things

- PS 4's grading is still ongoing (I spent a *lot* of time making new graphs); I am sorry
- PS 5's answer key is still in the works
- PS 6 this evening → Monday
- drill tomorrow
- next Monday we'll meet for a review
- we won't meet next Wednesday
- Exam 1 will be available on March 6, due March 11

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multi-factor designs: wrapping up

February 28, 2024

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contrast codes for a 2 x 3 design (previously introduced)

	intact 300	intact 450	intact 600	scr 300	scr 450	scr 600
T	+1/2	+1/2	+1/2	-1/2	-1/2	-1/2
R1	+1/3	+1/3	-2/3	+1/3	+1/3	-2/3
R2	+1/2	-1/2	0	+1/2	-1/2	0
T*R1	+1/6	+1/6	-2/6	-1/6	-1/6	+2/6
T*R2	+1/4	-1/4	0	-1/4	+1/4	0

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different summaries, same design

```
             Estimate      SE      t Pr(>|t|)
(Intercept)        53    0.99  53.62  < 2e-16
T                   6    1.98   3.03  0.00412
R1                 12    2.10   5.72 9.95e-07
R2                  4    2.42   1.65  0.10600
TR1                12    4.19   2.86  0.00655
TR2                 0    4.84   0.00  1.00000

            Df Sum Sq Mean Sq F value  Pr(>F)
text         1    432   432.0   9.210 0.00412
wpm          2   1664   832.0  17.738 2.6e-06
text:wpm     2    384   192.0   4.093 0.02376
Residuals   42   1970    46.9
```

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what is Model A/Model C? for variable R1 (300, 450 vs 600)

- Model A

$$Y = \beta_0 + \beta_1 T + \beta_2 R1 + \beta_3 R2 + \beta_4 TR1 + \beta_5 TR2$$

- Model C

$$Y = \beta_0 + \beta_1 T + 0R1 + \beta_3 R2 + \beta_4 TR1 + \beta_5 TR2$$

$$Y = \beta_0 + \beta_1 T \qquad\qquad \beta_3 R2 + \beta_4 TR1 + \beta_5 TR2$$

$$H_0\text{: } \beta_2 = 0$$

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what is Model A/Model C? for variable TR1

- Model A

$$Y = \beta_0 + \beta_1 T + \beta_2 R1 + \beta_3 R2 + \beta_4 TR1 + \beta_5 TR2$$

- Model C

$$Y = \beta_0 + \beta_1 T + \beta_2 R1 + \beta_3 R2 + 0TR1 + \beta_5 TR2$$

$$Y = \beta_0 + \beta_1 T + \beta_2 R1 + \beta_3 R2 + \qquad\qquad \beta_5 TR2$$

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other versions of Model C

- Model A

$Y = \beta_0 + \beta_1 T + \beta_2 R1 + \beta_3 R2 + \beta_4 TR1 + \beta_5 TR2$

- Model C for the typical ANOVA main effect of text

$Y = \beta_0 \qquad + \beta_2 R1 + \beta_3 R2 + \beta_4 TR1 + \beta_5 TR2$

- PRE gives R^2 for text (often reported as η_p^2)

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other versions of Model C

- Model A

$Y = \beta_0 + \beta_1 T + \beta_2 R1 + \beta_3 R2 + \beta_4 TR1 + \beta_5 TR2$

- Model C for the typical ANOVA main effect of rate/wpm

$Y = \beta_0 + \beta_1 T + \qquad \beta_4 TR1 + \beta_5 TR2$

- PRE gives R^2 for rate (often reported as η_p^2)

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other versions of Model C

- Model A

$Y = \beta_0 + \beta_1 T + \beta_2 R1 + \beta_3 R2 + \beta_4 TR1 + \beta_5 TR2$

- Model C for the typical ANOVA interaction effect

$Y = \beta_0 + \beta_1 T + \beta_2 R1 + \beta_3 R2 +$

- PRE gives R^2 for the interaction (often reported as η_p^2)

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other versions of Model C

- Model A

$$Y = \beta_0 + \beta_1 T + \beta_2 R1 + \beta_3 R2 + \beta_4 TR1 + \beta_5 TR2$$

- Model C for the whole model

$$Y = \beta_0$$

- PRE gives R^2 for the whole model

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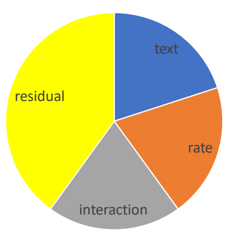
the typical ANOVA



