

Statistics with Spa OWS

Lecture 6

Julia Schroeder

Julia.schroeder@imperial.ac.uk

Outline

- Influence of df on test
- Hypothesis testing

Influence of df on t-test:

```
> t.test(d1$Tarsus~d1$Sex,na.rm=TRUE)
```

Welch Two Sample t-test

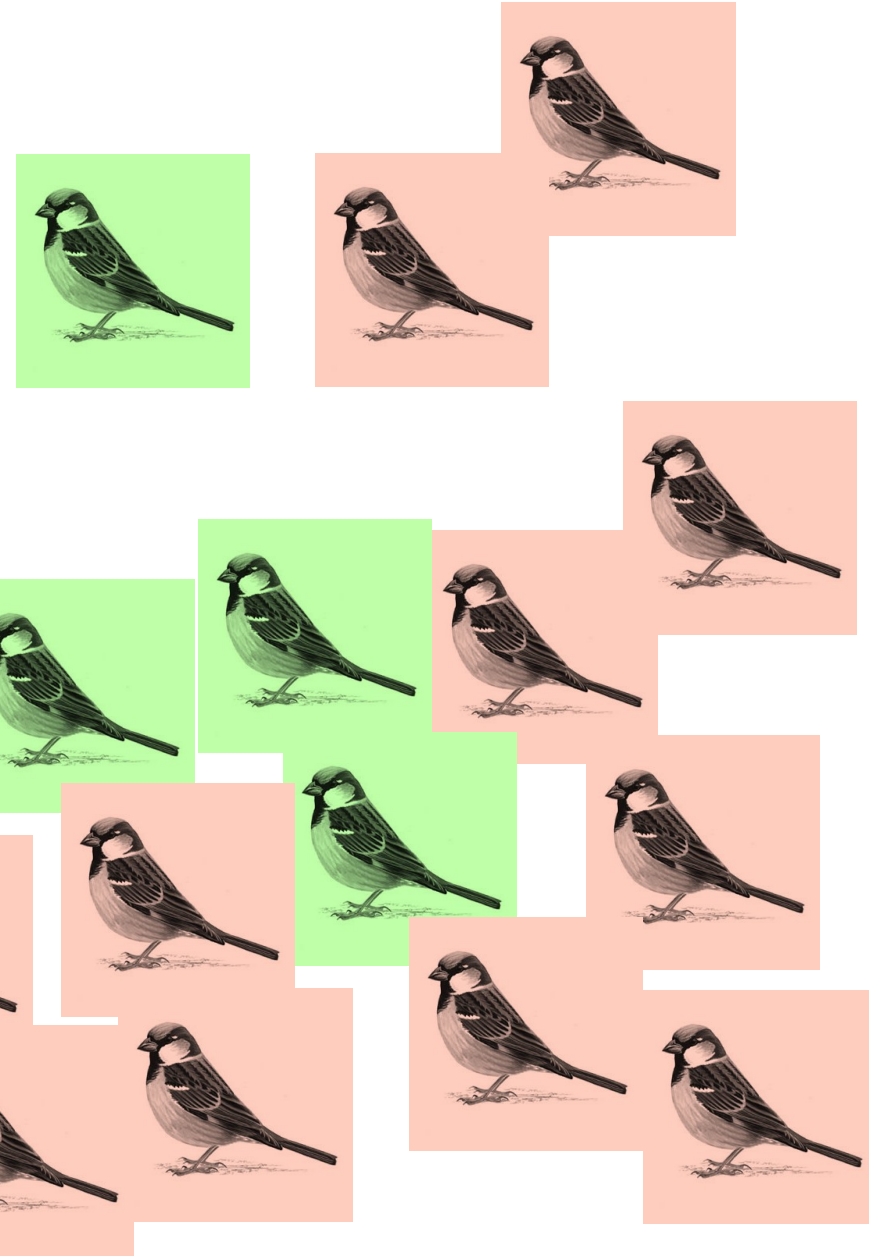
```
data: d1$Tarsus by d1$Sex
t = 1.2257, df = 139.07, p-value = 0.2224
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.1012318  0.4314949
sample estimates:
mean in group 0 mean in group 1
 18.27763      18.11250
```

```
> t.test(d$Tarsus~d$Sex,na.rm=TRUE)
```

Welch Two Sample t-test

```
data: d$Tarsus by d$Sex
t = -3.7382, df = 1677.4, p-value = 0.0001916
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.23814658 -0.07424028
sample estimates:
mean in group 0 mean in group 1
 18.44317      18.59936
```

```
> |
```



