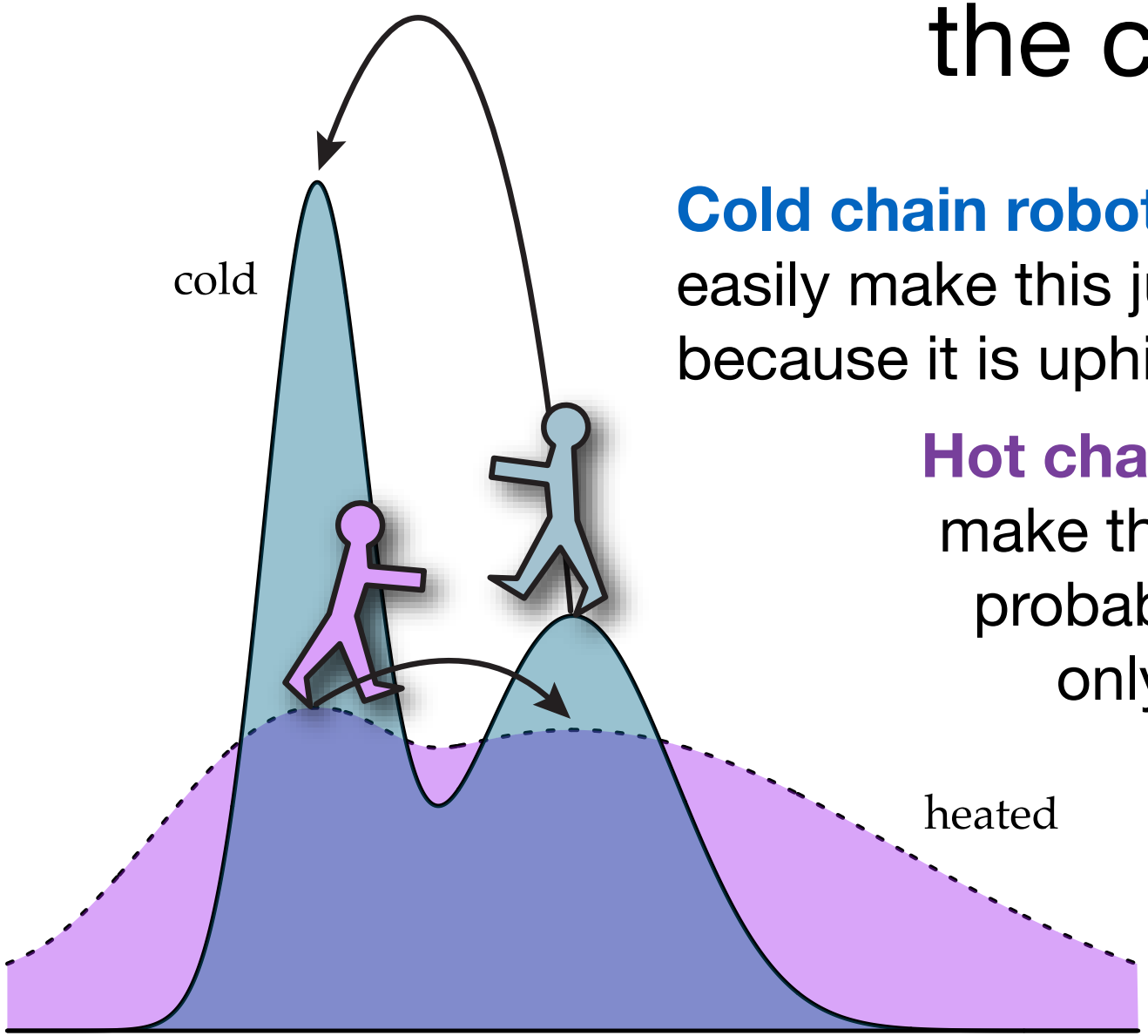
Heated chains act as scouts for the cold chain

