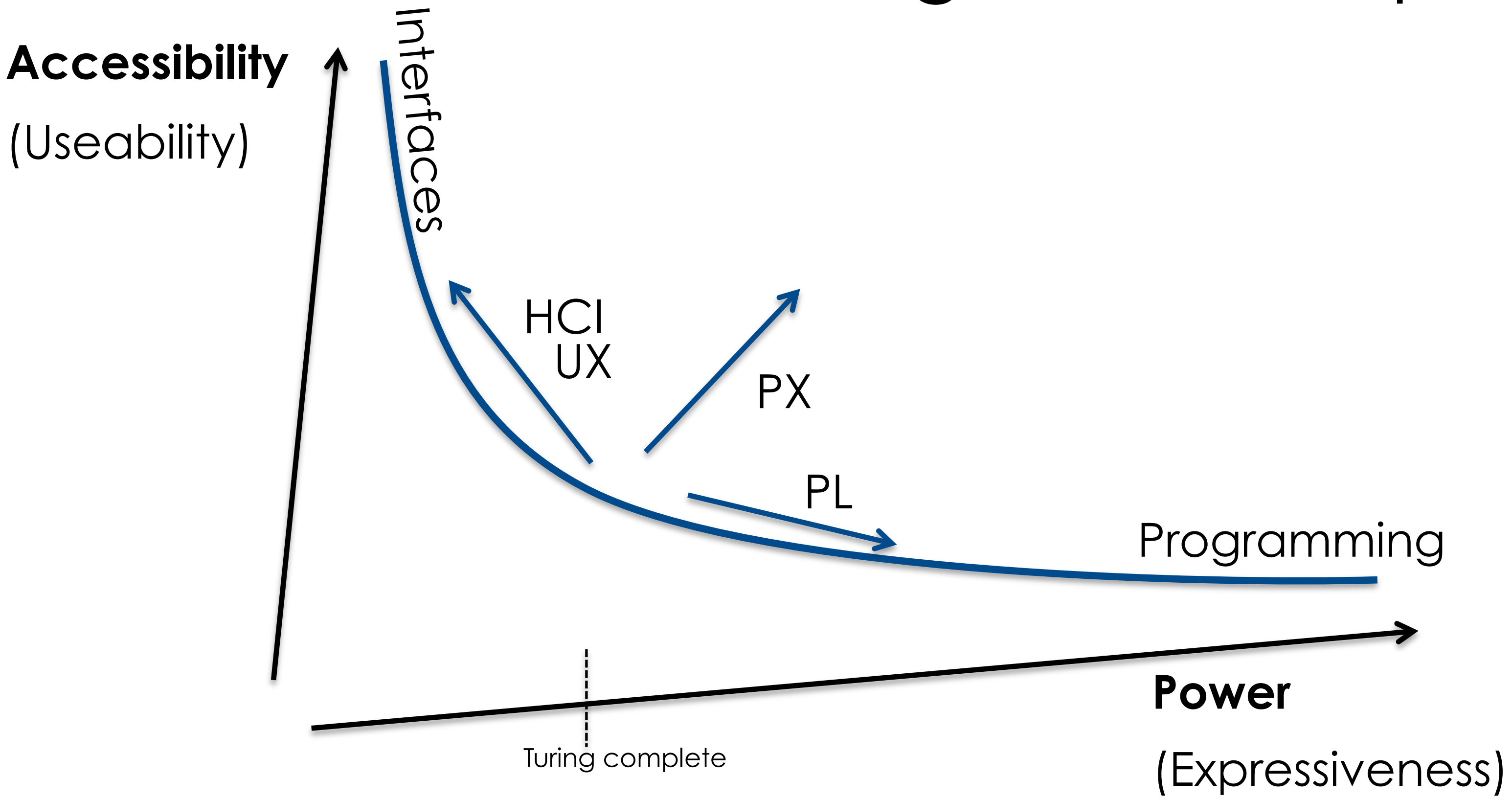
The Prospects for Programming-Experience Design

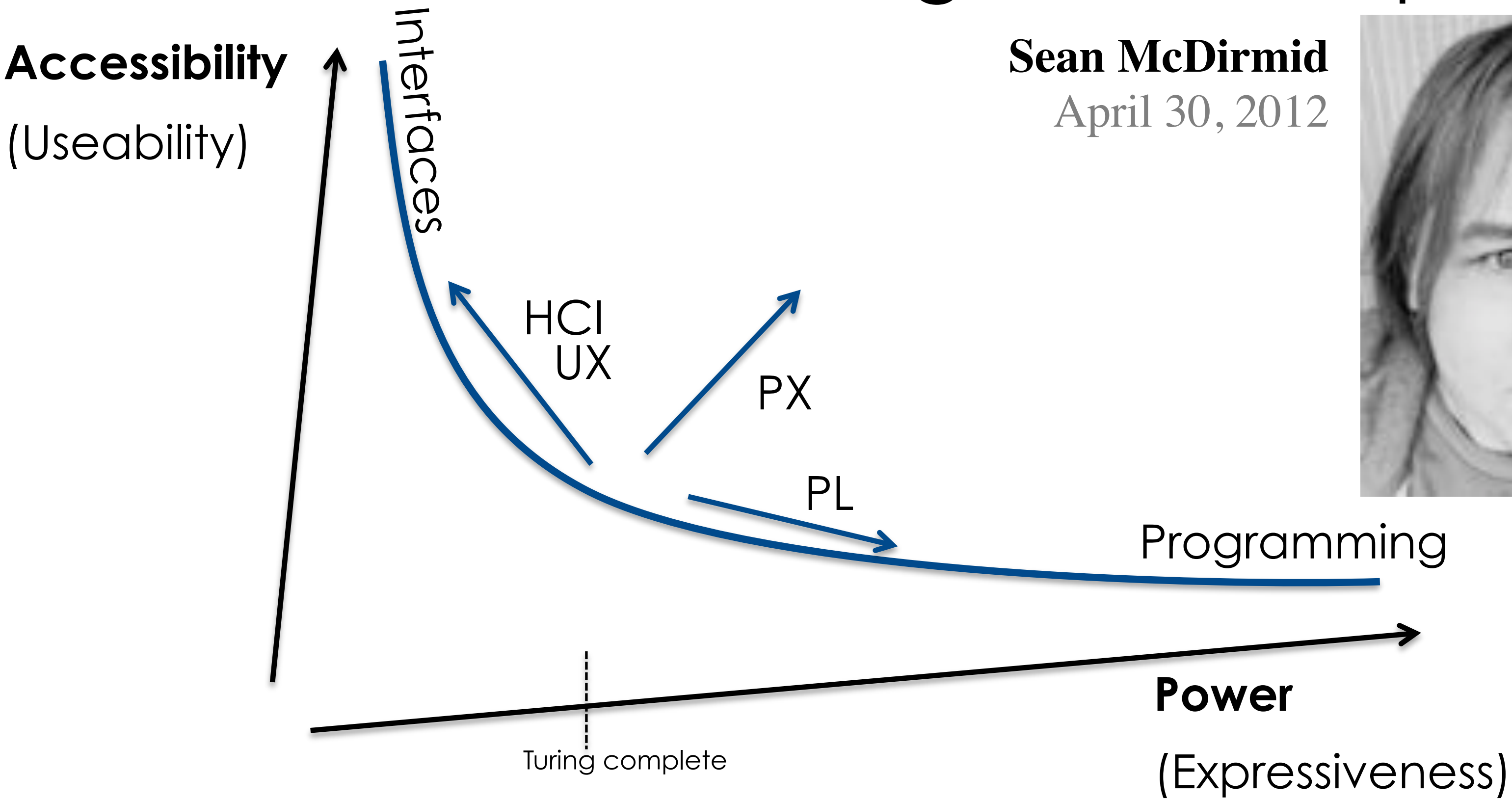
Gary Miller
University of Technology, Sydney