Influence of df on t-test:

```
> t.test(d1$Tarsus~d1$Sex,na.rm=TRUE)
```

Welch Two Sample t-test

data: d1\$Tarsus by d1\$Sex

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Welch Two Sample t-test

data: d\$Tarsus by d\$Sex

t = -3.7382, df = 1677.4, p-value = 0.0001916

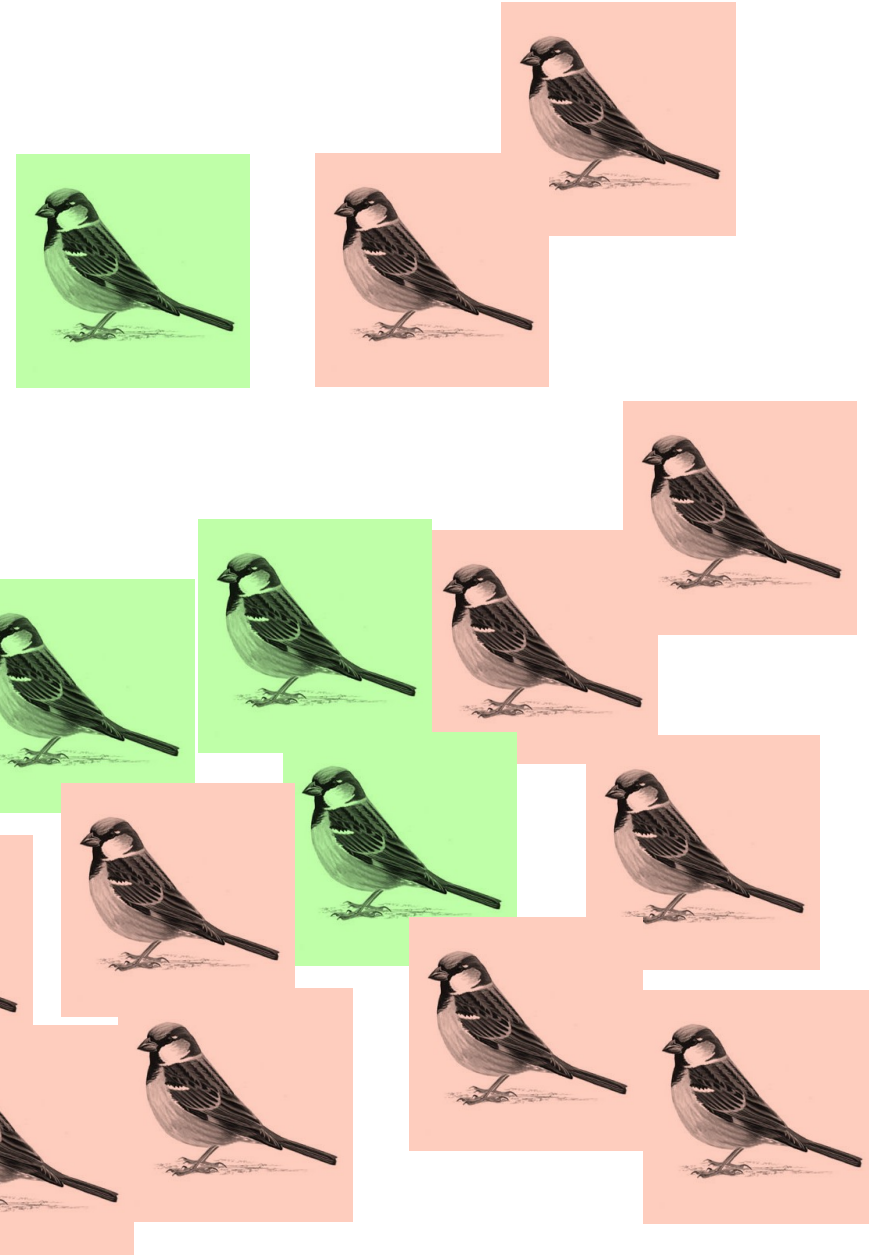
alternative hypothesis: true difference in means is not equal to 0

95 percent confidence interval:

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Influence of df (n) on t-test:

