## Factorial designs

### What if you wanted to test...

- Whether FOXP2 knockout mice vs. regular mice show differential _______ in motor learning tasks vs. _________ learning tasks
- Multiple _______
  - KO and regular: motor task
  - KO and regular: _________ task
- Or put it all into a _________

### What if you wanted to test...

- Whether driving in _________ conditions is more impaired by visual or auditory _________
  - Multiple experiments
    - Driving in _________: Vis and Aud
    - Driving in _________: Vis and Aud
    - _________: easy driving, hard driving
    - _________: easy driving, hard driving
- Or put it all into a _________

### What if you wanted to test...

- Do French speakers and English speakers show different _________ in speech?
  - Speech discrimination: French _________; Eng. _________
- Multiple _________
  - French on French and English sounds
  - English on French and English sounds
- Or put it all into a _________
Simple factorial design: 2 ________

• *Two independent variables* or _________
• Testing multiple hypotheses
  – *Main effects*:
    – IV 1 effect (H₀: _________)
    – IV 2 effect (H₀: _________)
  – *Interaction*:
    – IV 1 x IV 2: effects of IV1 are _________ depending on ____________ (or vice versa)
    – H₀: __________

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FOXP2 knockout and learning

<table>
<thead>
<tr>
<th>Task type</th>
<th>150</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor learning</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td>Olfactory learning</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Regular or KO</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

*Marginal means show you the main effects*

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Simple factorial design: 2 factors

• *Two independent variables* or _________
• Testing multiple hypotheses
  – *Main effects*:
    – Task difficulty: _________
    – Regular vs. KO mice: probably _________ worse
  – *Interaction*:
    – _________: motor learning shows *bigger impairment* than _________ for KO mice

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Simple factorial design: 2 factors

• *Two independent variables* or _________
• Testing multiple hypotheses
  – *Main effects*:
    – Driving conditions: _________ increase errors
    – Task type: _________ increases errors (vs. aud)
  – *Interaction*:
    – _________: visual task increases errors _________ when driving conditions are difficult
Driving and visual/auditory distraction

<table>
<thead>
<tr>
<th>Distraction type</th>
<th>Auditory</th>
<th>Visual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy driving</td>
<td>560</td>
<td></td>
</tr>
<tr>
<td>Hard driving</td>
<td>790</td>
<td></td>
</tr>
</tbody>
</table>

Driving conditions

<table>
<thead>
<tr>
<th></th>
<th>Easy driving</th>
<th>Hard driving</th>
</tr>
</thead>
<tbody>
<tr>
<td>570</td>
<td>705</td>
<td></td>
</tr>
</tbody>
</table>

Braking reaction time (ms)

<table>
<thead>
<tr>
<th>Distraction is</th>
<th>Auditory</th>
<th>Visual</th>
</tr>
</thead>
<tbody>
<tr>
<td>590</td>
<td>685</td>
<td></td>
</tr>
</tbody>
</table>

Simple factorial design: 2 factors

- Two independent variables or _________
- Testing multiple hypotheses
  - Main effects:
    - Language background: _________
    - Speech sound language: _________
  - Interaction:
    - LB x SSL: French speakers better at _________, English better at _________

French vs. English sounds

<table>
<thead>
<tr>
<th>Sound type:</th>
<th>French sounds</th>
<th>English sounds</th>
<th>Listeners' language</th>
</tr>
</thead>
<tbody>
<tr>
<td>French ppts.</td>
<td>50</td>
<td>94</td>
<td>72</td>
</tr>
<tr>
<td>English ppts.</td>
<td>95</td>
<td></td>
<td>72</td>
</tr>
</tbody>
</table>

Sound type: 72.5 71.5

Main effects and interactions

- Sometimes you’re looking for _________.
- Sometimes you’re looking for _________.
- Sometimes you’re looking for _________.
What if you have both main effect(s) and interactions?

- Sometimes you want an ________!
- Or not.

What kinds of factors?

- Totally between-groups
- Totally __________
  - (Distracted driving example)

- _______ design (AKA split-plot design)
  - _______ is within-subjects
  - _______ is between-groups
  - (Both the FOXP2 mouse example and the English/French speech perception example are _________)
Higher-order designs

• All of the examples we have considered are “________” or “2×2” designs.
  – Analyze with a 2-way Analysis of Variance (_______)
• If one factor has _________, it’s a 2×3.
  – Analyze with a 2-way Analysis of Variance (_______)
• If there are _________, could be a 2×2×2.
  – Analyze with a 3-way Analysis of Variance (_______)

How many factors?

• You can use lots and lots, but gets harder and harder to ________
• As few factors as you can use and still ______
  _________
• Why? Levels of _________:
  – The boy moved to Germany
  – The boy _________moved to Germany
  – The boy ________________moved to Germany

How many factors?

• As few as you can use and still draw ________
• Sometimes, some of your IVs are just controls or _________ (you don’t want to see effect)
• Sometimes, you really do want to see a 3-way interaction!
  – *(Also depends on how you code your
    ________________)
• Typical n00b error is to ___________________________________