AGSM @ UNSW Business School

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Unpacking Mental Models through Lab Experiments

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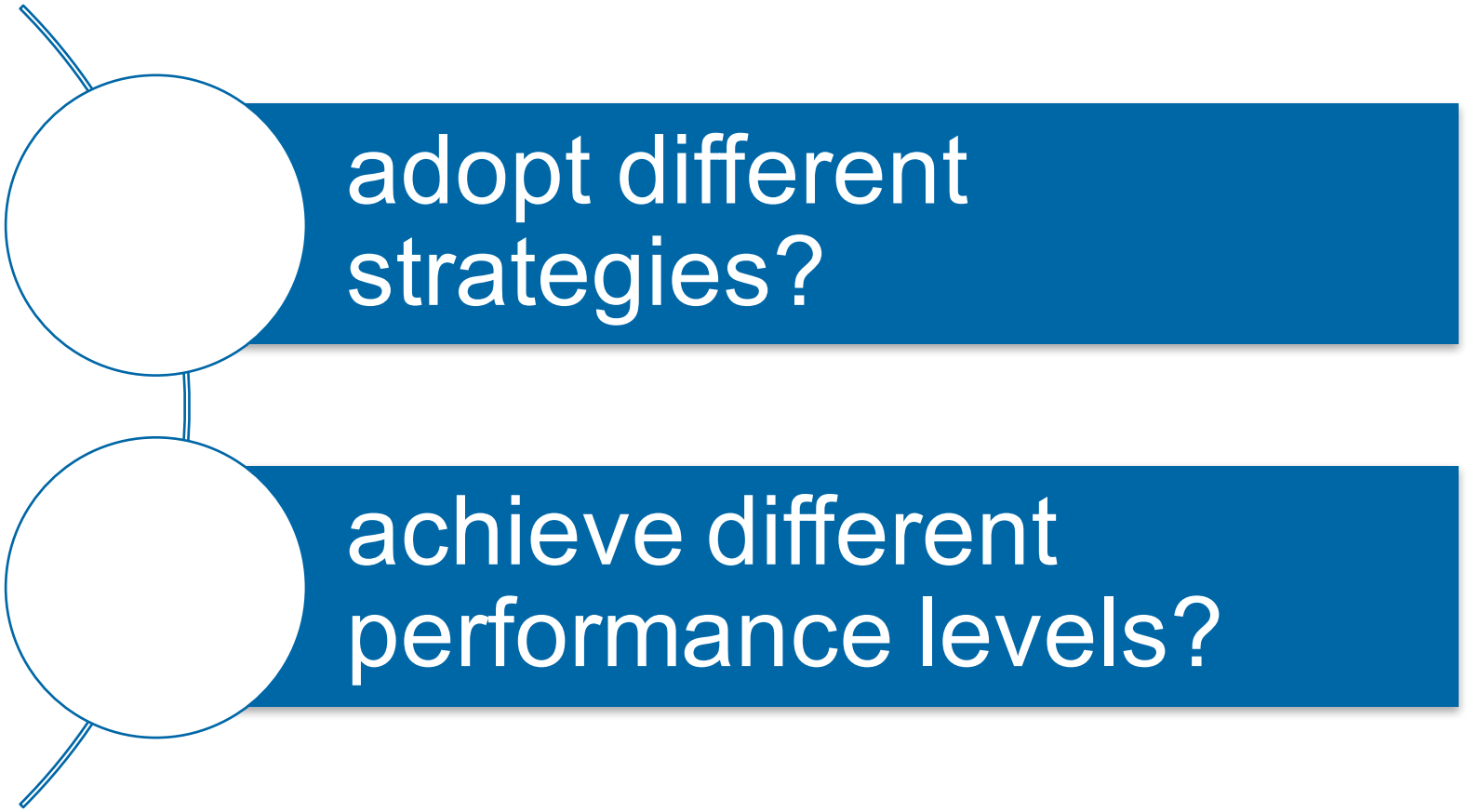
What are Mental Models?

"The psychological core of understanding… consists of having a 'working model' of the phenomenon in your mind. If you understand inflation, a mathematical proof, the way a computer works or DNA… you have a mental representation that serves as a model" (Johnson-Laird 1983: 3)

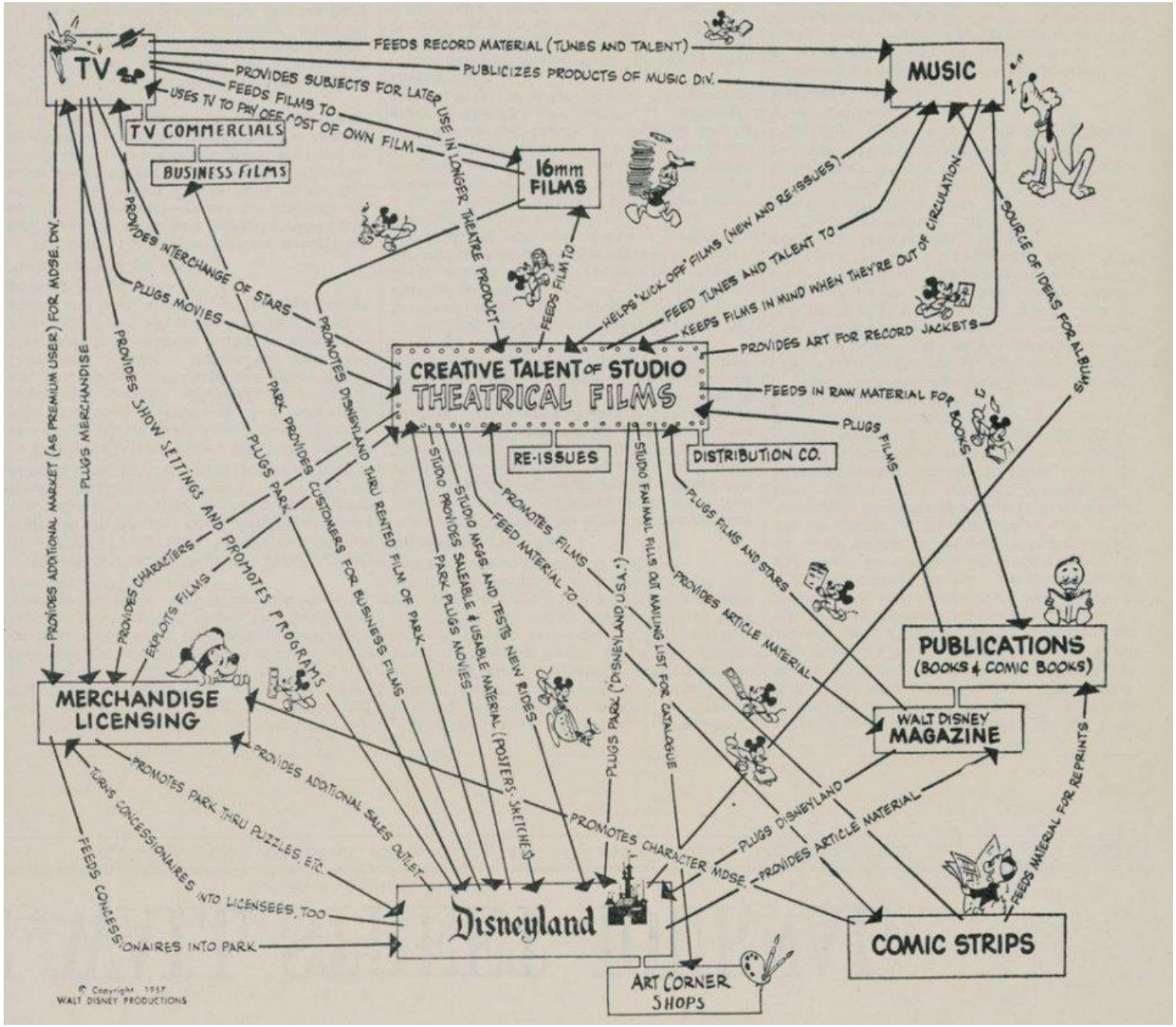
Alternative terms for Mental Models

Cognitive maps
Interpretative schemes
Industry recipes
Implicit theories
Corporate theory
Screens
Frames / Strategic frames
Mental templates
Causal maps
Belief structures
Tacit understanding
Schema
Dominant logic
Mindscapes
Worldview
Managerial lenses
Mental pictures
Organizing frameworks
Blindspots
Perception filters
Organizational ideologies
Heuristics
Decision biases
Core causal beliefs

