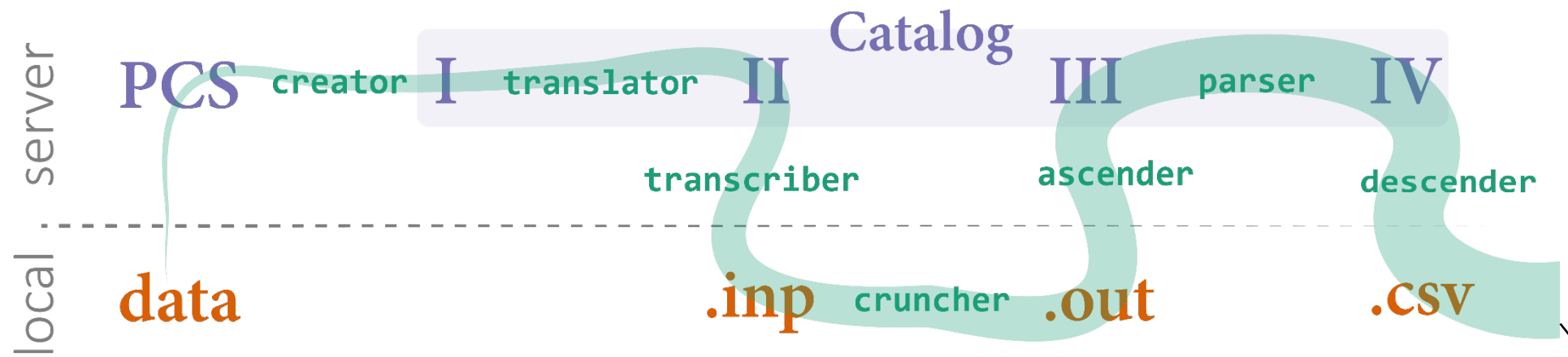
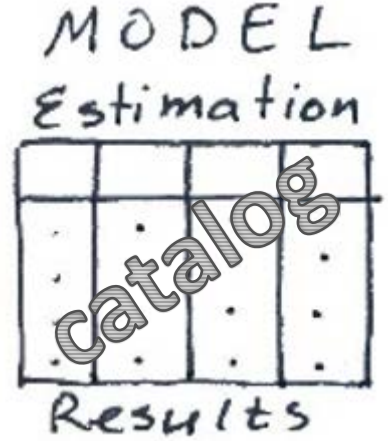
Portland : Analytic Strategy

