1. As you know, when designing a repeated measures experiment, or an experiment with a repeated measures factor, one must counterbalance. Why? In other words, if one did not counterbalance, why would the experiment be confounded? Be *very* explicit! An example might help. [5 pts.]

If one did not counterbalance, then any position/order or carry-over effects would fall unequally on the conditions. Imagine, for example, a fatigue effect (decrease in performance over time). If all subjects were to first get Condition A, followed by Condition B, followed by Condition C, then it might appear that Condition C led to poorer performance than the other two conditions. At the very least, the fatigue effects would be another way to explain any results you obtain, which is a confound. Thus, complete counterbalancing (in this case) would ensure that the fatigue effects would fall equally on the three conditions (A, B, and C would occur in the first, second, and third positions equally often).

2. Well, of course you expect to tell me about the impact of various designs on the number of participants needed. For this problem, assume that we want to have a minimum of 25 pieces of data in each cell/condition. [10 pts]

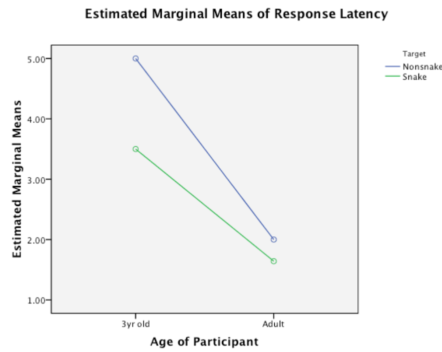
Design	# of participants	# of pieces of data
A 4x7 completely between (independent groups) design	**700**	**700**
A 4x7 completely within (repeated measures) design	**28**	**784**
A 4x7 mixed design, with the first factor between (independent groups) and the second factor within (repeated measures)	**112**	**784**
A 4x7 mixed design, with the first factor within (repeated measures) and the second factor between (independent groups)	**336**	**1344**
A 5x6 mixed design, with the first factor within (repeated measures) and the second factor between (independent groups)	**180 (Incomplete)** **720 (Complete)**	**900 (Incomplete)** **3600 (Complete)**

3. In a study of early ability to detect a fear-relevant stimulus (a snake), LoBue and DeLoache (2008) presented 3-year-old children and adults (Age: 3-year old vs. adult) a series of 3x3 matrices of pictures. The subject's task was to point out a target by touching one of the nine pictures on a touch-screen (Target: either a *snake* among eight non-snake distractors or a non-snake animal, such as a *caterpillar*, among eight snake distractors). Thus, we can think of this study as a 2x2 independent groups design. Below is a partially completed source table that is consistent with their results (Experiment 3). Complete the source table and interpret the results as completely as you can. Be sure to talk about the results as you might in a Discussion section (i.e., how would you make sense of these results). [15 pts]

Descriptive Statistics

Dependent Variable:Response Latency

Age of Parti...	Target	Mean	Std. Deviation	N
3yr old	Nonsnake	5.0000	.95346	12
	Snake	3.5000	.79772	12
	Total	4.2500	1.15156	24
Adult	Nonsnake	2.0000	.82572	12
	Snake	1.6000	.76396	12
	Total	1.8000	.80434	24
Total	Nonsnake	3.5000	1.76315	24
	Snake	2.5500	1.23500	24
	Total	3.0250	1.58053	48



Dependent Variable:Response Latency

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Observed Power[b]
Age	72.030	1	72.03	102.90	.000	.700	1.000
Target	10.830	1	10.83	15.47	.000	.259	.970
Age * Target	3.630	1	3.63	5.19	.028	.105	.604
Error	30.920	44	0.70				
Corrected Total	117.410	47					

$$HSD = 3.76\sqrt{\frac{.70}{12}} = .91$$

There was a significant main effect for Age, $F(1,44) = 102.9$, $MSE = .7$, $p < .001$, $\eta^2 = .7$. There was a significant main effect of target, $F(1,44) = 15.47$, $p < .001$, $\eta^2 = .259$. There was also a significant interaction between Age and Target, $F(1,44) = 5.19$, $p < .028$, $\eta^2 = .105$. Post hoc analyses using Tukey's HSD indicate that the interaction was due to the fact that 3-year-old children were faster to pick the snake from among the nonsnake stimuli (M = 3.5) compared to picking the nonsnake stimuli from among snake stimuli (M = 5.0). On the other hand, adults responded to the snake (M = 1.6) and nonsnake stimuli (M = 2.0) equally quickly.

