Separating intended and unintended implicit learning effect in preschooler language development study

STATS 570/409

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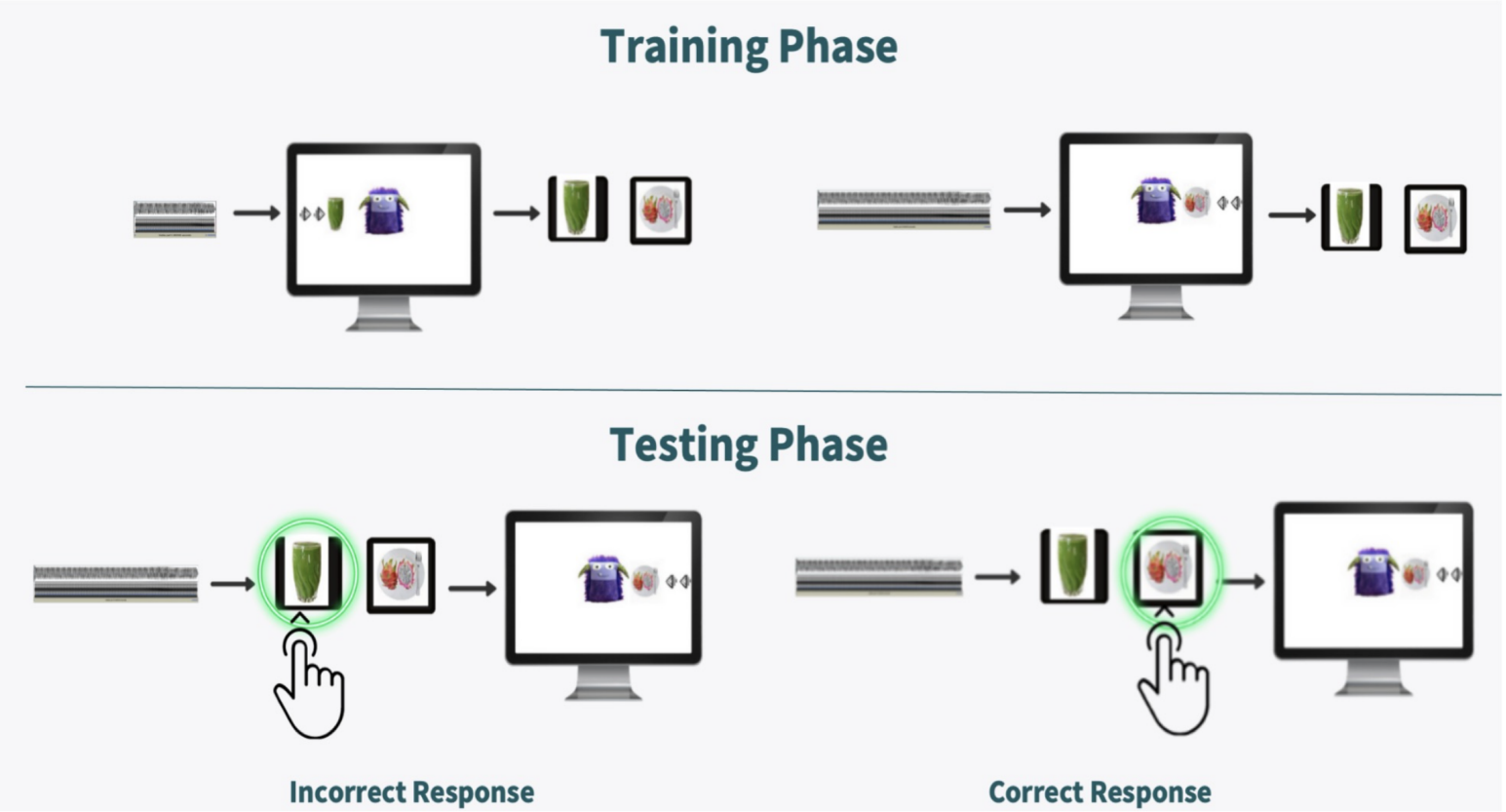
Background

- Experimental study comparing implicit learning in preschoolers with DLD and TLD.
- Participants seemed to learn an alternation heuristic in addition to associating sound with food or drink.



Goals

- Determine how to separate effect of alternation heuristic from learning of auditory cue corresponding to food or drink.
- If effects could not be separated, document difficulty in separating effects and impact of confounding.

