

# Choking and Excelling Under Pressure in Novices and Experts.

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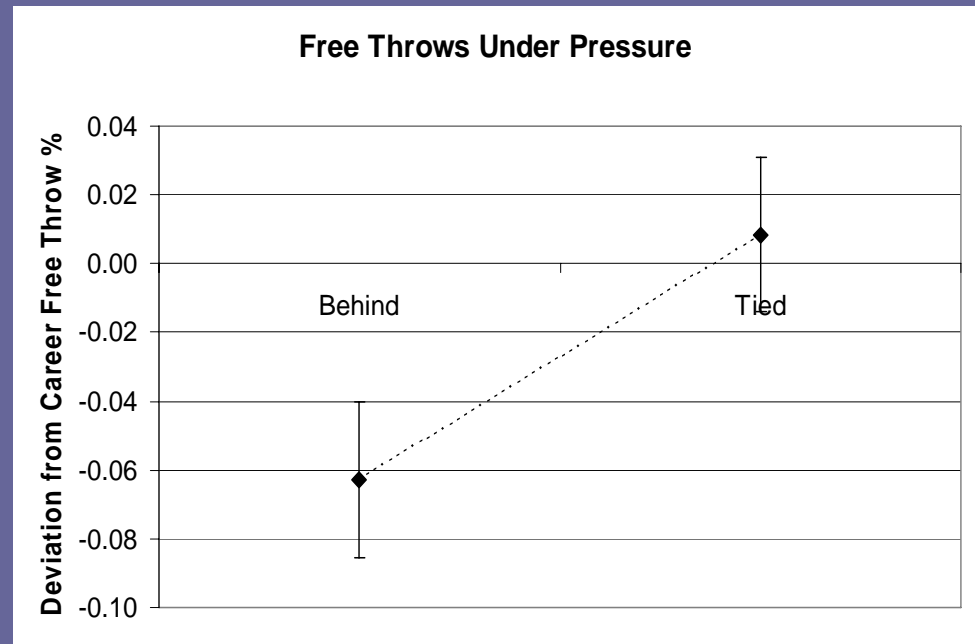
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# Outline

- Theories of choking under pressure
- Category learning domain
- Experiment 1 – Novices
- Experiment 2 - Experts

# Choking Under Pressure

- Anecdotal phenomenon (e.g. sports, test-taking, etc.)
- Unable to perform a task under pressure that would be performed well otherwise



# Distraction Hypothesis

(Beilock & Carr, 2005; Wine, 1971; Beilock et al., 2004, Ashcraft & Kirk, 2001).

- Pressure decreases available working memory (WM) resources.
- WM is filled with thoughts about the situation's importance.
- Negatively influences performance on WM demanding tasks

# Evidence of Distraction

- Beilock et al. (2004) - high pressure reduced subjects' ability to solve difficult math problems
- Beilock & Carr (2005) – high pressure caused performance declines for subjects high in WM capacity, but not for subjects low in WM capacity.
- Ashcraft & Kirk (2001) – individuals with high math anxiety did worse on math problems

# Explicit Monitoring Hypothesis

(Gray, 2004; Beilock, 2001; Masters, 1992; Lewis and Lindner, 1997;  
Baumeister, 1984)

- Alternative view of choking
- Pressure causes performance anxiety which increases the amount of attention paid to skilled performance which disrupts performance.
- *Explicit monitoring* of proceduralized processes disrupts performance.

# Evidence of Monitoring

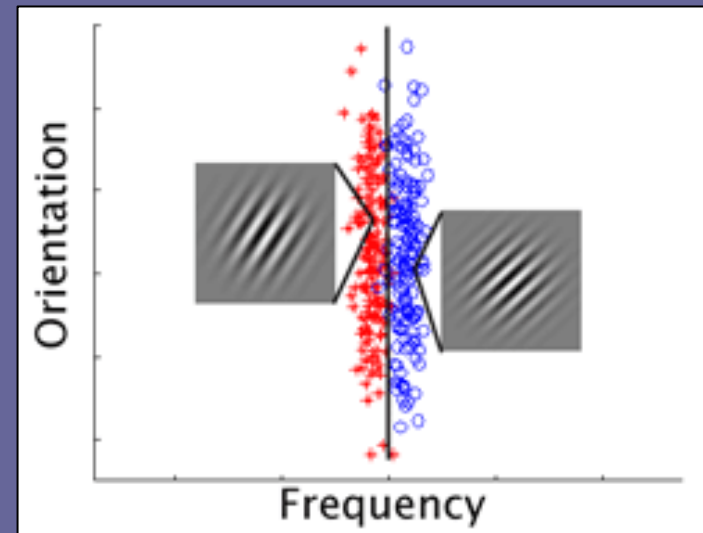
- Masters (1992) – subjects trained with explicit golf-putting instructions performed worse than those w/o explicit instructions
- Gray (2004) – Expert batters performed worse when focusing on their technique.
- Lewis and Linder (1997) – found evidence supporting monitoring and disconfirming distraction in golf-putting

# How Does Pressure Affect Category Learning?

- Multiple Systems Proposal of Category Learning (e.g. Maddox and Ashby, 2004)
- Different neural circuits mediate learning of different category structures
  - Explicit, hypothesis testing system mediates learning of “rule-based” (RB) category structures.
  - Implicit, procedural learning system mediate learning of “information-integration” (II) category structures.

# Rule Based

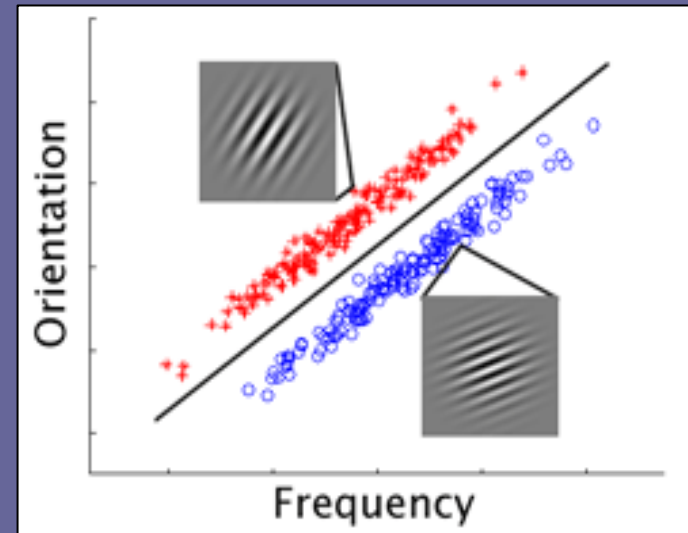
- Verbalizable rule can separate the two categories
- Requires working memory resources to learn the category structure
- Dual WM task interferes with learning (Zeithamova & Maddox, 2006)



Verbalizable

# Information Integration

- Cannot be solved by a verbalizable rule.
- Rule use may interfere with learning
- Dual WM task does not interfere with learning (Zeithamova & Maddox, 2006)

