Cognitive Foundations Tutorial 1

- Look at the syntactic alternatives locally and globally ambiguous sentences
  - Identify at which word ambiguity arises / at which word disambiguation occurs?
  - How do you think people resolve the local ambiguity (what's your preference)?
  - At the point of ambiguity, which structure does Frazier's theory predict will be constructed?
  - Tell what additional kinds of information would influence processing in an interactive model like McRae's.
- How to design an experiment to test whether Frazier or McRae is right?

Well-known local ambiguities

NP/VP Attachment Ambiguity:

"The cop [saw [the burglar] [with the binoculars]]"
"The cop saw [the burglar [with the gun]]"

NP/S Complement Attachment Ambiguity:

"The athlete [realised [his goals]] last week"
"The athlete realised [[his goals] were unattainable]"

Clause-boundary Ambiguity:

"Since Jay always [jogs [a mile]] [the race doesn't seem very long]"
"Since Jay always jogs [[a mile] doesn't seem very long]"

Reduced Relative-Main Clause Ambiguity:

"[The woman [delivered the junkmail on Thursdays]]"
"[[The woman [delivered the junkmail]] threw it away]"

Relative/Complement Clause Ambiguity:

"The doctor [told [the woman] [that he was in love with her]]"
"The doctor [told [the woman [that he was in love with]] [to leave]]"

Constraint Parameters

"The crook/cop arrested by the detective was guilty of taking bribes"

Verb tense/voice constraint: verb bias towards past or past participle
Relative log frequency is estimated from corpora: RR=.67 MC=.33

Main clause bias: general bias for structure for "NP verb+ed …"
Corpus: P(RR|NP + verb-ed) = .08, P(MC|NP + verb-ed) = .92

by-Constraint: extent to which 'by' supports the passive construction
Estimated for the 40 verbs from WSJ/Brown: RR= .8 MC= .2

Thematic fit: the plausibility of crook/cop as an agent or patient
Estimated using a rating study

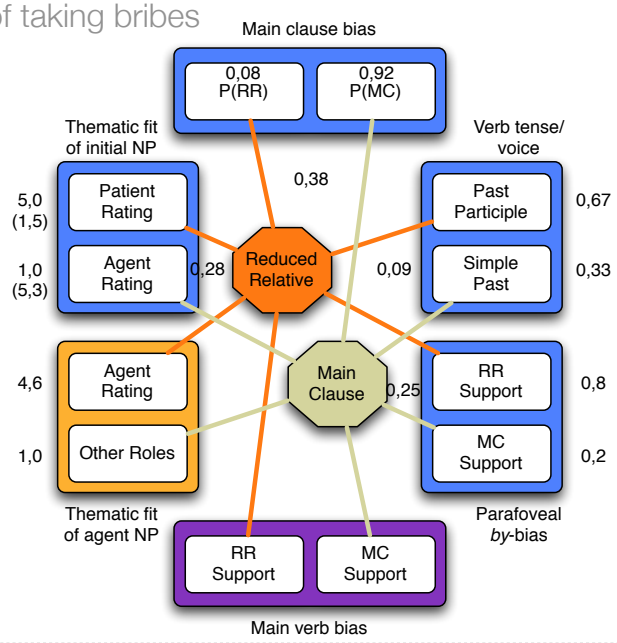
by-Agent thematic fit: good Agent is further support for the RR vs. MC
Same method as (4).

The complete model

Constraint Based (CB) Model
MC bias: .5094 x .75
Thematic Fit: .3684 x .75
Verb tense: .1222 x .75
by-bias: .25

The crook arrested by the detective was guilty of taking bribes

1. Combines constraints as they become available in the input
2. Input determines the probabilistic activation of each constraint
3. **Constraints are weighted according to their strength**
4. Alternative interpretations compete to a criterion
5. Cycles of competition mapped to reading times



On-line study

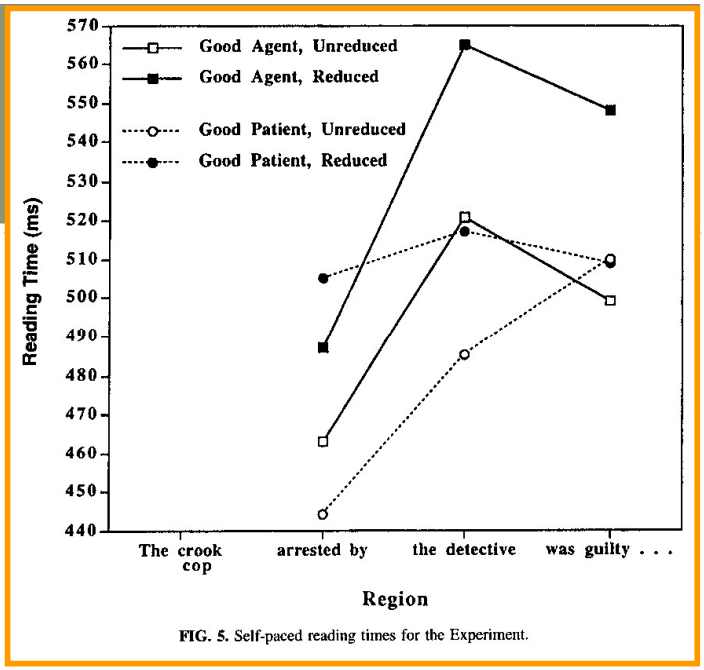


FIG. 5. Self-paced reading times for the Experiment.

