

# Mixed-Design ANOVA

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CPSY501

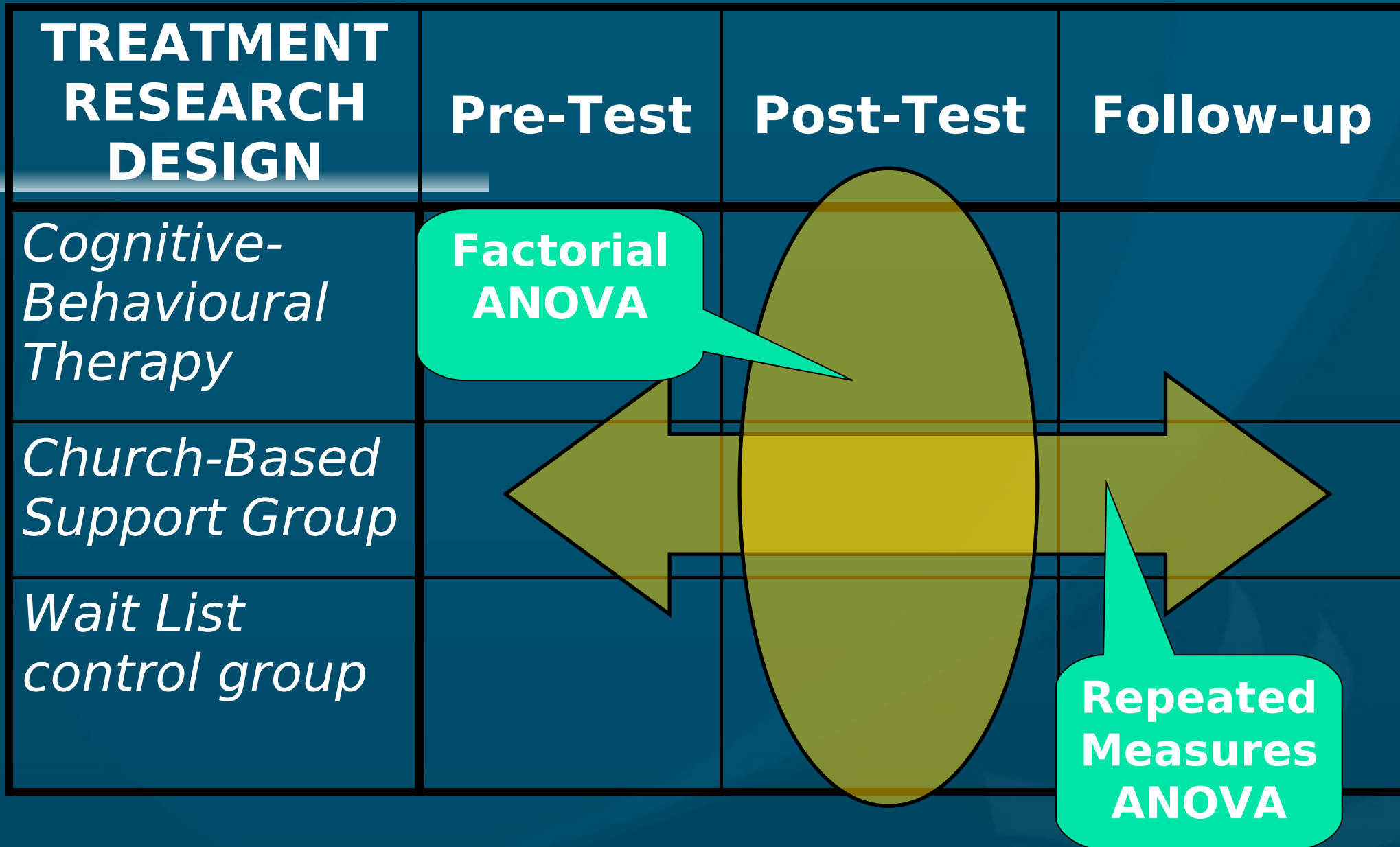
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*Please download:*  
• **treatment5.sav**

