Intervening to alleviate lexical retrieval difficulties in children
Challenges of research within an educational neuroscience framework

Michael Thomas

WORD Project: Word Retrieval and Development

WORD: WOrd Retrieval and Development

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- Study of typical development of productive vocabulary
- Study of atypical development
- Intervention – which technique works best
- Computational modelling of above to understand mechanisms
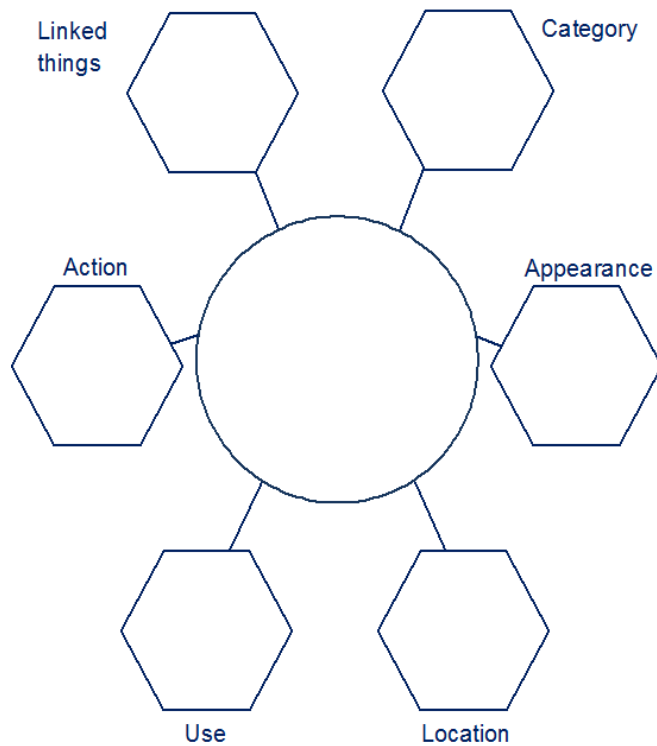
Word finding difficulties

- Developmental problems in productive vocabulary
- Characteristic behaviours:
  - the use of filler words (e. g., um), empty words (thing) or general verbs (doing) instead of more specific words
  - the use of a similar sounding word (canister for camera)
  - the use of a word with a similar meaning or in the same category (tiger for lion)
  - hesitation
  - repetition of words or phrases
  - rephrasing what they are saying
  - the use of gesture (miming cleaning teeth for toothbrush)
  - talking about their difficulty ("I know it, but I can't think of it")

Affects educational achievement, self-esteem

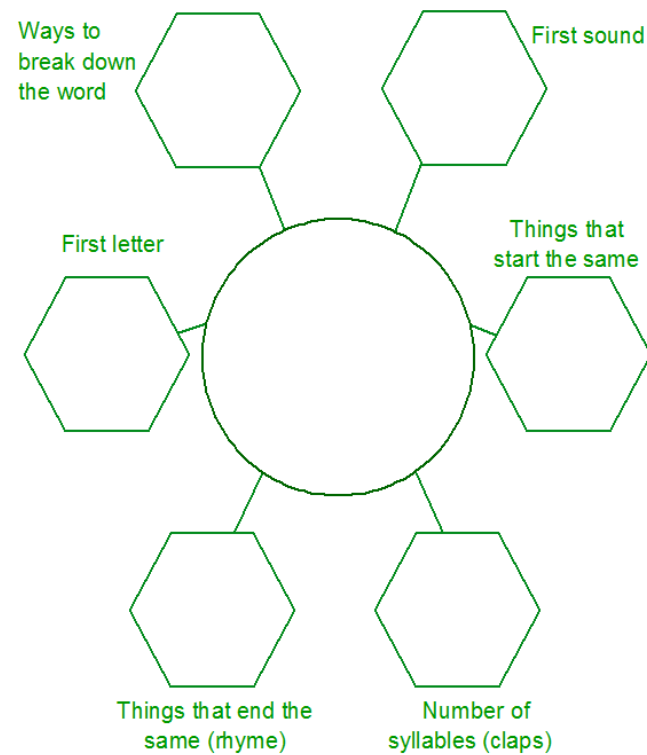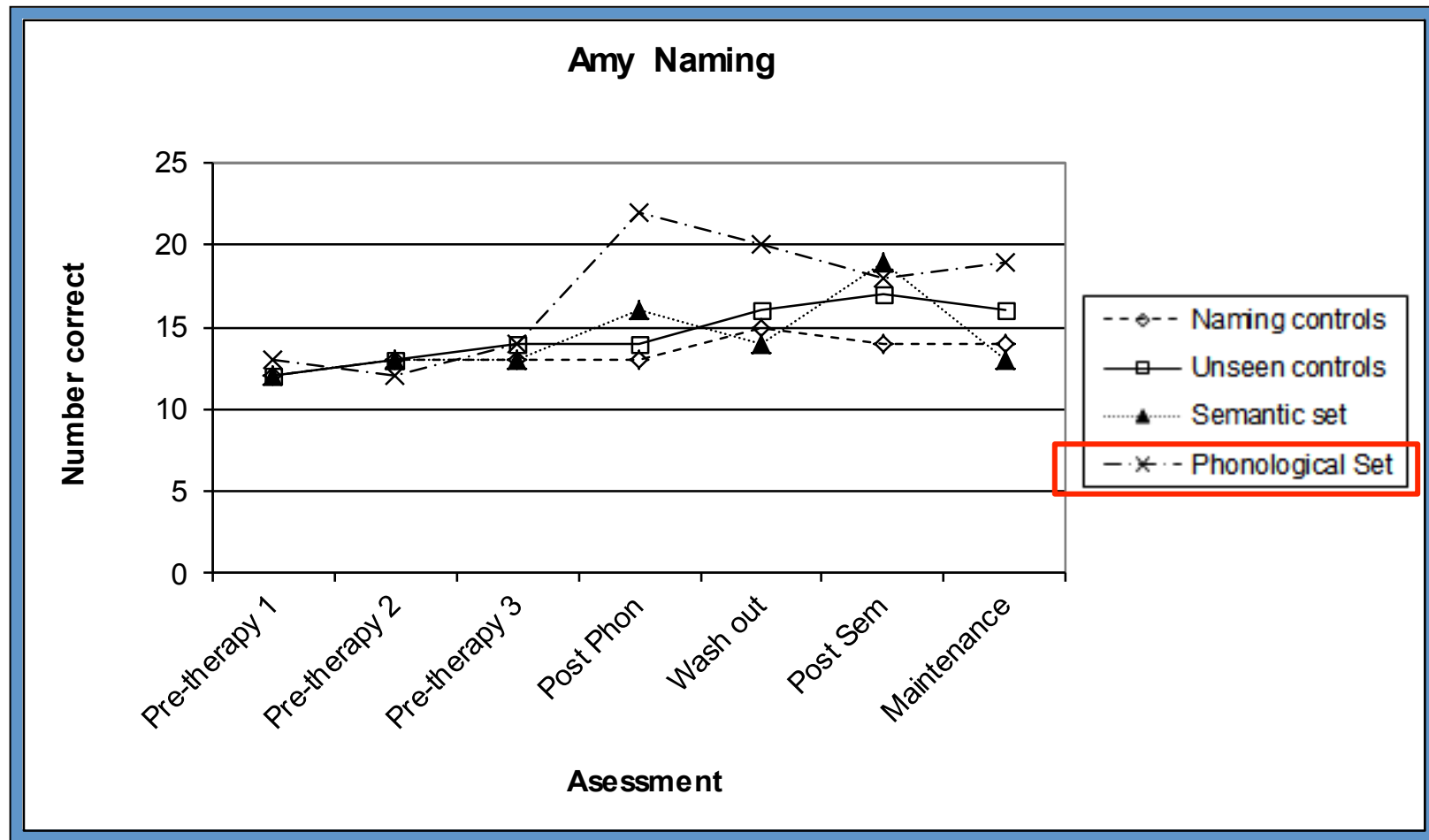**Primary but not necessary sole language deficit**

