Repeated Measures Designs

Psychology 3256

Introduction

- Say you are interested in learning or forgetting
- Independent groups won't really do
- You could test the same people over and over again
- Look at the change over time

You get this

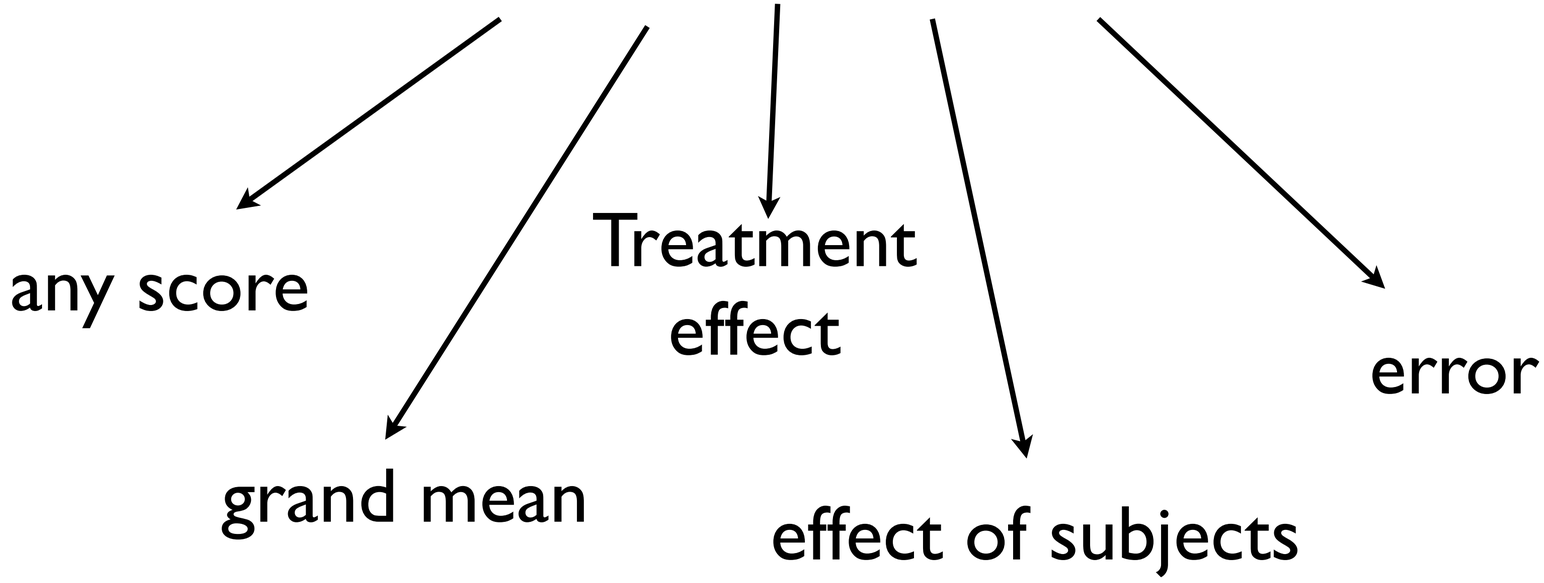
5 min	1 hr	24 hr
GI	GI	GI

Those of you scoring at home should have detected a problem at this point….

- Observations are not independent
- Well let's just throw that in the model!

So our model looks like this

$$x = \mu + \tau + \pi + \varepsilon$$



Now the design looks like this

- We have decreased ε but paid for it in a loss of df

	5 min	1 hr	24 hr
S1			
S2			
S3			
S4			

Paid for what?

Source	df
RI	2
Error	9
Total	11

One Way ANOVA

Source	df
RI	2
Subjects	3
Error	6
Total	11

With subject variation accounted for

any design has a finite amount of variation

- and a finite number of df
- we have partitioned the df (and variation) a little further
- MS_{RI} will be the same for both analyses
- Is the reduction in MSE worth the loss of df for error
- almost always yes

think about this

- is it realistic to think that $x = \mu + \tau + \pi + \varepsilon$?
- π should interact with τ
- much more sensible to assume it does
- Our model changes
- $x = \mu + \tau + \pi + \tau\pi$

$$x = \mu + \tau + \pi + \tau\pi$$

- What, no ε?
- Yup, no ε
- we have exhausted the df
- we treat S as just another variable

Source	df
RI	2
Subjects	3
RI x Sub	6
Total	11

So how does this work?