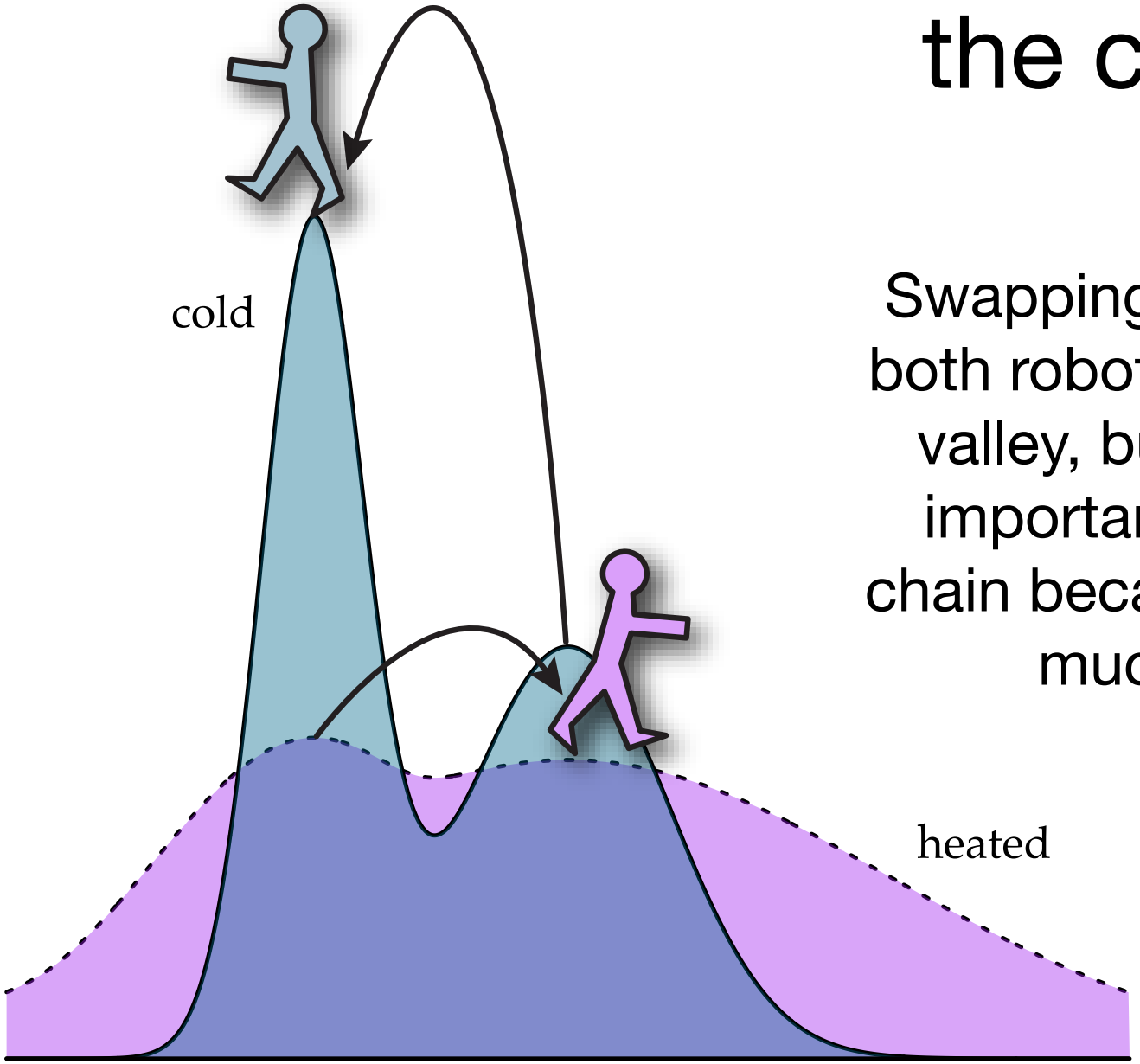


Cold chain robot can easily make this jump because it is uphill

Hot chain robot can also make this jump with high probability because it is only slightly downhill

Geyer (1991)

Heated chains act as scouts for the cold chain



Swapping places means both robots can cross the valley, but this is more important for the cold chain because its valley is much deeper

Metropolis Algorithm

$$\min\left\{\frac{p(D|\theta^*)\ p(\theta^*)}{p(D|\theta)\ p(\theta)}, 1\right\}$$

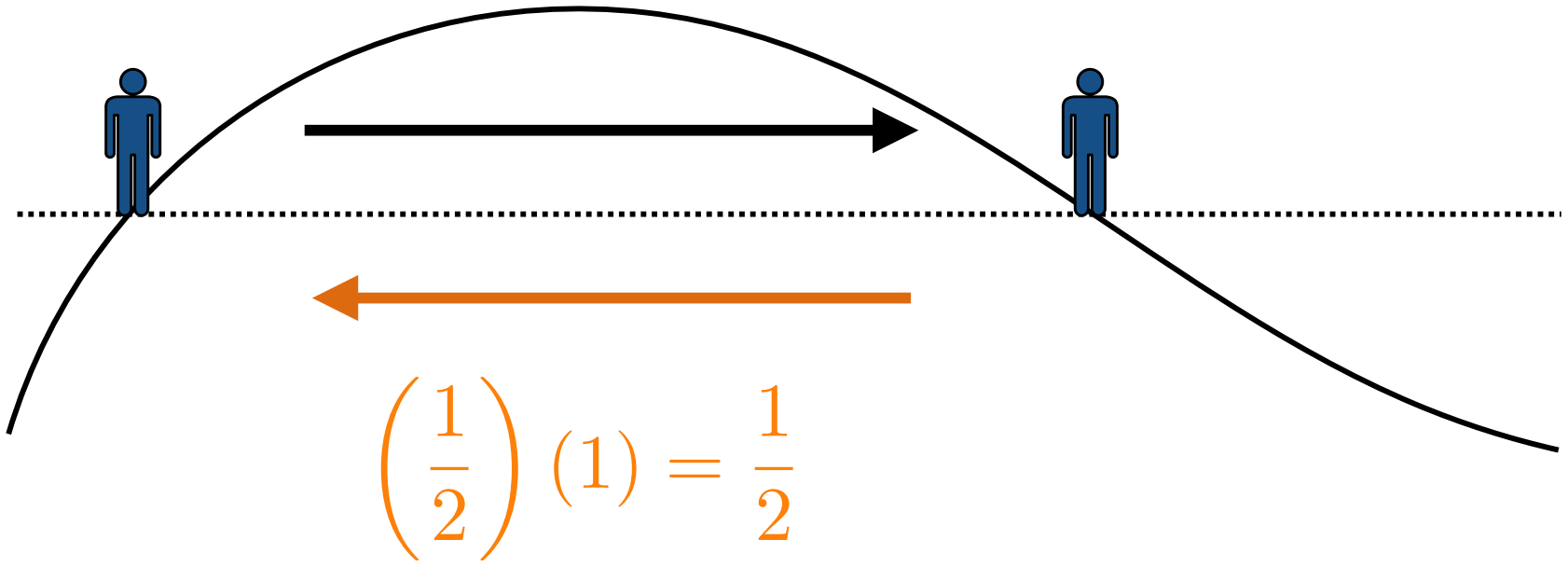
posterior ratio (*R*)

Probability of accepting the proposed move

Metropolis et al. (1953)