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```

Welch Two Sample t-test

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95 percent confidence interval:
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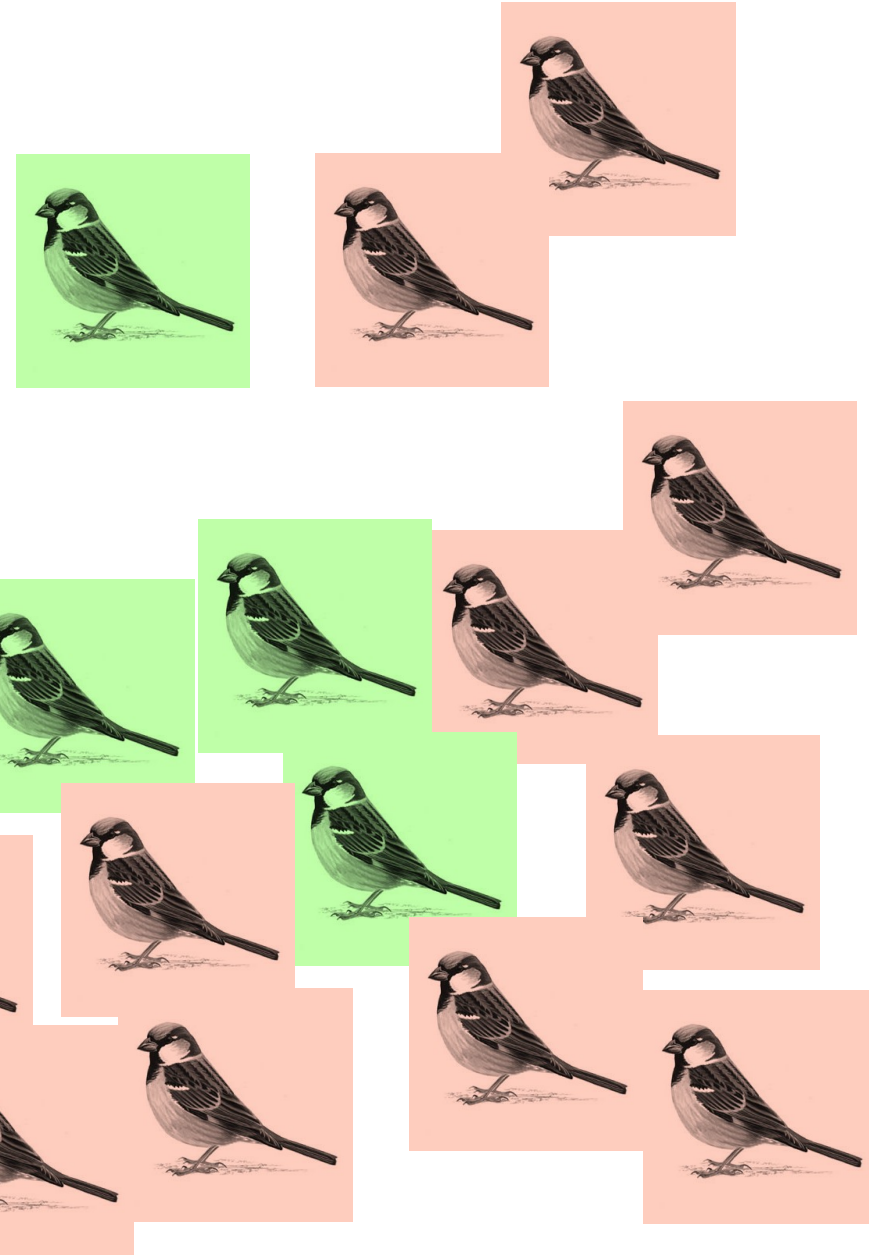
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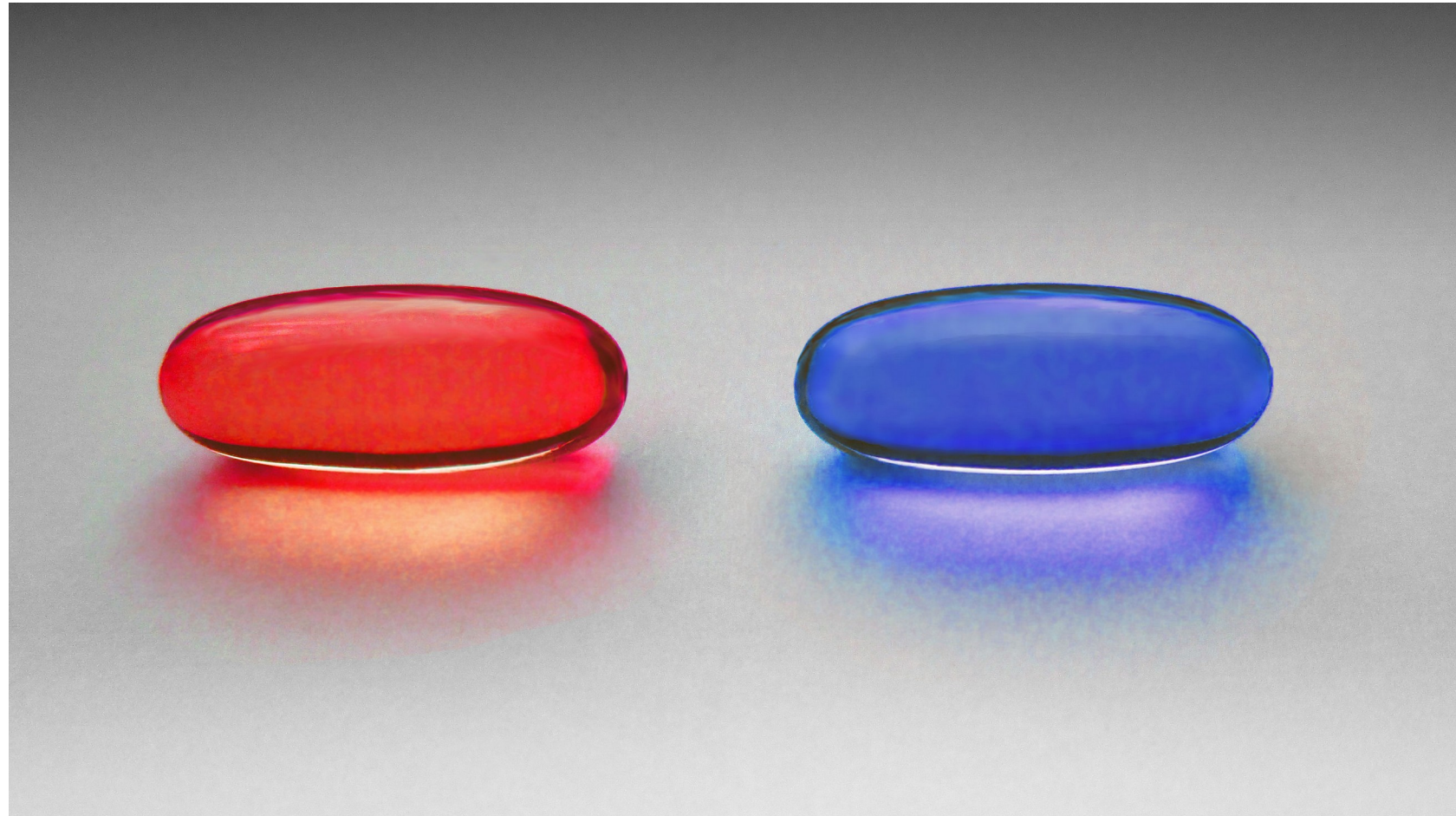
Wait, what?