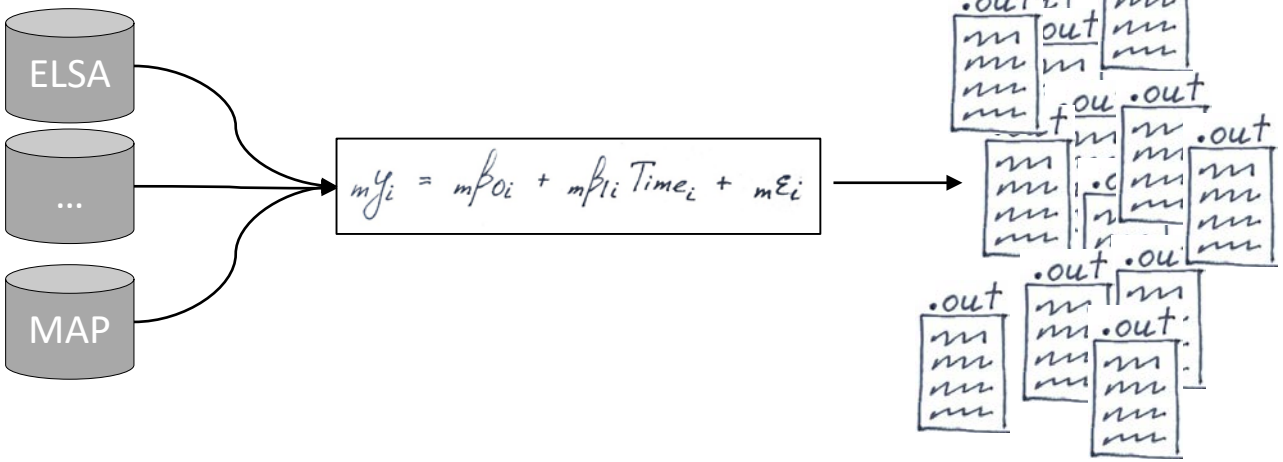
Brainstorming session

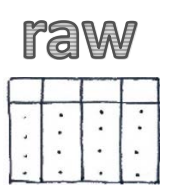
2016-08-30

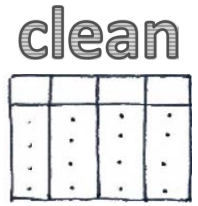
Primary Phase



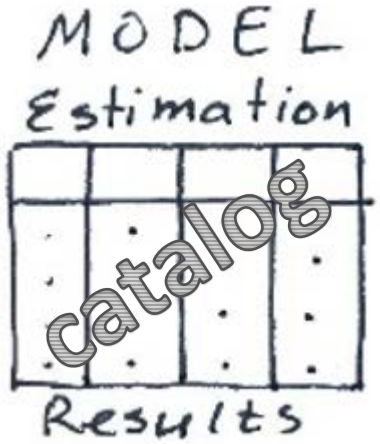


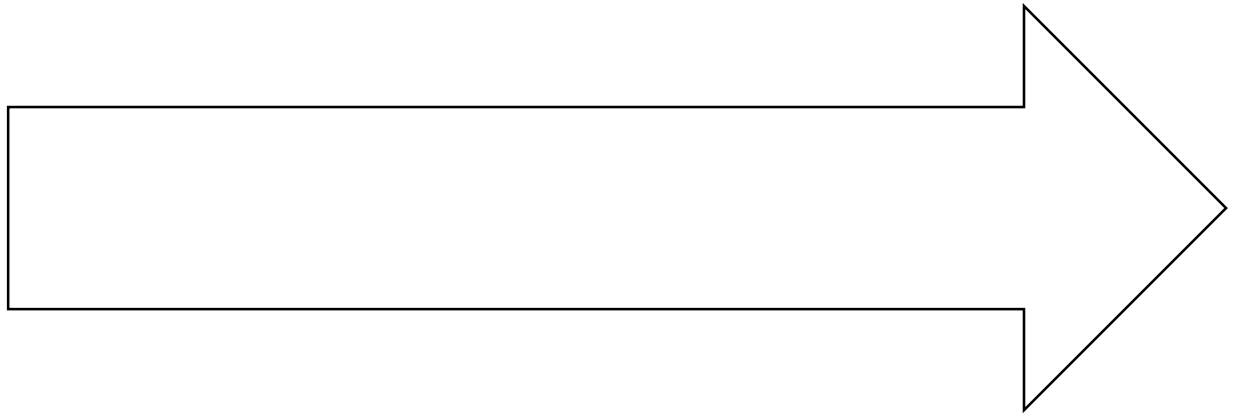


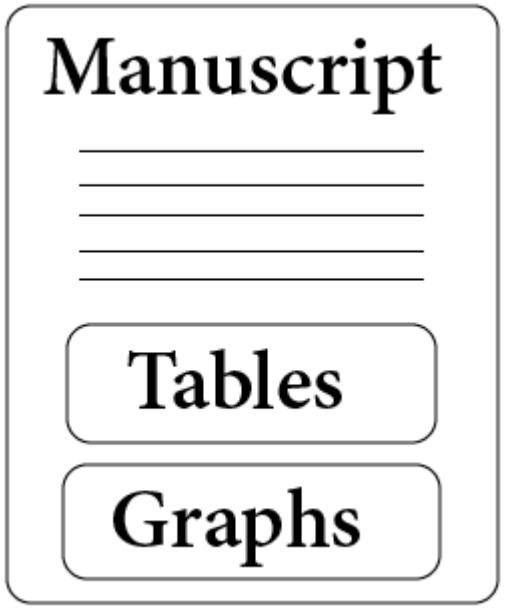




Secondary Phase

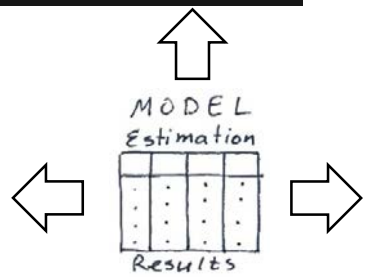






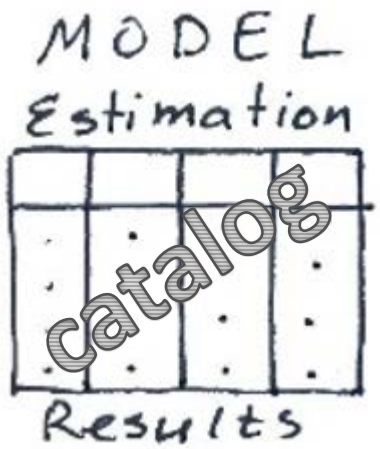
```
> t <- table(ds$process_a, ds$study_name); t[t==0]<-"."; t

        eas elsa hrs ilse lasa map nuage octo satsa
  fev     .    6     .    .     .    150 .       .    110
  fev100  .    6     .    .     .    .   .       .    .
  gait    110  8     30   .     6    .   .       9    .
  grip    109  6     30   10    6    149 12      80   52
  pef     36   .     30   .     6    .   .       54   .
  tug     .    .     .    35    .    .   .       .    .
```

```
> t <- table(ds$process_b_row, ds$process_a); t[t==0]<-"."; t

                          fev fev100 gait grip pef tug
  analogies               10  .       .    8    .   .
  auditory comprehension  8   .       .    8    .   .
  block design            10  .       12   22   13  6
  boston naming test      8   .       10   17   .   .
  categories              8   .       10   19   .   .
  digit ordering          8   .       .    8    .   .
  digit span backward     20  .       2    20   6   .
  digit span forward      20  .       2    20   6   .
  digit span total        .   .       10   10   9   .
  f-a-s phonemic words    .   .       10   10   1   .
  figure identification   6   .       .    6    .   .
  figure logic            .   .       .    8    4   .
  figure memory           10  .       .    .    .   .
  fluency                 .   .       2    2    .   5
  information             10  .       10   24   4   6
  IPSS spatial ability    .   .       .    2    .   6
  line orientation        8   .       .    8    .   .
  logical memory delayed  8   .       .    8    .   .
  logical memory immediate 7  .       .    8    .   .
  matrices                8   .       2    10   2   .
  memory in reality       .   .       .    8    4   .
  mini mental state exam  17  .       10   42   4   .
  number comparison       8   .       .    7    .   .
  perceptual speed        .   .       .    4    4   .
  picture completion      .   .       .    2    .   6
  prose recall delayed    8   .       .    8    .   .
  prose recall immediate  8   .       1    18   6   .
  prose recall total      .   .       10   9    .   .
  reading                 8   .       .    7    .   .
  rotations               10  .       .    .    .   .
  serial7                 .   .       6    6    6   .
  substitution            18  .       14   38   18  6
  switching               .   .       10   10   9   .
  synonyms                10  .       .    12   4   .
  tics                    .   .       6    6    6   .
  vocabulary              .   .       10   10   .   .
  word list delayed       12  4       16   24   12  .
  word list immediate     10  2       10   18   8   .
  word list recognition   8   .       .    7    .   .
```



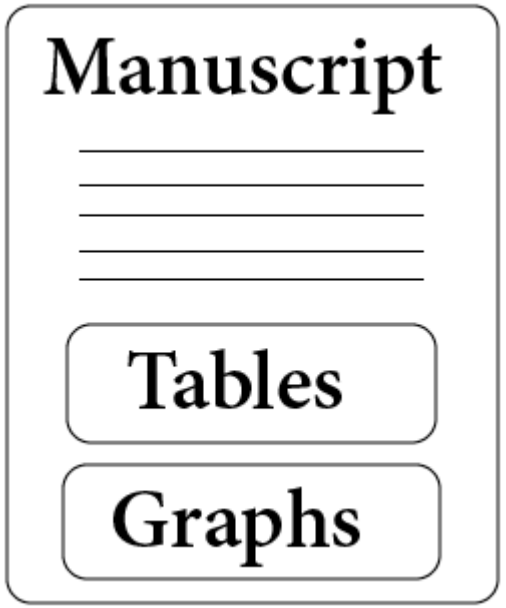
```
> t <- table(ds$process_b_row, ds$study_name); t[t==0]<-"."; t

                          eas elsa hrs ilse lasa map nuage octo satsa
  analogies               .   .    .   .    .    .   .     .    18
  auditory comprehension  .   .    .   .    .    16  .     .    .
  block design            27  .    .   6    .    .   .     18   12
  boston naming test      20  .    .   .    .    15  .     .    .
  categories              20  .    .   .    .    17  .     .    .
  digit ordering          .   .    .   .    .    16  .     .    .
  digit span backward     .   .    .   .    .    16  .     18   14
  digit span forward      .   .    .   .    .    16  .     18   14
  digit span total        29  .    .   .    .    .   .     .    .
  f-a-s phonemic words    21  .    .   .    .    .   .     .    .
  figure identification   .   .    .   .    .    .   .     .    12
  figure logic            .   .    .   .    .    .   .     12   .
  figure memory           .   .    .   .    .    .   .     .    10
  fluency                 .   2    .   7    .    .   .     .    .
  information             20  .    .   8    .    .   .     8    18
  IPSS spatial ability    .   .    .   8    .    .   .     .    .
  line orientation        .   .    .   .    .    16  .     .    .
  logical memory delayed  .   .    .   .    .    16  .     .    .
  logical memory immediate .  .    .   .    .    15  .     .    .
  matrices                .   .    .   .    6    16  .     .    .
  memory in reality       .   .    .   .    .    .   .     12   .
  mini mental state exam  20  .    .   .    .    15  12    8    18
  number comparison       .   .    .   .    .    15  .     .    .
  perceptual speed        .   .    .   .    .    .   .     8    .
  picture completion      .   .    .   8    .    .   .     .    .
  prose recall delayed    .   .    .   .    .    16  .     .    .
  prose recall immediate  .   .    .   .    .    16  .     17   .
  prose recall total      19  .    .   .    .    .   .     .    .
  reading                 .   .    .   .    .    15  .     .    .
  rotations               .   .    .   .    .    .   .     .    10
  serial7                 .   .    18  .    .    .   .     .    .
  substitution            30  .    .   8    6    16  .     16   18
  switching               29  .    .   .    .    .   .     .    .
  synonyms                .   .    .   .    .    .   .     8    18
  tics                    .   .    18  .    .    .   .     .    .
  vocabulary              20  .    .   .    .    .   .     .    .
  word list delayed       .   16   36  .    .    16  .     .    .
  word list immediate     .   8    18  .    6    16  .     .    .
  word list recognition   .   .    .   .    .    15  .     .    .
```