Towards <u>a</u> <u>theory</u> of Programming Language Design

PX - Programmer Experience



PX - Programmer Experience



Sean McDirmid
April 30, 2012

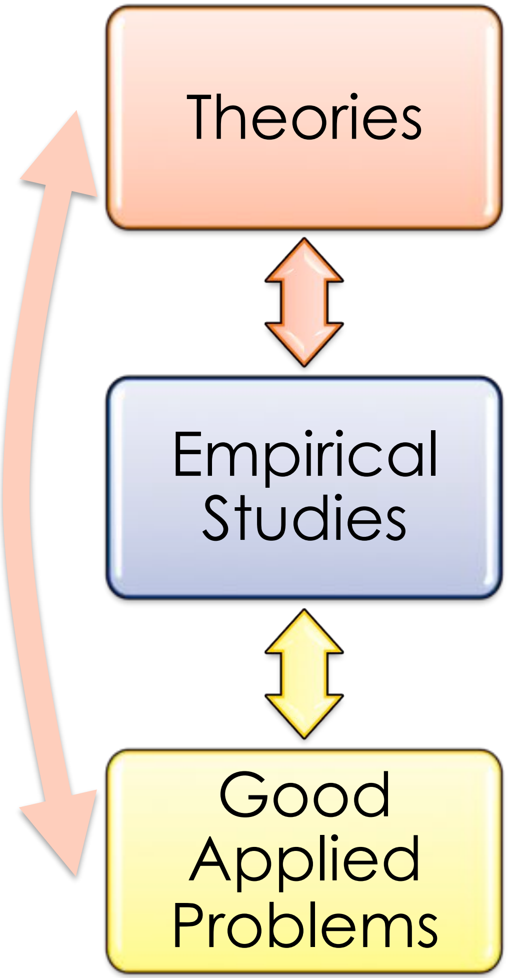
When is comes to computation
we are all disabled !

HUMAN COMPUTER INTERACTION, 1985, Volume 1, pp. 209-242

The Prospects for Psychological Science in Human-Computer Interaction

Allen Newell
Carnegie-Mellon University

Stuart K. Card
Xerox Palo Alto Research Center



HUMAN COMPUTER INTERACTION, 1985, Volume 1, pp. 209-242

The Prospects for Psychological Science in Human-Computer Interaction

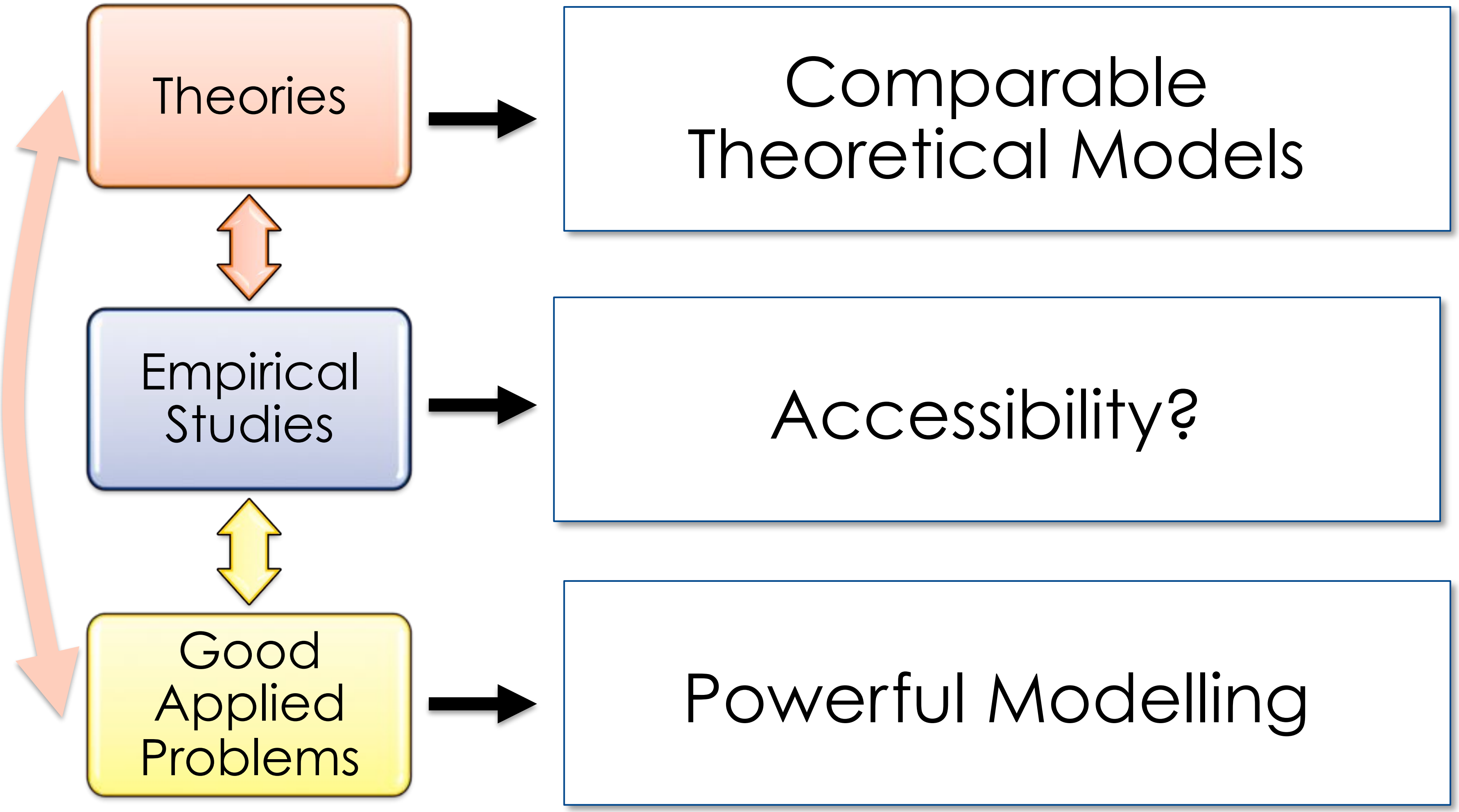
Gresham's Law: Hard Science Drives Out Soft.

There is Nothing so Useful as a Good Theory.

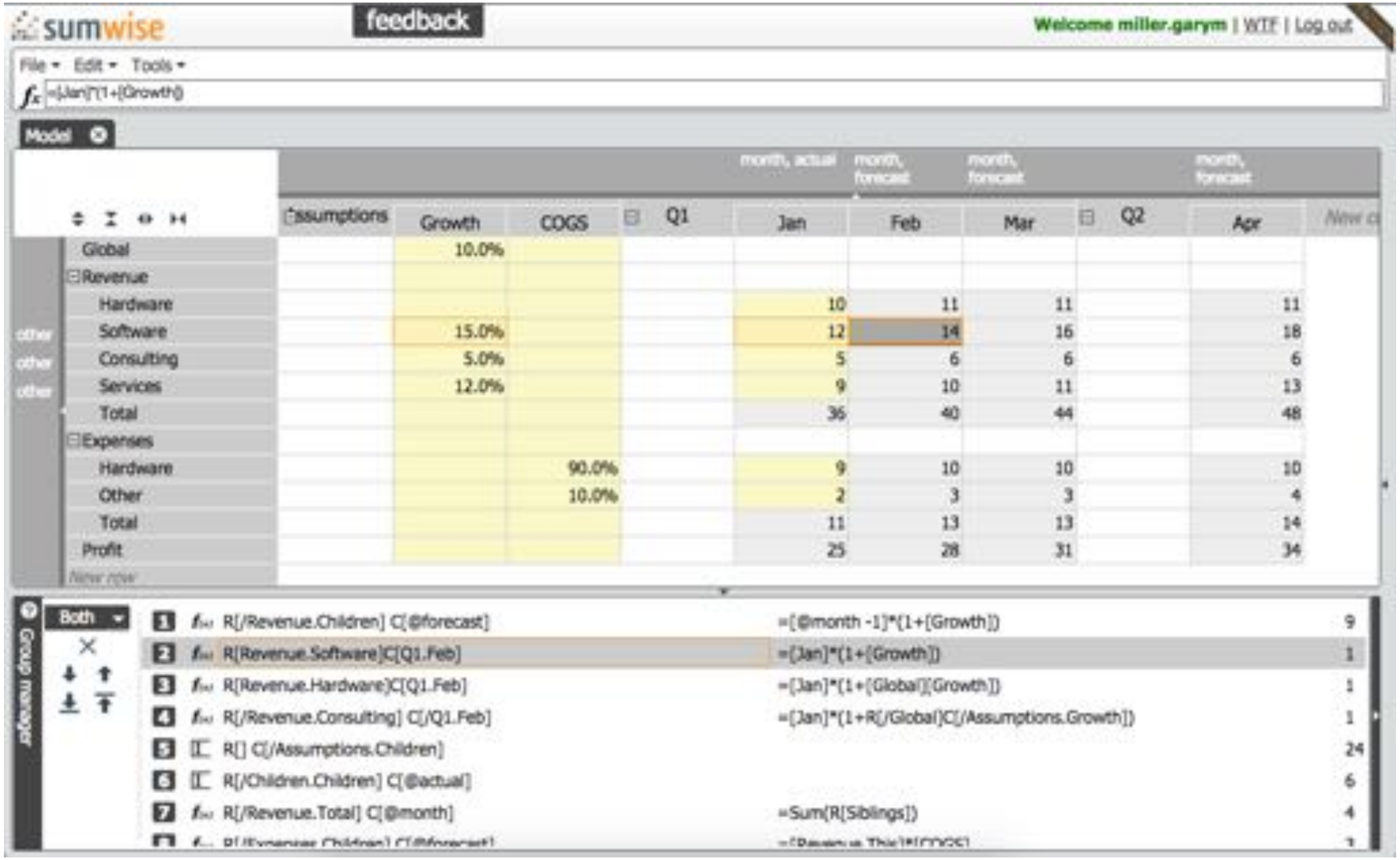
Good Studies of the Interface Yield Theories, Not Facts.