- Let's digress for a moment...



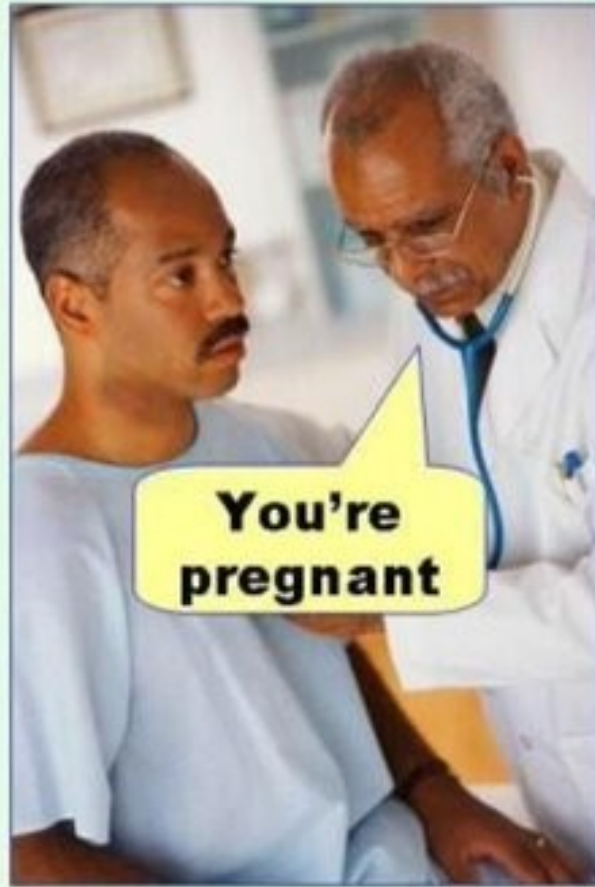
What does this mean?

