



Regulatory Fit and Cognitive Assessment

Brian D. Glass

W. Todd Maddox

Arthur B. Markman

University of Texas, Austin

J. Vincent Filoteo

University of California, San Diego

Outline

- Motivation and cognition - Regulatory Focus Theory
 - Regulatory Fit vs. Mismatch
 - Some findings
- Possible neuropsychological implications
- Gold standard test of executive function
(Wisconsin Card Sorting Task)
- Results: Motivational “impairment” in normal population
- Future directions

Regulatory Focus Theory

- Goals
 - Goals or manner for completing goals can be non-consciously adopted or effected
 - Approach goals vs. Avoidance goals
- State of readiness for goal type
 - Promotion focus (for Approach goals)
 - Prevention focus (for Avoidance goals)
- Sensitivity to environment structure
 - Potential gains (when in Promotion focus)
 - Potential losses (when in Prevention focus)
- Reliable cognitive consequences when Focus and Structure *match*

Regulatory Focus Theory

Basic cognitive processing influenced by interaction of:

Current regulatory focus

Promotion

Prevention

Local reward structure of the task

Gains

Losses


Regulatory Focus Theory



Basic cognitive processing influenced by interaction of:

Current regulatory focus

Promotion

Prevention

START STATE	GOAL	FUTURE STATE
0	approach →	

START STATE	GOAL	FUTURE STATE
	avoid →	

Local reward structure of the task

Gains

Losses

↑
0%



100%
↓

Regulatory Focus Theory

Basic cognitive processing influenced by interaction of:

