A Bayesian Method for Measuring Risk Taking in the Balloon Analogue Risk Task

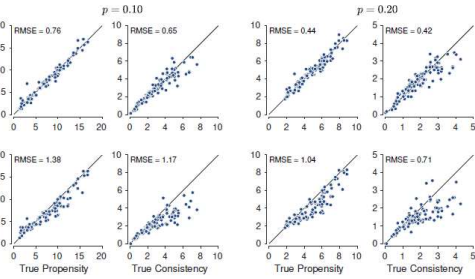Jeff Coon, Michael Lee

Introduction

- BART is a widely used method for measuring risk propensity
- Participants pump a balloon to increase reward, risking burst (and loss of reward) with each pump
- Burst balloons censor measurement of participants' intentions; we only know they wanted to pump at least that much
- Traditional metric, adjusted pumps, is mean pumps of unburst balloons
- By ignoring burst balloons, adjusted pumps mismeasures risk propensity

Methodology

Developed hierarchical Bayesian model to measure participants' intentions using all trials

- Used "dinterval" function in JAGS (Plummer, 2003) to account for censored measurements
- Implemented in R, MATLAB, and JASP (see OSF repository for code)
- Additional components for correlation and group comparison hypothesis tests
- Conducted parameter recovery study
- Examined pre-existing data (Guan et al., 2020; Lejuez et al., 2003) as test case

Results

Parameter recovery with our model (top row) and adjusted pumps (bottom row). Note that adjusted pumps underestimates risk propensity

The BART's traditional metric mismeasures risk propensity because it ignores censored measurements.
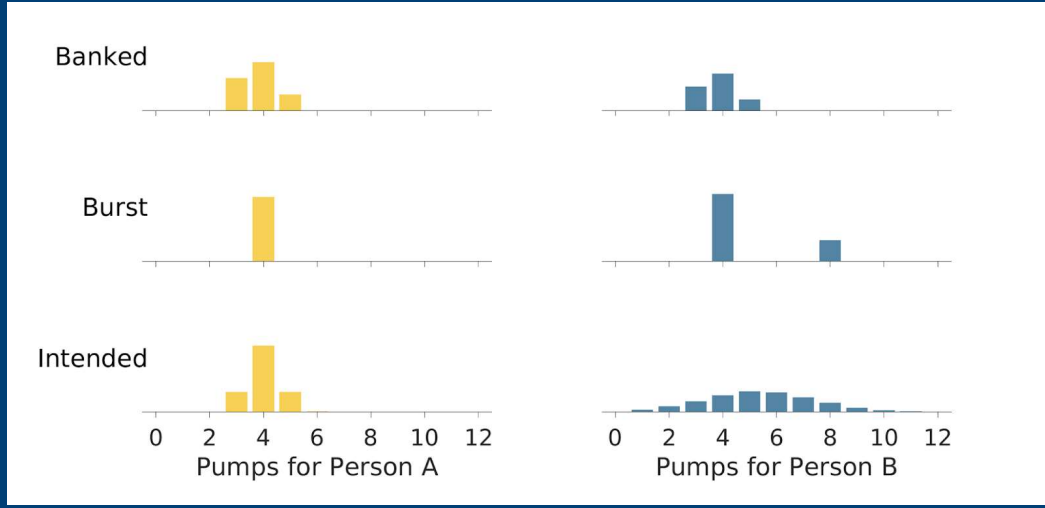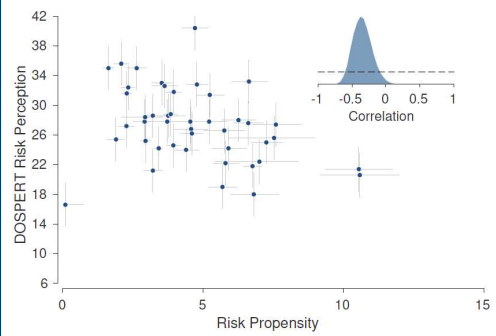

The adjusted pumps metric would interpret these participants' behavior as identical because it ignores trials where balloons burst. The output of our hierarchical Bayesian model (3rd row) accounts for burst trials as censored measurements of participants' intentions.
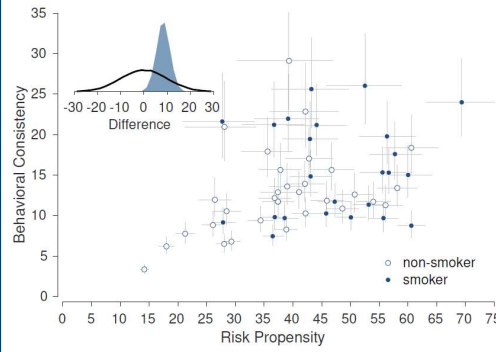
Hypothesis Testing

Worked example, applying model to testing for correlation between BART risk propensity and risk perception as measured by DOSPERT (data from Guan et al., 2020)

Worked example, applying model to testing for group differences in BART risk propensity between smokers and non-smokers (data from Lejuez et al., 2003)

PDF

OSF Repository (w/ code)