PP Extraposition in Spoken Dutch, a production experiment

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Introduction

- What is an extraposition?
- Why do we have extrapositions?
- The experiment
- Statistical analysis
  - Production Time
  - Extrapositions
  - Production Time & Extrapositions

What is an extraposition?

Ik **heb** een brief op duur briefpapier **geschreven**

What is an extraposition?

Ik **heb** een brief op duur briefpapier **geschreven**

VP Brace

What is an extraposition?

PP over V movement

Ik **heb** een brief op duur briefpapier **geschreven**

What is an extraposition?

Ik **heb** een brief **geschreven** op duur briefpapier

What is an extraposition?

Ik **heb** een brief **geschreven** op duur briefpapier

VP Brace

Exbraciated / Extraposed PP

What is an extraposition?

Definition of brace construction:

«a particular **discontinuous pattern**, whereby elements that belong together semantically are separated structurally»

(Van Canegem-Ardijns, 2006)

What is an extraposition?

Other typical Dutch brace constructions:

Ik **schrijf** me morgen voor de wedstrijd **in**

... dat **ik** me morgen **inschrijf**

Why do we have extrapositions?

- «a speaker doesn't like brace constructions and wants to say together elements that belong together»

(Van Haeringen, 1947)

- «Can't our computational brain count up to three?» (Jansen, 1979)

Why do we have extrapositions?

- Extraposition as a **product of proximity preference** among elements that belong together semantically

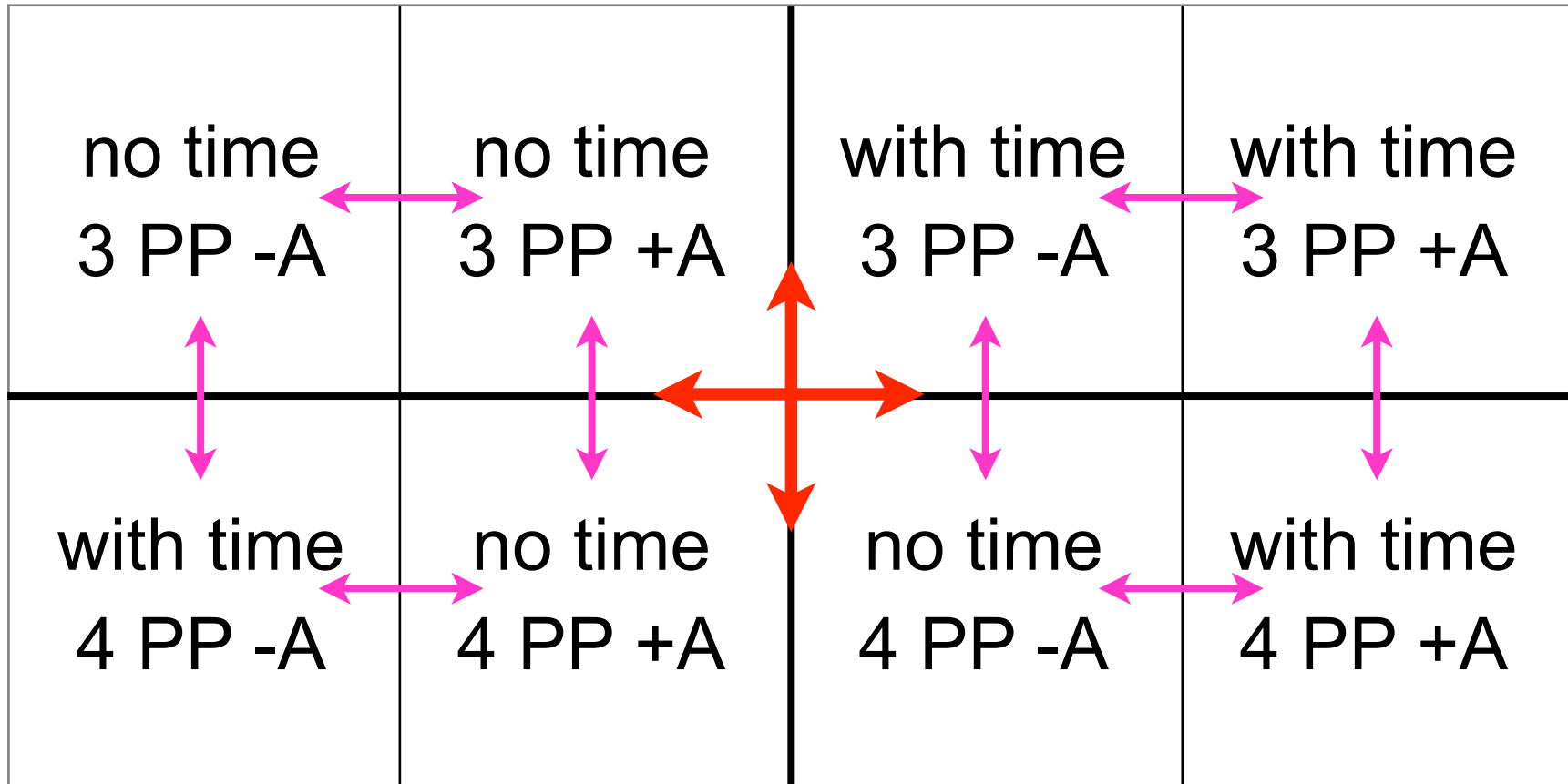- Extraposition as a **result of limitations** in speech production

