Communicative and Cognitive Pressures in Semantic Alignment

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Maze Task [GA87]

- 2 participants in different rooms
- connected by a 2-way audio link
- looking at a computer screen
- displaying a 2-dimensional maze
- each controls his position marker which is only visible only to him
- GOAL: reach the target node
- BUT: obstacles (gates)
- to open a gate one should instruct his partner to go to a particular switch-box
- recurrent coordination problem
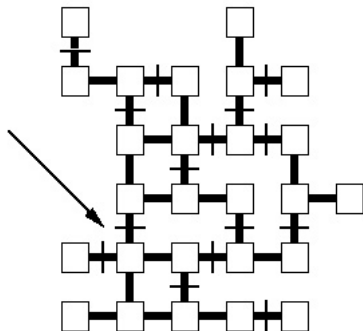
Description Types [GA87]

Figural : refers to salient features of the maze
"the l-shape sticking out at the top"
"the uppermost box"

Path : refers to a route from one node to
another
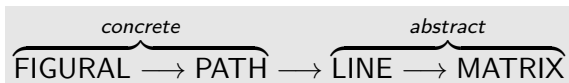"Go 2 up, 1 down, 2 along, 5 up"
"up, right, down, up"

Line : refers to nodes treated as intersects of
horizontal and vertical vectors
"3rd row, 5th box", "4th column, 2nd
square"
"The third row, fifth to the left"

Matrix : coordinate-system
"4,2", "A,1"
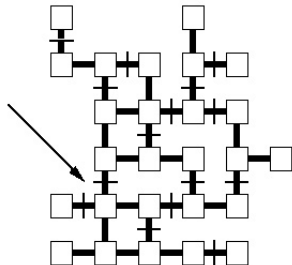
Migration Pattern

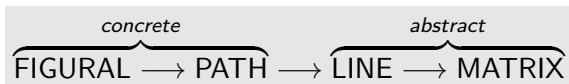Description types tend to migrate across trials in the following way:

0 mins: The piece of the maze sticking out

2 mins: The left hand corner of the maze

5 mins: The northenmost box

10 mins: Leftmost square of the row on top

15 mins: 3rd column middle square

20 mins: 3rd column 1st square

25 mins: 6th row longest column

30 mins: 6th row 1st column

40 mins: 6 r, 1 c

45 mins: 6,1

Figure 1: From [MH08]

Migration Pattern

$$\overbrace{\text{FIGURAL} \longrightarrow \text{PATH}}^{concrete} \longrightarrow \overbrace{\text{LINE} \longrightarrow \text{MATRIX}}^{abstract}$$

- ▶ robust result
- ▶ not explained by existing models of meaning coordination
  1. input-output coordination [GA87]
  2. interactive alignment [PG04]
  3. repair driven [Hea08]

How to explain it?

Explaining the Migration Pattern

Language shaped by multiple selectional pressures [Zip49, CC16]

Pressures valid for the time-scale of an interaction

1. communication $\rightarrow$ expressive meanings
2. communication $+$ interaction $\rightarrow$ ease of alignment
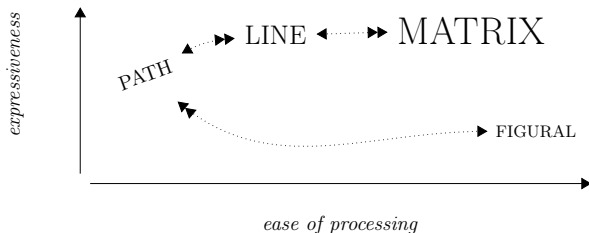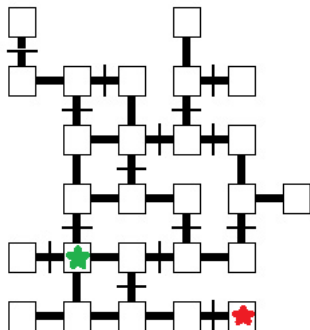3. cognition $\rightarrow$ easy meanings

Figure 2: Font size $\approx$ degree of ambiguity of a description type.