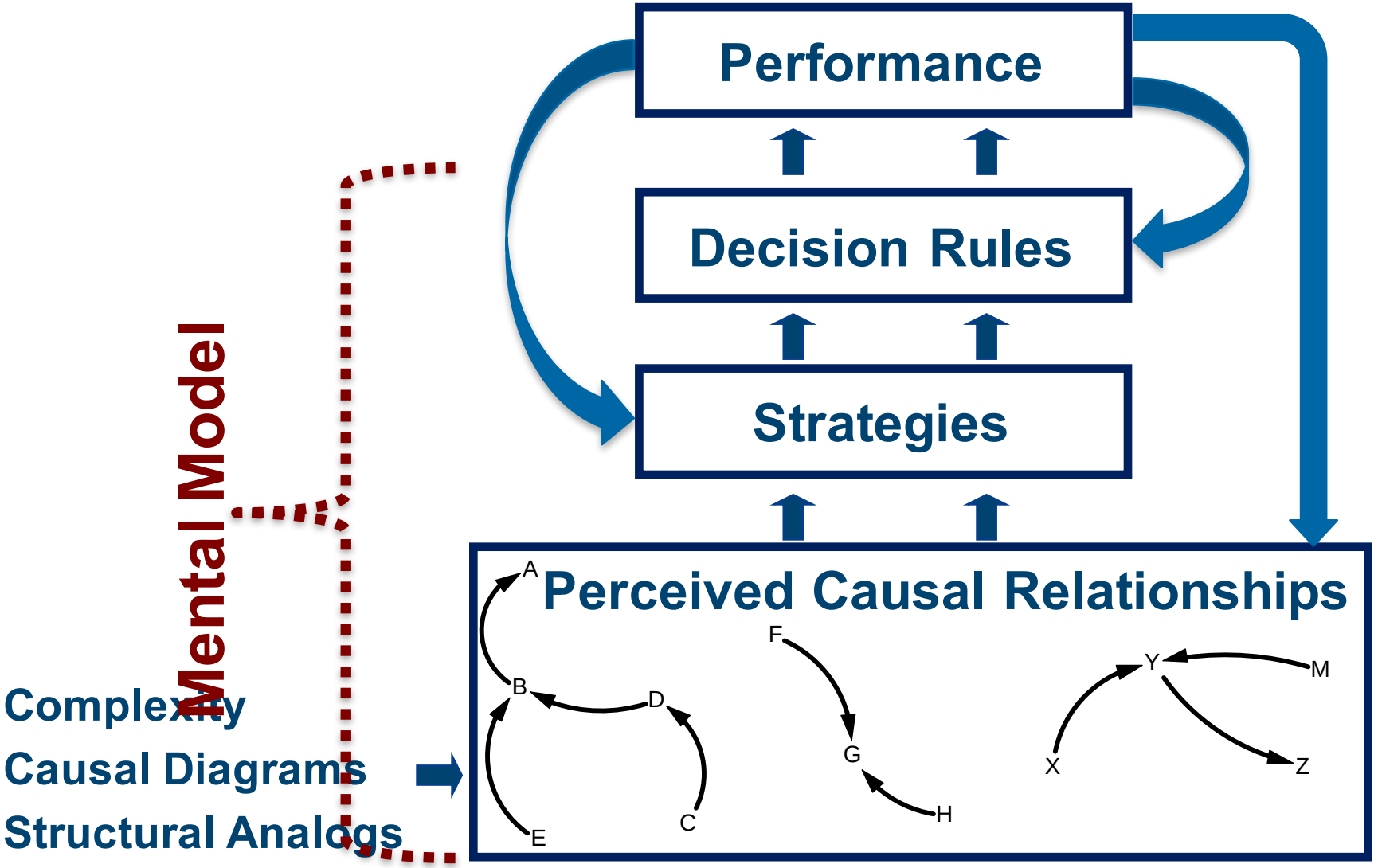
Strategy Puzzle: Why do firms…



Mental model of Disney's Corporate Strategy


TV
MUSIC
FEEDS RECORD MATERIAL (TUNES AND TALENT)
PUBLICIZES PRODUCTS OF MUSIC DIV.
PROVIDES SUBJECTS FOR LATER USE IN LONGER THEATRE PRODUCT
FEEDS FILMS TO
USES TV TO PAY OFF COST OF OWN FILM
TV COMMERCIALS
BUSINESS FILMS
16mm FILMS
HELPS 'KICK-OFF' FILMS (NEW AND RE-ISSUES)
FEED TUNES AND TALENT TO
KEEPS FILMS IN MIND WHEN THEY'RE OUT OF CIRCULATION
SOURCE OF IDEAS FOR ALBUMS
PROVIDES ART FOR RECORD JACKETS
PROVIDES INTERCHANGE OF STARS
PLUGS MOVIES
PROMOTES DISNEYLAND THRU RENTED FILM OF PARK
FEEDS FILM TO
CREATIVE TALENT OF STUDIO
THEATRICAL FILMS
FEEDS IN RAW MATERIAL FOR BOOKS
PLUGS FILMS
RE-ISSUES
DISTRIBUTION CO.
PROVIDES ADDITIONAL MARKET (AS PREMIUM USER) FOR MDSE. DIV.
PLUGS MERCHANDISE
PROVIDES SHOW SETTINGS AND PROMOTES PROGRAMS
PARK PROVIDES CUSTOMERS FOR BUSINESS FILMS
PLUGS PARK
PROMOTES FILMS
FEED MATERIAL TO
STUDIO MFGS. AND TESTS NEW RIDES
STUDIO PROVIDES SALEABLE & USABLE MATERIAL (POSTERS, SKETCHES)
PARK PLUGS MOVIES
PLUGS PARK ("DISNEYLAND, U.S.A.")
STUDIO FAN MAIL FILLS OUT MAILING LIST FOR CATALOGUE
PROVIDES ARTICLE MATERIAL
PLUGS FILMS AND STARS
PROVIDES CHARACTERS
EXPLOITS FILMS
PUBLICATIONS
(BOOKS & COMIC BOOKS)
MERCHANDISE LICENSING
WALT DISNEY MAGAZINE
PROMOTES PARK THRU PUZZLES, ETC.
TURNS CONCESSIONAIRES INTO LICENSEES, TOO
FEEDS CONCESSIONAIRES INTO PARK
PROVIDES ADDITIONAL SALES OUTLET
PROMOTES CHARACTER MDSE.
PLUGS DISNEYLAND
PROVIDES ARTICLE MATERIAL
FEEDS MATERIAL FOR REPRINTS
Disneyland
COMIC STRIPS
ART CORNER SHOPS
© Copyright 1957
WALT DISNEY PRODUCTIONS

Mental Models in Action



Three Studies on Mental Models

Mental models, decision rules, and performance heterogeneity. SMJ 2011

Dynamic decision making using the balance scorecard framework. TAR 2016

Enhancing mental models, analogical transfer, and performance in strategic decision making. SMJ 2012

Study 1: Examining effects of mental model accuracy on decision rules, strategies, and performance

Study 1: Research Questions

Do more accurate mental models of causal relationships increase performance?

Is mental model accuracy positively associated with better strategies and decision rules?

Do more accurate mental models of the key principles increase performance?

Do more accurate mental models have a greater positive effect on performance under higher dynamic complexity?

Study 1: New Product Launch Sim

Management Simulator ABC Ltd.
Quarter 17 of 40

How To Play
Reports

Price $110.00
Target Capacity 1,300,000

Simulate 1 Quarter

Exit Simulation

OPERATIONS

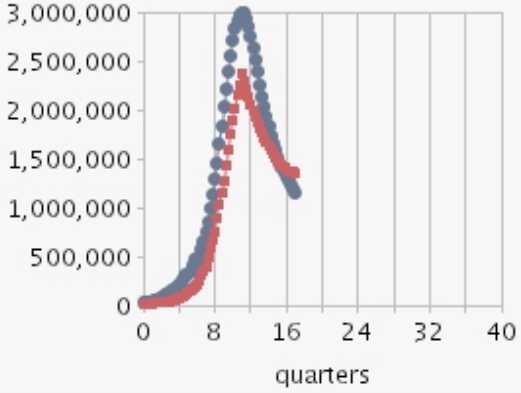
Orders	1,158,117
Backlog	3,401,753
Shipments	1,359,015
Cancellations	211,587
Price	$110.00
Unit Cost	$36.53
Delivery Delay (quarters)	2.50

	(units per quarter)
Capacity	1,359,015
Target Capacity	1,300,000

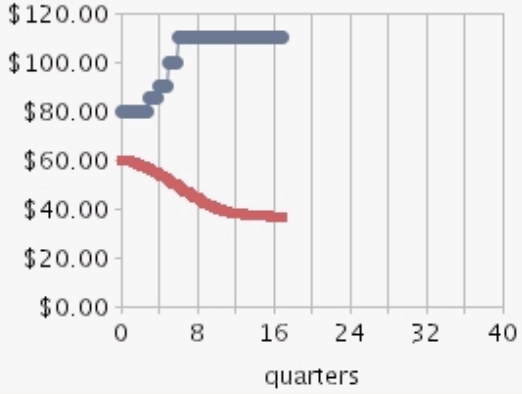
FINANCIALS

Revenues	$149,488,737
Costs	
Variable Costs	$8,869,228
Fixed Costs	$40,770,450
Marketing Spend	$7,474,437
Investment Costs	$103,276
Net Profit	$92,271,346
Cumulative Profit	$1,008,597,199