The experiment

- How do we get people into producing extrapositions?

- How do we limit their resources in speech production?

- Can the resource limit effects be emphasized by using a between-subjects factor?

The experiment

- **Anagram task** ⇨ no more relationship between content and syntactic structure

- **Resource limitation** ⇨ time limit, length increase, adjective factor

- **Between-subjects factor** ⇨ Subjects with different working memory spans

The Experiment: Orthogonality

no time 3 PP -A	no time 3 PP +A	with time 3 PP -A	with time 3 PP +A
with time 4 PP -A	no time 4 PP +A	no time 4 PP -A	with time 4 PP +A

The Experiment: Latin square

Patterns from "1" to "5"

Lists from "A" to "E" (what a subject sees)

3PP	3PP A	4 PP	4PP A	Check
Check	3PP	3PP A	4 PP	4PP A
4PP A	Check	3PP	3PP A	4 PP
4 PP	4PP A	Check	3PP	3PP A
3PP A	4 PP	4PP A	Check	3PP

The Experiment: sentences

3PP: Ik heb <u>maandagochtend</u> onder <u>begeleiding</u> van een <u>fysiotherapeut</u> gesport

3PPA: Ik heb <u>maandagochtend</u> vroeg onder strenge <u>begeleiding</u> van een goede <u>fysiotherapeut</u> gesport

4PP: Ik heb <u>maandagochtend</u> onder <u>begeleiding</u> van een <u>fysiotherapeut</u> in de <u>fitnessruimte</u> gesport

4PPA: Ik heb <u>maandagochtend</u> vroeg onder strenge <u>begeleiding</u> van een goede <u>fysiotherapeut</u> in de <u>nieuwe</u> <u>fitnessruimte</u> gesport

Check: Ik heb <u>maandagochtend</u> vroeg onder strenge <u>begeleiding</u> van een goede <u>fysiotherapeut</u> in de <u>fitnessruimte</u> gesport