Hastings ratio

$$\left(\frac{1}{2}\right)(1) = \frac{1}{2}$$

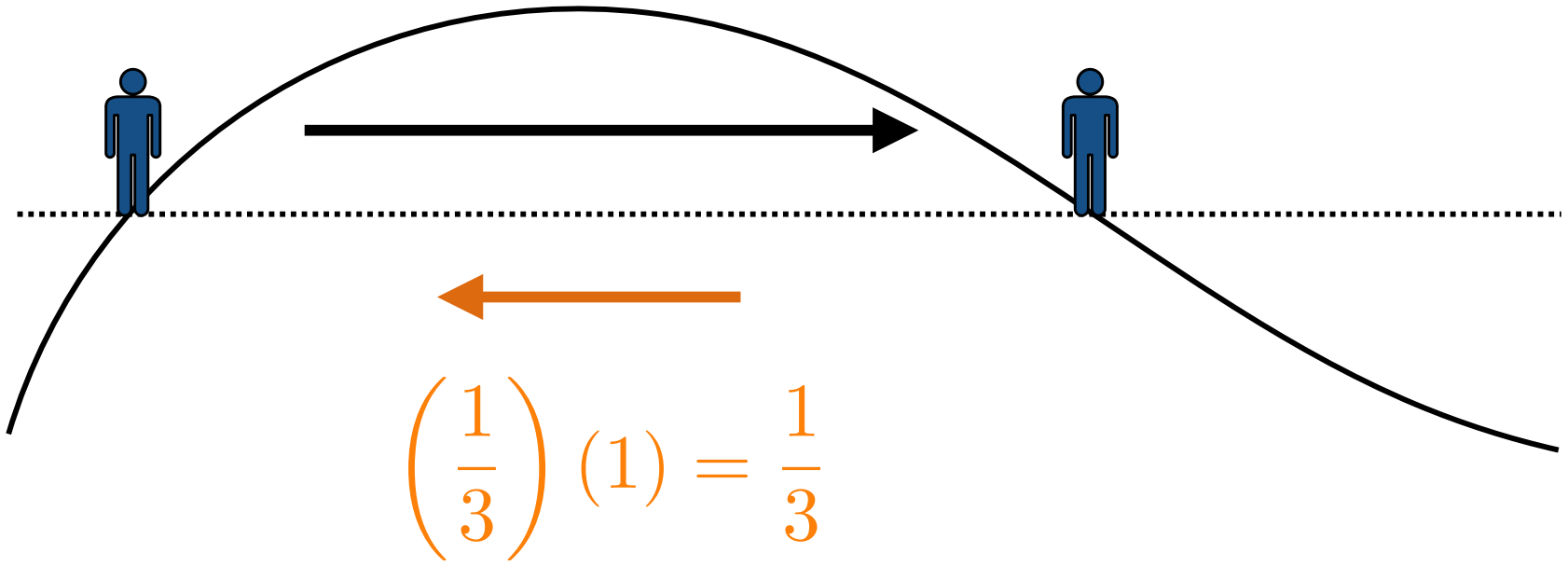


$$\left(\frac{1}{2}\right)(1) = \frac{1}{2}$$

Hastings (1970)

Hastings ratio

$$\left(\frac{2}{3}\right)(1) = \frac{2}{3}$$



$$\left(\frac{1}{3}\right)(1) = \frac{1}{3}$$

Hastings (1970)

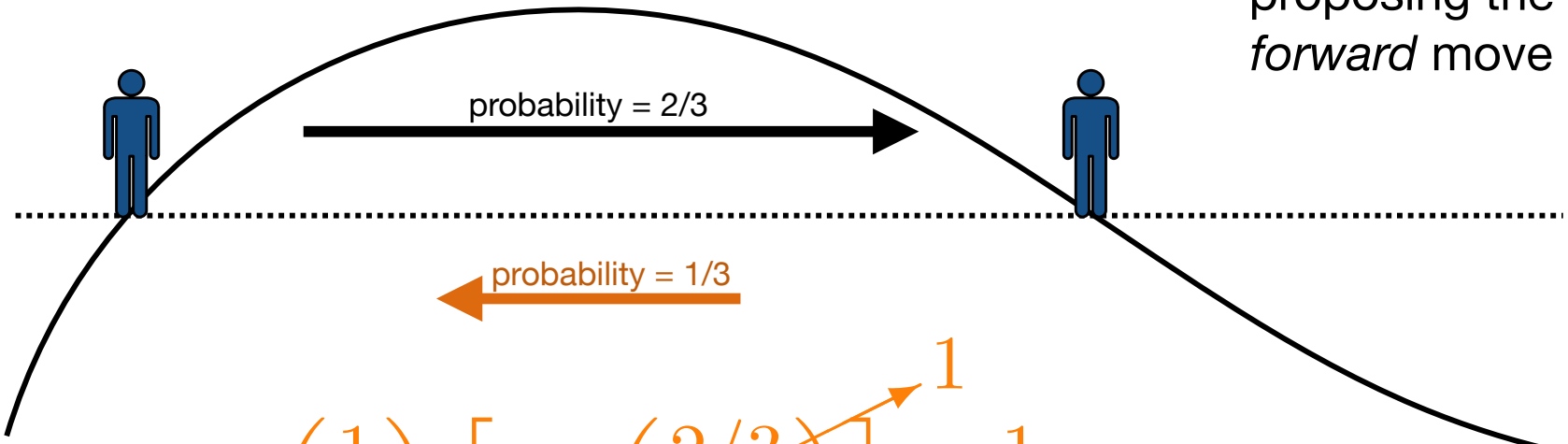
Hastings ratio

$$\left(\frac{2}{3}\right)\left[(1)\left(\frac{1/3}{2/3}\right)\right] = \frac{1}{3}$$

reverse move

forward move

The Hastings ratio is the ratio of the probability of proposing the *reverse* move to the probability of proposing the *forward* move



$$\left(\frac{1}{3}\right)\left[(1)\left(\frac{2/3}{1/3}\right)\right] = \frac{1}{3}$$

1

Hastings (1970)