Current regulatory focus

Promotion

Prevention

Gains

FIT

mismatch

**Local reward
structure of
the task**

Losses

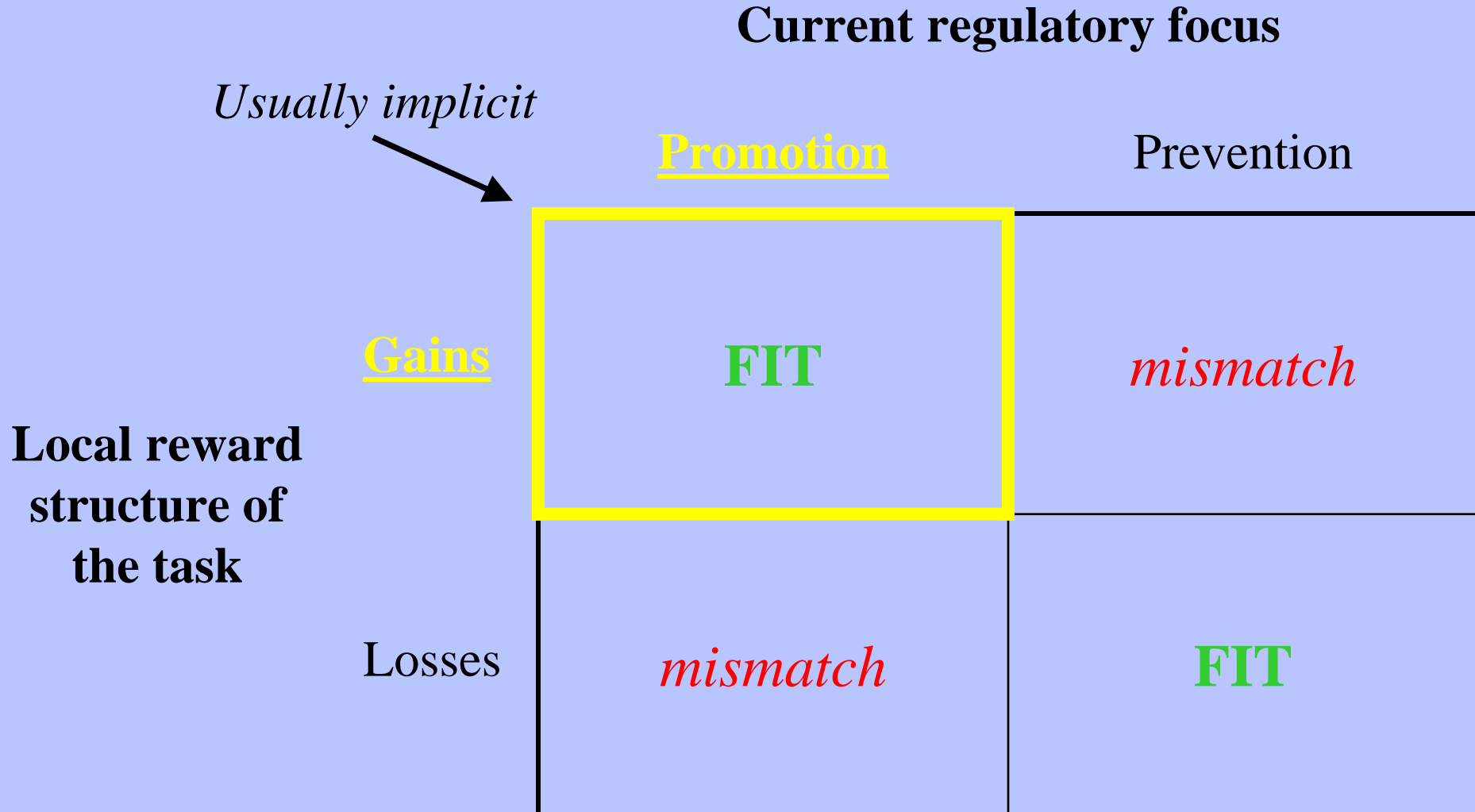
mismatch

FIT

	Promotion	Prevention
Gains	FIT	<i>mismatch</i>
Losses	<i>mismatch</i>	FIT

Regulatory Focus Theory

Basic cognitive processing influenced by interaction of:



Being in a Regulatory Fit

- Flexibility in classification learning
- Bias shifts in response to reward & sensitivity boosts in signal detection tasks
- Overcoming local reward minima in decision making task
- Increased exploration in an n -armed bandit task (whether optimal or not)
- Stereotype threat
 - Chronic stereotypes interact with reward structure
 - Gender and GRE math test
 - Primed stereotypes and rule based classification
- Beginning vs. End of semester

Markman, Maddox & Baldwin, 2005

Worthy, Maddox & Markman, 2007

Grimm, Markman, Maddox & Baldwin, 2008

Various manuscripts under review or in preparation

Possible Clinical Links

- **Possible chronic regulatory focus component**
 - Chronic avoidance in depression (Pizzagalli, Jahn & O'Shea, 2005; Taylor Tavares, et al., 2008)
 - Cognitive flexibility in OCD and trichotillomania (Chamberlain et al., 2006)
- **EF diagnosis may depend on regulatory fit**
 - Insensitivity to task with gains reward structure in first-episode psychosis (Murray et al., 2008)
 - Executive functioning impairments in traumatic brain injury and disease (Demakis, 2003)

Clinical Tests of Executive Functioning

➤ Tower of London test

➤ Trail-Making Test

➤ Stop signal task

➤ Wisconsin Card Sorting Task



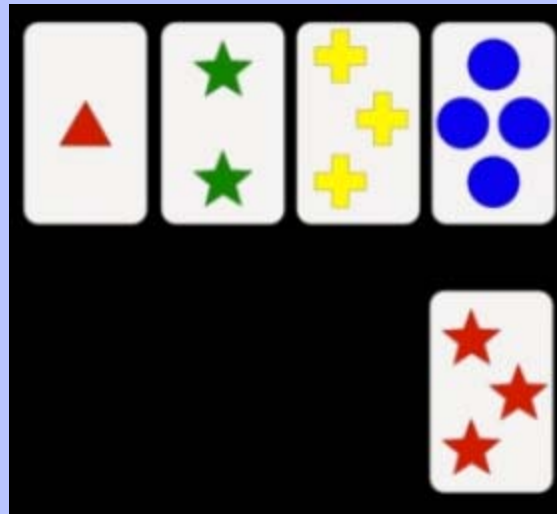
- Broad appeal
- Popular assessment and research tool
- Clinicians compare individuals to norms
- Part of batteries used diagnose people
- Flexibility is optimal for this task

Wisconsin Card Sorting Task

- Clinicians use WCST as part of a battery
- Diagnoses made, lives changed based on performance
- No control for motivational state of the client

