

Statistics with SpaRRows

Lecture 6

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Outline

- Influence of df on test
- Hypothesis testing

Influence of df on t-test:

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

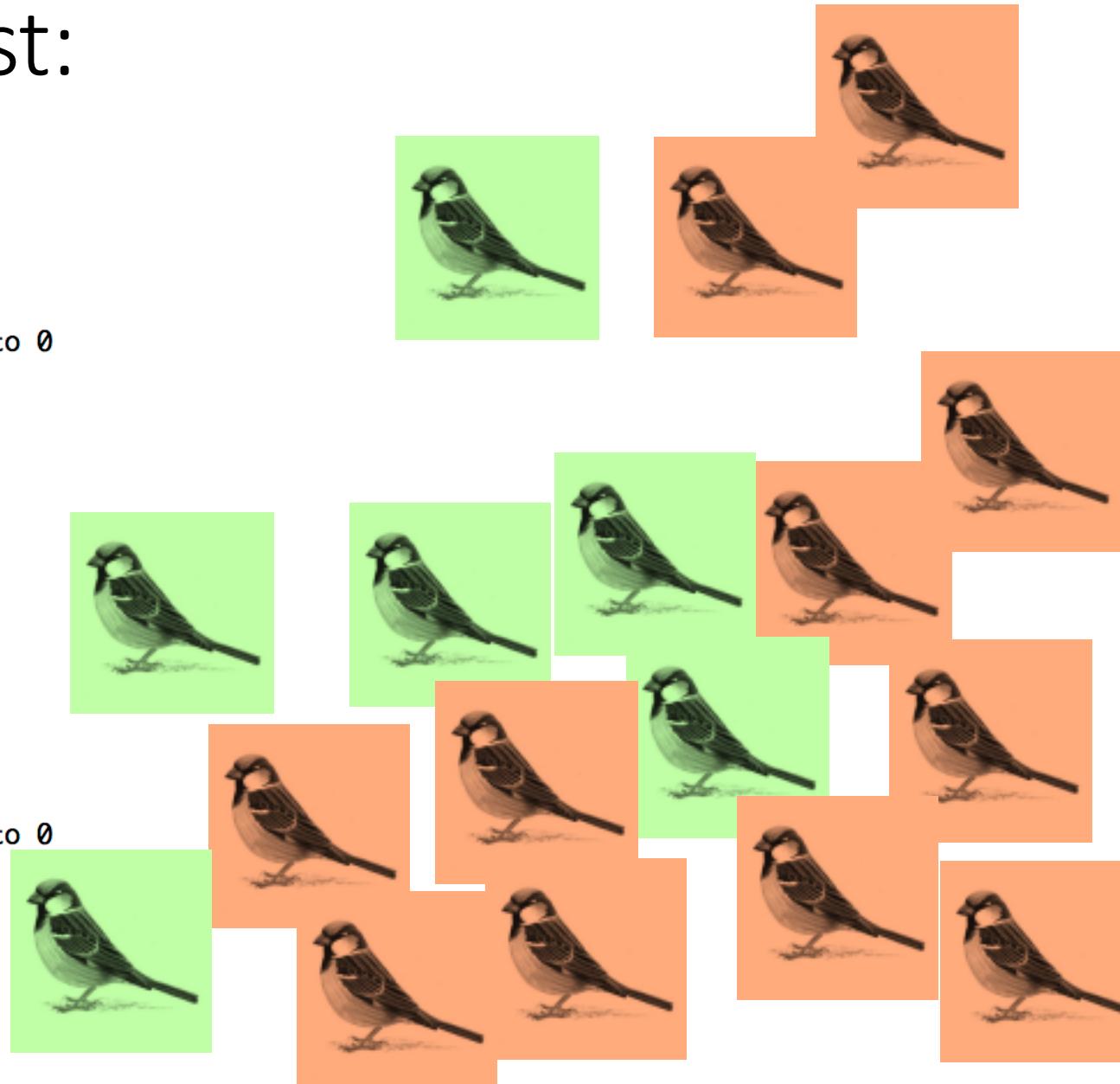
