

## Common Metric for Substance Use to Prevent HIV

- Can we link substance use severity across legacy and modern measures?
- This would allow comparisons across diverse studies and within cohorts that have changed measurement over time.
- To achieve this, we needed to interrogate how substance use severity is measured.



# How do we measure substance use severity?

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# What is substance use severity and how do we measure it

- Frequency:
  - In the past three months, how often have you used cocaine?
- Symptomology (DSM-5 / PROMIS)
  - My desire to use cocaine seemed overpowering
  - I felt I needed help for my cocaine use
  - During the past 12 months, did you have any serious problems like these at work, school, or home because of your use of cocaine?

# How do we measure (and model) use of multiple substances?

- Polydrug use is common and shared environmental and genetic liabilities for SUD across substances
- Three approaches:
  - Measure substance specific severity
    - Separately model cocaine severity, methamphetamine severity, etc.
  - General measure with specific items
    - Ask questions for each substance but model as a general spectrum
  - General measure with generic items
    - Ask generic questions about “drug use” and model as general spectrum

# How do we measure (and model) use of multiple substances?

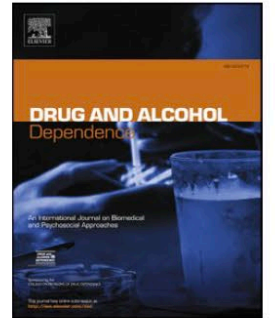
- Strong statistical support for a general measurement of severity but should we use generic or specific items?
- Generic items reduce burden and may be less sensitive to drug substitution
- However, do these questions *mean the same thing* for people using different drugs?
  - Certain drugs may have different physiological or psychological impacts.
- If questions behave differently across substances, then ‘scores’ of individuals cannot be compared across individuals with different drug use profiles.



Contents lists available at [ScienceDirect](#)

## Drug and Alcohol Dependence

journal homepage: [www.elsevier.com/locate/drugalcdep](http://www.elsevier.com/locate/drugalcdep)

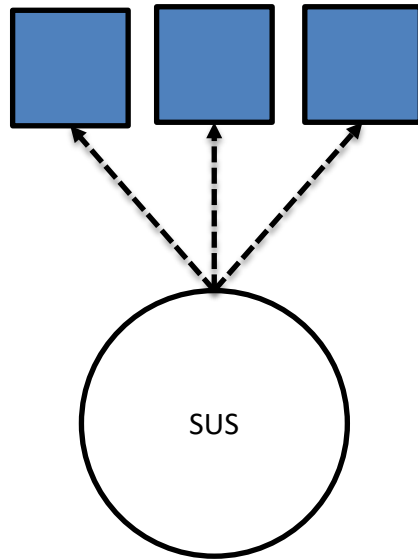


Can severity of substance use be measured across drug classes? Estimating differential item functioning by drug class in two general measures of substance use severity

Patrick Janulis<sup>a,b,\*</sup>, Jing Luo<sup>a</sup>, Xiaodan Tang<sup>a</sup>, Benjamin D. Schalet<sup>c,d</sup>

# Item response theory (IRT) and DIF

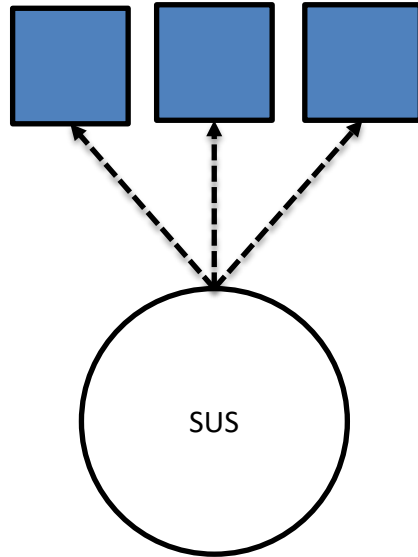
Substance use severity



$$P(X = 1|\theta, a, b) = \frac{e^{a(\theta-b)}}{1 + e^{a(\theta-b)}}$$

# Item response theory (IRT) and DIF

Substance use severity

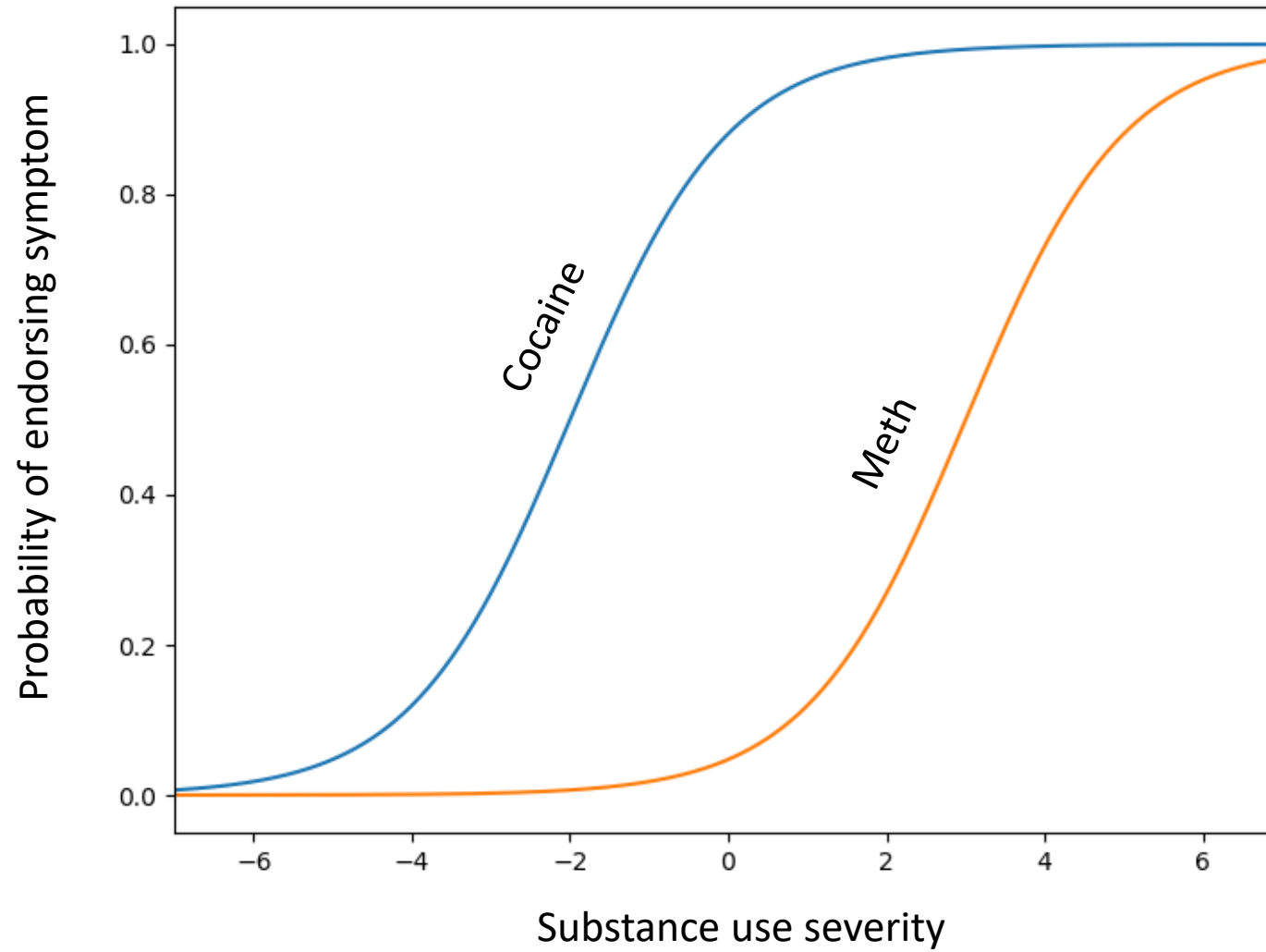


$$P(X = 1|\theta, a, b) = \frac{e^{a(\theta-b)}}{1 + e^{a(\theta-b)}}$$

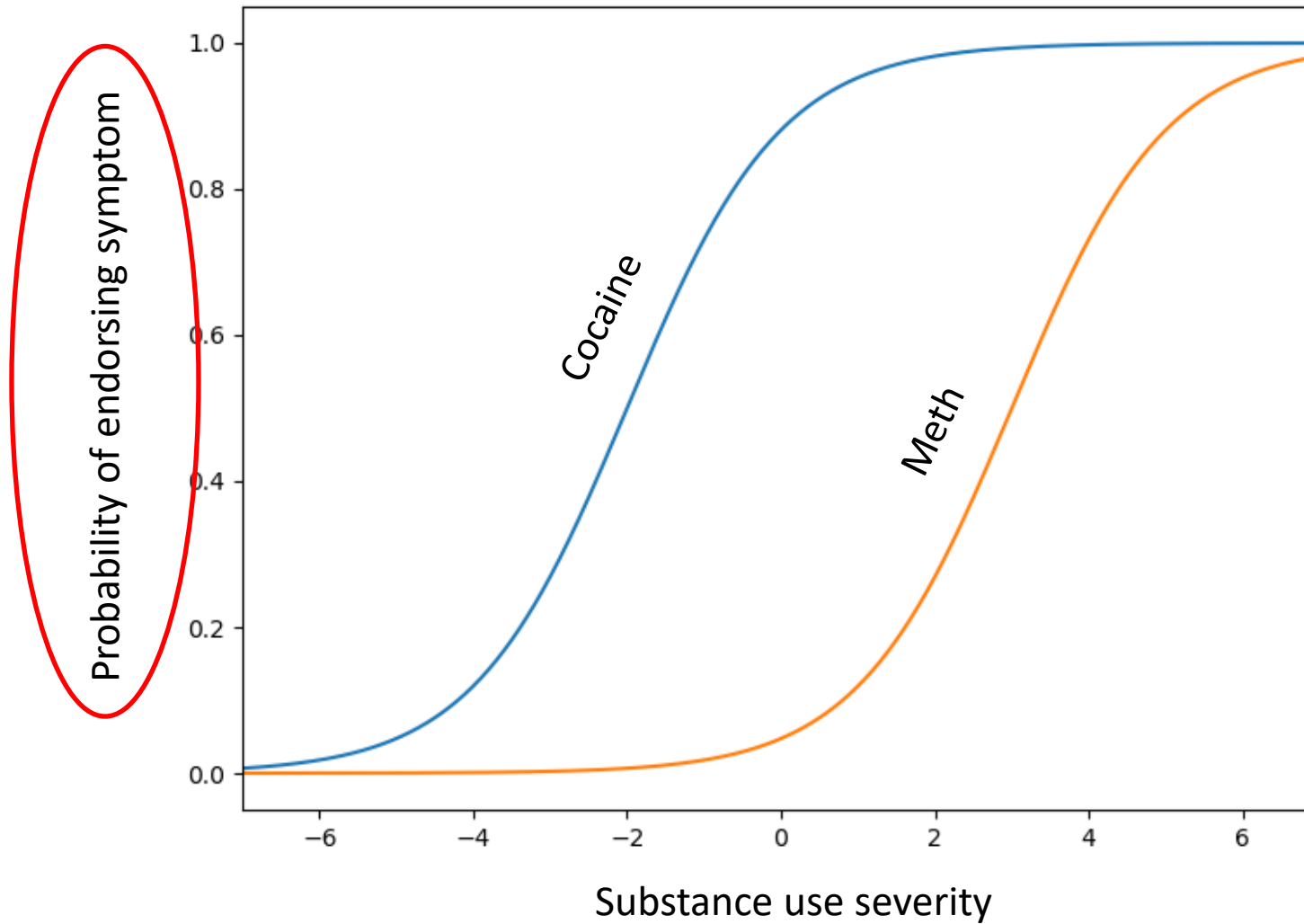
*Do these parameters differ for people using different substances?*



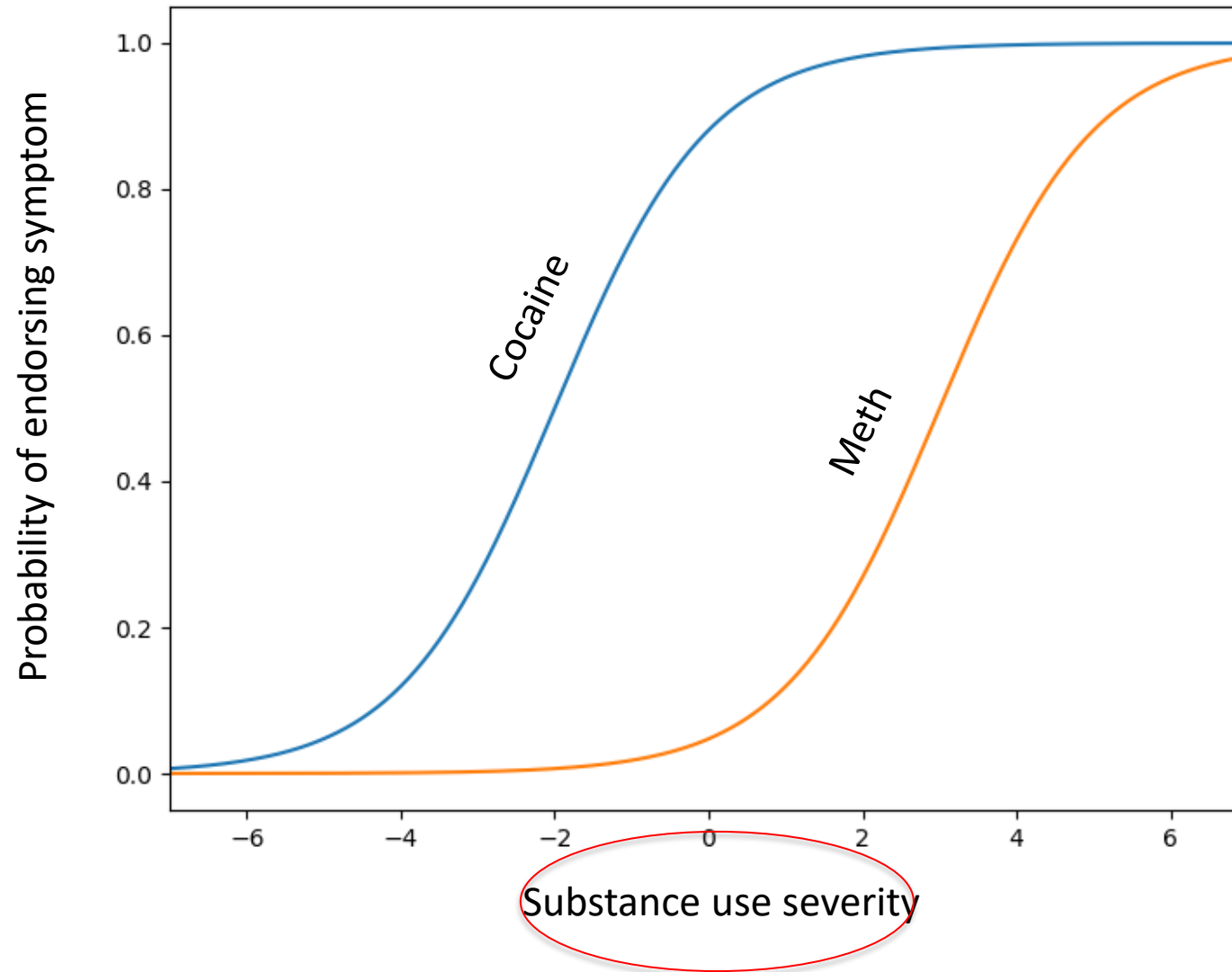
I felt that my drug use was out of control



