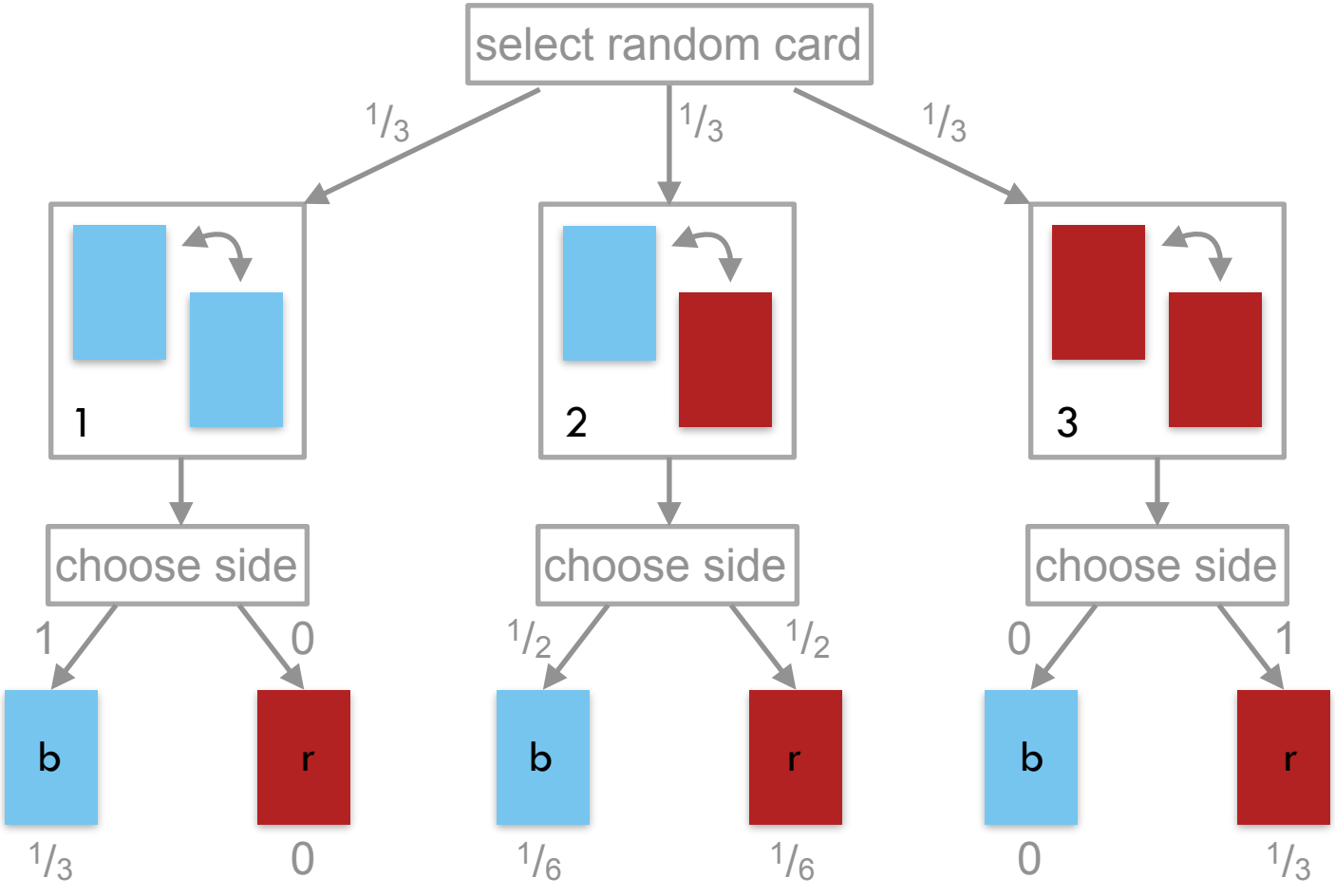
Replication, Preregistration & Open Science