Welch Two Sample t-test

```
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:  
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Influence of df on t-test:

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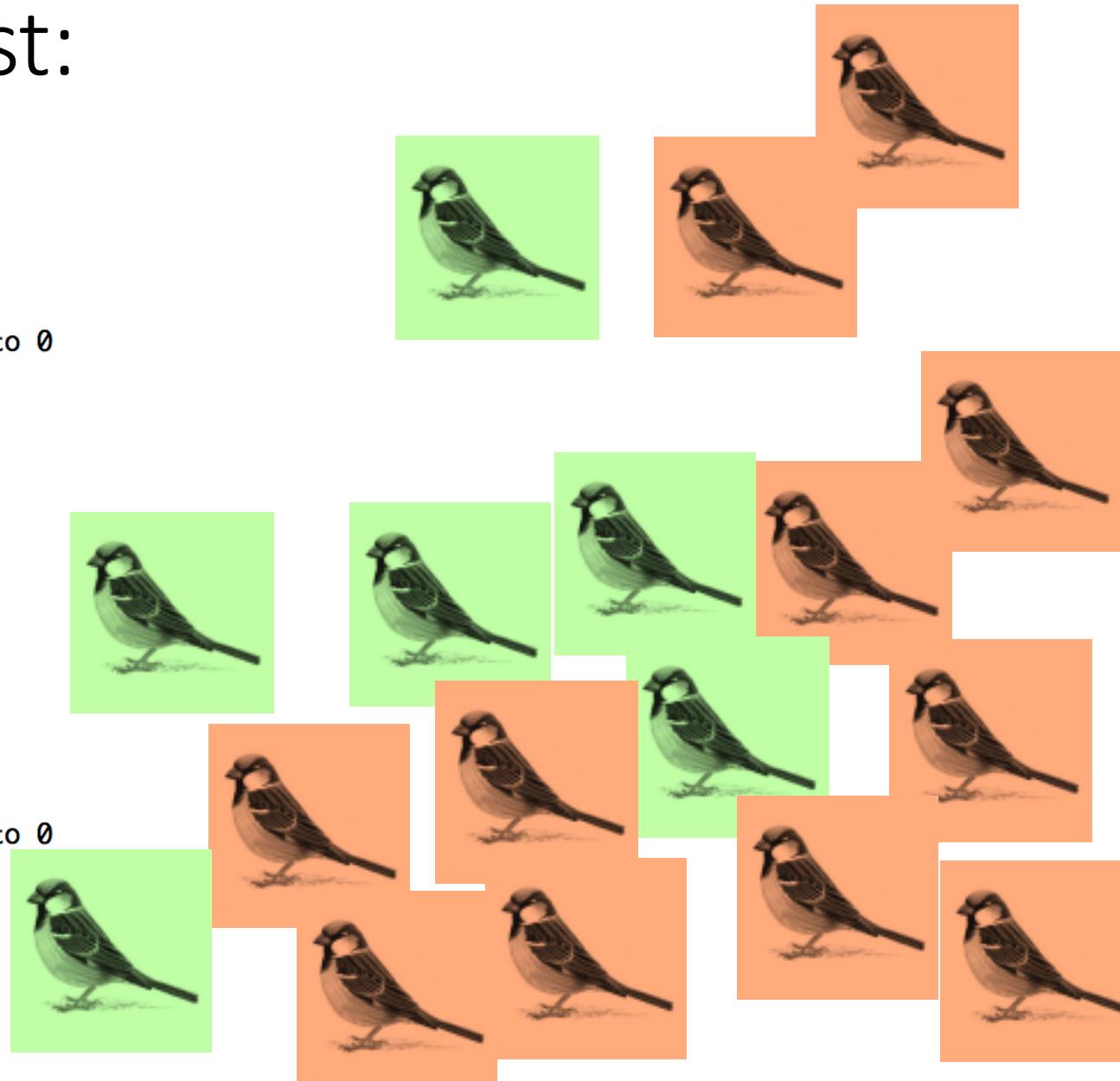