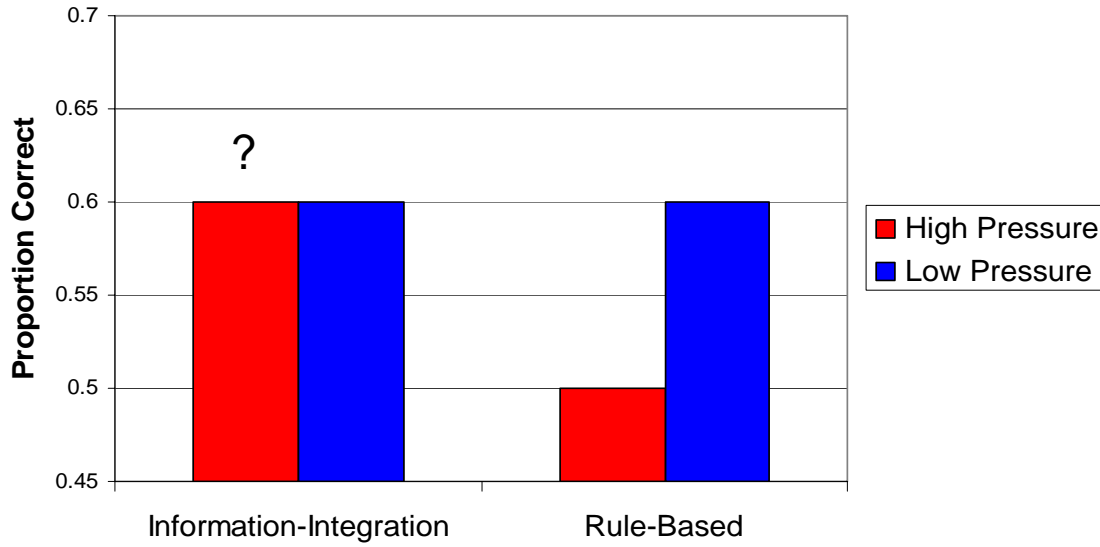


Not verbalizable

# Predictions from Theories of Choking

- *Distraction* and *Monitoring* theories make opposite predictions.
- **Distraction** – Pressure should harm performance on rule-based tasks, but should have either no effect or a positive effect on information-integration tasks
- **Monitoring** – Pressure should harm performance on information-integration tasks, but should have either no effect or a positive effect on rule-based tasks

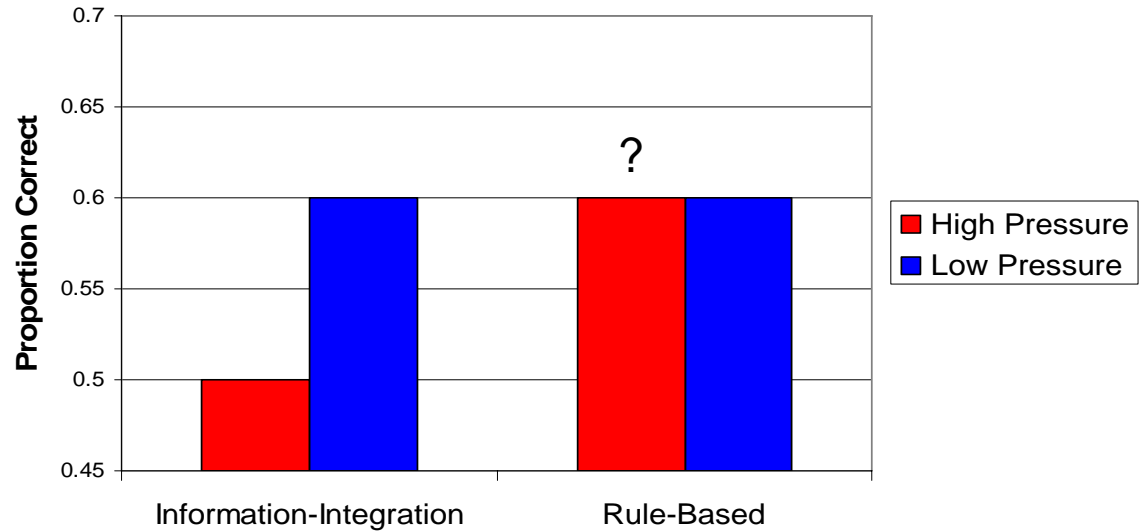
**Distraction Theory's Prediction**



← Distraction

Monitoring →

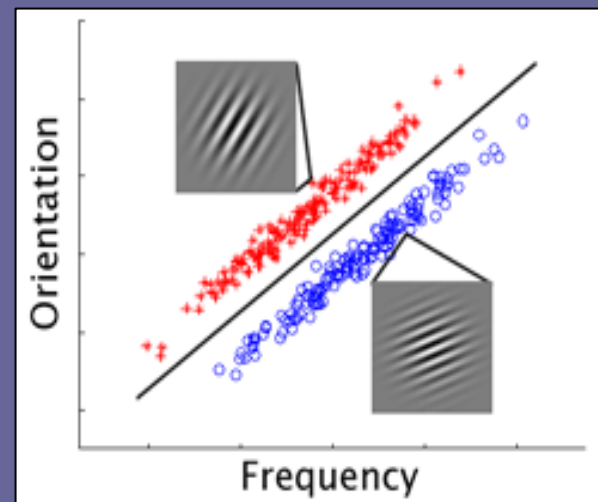
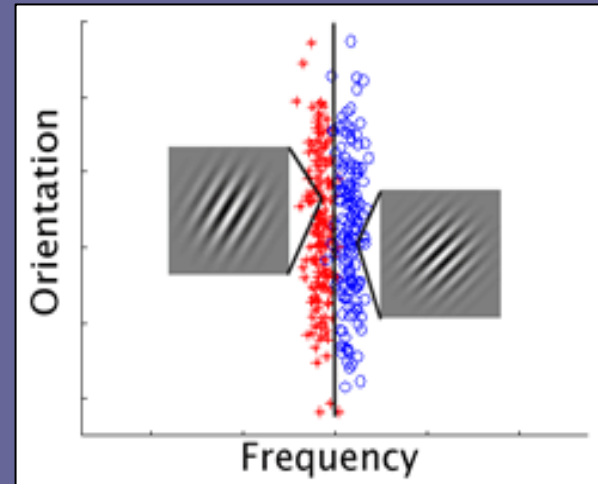
**Monitoring Theory's Prediction**



# Experiment 1

Markman, Maddox, & Worthy (in press) *Psychological Science*

- Examines choking in category learning with novice participants
- Used rule-based and information integration category-learning tasks to explore the effects of pressure on cognitive performance.



# Hypotheses

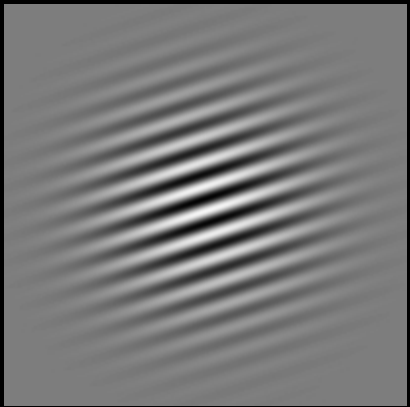
**Distraction** – Pressure should harm performance on rule-based tasks due to depletion of working memory resources, but should have either no effect or a positive effect on information-integration tasks

**Monitoring** – Pressure should harm performance on information-integration tasks due to a focus on explicit strategies, but should have either no effect or a positive effect on rule-based tasks

# Method

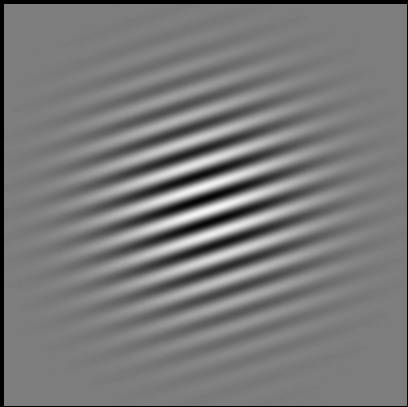
- Received two points for a correct classification and zero points for an incorrect one.
- Low pressure – “do your best”
- High pressure:
  - Paired with a ‘partner’
  - If both of you reach criterion, both get \$6
  - If one of you fails neither get \$6 bonus
  - Partner reached criterion