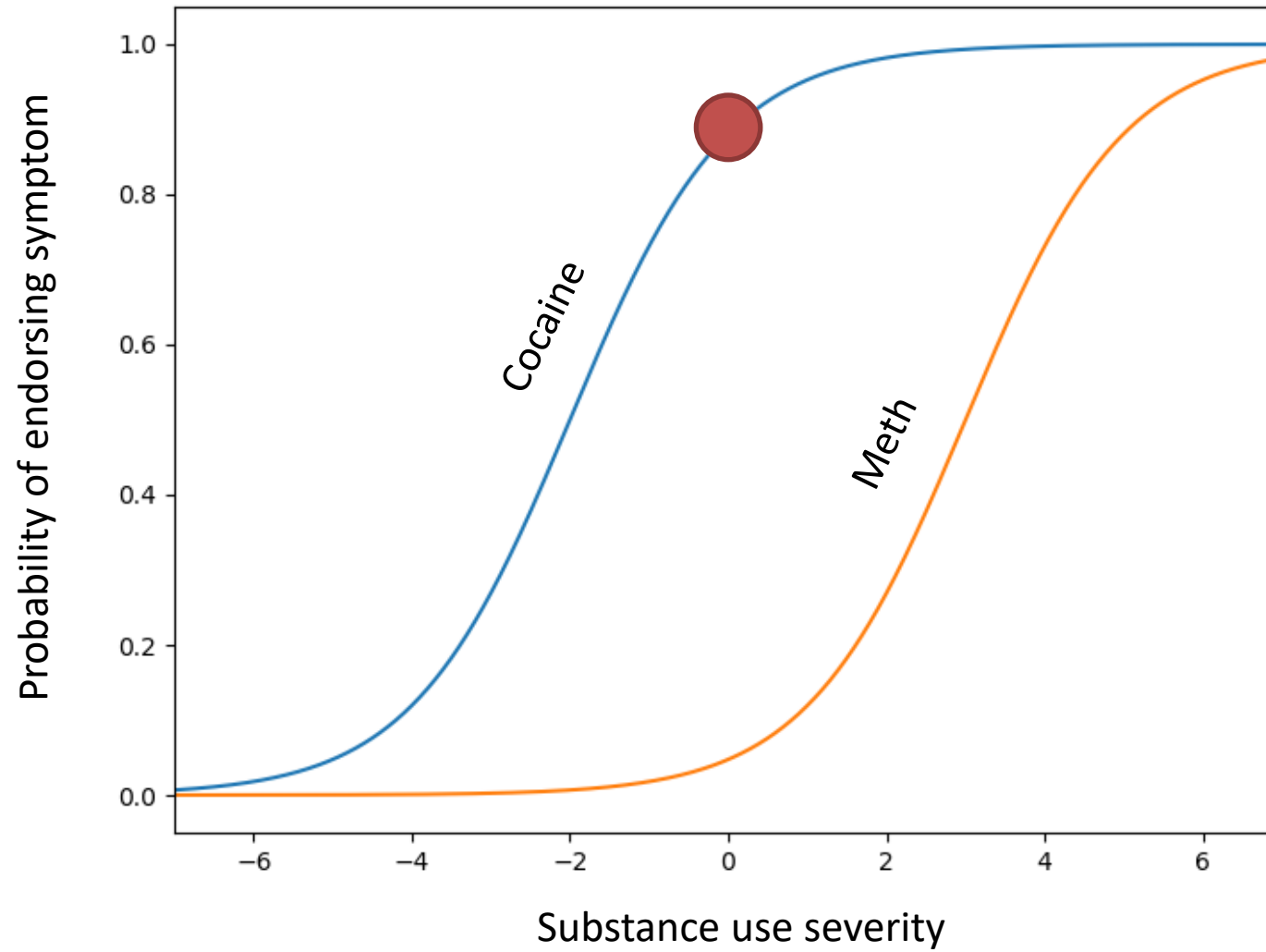
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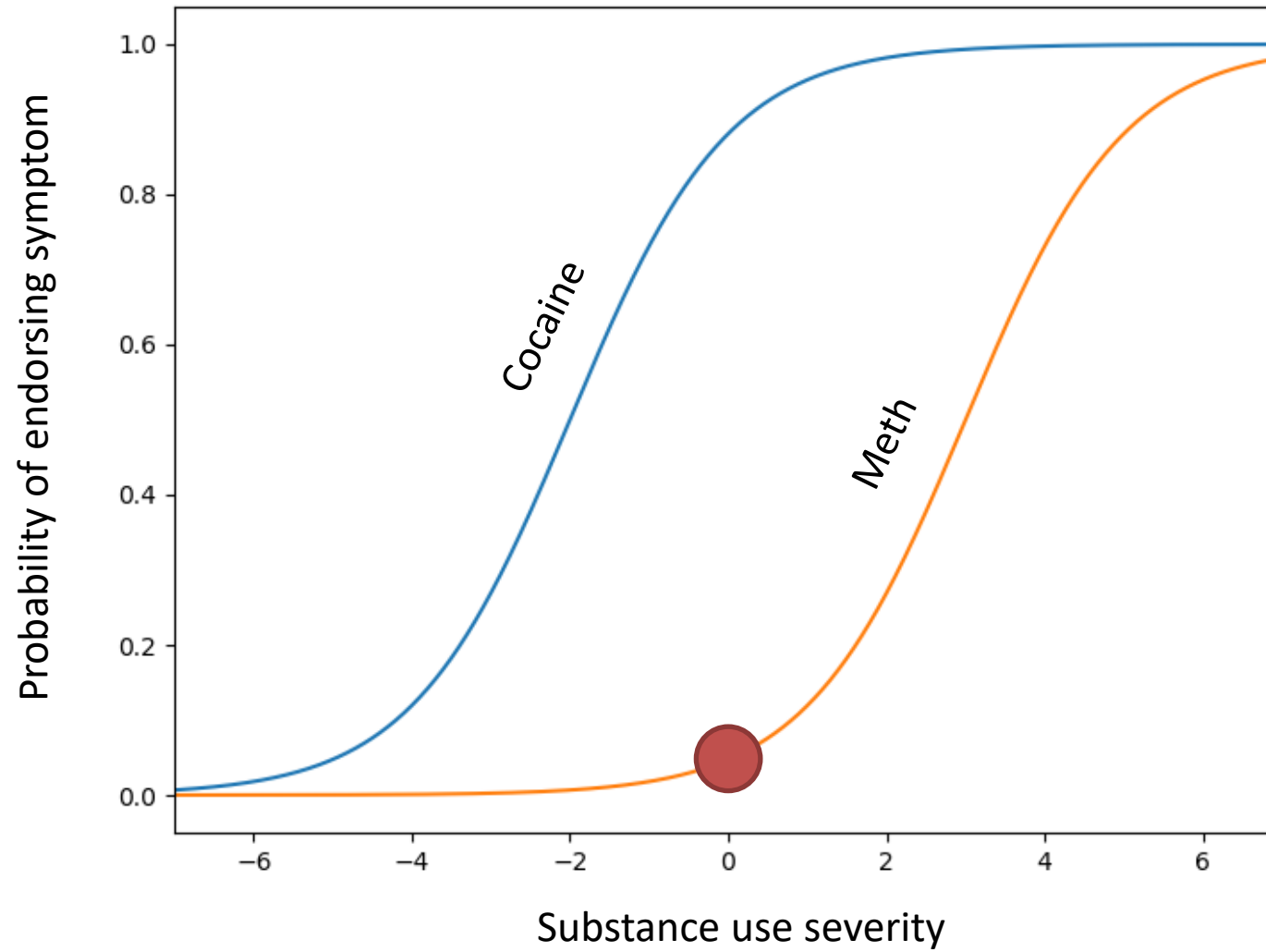
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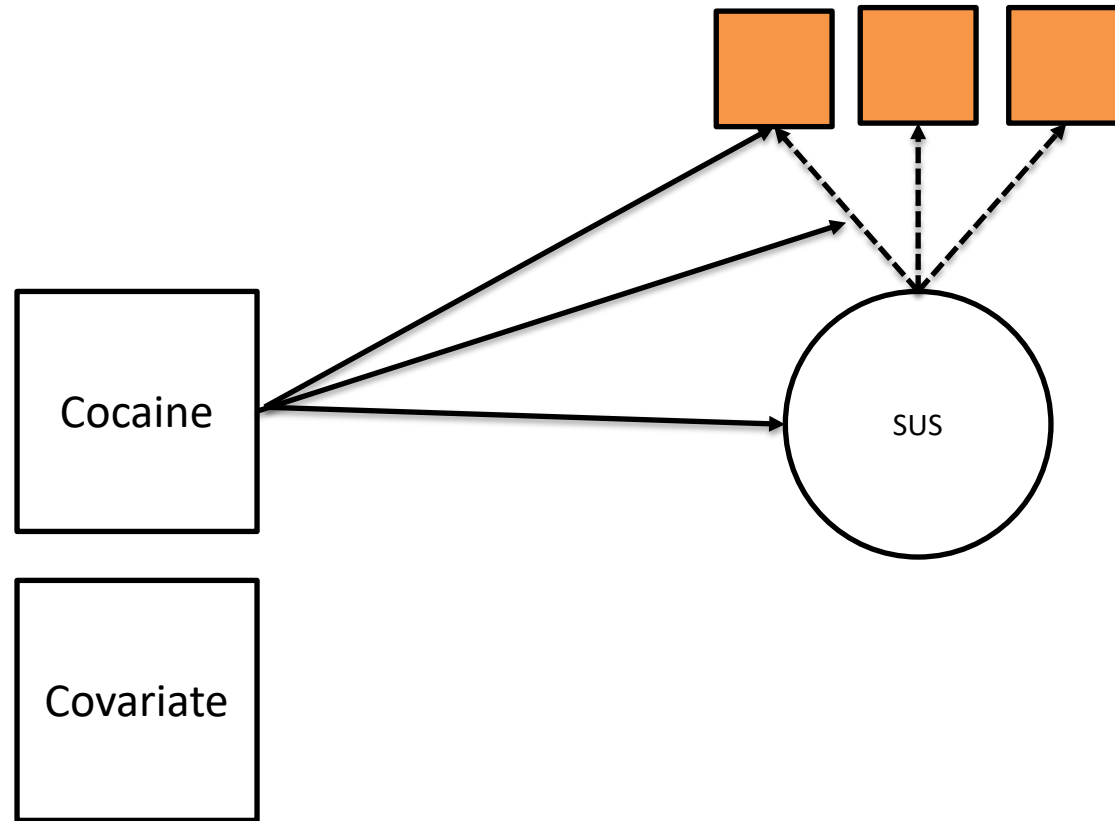
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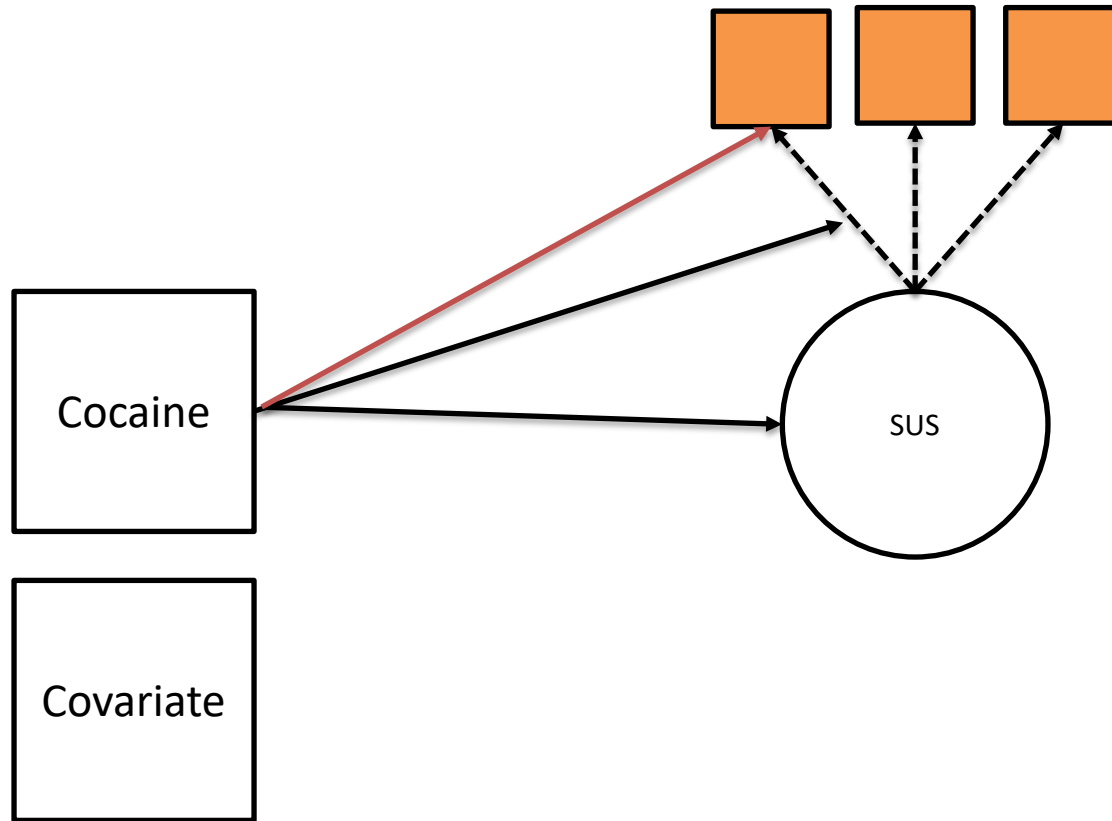
# Methods