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Influence of $df(n)$ on t-test:

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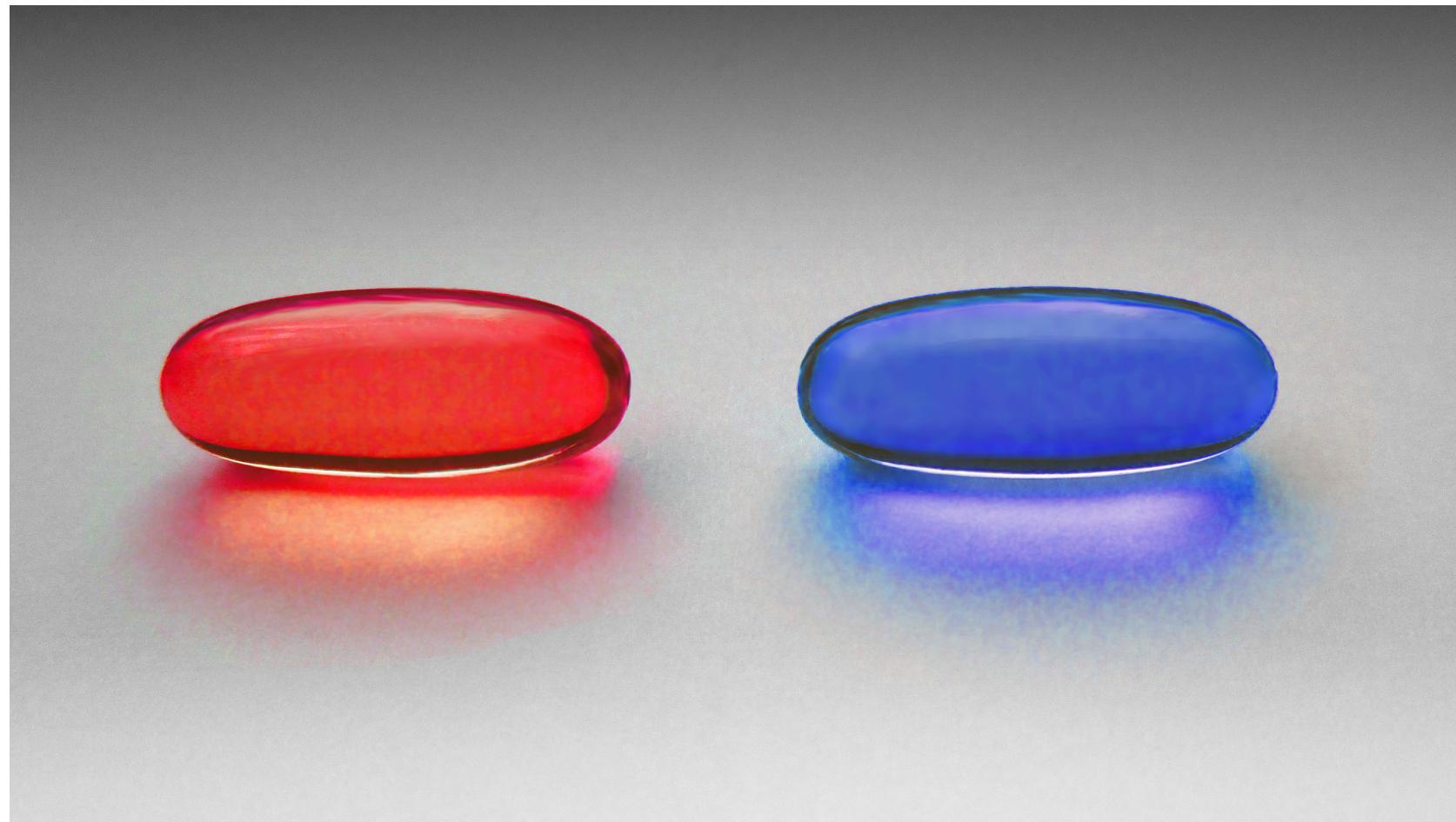
Wait, what?

- Let's digress for a moment...