Low- Pressure Rule-based	High- Pressure Rule-Based
Low- Pressure Information- Integration	High- Pressure Information- Integration



0

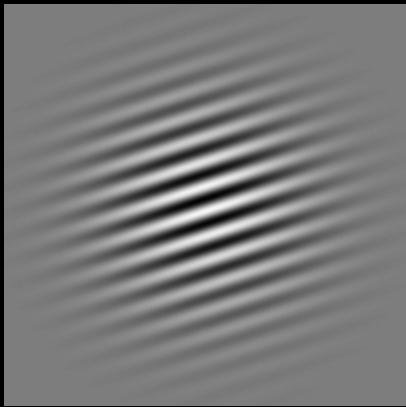
18



Correct

0

20  
18



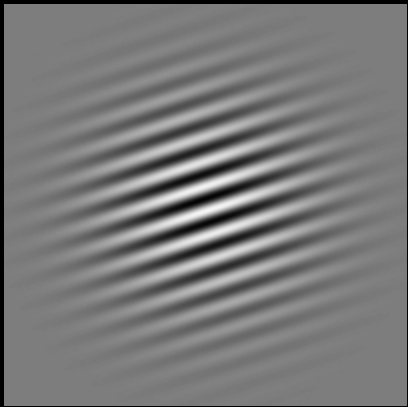
Yes  
Bonus  
No

Partner achieved bonus?

Yes

0

18



Yes  
Bonus  
No

20  
18

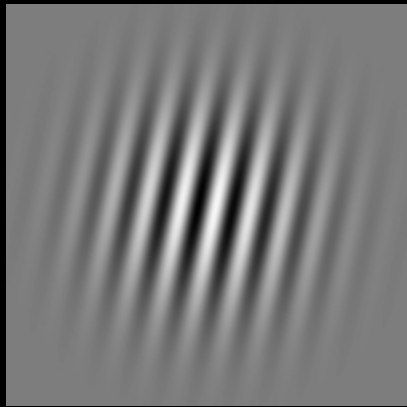
Correct

Partner achieved bonus?

Yes

0





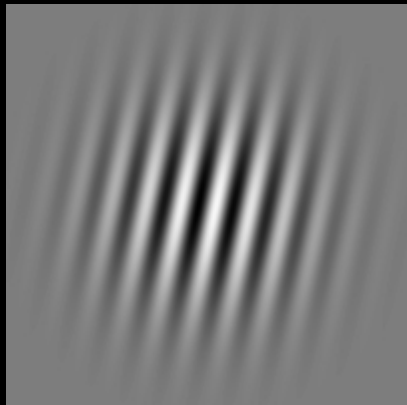
Yes  
Bonus  
No

20

Partner achieved bonus?