Interventions for WFD

Semantic therapy
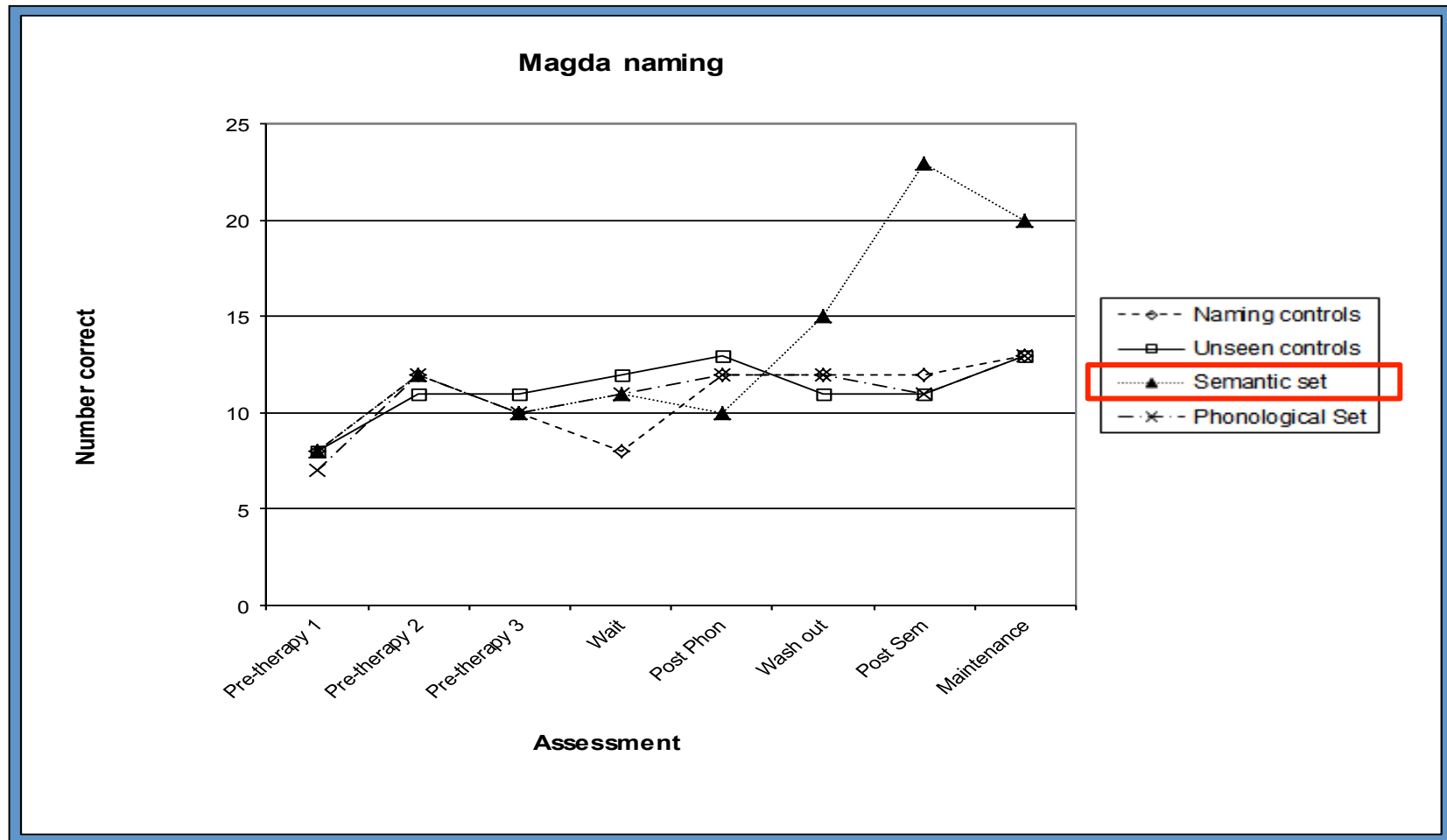

Linked things

Category

Action

Appearance

Use

Location

Phonological therapy

Ways to break down the word

First sound

First letter

Things that start the same

Things that end the same (rhyme)

Number of syllables (claps)

Two case studies

Two case studies

Magda naming

Challenges

- What is the link between mechanism and intervention?

Table 1: Therapists were asked to list any other difficulties which tend to co-occur with word-finding problems.
Language/learning difficulty (percentage of therapists)
- ☐ Phonological awareness (46%)
- ☐ Vocabulary (38%)
- ☐ Expressive language (33%)
- ☐ Phonology (25%)
- ☐ Literacy (21%)
- ☐ Auditory memory /Short term memory (17%)
- ☐ Semantics (13%)

Table 2: Therapists were asked to list approaches they routinely used with children with word-finding difficulties.
Therapy approaches (percentage of therapists)
- ☐ Semantic* (79%)
- ☐ Phonological awareness (54%)
- ☐ Vocabulary (38%)
- ☐ Strategies (21%)
- ☐ Phonology (13%)
- ☐ Visualisation** (13%)
- ☐ Self-cueing (using first-sound)** (13%)

Best, W. (2003) Finding the right approach: how do SLTs tackle word-finding problems in children. Bulletin of the Royal College of Speech and Language therapists, September p.5-6.

Challenges

- Therapy is a discovery process that is specific to the child – no general principles?

- Unclear whether best to work on areas of weakness or use areas of strength – depends on child? changes over time?

Table 3
Links between the nature of the children's problems and the type of intervention used
☐ It is important to find out why the WFD may be occurring and which storage is happening accurately –fuzzy storage needs working on!
☐ Visualisation for semantic difficulties
☐ Work on semantics gives them the tools to describe attributes of the sought after word
☐ Sorting tasks - less expressive children, Descriptive tasks - verbally confident
☐ Phonological awareness – when targeting literacy
☐ Use strategies to access words in semantic system –triggers words stored in lexicon
☐ Younger –gesture/description rather than initial sounds/other phonological
☐ When knows spelling use letter-to-sound
☐ When vocabulary deficit –use lots of contexts, LSA support appropriate
☐ It is important to take account of dysfluency

Best, W. (2003) Finding the right approach: how do SLTs tackle word-finding problems in children. Bulletin of the Royal College of Speech and Language therapists, September p.5-6.

Challenges

- Ask the child: what worked for you?

____1_____2_____3_____4_____5____

	Amy	Magda
How much did you enjoy taking part in WORD?	5	5
How helpful was it to think about the MEANING of words?	4	3 **(Semantic worked best)**
How helpful was it to think about the SOUNDS in words?	3 **(Phonological worked best)**	5
What helps you most when you are stuck?	Chunking out; doing the actions; sometimes spelling.	I show someone the action… Tell a teacher or friend.
Do you think finding words is easier now?	At the beginning 1 and now it is 3.	A little bit easier

CLINICIANS

MECHANISMS

Attempt to close the gap from both directions:

(1) Talk to clinicians about implicit causal theory

(2) Build formal models of atypical neuro-computational systems and simulate effects of intervention

Computational modelling as a way to investigate mechanism
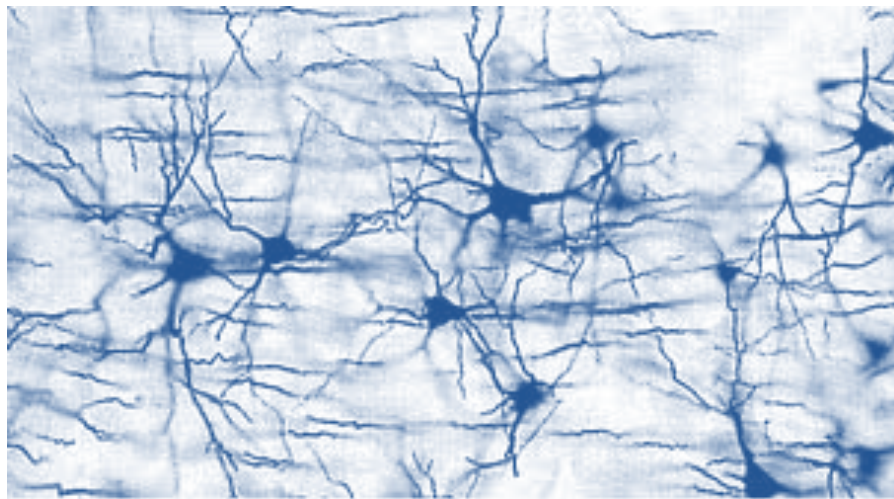
Real neural networks
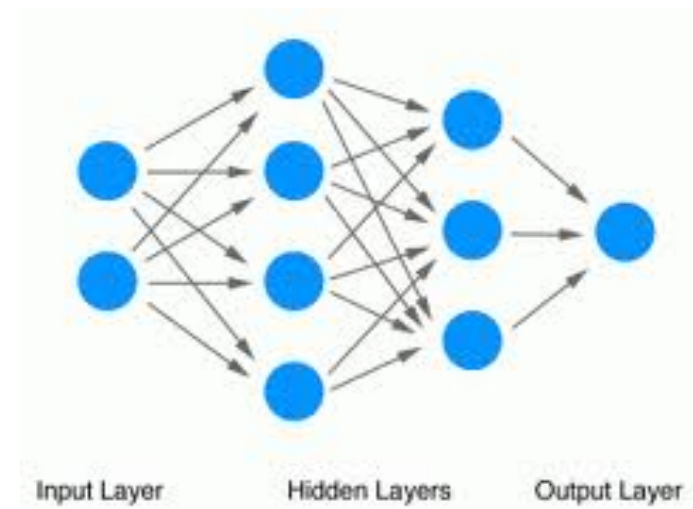
Artificial neural networks