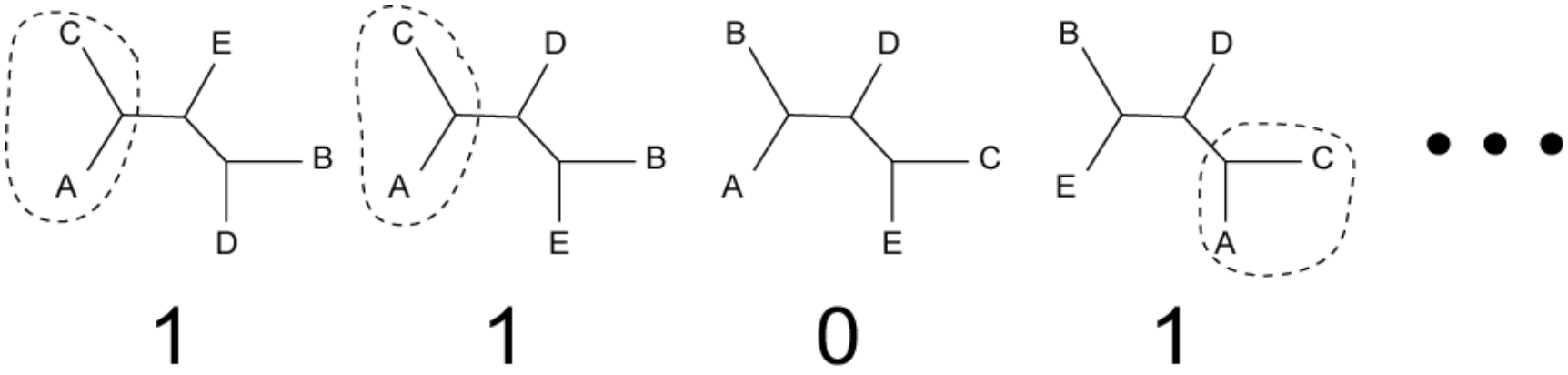
Metropolis-Hastings Algorithm

$$\min\left\{\left[\frac{p(D|\theta^*)\ p(\theta^*)}{p(D|\theta)\ p(\theta)}\right]\left[\frac{q(\theta|\theta^*)}{q(\theta^*|\theta)}\right], 1\right\}$$

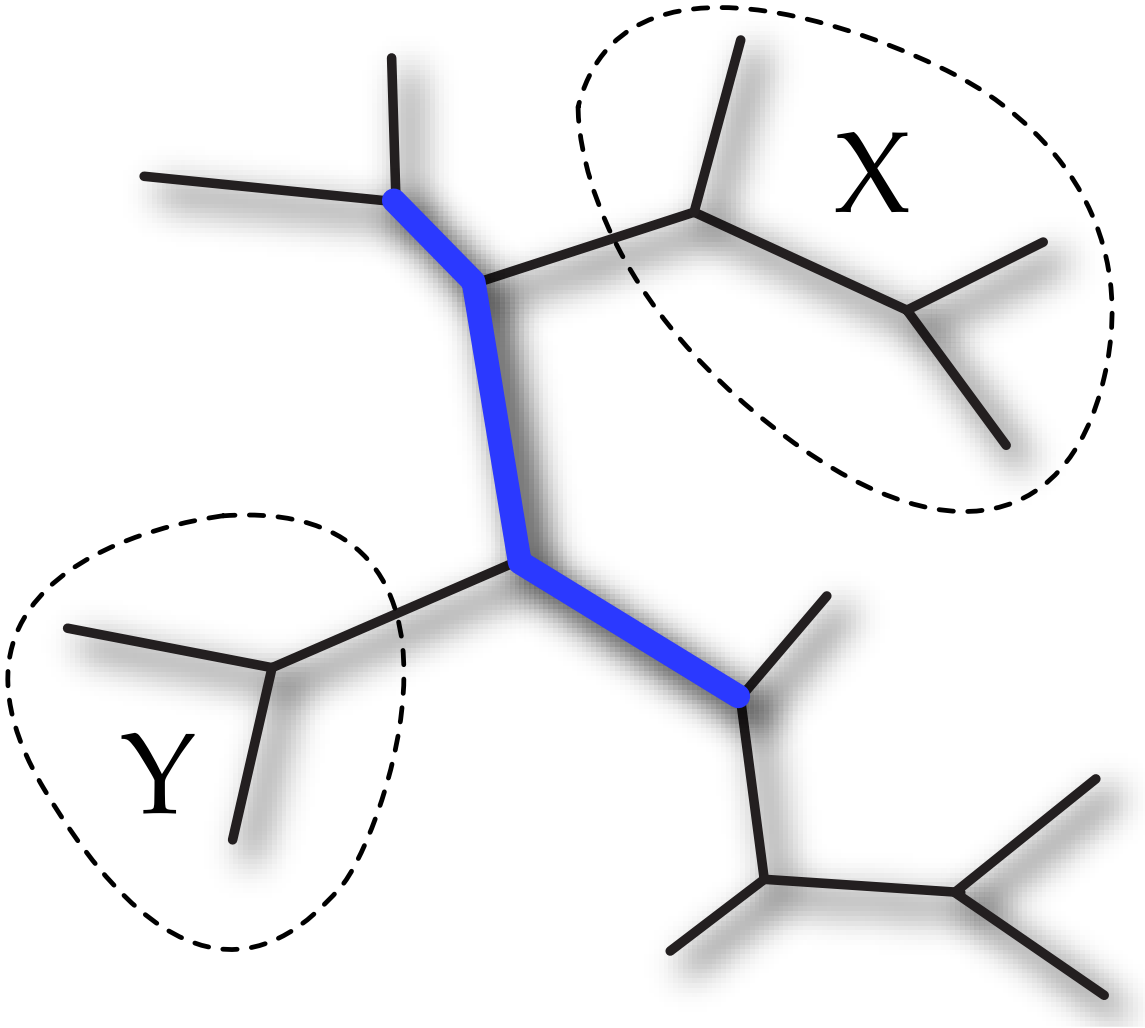
posterior ratio (*R*) Hastings ratio

Hastings (1970)

So, what's all this got to do with phylogenetics?