The Experiment: anagram patterns

		3	
	2		
5			
	6	4	1

The Experiment: anagram patterns

maandagochtend
vroeg

heb

van een goede
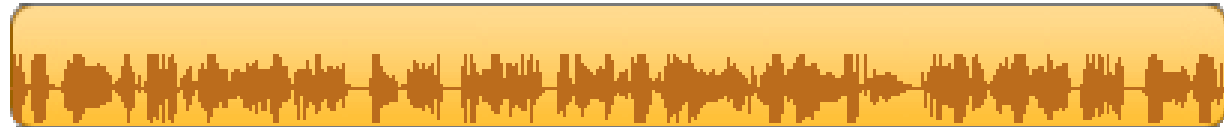fysiotherapeut

gesport

onder strenge
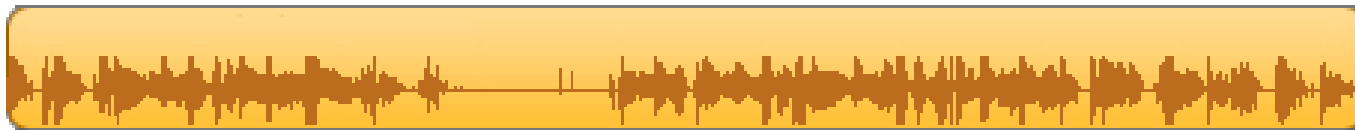begeleiding

ik

The Experiment: production

Low span 11.6 sec
(voice ~5.7 sec)
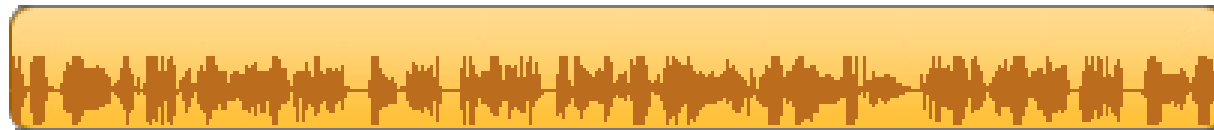

High span 11.1 sec
(voice ~5.1 sec)