Harm, McCandliss & Seidenberg (2003)
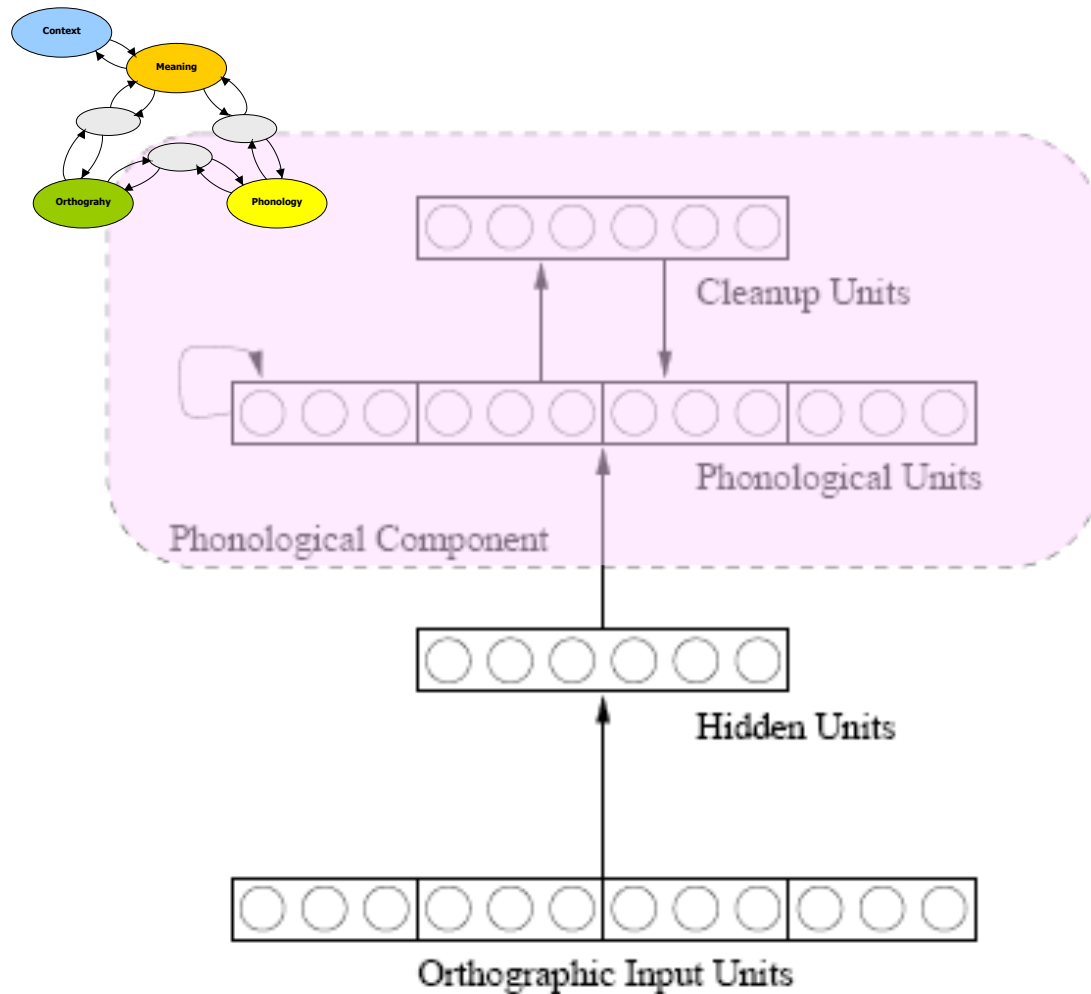
- Does it matter when phonological problem resolves?
- Compare with training on orthographic-phonology relationships

Word Building Intervention

Figure 4. Sample stimuli from the McCandliss et al. (in press) Word Building intervention. Consecutive items in the sequence were created by changing or moving only one grapheme.

Harm, McCandliss & Seidenberg (2003)

Context
Meaning
Orthograhy
Phonology

Cleanup Units

Phonological Units

Phonological Component

Hidden Units

Orthographic Input Units

- Does it matter when phonological problem resolves?
- Compare with training on orthographic-phonology relationships

Word Building Intervention

sat	tot	past
sap	pot	pat
tap	pat	pot
top	sat	pop
stop	spat	top
top	pats	stop

Figure 4. Sample stimuli from the McCandliss et al. (in press) Word Building intervention. Consecutive items in the sequence were created by changing or moving only one grapheme.

A good model but the ONLY model of intervention!

Model for investigating the principles of intervention

- Simple network
- Easy to visualize behaviour
- Esp. formation of internal representations

Output Category
1   2   3

...