ORDERS & CAPACITY HISTORY



PRICE HISTORY



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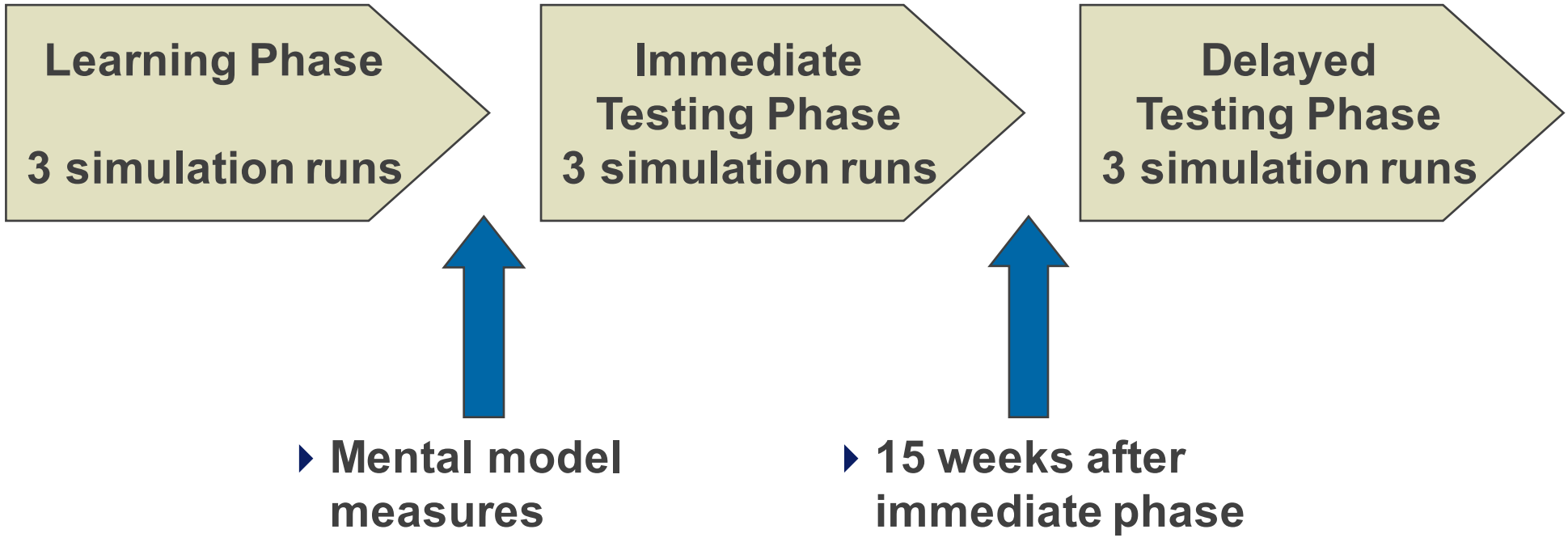
Study 1 Experimental Design



- Repeated measures design: 9 runs & 360 decision trials
- 63 2nd year MBA students randomized into 2 complexity levels

Not easy to recruit participants!

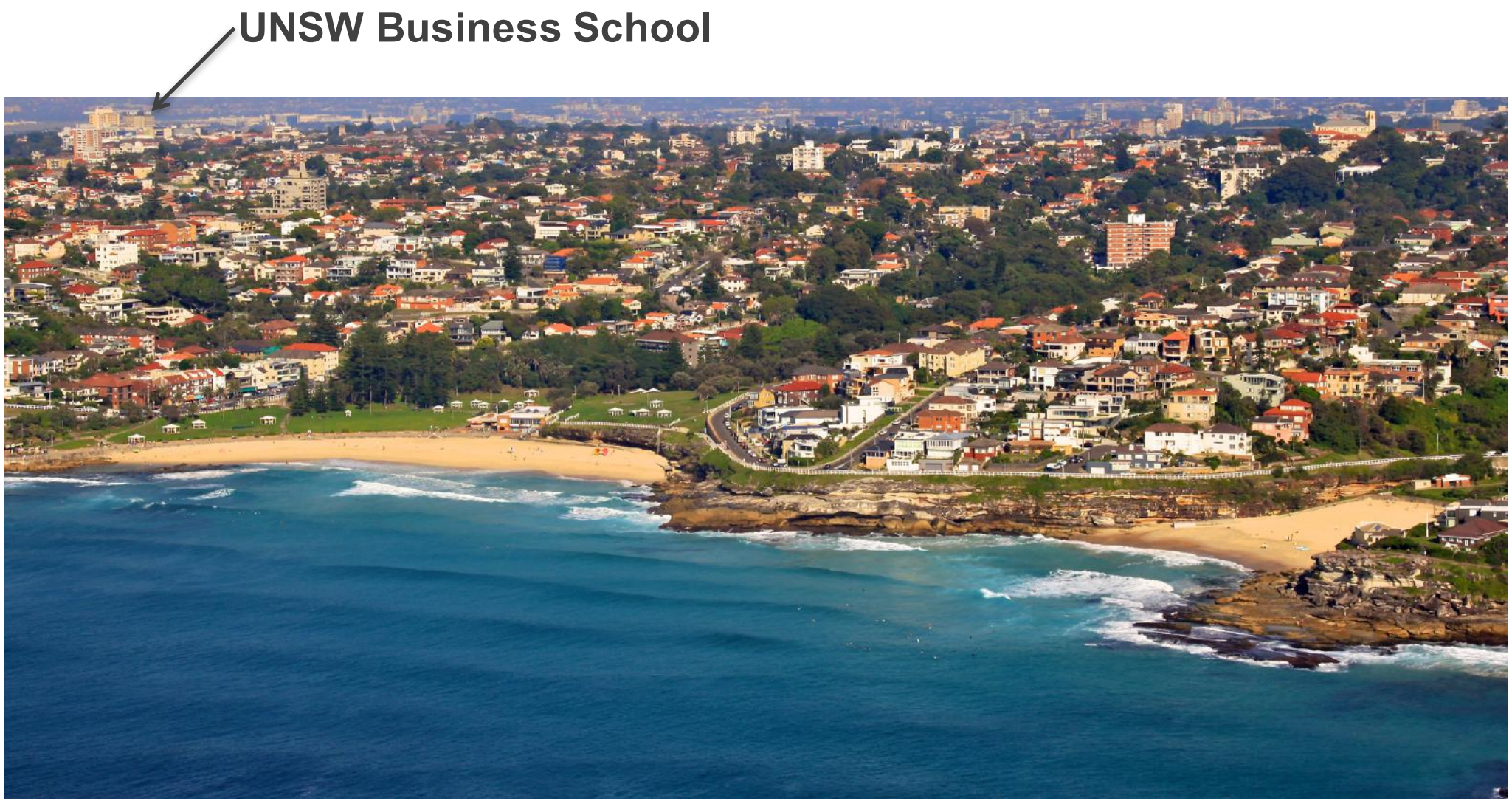


Photo courtesy of Alexander Tempel @photo.alexander.tempel

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Measures

Performance: Cumulative Net Income

Mental Model Accuracy

- Perceived causal relationships
- Mental simulations of small components (Graphical integration)
- Partial knowledge of core feedback structure (market diffusion process)

Control variables

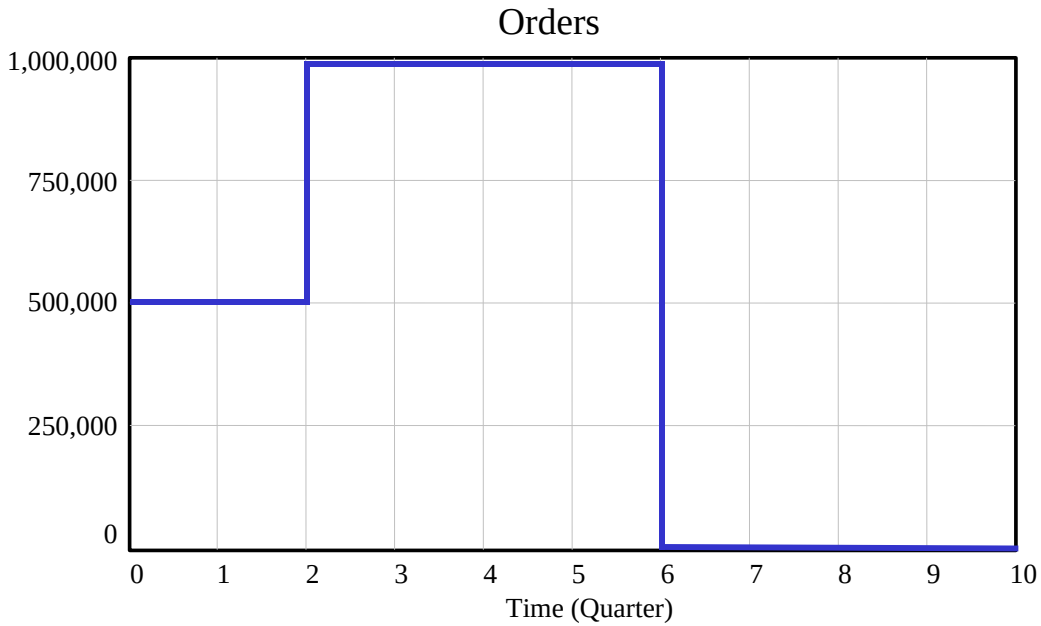
- Mental model complexity
- GMAT scores: general cognitive ability
- Self-efficacy: self confidence and motivation