Secondary Phase



Currently available Tools for
Examining the Results

1. Domain Map
2. Single Model
3. Growth Curve
4. Correlation

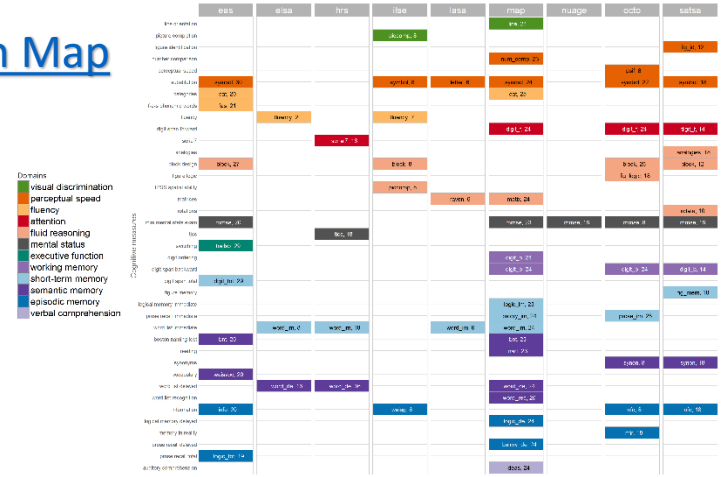


Physical outcome = gait
Model type = aehplus

Single Model

type	process	label	est	se	pval
Fixed Effect	a	Intercept	106.988	12.919	0.000
Fixed Effect	a	Slope	-2.183	4.469	0.625
Fixed Effect	a	Intercept * age	-0.460	0.533	0.388
Fixed Effect	a	Intercept * education	0.659	0.914	0.471
Fixed Effect	a	Intercept * height	0.001	0.487	0.998
Fixed Effect	a	Intercept * smoking	-1.267	7.508	0.866
Fixed Effect	a	Intercept * cardio	-4.787	12.488	0.701
Fixed Effect	a	Intercept * diabetes	-5.230	8.237	0.525
Fixed Effect	a	Slope * age	-0.108	0.185	0.560
Fixed Effect	a	Slope * education	-0.264	0.241	0.273
Fixed Effect	a	Slope * height	0.067	0.173	0.696
Fixed Effect	a	Slope * smoking	0.816	2.232	0.715
Fixed Effect	a	Slope * cardio	1.574	3.039	0.604
Fixed Effect	a	Slope * diabetes	0.286	2.796	0.919
Fixed Effect	b	Intercept	23.860	7.142	0.001
Fixed Effect	b	Slope	1.745	1.404	0.214
Fixed Effect	b	Intercept * age	0.254	0.382	0.507
Fixed Effect	b	Intercept * education	0.575	0.550	0.295
Fixed Effect	b	Intercept * height	0.035	0.231	0.880
Fixed Effect	b	Intercept * smoking	-3.900	3.612	0.280
Fixed Effect	b	Intercept * cardio	0.465	4.778	0.922
Fixed Effect	b	Intercept * diabetes	-3.874	3.336	0.246
Fixed Effect	b	Slope * age	-0.086	0.078	0.269
Fixed Effect	b	Slope * education	-0.082	0.107	0.443
Fixed Effect	b	Slope * height	-0.031	0.053	0.550
Fixed Effect	b	Slope * smoking	0.186	0.768	0.809
Fixed Effect	b	Slope * cardio	0.115	1.708	0.946
Fixed Effect	b	Slope * diabetes	-0.359	0.921	0.697
Variance	aa	Intercept	212.461	121.942	0.081
Variance	aa	Slope	1.180	5.851	0.840
Variance	a	Residual	74.196	17.458	0.000
Variance	bb	Intercept	41.498	20.299	0.041
Variance	bb	Slope	0.050	0.563	0.930
Variance	b	Residual	23.585	2.355	0.000
Covariance	ab	Intercept(a) - Intercept(b)	27.135	36.191	0.453
Covariance	ab	Slope(a) - Slope(b)	0.037	1.692	0.983
Covariance	ab	Intercept(a) - Slope(b)	2.058	6.717	0.759
Covariance	ab	Slope(a) - Intercept(b)	-3.856	6.094	0.527
		N	72.000		
		AIC	3934.502		
		BIC	4027.846		

