Can you think without words?

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EUSci Seminar – 24 March 2011

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  - Can you think *without words*?

    (Thinking using images, scenes, etc.)

  - Can you *think* without words?

    (Does language restrict the way we think?)

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- Can you *think* MATHS without words?

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    (Does language restrict the way we think?)

- Can you *think* MATHS without words?

- **But first**: A 3-slide intro to linguistics

Fry & Laurie (1989)

The study of language

- Letter/Sound level

- Word Level

- Sentence Level

The study of language

- Letter/Sound level
  - It is not hrad to raed a setcnene lkie tihs!
- Word Level

- Sentence Level

The study of language

- Letter/Sound level
  - It is not hrad to raed a setcnene lkie tihs!
- Word Level
  - Read to not it this like sentence hard is a.
- Sentence Level

The study of language

- Letter/Sound level

  – It is not hrad to raed a setcnene lkie tihs!

- Word Level

  – Read to not it this like sentence hard is a.

- Sentence Level

  – Hold the newsreader's nose squarely, waiter, or friendly milk will countermand my trousers.

The study of language

- Discourse Level

Can you think without words?

- Sapir-Whorf hypothesis:
  - Language shapes/restricts the way we think
  - Different languages impose different restrictions
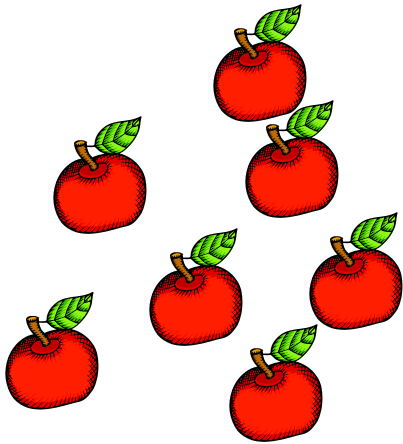
"The limits of my language mean the limits of my world"

Wittgenstein (Tractatus 5.6)

The case for maths

- Pirahã language – no words for numbers
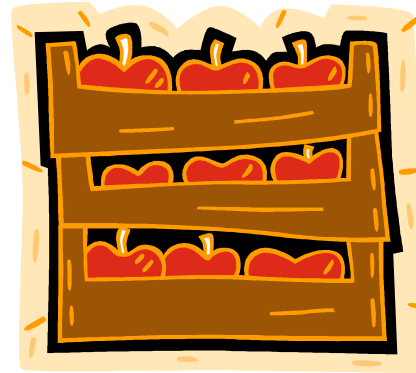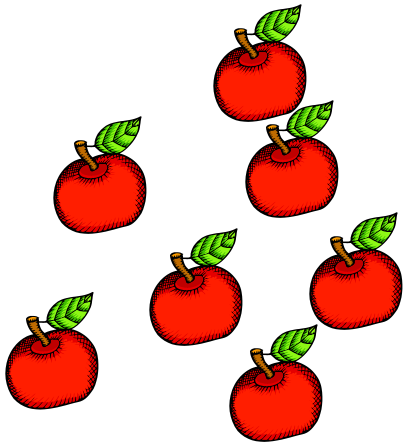- "Match-to-sample" tests:

The case for maths

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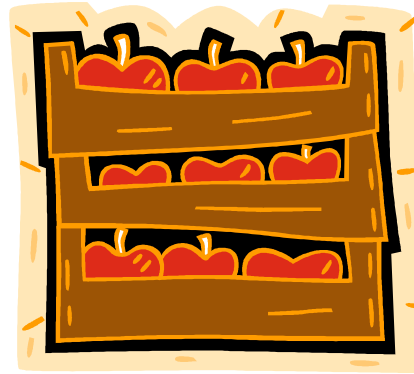
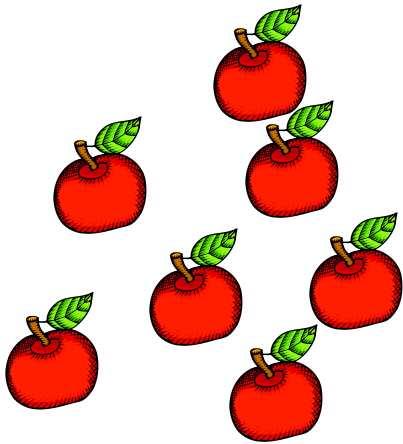# The case for maths

- Pirahã language – no words for numbers
- "Match-to-sample" tests:

The case for maths

- Pirahã language – no words for numbers
- "Match-to-sample" tests:

- Fail!

The case for maths

- Is it a cultural effect?
  - Language seems to be the key
    (EUSci Podcast #46)

The case for maths

- Is it a cultural effect?
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- Another explanation:
  - Language provides a mental shortcut
  - Recursive functions

Working memory & reference

- Referencing in crowded environments:
  - "The girl"

Working memory & reference

- Referencing in crowded environments:
  - "The girl"
  - "The girl by the bar"

Working memory & reference

- Referencing in crowded environments:
  - "The girl"
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  - "The girl by the bar with the black hair"

Working memory & reference

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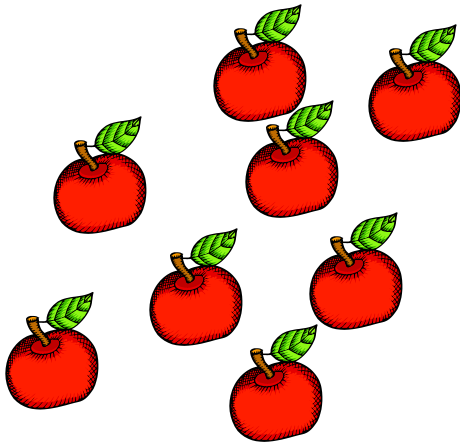
Working memory & reference

- Referencing in crowded environments:
  - "The girl"
  - "The girl by the bar"
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  - "The girl by the bar with the black hair and the red dress"

  - "Mary"!