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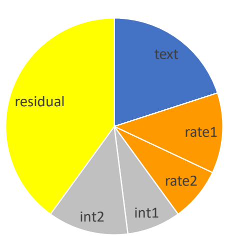
using single-*df* orthogonal contrasts



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3+ factors

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a design (based on real research)

- to understand factors related to eating behavior
- DV: amount of ice cream eaten
- Factor A: good vs bad ice cream
- Factor B: empty vs full stomach
- Factor C: average vs overweight participants

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results (*g* of ice cream eaten)

	bad		good	
	empty	full	empty	full
over	70	60	240	220
average	50	10	150	90

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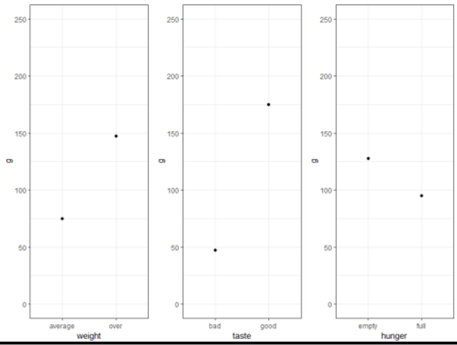
main effects



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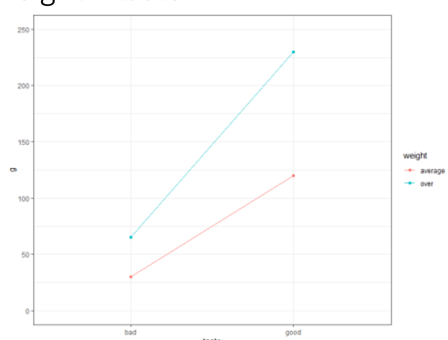
weight x taste



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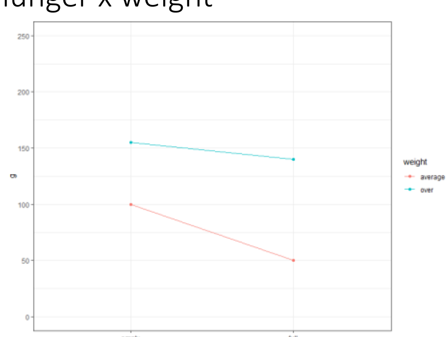
hunger x weight



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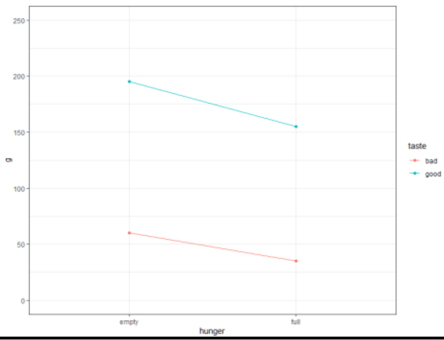
hunger x taste



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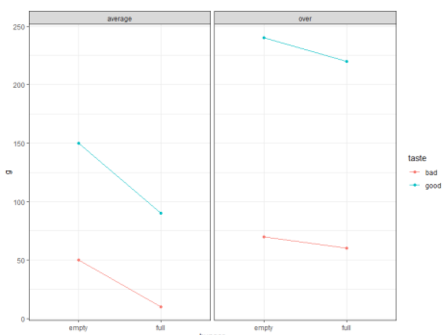
three-factor interaction



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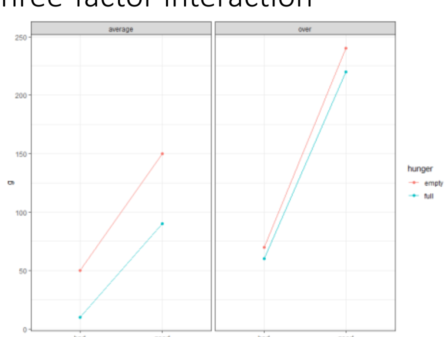
three-factor interaction



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in a three-factor design

- main effects are interpretable as usual
- two-factor interactions can be decomposed (probed, explained, etc.) with simple-effects tests
- three-factor interactions can be decomposed via simple-effect and/or simple-interaction tests
- but be aware that most people can't think very clearly about interactions among three factors (and more than that ... 🤕)
- all of the problems (i.e., the need for post-tests) that arise with >1 *df* effects apply here, but are potentially more complicated

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general advice

- the overall ANOVA will usually leave you needing follow-up tests in many cases
- let your substantive questions dictate the analyses you execute
- be aware of the costs and benefits of using orthogonal contrast codes vs other possibilities (e.g., dummy codes)
- use cell means to help you interpret what your slopes are about
- alternatively, you can interpret slopes as we did with continuous predictors; this may be easier with dummy codes than with orthogonal contrasts

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