- Our error term is actually a treatment by subject interaction
- subjects are a random factor so the expected values work out (there was a reason I went over that mixed model stuff…)
- we don’t test the subject factor

you mean we just leave it there?

- Yeah, we cannot test the $MS_{subjects}$
- There is no error term with the correct E(MS)
- plus, who cares?

Randomized Block Designs

- Remember the matched pairs / correlated t test?
- you know, the one where you use before and after, or where you use matched pairs of subjects?
- subjects are usually matched on the dv

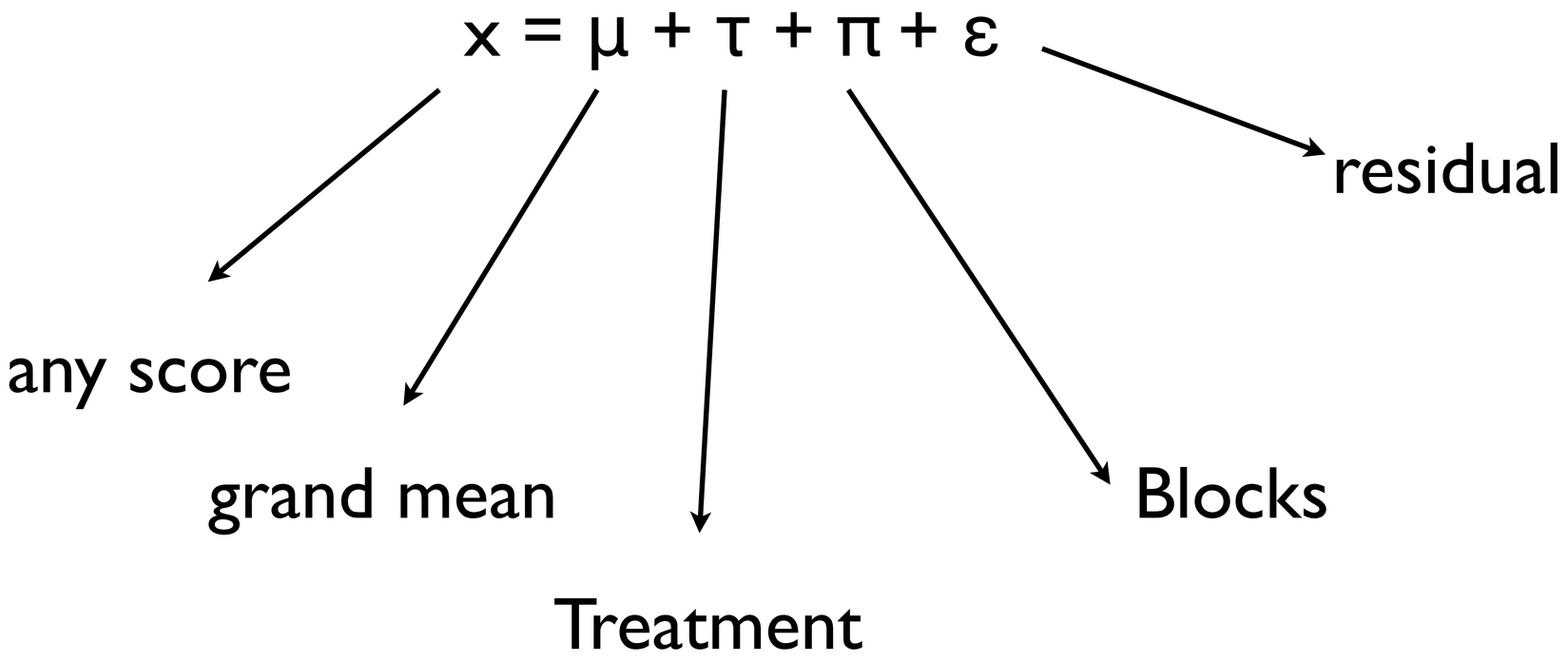
by extension..

- We can do the same thing with repeated ANOVA
- We need what is called homogeneity of experimental units
- This can be achieved in a few ways, litter mates, matched pairs, twins etc

Blocking

- So we call this variable, the one we block on, a nuisance variable
- This reduces ε which gives us greater power
- The structural model is pretty much the same

Speaking of the structural model...