Psychological Research Best Affects Design by Providing the Designer Tools for Thought.

The Race is Between the Tortoise of Cumulative Science and the Hare of Intuitive Design.

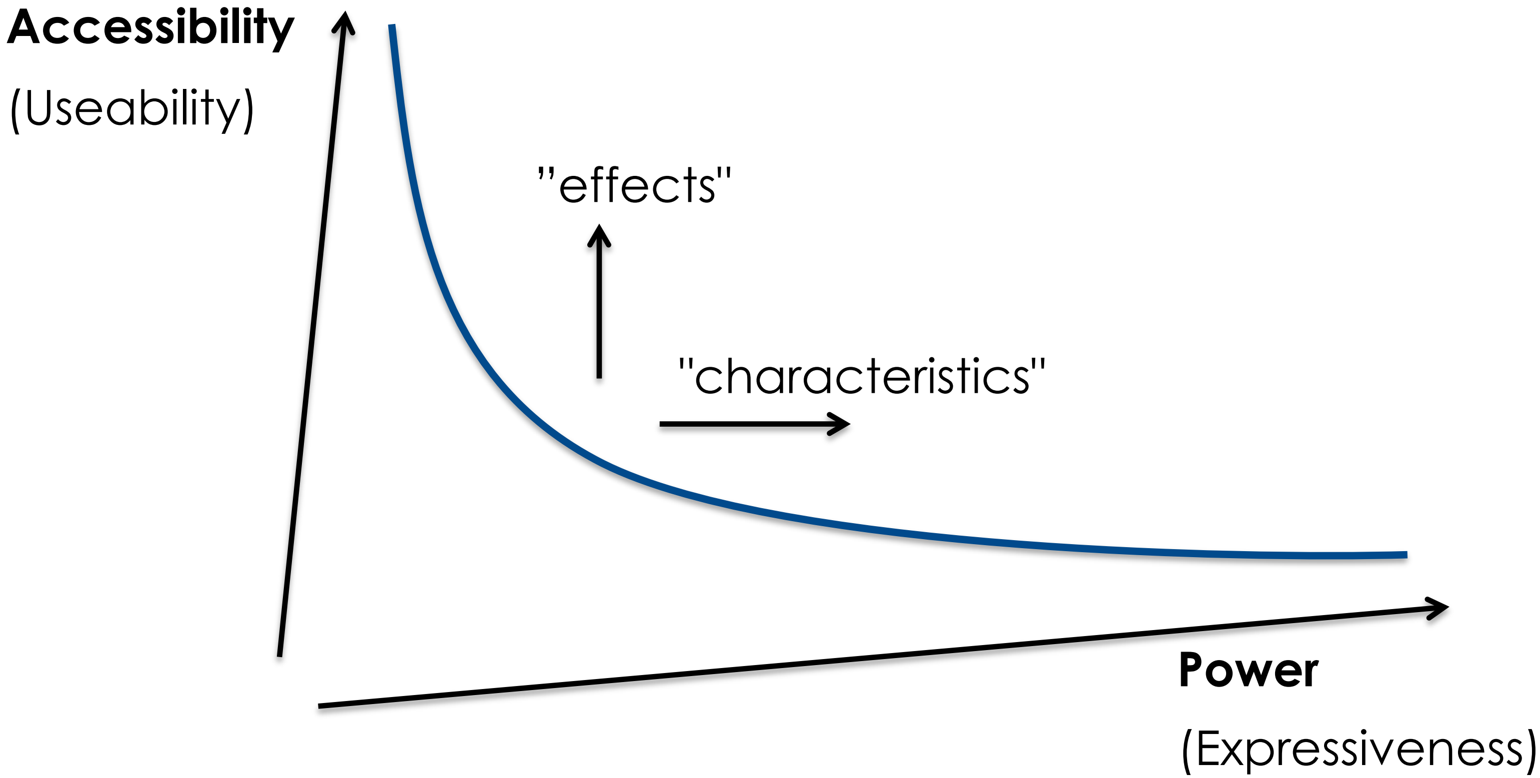


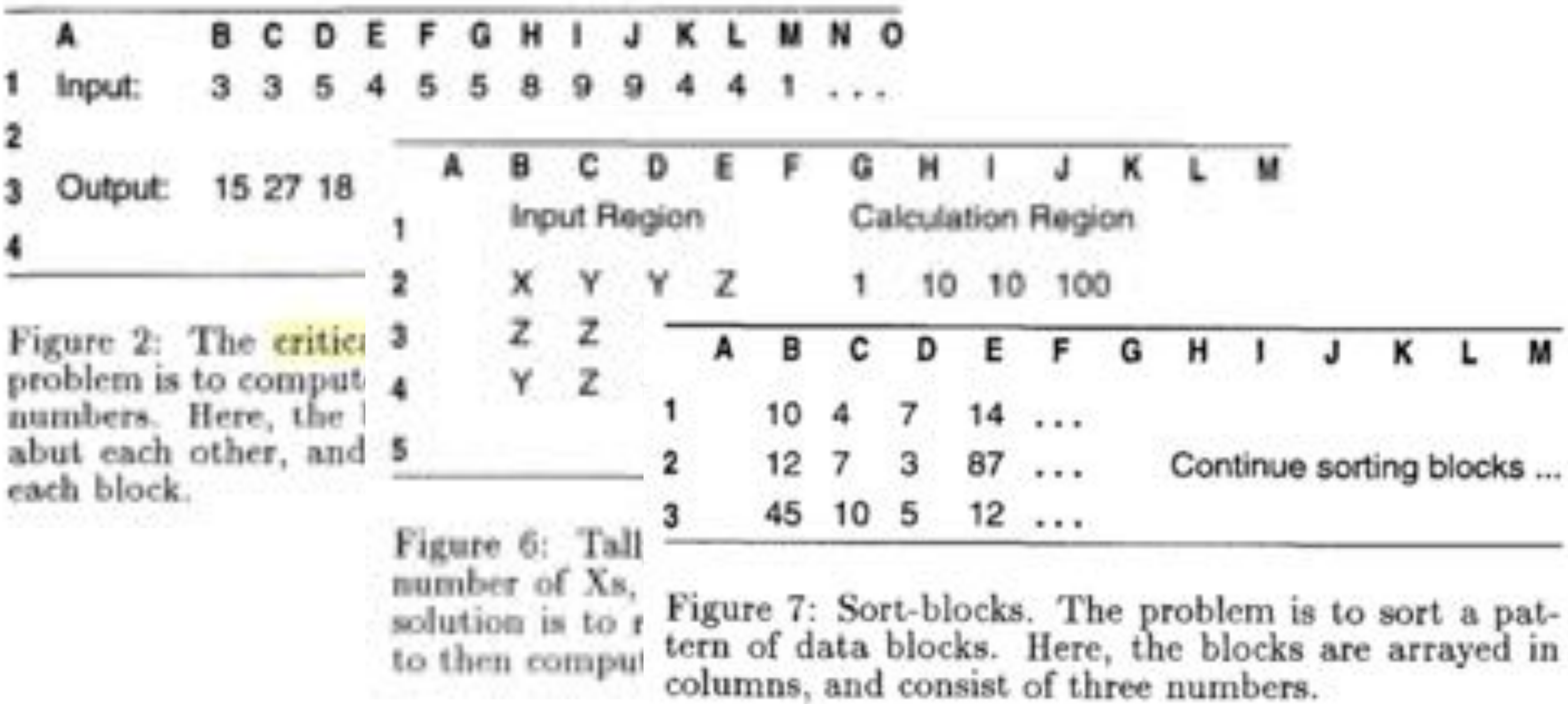
Theories
Comparable Theoretical Models
Empirical Studies
Accessibility?
Good Applied Problems
Powerful Modelling