Why most published research findings are false

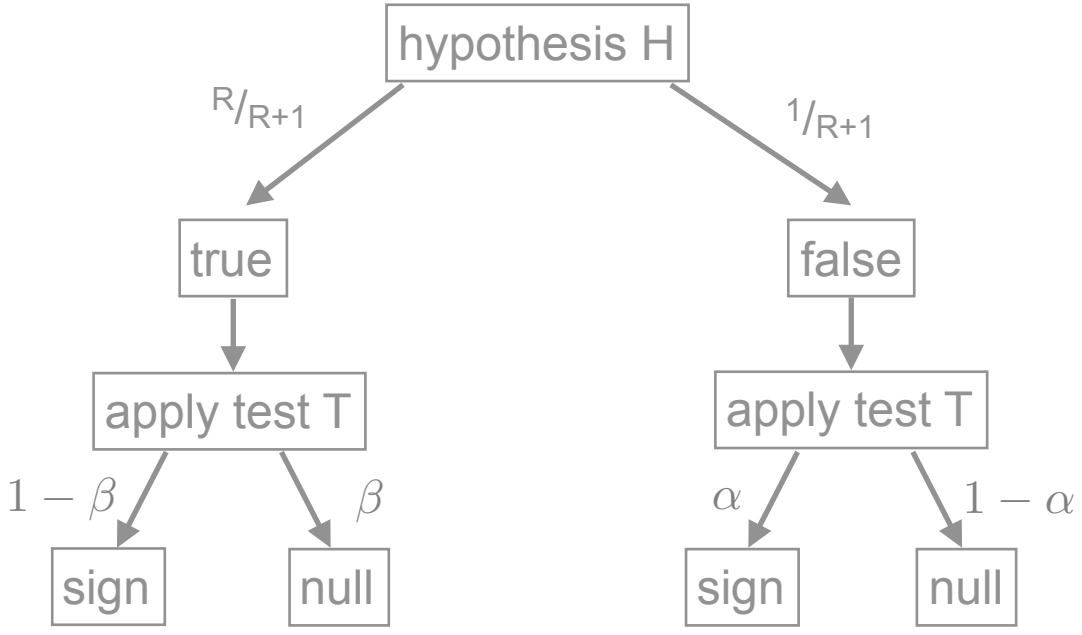

select random card
1/3
1/3
1/3
1
2
3
choose side
choose side
choose side
1
0
1/2
1/2
0
1
b
r
b
r
b
r
1/3
0
1/6
1/6
0
1/3

$$P(Card = i)$$

$$P(Obs = j \mid Card = i)$$

$$P(Obs = j \mid Card = i)P(Card = i)$$

$$\begin{aligned} P(Card = 1 \mid Obs = b) &= \frac{P(Obs = b \mid Card = 1)P(Card = 1)}{P(Obs = b)} \\ &= \frac{P(Obs = b \mid Card = 1)P(Card = 1)}{\sum_i P(Obs = b \mid Card = i)P(Card = i)} \\ &= \frac{\frac{1}{3}}{\frac{1}{2}} = \frac{2}{3} \end{aligned}$$



$P(H)$

$P(T \mid H)$

Positive predictive value

$$P(H = t \mid T = s) = \frac{P(T = s \mid H = t)P(H = t)}{P(T = s)}$$

$$= \frac{R(1-\beta)}{R(1-\beta)+\alpha}$$

"probability that the hypothesis is true, given a significant test result"