- What is real and what is an illusion?
- Decision errors

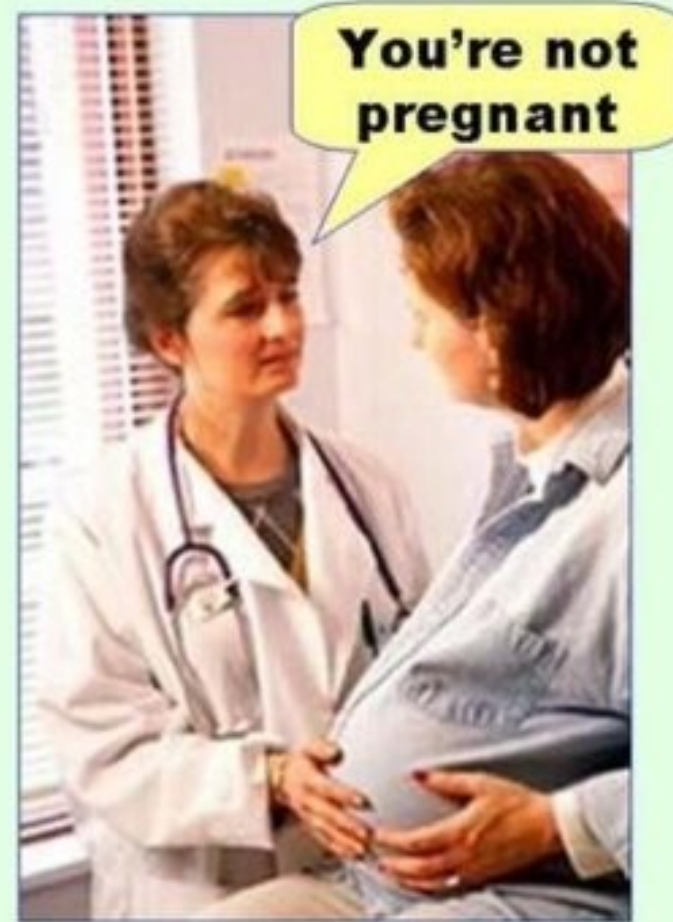


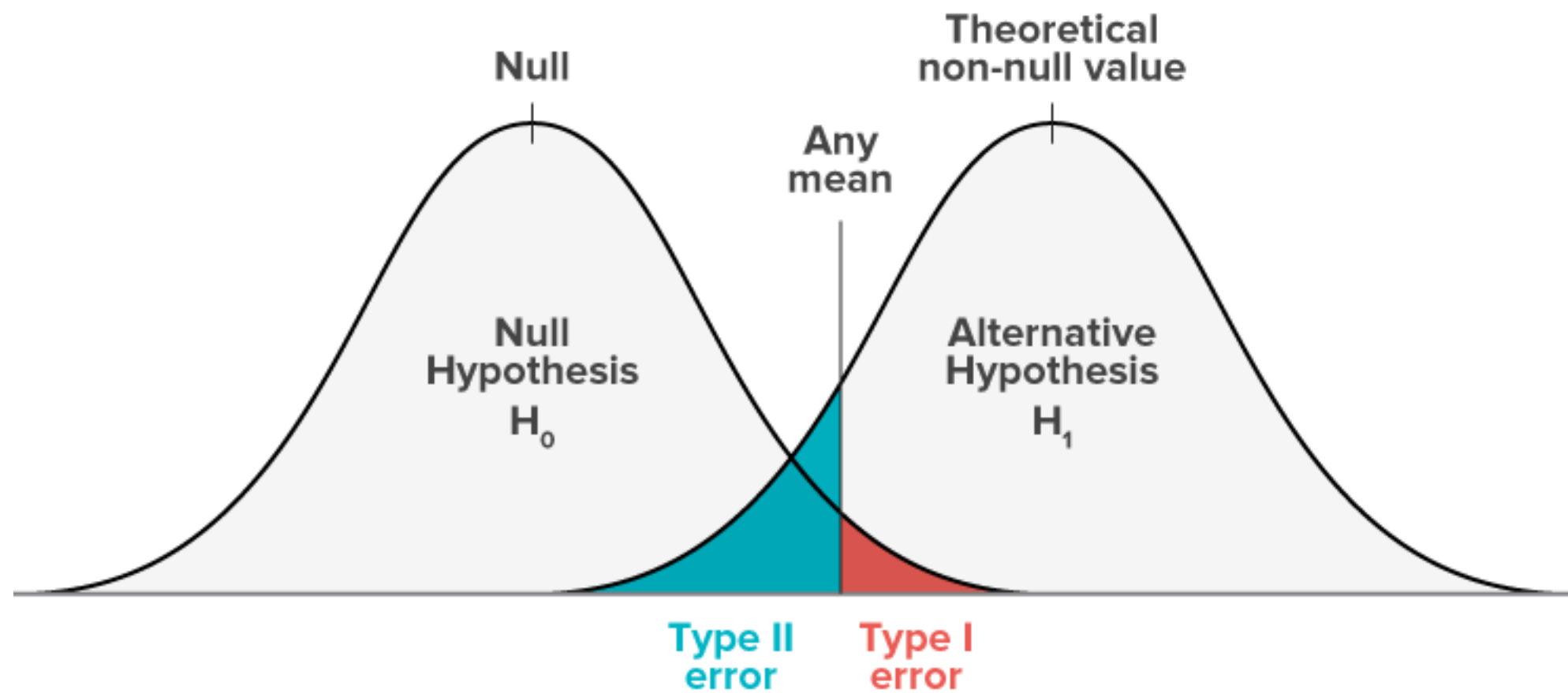
H0	Reality	Illusion
rejected	Effect detected Effect exists	Type I error Effect detected, but does not exist
accepted	No effect detected No effect exists	Type II error No effect detected, but it exists