Wisconsin Card Sorting Task

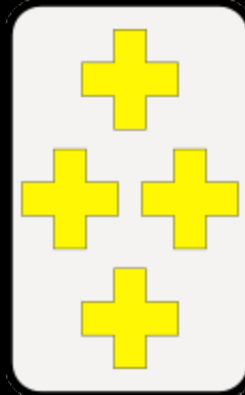
- Sort cards along three dimensions
- Relevant dimension changes after 10 correct responses (rule change)
- Thus, executive functioning impairments lead to perseverating on an irrelevant rule



~~Rule = Shape~~

Rule = Color

Incorrect



WCST Dependent Variables

- Trials to reach 1st rule
- Trials to reach 2nd rule
- Perseveration Rate

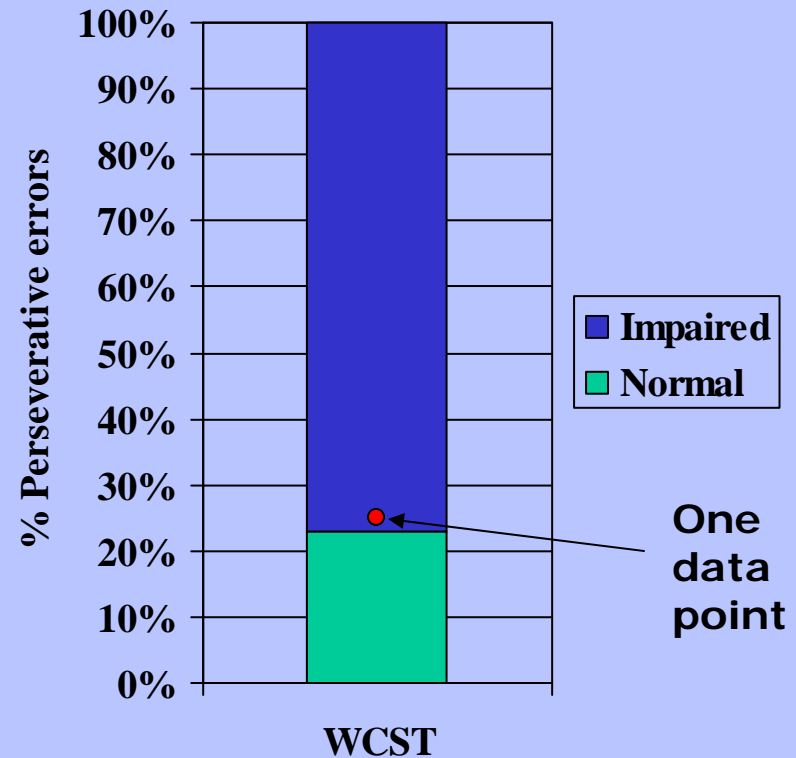
Clinical Example

- Traumatic brain injury (TBI)

- Perseverative errors on WCST-128 used as cutoff for Normal vs. Impaired

- +/- a few responses could change Dx

- What if motivational environment was different?