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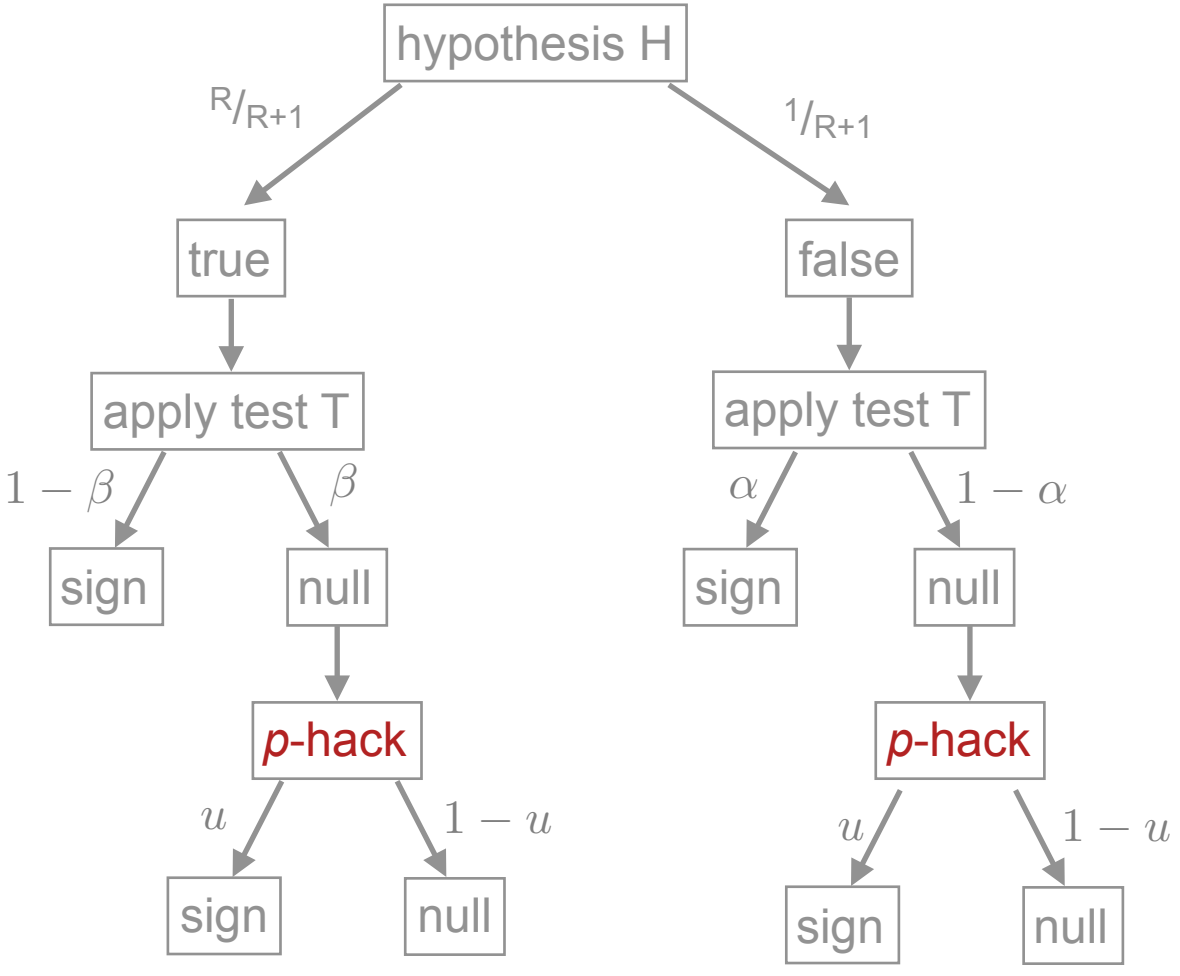
"probability that the hypothesis is true, given a significant test result"

example:

$R = 1, \quad \beta = 0.2, \quad \alpha = 0.05$

$$P(H = t \mid T = s) = \frac{0.8}{0.85} \approx 0.94$$



p-hacking ::: combination of design/presentation/analysis factors that favor a significant test result beyond the normal alpha level

Positive predictive value

$$P(H = t \mid T = s) = \frac{R(1-\beta) + u\beta R}{R(1-\beta) + u\beta R + \alpha + u(1-\alpha)}$$