Yes

0



Yes  
Bonus  
No

Wrong, that was an A

Partner achieved bonus?	Yes
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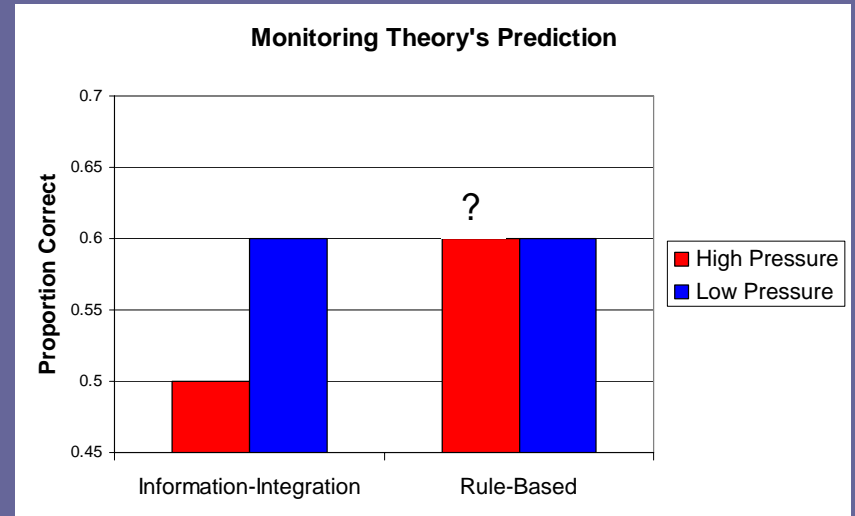
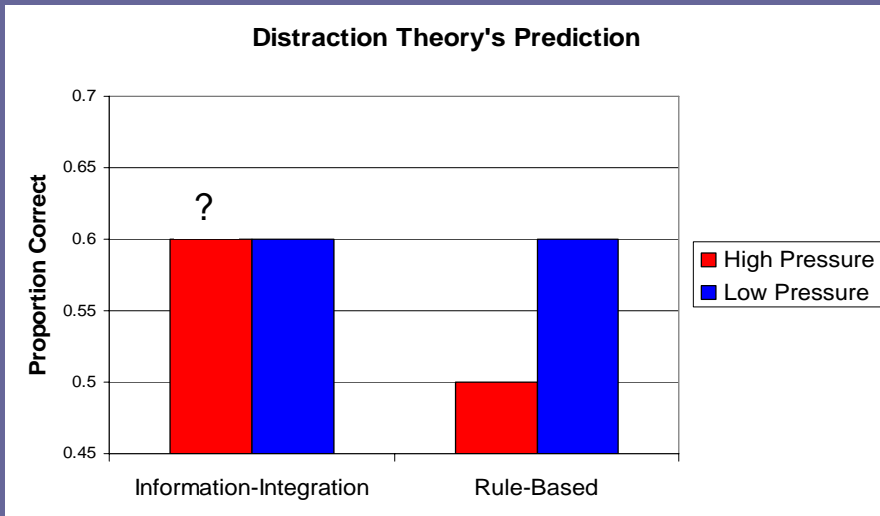
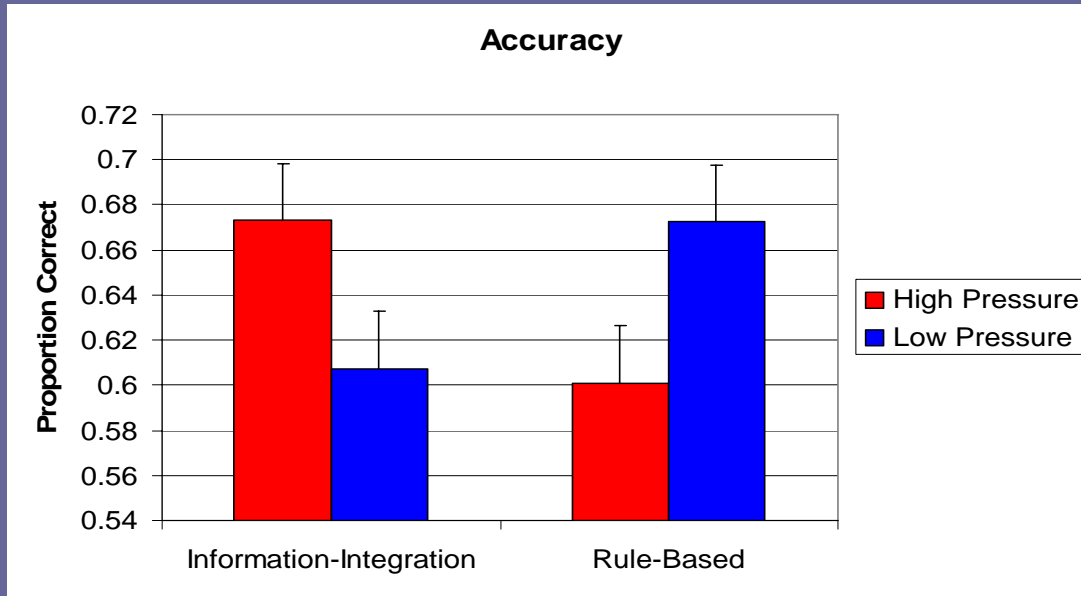