- Use two independent samples with people who use drugs on the same measure (PROMIS Severity of Substance Use)
- Sample 1: Pilkonis et al. (2015)
  - Clinical sample (n = 461)
  - Online sample (n = 875)
  - All items of scale
  - Comparing across sedatives, opioids, amphetamines, cocaine, and cannabis
- Sample 2: Schalet & Janulis (2023)
  - Online sample (n = 5,183)
  - 20 items with highest discrimination (i.e., factor loading)
  - Comparing across opioids, amphetamines, cocaine, and cannabis
- Examine for DIF using moderated non-linear factor analysis (MNLFA)

# Moderated non-linear factor analysis (MNLFA)

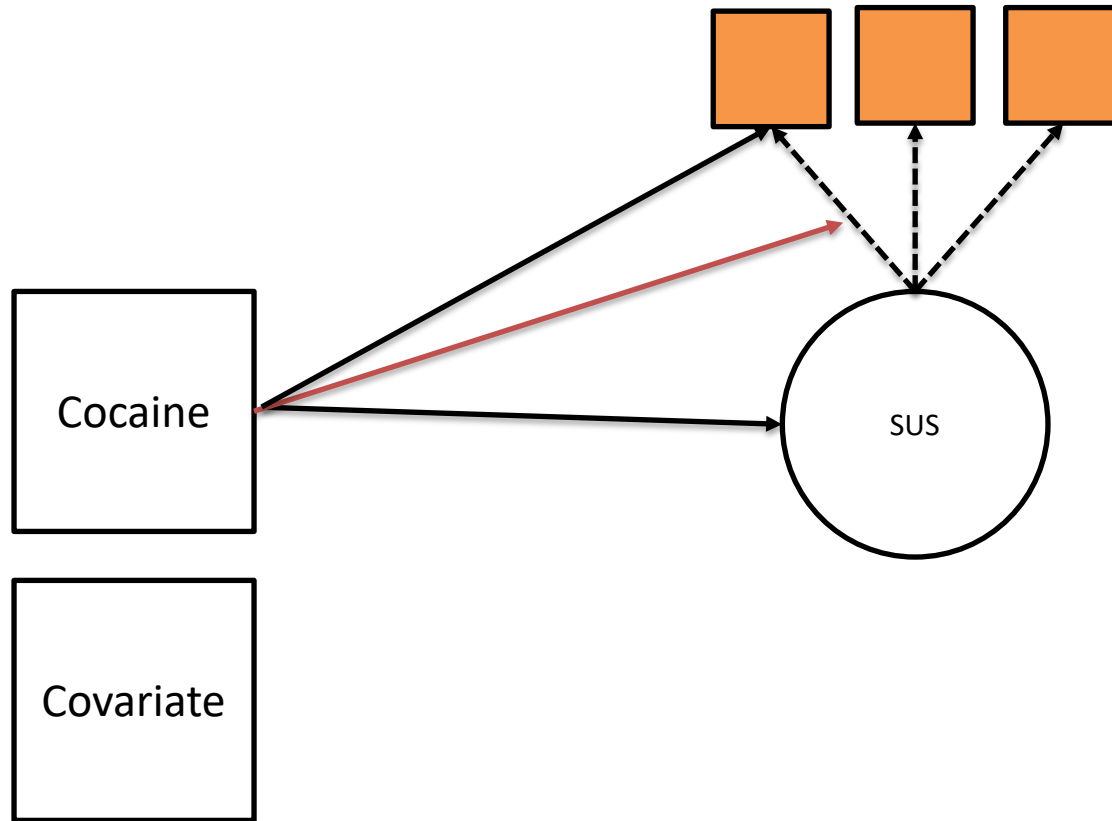


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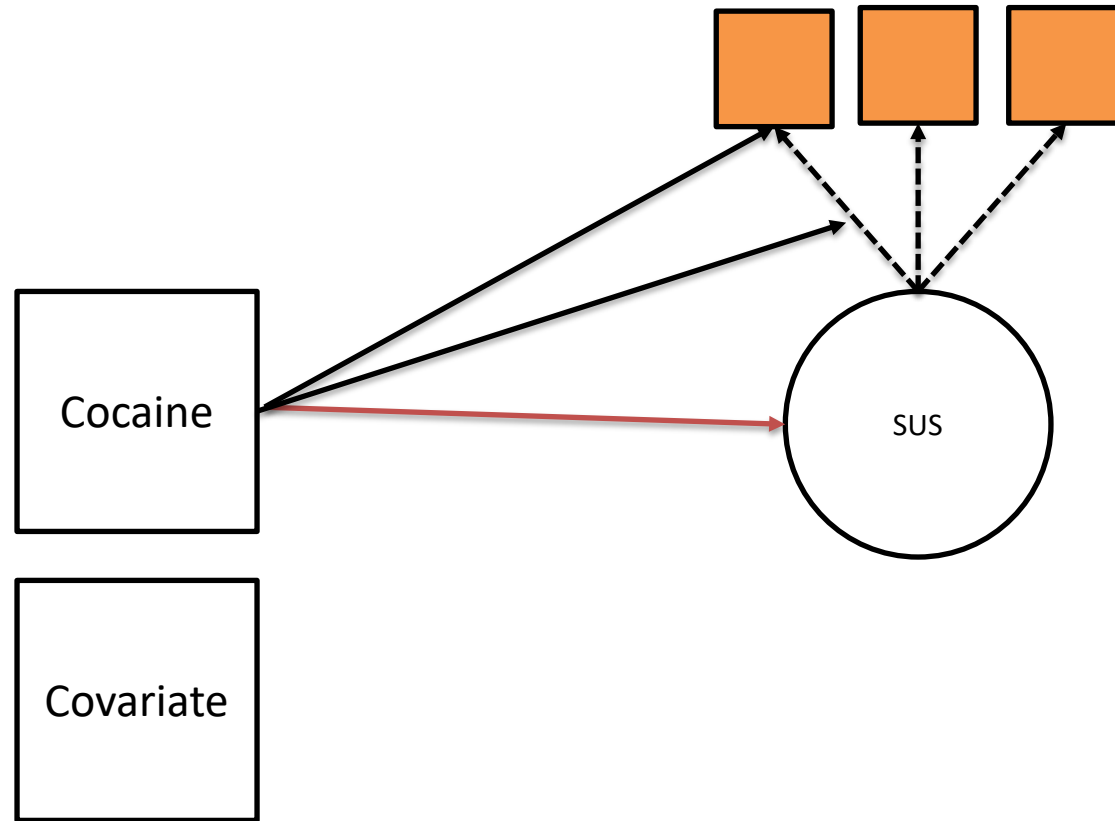




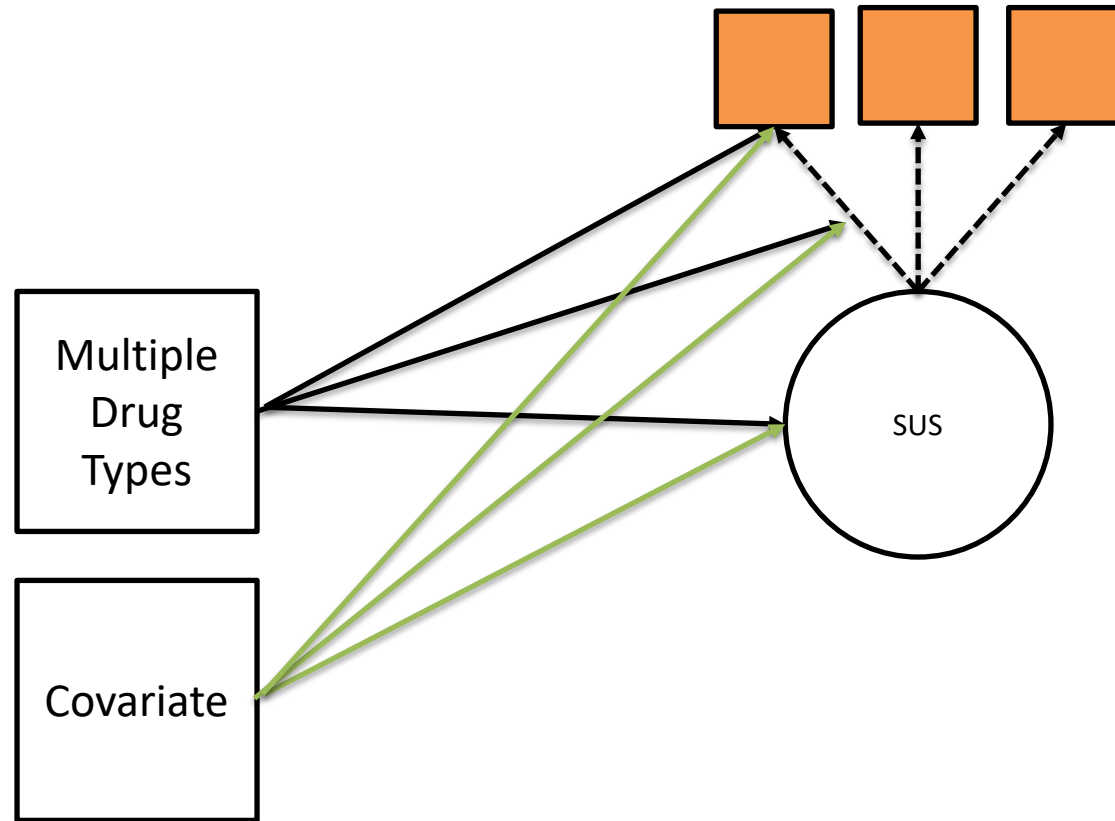
# Moderated non-linear factor analysis (MNLFA)



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# Moderated non-linear factor analysis (MNLFA)



# Methods

- Estimate DIF using moderated non-linear factor analysis (MNLFA)
- If any DIF is observed, how do we understand the meaningfulness of DIF?
- Estimate factor scores controlling for DIF and not controlling for DIF
- Use these scores to see if they have observable patterns
  - Look at correlation in scores
  - Do they differ across users of specific substances?
  - Do scores differ across levels of substance use severity?

# Results

- Sample 1: 5/37 items had statistically significant DIF
- Sample 2: 7/20 items had statistically significant DIF
- No overlap of which items showed DIF
- No consistent pattern of which substances indicating DIF
- How do factor scores compare?

**Table 1**

PROMIS Sample 1 items with statistically significant differential item functioning by drug class.

#	Item Summary	Cannabis DIF		Cocaine DIF		Amphetamine DIF		Opioid DIF	
		Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope
1	Out of control					2.41 (0.83)	-1.54 (0.51)		
4	Needed help	-2.53 (0.69)	1.32 (0.44)						
11	Sold belongings							3.10 (0.89)	-1.68 (0.50)
19	Emotional problems			0.87 (0.26)					
27	Got headaches							0.84 (0.25)	

Note. Estimate and standard errors for parameters in the simultaneous DIF model. Positive estimates indicate higher difficulty (intercept) or discrimination (slope). PROMIS item text is truncated.

**Table 2**

PROMIS Sample 2 items with statistically significant differential item functioning by drug class.

