Fixed and Random Effects, Linear Mixed Effects Models

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Fixed Effects

- The dependent variable in statistical tests is a function of one or more independent variables
  - E.g. Factors (male vs. female, young vs. old) or covariates (age in years, years of education)
- These represent a hypothesis about how the world works
- Usually, we assume that values of an IV are FIXED
  - They represent the entire population of values we're interested in

Fixed Effects

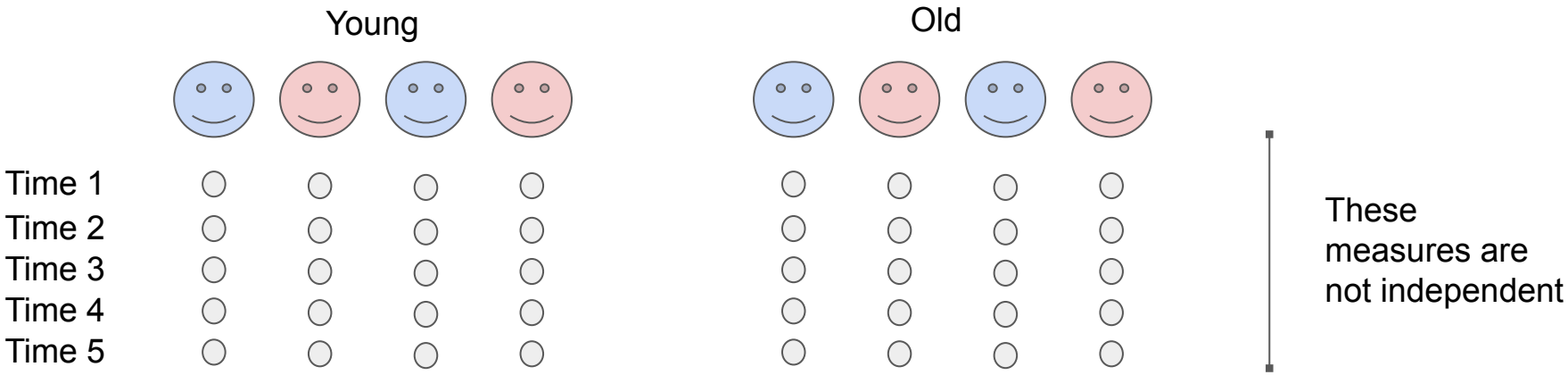
- Fixed effect: Age
  - Two levels: Young, Old
  - We want to know which of the two age groups is smarter (DV)
  - There might be other factors that influence IQ, but they’re not the focus of this study

Random Effects

- Sometimes, we should assume that the values of the IV are drawn at random from a larger pool of possibilities
    - E.g. instead of comparing IQ between two age groups, we might be interested in investigating IQ amongst people in general

Using cognition as an example...

- Instead of just one measure per participant, what if we took cognitive measures over time?



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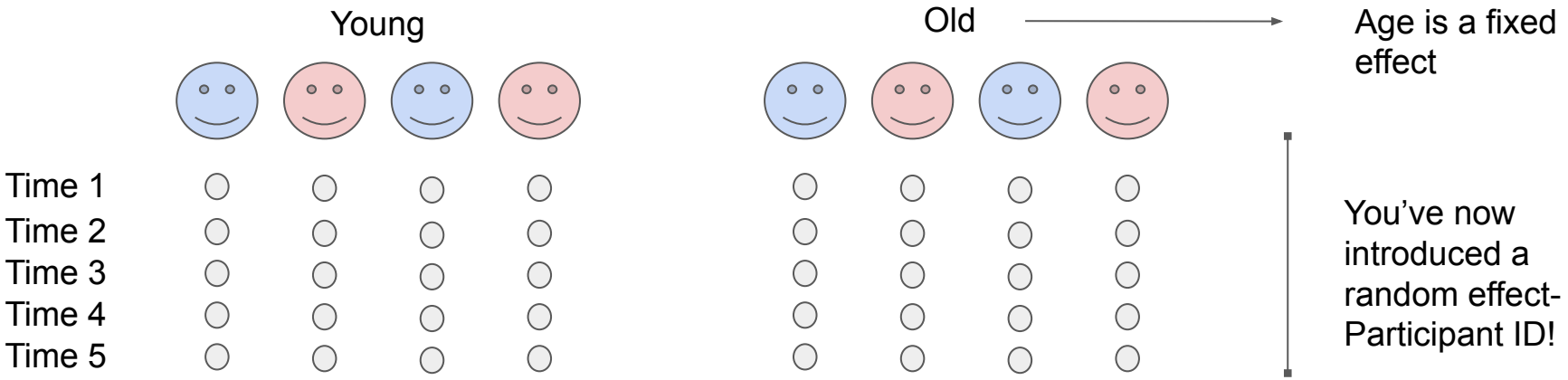

Using cognition as an example...

- We randomly draw participants from a larger study population
- Are we really interested in whether one particular participant has higher or lower reaction time than another?
  - Generally, we're interested in the group level effects (i.e. the fixed effect of age)
- However, we should account for the fact that the repeated measures within participants are probably correlated
  - Some people will have lower/higher levels of whatever you're measuring which likely has nothing to do with their age

Using cognition as an example...

- You may be thinking, well just stop taking repeated measures… Which is fair enough. However:
  - What if we have different experimenters collecting the data? Each person might do things slightly differently. Whoops, a new random effect
- What about taking the average?
  - Well, yes you can do that. But sometimes that leads to data being thrown away that might be useful to us
- Or, we model it appropriately using linear mixed effects models

Linear Mixed Effects Models

- Allow you to take into account both fixed AND random effects
- Advantages over repeated measures ANOVA
  - Can deal with missing data
  - Can deal with clustering (e.g. data collected across multiple sites)
  - Can treat time as a continuous variable instead of categorical (e.g. rather than 3 discrete timepoints for weeks 1, 3 and 6, you can use those as continuous time points which takes into account spacing)
  - Basically, mixed models will cover most of the cases where RM ANOVA doesn't work