The Experiment: production
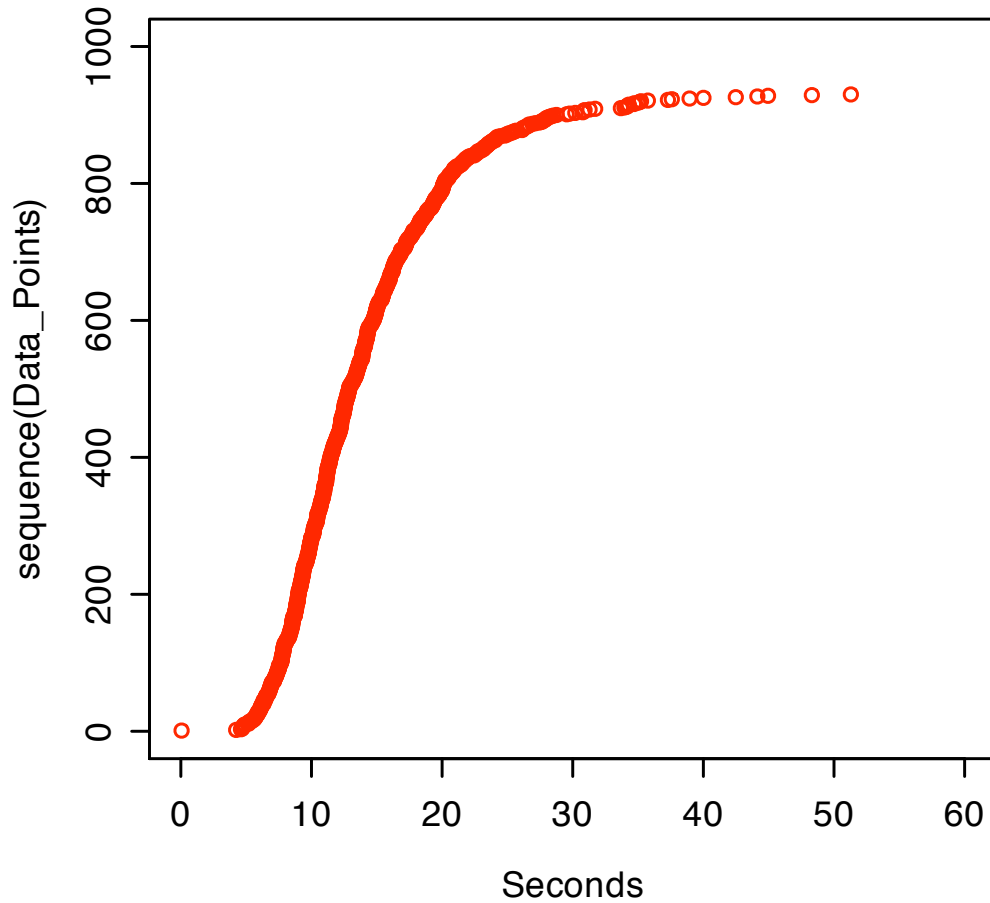

Low span ~5.7 sec

The Experiment: production

High span ~5.1 sec
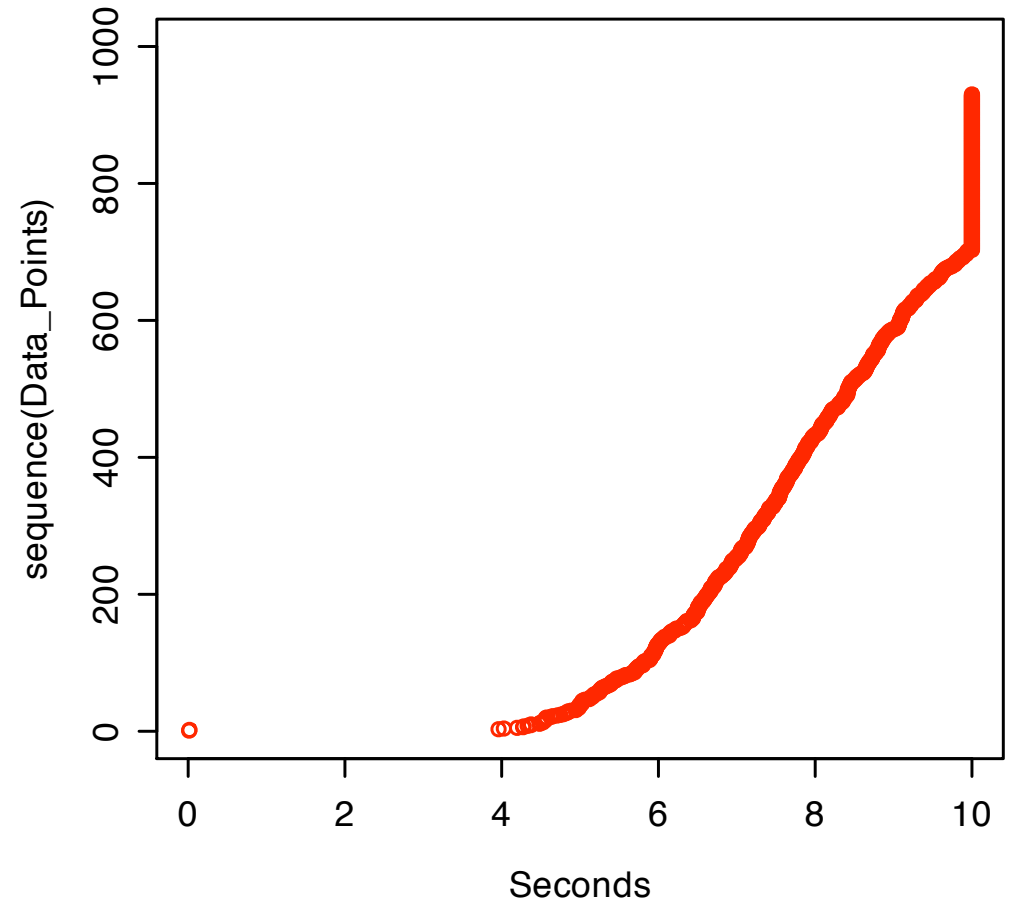
Statistical Analysis

- What variables do we collect from the experiment?
  - number of extraposed PP's per sentence