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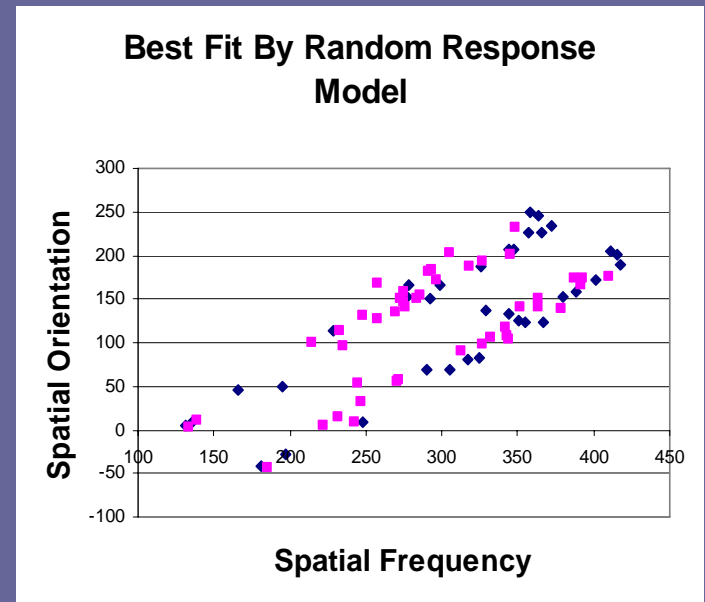
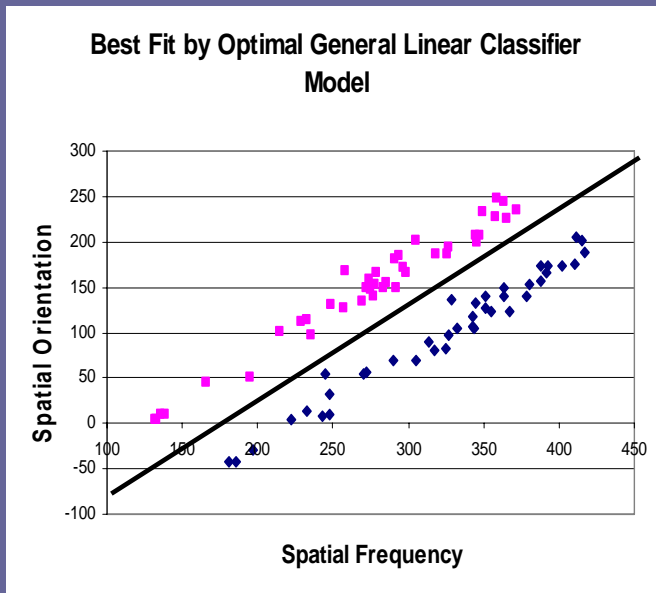
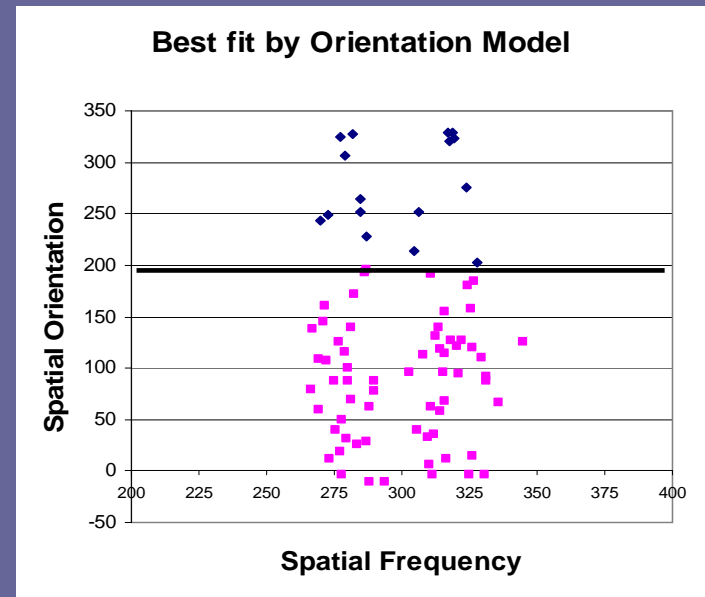
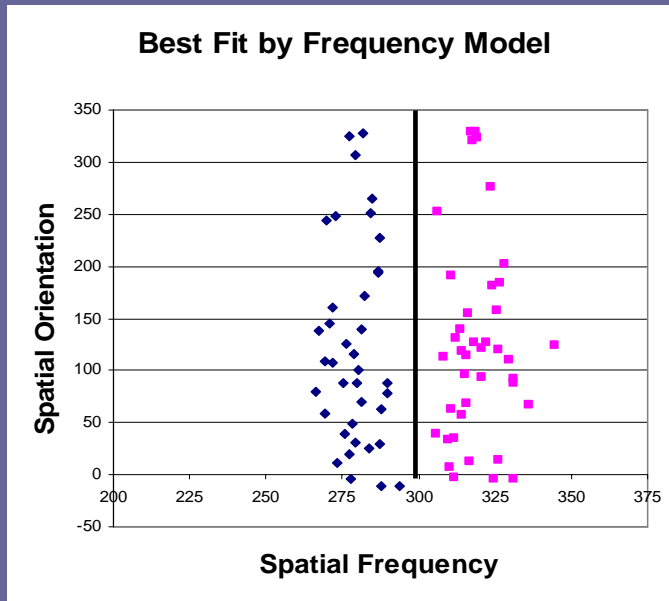
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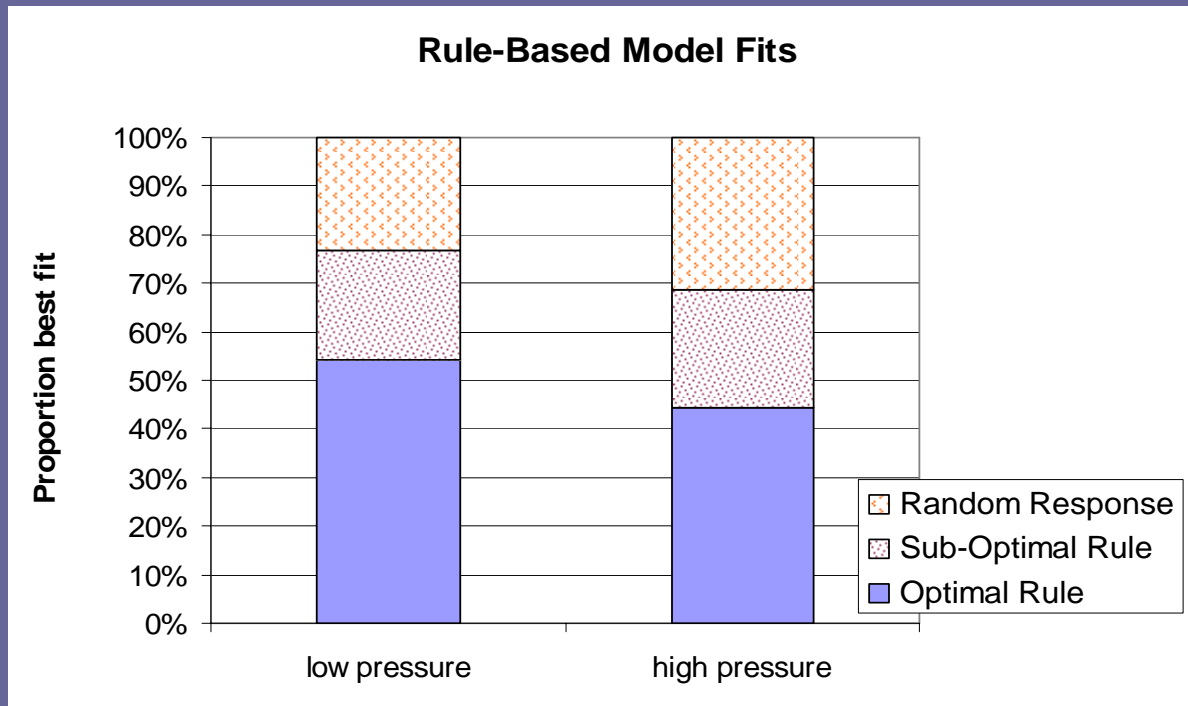
# Results