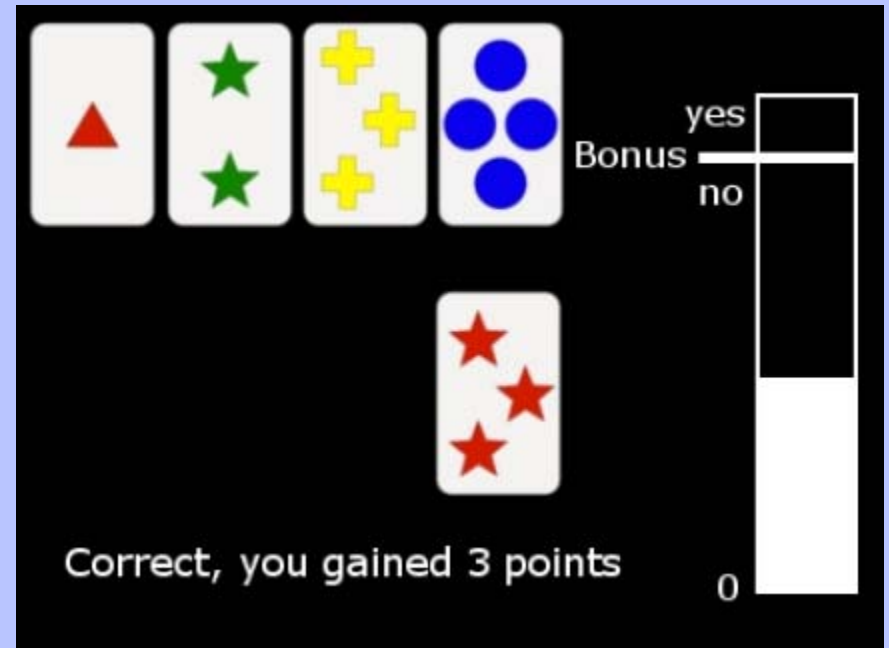


WCST + Motivation

- Incorporate Regulatory Focus framework



	Promotion	Prevention
Gains	FIT	<i>mismatch</i>
Losses	<i>mismatch</i>	FIT






WCST + Motivation

Regulatory Focus

Promotion

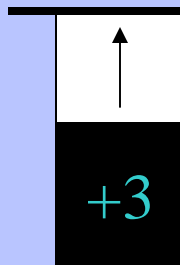
Prevention

START STATE	GOAL	FUTURE STATE
0	approach →	

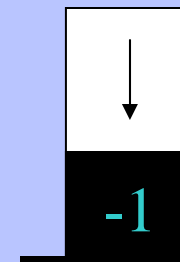
START STATE	GOAL	FUTURE STATE
	avoid →	

Reward Structure

Gains



Losses



Wisconsin Card Sorting Task

- Situational focus

Promotion	Prevention
EARN raffle ticket	KEEP raffle ticket

- Reward structure of the task

Gains	Losses
+3 correct	-1 correct
+1 wrong	-3 wrong

Wisconsin Card Sorting Task

Promotion

Prevention

Gains

FIT

You currently have no ticket for a special prize.

Correct, you gained 3 points

mismatch

Try not to lose this!

Correct, you gained 3 points

Losses

mismatch

You currently have no ticket for a special prize.