1   2
Input Dimension
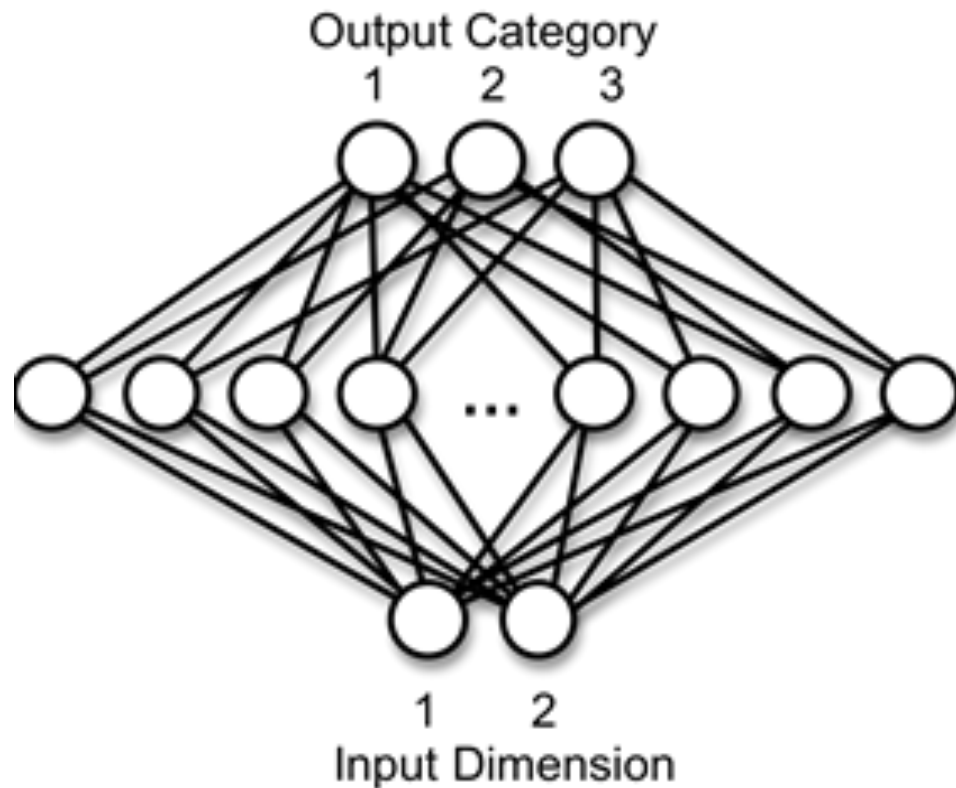
Input space
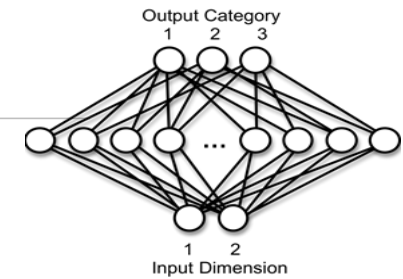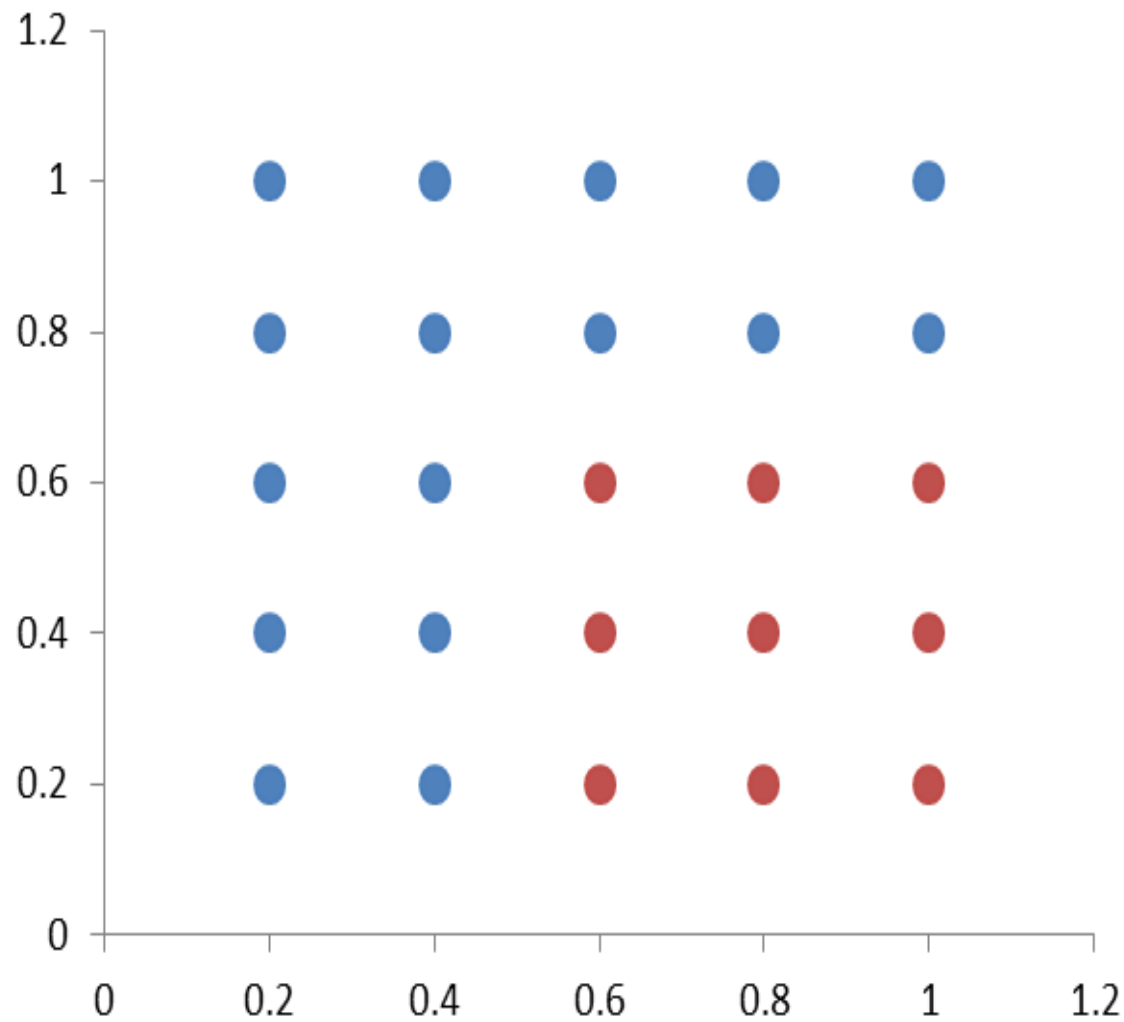
Range: -0.5, 0.5
10 000 items
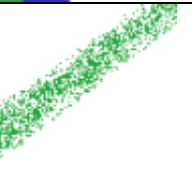
Simple learning problems
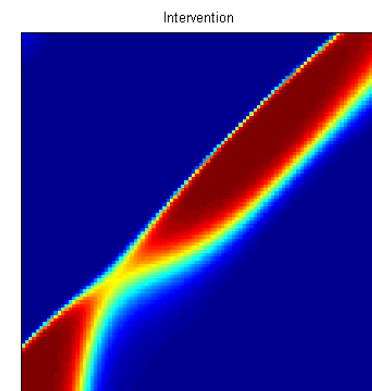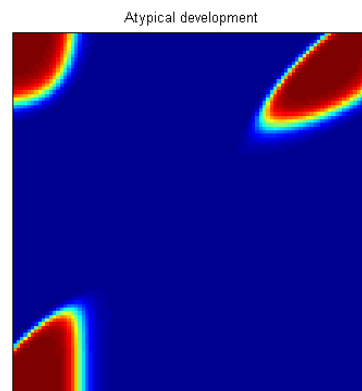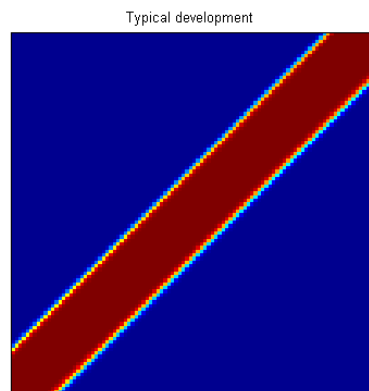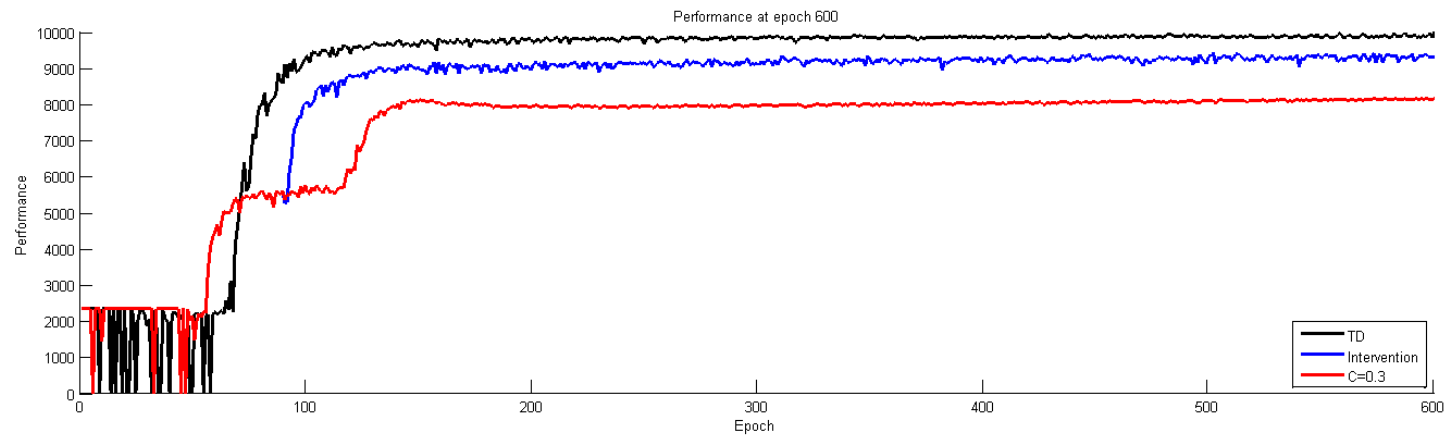
Diagonal