Moving through treespace

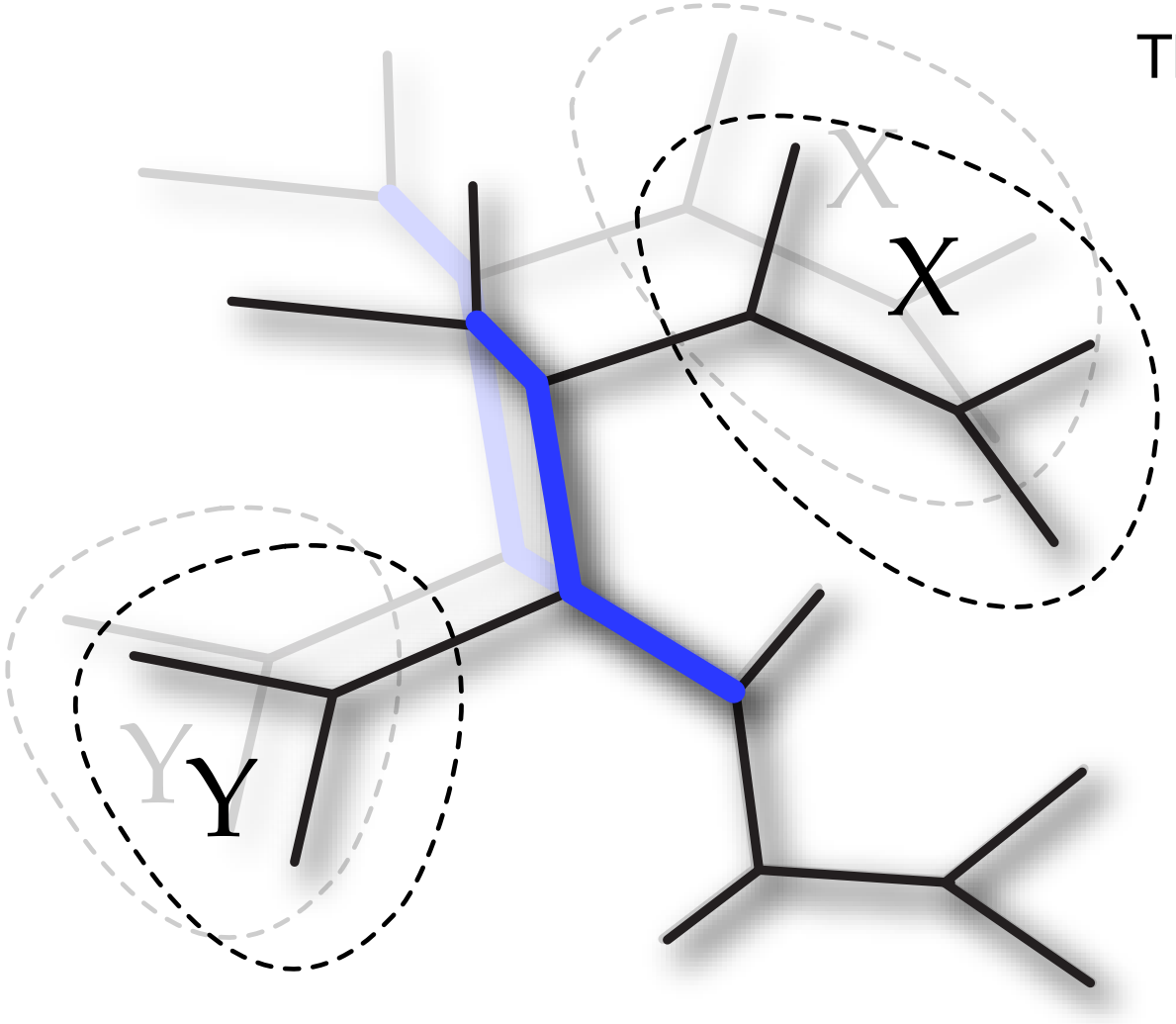


The Larget-Simon move

Step 1:
Pick 3 contiguous edges randomly, defining two subtrees, X and Y

Larget and Simon (1999)

Moving through treespace



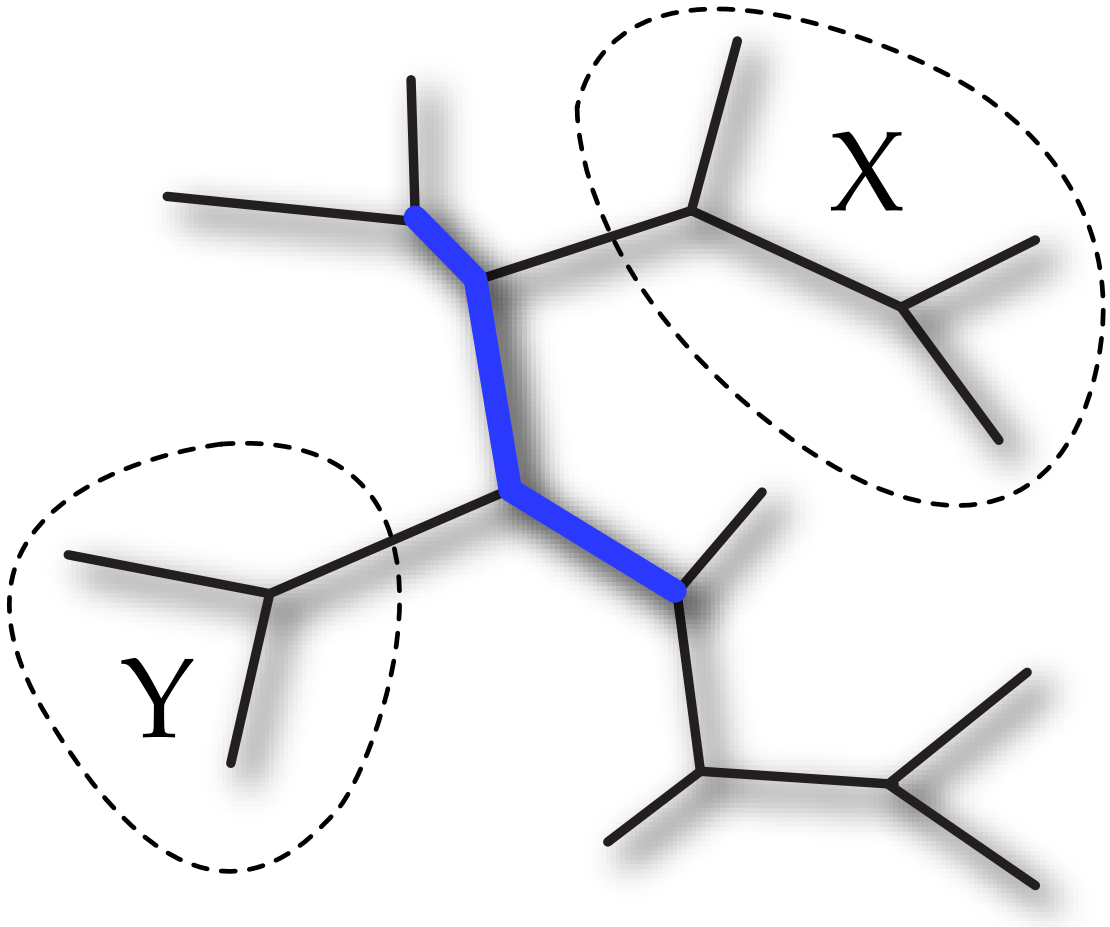
The Larget-Simon move

Step 1:
Pick 3 contiguous edges randomly, defining two subtrees, X and Y

Step 2:
Shrink or grow selected 3-edge segment by a random amount

Larget and Simon (1999)