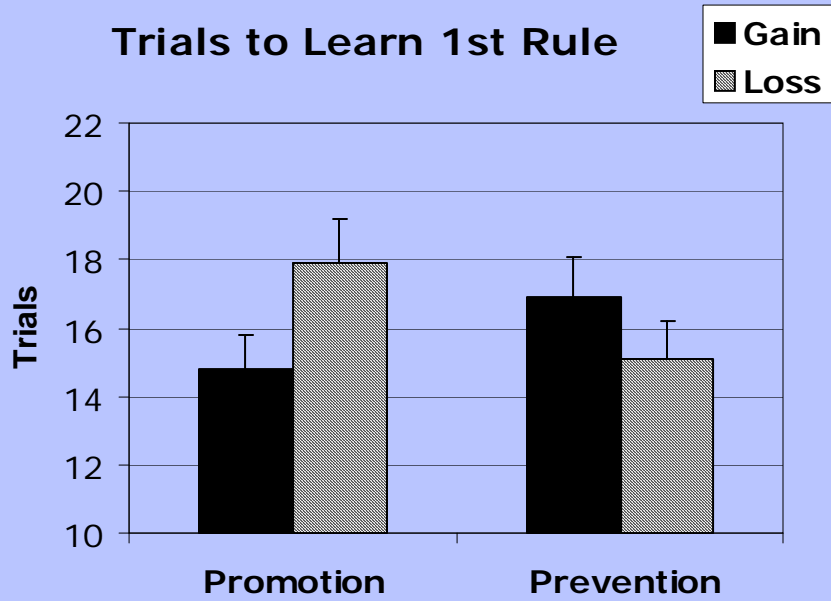
Correct, you lost 1 point

FIT

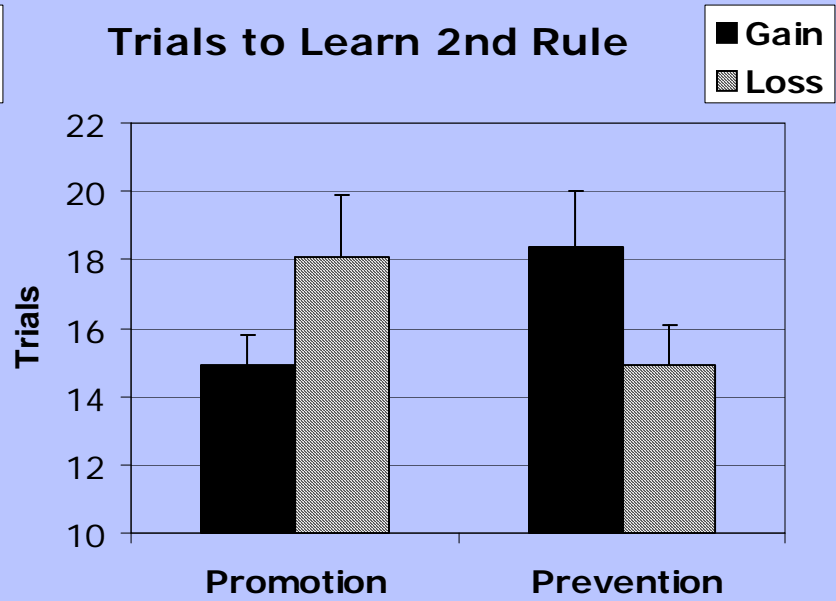
Try not to lose this!

Correct, you lost 1 point

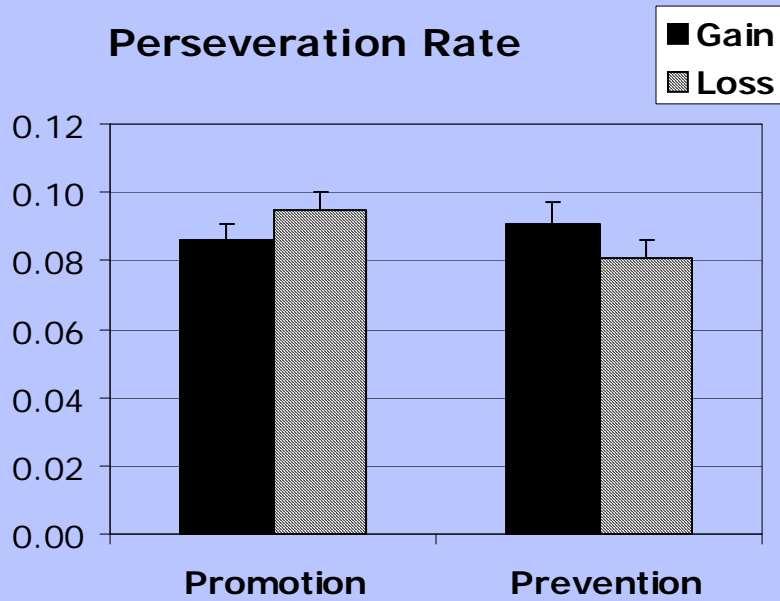
Trials to Learn 1st Rule



Trials to Learn 2nd Rule



Perseveration Rate



Regulatory Focus and WCST

Only high functioning individuals that were able to complete the task were used for analysis

Regulatory fit

- Learn first and second rule faster
- Less perseverative errors

Regulatory mismatch

- Slower learning
- More perseverative errors

	Promotion	Prevention
Gains	FIT	<i>mismatch</i>
Losses	<i>mismatch</i>	FIT

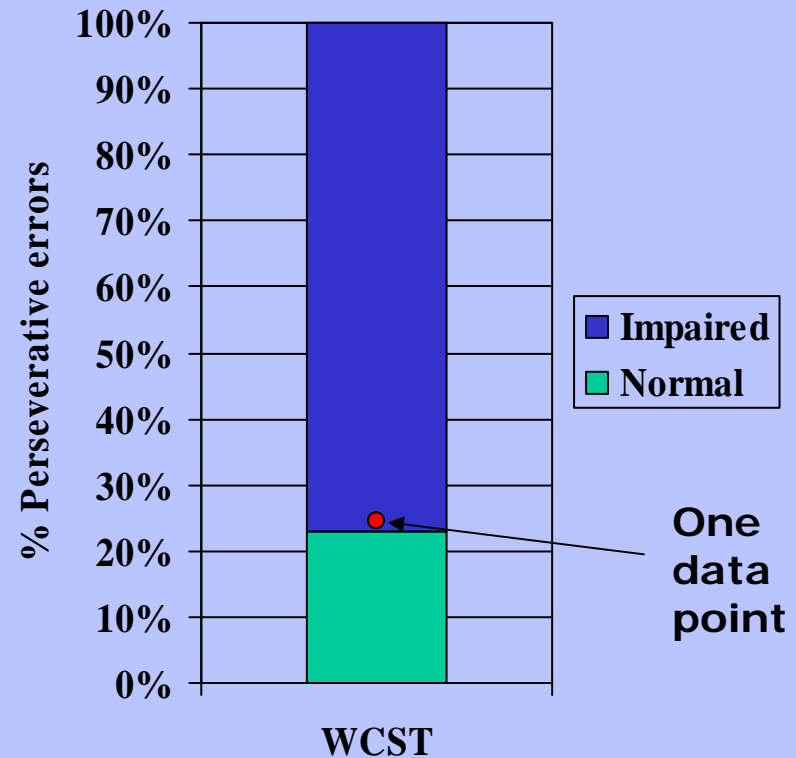
Clinical Example (reiterated)