# Decision Bound Modeling

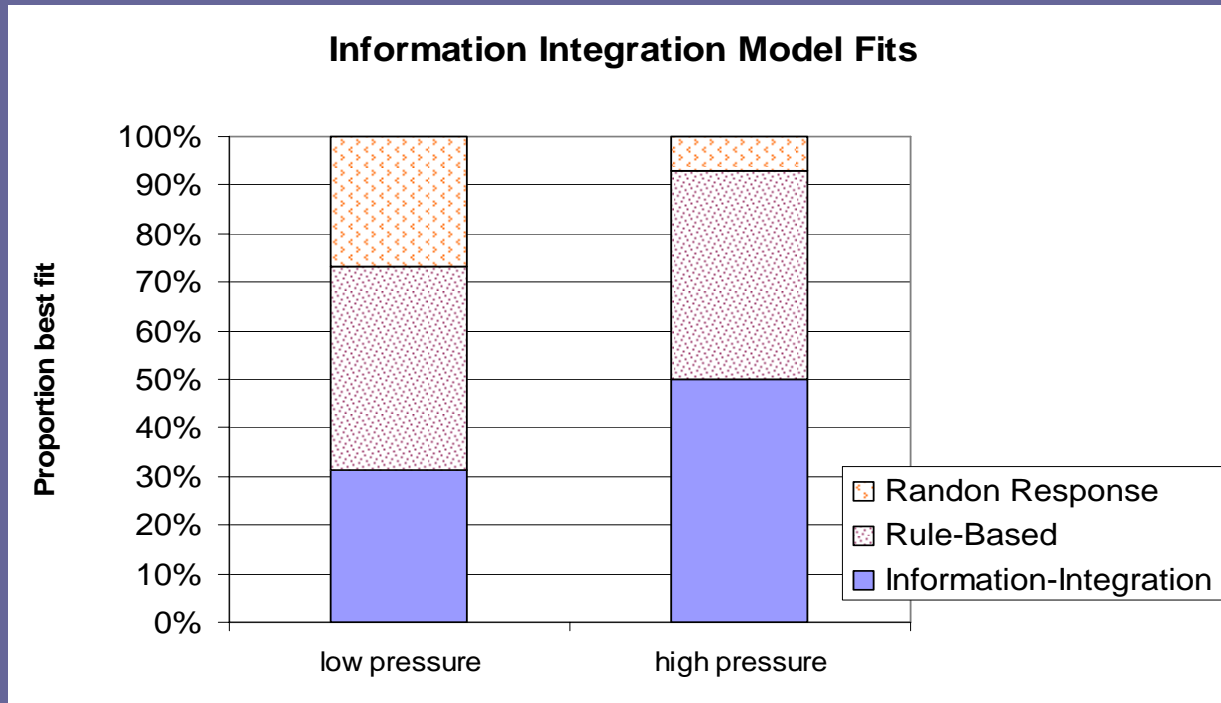


# Rule-Based Modeling



- Higher proportion of Low Pressure subjects were best fit by the unidimensional frequency rule model.

# Information integration modeling



- Higher proportion of high pressure subjects best fit by an information integration model (GLC).

# Discussion

- Consistent with Distraction Theory that pressure decreases available working memory resources.
- Novel finding that pressure *improves* performance on II tasks.
- High pressure II subjects abandon rule use quicker and allow performance to be driven by an implicit similarity based process.
- Choking *and* excelling under pressure.

# Discussion

- Also consistent with multiple systems views of category learning. (COVIS, Maddox & Ashby, 2004)
- Demonstrates the value of examining motivational variables on cognitive tasks.

# Experiment 2

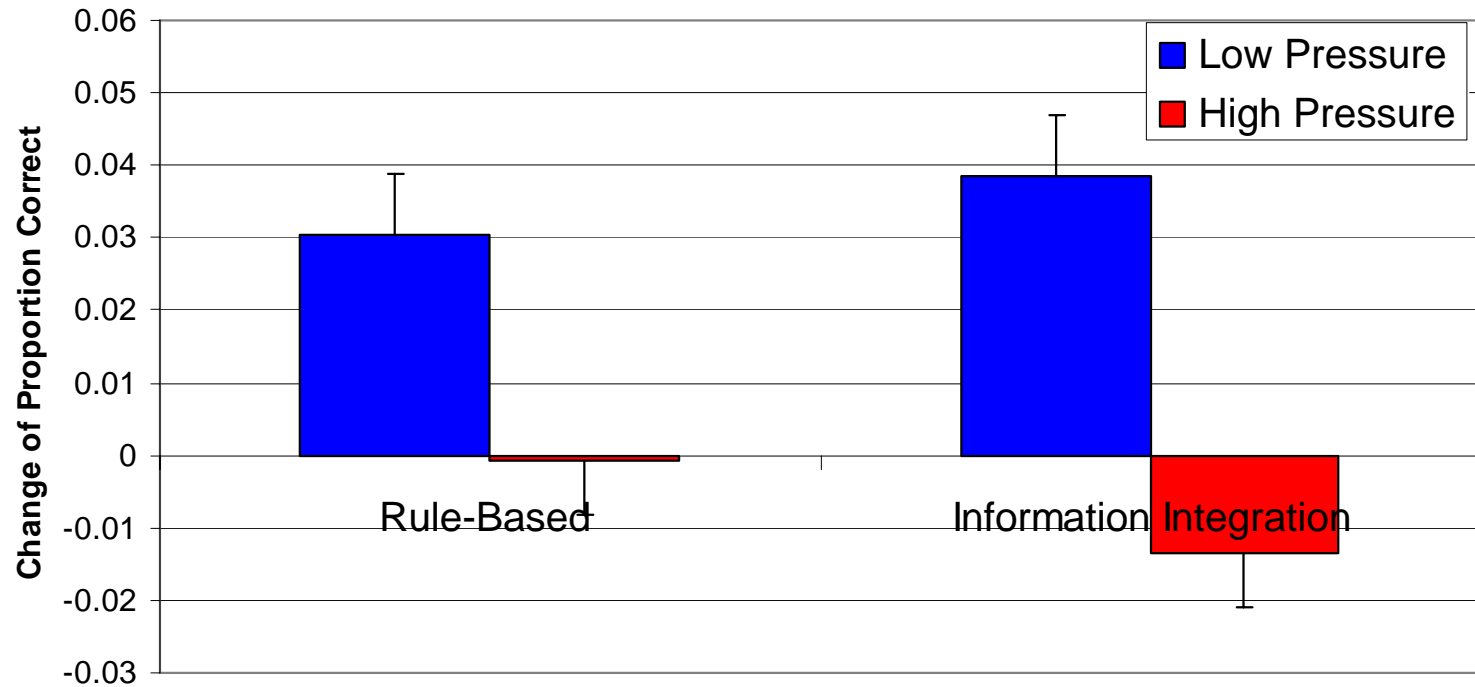
- Examined performance under pressure in classification tasks for “experts”.
- Different pattern may emerge when tasks are more well learned.
- Both RB and II tasks may be hindered.
- Explicit Monitoring Hypothesis might be more valid for experts.