Domain Map



eas Correlation

Processes	Gender	n	$r_{intercepts}$	r_{slopes}	$r_{residuals}$
gait vs block	female	150	0.17(0.16),p=.28	0.02(0.67),p=.98	-0.07(0.08),p=.36
gait vs block	male	72	0.29(0.37),p=.43	0.15(7.19),p=.98	0.01(0.15),p=.95

eas Growth Curve

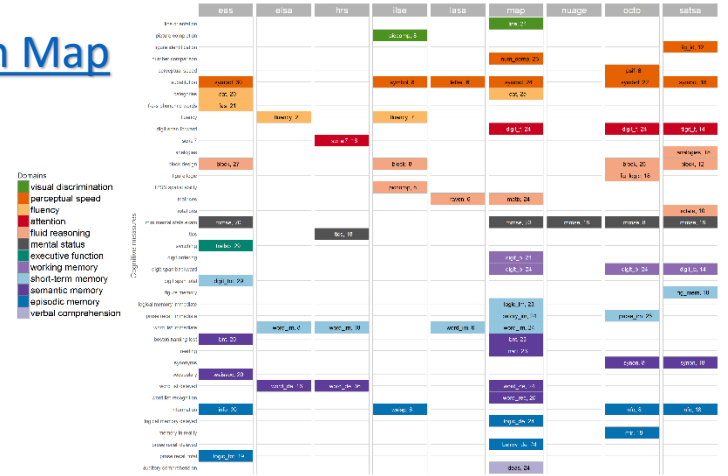
Process	Gender	n	species	intercept	slope
block	female	150	intercept	18.93(2.41),p<.01	0.80(0.47),p=.09
			age	-0.15(0.16),p=.37	-0.04(0.03),p=.15
			education	0.88(0.26),p<.01	-0.07(0.05),p=.17
			height	-0.01(0.11),p=.91	-0.01(0.02),p=.66
			smoking	1.53(1.44),p=.29	-0.10(0.26),p=.69
			cardio	-0.38(2.44),p=.88	-0.07(0.73),p=.93
			diabetes	-4.39(2.59),p=.09	0.18(0.40),p=.65
block	male	72	intercept	24.09(7.14),p<.01	1.46(1.58),p=.36
			age	0.25(0.45),p=.57	-0.09(0.08),p=.28
			education	0.58(0.53),p=.28	-0.09(0.11),p=.44
			height	0.04(0.22),p=.85	-0.03(0.05),p=.48
			smoking	-3.94(3.47),p=.26	0.25(0.78),p=.80
			cardio	0.32(4.47),p=.93	0.22(1.57),p=.89
			diabetes	-3.76(3.99),p=.35	-0.42(1.11),p=.71

Physical outcome = gait
Model type = aehplus

target process a : gait

	Fixed effects	animals	bnt	mmse	gait
a	intercept	18.93(2.41),**	18.93(2.41),**	18.93(2.41),**	18.93
a	slope	0.80(0.47)*	0.80(0.47)*	0.80(0.47)*	0.08
a	age	-0.15(0.16)**	-0.15(0.16)**	-0.15(0.16)**	-0.15
a	education	0.88(0.26)***	0.88(0.26)***	0.88(0.26)***	0.88
a	height	-0.01(0.11)	-0.01(0.11)	-0.01(0.11)	0
a	smoking	1.53(1.44)	1.53(1.44)	1.53(1.44)	1.15
a	cardio	-0.38(2.44)*	-0.38(2.44)*	-0.38(2.44)*	0
a	diabetes	-4.39(2.59)***	-4.39(2.59)***	-4.39(2.59)***	-4.39
a	slope*age	-0.04(0.03)**	-0.04(0.03)**	-0.04(0.03)**	-0.04
a	slope*education	-0.07(0.05)	-0.07(0.05)	-0.07(0.05)	0
a	slope*height	-0.01(0.02)	-0.01(0.02)	-0.01(0.02)	0
a	slope*smoking	-0.10(0.26)*	-0.10(0.26)*	-0.10(0.26)*	0
a	slope*cardio	-0.07(0.73)***	-0.07(0.73)***	-0.07(0.73)***	-0.07
a	slope*diabetes	0.18(0.40)	0.18(0.40)	0.18(0.40)	0.01
b	intercept	38.58(2.78)*	38.58(2.78)*	38.58(2.78)*	
b	slope	-0.78(0.72)***	-0.78(0.72)***	-0.78(0.72)***	
b	age	-0.35(0.19)***	-0.35(0.19)***	-0.35(0.19)***	
b	education	0.72(0.29)	0.72(0.29)	0.72(0.29)	
b	height	-0.10(0.14)	-0.10(0.14)	-0.10(0.14)	
b	smoking	0.78(1.34)	0.78(1.34)	0.78(1.34)	
b	cardio	1.06(3.11)	1.06(3.11)	1.06(3.11)	
b	diabetes	-5.08(2.30)**'	-5.08(2.30)**'	-5.08(2.30)**'	
b	slope*age	-0.03(0.04)**	-0.03(0.04)**	-0.03(0.04)**	
b	slope*education	0.07(0.06)	0.07(0.06)	0.07(0.06)	
b	slope*height	0.00(0.03)	0.00(0.03)	0.00(0.03)	
b	slope*smoking	0.08(0.39)*	0.08(0.39)*	0.08(0.39)*	
b	slope*cardio	0.00(0.76)	0.00(0.76)	0.00(0.76)	
b	slope*diabetes	0.01(0.66)	0.01(0.66)	0.01(0.66)	
	Variance components				
a	Intercept	6.13(.52)**	6.13(.52)**	6.13(.52)**	
a	Slope	.85(.12)*	.85(.12)*	.85(.12)*	
a	Residual	1.23(1.02)***	1.23(1.02)***	1.23(1.02)***	
b	Intercept	3.34(.52)***	3.34(.52)***	3.34(.52)***	
b	Slope	.66(.08)*	.66(.08)*	.66(.08)*	
b	Residual	2.08(.82)*	2.08(.82)*	2.08(.82)*	
	Covariance Components				
	Cov(IPhys-ICog)	0.076(.051)	0.076(.051)	0.076(.051)	
	Cov(SPhys-SCog)	0.076(.051)	0.076(.051)	0.076(.051)	
	Cov(IPhys-SCog)	0.076(.051)	0.076(.051)	0.076(.051)	
	Cov(ICog-SPhys)	0.076(.051)	0.076(.051)	0.076(.051)	
	AIC	44259.46	44259.46	44259.46	
	BIC	44345.68	44345.68	44345.68	

Domain Map



eas Correlation

Processes	Gender	n	$r_{intercepts}$	r_{slopes}	$r_{residuals}$
gait vs block	female	150	0.17(0.16),p=.28	0.02(0.67),p=.98	-0.07(0.08),p=.36
gait vs block	male	72	0.29(0.37),p=.43	0.15(7.19),p=.98	0.01(0.15),p=.95