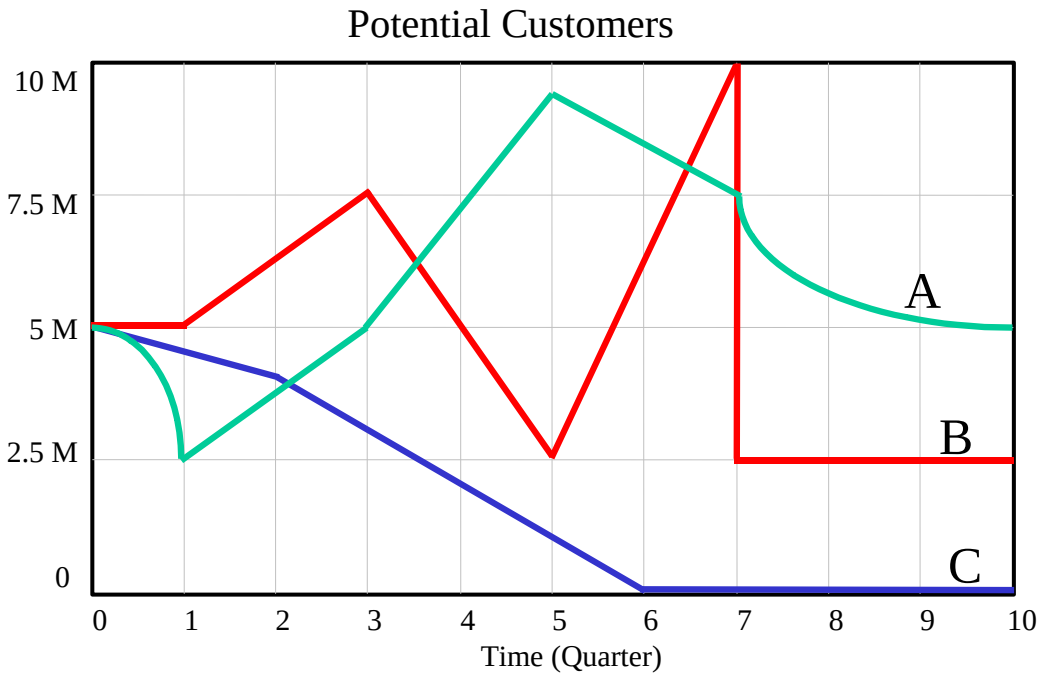
Example Causal Relationship Questions

	An increase in X results in an increase in Y, or a decrease in X results in a decrease in Y. X and Y move in the SAME direction.
	X and Y move in the OPPOSITE direction. An increase in X results in a decrease in Y, or a decrease in X results in an increase in Y.