# Method

- Participants completed 4 sessions of RB or II tasks identical to the low pressure conditions in experiment 1.
- On the fifth session half were given pressure manipulation.
- “Partner” reached the bonus criterion and if you also reach the bonus then you will each get \$50.
- Told the block which determines the bonus eligibility would be selected randomly.

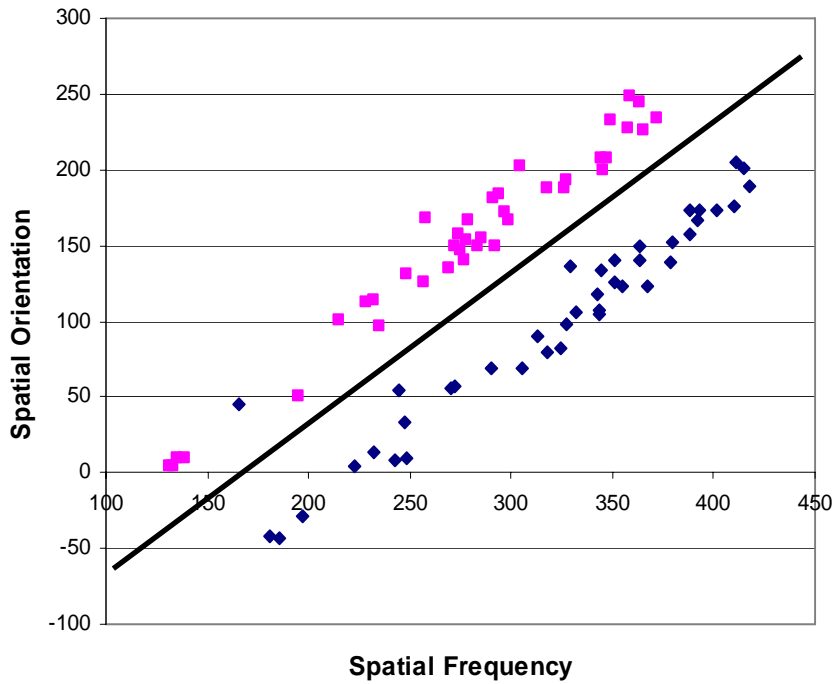
# Results

**Change in Proportion Correct After Pressure Manipulation**

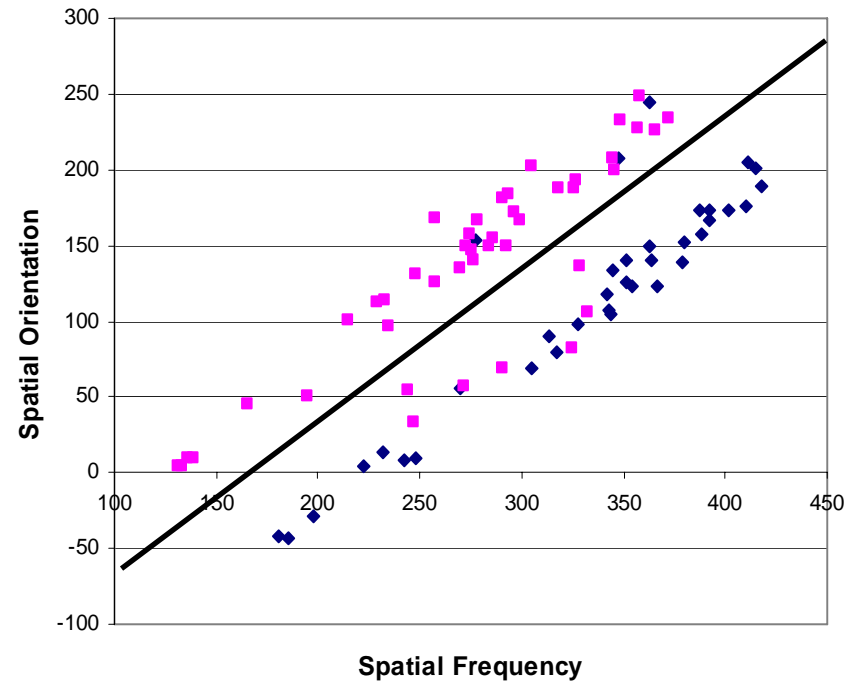


# Modeling

Low Critical Noise

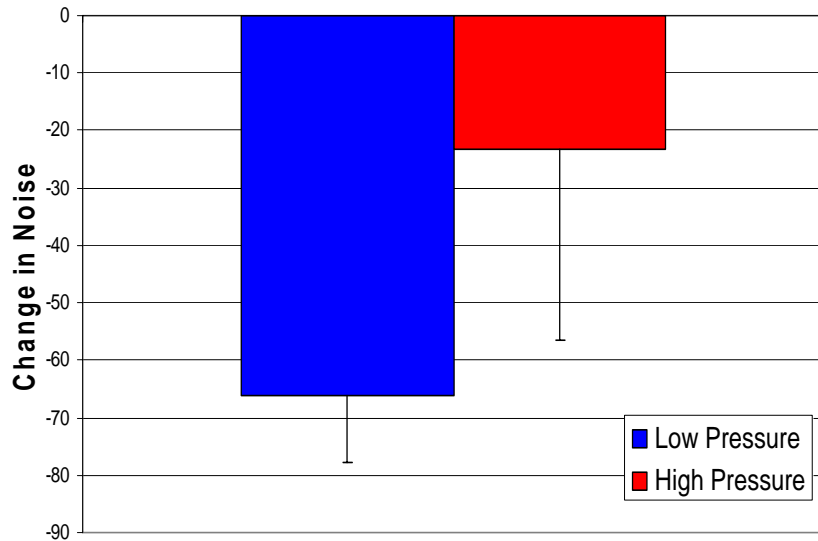


High Critical Noise

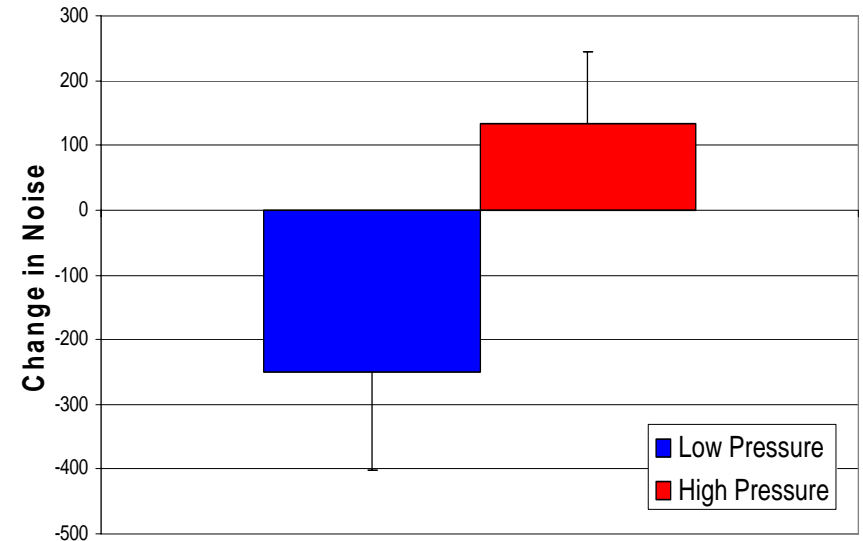


# Criterial Noise

### Rule-Based Change in Criterial Noise



### Information Integration Change in Criterial Noise



Note: Noise values are higher for II than for RB due to a greater distance from the bound for the II categories.

# Summary

- In experts performance declined for subjects under pressure in both RB and II conditions.
- In novices RB subjects choked under pressure, and II subjects excelled under pressure.

# Discussion

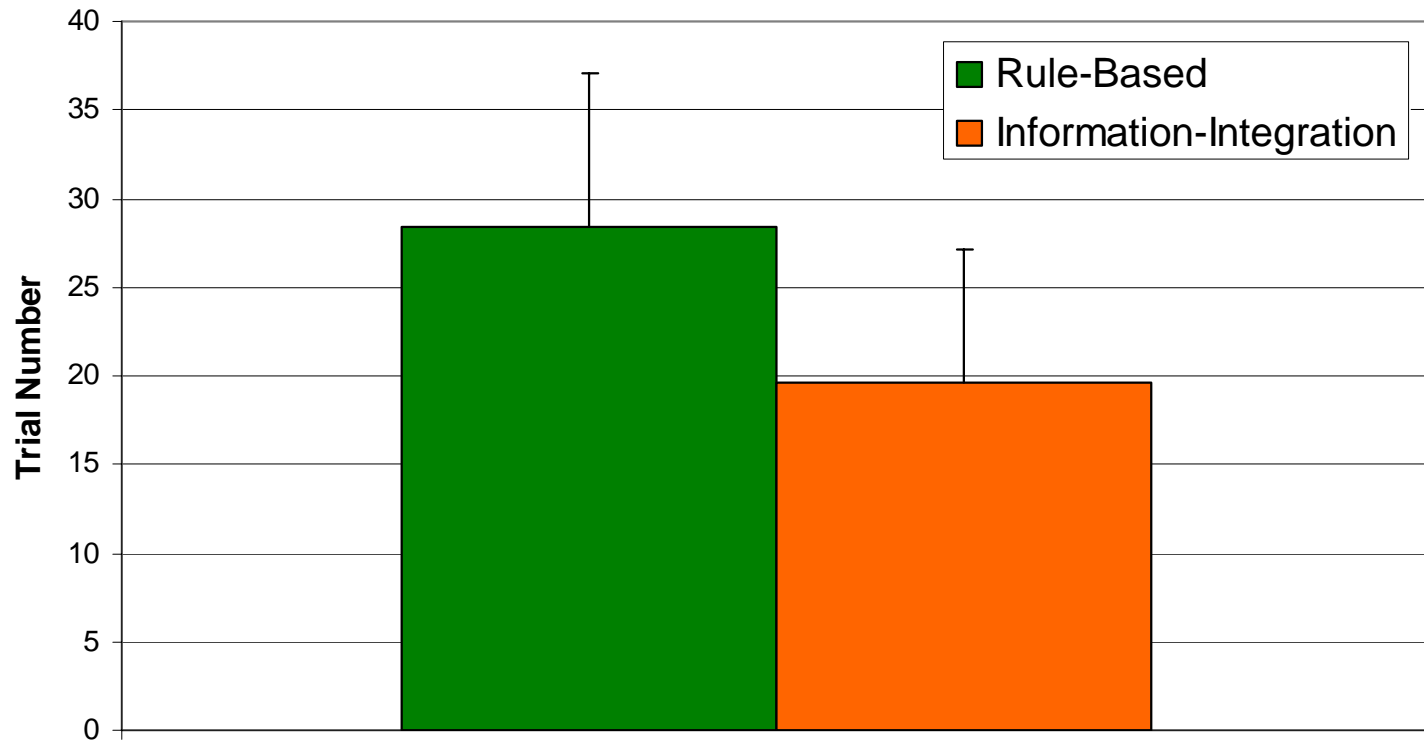
- Expert performance may be mediated by a similar system for II and RB that automates responses
- When under pressure automated system is disrupted
- RB subjects experience less severe decrements than II subjects because they have explicit strategies to fall back to
- Suggests that the *explicit monitoring* view may be appropriate for experts, but the *distraction* view may be appropriate for novices.

# Final Block

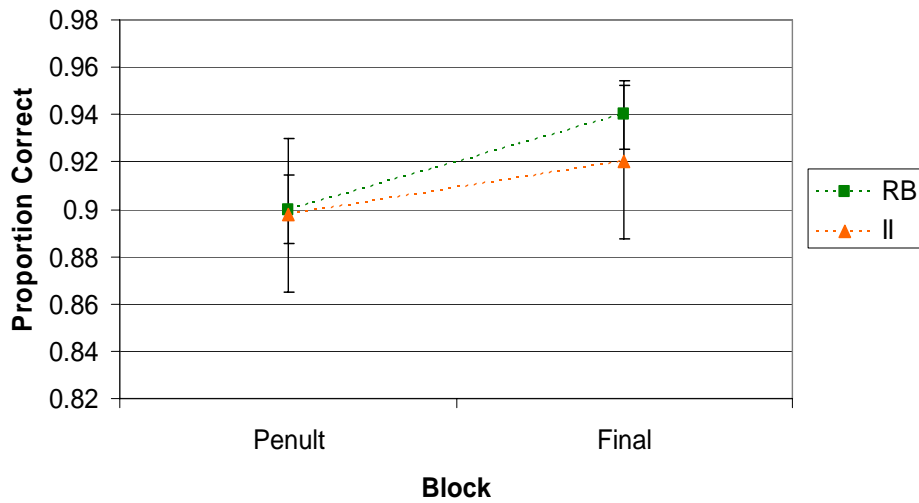
- After completing 8 blocks during the final session pressure condition subjects were told they would earn \$100 if they did not make a single incorrect classification on the final block.
- Told that this block could still be randomly chosen for the \$50 bonus.