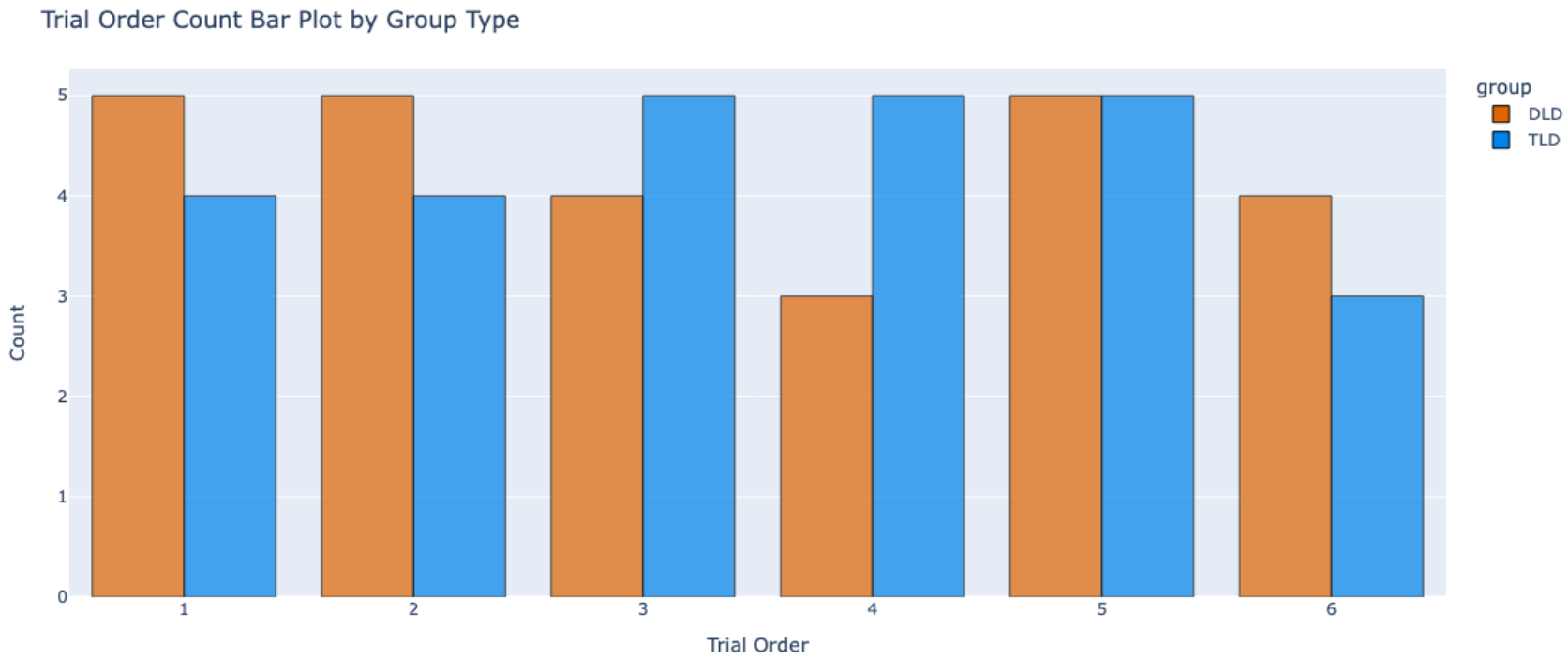
Basic Data Description

- Experimental data in tabular form.
- Response variable is binary indicating correctness of participant's indication of monster's request for food or drink.
- Additional variables explored: response time, trial number, trial order, sound type, experimental phase, alternation from previous trial, and participant type (TLD and DLD).
- 26 participants of each type (TLD and DLD).