- Two-word, self-paced presentation: (similar to completion studies)

The crook / arrested by / the detective / was guilty / of taking bribes

The cop / arrested by / the detective / was guilty / of taking bribes

The crook / that was / arrested by / the detective / was guilty / of taking bribes

The cop / that was / arrested by / the detective / was guilty / of taking bribes

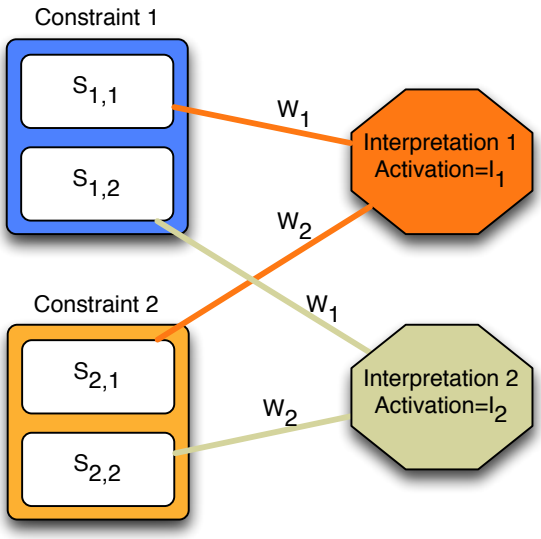
The recurrence mechanism

- $S_{c,a}$ is the raw activation of the node for the c^{th} constraint, supporting the a^{th} interpretation,
- w_c is the weight of the c^{th} constraint
- I_a is the activation of the a^{th} interpretation
- 3-step normalized recurrence mechanism:
  - Normalize:
  - Integrate:
  - Feedback:

$$S_{c,a}(norm) = \frac{S_{c,a}}{\sum_a S_{c,a}}$$

$$I_a = \sum_c \left[w_c \cdot S_{c,a}(norm) \right]$$

$$S_{c,a} = S_{c,a}(norm) + I_a \cdot w_c \cdot S_{c,a}(norm)$$



$$\sum_i w_i = 1$$

Example of Recurrence

	Constraint 1			Constraint 2			Activation		Constraint 1		Constraint 2	
	MC	RR	Weight	MC	RR	Weight	I_MC	I_RR	MC	RR	MC	RR
0	0,6	0,4	0,35	0,4	0,6	0,65	0,47	0,53	0,6987	0,4742	0,5222	0,8067
1	0,596	0,404	0,350	0,393	0,607	0,650	0,464	0,536	0,692	0,480	0,511	0,819
2	0,591	0,409	0,350	0,385	0,615	0,650	0,457	0,543	0,685	0,487	0,499	0,833
3	0,584	0,416	0,350	0,375	0,625	0,650	0,448	0,552	0,676	0,496	0,484	0,850
4	0,577	0,423	0,350	0,363	0,637	0,650	0,438	0,562	0,665	0,507	0,466	0,870
5	0,568	0,432	0,350	0,349	0,651	0,650	0,425	0,575	0,652	0,519	0,445	0,895
6	0,557	0,443	0,350	0,332	0,668	0,650	0,411	0,589	0,637	0,535	0,421	0,924
7	0,543	0,457	0,350	0,313	0,687	0,650	0,394	0,606	0,618	0,553	0,393	0,958
8	0,528	0,472	0,350	0,291	0,709	0,650	0,374	0,626	0,597	0,576	0,362	0,998
9	0,509	0,491	0,350	0,266	0,734	0,650	0,351	0,649	0,571	0,603	0,327	1,044
10	0,487	0,513	0,350	0,238	0,762	0,650	0,325	0,675	0,542	0,634	0,289	1,095
11	0,461	0,539	0,350	0,209	0,791	0,650	0,297	0,703	0,509	0,672	0,249	1,153
12	0,431	0,569	0,350	0,178	0,822	0,650	0,266	0,734	0,471	0,715	0,208	1,215
13	0,397	0,603	0,350	0,146	0,854	0,650	0,234	0,766	0,430	0,765	0,169	1,279
14	0,360	0,640	0,350	0,117	0,883	0,650	0,202	0,798	0,385	0,819	0,132	1,342
15	**0,320**	**0,680**	**0,350**	**0,089**	**0,911**	**0,650**	**0,170**	**0,830**	**0,339**	**0,878**	**0,099**	**1,402**
16	0,278	0,722	0,350	0,066	0,934	0,650	0,140	0,860	0,292	0,939	0,072	1,456
17	0,237	0,763	0,350	0,047	0,953	0,650	0,114	0,886	0,247	0,999	0,051	1,502
18	0,198	0,802	0,350	0,033	0,967	0,650	0,091	0,909	0,204	1,057	0,035	1,539
19	0,162	0,838	0,350	0,022	0,978	0,650	0,071	0,929	0,166	1,110	0,023	1,569
20	0,130	0,870	0,350	0,014	0,986	0,650	0,055	0,945	0,133	1,158	0,015	1,591