sumwise
feedback
Welcome miller.garym | WTF | Log out
File Edit Tools
=[Jan]*(1+[Growth])
Model
month, actual
month, forecast
month, forecast
month, forecast
Assumptions Growth COGS Q1 Jan Feb Mar Q2 Apr
Global 10.0%
Revenue
Hardware 10 11 11 11
Software 15.0% 12 14 16 18
Consulting 5.0% 5 6 6 6
Services 12.0% 9 10 11 13
Total 36 40 44 48
Expenses
Hardware 90.0% 9 10 10 10
Other 10.0% 2 3 3 4
Total 11 13 13 14
Profit 25 28 31 34
New row
Group manager
Both
1 R[/Revenue.Children] C[@forecast] =[@month -1]*(1+[Growth]) 9
2 R[Revenue.Software]C[Q1.Feb] =[Jan]*(1+[Growth]) 1
3 R[Revenue.Hardware]C[Q1.Feb] =[Jan]*(1+[Global][Growth]) 1
4 R[/Revenue.Consulting] C[/Q1.Feb] =[Jan]*(1+R[/Global]C[/Assumptions.Growth]) 1
5 R[] C[/Assumptions.Children] 24
6 R[/Children.Children] C[@actual] 6
7 R[/Revenue.Total] C[@month] =Sum(R[Siblings]) 4

Status of the Theory





Display-based problems in spreadsheets:
a critical incident and a design remedy.
Hendry, D.G., 1995.

Problem – Repetition

Tasks	Est.	Mon	Tues	Wed
Task 1	10	6		
Task 2	9		3	
Task 3	8			
Remaining	27	23	17	17

Mon	Tues	Wed
6	6	6
9	3	3
8	8	8
23	17	17

Problem – Repetition

Tasks	Est.	Mon	Tues	Wed
Task 1	10	[illegible]		
Task 2	9		3	
Task 3	8			
Remaining	27	23	17	17

Mon	Tues	Wed
[illegible]	[illegible]	[illegible]
9	3	3
8	8	8
23	17	17

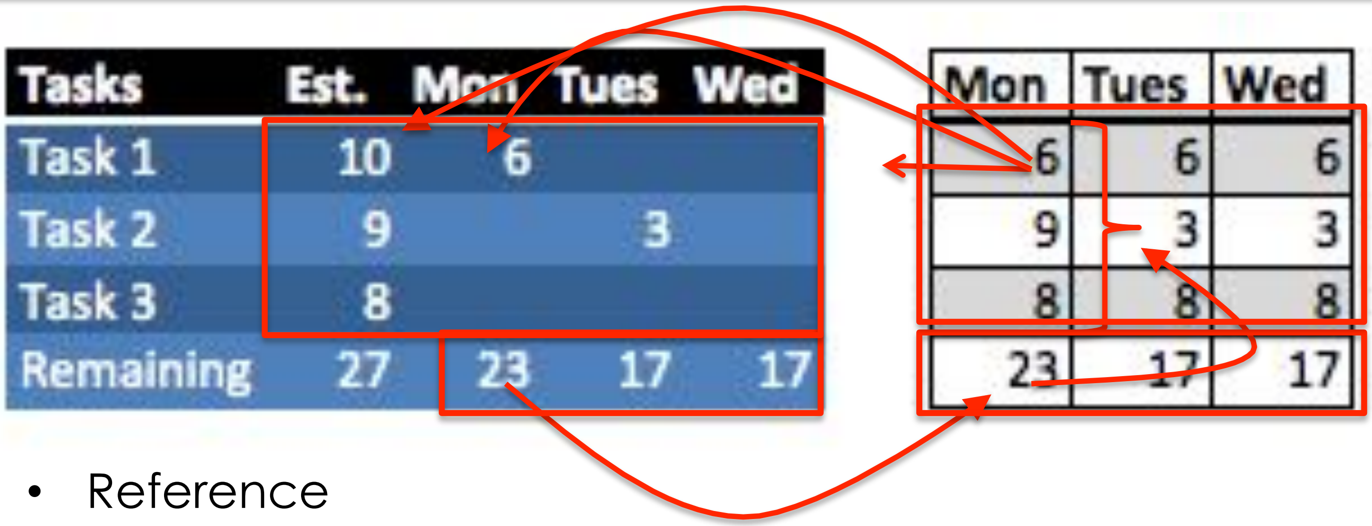
Mon	Tues	Wed
=IF(ISBLANK(H9),IF(ISBLANK(K9),G9,K9),H9)	=IF(ISBLANK(I9),IF(ISBLANK(L9),H9,L9),I9)	=IF(ISBLANK(J9),IF(ISBLANK(M9),I9,M9),J9)
=IF(ISBLANK(H10),IF(ISBLANK(K10),G10,K10),H10)	=IF(ISBLANK(I10),IF(ISBLANK(L10),H10,L10),I10)	=IF(ISBLANK(J10),IF(ISBLANK(M10),I10,M10),J10)
=IF(ISBLANK(H11),IF(ISBLANK(K11),G11,K11),H11)	=IF(ISBLANK(I11),IF(ISBLANK(L11),H11,L11),I11)	=IF(ISBLANK(J11),IF(ISBLANK(M11),I11,M11),J11)
=SUM(L9:L11)	=SUM(M9:M11)	=SUM(N9:N11)

Fri	Mon	Tues
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	=SUM(R[-3]C:R[-1]C)	=SUM(R[-3]C:R[-1]C)

=IF(ISBLANK(RC[-5]),IF(ISBLANK(RC[-1]),RC[-6],RC[-1]),RC[-5])

=SUM(R[-3]C:R[-1]C)

Problem – Description



Tasks	Est.	Mon	Tues	Wed
Task 1	10	6		
Task 2	9		3	
Task 3	8			
Remaining	27	23	17	17

Mon	Tues	Wed
6	6	6
9	3	3
8	8	8
23	17	17

- Reference
- Sum
- Carry over
- Group
- Inputs

Solutions

Input		Est	day Mon	day Tues	day Wed
task	Task 1	10	6		
task	Task 2	9		3	
task	Task 3	8			
	Remaining	27	23	17	17

Calc	day Mon	day Tues	day Wed
task	6	6	6
task	9	3	3
task	8	8	8
total	23	17	17

1. Expanding Nodes
2. Atticus Operator

Expanding Nodes

Cell Groups
Enable separation of
data and logic

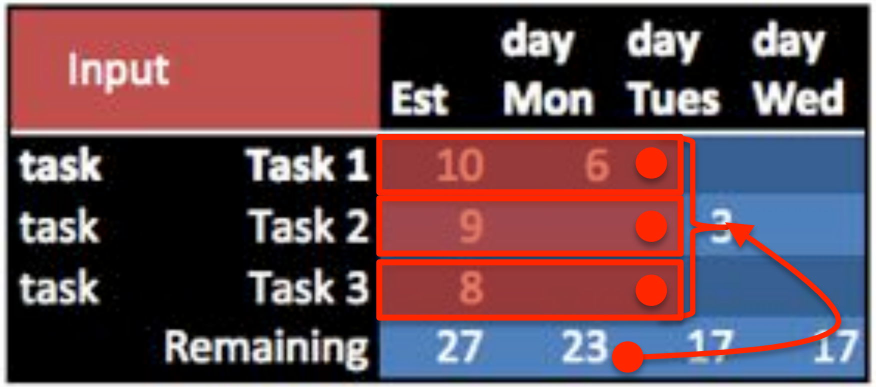
Input			day	day	day
		Est	Mon	Tues	Wed
task	Task 1	10	6		
task	Task 2	9		3	
task	Task 3	8			
	Remaining	27	23	17	17