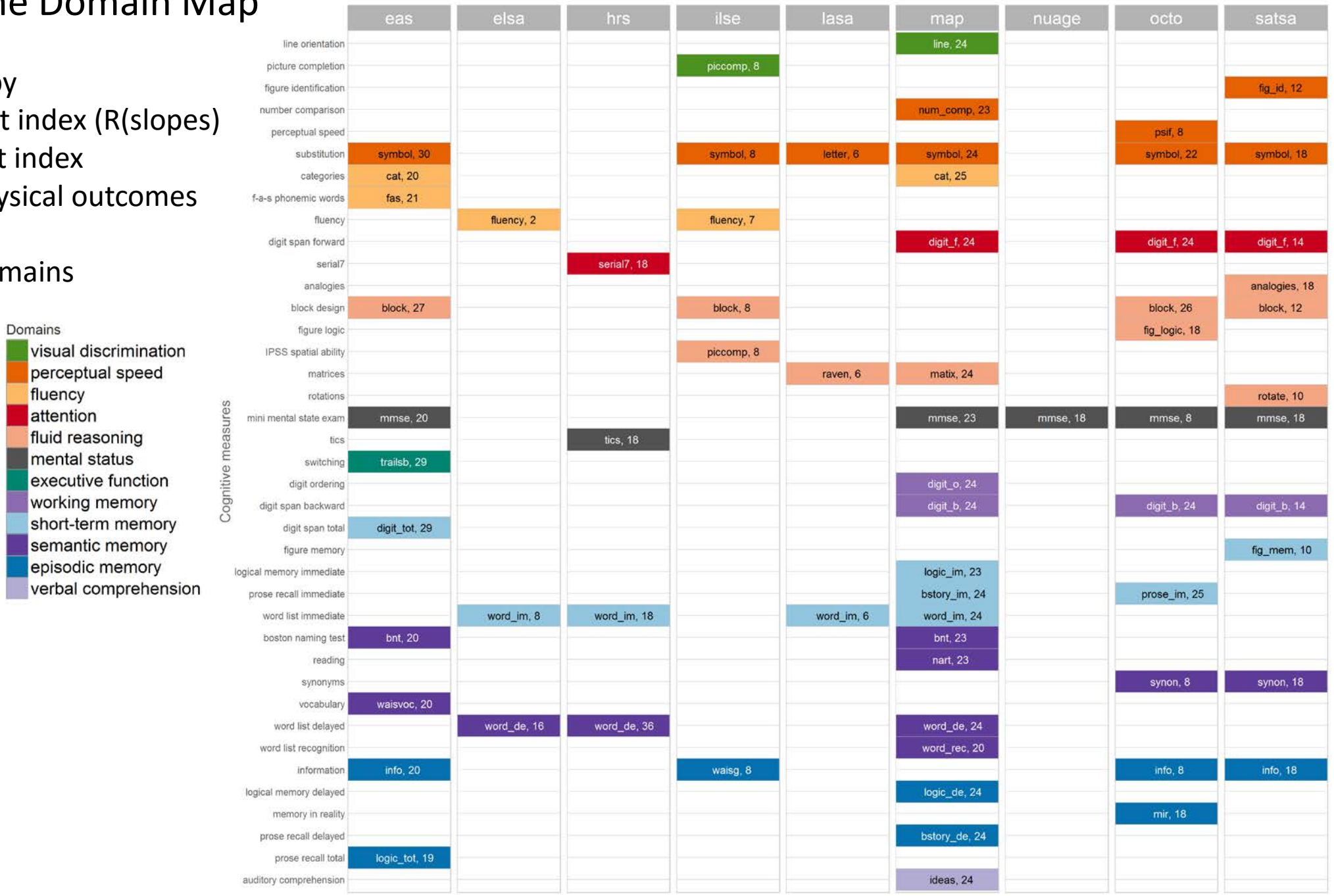
eas Growth Curve

Process	Gender	n	species	intercept	slope
block	female	150	intercept	18.93(2.41),p<.01	0.80(0.47),p=.09
			age	-0.15(0.16),p=.37	-0.04(0.03),p=.15
			education	0.88(0.26),p<.01	-0.07(0.05),p=.17
			height	-0.01(0.11),p=.91	-0.01(0.02),p=.66
			smoking	1.53(1.44),p=.29	-0.10(0.26),p=.69
			cardio	-0.38(2.44),p=.88	-0.07(0.73),p=.93
			diabetes	-4.39(2.59),p=.09	0.18(0.40),p=.65
block	male	72	intercept	24.09(7.14),p<.01	1.46(1.58),p=.36
			age	0.25(0.45),p=.57	-0.09(0.08),p=.28
			education	0.58(0.53),p=.28	-0.09(0.11),p=.44
			height	0.04(0.22),p=.85	-0.03(0.05),p=.48
			smoking	-3.94(3.47),p=.26	0.25(0.78),p=.80
			cardio	0.32(4.47),p=.93	0.22(1.57),p=.89
			diabetes	-3.76(3.99),p=.35	-0.42(1.11),p=.71

Modifications to the Domain Map

1) Replace cell values by
   - Values of target index (R(slopes)
   - Dense of target index
2) Alternate among physical outcomes