- Regular

Islands

- Irregular

Developmental deficits
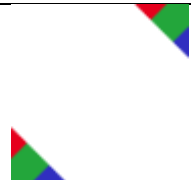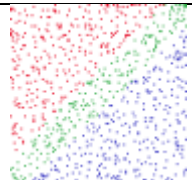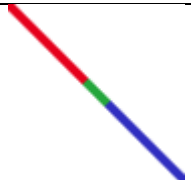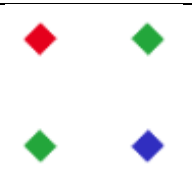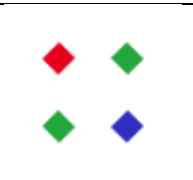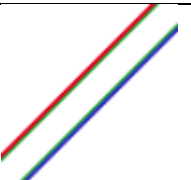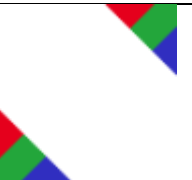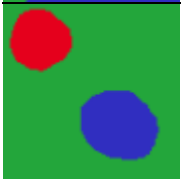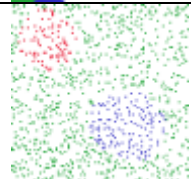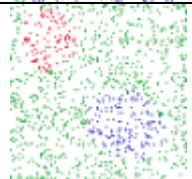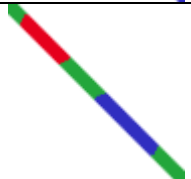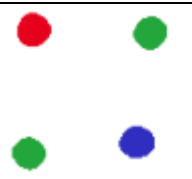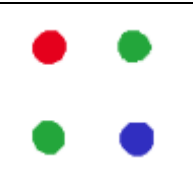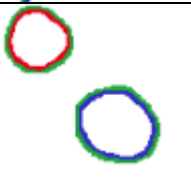
Low connectivity (C = 0.3)
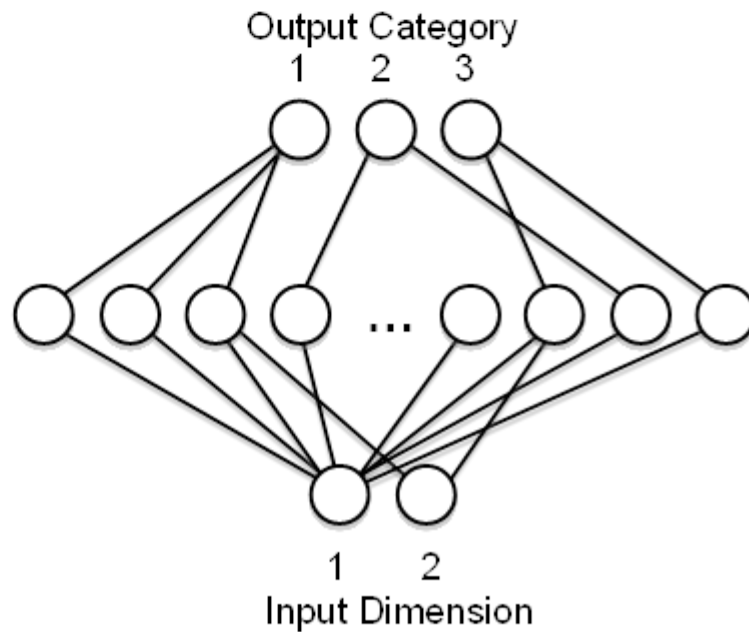
Low temperature (T = 0.5)
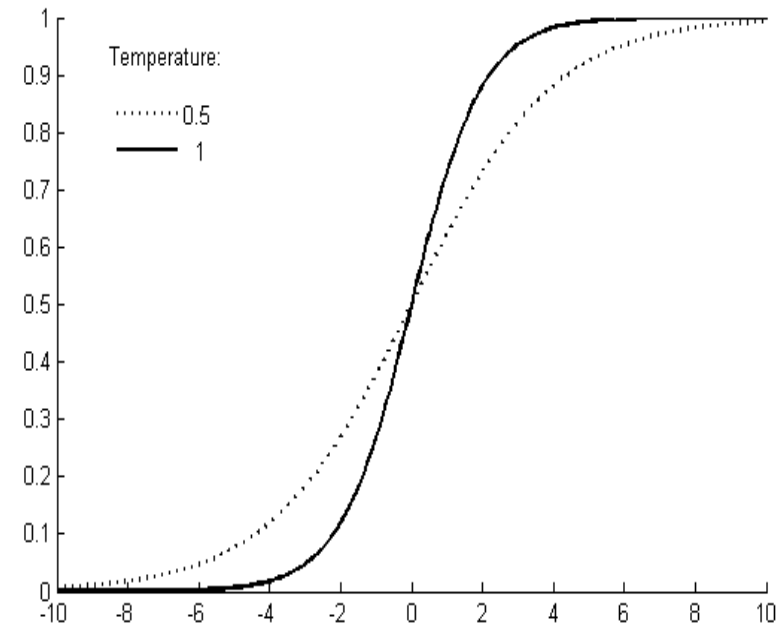
Intervention patterns

Trajectories

Performance at epoch 600

Output Category
1 2 3

Input Dimension
1 2

Sample animations…

- https://www.youtube.com/watch?v=_RCSFhoFg6s

- https://www.youtube.com/watch?v=WIrr0Jr6kfo

- https://www.youtube.com/watch?v=WIrr0Jr6kfo

Principles

- Importance of timing of intervention
- Specificity to deficit type?
- Specificity to problem domain?

Back to word-finding difficulties

- Aim:
  - Model individual profiles of developmental deficits in naming
  - Model interventions – which is most effective?
  - Test predictions against real data

- Key data: compare performance on four tasks, child vs. model
  - Picture naming
  - Picture comprehension
  - Semantic associations
  - Phonological ability

Picture naming task

Target: Triangle
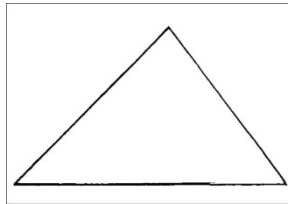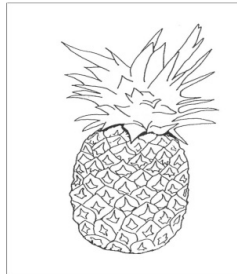

"Square"

Target: Coconut

"Cocoon...some beach thing"

Target: Llama
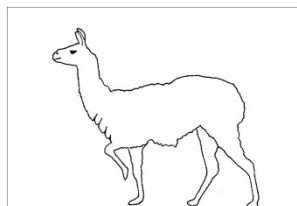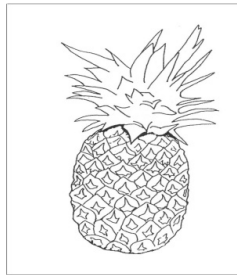

"Ghost" (via goat)

Picture comprehension

Time 1: Is it pineapple?   YES

Time 2: Is it melon?   NO
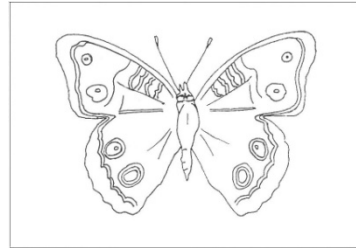
Combined accuracy score: 1
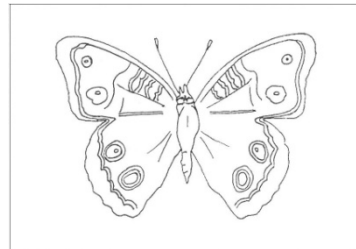
Picture comprehension