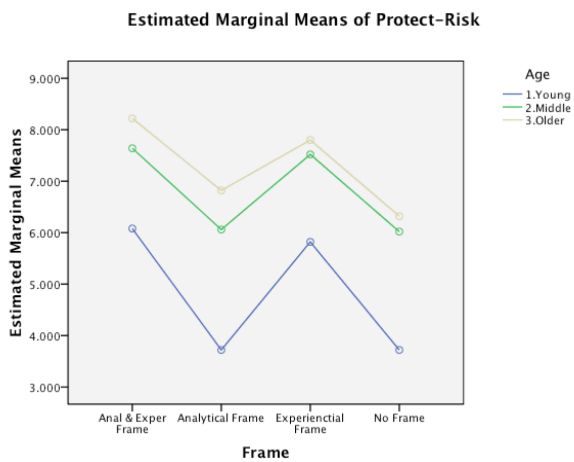
It's interesting that even very young children seem to treat snake stimuli differently from other animal stimuli. It's not clear if their responses were slowed down by the number of distractor snakes present in the display (when picking out the nonsnake stimulus) or if they were quick to pick out a snake from among other stimuli. Nonetheless, these young children respond faster to the displays with a snake target among nonsnake distractors compared to displays with a nonsnake target among snake distractors. Adults have generally faster response times, but the difference in their speed to respond to the snake and nonsnake targets is not statistically significant.

4. One area of psychology looks at factors that influence decision-making. One factor that people have studied is how a decision is influenced by the way in which the information is delivered. Even though the information is identical, people's decisions will differ when the information is placed in a different context (frame). Suppose that a researcher was interested in looking at the impact of four different frames on people's willingness to engage in risky behavior (or to be more protective). One scenario involves the participant's willingness to smoke cigarettes. The four frames are: NF = No Frame (so it just asks the participant to imagine that he or she has been smoking for a while and enjoys doing so), AF = Analytical Frame (with statistical information about the scenario, such as how many people die of lung cancer each year), EF = Experiential Frame (which attempts to make the scenario personally relevant by asking the participant to think about a family member dying from lung cancer), and AEF = Analytical + Experiential Frames (which puts the two types of information together). Participants read a series of scenarios and then gave a response that indicated their willingness to engage in risky behavior. The dependent variable is called Protect-Risk, where a positive score indicates a more protective response and a negative score represents a willingness to engage in riskier behavior. Suppose that the researcher is also interested in looking at the impact of age (Young 18-23, Middle 38-43, and Older 58-63). Complete the source table below and interpret the results as completely as you can. Finally, discuss the results as you might in a Discussion section. [15 pts]

Descriptive Statistics

Dependent Variable:Protect-Risk

Frame	Age	Mean	Std. Deviation	N
Anal & Exper Frame	1.Young	6.08000	.356371	5
	2.Middle	7.64000	.296648	5
	3.Older	8.22000	.277489	5
	Total	7.31333	.978969	15
Analytical Frame	1.Young	3.72000	.370135	5
	2.Middle	6.06000	.680441	5
	3.Older	6.82000	.402492	5
	Total	5.53333	1.443046	15
Experienctial Frame	1.Young	5.82000	.653452	5
	2.Middle	7.52000	.311448	5
	3.Older	7.80000	.400000	5
	Total	7.04667	1.007732	15
No Frame	1.Young	3.72000	.486826	5
	2.Middle	6.02000	1.023230	5
	3.Older	6.32000	.426615	5
	Total	5.35333	1.365319	15
Total	1.Young	4.83500	1.230009	20
	2.Middle	6.81000	.991490	20
	3.Older	7.29000	.850944	20
	Total	6.31167	1.478099	60