1.	Orders	Backlog
2.	Shipments	Backlog
3.	Backlog	Delivery Delay

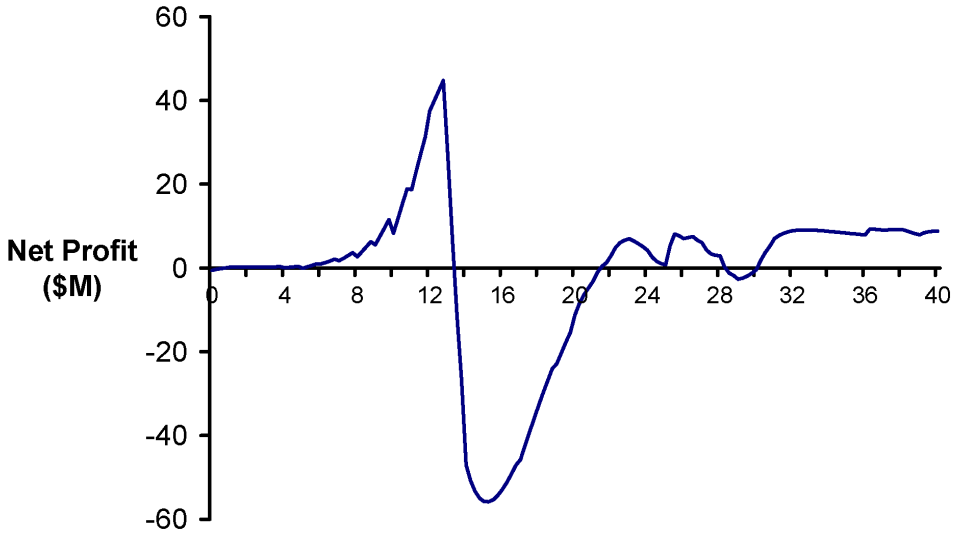
Example graphical scenario question



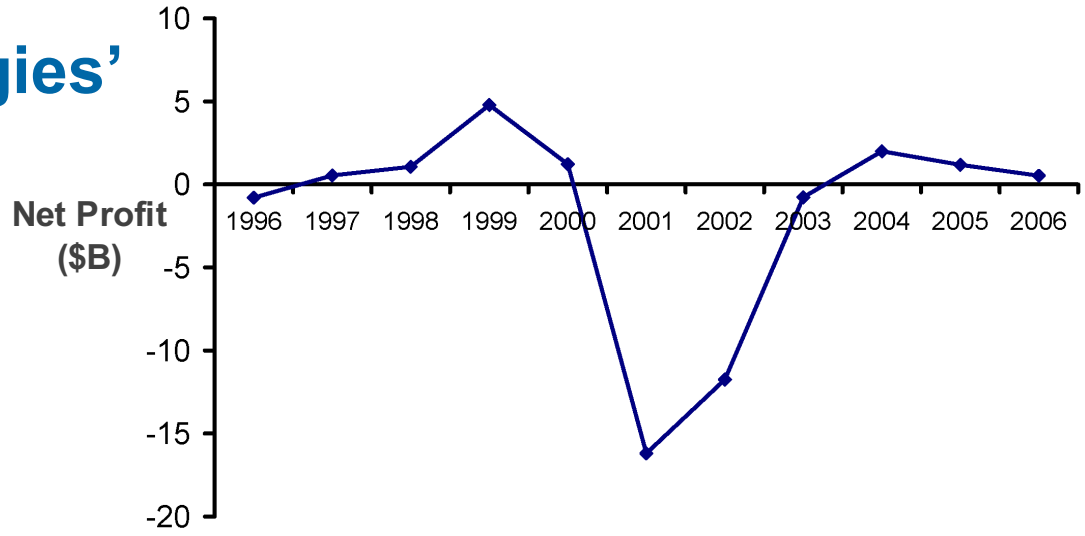


Results: Decision makers replicate boom & bust patterns observed in the field

Typical Simulated Performance

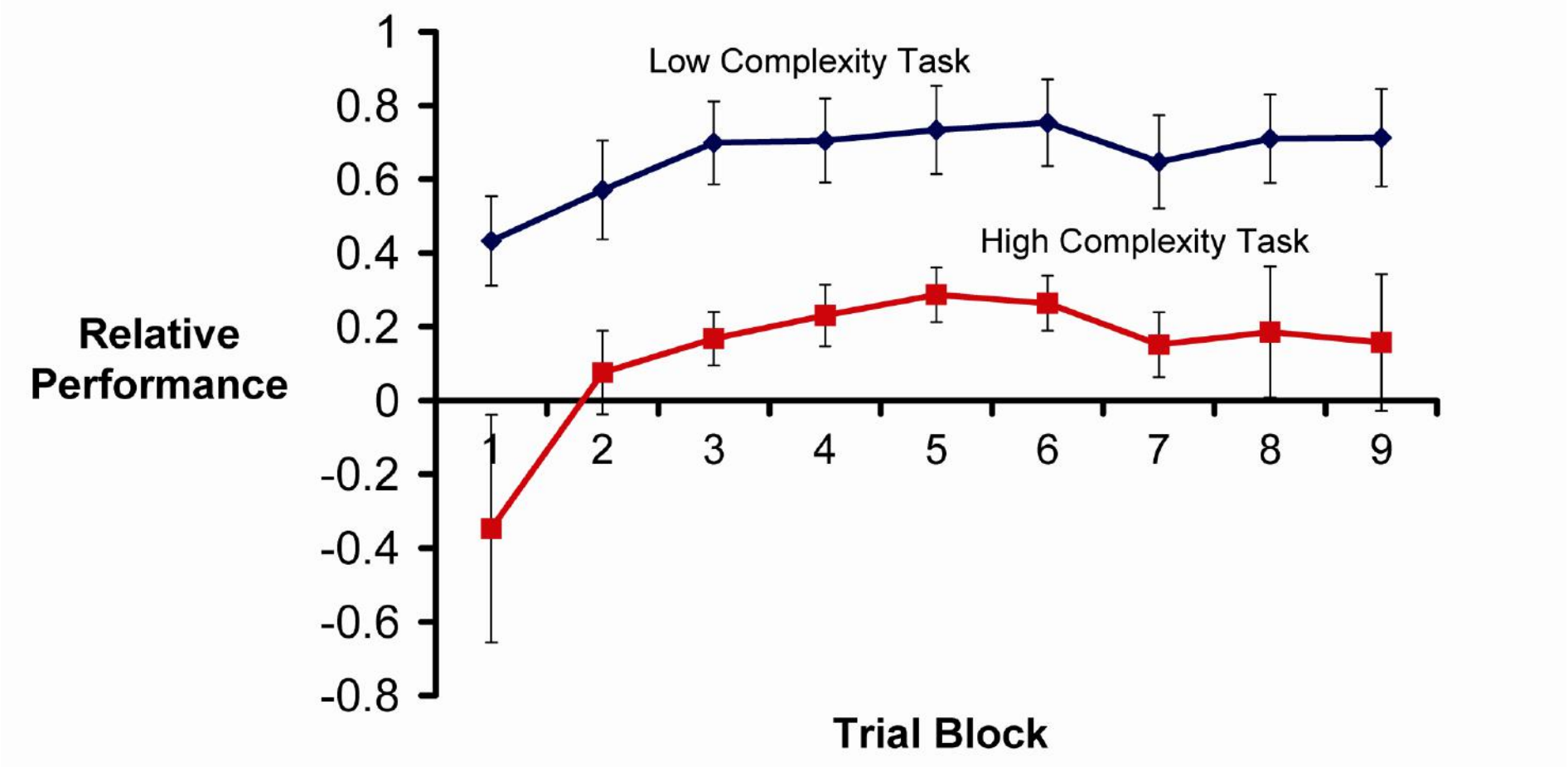


Lucent Technologies' Boom & Bust



Gary et al. 2008. Boom and Bust Behavior: On the Persistence of Strategic Decision Biases

Performance Relative to Benchmark



Mental Model Accuracy & Performance

More accurate mental models improve performance

- Range .32 - .81, mean .56 (.11)
- Increasing MMA 1 std deviation ⇧ performance 22-40%

More accurate mental models of key principles improve performance

- 1 std deviation ⇧ performance 17-38%

Two types of mental model errors

- Causal blind spots
- Superstitious causal beliefs

Decision Rules

Capacity investment rule:

$$\log(C_t^*) = c + a_0 \log(D_{t-1}) + a_1 \log(1 + g_{t-1}) + a_2 \log(B_{t-1} / C_{t-1}) + \varepsilon_1$$

Price decision rule:

$$\log(P_t) = b_0 + b_1 \log(UVC_{t-1}) + b_2 \log(B_{t-1} / C_{t-1}) + \varepsilon_2$$

Mental Models and Decision Rules

More accurate mental models improve decision rules

- Increasing MMA reduces deviation from optimal information weights for behavioral rules

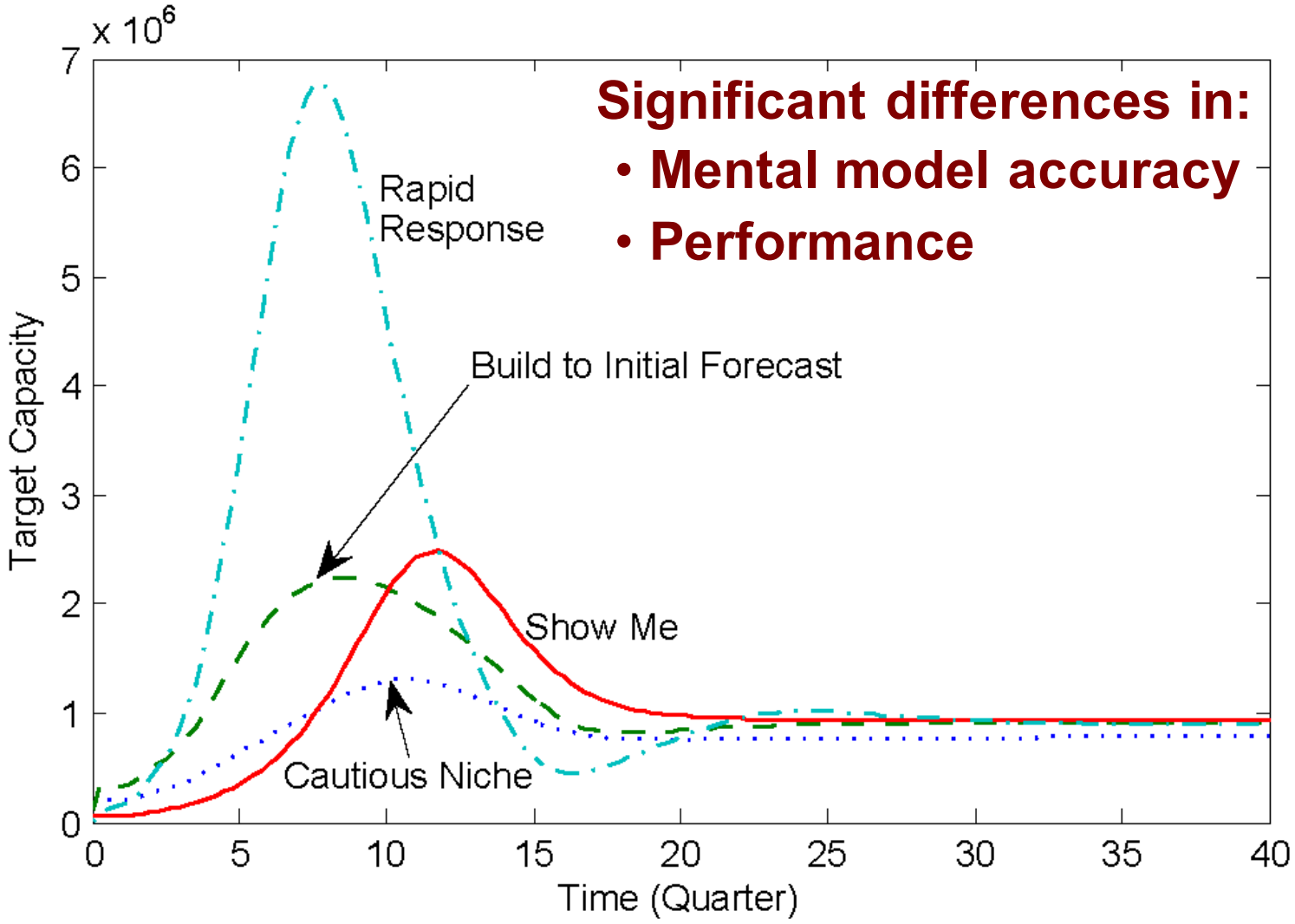
More accurate mental models of key principles improve decision rules

Increasing dynamic complexity impairs decision rules

Participants' decision rules stabilized rapidly

- No differences in information weights after 4th trial block

Identified 4 Distinct Strategies on High Complexity Task



Significant differences in:

- **Mental model accuracy**
- **Performance**

In a Nutshell…

Connects heterogeneity in mental model accuracy, decision rules, and strategies to variation in performance outcomes