- Traumatic brain injury (TBI)

- Perseverative errors on WCST-128 used as cutoff for Normal vs. Impaired

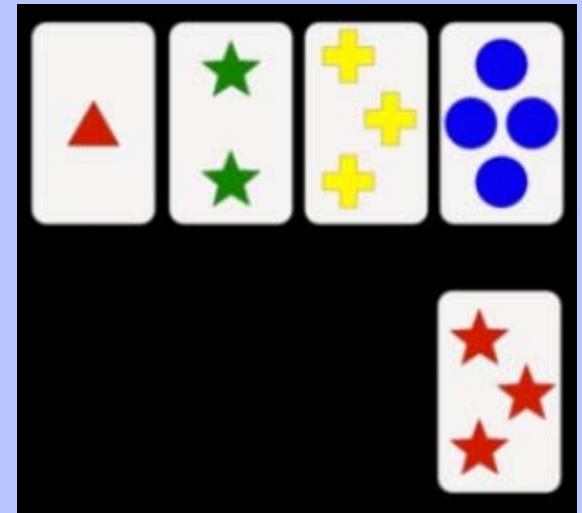
- +/- a few responses could change Dx

- **What if motivational environment was different?**



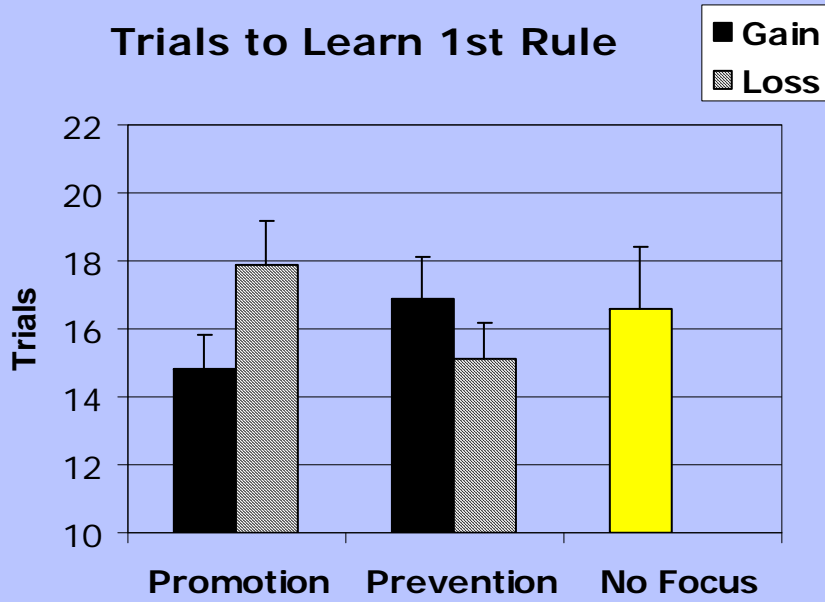
Impairment Analysis

- Control group used to create a normative sample
 - ✓ No situational focus manipulation
 - ✓ No point-based reward structure