Exploratory Data Analysis

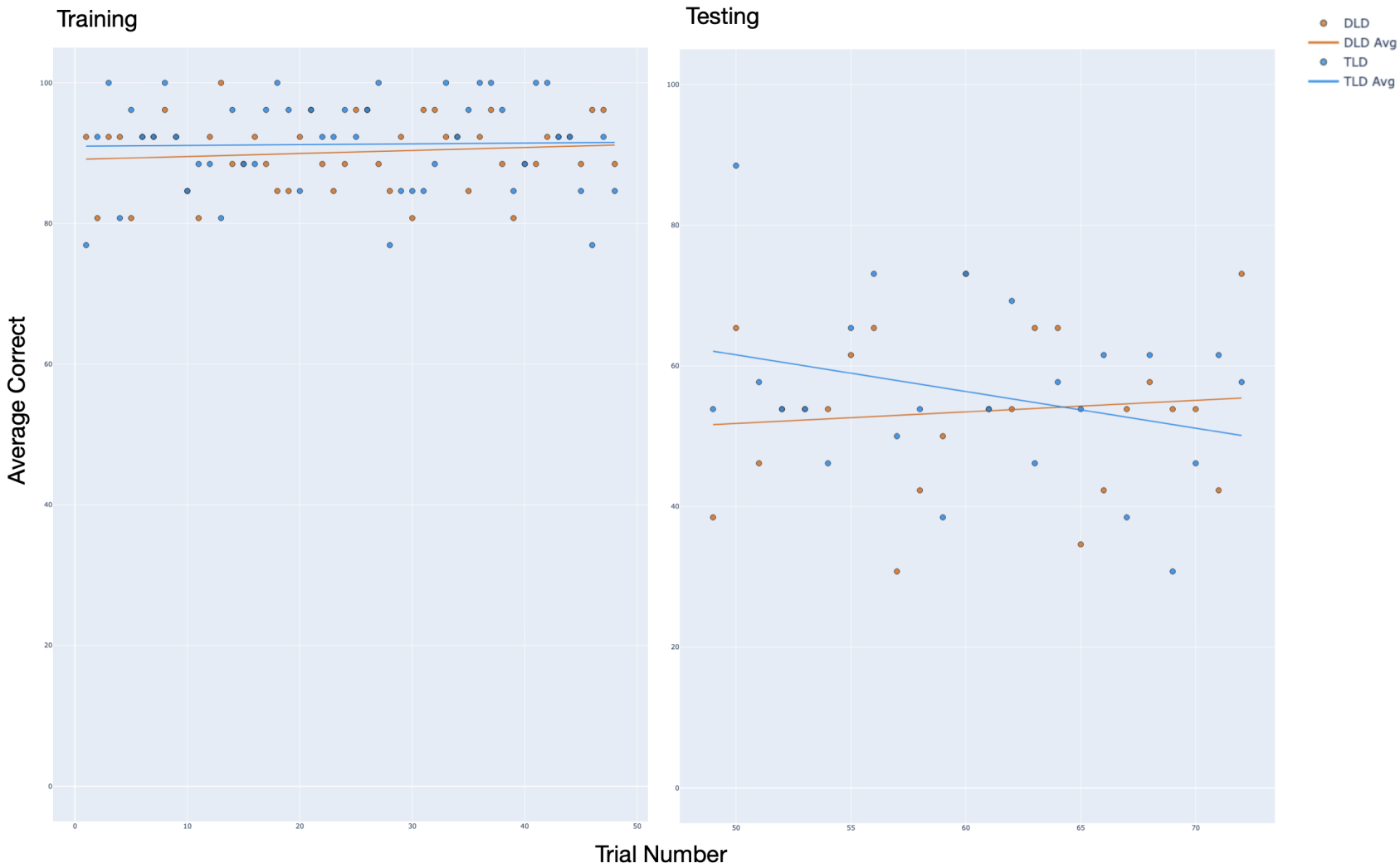
- No obvious outliers were observed in response times, correctness percentage, or side-switching counts for either DLD or TLD participants.
- The number of participants in each type, trial order group combination was examined.
- The trial order group specifies the sequence of alternation of the stimuli in the training and tests.

Trial Order Count Plot



Response Time Plot: EDA

Correctness Plot: EDA



Methods explored but determined unsuitable

- Treating individual trials as treatment periods in a crossover experimental design
  - Would have involved employing a mixed effects model
  - Determined unsuitable since carryover effects appear to be present between trials in testing phase of experiment
- Generalized additive mixed models using the ‘mcgv‘ library
  - Considered adding autoregressive terms to capture time varying treatment effect
  - Determined time varying confounding effects (alternation sequence) biases time varying treatment effect estimates

Methods explored that can handle time varying confounding

- Causal inference methods (used in longitudinal studies)
  - G-computation formula
  - Inverse probability weighting estimation of marginal structural models
  - G-estimation of structural nested models
- Sequential conditional mean models with propensity scores

Adapting Study Data to gfoRmula Package

- Specify the outcome type
- Structure an input dataset to the main function gformula()
- Interpret output (gformula class object)

follow-up time *k* for each subject	*p* time-varying covariates	values of time-fixed baseline confounders	value of the outcome in interval *K*+1
...	...	...	...

Conclusions

Recommend experimenting with implementing:

- G-computation formula via R package ‘gfoRmula‘
- Sequential conditional mean models with propensity scores via R package ‘geepack‘

Appendix

Causal Inference

- James Robins' generalized methods
- Originally developed for addressing problems with longitudinal studies in medicine and epidemiology
- This project could extend these methods to a novel context