Tests of Between-Subjects Effects

Dependent Variable:Protect-Risk

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[b]
Frame	46.017	3	15.339	57.449	.000	.782	172.346	1.000
Age	67.720	2	33.860	126.816	.000	.841	253.634	1.000
Frame * Age	2.352	6	.392	1.468	.210	.155	8.798	.515
Error	12.816	48	.267					
Corrected Total	128.905	59						

Frame: $HSD = 3.76\sqrt{\frac{.267}{15}} = .50$	Age: $HSD = 3.42\sqrt{\frac{.267}{20}} = .40$

There was a significant main effect for Frame, $F(3,48) = 57.449$, $MSE = .267$, $p < .001$, $\eta^2 = .782$. Post hoc analyses using Tukey's HSD indicate that people were more protective (less willing to take risk) when given the Experential Frame ($M = 7.047$) or the Analytical+Experiential Frame ($M = 7.313$) compared to the Analytical Frame ($M = 5.533$) or No Frame ($M = 5.353$). There was a significant main effect for Age, $F(2,48) = 126.816$, $p < .001$, $\eta^2 = .841$. Post hoc analyses using Tukey's HSD indicate that older people were more protective (M = 7.29) than the Middle Age ($M = 6.81$) or the Young participants ($M = 4.835$), with the Middle Age participants more protective than Young participants. The interaction between Frame and Age was not significant, $F(6,48) = 1.468$, $p = .210$, $\eta^2 = .155$.

Thus, it appears that as people age, they are less willing to take risks. Perhaps older people believe that they have more to lose. Or perhaps younger people are more willing to take risks because they believe that they would have time to recover from negative consequences. Of course, because age isn't manipulated, it could be that a variable related to age (e.g., economic conditions experienced while growing up) is producing the effect. Regardless of age, it appears that framing a scenario in terms of a person's experience (either alone, or in conjunction with an analytical frame) leads to more protective responses than an analytical frame or no frame at all. The experiential frame likely makes the scenario more personal, which may lead people to treat the negative consequences are more relevant.

5. In independent groups ANOVAs, such as the one in Problem #3: [10 pts.]

a. Using just the information provided in the Descriptive Statistics, how could you have arrived at MS_{Error}? What is the function of MS_{Error} in the analysis? That is, what population parameter is it intended to estimate?

$$MS_{Error} = \hat{\sigma}^2$$

$$MS_{Error} = \frac{s^2 + s^2 + s^2 \ldots}{k}$$

with k conditions in the study

In the study in Question 4, $MS_{Error} = \dfrac{.356^2 + .297^2 + .277^2 + .370^2 + \ldots + 1.023^2 + .427^2}{12} = .267$

b. Again, looking solely at the information in the Descriptive Statistics, what would contribute to the MS_{Frame} main effect? (point out the specific scores involved)

The four means for the type of frame: 7.313, 5.533, 7.047, and 5.353.

c. Suppose that you re-computed the ANOVA as a single-factor analysis on the Frame factor. What would that source table look like?

SOURCE	*SS*	*df*	*MS*	*F*
Frame	46	3	15.34	10.36
Error	82.9	56	1.48	
Total	128.9	59		

d. Looking at the effect size (partial eta squared) and the power for the interaction (Frame x Age), what might you say about why the interaction is not significant?

The power is quite low (.515), as is the effect size (.155). That is, with that small effect size, you'd need to have a larger sample size to increase the power to the point that you'd find a significant effect with such a small effect size.