Time 1: Is it butterfly?   YES

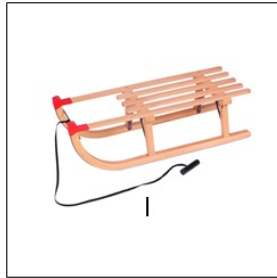Time 2: Is it wasp?   YES

Combined accuracy score: 0

Semantic associations

Semantic associations

Phonological ability (nonword repetition)
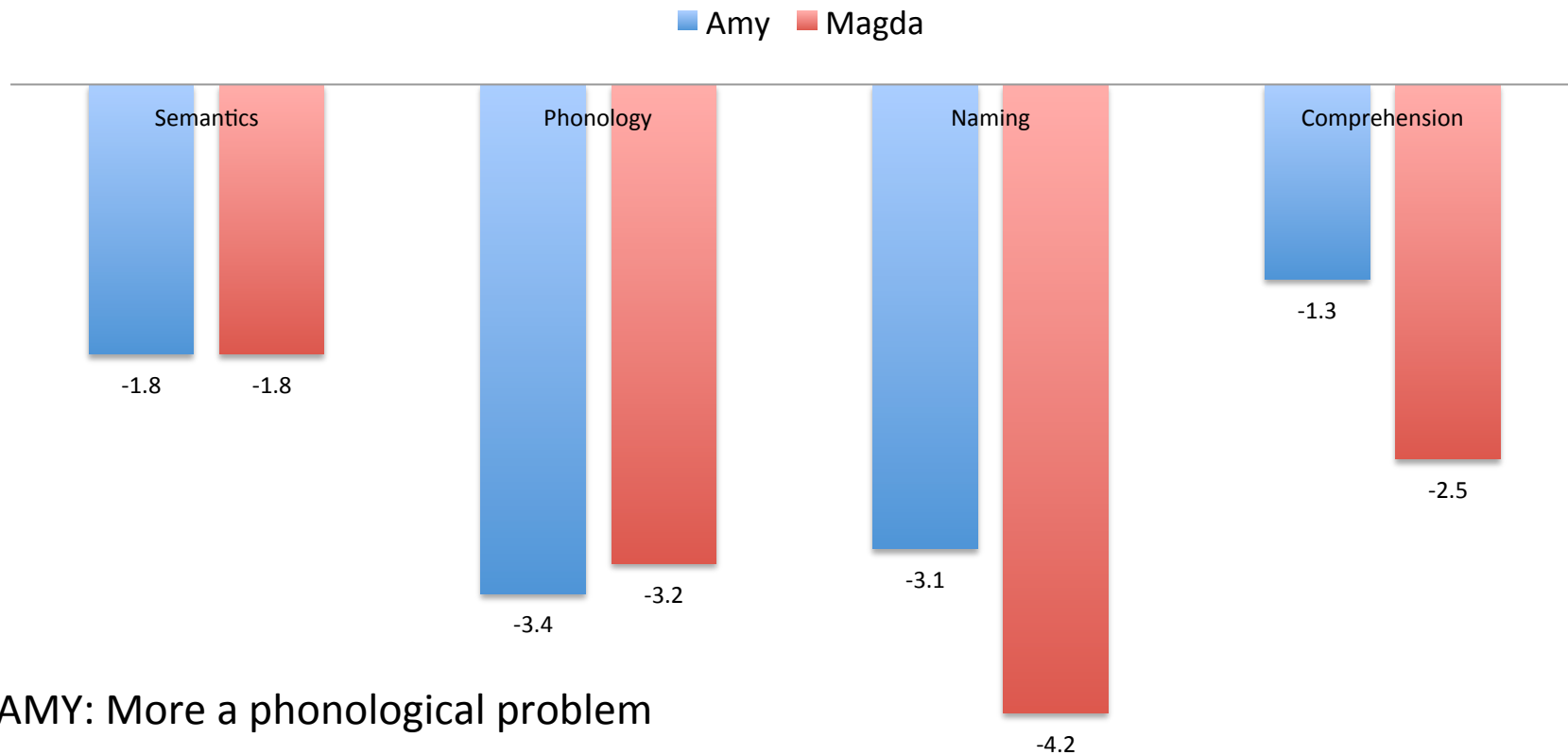
pennel

commeecitate

perplisteronk
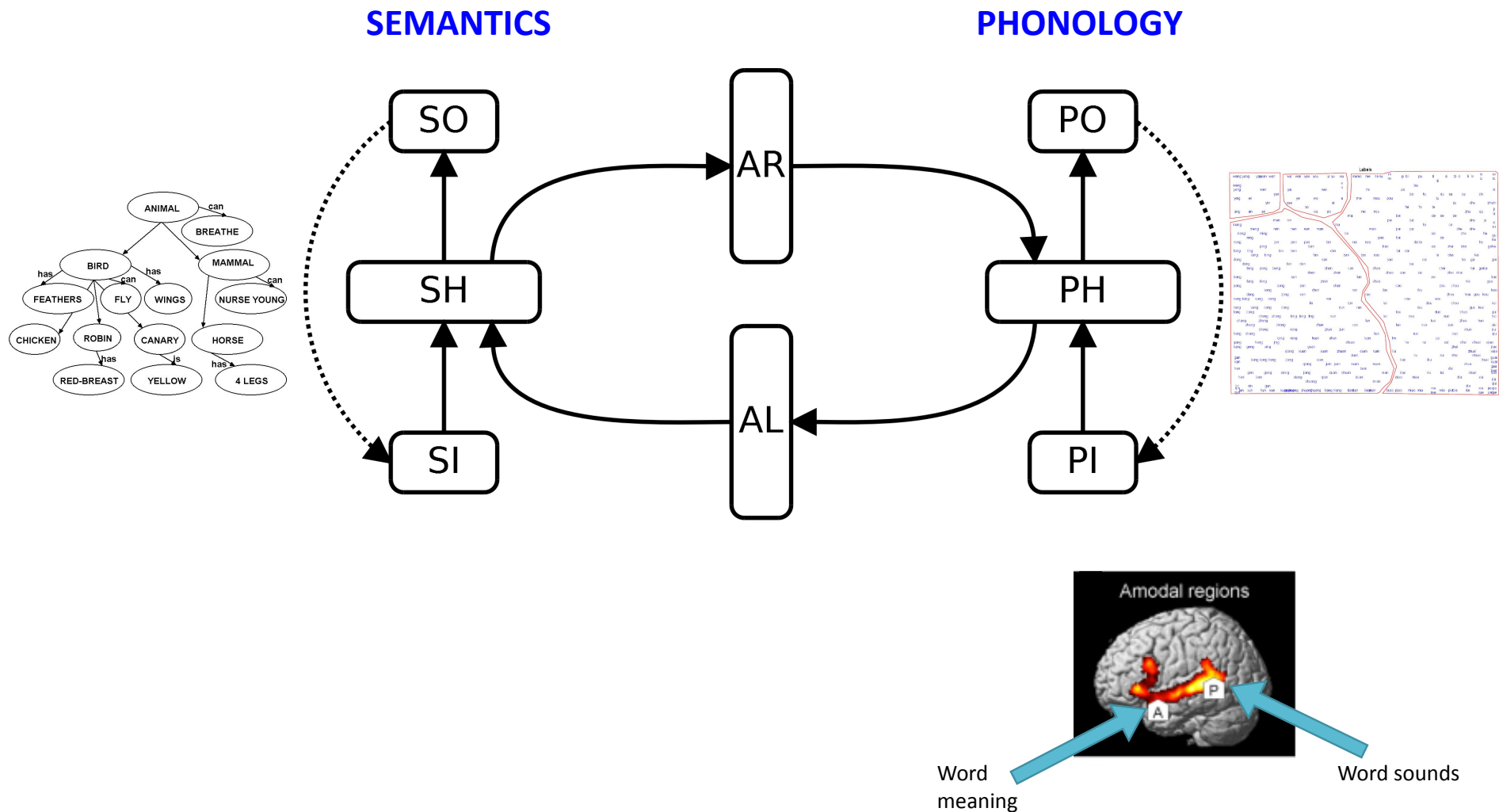
skiticult

ballop

woogalamic

Two case studies

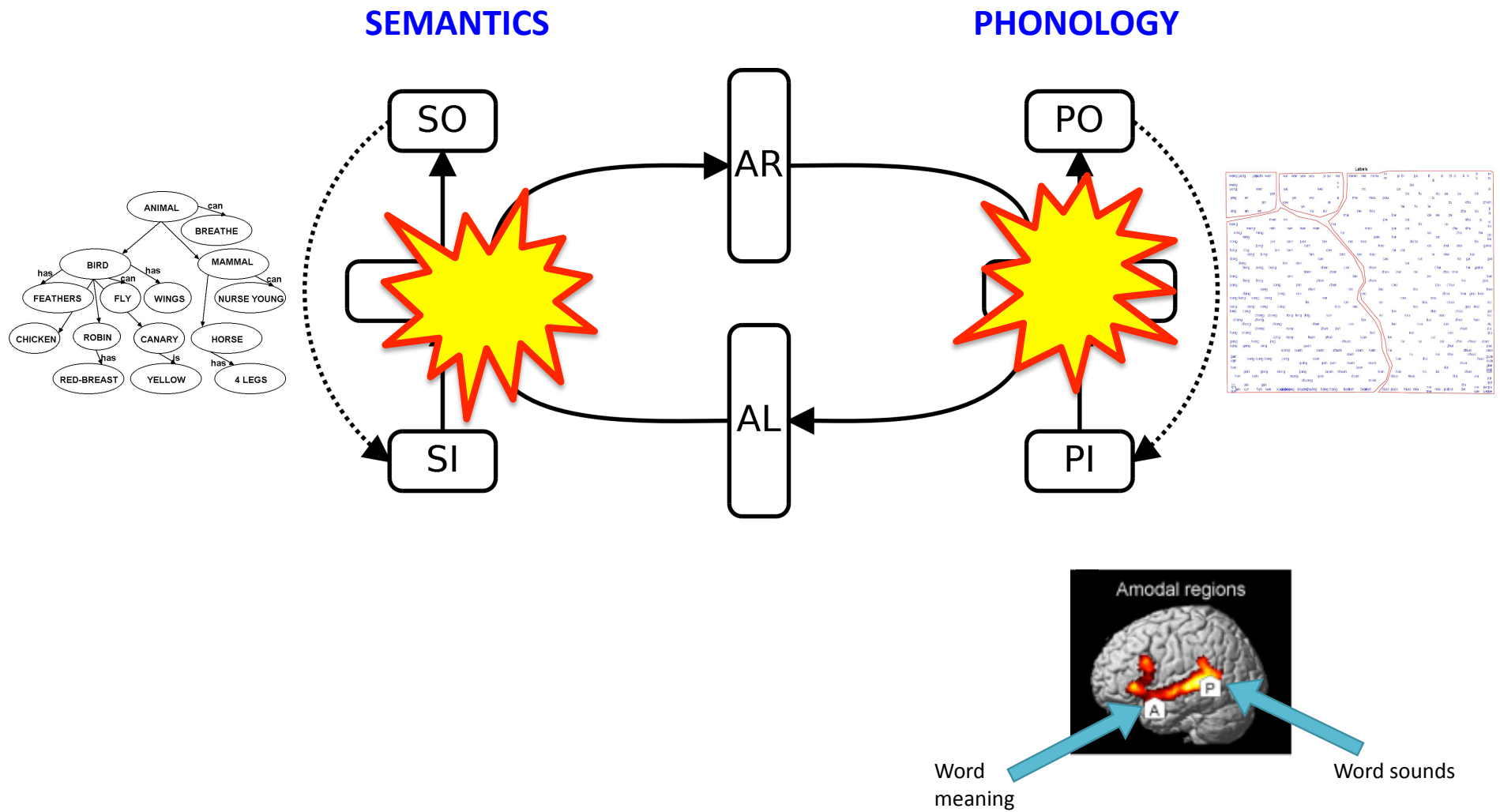**Comparison to controls (SDs from mean)**