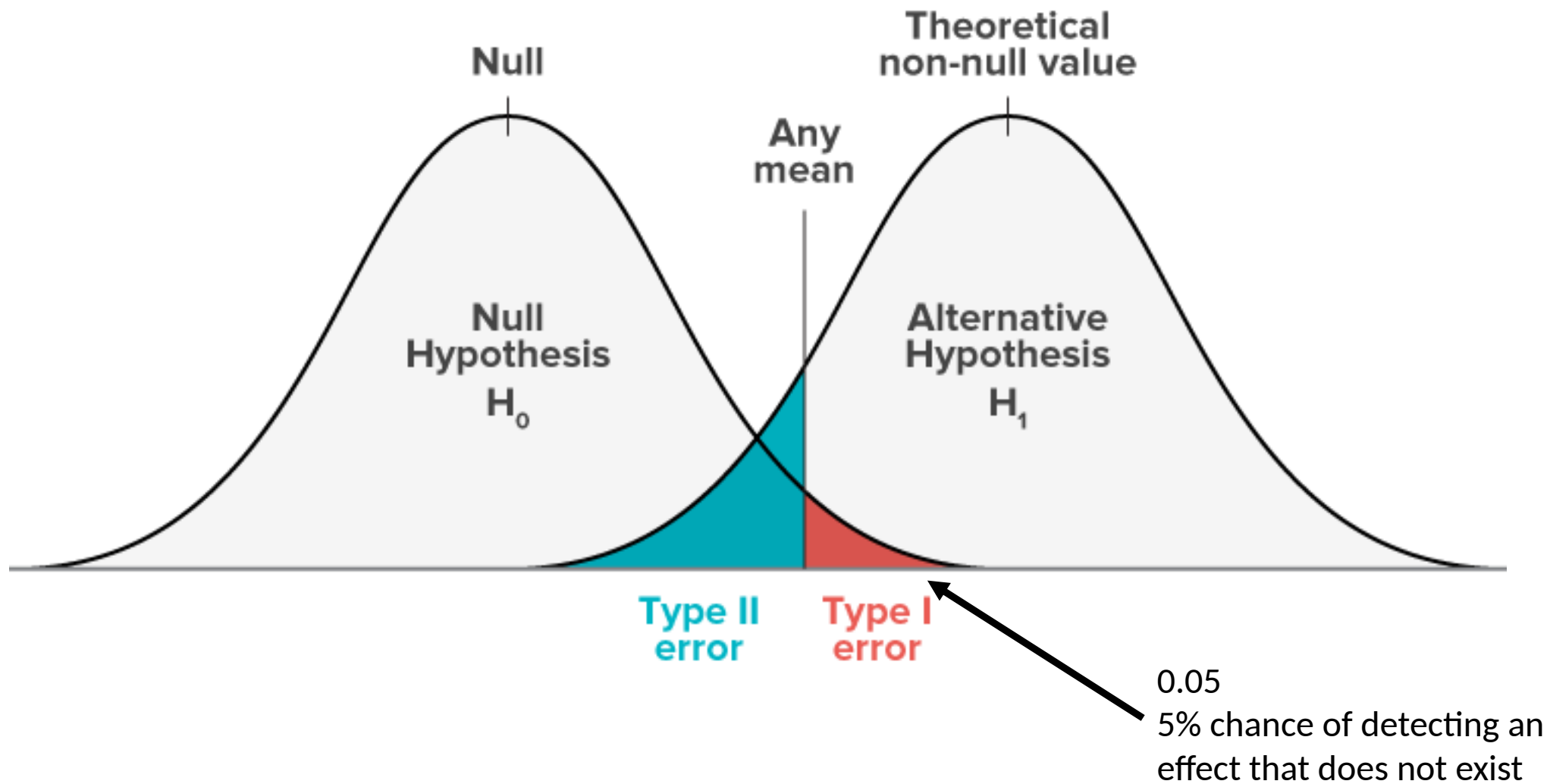
Type I error
(false positive)