Assumptions

$$\sum \tau = 0$$

$$\pi NID(0,\sigma_{\pi}^{2})$$

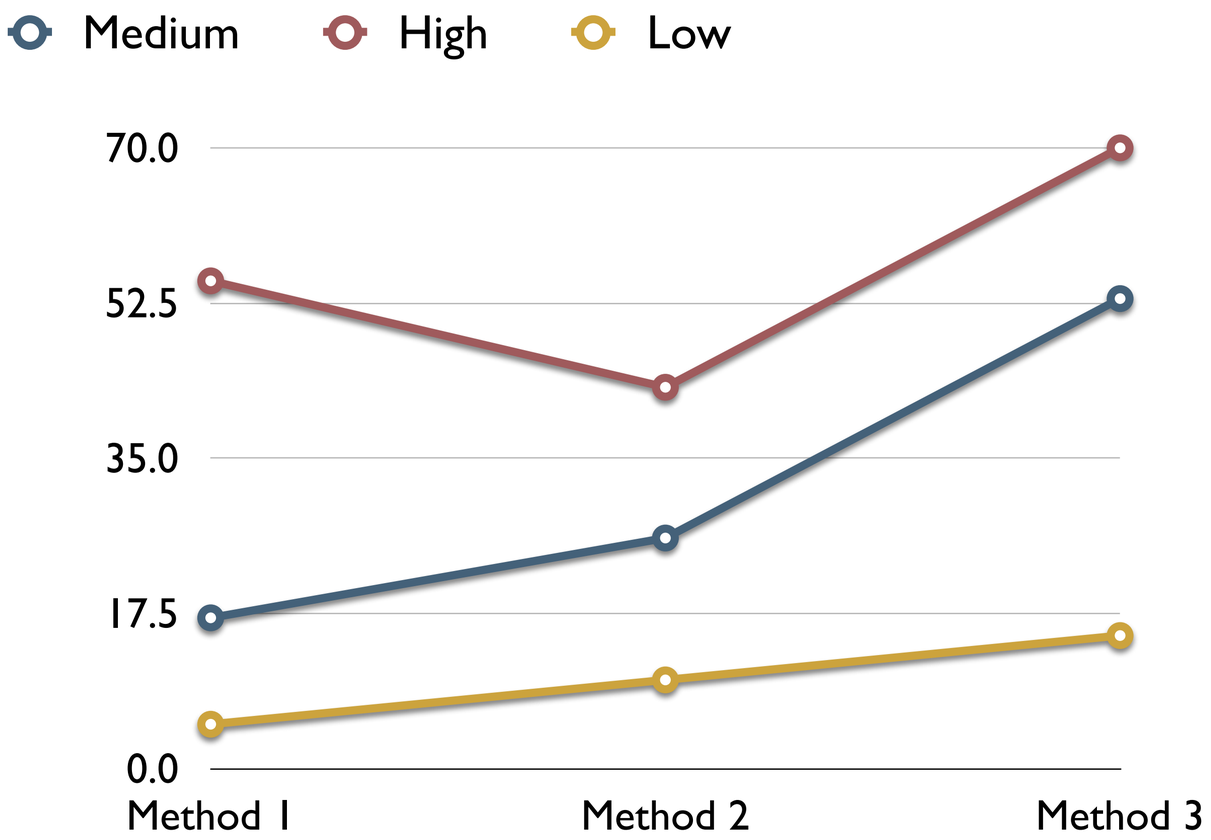
$$\varepsilon NID(0,\sigma_{\varepsilon}^{2})$$

- ε are INDEPENDENT of π
- no interactions no τ π interactions either...

If there is an interaction

- Well then ε will increase
- you will lose power
- basically, don't have interactions in your data...

An Example



You could use more than one repeated variable

	5 min	1 hr	24 hr
Implicit	GI	GI	GI
Explicit	GI	GI	GI

so, what is the model here?

- $x = \mu + \alpha + \beta + \alpha\beta + \pi + \alpha\pi + \beta\pi + \alpha\beta\pi$
- There are a lot of terms here, and many potential error terms (those with a subject factor in them) what do we test with what?

assume
n=10

Here you go..

sv	df	test
S	9	
RI	2	SxRI
SxRI	18	
M	1	MxS
MxS	9	
MxRI	2	MxSxRI
MxSxRI	18	
TOTAL	59	

Conclusions

- Repeated measures are used a lot
- When you think of subjects as just another factor, albeit a random one, you can easily figure out error terms.
- Figuring out error terms and components of a model like this is called listing the terms in Yates' order