3) Highlight specific domains



```
> t <- table(ds$process_b_row, ds$study_name); t[t==0]<-"."; t

                          eas elsa hrs ilse lasa map nuage octo satsa
  analogies                 .    .   .    .    .   .     .    .    18
  auditory comprehension    .    .   .    .    .  16     .    .     .
  block design             27    .   .    6    .   .     .   18    12
  boston naming test       20    .   .    .    .  15     .    .     .
  categories               20    .   .    .    .  17     .    .     .
  digit ordering            .    .   .    .    .  16     .    .     .
  digit span backward       .    .   .    .    .  16     .   18    14
  digit span forward        .    .   .    .    .  16     .   18    14
  digit span total         29    .   .    .    .   .     .    .     .
  f-a-s phonemic words     21    .   .    .    .   .     .    .     .
  figure identification     .    .   .    .    .   .     .    .    12
  figure logic              .    .   .    .    .   .     .   12     .
  figure memory             .    .   .    .    .   .     .    .    10
  fluency                   .    2   .    7    .   .     .    .     .
  information              20    .   .    8    .   .     .    8    18
  IPSS spatial ability      .    .   .    8    .   .     .    .     .
  line orientation          .    .   .    .    .  16     .    .     .
  logical memory delayed    .    .   .    .    .  16     .    .     .
  logical memory immediate  .    .   .    .    .  15     .    .     .
  matrices                  .    .   .    .    6  16     .    .     .
  memory in reality         .    .   .    .    .   .     .   12     .
  mini mental state exam   20    .   .    .    .  15    12    8    18
  number comparison         .    .   .    .    .  15     .    .     .
  perceptual speed          .    .   .    .    .   .     .    8     .
  picture completion        .    .   .    8    .   .     .    .     .
  prose recall delayed      .    .   .    .    .  16     .    .     .
  prose recall immediate    .    .   .    .    .  16     .   17     .
  prose recall total       19    .   .    .    .   .     .    .     .
  reading                   .    .   .    .    .  15     .    .     .
  rotations                 .    .   .    .    .   .     .    .    10
  serial7                   .    .  18    .    .   .     .    .     .
  substitution             30    .   .    8    6  16     .   16    18
  switching                29    .   .    .    .   .     .    .     .
  synonyms                  .    .   .    .    .   .     .    8    18
  tics                      .    .  18    .    .   .     .    .     .
  vocabulary               20    .   .    .    .   .     .    .     .
  word list delayed         .   16  36    .    .  16     .    .     .
  word list immediate       .    8  18    .    6  16     .    .     .
  word list recognition     .    .   .    .    .  15     .    .     .
```

```
, ,  = grip

                          eas elsa hrs ilse lasa map nuage octo satsa
  analogies                 .    .   .    .    .   .     .    .     8
  auditory comprehension    .    .   .    .    .   8     .    .     .
  block design             10    .   .    .    .   .     .   10     2
  boston naming test       10    .   .    .    .   7     .    .     .
  categories               10    .   .    .    .   9     .    .     .
  digit ordering            .    .   .    .    .   8     .    .     .
  digit span backward       .    .   .    .    .   8     .   10     2
  digit span forward        .    .   .    .    .   8     .   10     2
  digit span total         10    .   .    .    .   .     .    .     .
  f-a-s phonemic words     10    .   .    .    .   .     .    .     .
  figure identification     .    .   .    .    .   .     .    .     6
  figure logic              .    .   .    .    .   .     .    8     .
  figure memory             .    .   .    .    .   .     .    .     .
  fluency                   .    .   .    2    .   .     .    .     .
  information              10    .   .    2    .   .     .    4     8
  IPSS spatial ability      .    .   .    2    .   .     .    .     .
  line orientation          .    .   .    .    .   8     .    .     .
  logical memory delayed    .    .   .    .    .   8     .    .     .
  logical memory immediate  .    .   .    .    .   8     .    .     .
  matrices                  .    .   .    .    2   8     .    .     .
  memory in reality         .    .   .    .    .   .     .    8     .
  mini mental state exam   10    .   .    .    .   8    12    4     8
  number comparison         .    .   .    .    .   7     .    .     .
  perceptual speed          .    .   .    .    .   .     .    4     .
  picture completion        .    .   .    2    .   .     .    .     .
  prose recall delayed      .    .   .    .    .   8     .    .     .
  prose recall immediate    .    .   .    .    .   8     .   10     .
  prose recall total        9    .   .    .    .   .     .    .     .
  reading                   .    .   .    .    .   7     .    .     .
  rotations                 .    .   .    .    .   .     .    .     .
  serial7                   .    .   6    .    .   .     .    .     .
  substitution             10    .   .    2    2   8     .    8     8
  switching                10    .   .    .    .   .     .    .     .
  synonyms                  .    .   .    .    .   .     .    4     8
  tics                      .    .   6    .    .   .     .    .     .
  vocabulary               10    .   .    .    .   .     .    .     .
  word list delayed         .    4  12    .    .   8     .    .     .
  word list immediate       .    2   6    .    2   8     .    .     .
  word list recognition     .    .   .    .    .   7     .    .     .
```