Calc	day Mon	day Tues	day Wed
task	6	6	6
task	9	3	3
task	8	8	8
total	23	17	17

cell groups   formulae

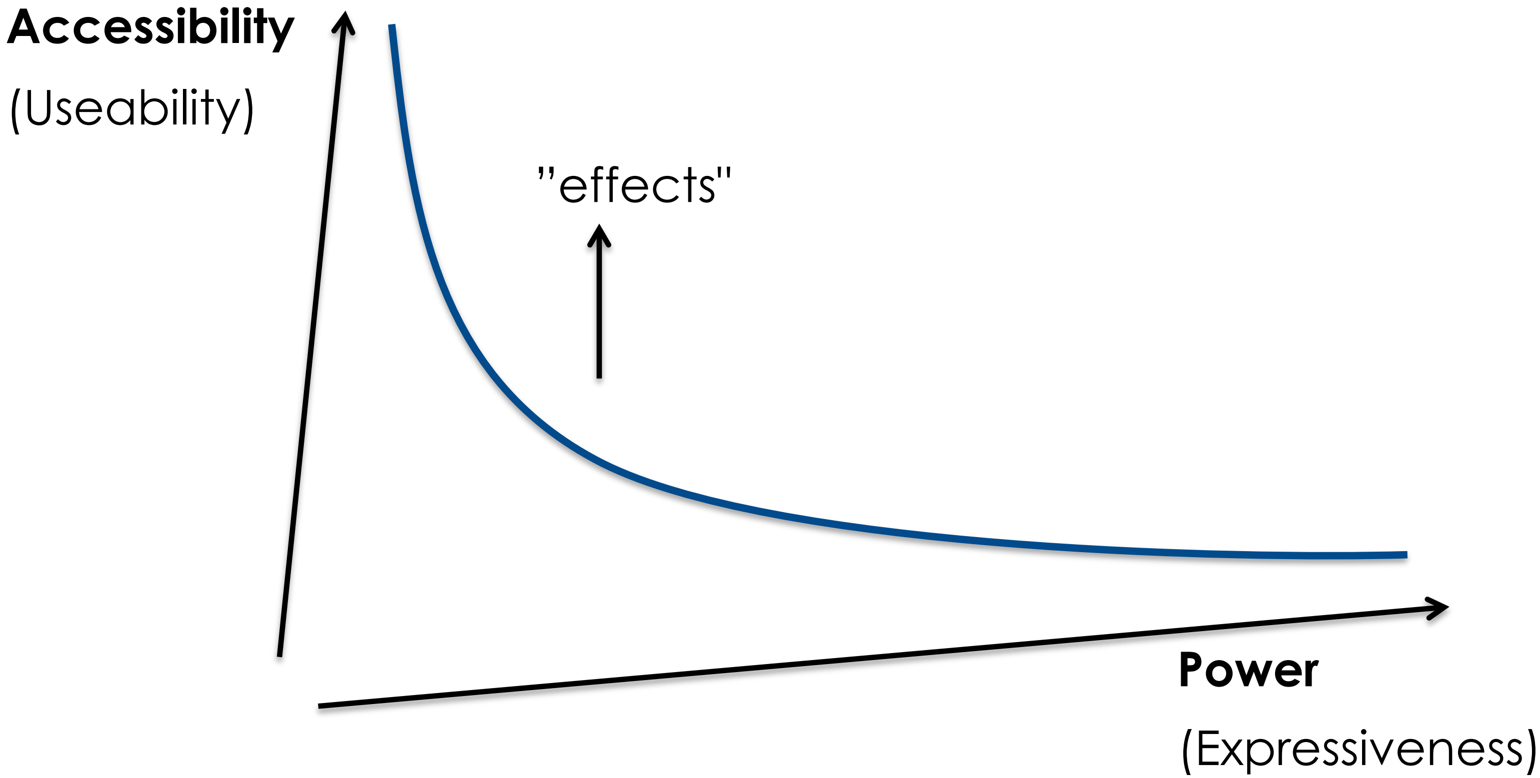
```
Calc![task][#all] = "=IF(ISBLANK(RC[-4]),IF(ISBLANK(RC[-1]),RC[-5],RC[-1]),RC[-4])"
Calc![total][#all] = "=SUM(R[-3]C:R[-1]C)"
Calc![#columns] = "=Input![#columns ? 'day']"
```

Atticus Operator



[task] => C[Est:0] #NonBlank.#Last | #Sum

Status of the Theory



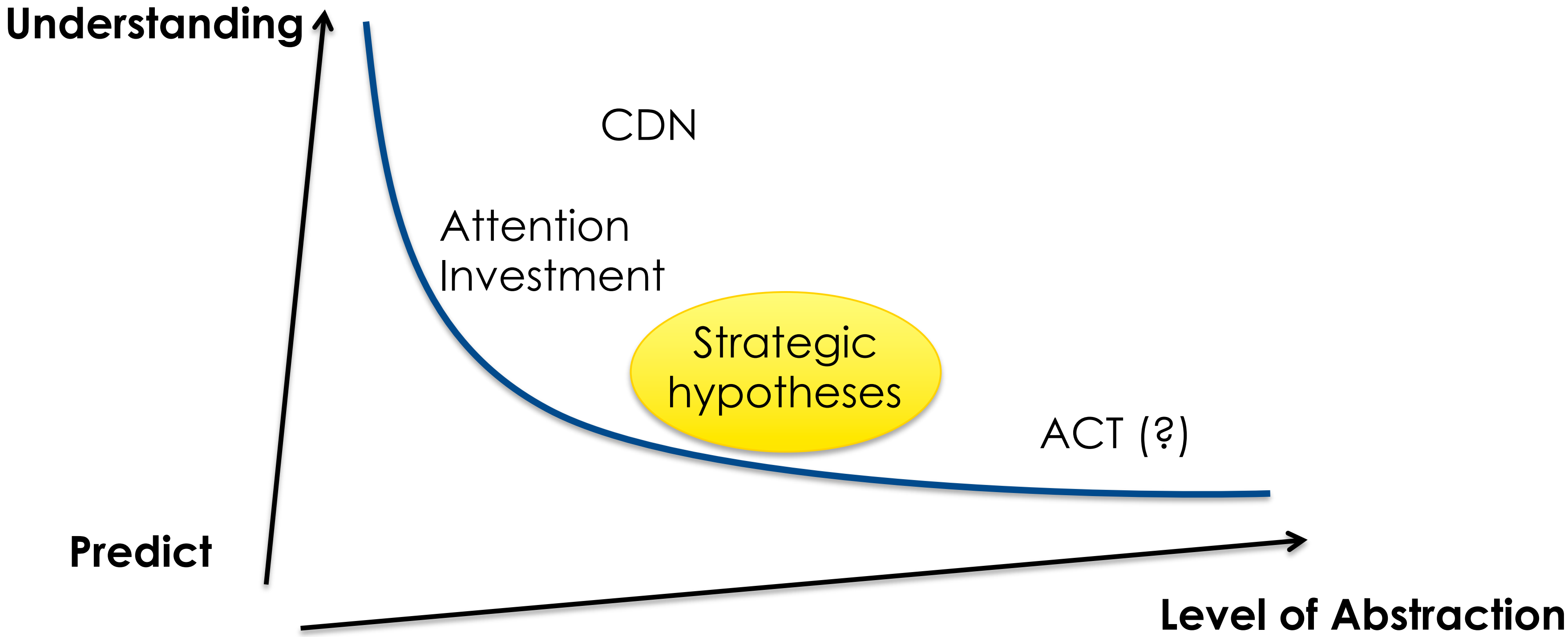
Potential Theoretical Models

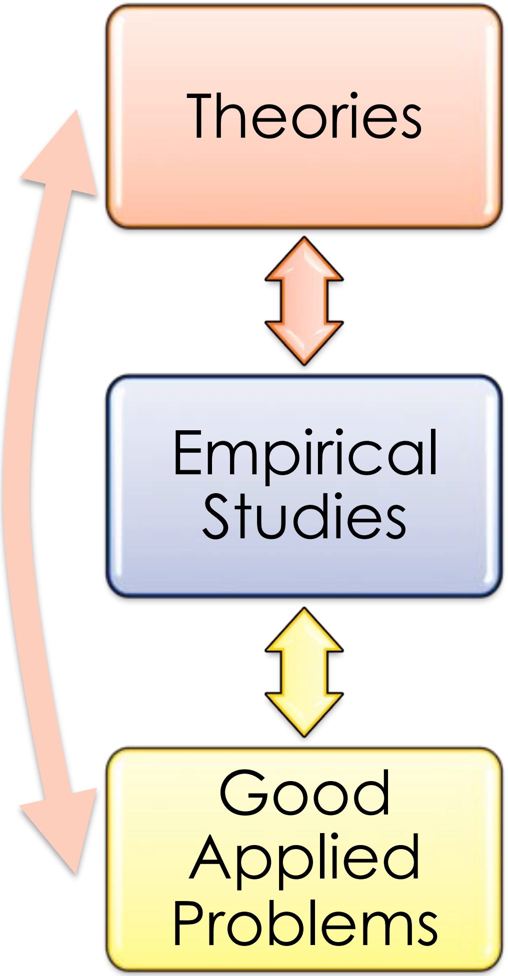
- ? Mental models, Cognitive fit
- ? Concept maps
- ? Hierarchical Bayesian Models of Cognition
- ? Ideal student (from intelligent tutoring systems)

Theories

- (PLP)Power Law of Practice
- (ZPD) Zone of Proximal Development
- (ICA) Innate cognitive abilities
- (CAL) Capturing Abstractions in Language

Status of the Hypotheses





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The Prospects for Psychological Science in Human-Computer Interaction

Good Studies of the Interface Yield Theories, Not Facts.