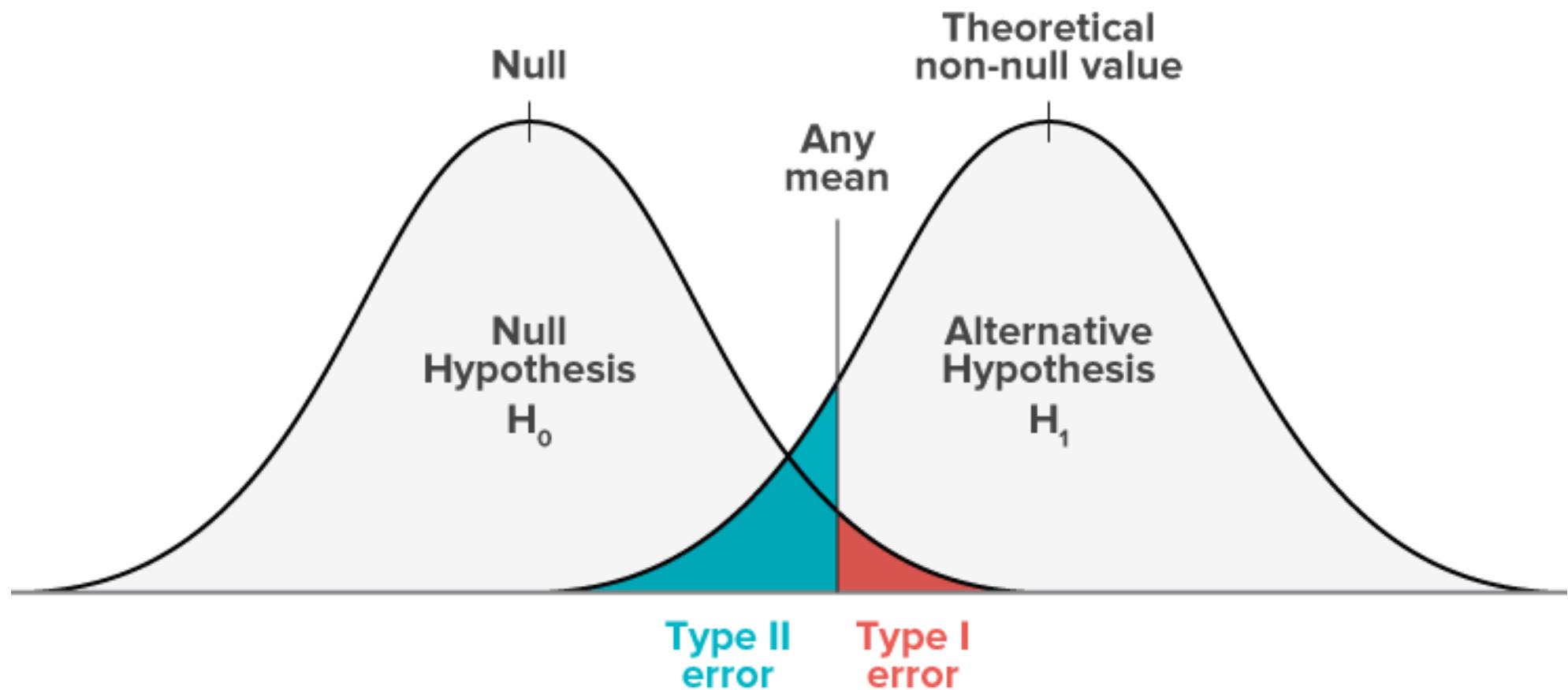


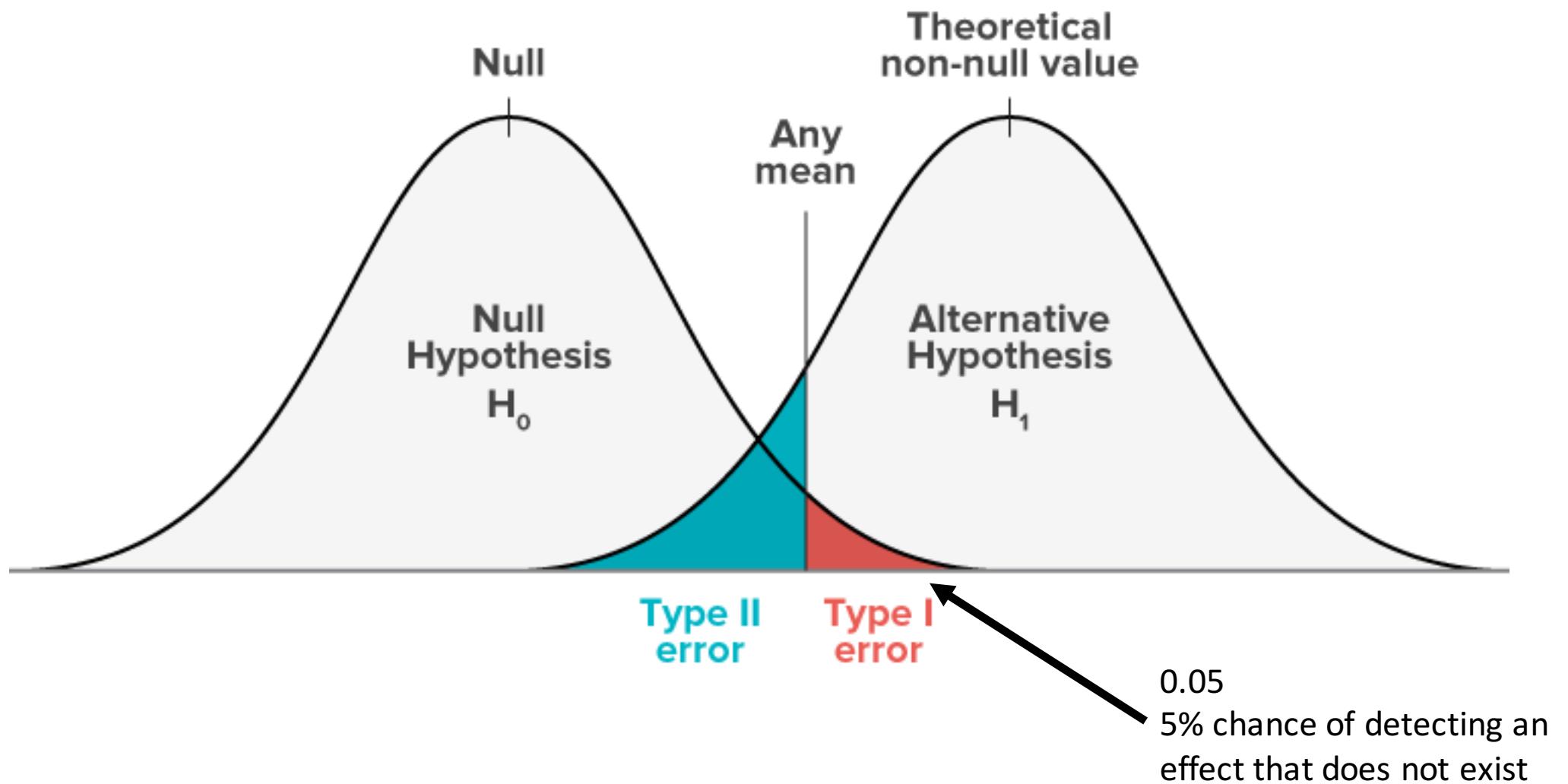