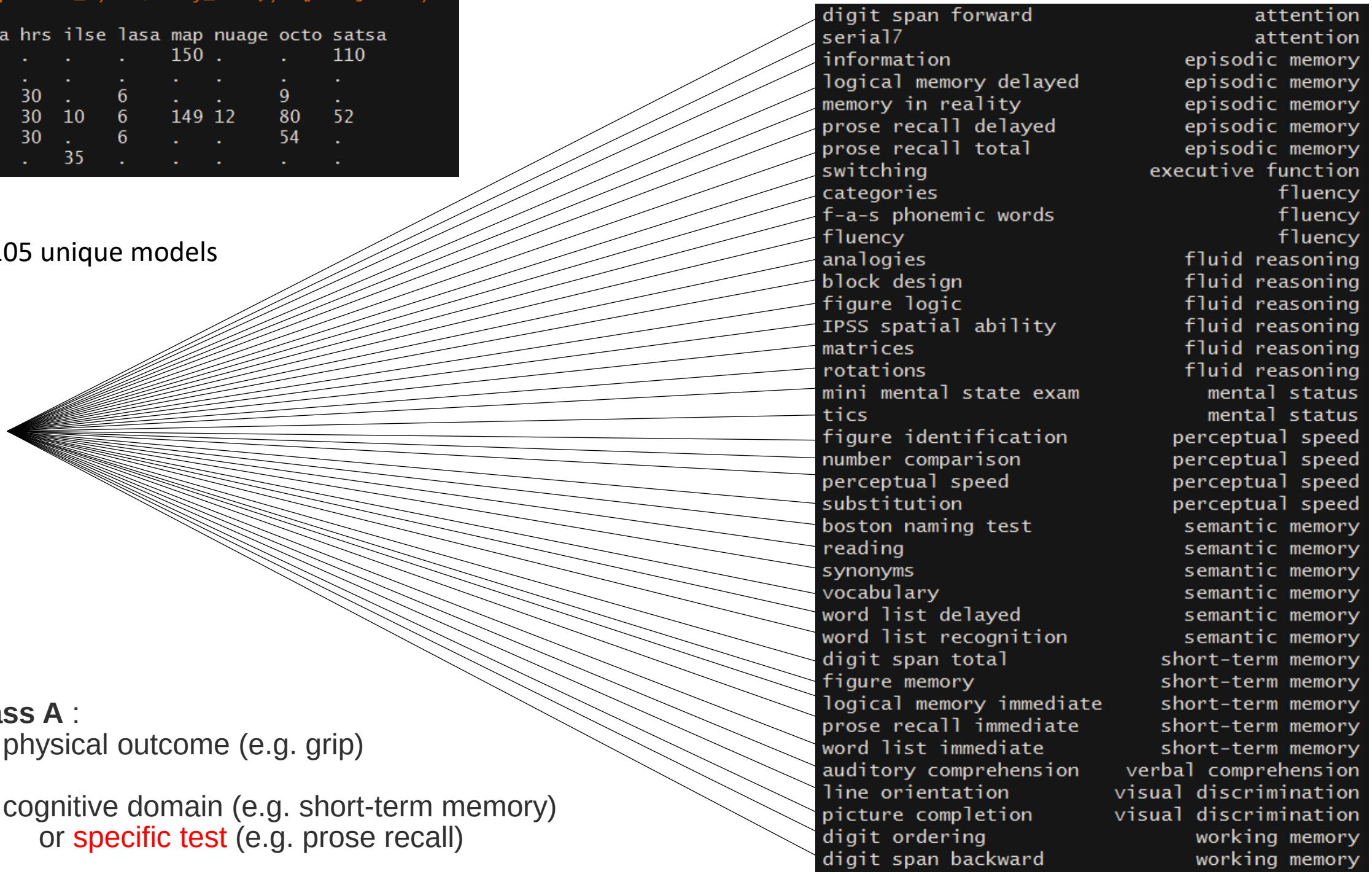
```
> t <- table(ds$process_b_row, ds$study_name); t[t==0]<-"."; t

                          eas elsa hrs ilse lasa map nuage octo satsa
  analogies                 .    .   .    .    .   .     .    .    18
  auditory comprehension    .    .   .    .    .  16     .    .     .
  block design             27    .   .    6    .   .     .   18    12
  boston naming test       20    .   .    .    .  15     .    .     .
  categories               20    .   .    .    .  17     .    .     .
  digit ordering            .    .   .    .    .  16     .    .     .
  digit span backward       .    .   .    .    .  16     .   18    14
  digit span forward        .    .   .    .    .  16     .   18    14
  digit span total         29    .   .    .    .   .     .    .     .
  f-a-s phonemic words     21    .   .    .    .   .     .    .     .
  figure identification     .    .   .    .    .   .     .    .    12
  figure logic              .    .   .    .    .   .     .   12     .
  figure memory             .    .   .    .    .   .     .    .    10
  fluency                   .    2   .    7    .   .     .    .     .
  information              20    .   .    8    .   .     .    8    18
  IPSS spatial ability      .    .   .    8    .   .     .    .     .
  line orientation          .    .   .    .    .  16     .    .     .
  logical memory delayed    .    .   .    .    .  16     .    .     .
  logical memory immediate  .    .   .    .    .  15     .    .     .
  matrices                  .    .   .    .    6  16     .    .     .
  memory in reality         .    .   .    .    .   .     .   12     .
  mini mental state exam   20    .   .    .    .  15    12    8    18
  number comparison         .    .   .    .    .  15     .    .     .
  perceptual speed          .    .   .    .    .   .     .    8     .
  picture completion        .    .   .    8    .   .     .    .     .
  prose recall delayed      .    .   .    .    .  16     .    .     .
  prose recall immediate    .    .   .    .    .  16     .   17     .
  prose recall total       19    .   .    .    .   .     .    .     .
  reading                   .    .   .    .    .  15     .    .     .
  rotations                 .    .   .    .    .   .     .    .    10
  serial7                   .    .  18    .    .   .     .    .     .
  substitution             30    .   .    8    6  16     .   16    18
  switching                29    .   .    .    .   .     .    .     .
  synonyms                  .    .   .    .    .   .     .    8    18
  tics                      .    .  18    .    .   .     .    .     .
  vocabulary               20    .   .    .    .   .     .    .     .
  word list delayed         .   16  36    .    .  16     .    .     .
  word list immediate       .    8  18    .    6  16     .    .     .
  word list recognition     .    .   .    .    .  15     .    .     .
```

```
, ,  = gait

                          eas elsa hrs ilse lasa map nuage octo satsa
  analogies                 .    .   .    .    .   .     .    .     .
  auditory comprehension    .    .   .    .    .   .     .    .     .
  block design             10    .   .    .    .   .     .    2     .
  boston naming test       10    .   .    .    .   .     .    .     .
  categories               10    .   .    .    .   .     .    .     .
  digit ordering            .    .   .    .    .   .     .    .     .
  digit span backward       .    .   .    .    .   .     .    2     .
  digit span forward        .    .   .    .    .   .     .    2     .
  digit span total         10    .   .    .    .   .     .    .     .
  f-a-s phonemic words     10    .   .    .    .   .     .    .     .
  figure identification     .    .   .    .    .   .     .    .     .
  figure logic              .    .   .    .    .   .     .    .     .
  figure memory             .    .   .    .    .   .     .    .     .
  fluency                   .    2   .    .    .   .     .    .     .
  information              10    .   .    .    .   .     .    .     .
  IPSS spatial ability      .    .   .    .    .   .     .    .     .
  line orientation          .    .   .    .    .   .     .    .     .
  logical memory delayed    .    .   .    .    .   .     .    .     .
  logical memory immediate  .    .   .    .    .   .     .    .     .
  matrices                  .    .   .    .    2   .     .    .     .
  memory in reality         .    .   .    .    .   .     .    .     .
  mini mental state exam   10    .   .    .    .   .     .    .     .
  number comparison         .    .   .    .    .   .     .    .     .
  perceptual speed          .    .   .    .    .   .     .    .     .
  picture completion        .    .   .    .    .   .     .    .     .
  prose recall delayed      .    .   .    .    .   .     .    .     .
  prose recall immediate    .    .   .    .    .   .     .    1     .
  prose recall total       10    .   .    .    .   .     .    .     .
  reading                   .    .   .    .    .   .     .    .     .
  rotations                 .    .   .    .    .   .     .    .     .
  serial7                   .    .   6    .    .   .     .    .     .
  substitution             10    .   .    .    2   .     .    2     .
  switching                10    .   .    .    .   .     .    .     .
  synonyms                  .    .   .    .    .   .     .    .     .
  tics                      .    .   6    .    .   .     .    .     .
  vocabulary               10    .   .    .    .   .     .    .     .
  word list delayed         .    4  12    .    .   .     .    .     .
  word list immediate       .    2   6    .    2   .     .    .     .
  word list recognition     .    .   .    .    .   .     .    .     .
```

```
> t <- table(ds$process_a, ds$study_name); t[t==0]<-"."; t

      eas elsa hrs ilse lasa map nuage octo satsa
fev     .    6    .    .    .   150     .    .   110
fev100  .    6    .    .    .     .     .    .     .
gait  110    8   30    .    6     .     .    9     .
grip  109    6   30   10    6   149    12   80    52
pef    36    .   30    .    6     .     .   54     .
tug     .    .    .   35    .     .     .    .     .
```

35 x 3 = 105 unique models

pulmonary
OR
gait
OR
grip



digit span forward	attention
serial7	attention
information	episodic memory
logical memory delayed	episodic memory
memory in reality	episodic memory
prose recall delayed	episodic memory
prose recall total	episodic memory
switching	executive function
categories	fluency
f-a-s phonemic words	fluency
fluency	fluency
analogies	fluid reasoning
block design	fluid reasoning
figure logic	fluid reasoning
IPSS spatial ability	fluid reasoning
matrices	fluid reasoning
rotations	fluid reasoning
mini mental state exam	mental status
tics	mental status
figure identification	perceptual speed
number comparison	perceptual speed
perceptual speed	perceptual speed
substitution	perceptual speed
boston naming test	semantic memory
reading	semantic memory
synonyms	semantic memory
vocabulary	semantic memory
word list delayed	semantic memory
word list recognition	semantic memory
digit span total	short-term memory
figure memory	short-term memory
logical memory immediate	short-term memory
prose recall immediate	short-term memory
word list immediate	short-term memory
auditory comprehension	verbal comprehension
line orientation	visual discrimination
picture completion	visual discrimination
digit ordering	working memory
digit span backward	working memory