TABLE I

Framework for Analysis of Research Levels of Abstraction

Phase \ Activity	New Program Development	Repair Maintenance[1]	Adaptive Maintenance[2]	Perfective Maintenance[3]
Problem Planning/Analysis				
Program Design				
Coding				
Testing/Debugging				
Documentation				
Implementation/Delivery				

Notes: 1. Correction of logic errors in released programs.
2. Alterations carried out to meet changed program specifications.
3. Alterations to improve resource consumption efficiency.

Test vectors

Expanding Nodes

v1	=IF(ISBLANK(RC[-4]),IF(ISBLANK(RC[-1]),RC[-5],RC[-1]),RC[-4])
v2	=IF(ISBLANK(C[-4]),IF(ISBLANK(C[-1]),C[-5],C[-1]),C[-4])
v3	=Last(NonBlank(C[-5,-1,-4]))
v4	=C[-5,-1,-4].#NonBlank.#Last

Semantic Equivalent

Atticus Operator

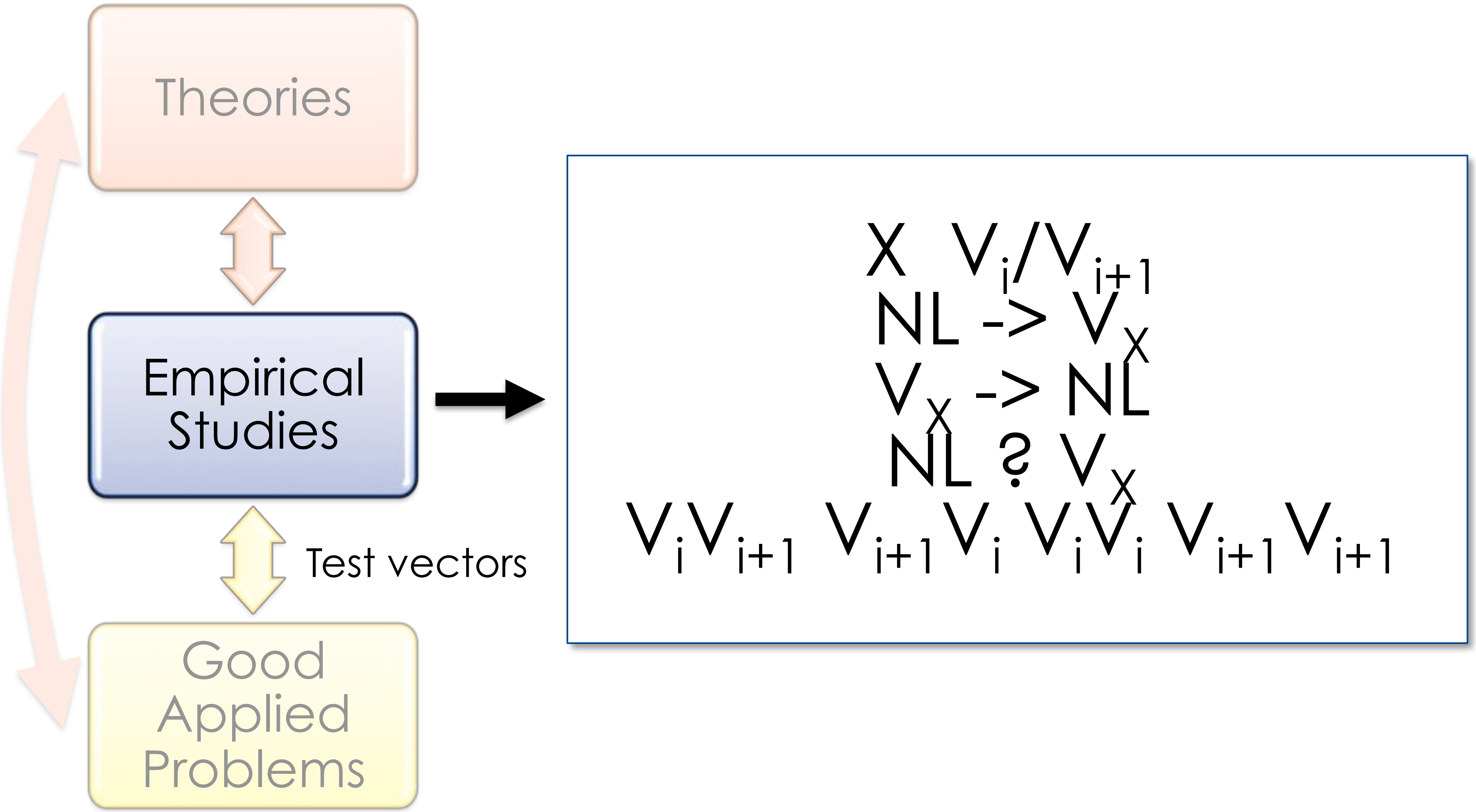
v1	=SUM(R[-3]C:R[-1]C => Last(NonBlank(RC7:RC)))
v2	=SUM(CR[-3]:CR[-1] => Last(NonBlank(C7R:CR)))
v3	=SUM(CR[-3:-1] => Last(NonBlank(C[$7:0]R)))
v4	=SUM(R[-3:-1] => Last(NonBlank(C[$7:0])))
v5	=Sum([task] => Last(NonBlank(C[Est:0])))
v6	=[task] => C[Est:0].#NonBlank.#Last | #Sum

Semantic Equivalent

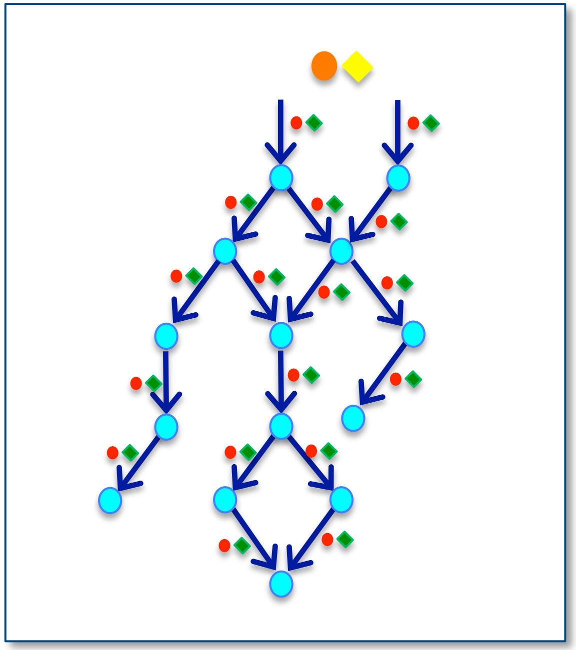
	A		B	C	D	E
				tag1	tag1	
1			Alpha	Beta; tag1	Gamma; tag1	Delta
2		One			1	1
3	tag2	Two; tag2			1	1
4	tag2	Three; tag2	1	1		
5	tag2	Four; tag2				
6		Five		1		