What does this mean?

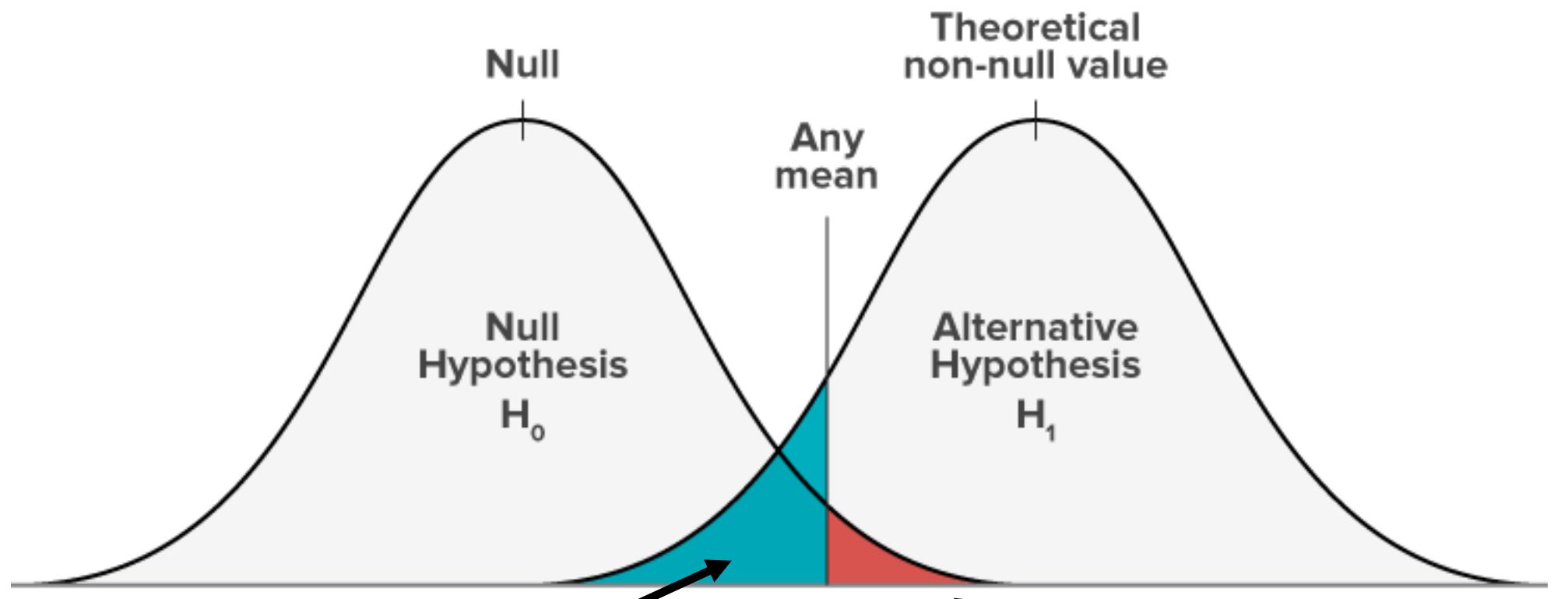
- What is real and what is an illusion?