Moving through treespace



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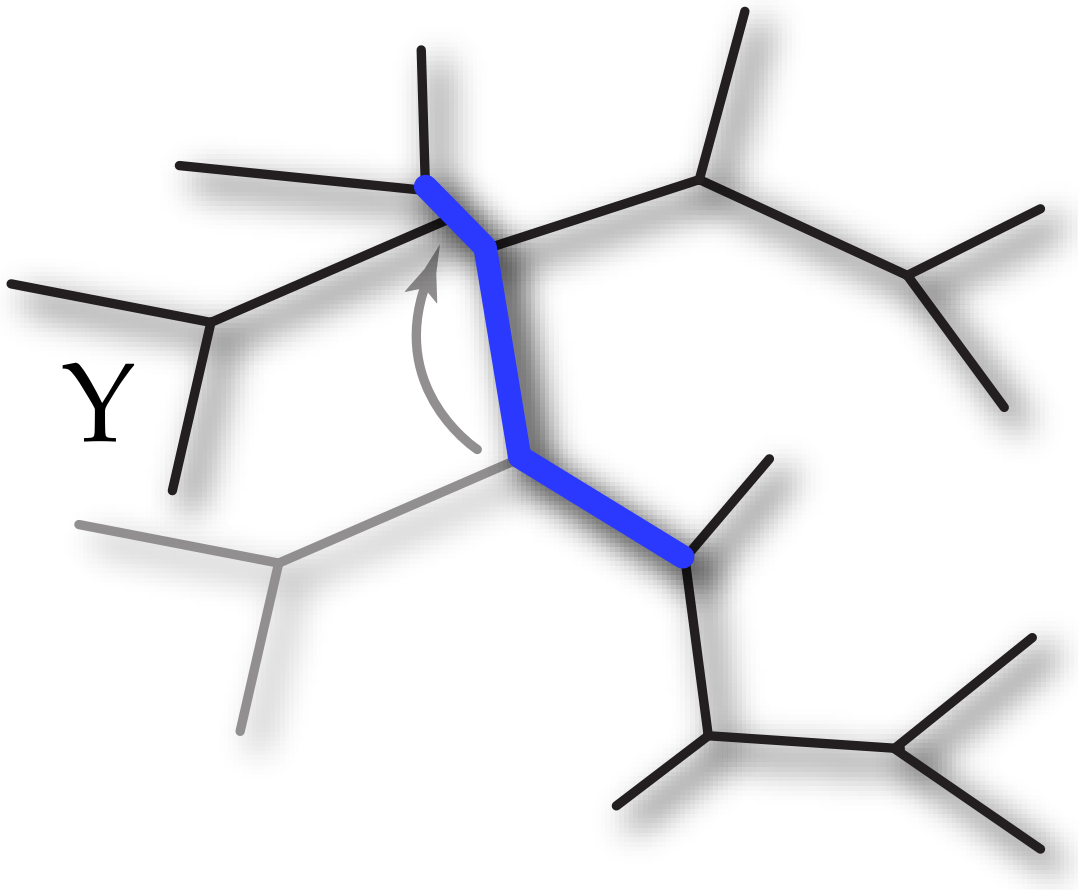


The Larget-Simon move

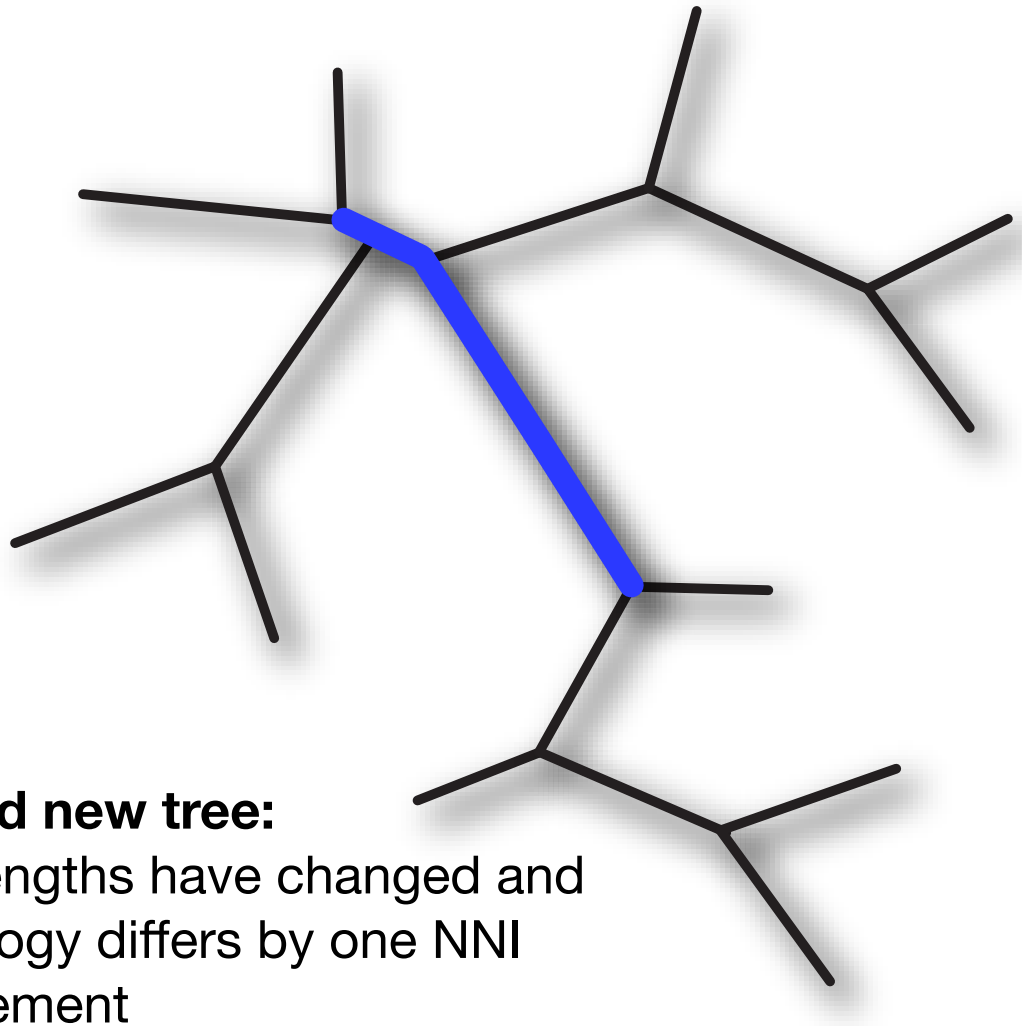
Step 1:
Pick 3 contiguous edges randomly, defining two subtrees, X and Y