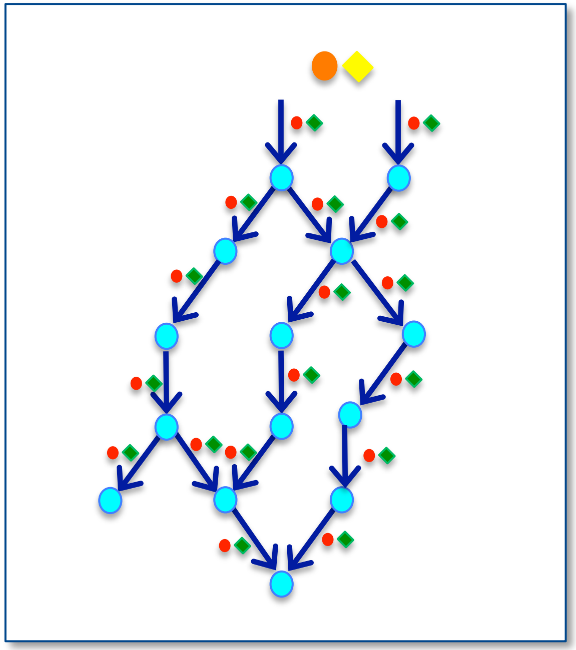
Valid EXCEL	
Intersect Columns & Rows	=COUNT($C:$D $3:$5)
Intersect Rows & Columns	=COUNT($3:$5 $C:$D)
Range by corners	=COUNT($C$3:$D$5)
Intersect Columns & Rows	=COUNT(C:D 3:5)
Intersect Rows & Columns	=COUNT(3:5 C:D)
Range by corners	=COUNT(C3:D5)
Intersect Columns & Rows	=COUNT(R3:R5 C2:C3)
Intersect Rows & Columns	=COUNT(C2:C3 R3:R5)
Range by corners	=COUNT(R2C2:R4C3)

Potential experiments	
Absolute index	=COUNT([C:D][3:5])
Relative & Attcus	=COUNT(A1[0][-3] => :A1[+1][+3])
A1 & Attcus	=COUNT(C3 => [0][0]:C[+1]R[+2])
A1 & Attcus	=COUNT([Beta][Two] => [0][0]:C[+1]R[+2])
Name	=COUNT([tag1][tag2])
Name explicit row column	=COUNT(C[tag1]R[tag2])
Name range	=COUNT([Beta:Gamma][Two:Four])
Name range - explict row colu	=COUNT(C[Beta:Gamma]R[Two:Four])
Name range - alternate row c	=COUNT([$C\|Beta:Gamma][$R|Two:Four])
Hierarchy	=COUNT([Alpha.@Children][One.@Children])
Hierarchy - explict row colum	=COUNT(C[Alpha.@Children]R[One.@Children])
Concatative	=[C:D][3:5]@COUNT

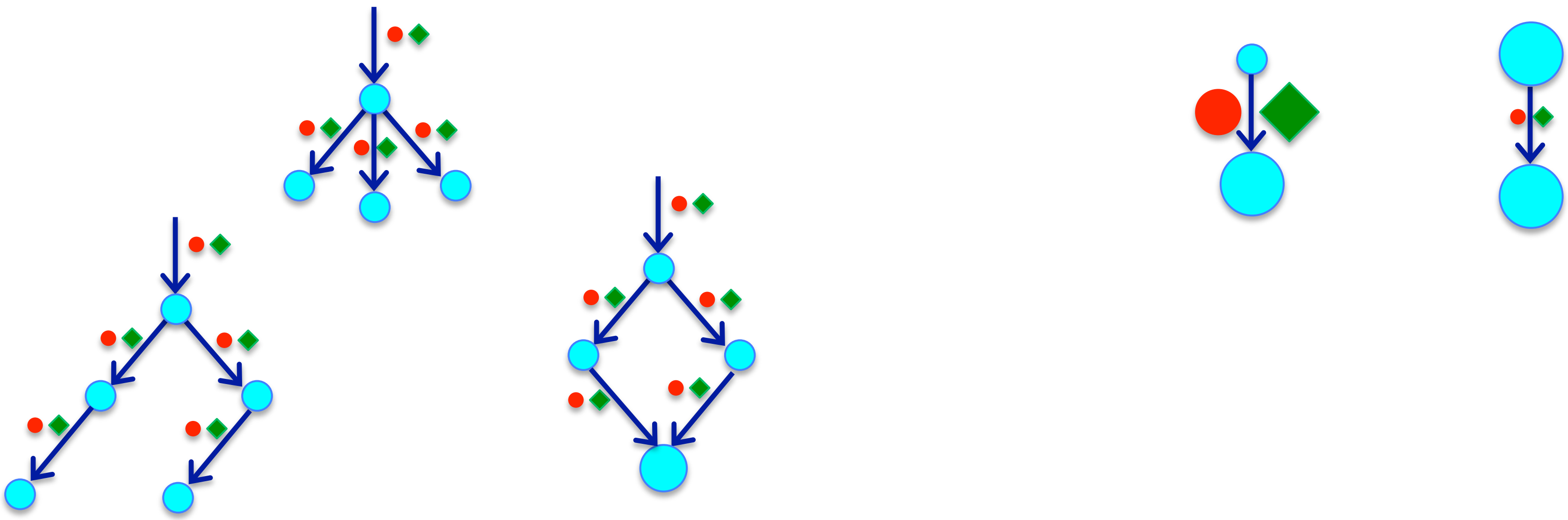

Theories
Empirical Studies
Good Applied Problems
Test vectors
X Vi/Vi+1
NL -> Vx
Vx -> NL
NL ? Vx
ViVi+1 Vi+1Vi ViVi Vi+1Vi+1

Hypotheses
Comparable Models





Hypotheses
Comparable Models



Potential Theoretical Models

- ? Mental models, Cognitive fit
- ? Concept maps
- ? Hierarchical Bayesian Models of Cognition
- ? Ideal student (from intelligent tutoring systems)

Hypotheses

- Testable Models of Language (PLP)
- Abstraction gradient (ZPD)
- Natural ordering of language, Spatial navigability, Numeracy (ICA)
- Language evolution = pattern capture (AL)
- Orthogonality, Motivation etc. (other)

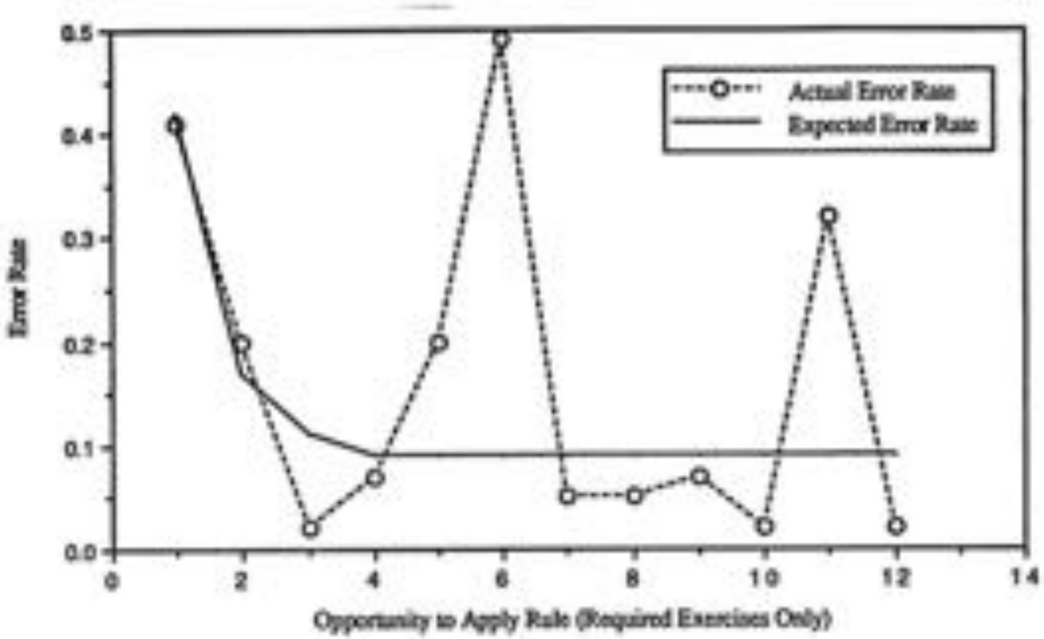
Hypotheses
Comparable Models

Parameter Estimates and Correlation Coefficient for
the Twenty-One Rules in the Cognitive Model

	pL_0	pT	pG	pS	r
Section 1					
Code Car	0.53	1.00	0.00	0.03	0.91
Section 4					
Code Defun	0.80	0.99	0.10	0.05	0.73
Declare Function Name	0.86	0.44	0.04	0.07	0.54

