

INTRODUCTION

- Ba* constructions in Mandarin Chinese are daunting for language learners; also Chinese native speakers can often not explain when and how these constructions are used
- Ba* constructions could be considered as special verb-argument constructions.
- (e.g. 把*Ba* 书book 放put 在这里here / put book here)
- Constructions are form-meaning pairings. The verb is core of the verb-argument construction and serves as the interface of form and meaning.
- Ellis et al. (2014), Römer et al. (2015) and Gries et al. (2015) inspired us.

QUESTIONS

- What's the statistical pattern of verb usage (frequency, contingency, semantic centrality) in *Ba* constructions in BCC Chinese corpus (BLCU Corpus Center)?
- Are native speakers sensitive to these statistical features when they are processing *Ba* constructions?

METHODS

- Corpus analysis:** Calculate type and token frequencies of verbs that appear in each *Ba* constructions.
 - Frequency:**
 - Zipfian distribution: generate a verb type-token frequency list and fit the Zipfian distribution model.
 - Selectiveness of verbs: compare the rank of verb frequency in construction with BCC corpus.
 - Contingency:**
 - Faithfulness: the proportion of tokens of total verb usage that appear in this particular construction.
 - Directional Mutual Information: an information science statistic that has been shown to predict language processing fluency.
 - Directional one-way association: ΔP (from verb to construction ΔP_{wc} or from construction to verb ΔP_{cw}) (Shanks, 1995)
- Semantic network analysis:** Build up semantic networks of verbs according to their semantic similarity with Pajek (social network analysis software).
 - Semantic centrality:**
 - Scale-free or random network
 - Betweenness centrality
- Experiment 1:** Free association test
 - 156 participants were asked to complete the blanks in 34 *Ba* constructions skeletons with the first verb that came to their mind.
- Experiment 2:** Word fluency test (probe depth of construction knowledge)
 - 77 participants were asked to complete the blanks in 17 *Ba* constructions skeletons with as many verbs as possible.

3

Example stimulus:

1. 把 他 (她) 在

把 它 在 *Ba* He (She) / It at

RESULTS

- Corpus analysis**
 - Frequency:

1

1	放	43674							
2	留	4584							
3	摆	4432					
4	挂	2756	19	写	1315				
			20	压	1311				
			21	花	1284		
			22	闹	1282	998	分隔	5	
						999	守候	5	

Ba Constructions	tau	z	p
把.....v在	0.12	1.81	ns
把.....v进去	0.17	2.57	*
把.....v得	0.21	3.06	**
把.....v成	0.15	2.21	*
把.....v	0.12	1.82	ns

Signif. codes: 0. '***' 0.01 '**' 0.05

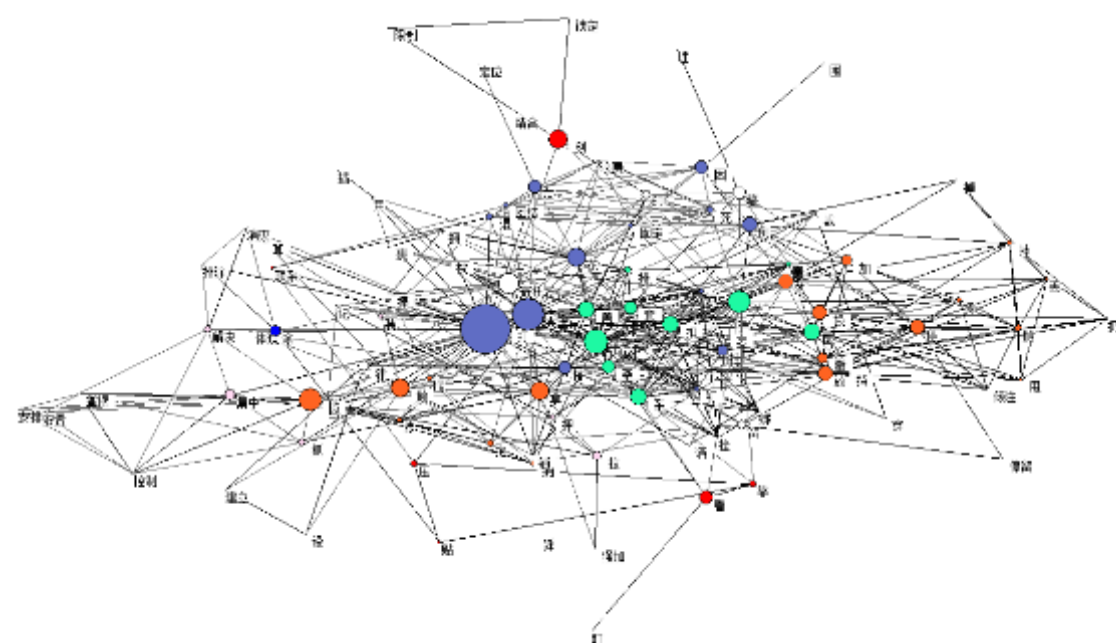
- Contingency:

Verb	FreqCons	FreqBCC	faithfulness	Mlcw	Mlwc	APcw	APwc
放	43674	954721	0.046	22.723	20.142	0.270	0.045
留	4584	410256	0.011	20.689	19.327	0.027	0.011
摆	4432	163848	0.027	21.965	21.927	0.027	0.026

- Semantic network analysis**

2

Verb	RankFreq	Degree	Closeness	Betweenness	Eigenvector
打	97	82	0.589	0.267	0.225
夹	38	64	0.532	0.114	0.250
带	40	53	0.523	0.074	0.244

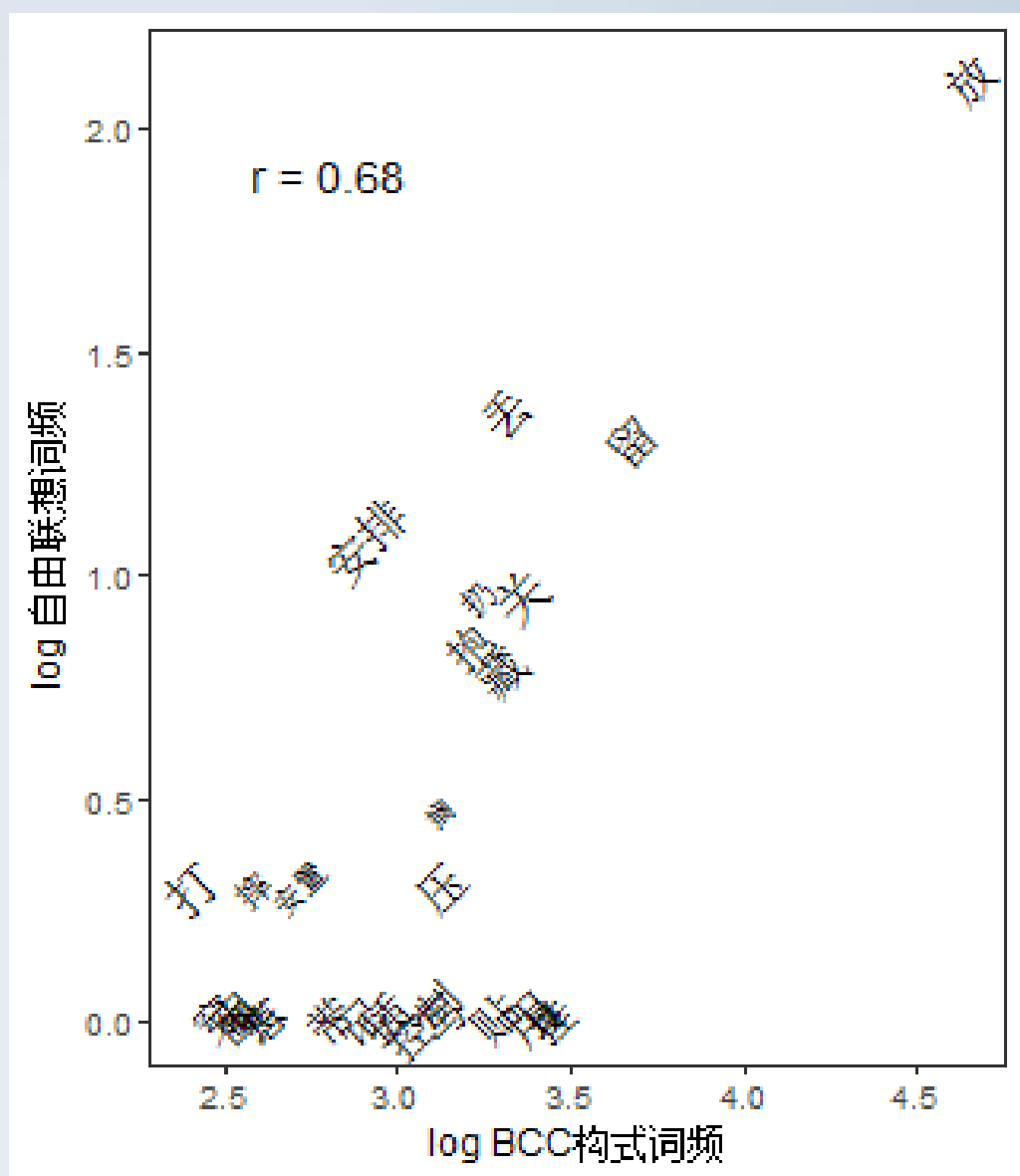


- Experiment 1 & 2**

3

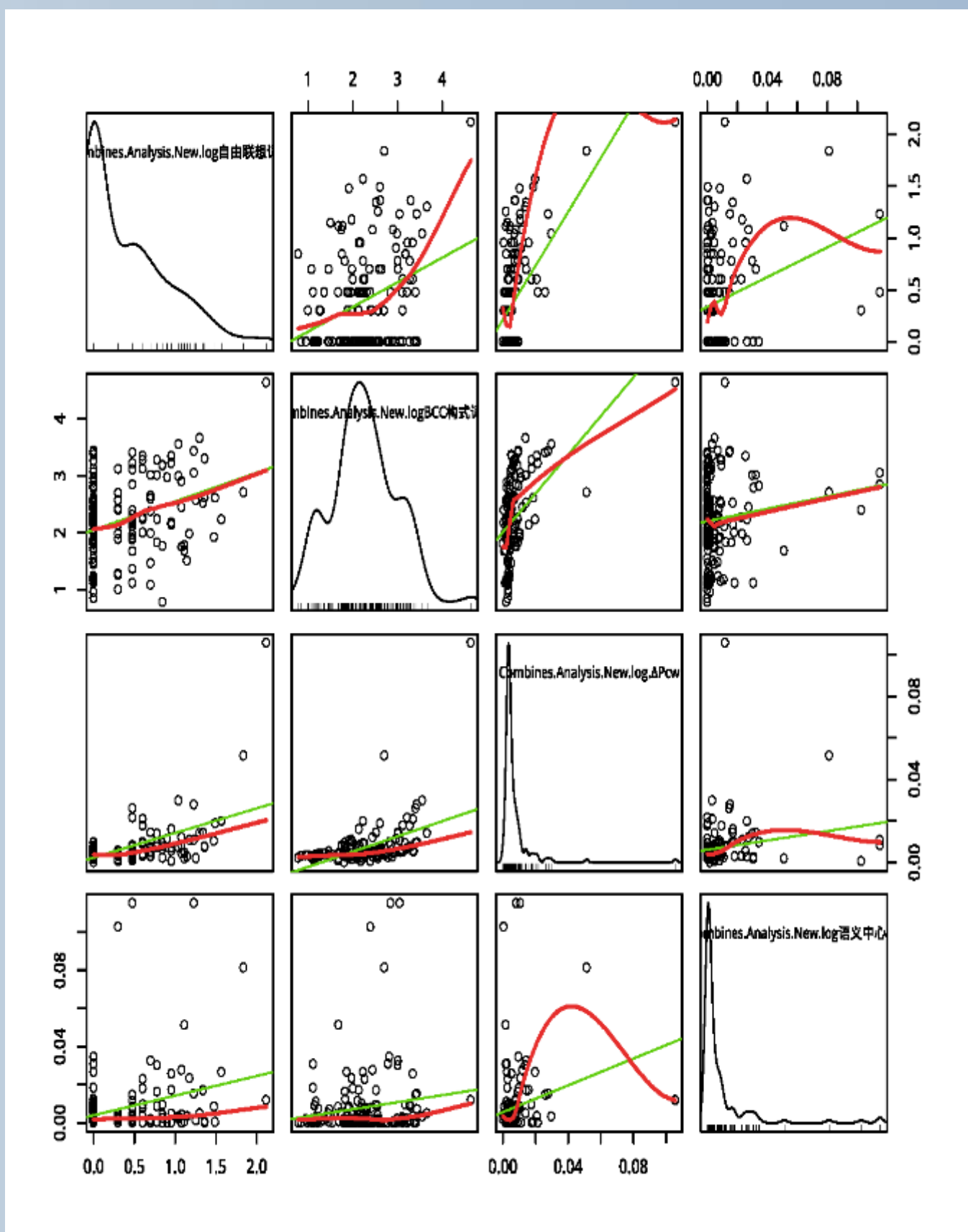
- Analysis 1**
 - Correlation: Frequency of collected verbs and BCC frequency of verbs in constructions
- Analysis 2**
 - Correlation: Frequency of collected verbs and BCC ΔP_{cw}
- Analysis 3**
 - Correlation: Frequency of collected verbs and semantic centrality
- Overall Frequency Analysis**
 - Correlation: Frequency of collected verbs and BCC overall frequency of verb
- Combined Analysis**
 - Correlation: Frequency of collected verbs across different constructions and BCC frequency of verbs in constructions, BCC ΔP_{cw} , semantic centrality