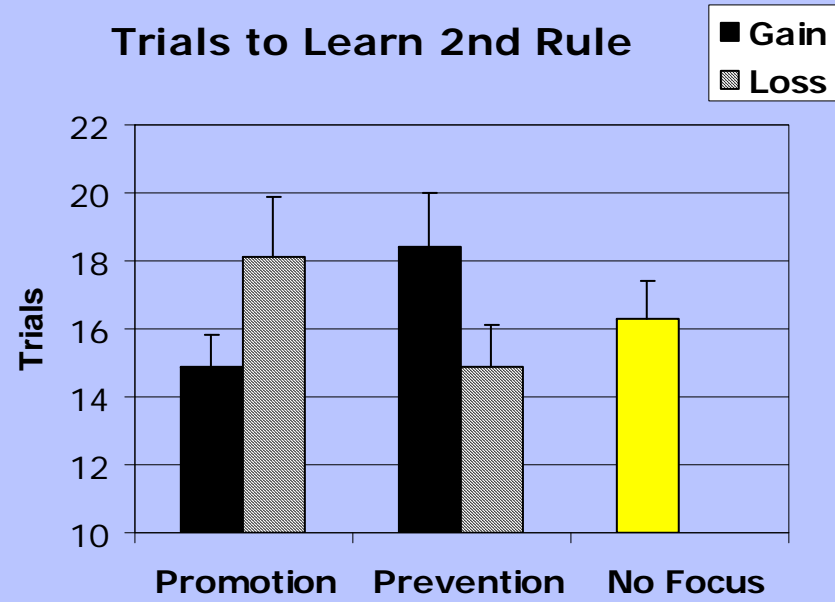


- Classify individuals as “impaired”
 - ✓ 1.1 SD from control mean considered impaired
 - ✓ Typical for clinical assessment