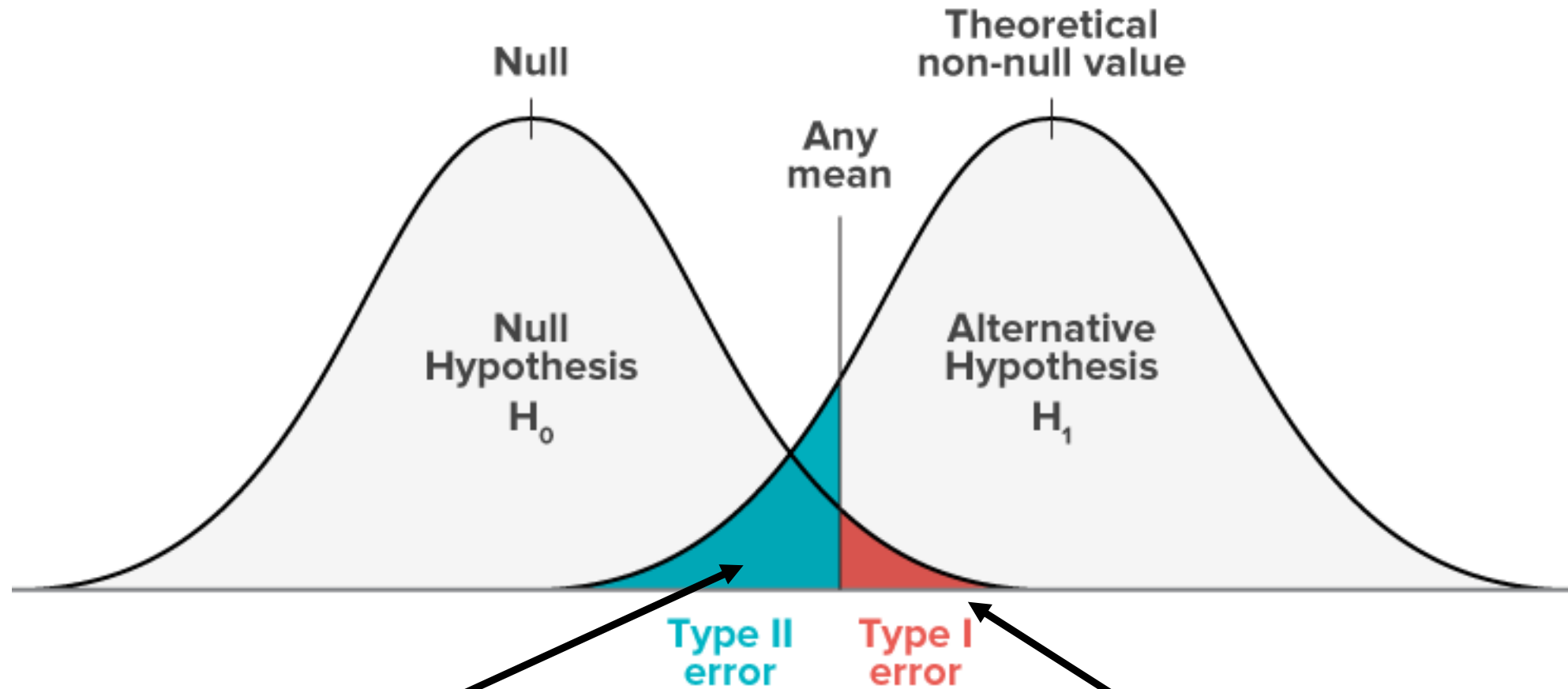


Type II error
(false negative)









Type II effects depend on statistical power
The bigger the sample size, the smaller the chance for type II errors

0.05
5% chance of detecting an effect that does not exist

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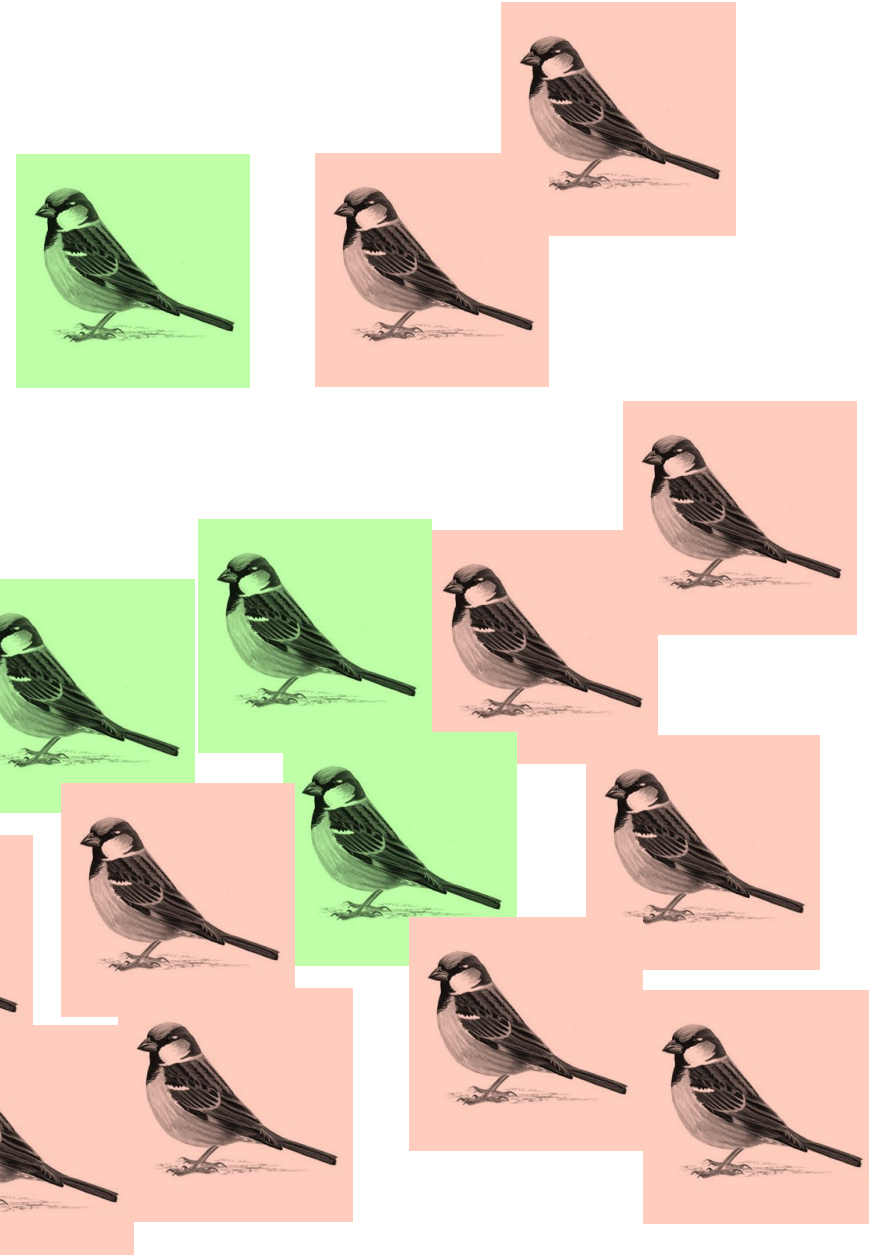
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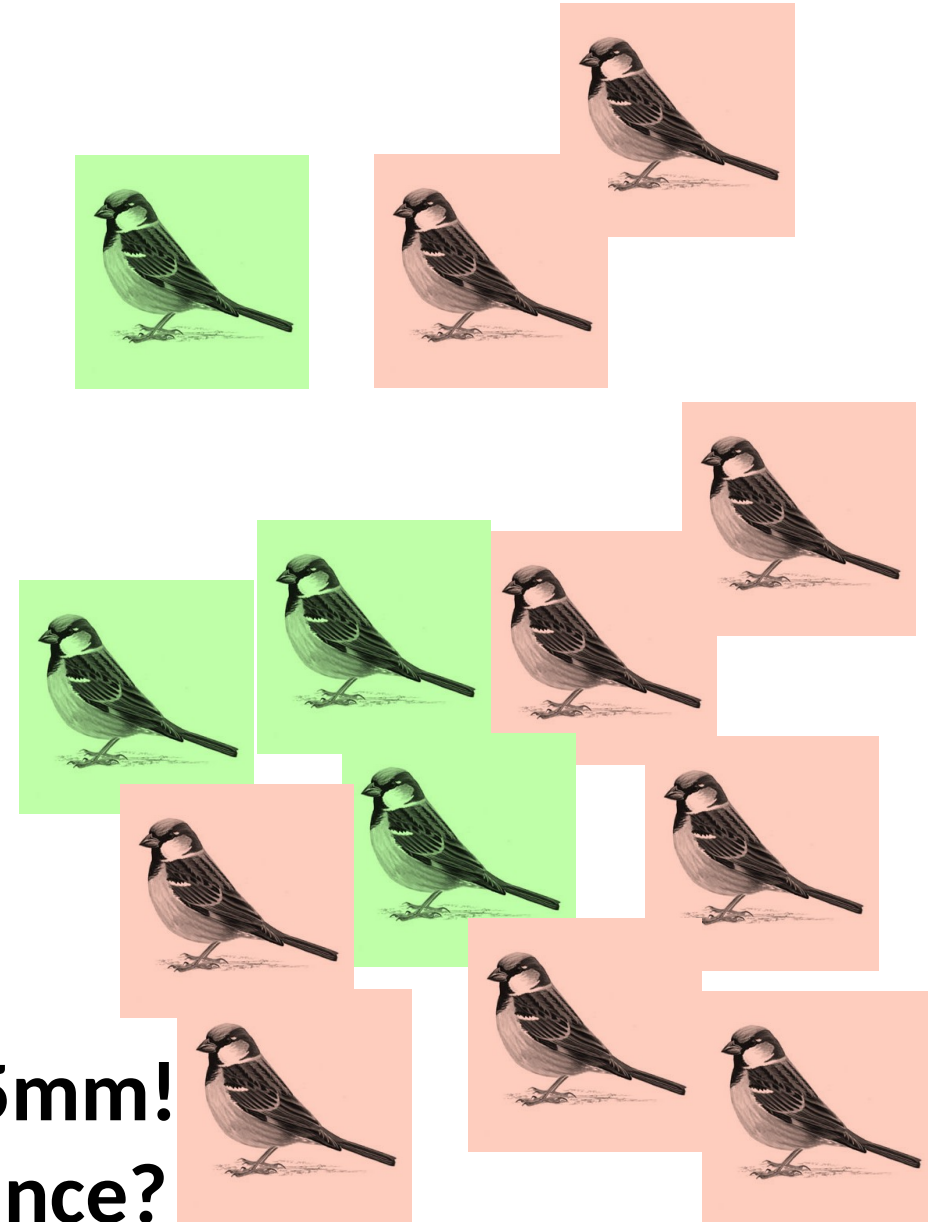
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**Difference of 0.5mm!
Biological relevance?**