■ Amy ■ Magda

Semantics	Phonology	Naming	Comprehension

Amy Semantics: -1.8
Magda Semantics: -1.8
Amy Phonology: -3.4
Magda Phonology: -3.2
Amy Naming: -3.1
Magda Naming: -4.2
Amy Comprehension: -1.3
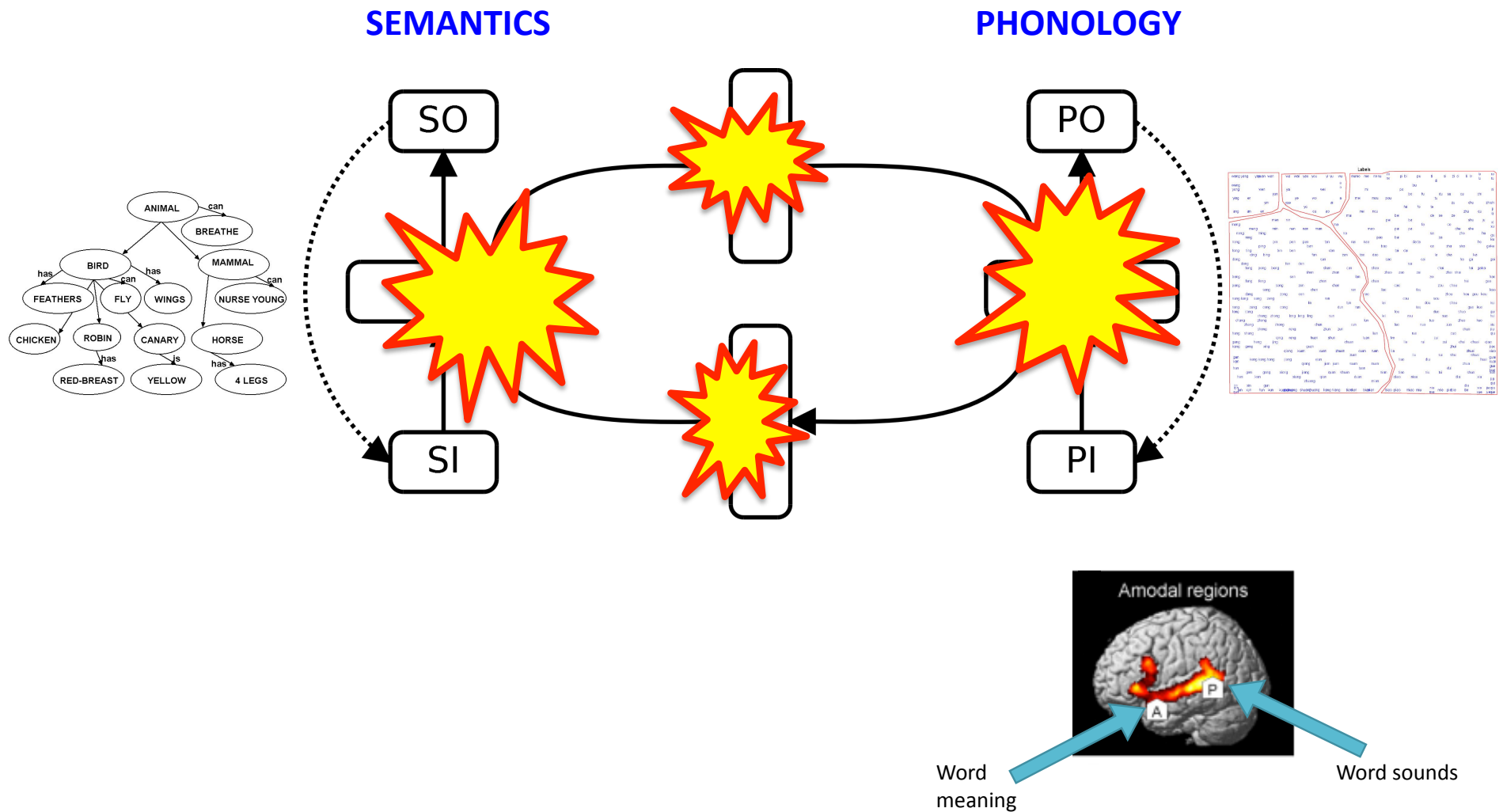Magda Comprehension: -2.5

AMY: More a phonological problem

MAGDA: … *and* a semantic problem

Model of naming development

SEMANTICS

PHONOLOGY

SO
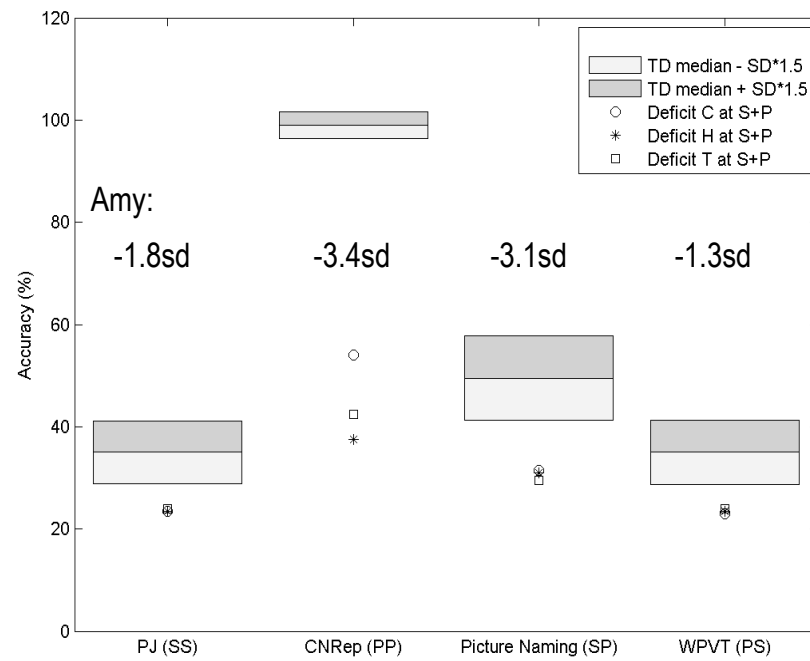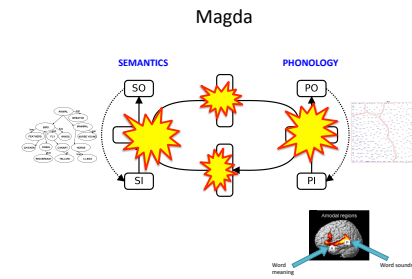
AR