- Important role of mental models in the origins of successful strategies

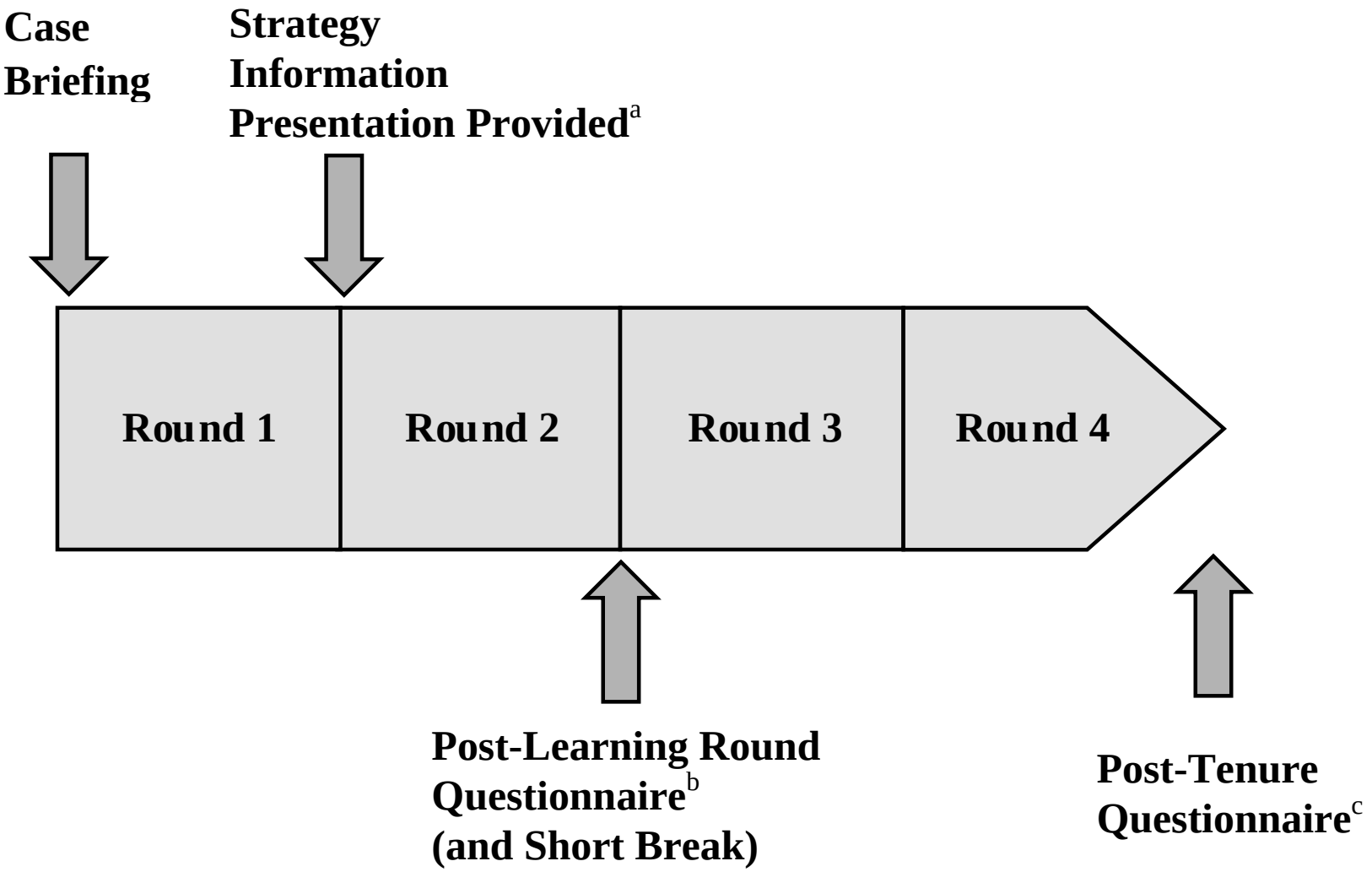
Study 2: Examining effects of a strategy map with causal relationships and time delay information on mental model accuracy and performance

Study 2: Research Questions

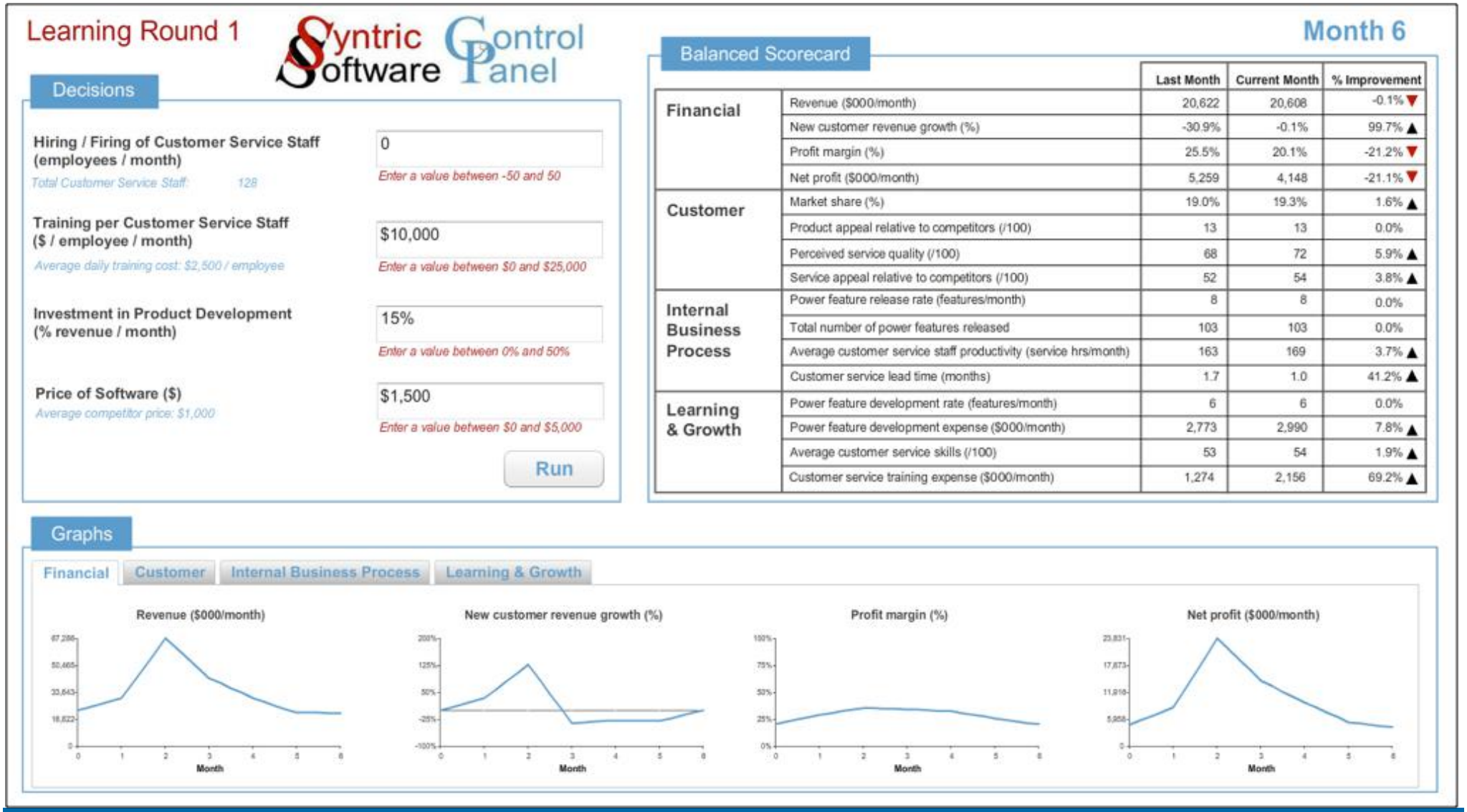
Does providing a strategy map with key causal relationships increase mental model accuracy and performance?

Does providing a strategy map with key causal relationships and time delays increase mental model accuracy and performance?

Study 2: Experimental Design



Study 2: Balanced Scorecard Sim



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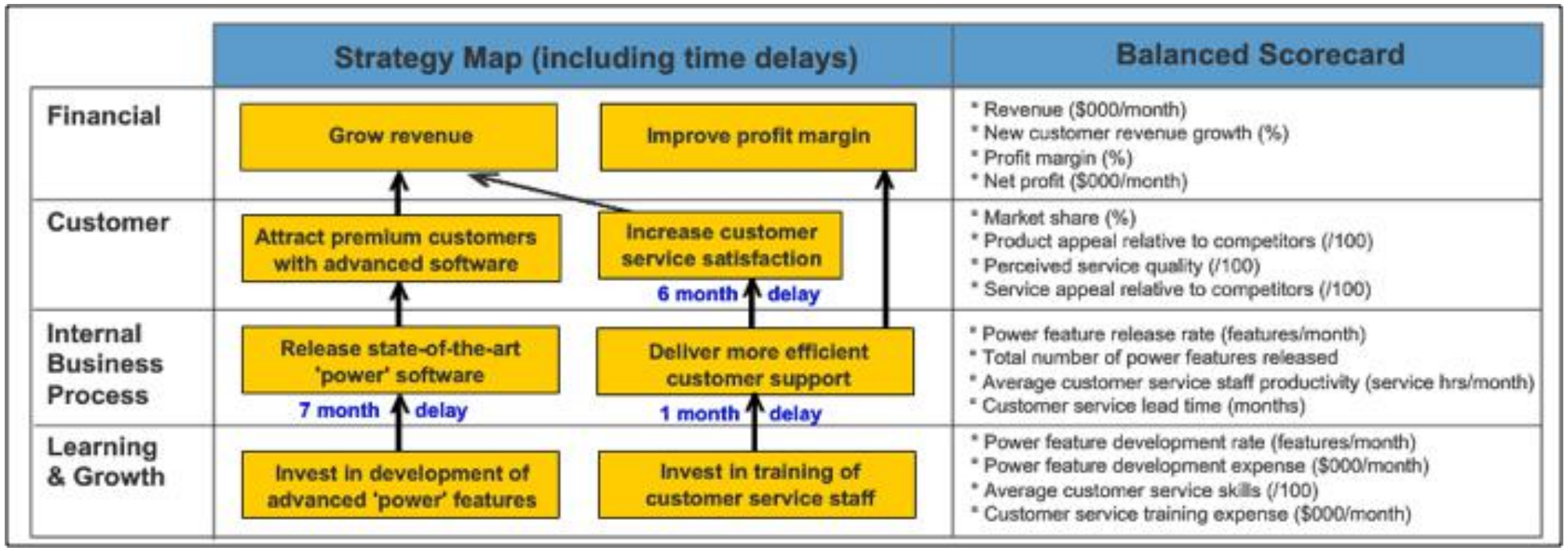
Treatments: Strategy Map