#	Item Summary	Cannabis DIF		Amphetamine DIF		Opioids DIF	
		Intercept	Slope	Intercept	Slope	Intercept	Slope
2	Desire to use overpowering					0.48 (0.13)	
6	Spent more time than intended					-0.50 (0.15)	
7	Have a problem	-0.52 (0.18)					
10	Addicted to drugs			0.37 (0.13)		0.57 (0.14)	
14	Kept from getting things done			-1.40 (0.31)	0.77 (0.22)	-0.59 (0.14)	
17	Spent a lot of time	0.53 (0.14)					
20	Planned my activities around	1.35 (0.33)	-0.73 (0.23)				

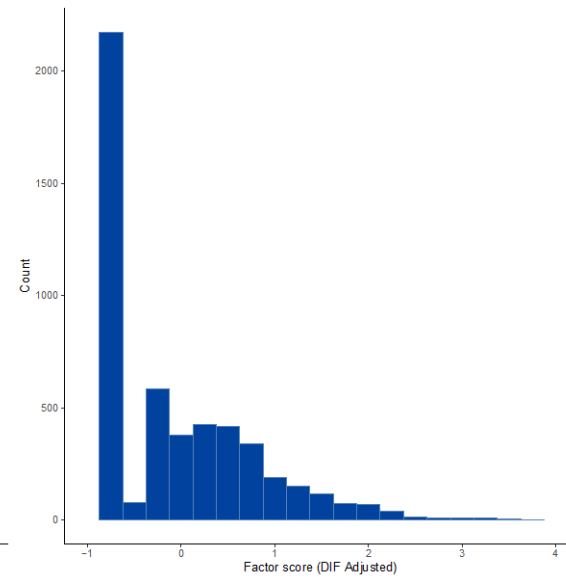
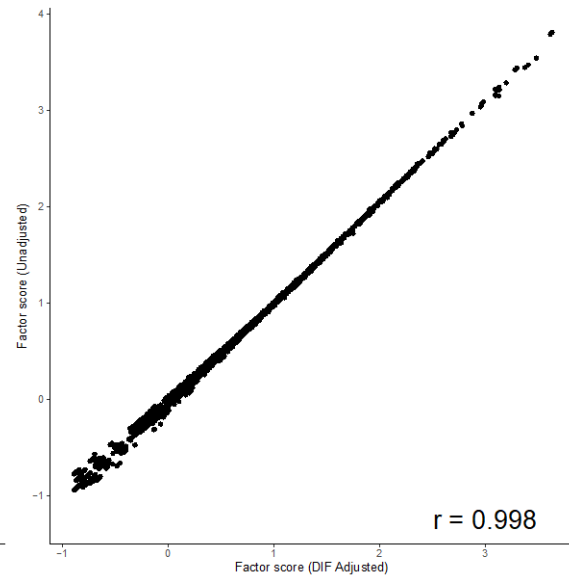
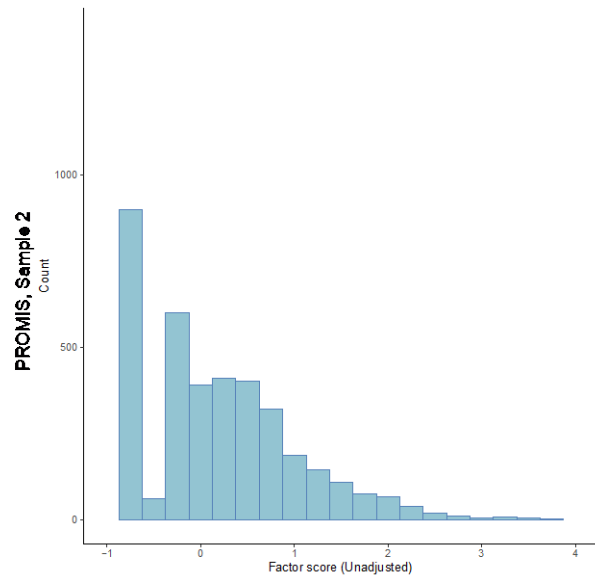
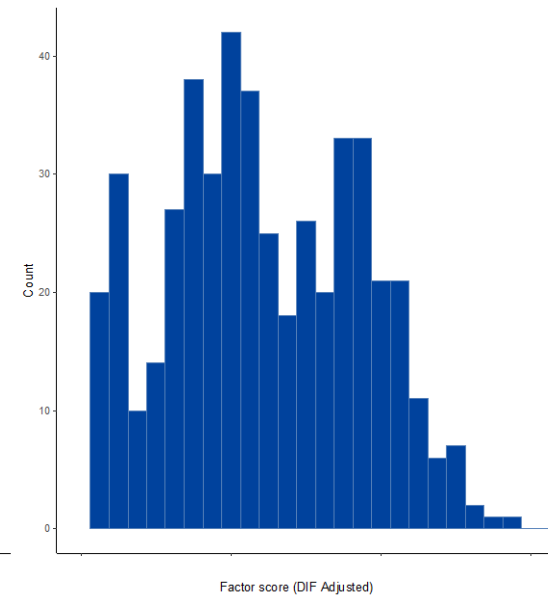
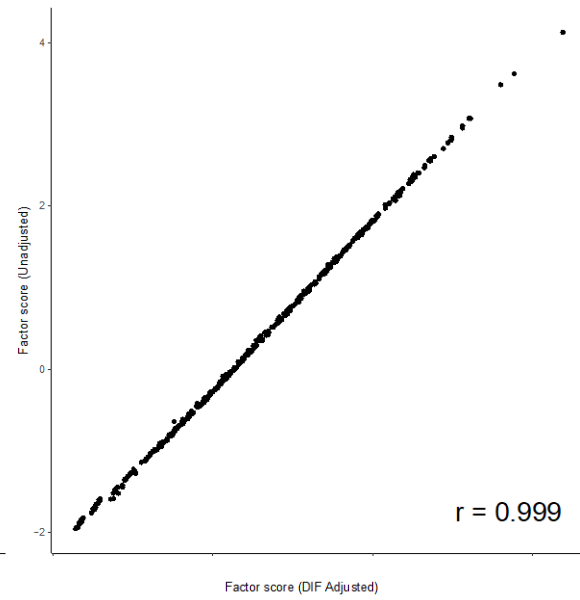
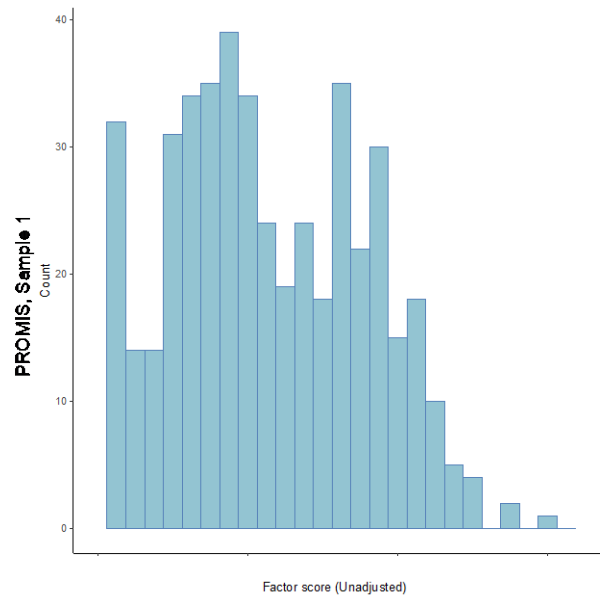