# Outline: Mixed-Design ANOVA

- Mixed-Design ANOVA: concept, SPSS, output
- Interactions: finding significant effects
  - Graphing, estimated marginal means
  - Using simple effects to aid interpretation
  - Extra main effects beyond the interactions
- Exploring gender as a moderator
- Misc: APA style
- Misc: Practise mixed-design ANOVA
- Misc: Covariates: Mixed-design ANCOVA



# Assumptions of RM ANOVA

- **Parametricity**: (a) interval-level DV, (b) normal DV, (c) homogeneity of variances.
  - But not independence of scores!
- **Sphericity**: homogeneity of variances of pairwise differences between levels of the within-subjects factor
  - **Test**: if Mauchly's  $W \approx 1$ , we are okay
  - If the within-subjects factors has only 2 cells, then  $W=1$ , so no significance test is needed.

# Mixed-Design ANOVA

- Advantages: More complete model
  - Moderators!
  - Treatment effects of interventions:  
Treatment groups (**between**-subjects) X  
Time (pre-/post-) (**within**-subjects)
  - Any **therapy** study would use this!!
- Disadvantages: “More work...”
  - Tracking, **interpreting** interactions
  - Can we **trust** complex results?
  - May need larger **sample sizes**

# Treatment5 Example

- DV: Depressive symptoms
  - (healing = decrease in reported symptoms)
- IV1: Treatment group (between-subjects)
  - CBT: Cognitive-behavioural therapy
  - CSG: Church-based support group
  - WL: Wait-list control
- IV2: Time (pre-, post-, follow-up) (within-subj)
- We will now do a full mixed-design study using both Treatment group and Time

# Mixed-Design: SPSS

- Analyze → GLM → Repeated measures → Define:  
Add IVs to “Between Subjects Factor(s)”
- Options: Effect size, Homogeneity tests, etc.
- Check assumptions: Parametricity, sphericity
  - Note: sphericity holds for treatment5 if we include the treatment groups in the design!

