From Modeler-free Individual Data Fitting to 3-D Parametric Landscapes: A Research Expedition

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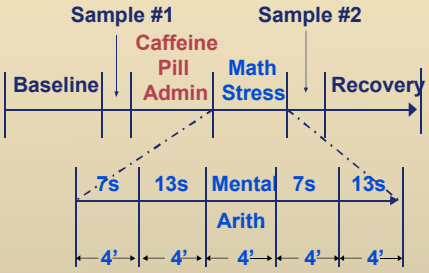
9095	6233
-7	-13
9088	6220
-7	-13
9081	6207
-7	-13
9074	6194
-7	-13
9067	6181
-7	-13
9060	6168
-7	-13
9053	6155
-7	-13
9046	6142
-7	-13
9039	6129
-7	-13
9032	6116
. . .	. . .

Data set
Experimental design
Serial subtraction task



Serial subtraction mental arithmetic part of the Trier Social Stress Test used to study stress responses in a laboratory setting

Four 4-minute blocks of subtracting by 7s or 13s

Preformed mentally without visual or paper clues

Subjects speak answer to each problem

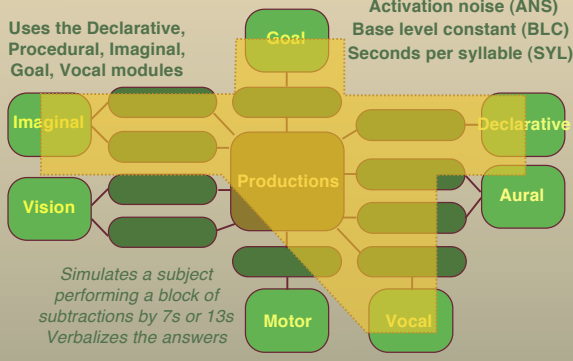
(N=15)	7-bk1	13-bk1	7-bk2	13-bk2
Attempts	47.3 (15.2)	41.9 (16.0)	56.9 (21.7)	47.8 (19.2)
%Correct	82.0 (10.0)	82.0 (12.0)	88.0 (7.0)	84.0 (10.0)

Human performance
Averaged across subjects
Mean and standard deviations
Four 4-min blocks of serial subtraction

Serial subtraction model
ACT-R 6.0

Uses the Declarative, Procedural, Imaginal, Goal, Vocal modules

3 Parameters investigated
Activation noise (ANS)
Base level constant (BLC)
Seconds per syllable (SYL)



Simulates a subject performing a block of subtractions by 7s or 13s
Verbalizes the answers

Fitting (or *optimizing*) a cognitive model to human data is a stochastic global optimization problem

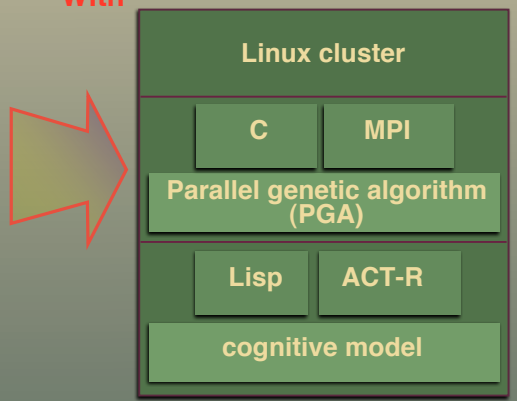
Replace

Manual optimization process

1. Set parameter values (by hand)
2. Run model in architecture
3. Compare model predictions to data
4. Decide what values to try next . . .

Repeat until 'good enough' fit is found

With

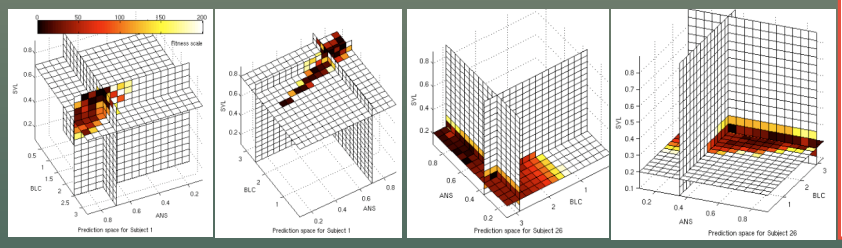


Results when using PGA to fit model to individual subject data

Number of attempts | Percent correct | ANS, BLC, SYL

Subject	Human Performance	Model Prediction	Fitness Value	Genotype (ACT-R parameters)
1	28, 67.9	28.0, 67.8	0.0006	0.83, 2.76, 0.87
47	29, 62.1	29.3, 62.0	0.0866	0.66, 2.25, 0.83
25	31, 80.7	30.8, 80.8	0.0487	0.48, 2.25, 0.76
11	35, 65.7	34.5, 65.1	0.6836	0.82, 2.49, 0.69
14	37, 75.7	36.3, 75.8	0.5523	0.83, 2.75, 0.62
2	37, 78.4	36.2, 78.6	0.7682	0.81, 2.80, 0.63
46	45, 80.0	44.7, 80.4	0.2510	0.43, 1.90, 0.47
27	46, 87.0	46.1, 87.7	0.4917	0.76, 2.96, 0.46
16	50, 92.0	50.4, 92.3	0.2233	0.50, 2.46, 0.41
43	54, 89.0	53.9, 89.0	0.0214	0.72, 2.88, 0.38
41	55, 87.3	55.2, 86.8	0.2261	0.54, 2.32, 0.36
23	57, 84.2	56.8, 84.4	0.0744	0.79, 2.71, 0.35
9	57, 87.7	57.2, 87.1	0.4089	0.78, 2.92, 0.35
21	65, 90.8	64.8, 91.2	0.1997	0.53, 2.24, 0.29
26	83, 94.0	83.3, 94.2	0.1463	0.47, 2.14, 0.16

3-D plots using slice planes (subjects 1 & 26) Black = perfect model-to-data fit



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