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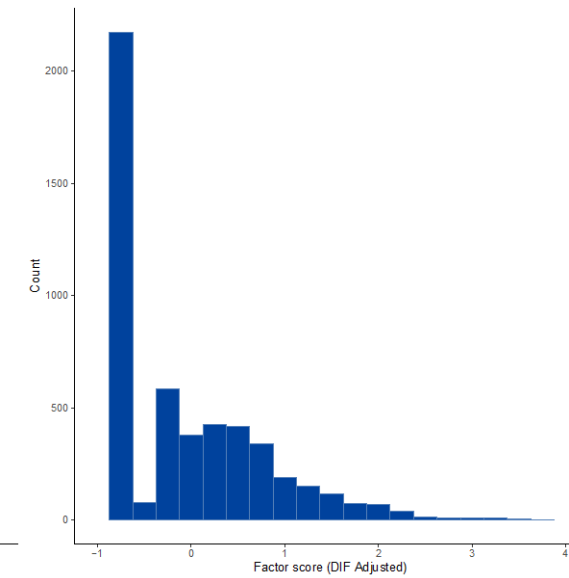
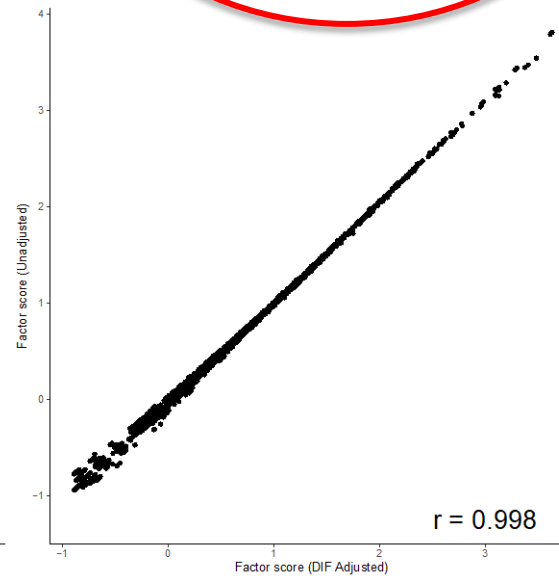
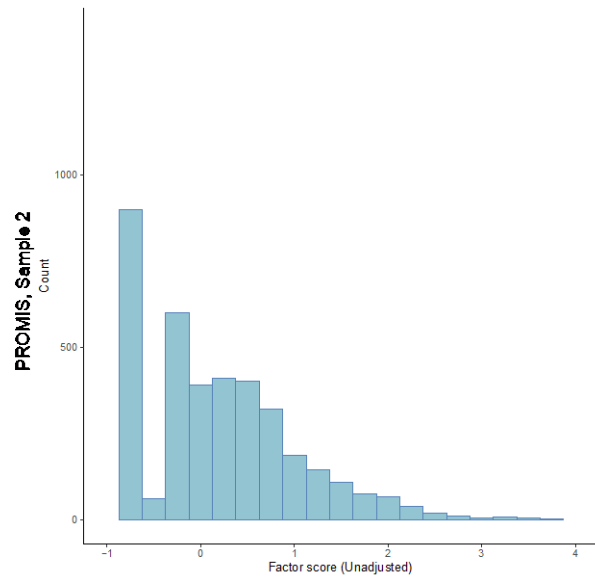
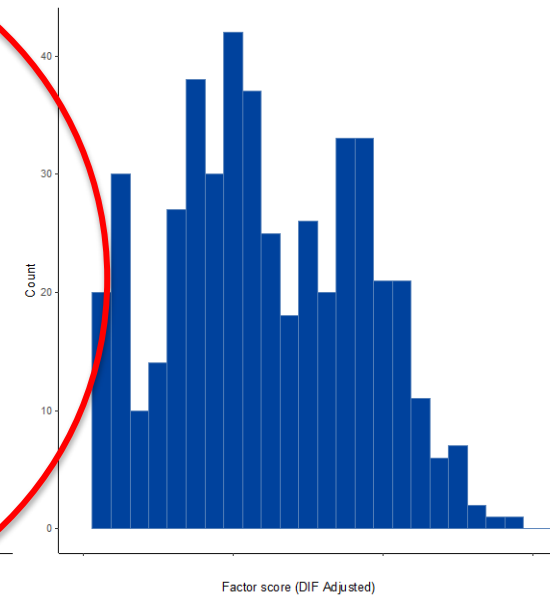
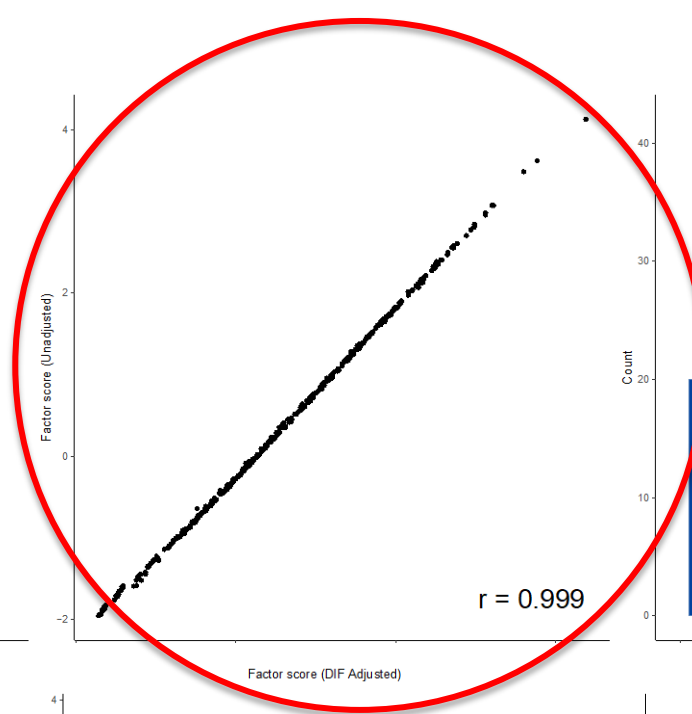
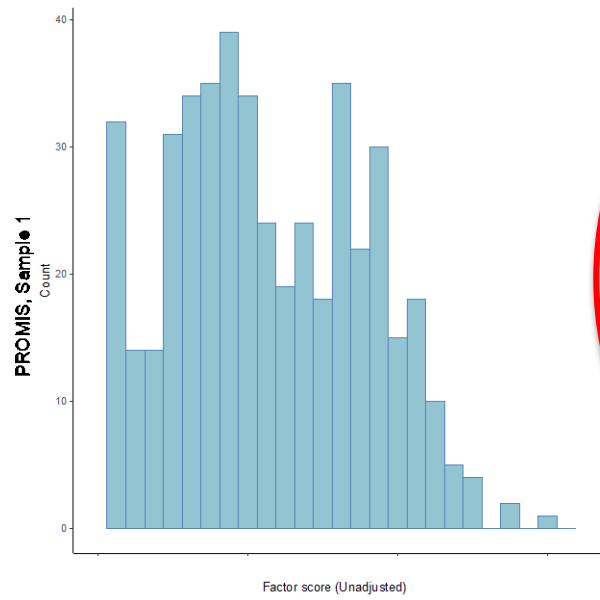
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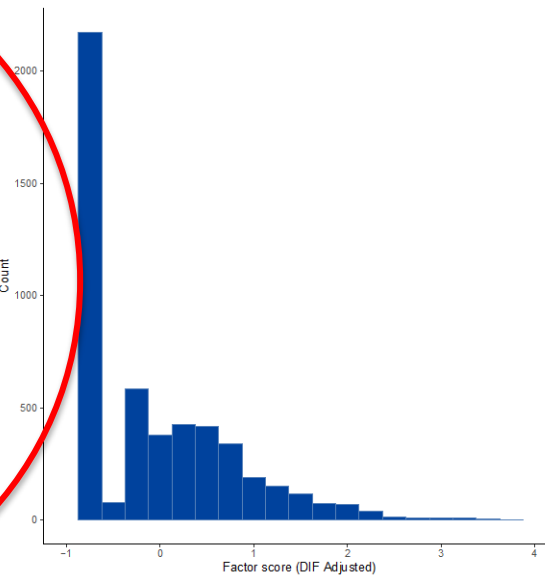
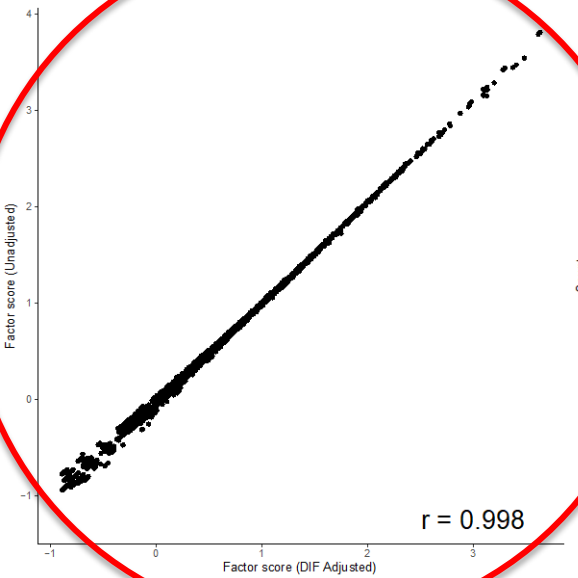
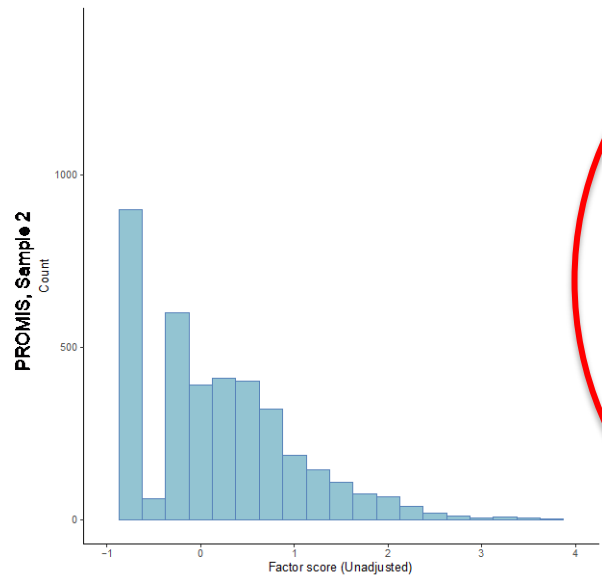
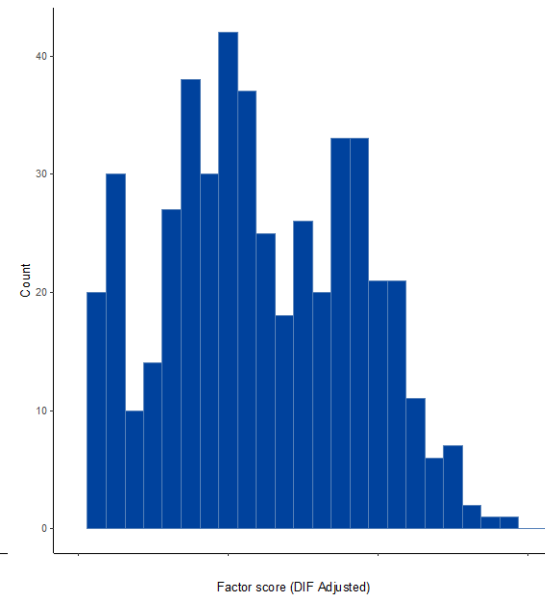
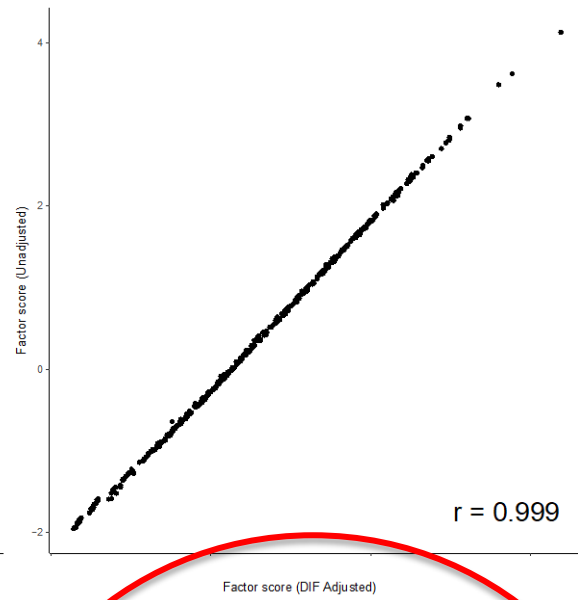
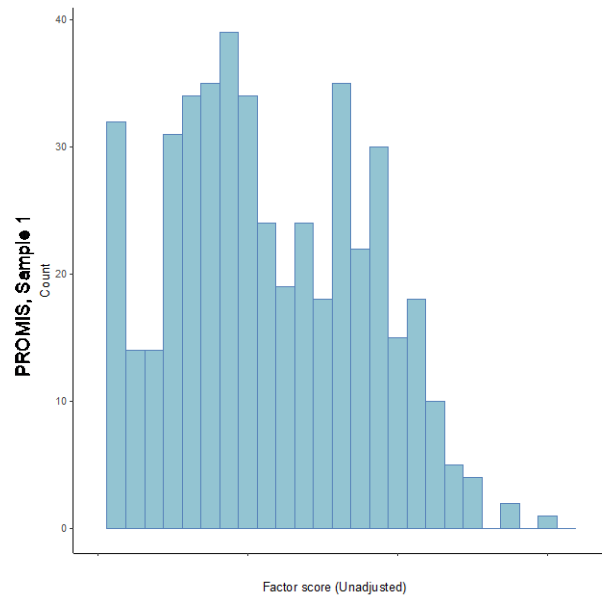
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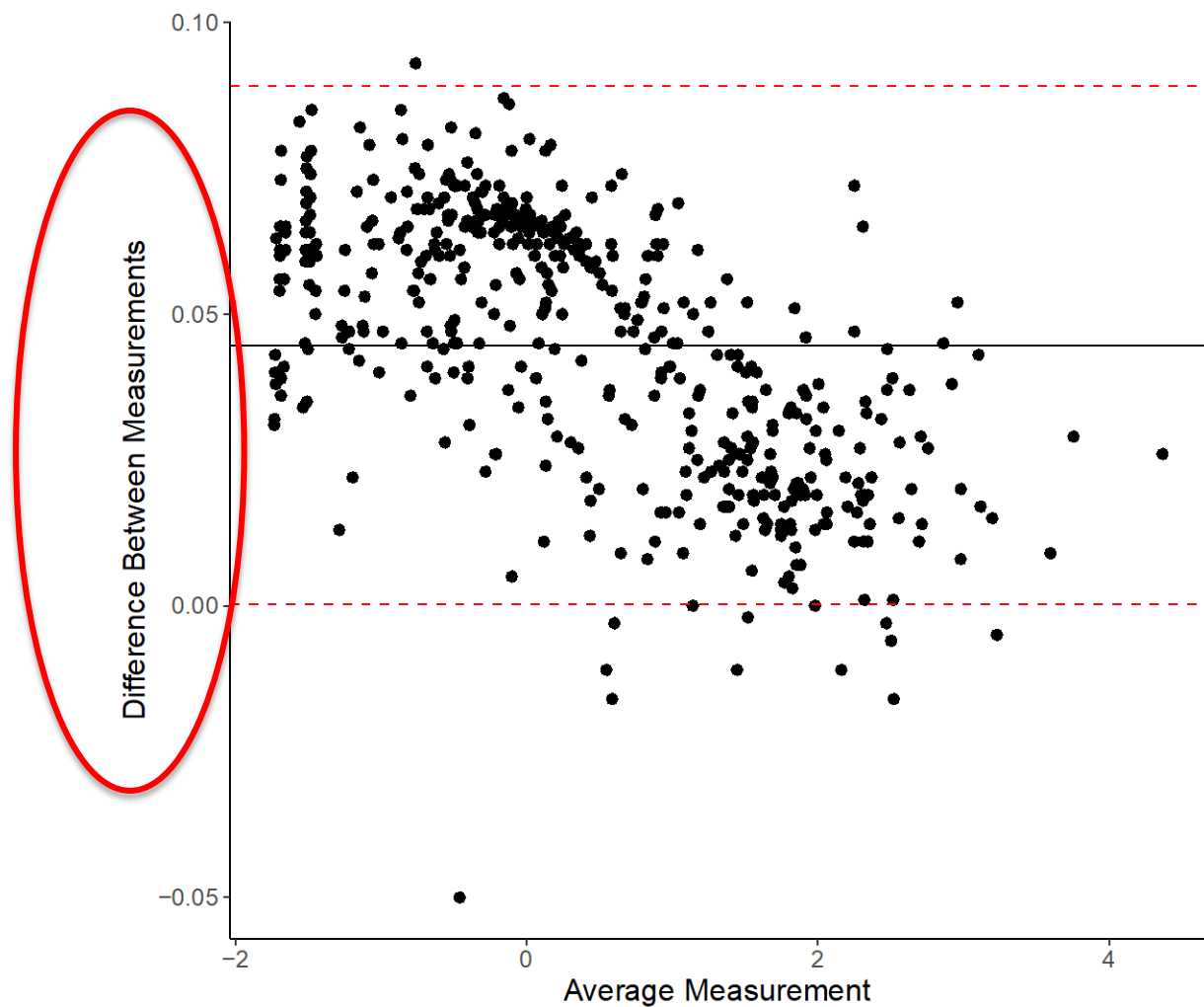




