Recognizing Focus in Noise Filled Sentences

Ching X. Xu & Yi Xu
Northwestern University & University of Chicago
xxq@northwestern.edu & xuyi@uchicago.edu

Motivation

To identify the intrinsic constituents of focus, we need to know what cues can be used by listeners in recognizing focus.

Stimuli

- Twelve four-word Mandarin sentences.
- Recorded by a male native speaker.
- Five focus condition: 0 ~ no focus; n (n = 1, 2, 3 or 4) ~ focus on the n# word.
- One, two or three words in each original sentence were replaced by pink noise of the same length.

Subjects

- Ten native Mandarin speakers.
- Half females and half males.
- From 20 to 35 years old.
- No history of speech or hearing problem.

Procedure

- The noise-filled sentences were presented to subjects along with the text.
- The subjects' task: to determine the original focus condition of each stimulus sentence.

Measurement

- Calculated the recognition rate of focus for each focus and noise replacement condition.
- Summarized across subjects.

Results

- The underscored gray word(s) represent the part replaced by loud pink noise in the stimulus sentence.
- The red values are percentages of accurate focus recognition.

- The orange values are percentages of acceptable errors.

  Two kinds of errors were counted as "acceptable errors". One is that neutral focus (focus 0) was mistaken as sentence final focus (focus 4), or vice versa. The other is that more than one words, including the focused word, were replaced by noise, listeners recognized the existence of focus on one of the missing words, but failed to identify the exact location.

1. *word1 word2* word3 *word4.*

Detected Focus	Actual Focus				
	0	1	2	3	4
0	70%	6.7%	0	0	14.2%
1	13.3%	72.8%	0	0	13.3%
2	10%	20.5%	96.7%	0	3.3%
3	0	0	3.3%	100%	6.7%
4	6.7%	0	0	0	62.5%
Total	100%	100%	100%	100%	100%

2. *word1 word2 word3 word4.*

Detected Focus	Actual Focus				
	0	1	2	3	4
0	56.9%	2%	2.5%	0	26.5%
1	5.8%	87.9%	20.4%	2.1%	3.2%
2	3.6%	10.1%	69.4%	1.1%	1.1%
3	7%	0	7.7%	96.8%	5.3%
4	26.7%	0	0	0	63.9%
Total	100%	100%	100%	100%	100%

3. *word1 word2 word3 word4.*

Detected Focus	Actual Focus				
	0	1	2	3	4
0	63.5%	0	0	3.5%	21.9%
1	8.9%	98.8%	3.1%	3.5%	2.3%
2	4.3%	1.2%	95.9%	12.8%	1.1%
3	3.5%	0	1%	79.1%	2.3%
4	19.8%	0	0	1.1%	72.4%
Total	100%	100%	100%	100%	100%

4. *word1 word2 word3 word4.*

Detected Focus	Actual Focus				
	0	1	2	3	4
0	67.7%	3.8%	0	7.1%	25.6%
1	0	92.3%	2.9%	3.6%	7.1%
2	3.1%	0	97.1%	0	14.3%
3	9.4%	3.9%	0	89.3%	0
4	19.8%	0	0	0	53%
Total	100%	100%	100%	100%	100%

5. *word1 word2* ***word3 word4.***

Detected Focus	Actual Focus				
	0	1	2	3	4
0	63.9%	4.7%	21.6%	0	27.3%
1	3.4%	38.4%	20.9%	1.6%	0
2	0	51.9%	44.3%	3.2%	8.1%
3	10.3%	5%	11.4%	95.2%	6.4%
4	22.4%	0	1.8%	0	58.2%
Total	100%	100%	100%	100%	100%

6. ***word1*** *word2 word3* ***word4.***

Detected Focus	Actual Focus				
	0	1	2	3	4
0	45.8%	1.6%	3.5%	4.1%	11.5%
1	10%	94.4%	27.8%	7.4%	1.7%
2	9.3%	1.6%	57.1%	48.6%	0
3	2.5%	2.4%	11.6%	38.9%	2.5%
4	32.4%	0	0	1%	84.3%
Total	100%	100%	100%	100%	100%

7. ***word1 word2*** *word3 word4.*

Detected Focus	Actual Focus				
	0	1	2	3	4
0	45.4%	0	1.4%	26.9%	26.7%
1	3.2%	96%	1.4%	1.8%	5.3%
2	11.1%	2%	97.2%	8.9%	16.3%
3	38.6%	2%	0	53.3%	46.1%
4	1.7%	0	0	9.1%	5.6%
Total	100%	100%	100%	100%	100%

8. *word1 word2 word3* ***word4.***

Detected Focus	Actual Focus				
	0	1	2	3	4
0	47%	14.2%	26.4%	10.5%	22.1%
1	4.5%	13.7%	12.6%	7.3%	.8%
2	4.4%	27.5%	30.2%	23.5%	.8%
3	5.4%	42.9%	30.8%	57%	4.1%
4	38.7%	1.7%	0	1.7%	72.2%
Total	100%	100%	100%	100%	100%

9. ***word1*** *word2 word3 word4.*

Detected Focus	Actual Focus				
	0	1	2	3	4
0	33.2%	4.7%	18.2%	33.3%	27.7%
1	28.5%	92.5%	16.7%	9.3%	18.8%
2	17.4%	2.8%	45.6%	34.6%	37.2%
3	17.4%	0	17.1%	21.8%	12.7%
4	3.5%	0	2.4%	1%	3.6%
Total	100%	100%	100%	100%	100%

Summary

- When both on-focus and post-focus words were present, focus could be recognized consistently.
- When the post-focus part was not available, while the focused word was present and it was not sentence final, focus could be recognized fairly well.

- When the focused word was not available, while the post-focus word(s) was(were) present, focus could still be detected, but its exact localization might be judged wrong.
- When neither the focused word nor its following part was available, it was generally hard to determine the focus condition.

Conclusion

The results seem to support the dual-component hypothesis about focus.