Step 2:
Shrink or grow selected 3-edge segment by a random amount

Step 3:
Choose X or Y randomly, then reposition randomly

Larget and Simon (1999)

Moving through treespace



Proposed new tree:
3 edge lengths have changed and the topology differs by one NNI rearrangement

The Larget-Simon move

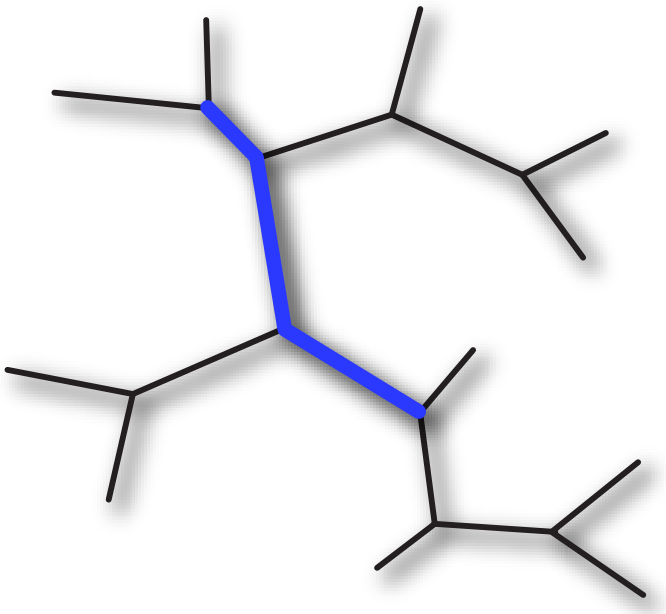
Step 1:
Pick 3 contiguous edges randomly, defining two subtrees, X and Y

Step 2:
Shrink or grow selected 3-edge segment by a random amount

Step 3:
Choose X or Y randomly, then reposition randomly

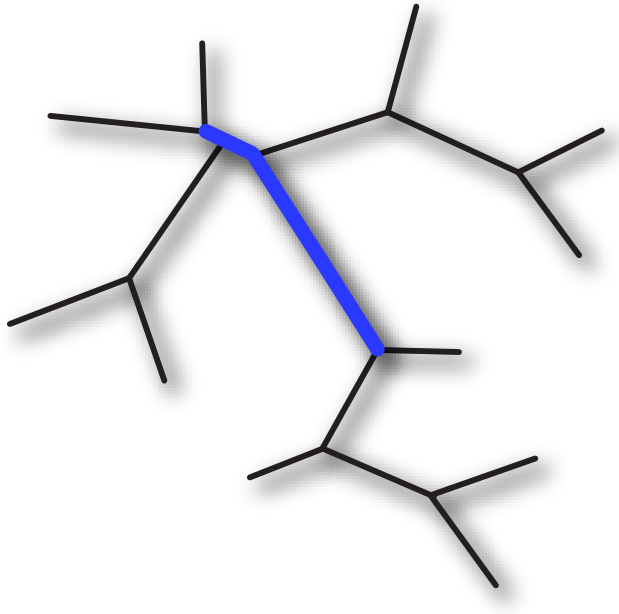
Larget and Simon (1999)