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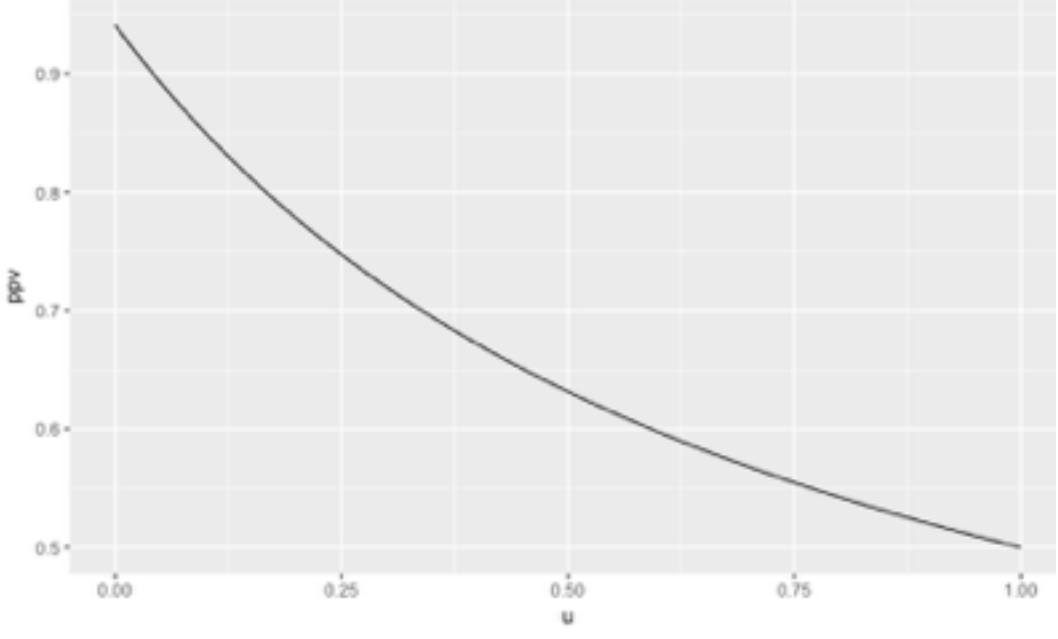

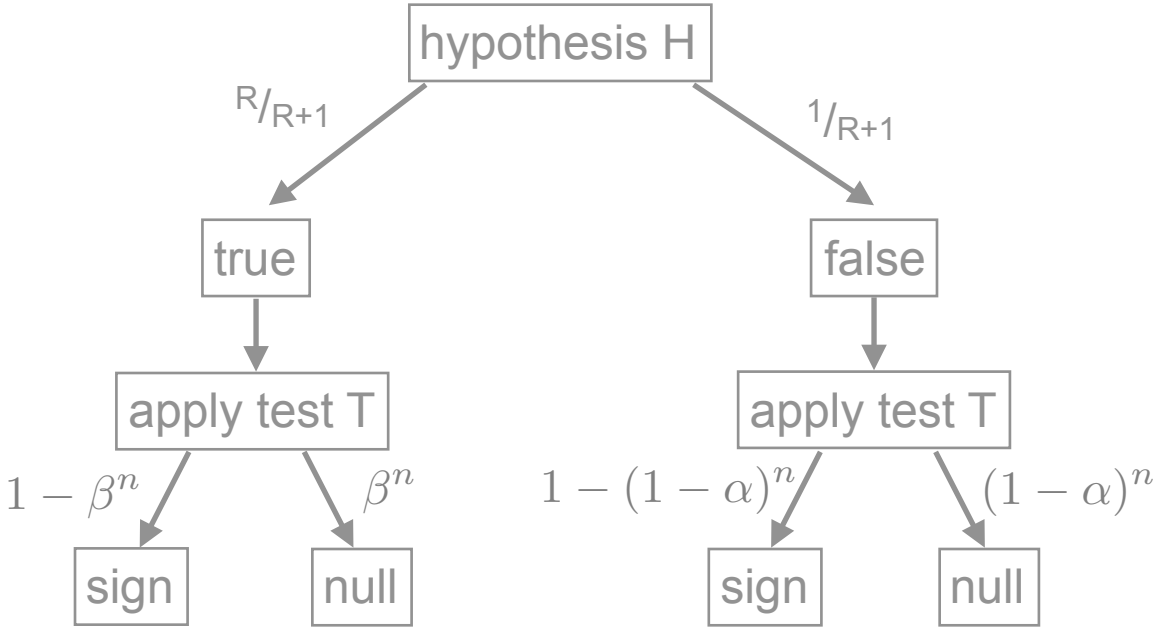

p-fishing ::: reporting at least one significant test results from *n* (equally powered) studies

Positive predictive value

$$P(H = t \mid T = s) = \frac{R(1-\beta^n)}{R+1-(1-\alpha)^n - R\beta^n}$$

p-fishing ::: reporting at least one significant test results from *n* (equally powered) studies

example:

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