6. Dr. Jones decides to test the effectiveness of two different experimental methodology textbooks. He gets two of his colleagues to agree to use the texts (Colleague A uses Text A in Methodology Class Section A, Colleague B uses Text B in Methodology Class Section B) and to give the same exams throughout the term. At the end of the term, he finds that there was no difference in mean performance between the two classes (Mean = 94% and 96% for Class A and Class B, respectively). He concludes that there is no difference between the two texts. Would you agree? [5 pts]

No. First of all, there is a confound of teacher and text. Thus, you can't know if a difference is due to teacher or due to text. Second, it appears that the test may be too easy, because the scores for both classes were quite high (means near 100% in both classes). Finally, as is true of the typical class, students aren't randomly assigned. Thus, there is the possibility that one class may have more capable students than the other class.

I think that you'd have to find some way to randomly assign people to the two classes. Then, you'd want to have multiple classes for each text, each with a different teacher. Finally, you'd want to use a more difficult test, to eliminate the ceiling effect.

7. Ghetti (2008) published an article in *Current Directions in Psychological Science* called "Rejection of false events in childhood." Her abstract reads:

Knowing how to identify events that we never experienced is an important skill: This ability enables us to reject such events as part of our past and thus reduces the risk of creating false memories. Recent research highlights the involvement of metamemory processes in this domain. I review empirical evidence pertaining to the functioning and development of the memorability-based strategy, a specific mechanism rooted in metamemory. The substantial development of this mechanism during childhood can provide an account for children's vulnerability to false-memory formation.

Suppose that you saw data such as those below. One IV would be age (with four levels) and one IV would be memorability. Some events (i.e., trials in a memory experiment) may occur more frequently than others, which should make them more memorable. Let's assume that there is a memorability-based strategy (MBS) that allows one to reject events as unlikely to have actually occurred. Such a strategy would involve using memorability of events to determine the events that had, or had not, occurred. The DV in this study is the probability of correct rejection (correctly saying that an event had not occurred in the experiment…or one's life). Had you obtained results such as those displayed below, what would you expect to find in an ANOVA, in terms of main effects and the interaction? How would you interpret your results, as in a Discussion section? (10 pts)

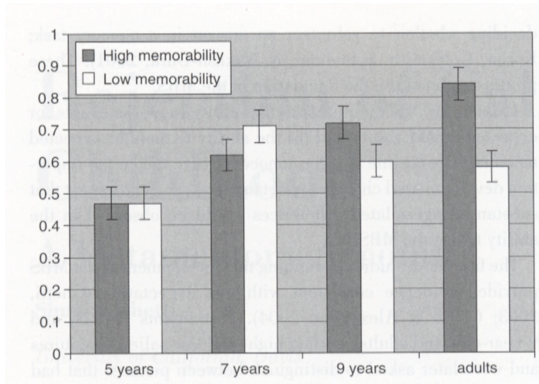


Fig. 1. Rates of correct rejection of high- and low-memorability false events by age group.

For the main effect for memorability, I'd interpolate the data as follows:

$$High = \frac{.46 + .62 + .72 + .83}{4} = .66 \qquad Low = \frac{.47 + .71 + .60 + .59}{4} = .59$$

Thus, it appears that high memorability events lead to greater correct rejection of false events.

For the main effect for age:

5 Yr = .465	**7 Yr = .67**	**9 Yr = .66**	**Adult = .71**

Thus, it appears that adults have higher rejection rates than other age groups, with no difference between 7- and 9-year-olds, both of which have higher rejection rates for false events than 5-year-olds.

For the interaction:

For 5-year-olds, memorability has no effect on the rate of correct rejection of false events (both low and high memorability at about .475). However, 7-year-olds appear to have higher correct rejection of false events for low memorability events compared to high memorability events. (That's a bit strange, eh?) For older participants (9-year-olds and adults), high memorability events lead to greater correct rejection of false events than low memorability events.

In general, it appears that older participants (9-year-olds and adults) have more fully developed memory systems (better metamemory), which enable them to make better use of the memorability information in the events to determine which are likely false events. The younger participants aren't able to make use of the memorability information to classify events as false.