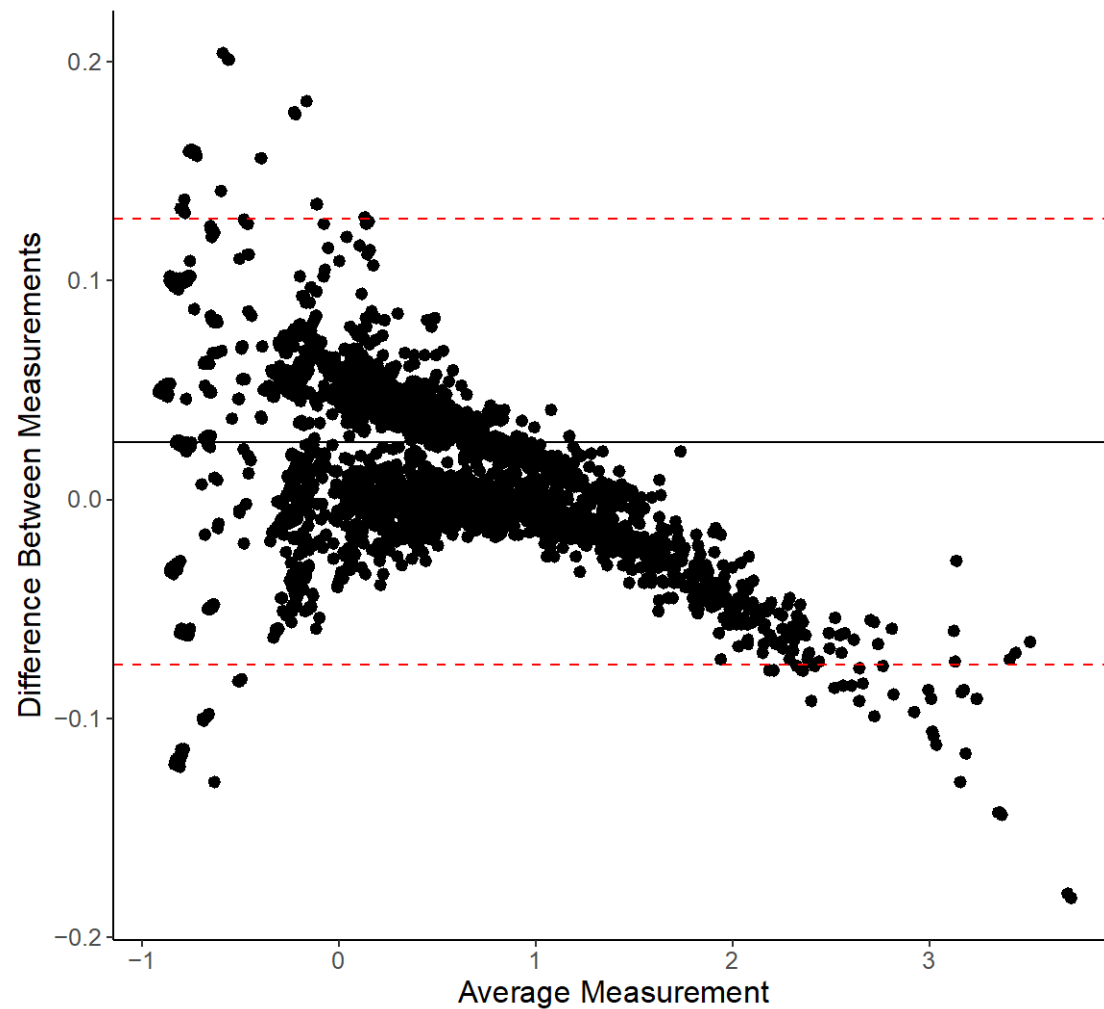




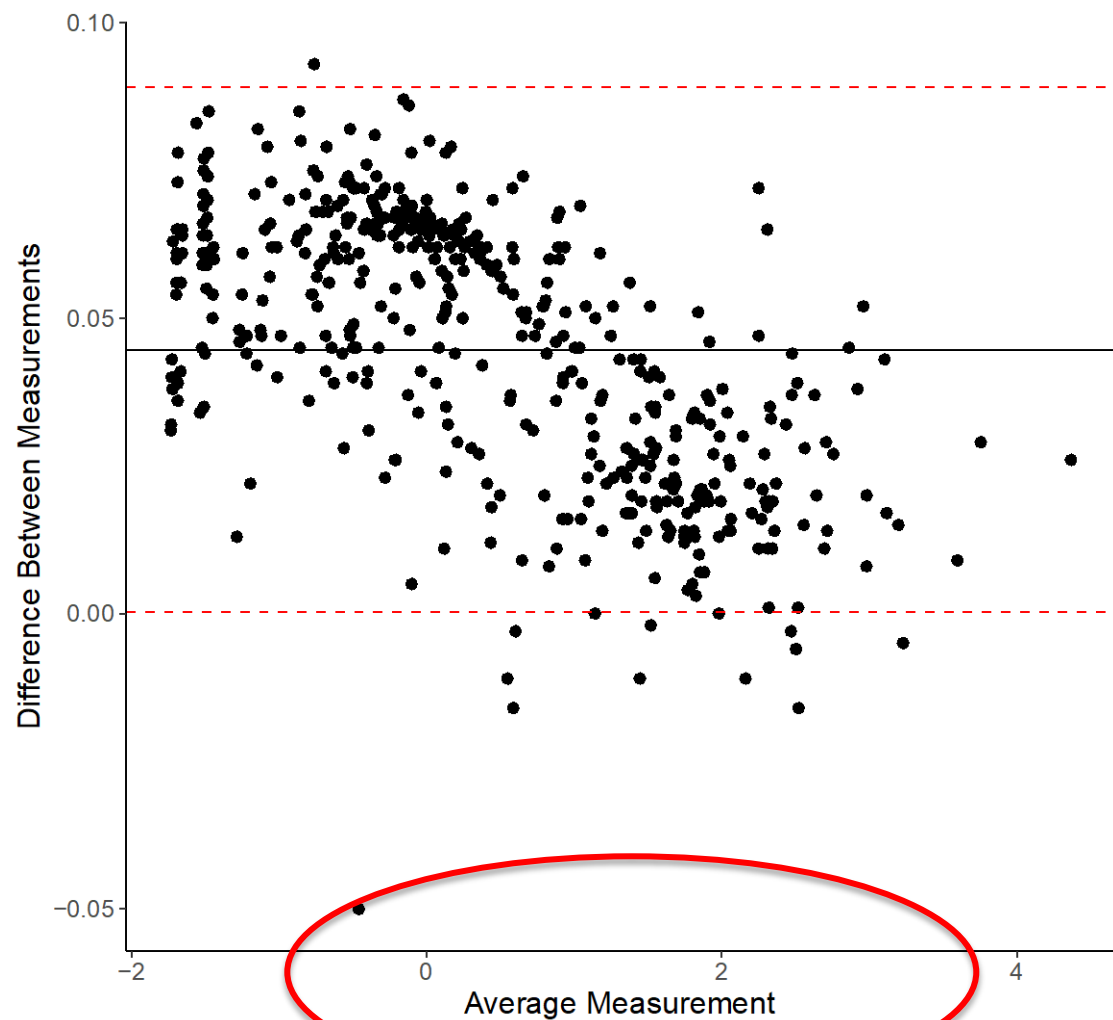
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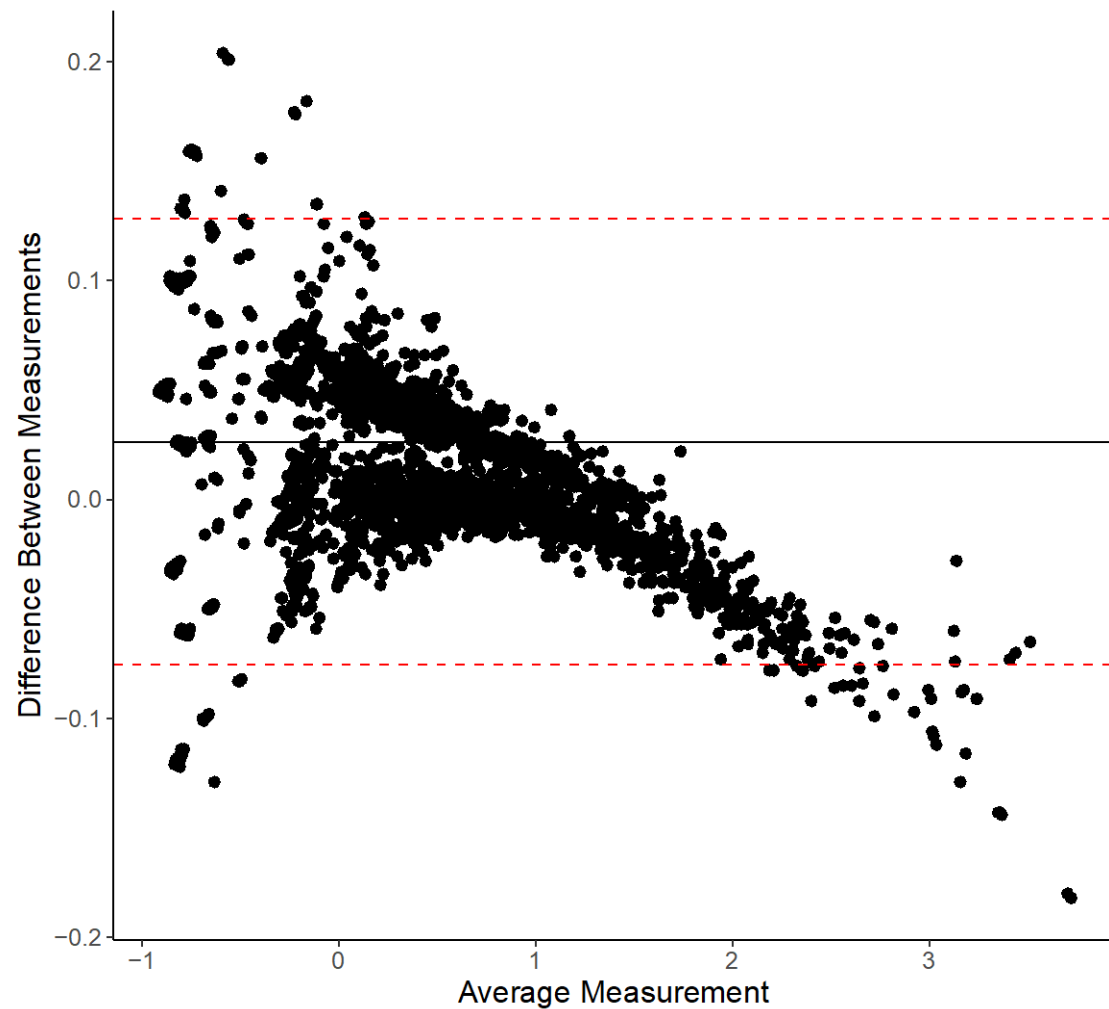
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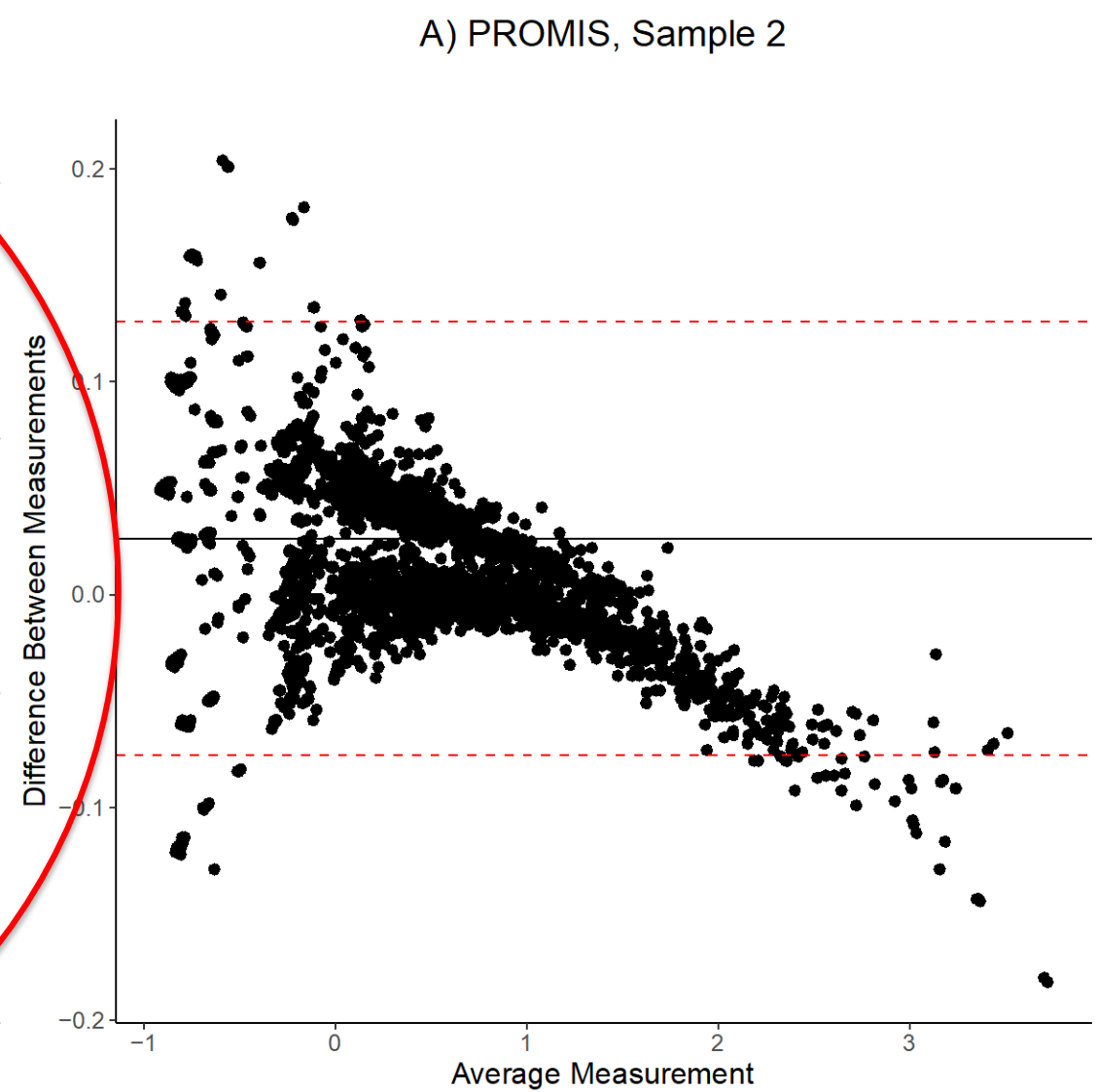
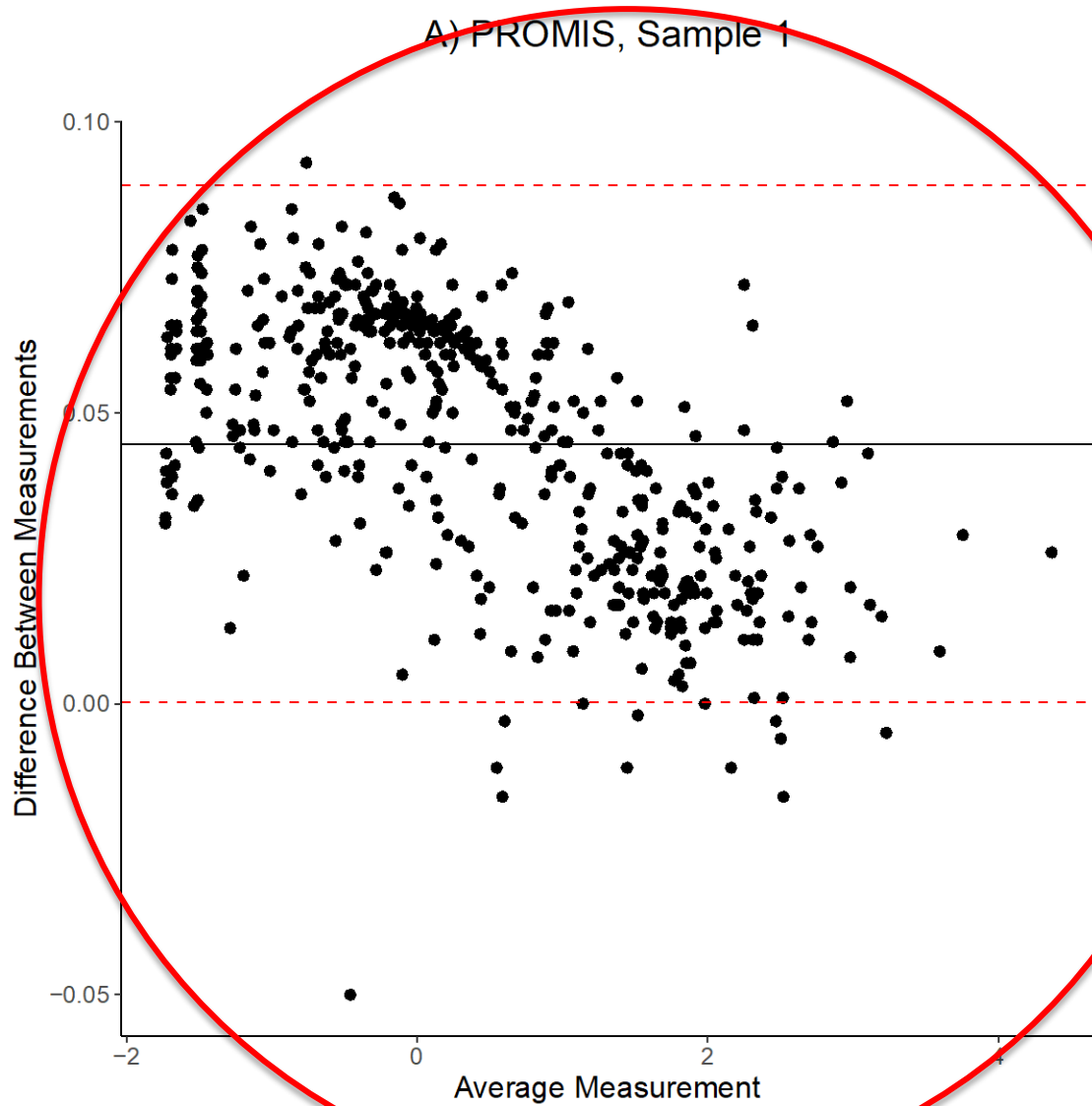