Ba Constructions	Verb types	r log BCC ConsFreq	p	r log ΔP_{cw}	p	r log Sem centrality	p	r log BCC Verb Freq	p
把.....v 在	55	0.68	**	0.65	**	0.06	ns	0.15	ns
把.....v 进去	48	0.75	**	0.68	**	0.63	**	0.13	ns
把.....v 得	103	0.65	**	0.56	**	0.41	*	0.44	**
把.....v 成	57	0.61	**	0.42	**	0.12	ns	0.18	ns
把.....v	70	0.59	**	0.62	**	0.29	ns	0.15	ns
Mean		0.65		0.59		0.30		0.21	



Coefficients	Estimate	SE	t	Pr(> t)
(Intercept)	0.08	0.11	0.68	0.50
BCC ConsFreq	0.06	0.05	1.06	0.29
BCCAPcw	22.55	3.65	6.18	5.79e-09 ***
BCC Sem centrality	4.34	1.80	2.41	0.0171 *
Signif. codes: '***'0.001 '**'0.01 '*' 0.05				
Residual S.E.: 0.3926 df = 148				
Multiple R-squared: 0.3404			Adjusted R-squared: 0.3271	
F-statistic: 25.46 on 3 and 148 df p = 2.43e-13				
Relative importance metrics				Variance Inflation test
	lmj	first		vif
BCC ConsFreq	0.06	0.12		1.34
BCCAPcw	0.24	0.31		1.36
BCC Sem centrality	0.05	0.07		1.04

Example: Analysis 1-3



Example: Combined Analysis

DISCUSSION AND CONCLUSION

The processing of Chinese *Ba* constructions is **sensitive** to frequency, contingency and semantic centrality. This lead us to the discussion:

- Entrenchment** (Analysis 1)
 - Usage of verbs in *Ba* constructions entrenches in the linguistic knowledge as frequency accumulates.
- Contingency** (Analysis 2)
 - Association of *Ba* constructions and verbs is actually the pairing process of form and meaning.
- Prototypicality of semantics** (Analysis 3)
 - A handful of verbs emerge as prototype in the semantic networks, their meanings construct the prototypicality of meaning of *Ba* constructions.
- Combined Effect** (Combined Analysis)
 - The result of our combined analysis is a little bit different from Ellis et al. (2014), which the three factors all have statistical significant contribution to the processing of verb-argument constructions.

REFERENCES

Ellis, N. C.; O'Donnell, M. B.; Römer, U. 2014. The processing of verb-argument constructions is sensitive to form, function, frequency, contingency and prototypicality. *Cognitive Linguistics*, 25(1), 55-98.
Römer, U.; O'Donnell, M. B.; Ellis, N. C. 2015. Chapter 2. Using COBUILD grammar patterns for a large-scale analysis of verb-argument constructions. *Corpora, Grammar and Discourse*.
Gries, S. T.; Ellis, N. C. 2015. Statistical measures for Usage-based linguistics. *Currents in Language Learning*, 2, 228-255.
Shanks, D. R. 1995. *The psychology of associative learning*. Cambridge: Cambridge University Press.

CONTACT

Yucheng Liu
liuyucheng@ufl.edu