Working memory & reference

- How many apples where in the previous slide?
  - Try again

Working memory & reference

- How many apples where in the previous slide?
  - Try again
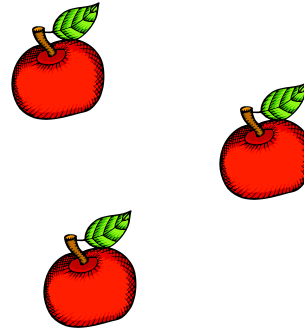
Working memory & reference

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Working memory & reference

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  - Try again

Working memory & reference

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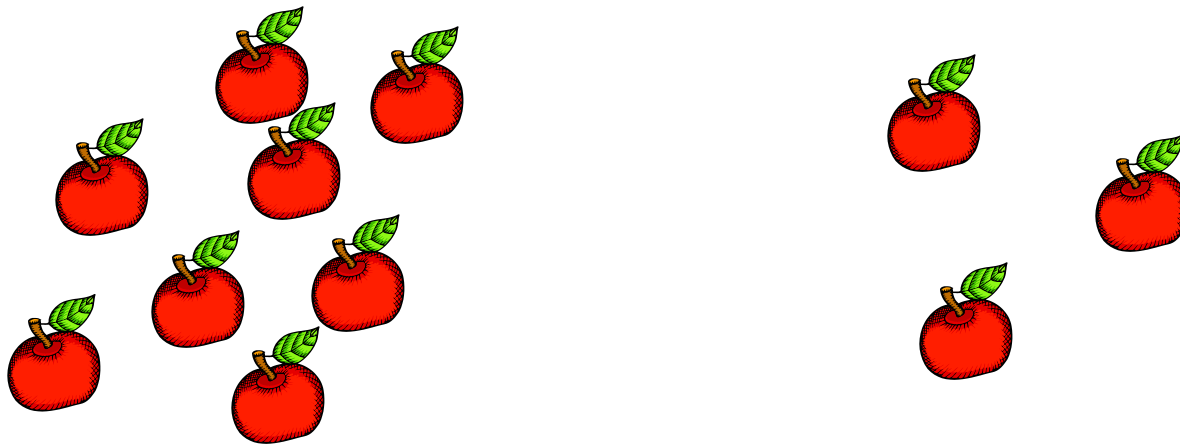 - Try again

Working memory & reference

- How many apples where in the previous slide?
  - Try again

  - Limited to a small number of items at a time (<4)

WARNING:

MATHEMATICAL CONTENT AHEAD
(including lamda calculus)

Numbers and counting

A way of defining numbers:

- $n := \lambda f x. f^{(n)}(x)$ and $x = 0, \quad f(x) = S(x)$

$$n := \underbrace{S(S(...(S(0))))}_{n} = S^n(0)$$

Numbers and counting

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$$n := \underbrace{S(S(\ldots(S(0))))}_{n} = S^n(0)$$

- No number "essence"
  – Number of successive actions performed

Numbers and counting

- All you need:
  - A finite set of labels (sounds, fingers, etc.)
  - A recursive function (successor)

- Language provides both
  - Number words (one, seven, -teen, etc.)
  - Recursive constructions

Recursion in language

This is the man all tattered and torn.

Recursion in language

This is the man all tattered and torn
that kissed the maiden all forlorn

Recursion in language

This is the man all tattered and torn
  that kissed the maiden all forlorn
    that milked the cow with the crumpled horn

Recursion in language

This is the man all tattered and torn
  that kissed the maiden all forlorn
    that milked the cow with the crumpled horn
      that tossed the dog

Recursion in language

This is the man all tattered and torn

that kissed the maiden all forlorn

that milked the cow with the crumpled horn

that tossed the dog

that worried the cat

Recursion in language

This is the man all tattered and torn

that kissed the maiden all forlorn

that milked the cow with the crumpled horn

that tossed the dog

that worried the cat

that killed the rat

Recursion in language

This is the man all tattered and torn

that kissed the maiden all forlorn

that milked the cow with the crumpled horn

that tossed the dog

that worried the cat

that killed the rat

that ate the malt

Recursion in language

This is the man all tattered and torn

that kissed the maiden all forlorn

that milked the cow with the crumpled horn

that tossed the dog

that worried the cat

that killed the rat

that ate the malt

that lay in the house

Recursion in language

This is the man all tattered and torn

that kissed the maiden all forlorn

that milked the cow with the crumpled horn

that tossed the dog

that worried the cat

that killed the rat

that ate the malt

that lay in the house

that Jack built.

Recursion and counting

- Pirahã don't have recursive language
    - Only one level of embedding allowed
    - Therefore they don't have numbers

        (or is it the other way round?)

Recursion and counting

- Pirahã don't have recursive language
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    (or is it the other way round?)

- Can they be taught how to count?
  - Evidence suggests they *can't*
  - But can they be taught to use recursions?

Can you think ~~MATHS~~ without words?

- YES!
- But you can do much more *with* them...
- Data reduction

Can you think MATHS without words?

- YES!
- But you can do much more *with* them...
- Data reduction

Image = 172,000 bytes
                    (compressed)

1000 words = 1,000 bytes