Story of class A :
change in a physical outcome (e.g. grip)
is related to
change in a cognitive domain (e.g. short-term memory)
or specific test (e.g. prose recall)

```
> t <- table(ds$process_a, ds$study_name); t[t==0]<-"."; t

       eas elsa hrs ilse lasa map nuage octo satsa
fev    .   6    .   .    .    150 .     .    110
fev100 .   6    .   .    .    .   .     .    .
gait   110 8    30  .    6    .   .     9    .
grip   109 6    30  10   6    149 12    80   52
pef    36  .    30  .    6    .   .     54   .
tug    .   .    .   35   .    .   .     .    .
```

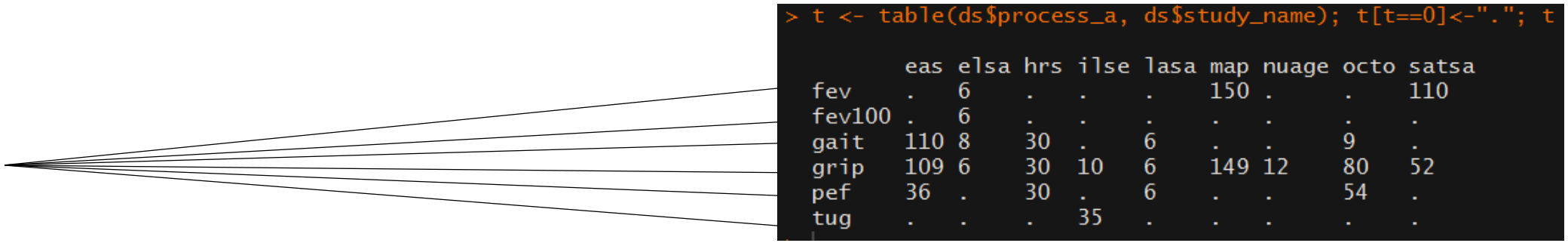
35 x 3 = 105 unique models

pulmonary
OR
gait
OR
grip

digit span forward	attention
serial7	attention
information	episodic memory
logical memory delayed	episodic memory
memory in reality	episodic memory
prose recall delayed	episodic memory
prose recall total	episodic memory
switching	executive function
categories	fluency
f-a-s phonemic words	fluency
fluency	fluency
analogies	fluid reasoning
block design	fluid reasoning
figure logic	fluid reasoning
IPSS spatial ability	fluid reasoning
matrices	fluid reasoning
rotations	fluid reasoning
mini mental state exam	mental status
tics	mental status
figure identification	perceptual speed
number comparison	perceptual speed
perceptual speed	perceptual speed
substitution	perceptual speed
boston naming test	semantic memory
reading	semantic memory
synonyms	semantic memory
vocabulary	semantic memory
word list delayed	semantic memory
word list recognition	semantic memory
digit span total	short-term memory
figure memory	short-term memory
logical memory immediate	short-term memory
prose recall immediate	short-term memory
word list immediate	short-term memory
auditory comprehension	verbal comprehension
line orientation	visual discrimination
picture completion	visual discrimination
digit ordering	working memory
digit span backward	working memory

Story of class A :
change in a physical outcome (e.g. grip)
is related to
change in a cognitive domain (e.g. short-term memory)
or specific test (e.g. prose recall)

mmse
tics



```
> t <- table(ds$process_a, ds$study_name); t[t==0]<-"."; t

        eas elsa hrs ilse lasa map nuage octo satsa
  fev     .   6     .    .     .    150 .      .    110
  fev100  .   6     .    .     .    .   .      .    .
  gait    110 8     30   .     6    .   .      9    .
  grip    109 6     30   10    6    149 12     80   52
  pef     36  .     30   .     6    .   .      54   .
  tug     .   .     .    35    .    .   .      .    .
```

Story of class B :
performance in a cognitive domain (e.g. fluid reasoning)
is sensitive to
changes in a physical function (e.g. gait)

Check points for individual model evaluation

- ❑ Significant pc TAU 11
- ❑ Significant pc R 11
- ❑ Sufficient pp TAU 11
- ❑ Sample size < threshold
- ❑ ?
- ❑ ?
- ❑ ?

$$_{o=\text{Physical}}\beta_{0i} = {}_{p}\gamma_{00} + {}_{p}\Gamma_{0k}(CovSet) + {}_{p}u_{0i}$$

$$_{o=\text{Physical}}\beta_{1i} = {}_{p}\gamma_{10} + {}_{p}\Gamma_{1k}(CovSet) + {}_{p}u_{1i}$$

$${}_{o}y_{ti} = {}_{o}\beta_{0i} + {}_{o}\beta_{1i}(Time_{ti}) + {}_{o}\varepsilon_{ti}$$

$$_{o=\text{Cognitive}}\beta_{1i} = {}_{c}\gamma_{10} + {}_{c}\Gamma_{1k}(CovSet) + {}_{c}u_{1i}$$

$$_{o=\text{Cognitive}}\beta_{0i} = {}_{c}\gamma_{00} + {}_{c}\Gamma_{0k}(CovSet) + {}_{c}u_{0i}$$

Physical Intercept
Physical Slope
Cognitive Slope
Cognitive Intercept

Fixed Effects

$$\begin{matrix} {}_{p}\gamma_{00} & {}_{p}\gamma_{01} & {}_{p}\gamma_{02} \cdots {}_{p}\gamma_{0k} \\ {}_{p}\gamma_{10} & {}_{p}\gamma_{11} & {}_{p}\gamma_{12} \cdots {}_{p}\gamma_{1k} \\ {}_{c}\gamma_{10} & {}_{c}\gamma_{11} & {}_{c}\gamma_{12} \cdots {}_{c}\gamma_{1k} \\ {}_{c}\gamma_{00} & {}_{c}\gamma_{01} & {}_{c}\gamma_{02} \cdots {}_{c}\gamma_{0k} \end{matrix}$$

Random Effects

$$\begin{matrix} {}_{pp}\tau_{00} & {}_{pp}\tau_{01} & {}_{pc}\tau_{01} & {}_{pc}\tau_{00} \\ & {}_{pp}\tau_{11} & {}_{pc}\tau_{11} & {}_{pc}\tau_{10} \\ & & {}_{cc}\tau_{11} & {}_{cc}\tau_{10} \\ & & & {}_{cc}\tau_{00} \end{matrix}$$

Residuals

$${}_{p}\sigma \qquad {}_{pc}\sigma \qquad {}_{c}\sigma$$

Check points for domain evaluation