- Repeated measures design: 4 runs & 144 decision trials
- 69 graduate students randomized across 3 treatments

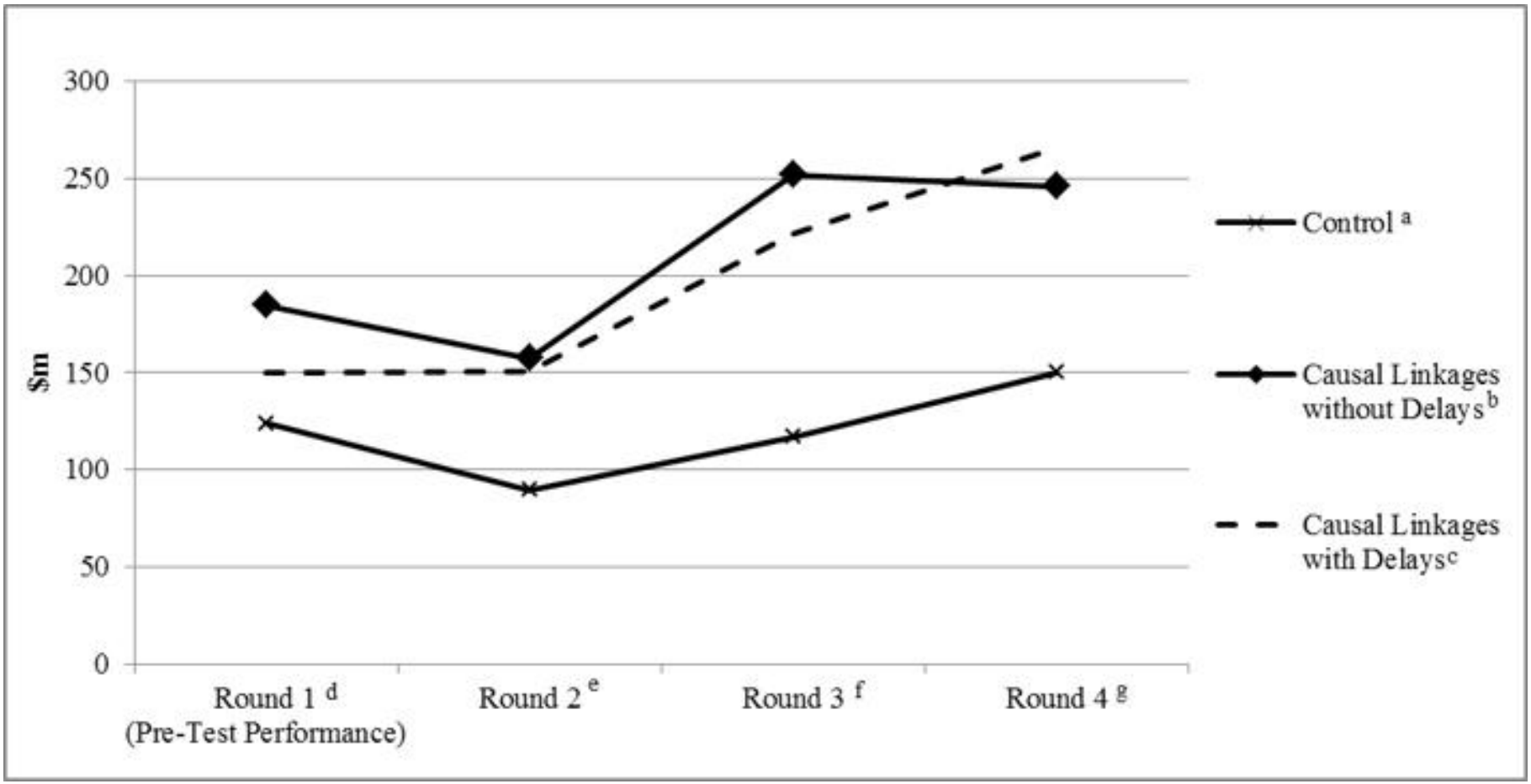
Study 2 Measures

Performance: Cumulative Profit

Mental Model Accuracy of causal relationships and delays

- Perceived causal relationships
- Mental simulations of small components
- Partial knowledge of key principles

Cumulative Profit by Sim Round & Treatment



Strategy Map, Mental models, & Performance

Both strategy map treatments ⇧ MMA of causal relationships compared with control group (μ= .65, .67, & .56; p's < .01)

Strategy map with delays treatment ⇧ MMA of delays (μ= .42) compared with strategy map without delays (μ= .30, p=0.03) and control group (μ= .30, p=0.02)

Both strategy map treatments ⇧ performance compared with control group (μ= $249m, $244m, & $134m; p's < 0.01)

More accurate mental models of causal relationships and delays ⇧ performance (p's<0.05)

In a nutshell…

Strategy maps with information about causal relationships and time delays improve mental models and performance

Study 3: Examining mental models and transfer performance between structural analogs

Situations with same feedback structure but different surface features

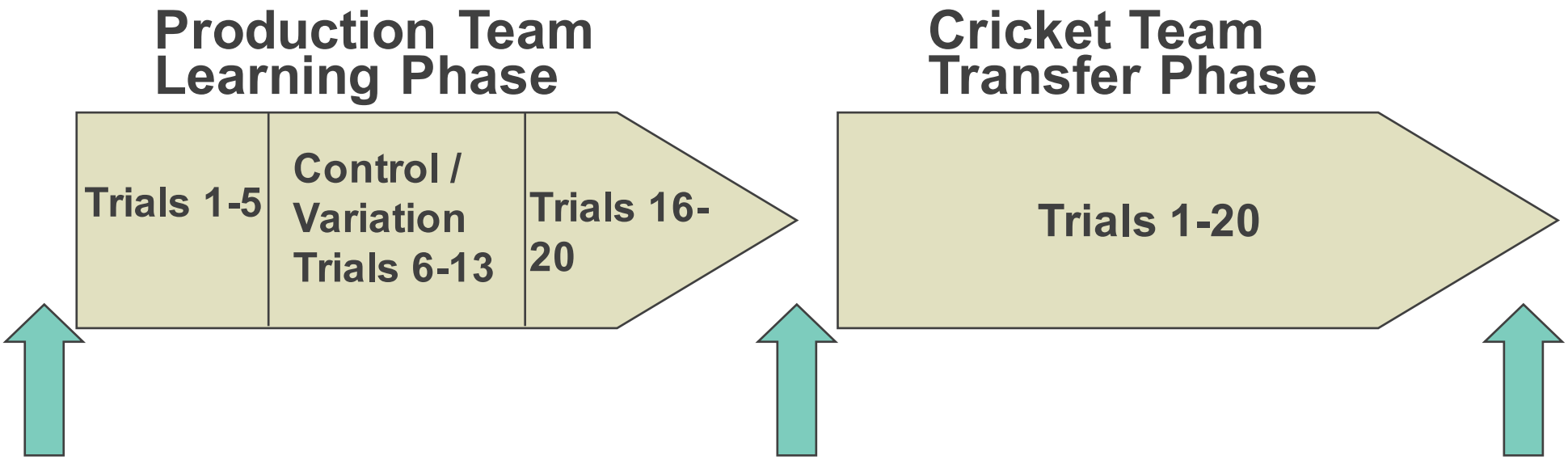
Study 3: Research Questions

Do more accurate mental models of a management situation increase (transfer) performance on a structurally analogous situation?

Does variation in the initial management situation increase transfer performance?

Does increasing use of a systematic search strategy to explore the initial management situation increase transfer performance?