# Output: ANOVA Tables

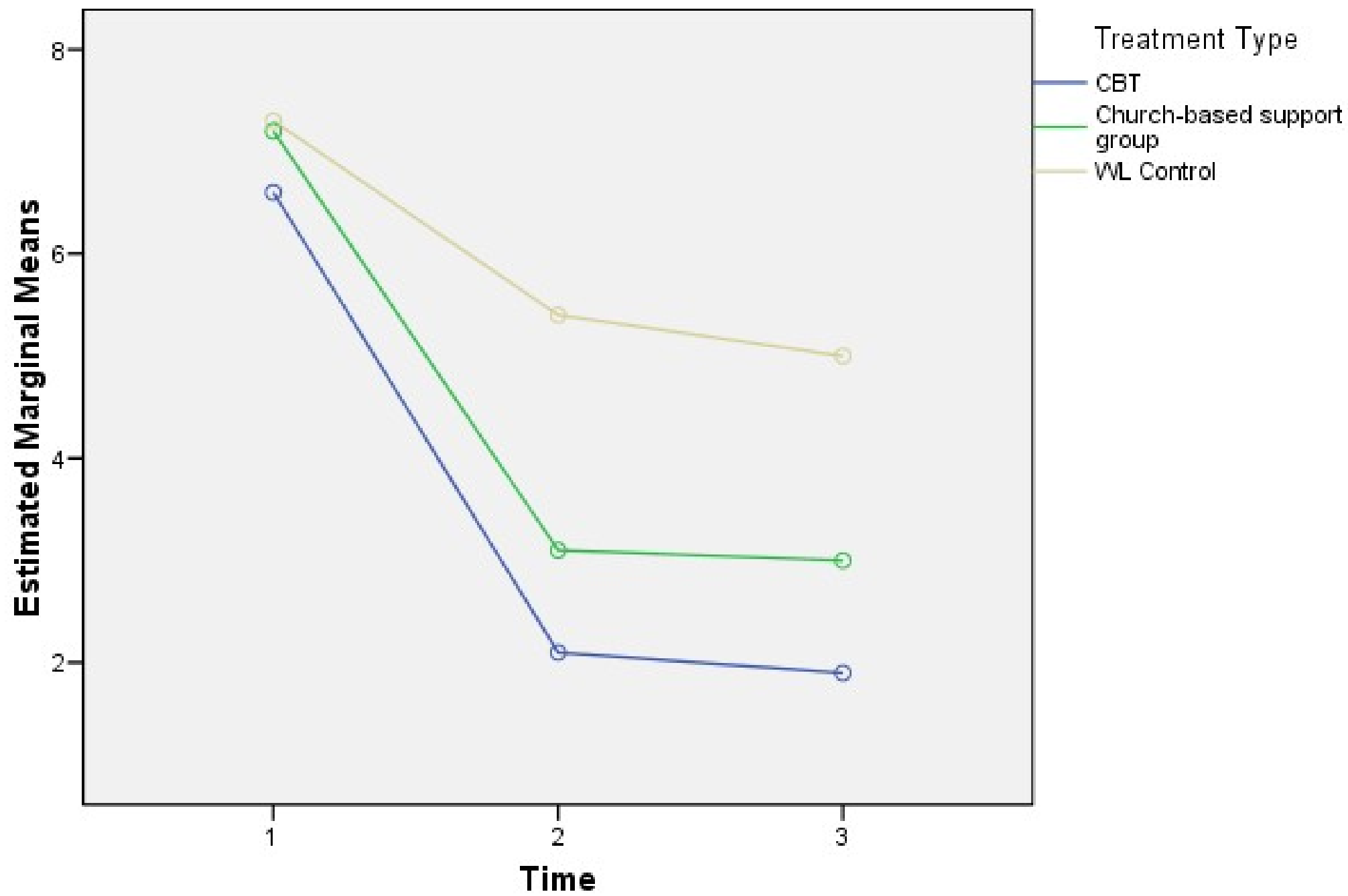
- Output: first purely **between-subjects** effects
  - Then **within-subjects** effects and **interactions** involving within-subjects factors
- Main effects and **interaction** effects:  
check **F-ratios**, **significance** level, and **effect size**
  - **Highest**-order significant interactions first
- For all **significant** effects, do follow-up:
  - **Graph** interactions
  - **Post-hoc** cell-by-cell comparisons
  - See if **main** effects have an interpretation beyond the higher-order interactions



# Examining Interactions

- **Graph** significant interactions to understand
  - Graphs plot the **estimated marginal means**
- Confirm with the **numbers** behind the plots:
  - Options: **Estimated Marginal Means**
  - Examine **confidence** intervals
- Treatment5: “The interaction of treatment group by time is significant,  $F(4, 54) = 7.28$ ,  $p < .001$ ,  $\eta^2 = .350$ , demonstrating that ...”

**Estimated Marginal Means of MEASURE\_1**



# Interactions: Simple Effects

- Follow-up on significant interaction:
- Use simple effects to describe precisely which treatment groups differ significantly
  - E.g., focus on just post-treatment time and do one-way ANOVA with Bonferroni post-hoc
  - Confirm with estimated marginal means
- The effect here is strong and clear, so even this conservative strategy shows that both treatment groups are lower than WL group, at post-treatment and follow-up times.

# Interactions: Interpretation

- We found a **significant** interaction:
  - “The interaction of treatment group by time is significant,  $F(4, 54) = 7.28, p < .001, \eta^2 = .350$ , demonstrating that ...”
- **Graphing + simple effects + est. marg. means** give us the **interpretation** of the interaction:
  - “...the decrease in symptoms of depression from pre-test to post-test and follow-up was greater for the treatment groups than it was for the WL control group.”