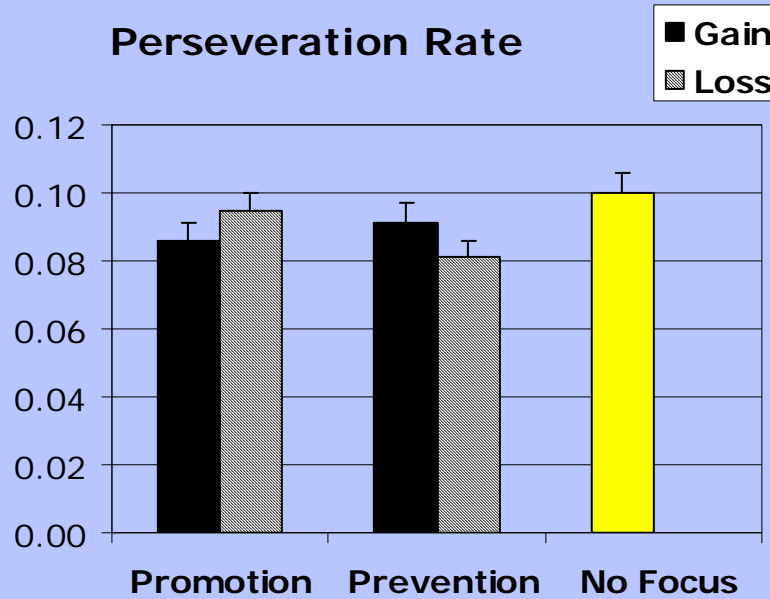
Trials to Learn 1st Rule



Trials to Learn 2nd Rule

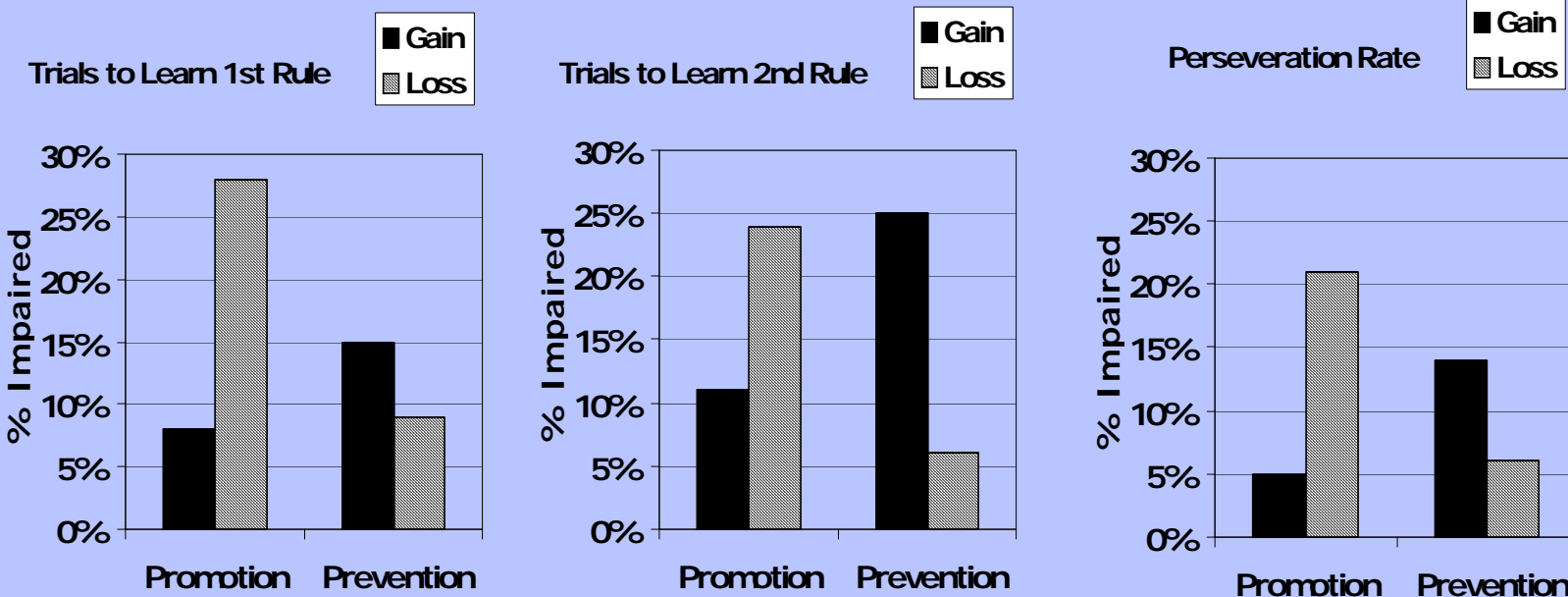


Perseveration Rate



Impairment Analysis

- Control group used to create a normative sample
- 1.1 SD from control mean considered impaired
- Typical procedure that used in psychiatric nosology



- This is a high functioning population

Implications for Assessment

- Poor WCST performance
 - ✓ May partly reflect differences in regulatory fit
 - ✓ WCST usually in gain/undetermined reward environment
- Assessment
 - ✓ Some neuropsychiatric disorders may have components that are influenced by regulatory focus
 - Chronic avoidance in Depression
 - Cognitive flexibility in OCD and trichotillomania
 - ✓ Idea: Manipulate reward structure (Gains vs. Losses)

Implications for Treatment

- Environment modification
 - ✓ Modify home or learning environment to counteract or cater to chronic focus
 - ✓ Example: Emphasize loss minimization to foster a regulatory fit with chronic prevention focus
- Social neuroscience and treatment
 - ✓ Evidence that rewards/punishments mediated by different neural systems
 - ✓ So, possible that $FIT_{\text{Promotion-Gains}}$ and $FIT_{\text{Prevention-Losses}}$ mediated by different neural circuits
 - ✓ Switch regulatory focus style to emphasize a normal neural pathway over a damaged one

Conclusion

- Regulatory focus theory (Regulatory fit vs. mismatch)
- Proof of Concept
 - Normal high functioning population!
 - WCST performance depending on motivation state
 - Up to 25% of those in regulatory mismatch conditions may be considered “impaired”
- Some neuropsychiatric disorders may have motivational component
- Some diagnoses could depend on motivational state

Future Directions

- Social neuroscience
 - ✓ Possible that although same behavior within fit and mismatch conditions, they are mediate by different neural circuits
 - ✓ Modified version for fMRI investigation
- Test clinical populations (underway at UCSD)
 - ✓ Depression
 - ✓ Eating disorders
 - ✓ Parkinson's disease
- Use reward structure manipulation (Gains vs. Losses) to look for chronic regulatory focus component

Thanks to the Motivation Group & MaddoxLab

Todd Maddox

Art Markman

Jennifer Beer

Alison Preston

Marlone Henderson

Lisa Grimm

Darrell Worthy

Ross Otto

Caitlin Brez

Bo Zhu