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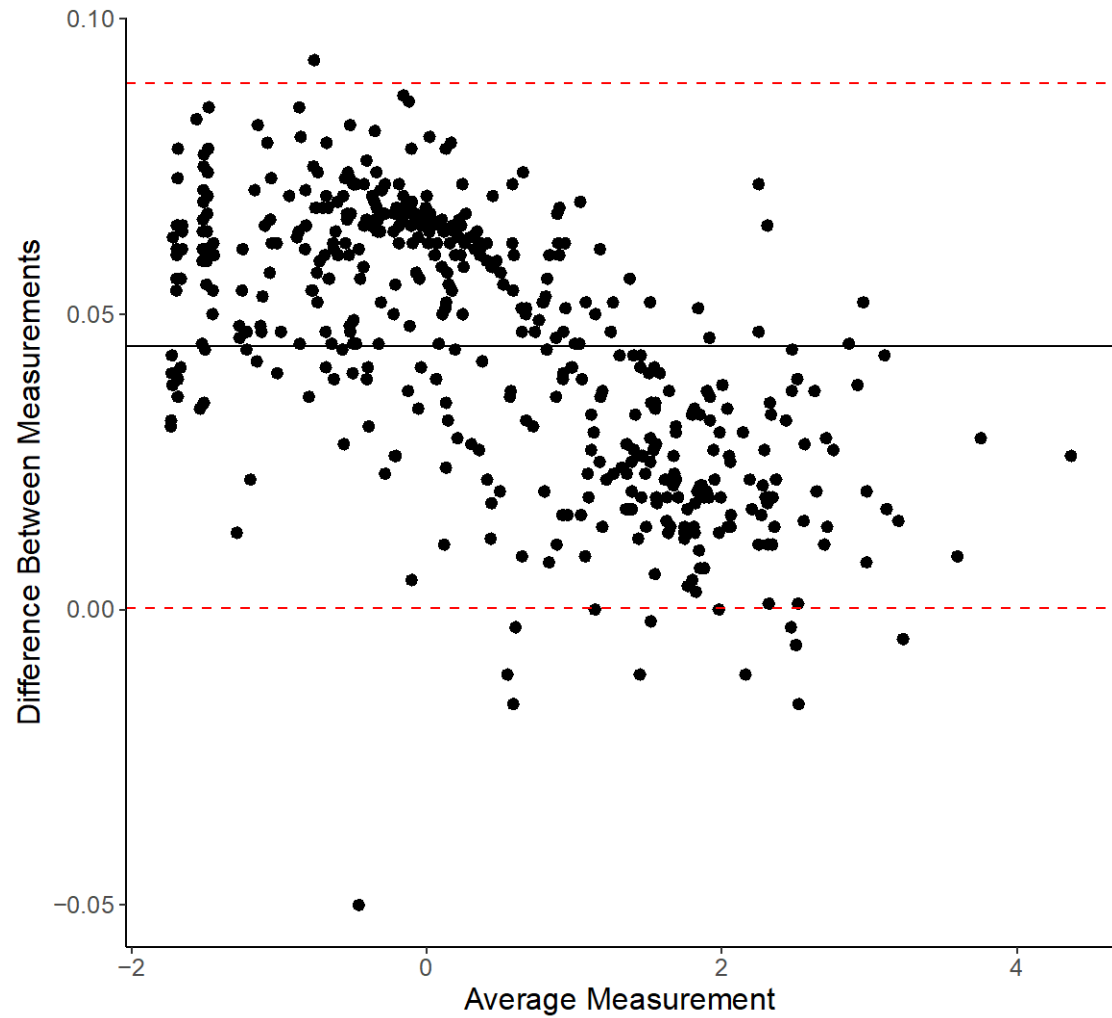


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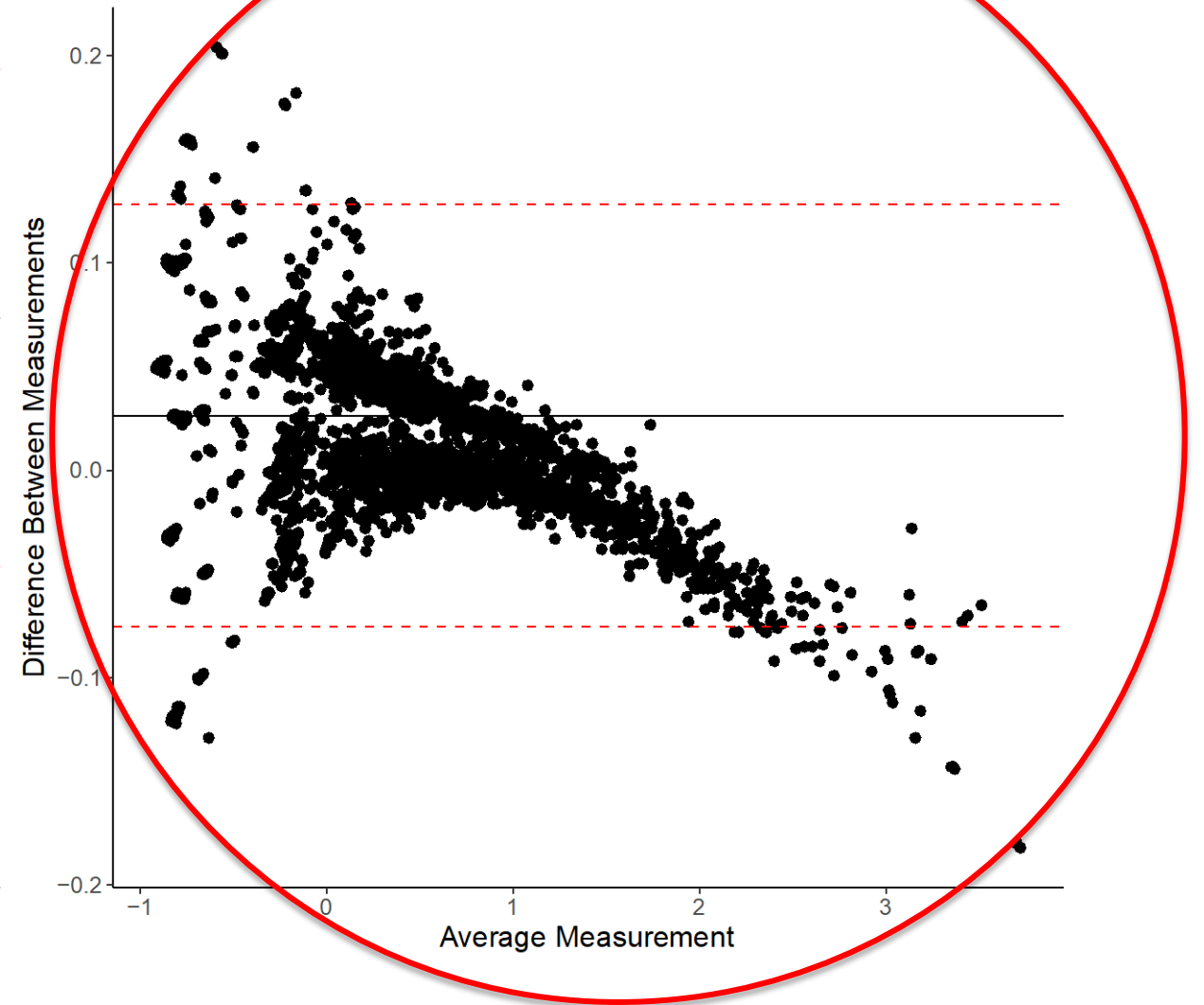