Statistical power

- Probability to detect an effect of specific size
- What effect size do you need?
- What effect size is biological meaningful?

Statistical power

- To calculate statistical power you need
- Mean in each group (make one 0, the other difference. 0.16)
- N (sample size – we want to find that one out)
- Sd of combined groups 0.96
- Power level (usually 80% is ok)

Statistical power

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- Mean in each group (make one 0, the other difference. 0.16)
- N (sample size – we want to find that one out)
- Sd of combined groups 0.96
- Power level (usually 80% is ok = type II error chance 20%)

```
> library(pwr)  
> pwr.t.test(d=(0-0.16)/0.96,power=.8,sig.level=.05,type="two.sample",alternative="two.sided")
```

Two-sample t test power calculation

```
      n = 566.0799  
      d = 0.1666667  
sig.level = 0.05  
  power = 0.8  
alternative = two.sided
```

NOTE: n is number in *each* group

Statistical power

- To calculate statistical power you need
- Mean in each group (make one 0, the other difference. 0.16)
- N (sample size – we want to find that one out)
- Sd of combined groups 1
- Power level (usually 80% is ok = type II error chance 20%)

```
> library(pwr)  
> pwr.t.test(d=(0-0.16)/0.96,power=.8,sig.level=.05,type="two.sample",alternative="two.sided")
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Two-sample t test power calculation

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n = 566.0799  
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sig.level = 0.05  
power = 0.8  
alternative = two.sided
```

NOTE: n is number in *each* group

DO IT NOW – no handout!

- Download package “pwr”
- Run a power analysis to find out how large a sample of wing length data must be to detect a difference of an effect size of 5mm!

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- Download package “pwr”
- Run a power analysis to find out how large a sample of wing length data must be to detect a difference of an effect size of 5mm!
- effect size d = effect size you want to detect (difference between two means) = $5/sd$