Hypothesis -

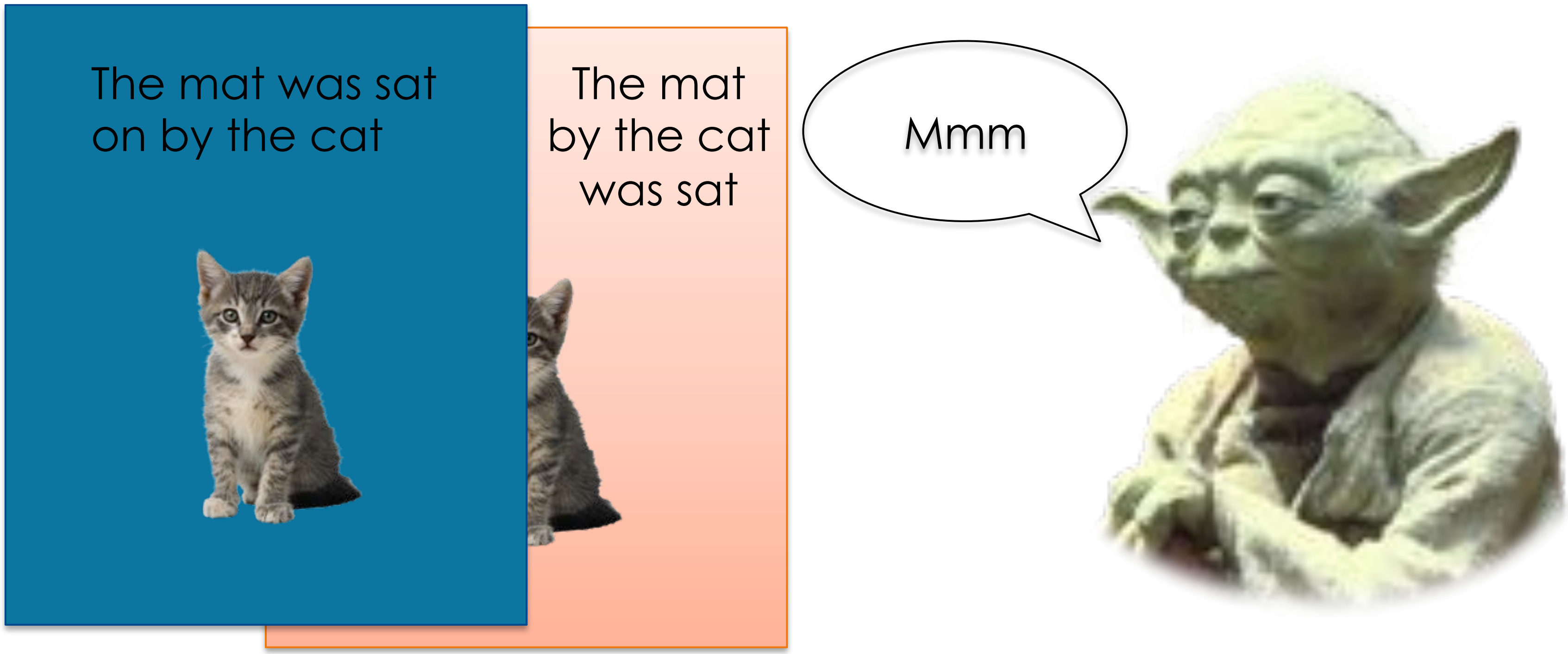
Testable Models of Language (PLP)



Hypothesis – Natural ordering

SOV	44 percent	VOS	2 percent
SVO	35 percent	OVS	0 percent
VSO	19 percent	OSV	0 percent

Hypothesis – Natural ordering



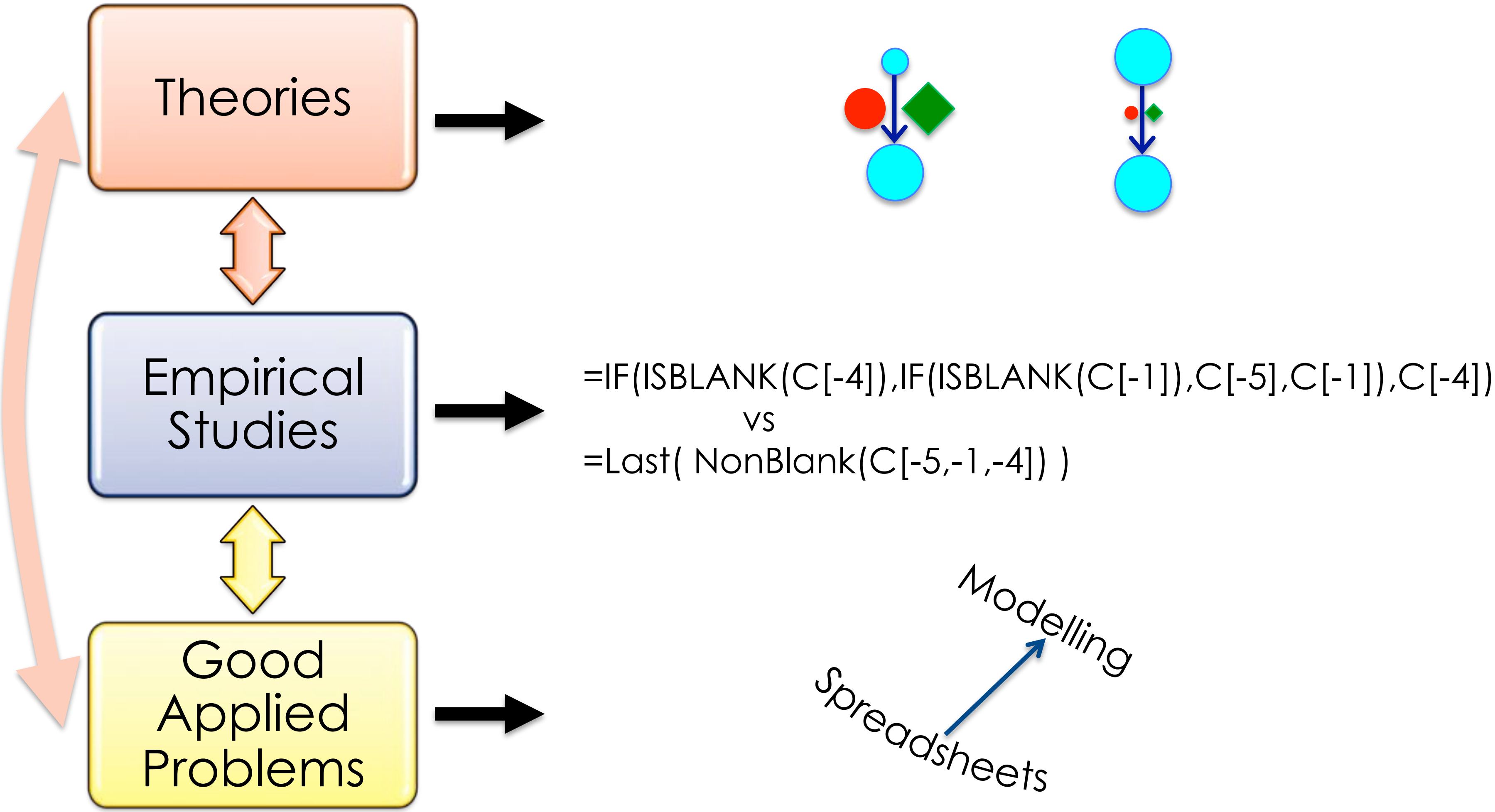
Language is the medium through which thoughts are communicated.

Our abstractions should be solid from a distance but permeable up close

“One language's patterns are the next ones features”

Richard Helm

Sydney Design Patterns SIG ‘96


Theories
Empirical Studies
Good Applied Problems
=IF(ISBLANK(C[-4]),IF(ISBLANK(C[-1]),C[-5],C[-1]),C[-4])
vs
=Last(NonBlank(C[-5,-1,-4]))
Modelling
Spreadsheets

References

Anderson, J.R., 2000. Cognitive psychology and its implications . fifth edit., WH Freeman/Times Books/Henry Holt & Co.

Corbett, A.T. & Anderson, J.R., 1993. Student modeling in an intelligent programming tutor. In Cognitive models and intelligent environments for learning programming. Springer, pp. 135–144.

Vessey, I. & Weber, R., 1984. Research on structured programming: An empiricist's evaluation. Software Engineering, IEEE Transactions on, (4), pp. 397–407.

Display-based problems in spreadsheets: a critical incident and a design remedy. Hendry, D.G., 1995.

The Prospects for Programming-Experience Design

Questions?

Towards a theory of Programming Language Design