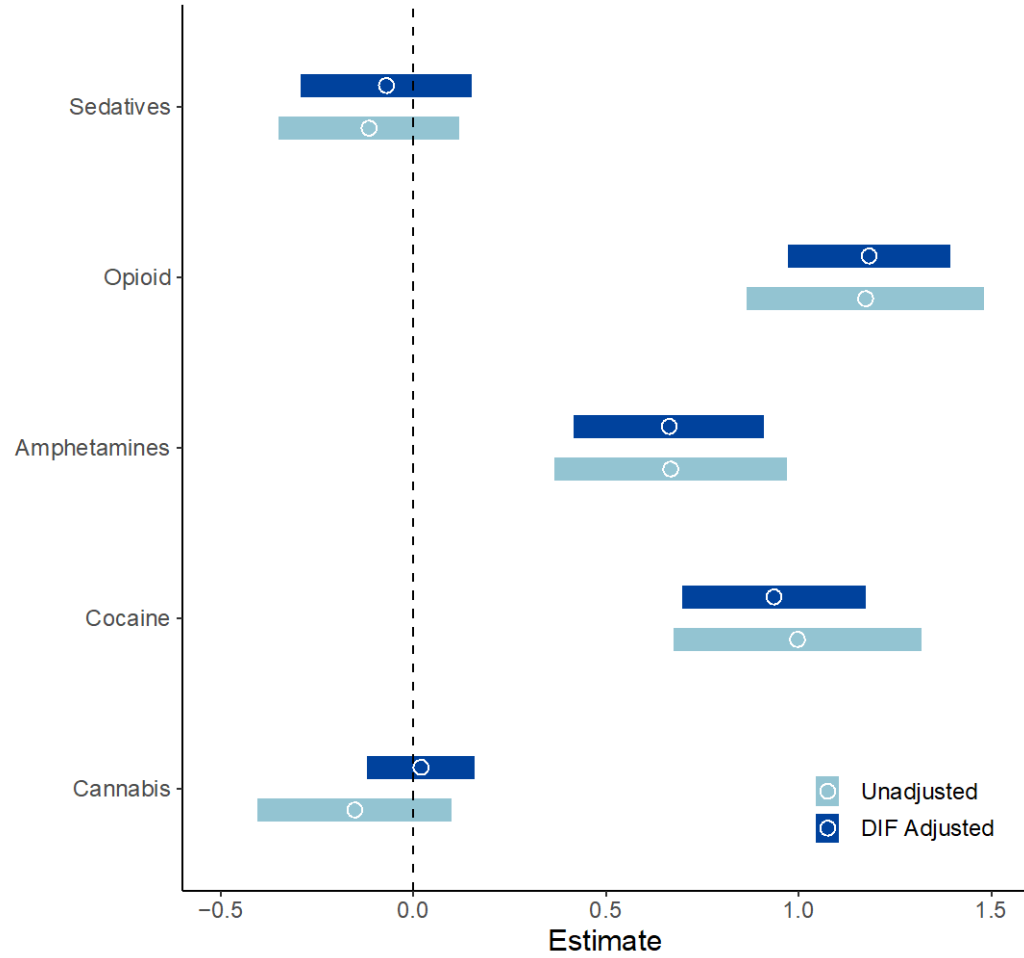
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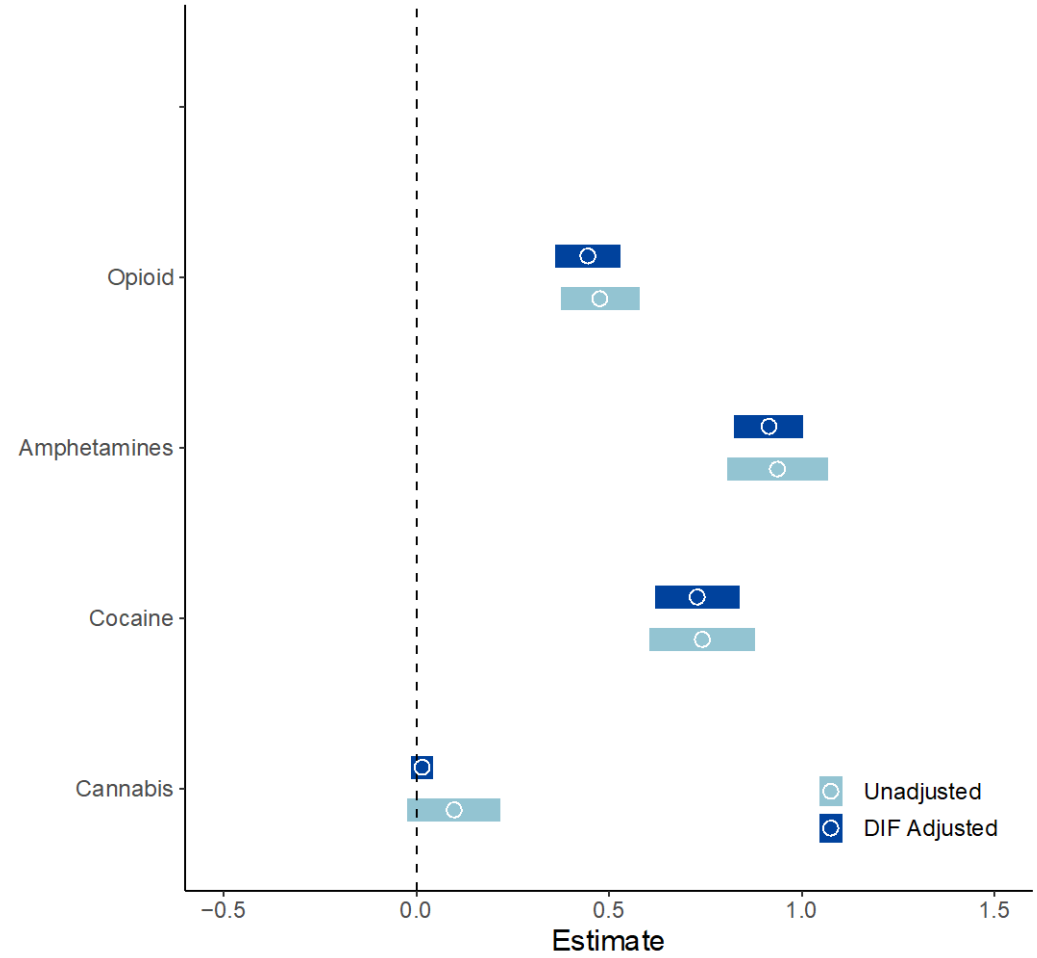
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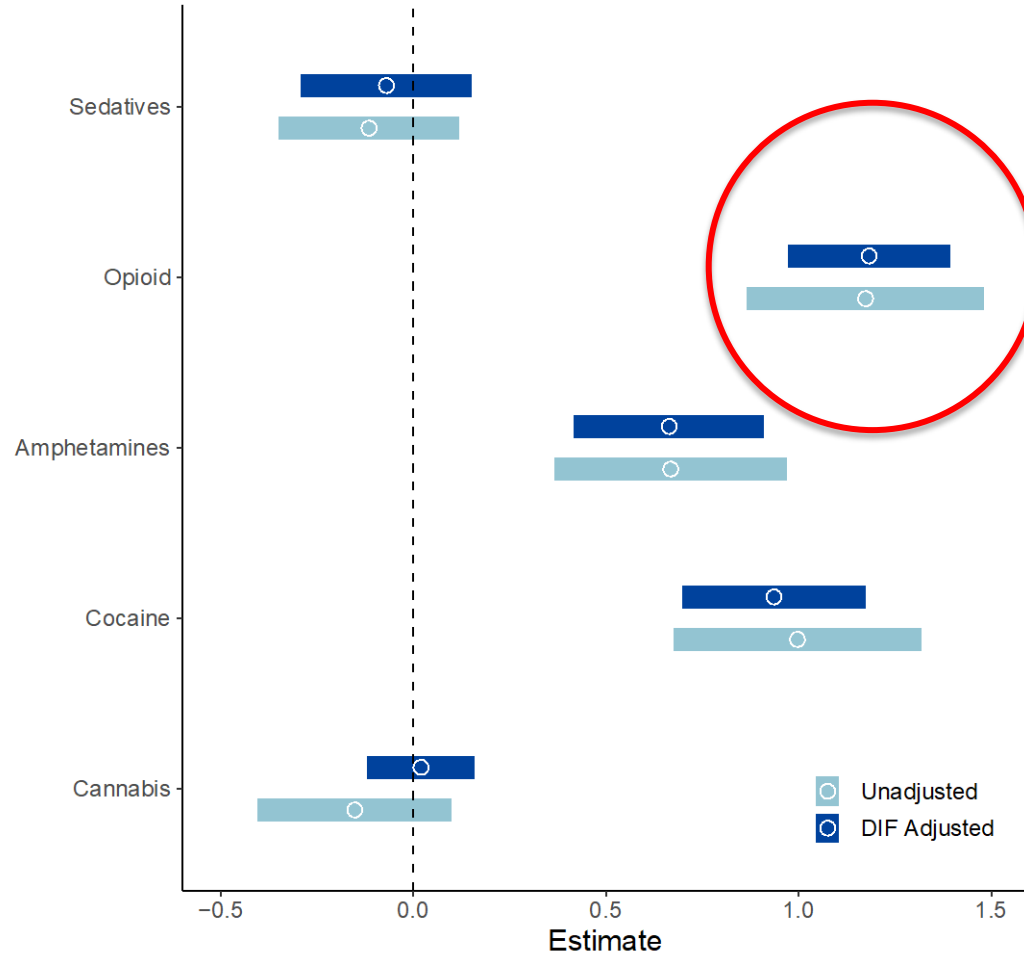
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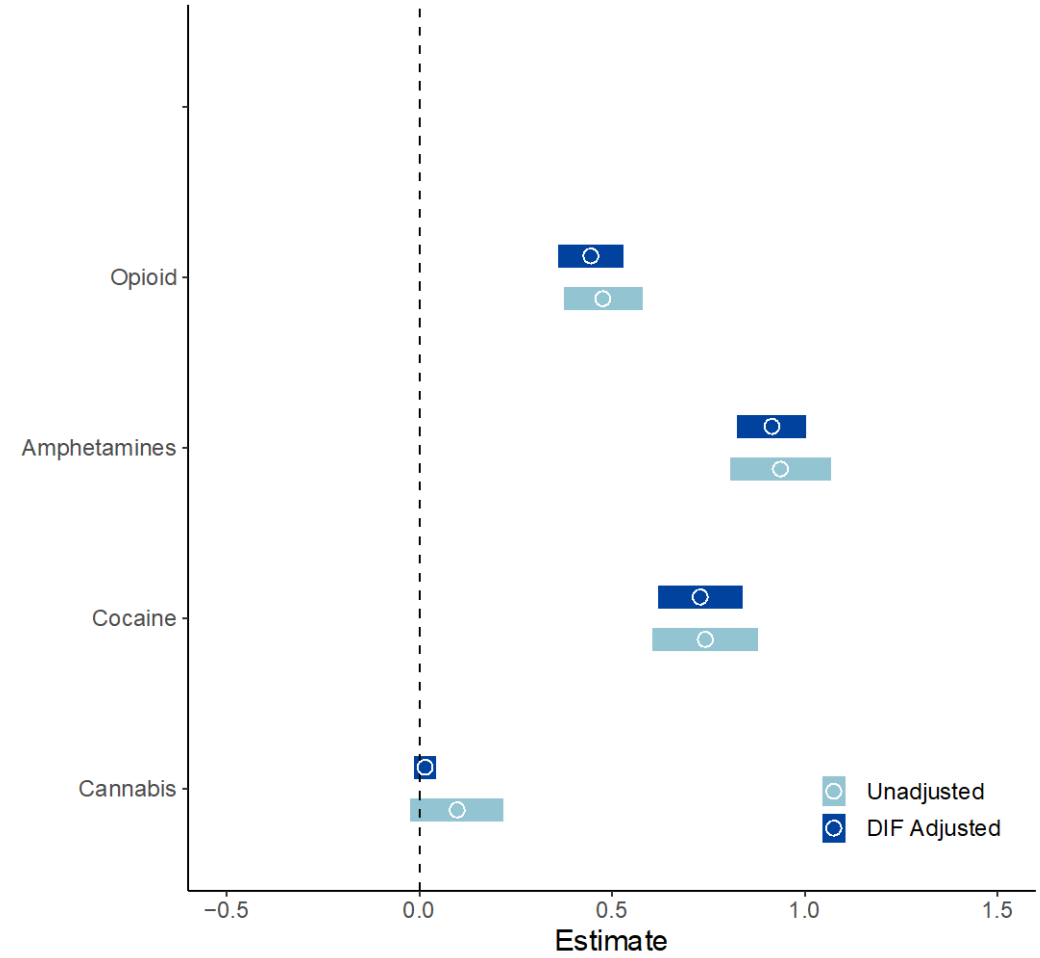
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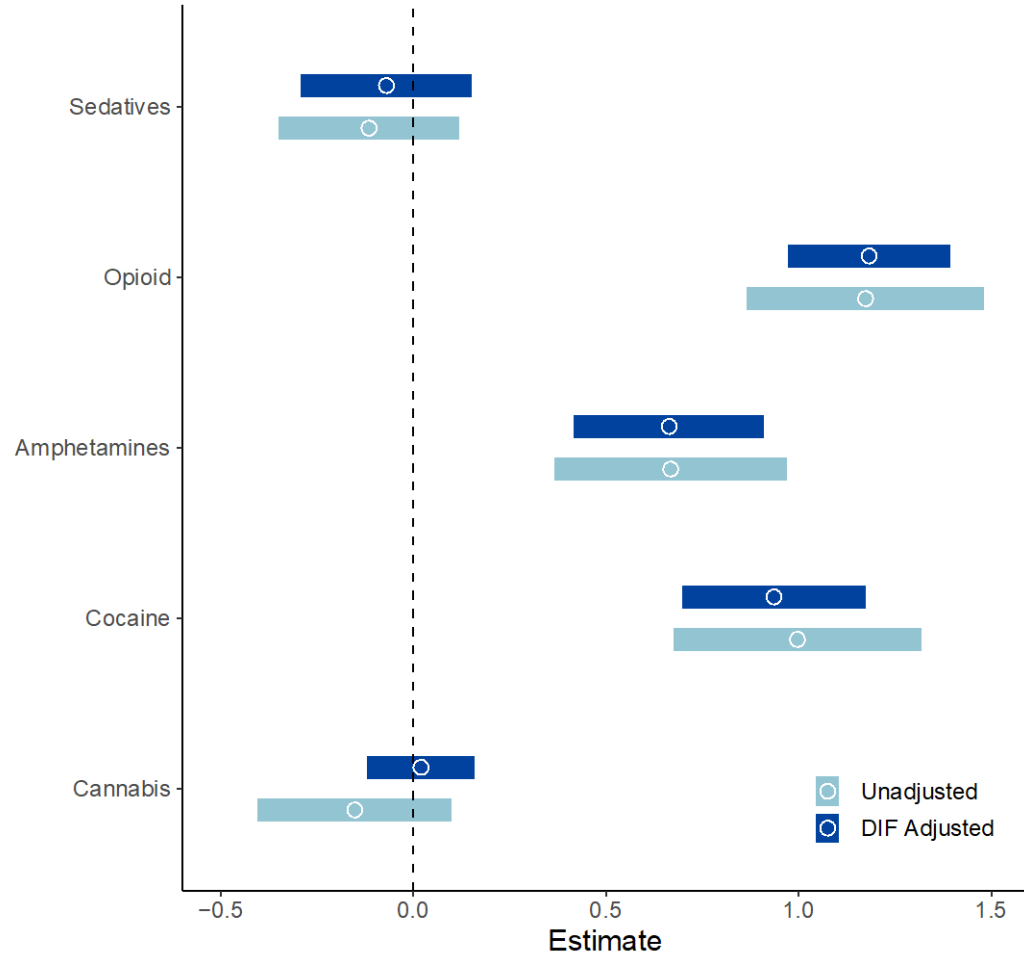
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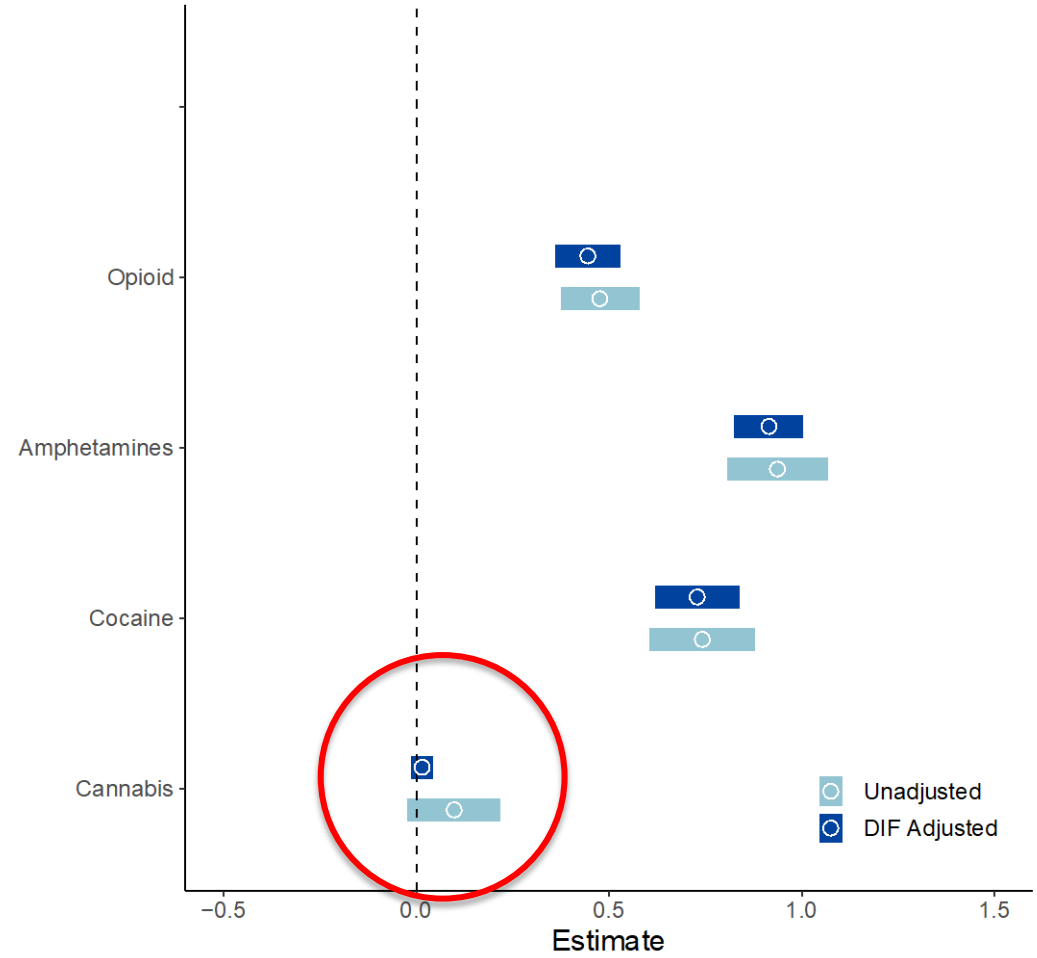
B) PROMIS, Sample 2



A) PROMIS, Sample 1



B) PROMIS, Sample 2





# Take away

- Some DIF across a general measure of substance use severity with generic items
- Impact of this DIF appeared minimal relative to differences in substance use severity across individuals using different substances
- Adjusting for DIF in these measures might not be needed
- However, continued caution is warranted - especially at highest/lowest levels of severity