# First Incorrect Trial

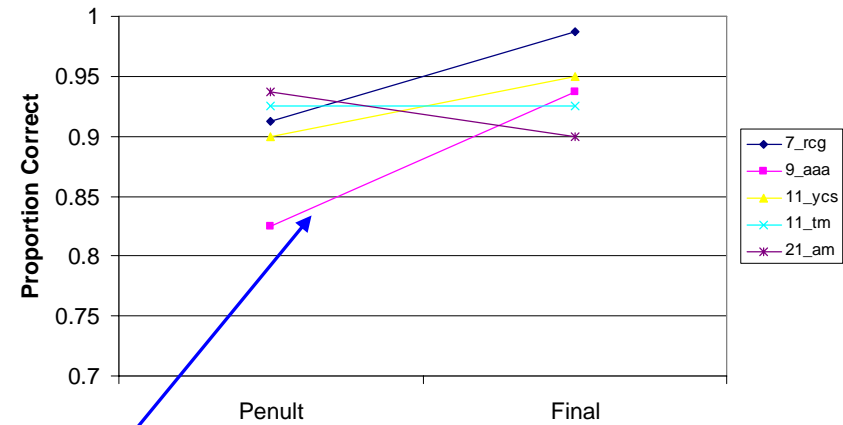
First Incorrect Trial On Final Block



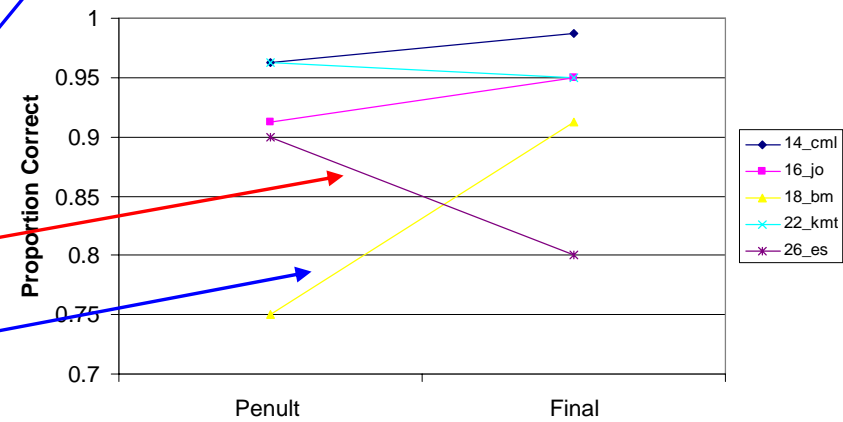
### Block Accuracy



### Rule-Based



### Information Integration



Choking

Excelling



# Future Directions

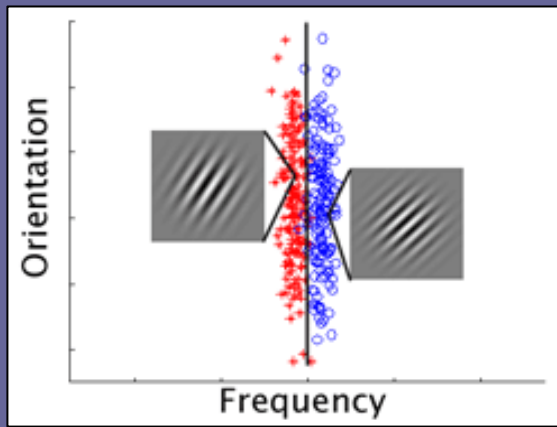
- Run more experts.
- Increase time of expert training
- Explore different pressure manipulations.
- Use different tasks such as proceduralized motor tasks (VR).
- Examine the relationship between social pressure and other motivational variables like regulatory focus.

# Acknowledgements

Thanks to Scott Lauritzen and others in Maddox Lab for data collection. Thanks to Grant Baldwin for Matlab tutorials and use of his old programs.

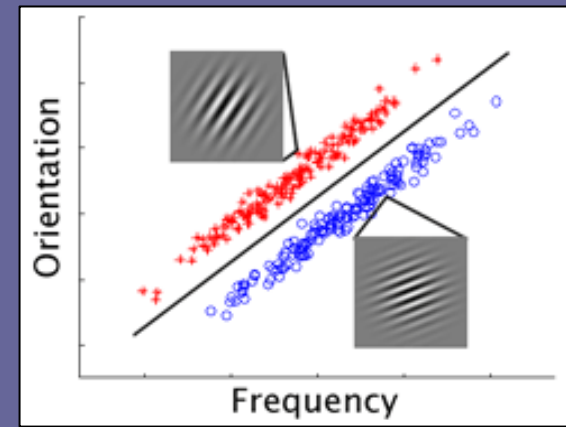
# Category Structures

## Rule-Based



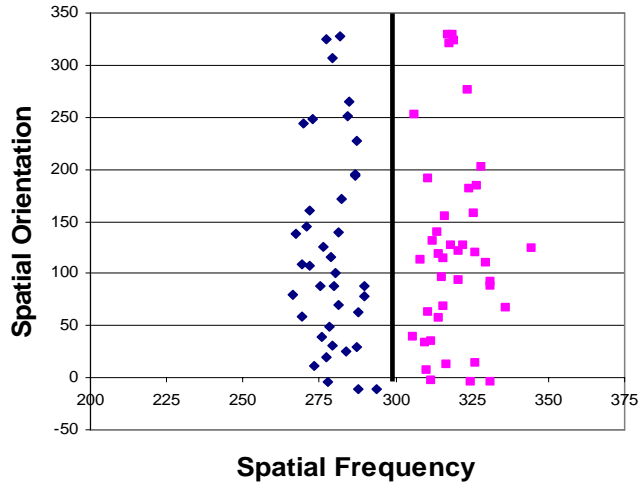
Verbalizable

## Information-Integration

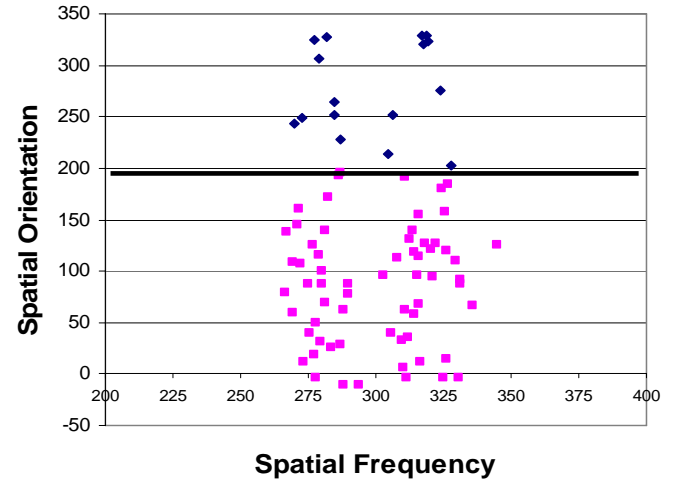


Not verbalizable

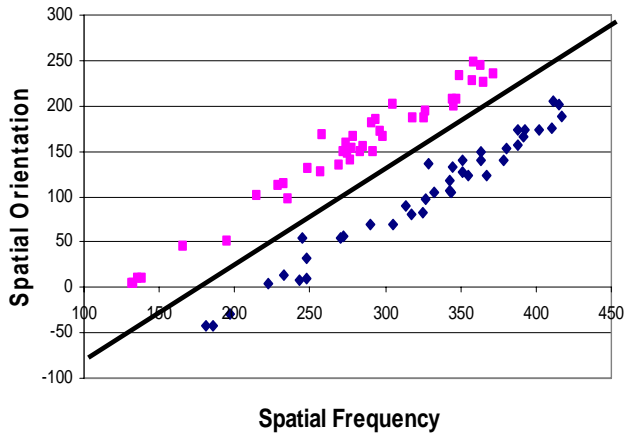
**Best Fit by Frequency Model**



**Best fit by Orientation Model**



**Best Fit by Optimal General Linear Classifier Model**



**Best Fit By Random Response Model**