PO

SH

PH

SI

AL

PI

Amodal regions

Word meaning

Word sounds

Amy

SEMANTICS

PHONOLOGY

Word meaning
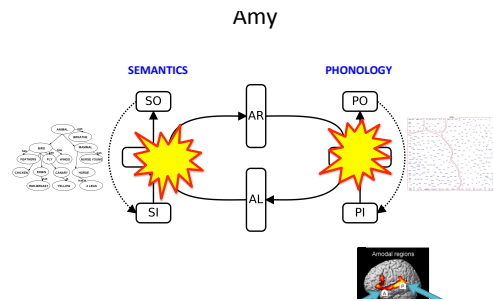
Word sounds

Magda

Amy
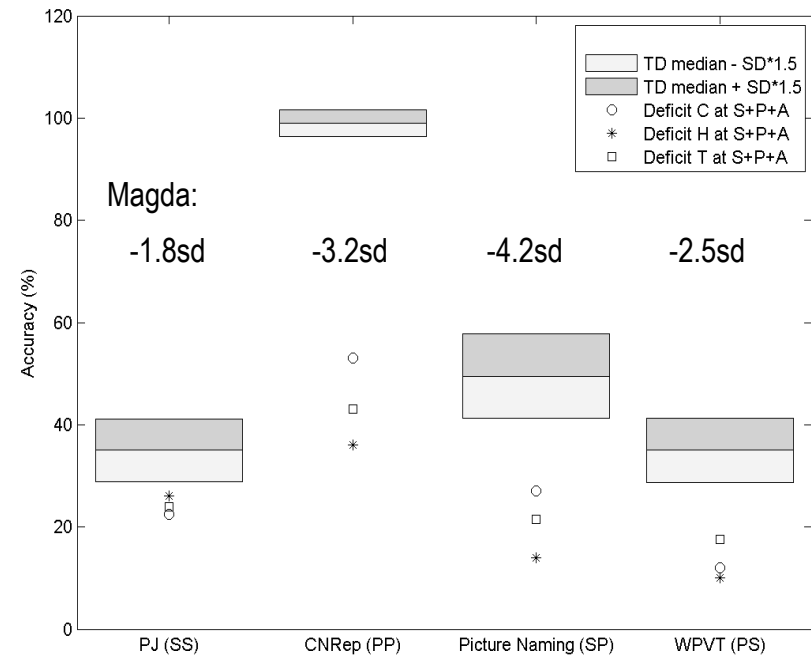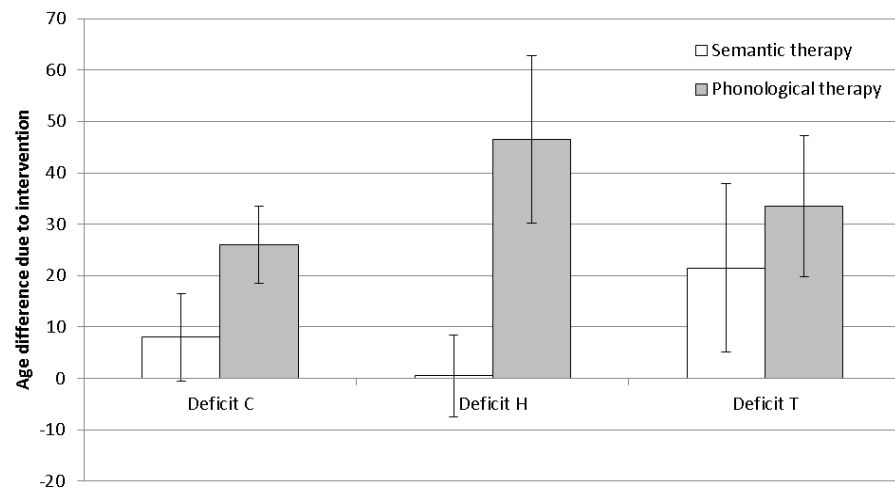
Magda

Simulate the intervention
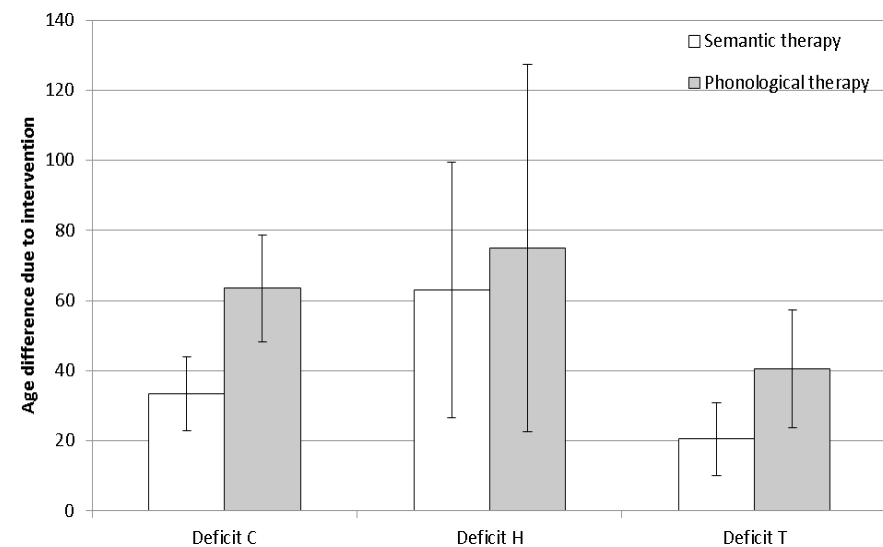
Amy

Magda

Simulate the intervention
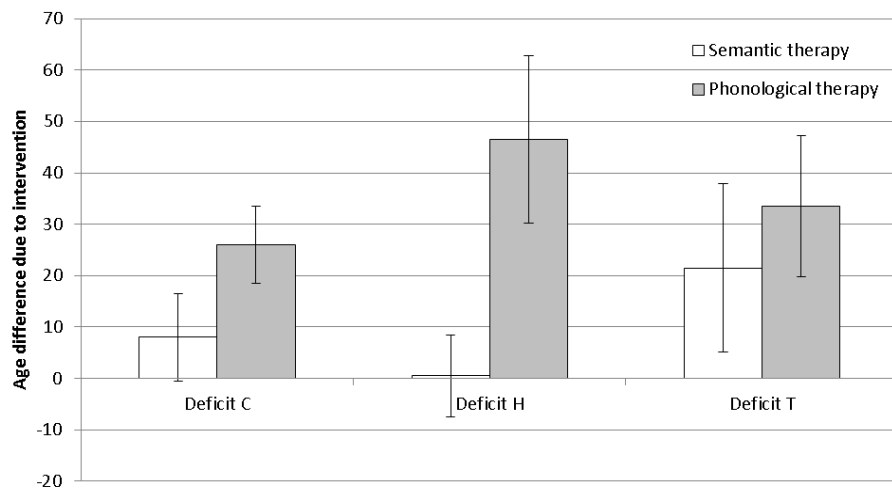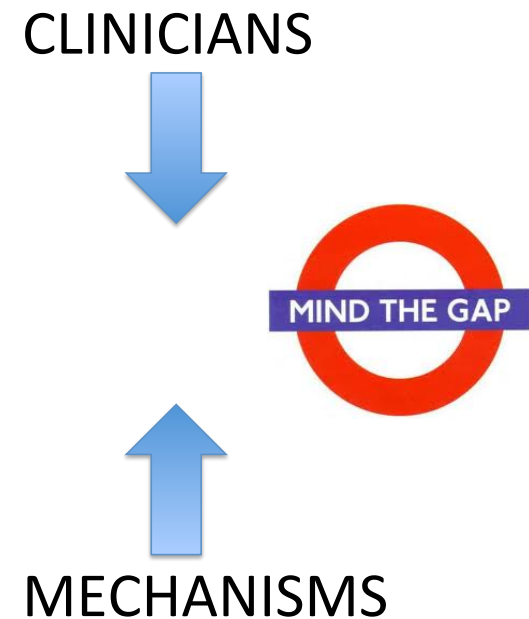
Conclusions

- Link intervention with underlying mechanism

- Use computational models to advance theory / generate predictions

- Work with clinicians to understand (a) their implicit causal theories (b) what kinds the interventions they use

- Intervention studies = lots of challenges!

CLINICIANS

MIND THE GAP

MECHANISMS

Acknowledgements

- Colleagues: Wendy Best, Jackie Masterson, Anna Fedor, Lucy Hughes, Silvia Roncoli, Donna-Lynn Shepherd, Liory Fern-Pollak, Anna Kapikian, Hala Alireza

- Project website: https://sites.google.com/site/wordfinding/home