- Decision errors



H_0	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 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

Influence of df on t-test:

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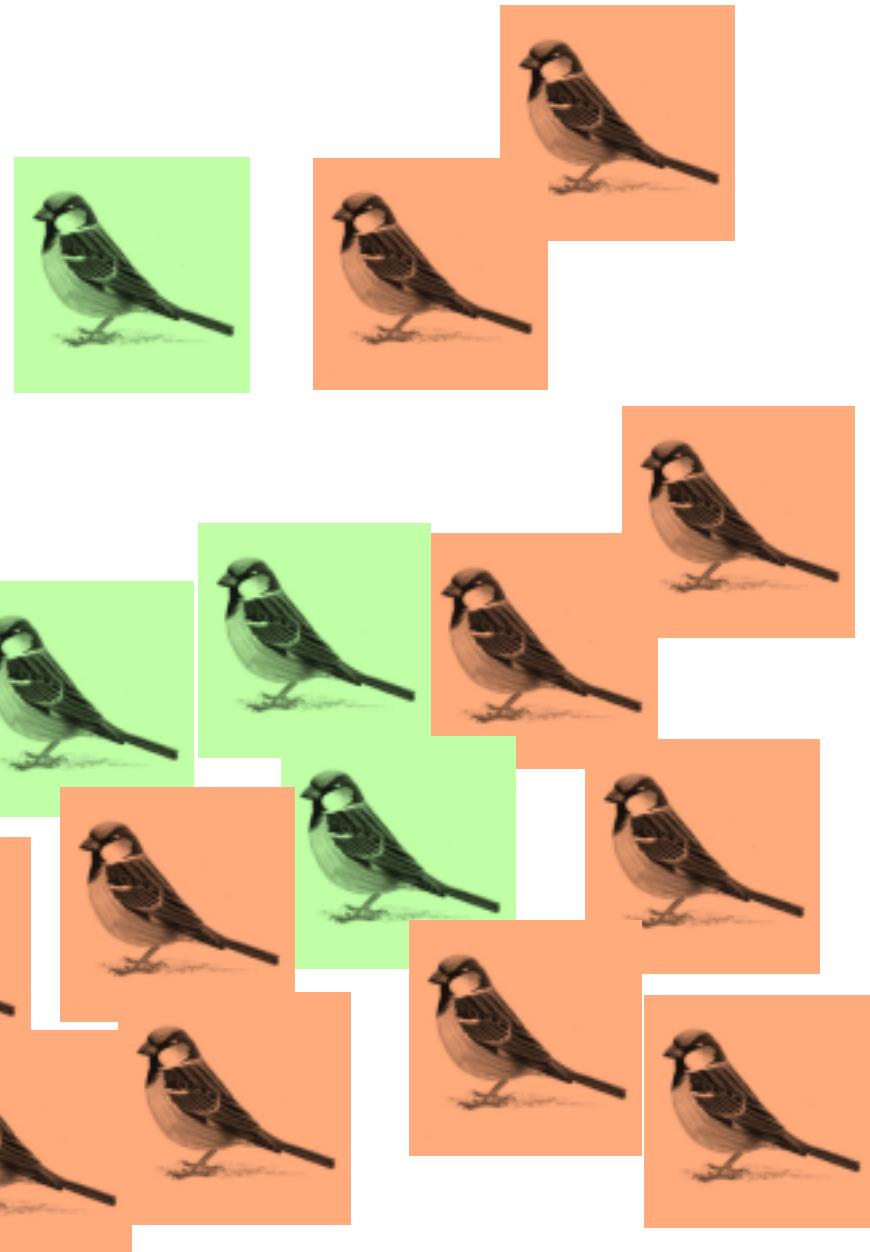
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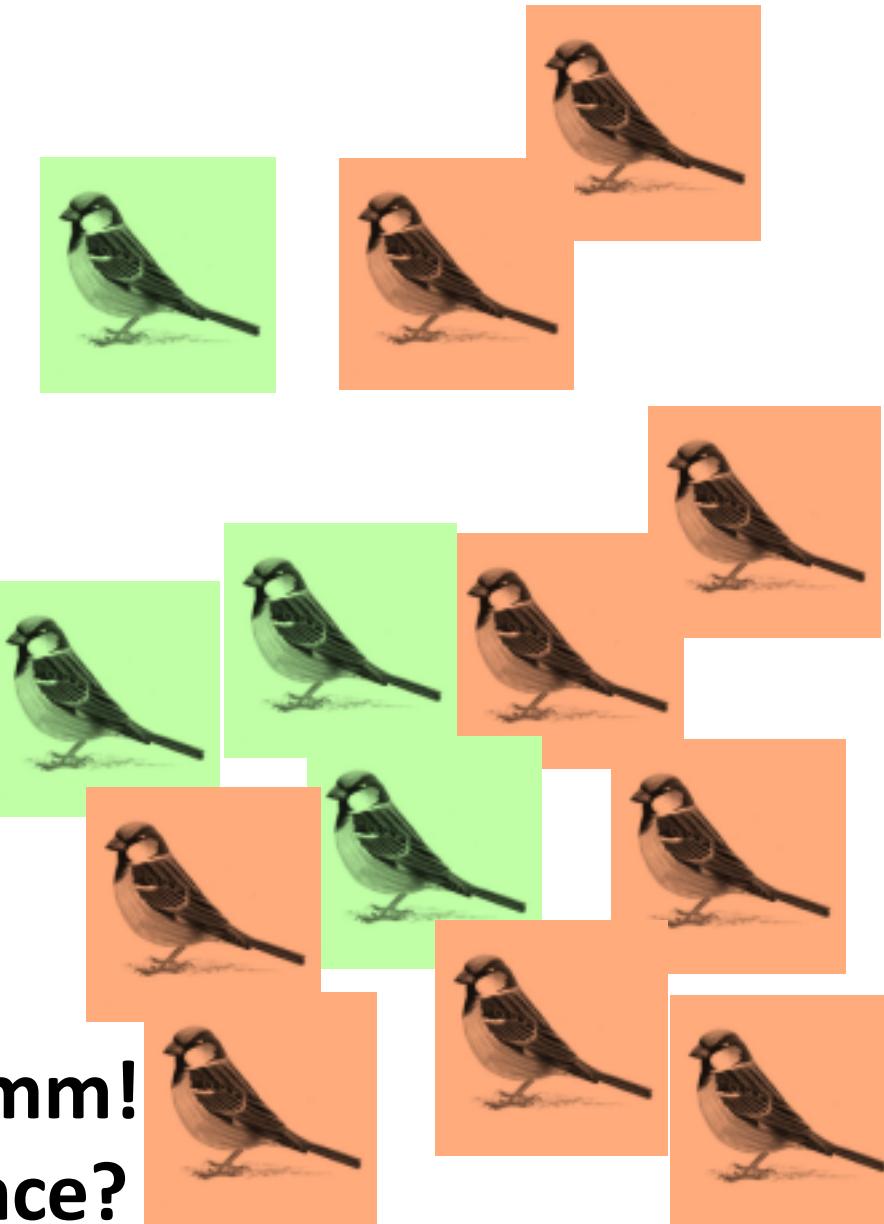
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Difference of 0.5mm!
Biological relevance?

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%)

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Two-sample t test power calculation

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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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- 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 $d = \text{effect size you want to detect} / (\text{difference between two mean}) = 5/\text{sd}$