Expressiveness of FIGURAL

- goal: describe a box in the maze
- red: "the rightmost box of the row on bottom"
- uses salient features of the maze
- but the green box?
- some mazes are likely to invoke FIGURAL [GA87]
- depends on how many boxes are easily identifiable by FIGURAL descriptions
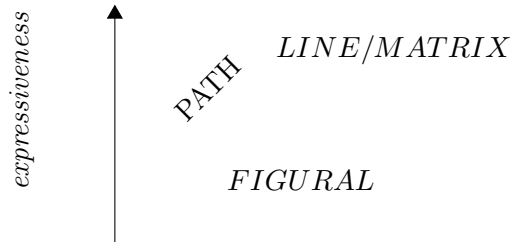
Expressiveness of PATH and LINE/MATRIX

- ▶ goal: describe a box in the maze
- ▶ green is easy to describe
  "go one right, one up"
  ⇒ more expressive then FIGURAL
- ▶ caveat: obstacles (comment)
- ▶ LINE/MATRIX most expressive
  "second row, second box from the left"
  "3,4"
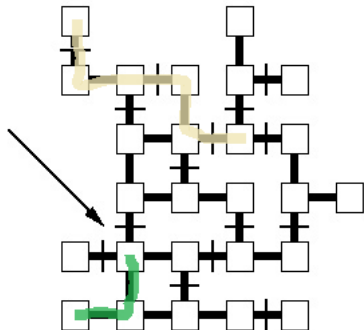
Order of expressiveness

expressiveness ↑

PATH

LINE/MATRIX

FIGURAL

Alignement vs Ambiguity

Why not use LINE/MATRIX right from the start?

- ▶ the ordering of migration preserves the increasing amount of ambiguity in description types

  FIGURAL (1) $\longrightarrow$ PATH (2) $\longrightarrow$ LINE (4) $\longrightarrow$ MATRIX (8)

- ▶ ambiguity makes alignment more difficult

"2,3", "2nd row, 3rd box"

- ▶ several natural algorithms
- ▶ parameters: horizontal/vertical, counting
- ▶ ≥ 3 parameters with ≥ 2 degs of freedom
  $\Rightarrow \geq 8$ extensionally non-equivalent
  procedures
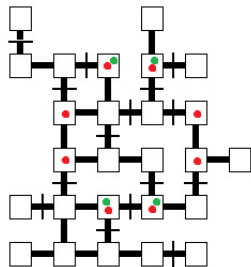
"Natural" meanings within a given description type are equally expressive and complex which makes them roughly equally likely to be selected during alignment.

Ease of processing: contraction

1. Shortening of descriptions ⇒ smaller effort

0 mins:	The piece of the maze sticking out
2 mins:	The left hand corner of the maze
5 mins:	The northenmost box
10 mins:	Leftmost square of the row on top
15 mins:	3rd column middle square
20 mins:	3rd column 1st square
25 mins:	6th row longest column
30 mins:	6th row 1st column
40 mins:	6 r, 1 c
45 mins:	6,1

PATH is peculiar: length of descr. depends on the length of the path

Meaning as algorithm [Tic69, Sup80]

Participants associate procedures with description forms

interpretation : going step by step from "4,3" to the identification
of the box

production : going step by step from the intended box to
producing a form "4,3"

Complexity measures of procedures are cognitively relevant, e.g.,
[SZ10]

Semantic Complexity

▶ FIGURAL: easy ad hoc procedures
▶ PATH: find a route between given nodes in a graph (non-trivial)
▶ PATH > LINE/MATRIX
▶ LINE/MATRIX linear time wrt n
▶ compr./prod. of LINE/MATRIX of more distant nodes is easier
▶ important: participants cannot bypass finding a route
▶ so its a matter of minimizing the effort
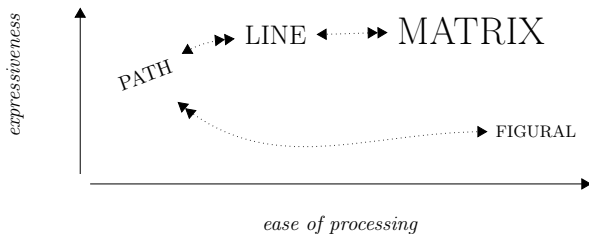▶ also collaborative effort [CWG86] – consider longer PATH descriptions

Summarizing Picture

Figure 3: Font size ≈ degree of ambiguity of a description type.

Conclusions and Perspectives

- interlocutors are affected by multiple selectional forces during interaction
- selectional forces shape the language being used and developed by participants
- this way we are able to explain the migration pattern
- take relevant selectional pressures seriously when modelling semantic alignment
- put the proposed hypotheses to the test

Thank you for your attention!

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