Study 3: Experimental Design



- Measure of learning orientation
- Measures: MMA, systematic search strategy, controls
- Post-experiment interviews

- 96 university students randomized across two conditions
- Baseline study with 16 university students on Cricket team sim

35

Measures

Performance score

Mental Model Accuracy

- Knowledge of causal relationships

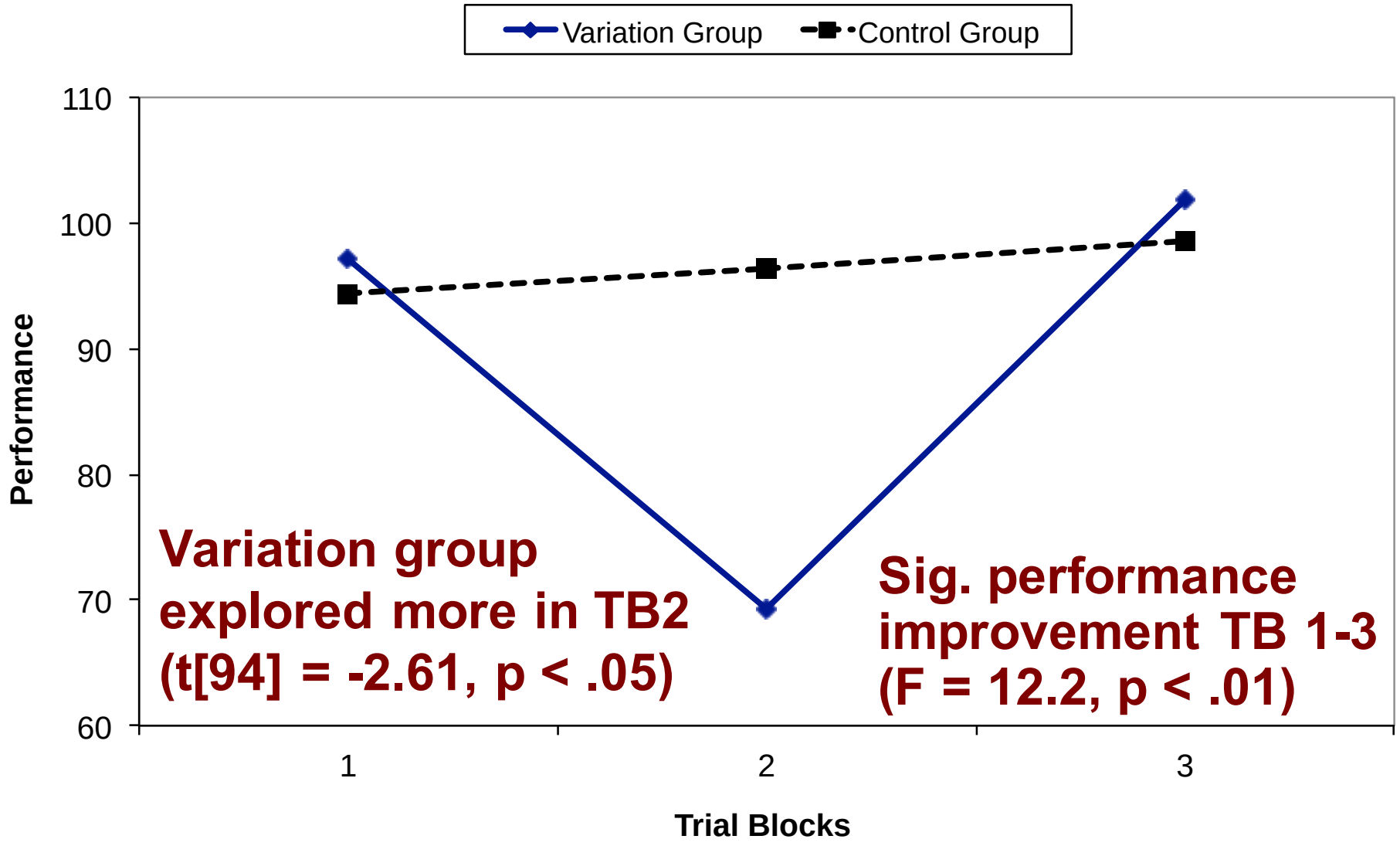
Systematic search strategy

- # of unconfounded changes (VOTAT) for each trial block

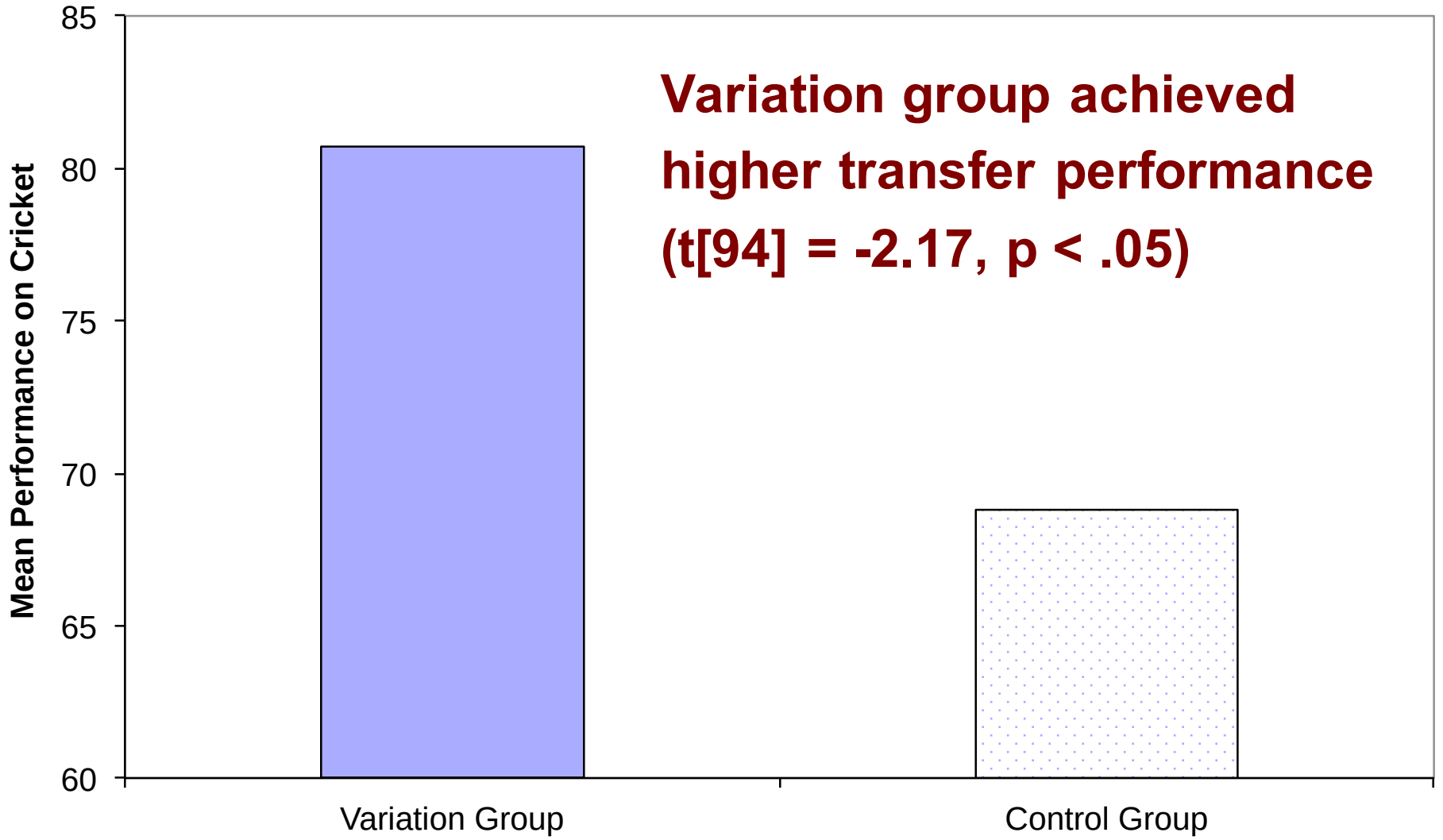
Control variables

- Learning goal orientation
- Metacognitive activity
- Interest

Performance on Initial Microworld



Performance on Analogous Microworld



Mental Model Accuracy, Search, and Transfer Performance

Increasing mental model accuracy ⇧ performance on initial microworld ($p < .01$)

Higher performance on initial microworld increases transfer performance on the structurally analogous microworld ($p < .01$)

Higher levels of systematic search on the initial microworld increase transfer performance ($p < .05$)

Only 42% of participants realized the 2 microworlds were structural analogs: 52% in variation condition vs. 31% in control ($p < .05$)

A Lot More Research is Needed!

Interventions for developing accurate mental models

- Testing decision aids (e.g. stock & flow diagraming, CLDs, microworlds, goal setting, mental simulation)
- Testing different learning paths & exposure to scenarios

Identify common management challenges/problems and build models rigorously grounded in empirical data so we can develop microworlds to use in experiments

Systematic simplifications in mental models, decision rules, & the consequences

Transferring knowledge across similar management situations (generic structures & analogical reasoning)