# Main Effects with Interactions

- Main effects are only meaningful if they tell us something beyond what the interaction tells us.
- In Treatment5, both Treatment and Time main effects merely reflect the interaction effect.
  - Only report the interaction with follow-up

# Follow-up for Main Effects

- To look for **main** effects beyond the interaction:
- If there are only **2 levels** of a **repeated** measure, **no post-hoc** is needed; the main effect is simply the **pairwise difference** between the two levels.
- If there are **more than 2 levels**:
- For **between**-subjects factors: “**Post Hoc**” button
  - Select appropriate post-hoc test
- For **within**-subjects factors:  
Options: “**Compare means**”
  - Remember to use **Bonferroni** correction

# Treatment5: Interpretation

- Last time, we ran a simple **RM ANOVA** on treatment5 and found a significant **main** effect for **Time**
- But that is **not** the best model to explain the data, as we found today with **Mixed-Design**:
- What's really going on is the **interaction** between **Treatment Group** and **Time**:
  - **Treatment effect** over time

# Other Moderators: Gender?

- We found a clear **treatment effect**, but are there other potential **moderators** to add to the model?
- In counselling psychology, **gender** often is an important variable in many analyses
- **RQ**: Do the treatments seem to work “the same” for both **women** and **men**?
  - Look for **3-way**: **Gender** \* **Time** \* **Treatment**
  - **2-way** interaction may also be useful: **Gender** \* **Time** or **Gender** \* **Treatment**
  - **Main** effect for gender not useful here



# Gender as Moderator: SPSS

- Clean and check assumptions on Gender
  - We actually have missing data for gender
- Analyze → GLM → Repeated measures → Define:
  - “Between Subjects Factor(s)”:  
now add both Treatment Group and Gender
- Interpret output tables for interactions:
  - Remember that SPSS prints  
pure between-subjects effects separately  
from within-subjects effects and interactions

# Output: Gender effects

- Between-subjects effects:
  - Gender \* Group effect is not significant
- Within-subjects effects:
  - No 3-way interaction
  - Time \* Gender effect is significant (21% effect size)
- Follow-up on Time \* Gender:
  - Graph and get estimated marginal means to try to understand the interaction

# Summary: Moderation analysis

- Women showed less improvement on average than did the men, but that did not depend on treatment group.
- So gender moderates response to treatment (but also to Waitlist!)
  - Doesn't change our interpretation of the treatment effect – it still seems to “fit” both women and men
  - For research publications, this “check” might not even be reported for the journal.

# APA style notes

- Provide **evidence** for your interpretations!
  - Explain **why** you think something is true and report the **statistics** ...
- No **space** between F and (): “ $F(2, 332) = \dots$ ”
- $R^2$  is NOT the same as  $r^2$
- **Kolmogorov-Smirnov** test: “ $D(105) = \dots$ ”
- **Round** to **2** decimal places for most stats
  - Round to **3** for  $p$  and  $\eta^2$
- **Italicize** Latin letters ( $p$ ), not Greek letters ( $\eta^2$ )

# Practise: Mixed ANOVA

- Treatment5: try a Mixed ANOVA with:
  - Within-subjects: “outcome” and “follow-up”
  - Between-subjects: “relationship status”
- Check assumptions
- Is there a significant interaction effect between pre/post treatment and relationship status?
  - If so, interpret the interaction.

# FYI: Covariates in Mixed-Design

- ANCOVA + RM + Factorial:
  - Enter “Covariates” in GLM → RM dialog
- Covariates must remain **constant** across all levels of the within-subjects (RM) factor
  - “**Varying**” covariates: enter as second **RM IV** in the model (or use multi-level modelling)
- Covariates should not be **related** to predictors
  - Should have no significant **interactions**
  - Need for homogeneity of **regression slopes**