Moving through treespace



Current tree

log-posterior = -34256



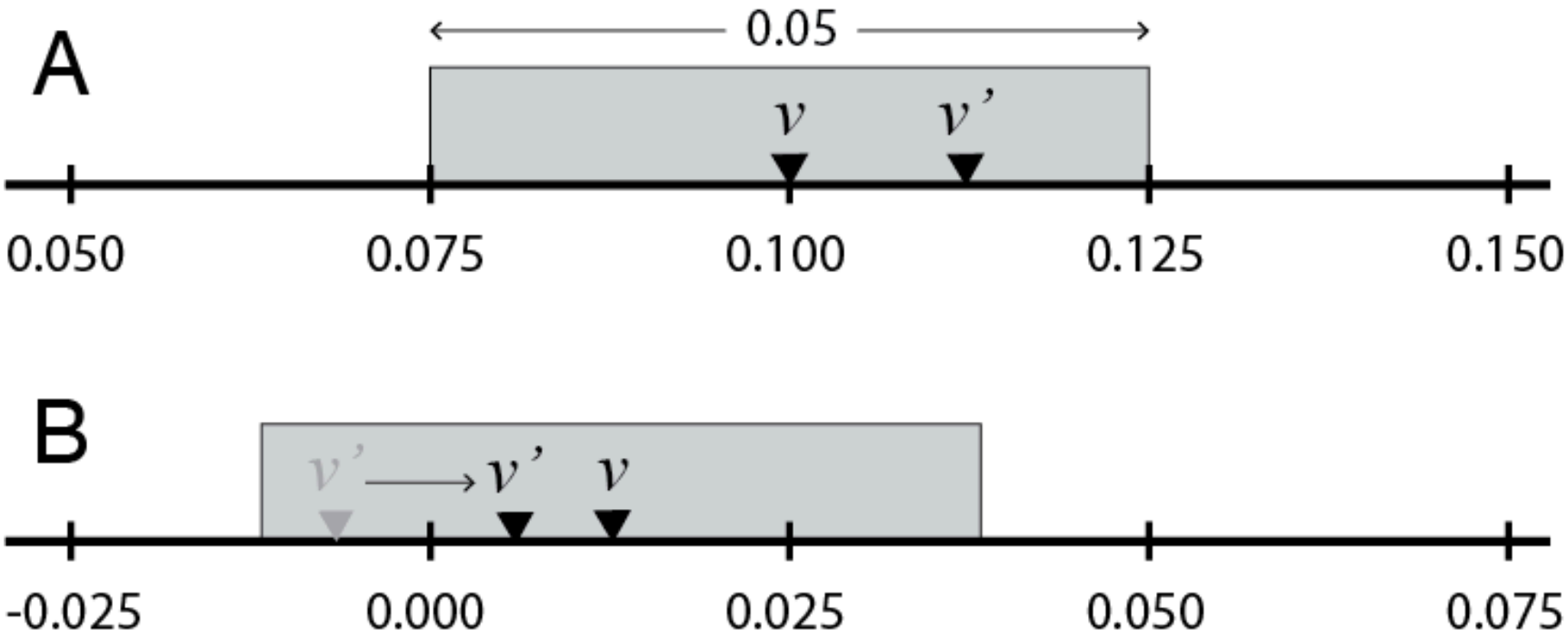
Proposed tree

log-posterior = -32519

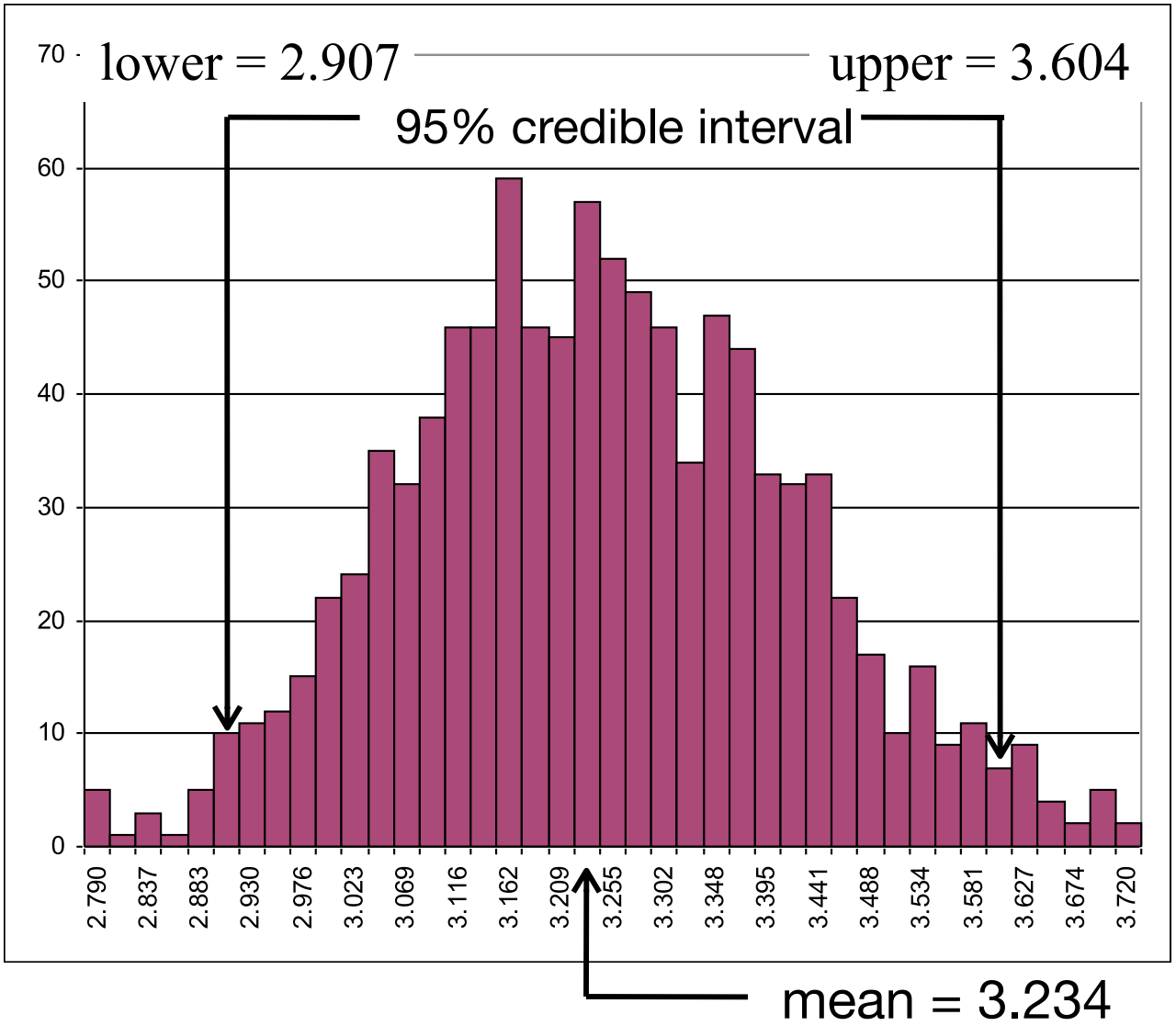
(better, so accept)

Larget and Simon (1999)

Proposing a new value of a model parameter



Marginal Posterior Distribution of κ



Histogram created from a sample of 1000 kappa values.

Kernel Density Estimation

Estimate density function using sampled points