  - production time (time in between two button pressures: from the moment they first see a slide to the moment they move on to the next)
  - work in progress! :-)
- What variables do we derive from the data
  - binary count of the sentences showing extraposed PP's (extraposition 1|0)
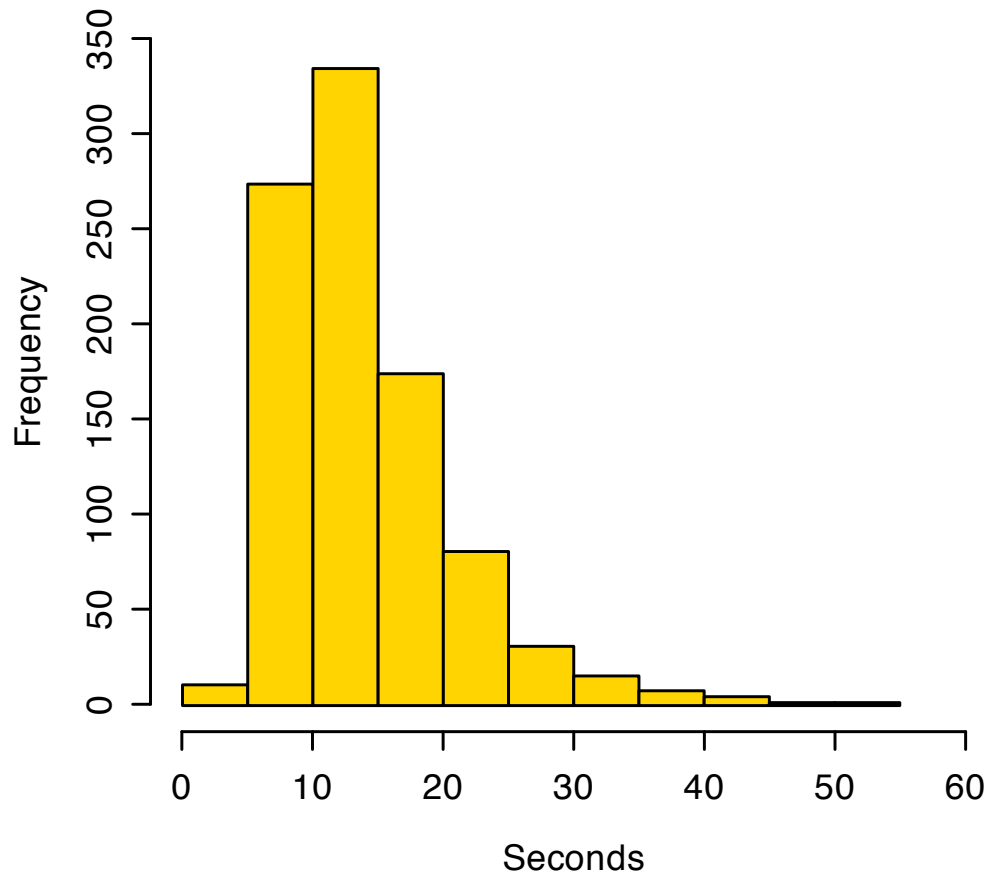 - work in progress here as well! :-)
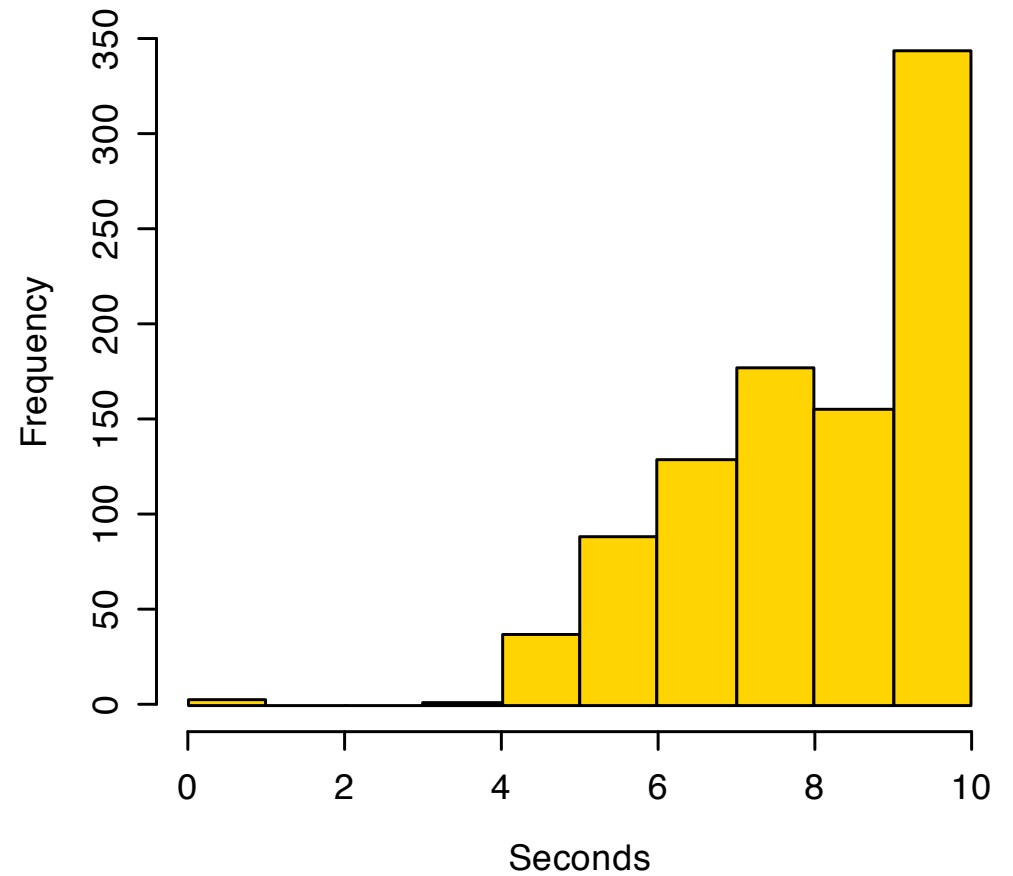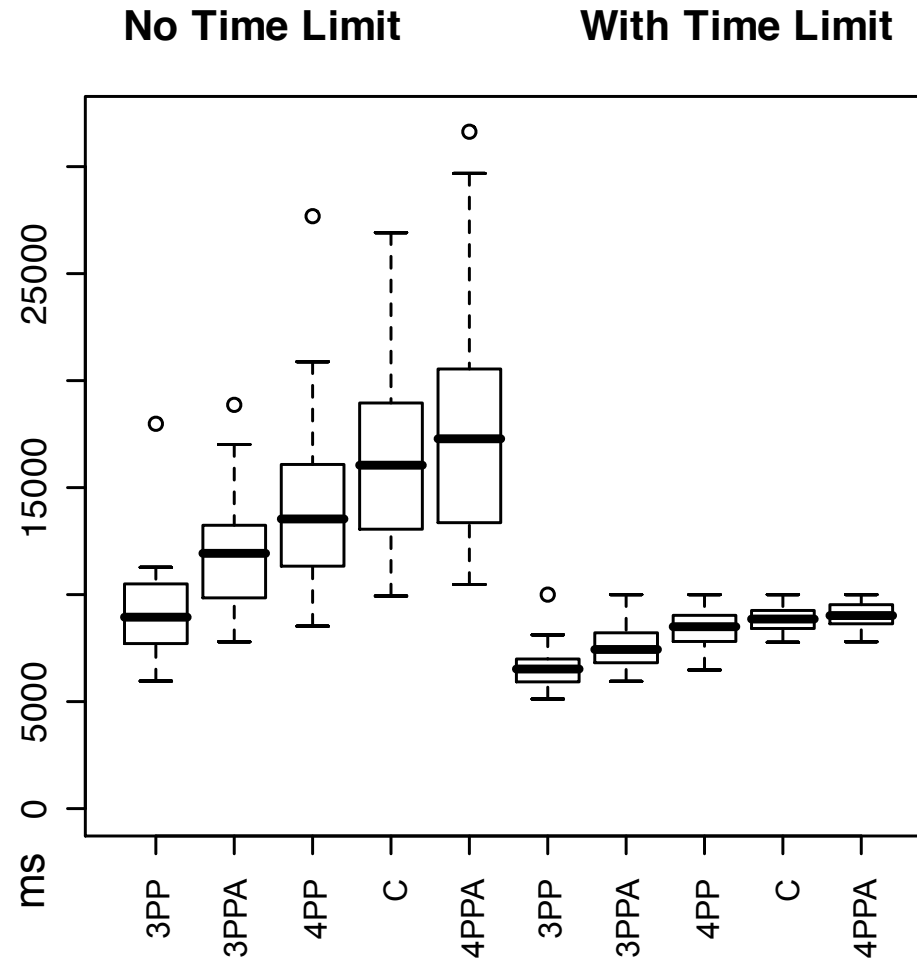
Analysis: Production Time

Analysis: Production Time

- We would have liked to use a repeated measures ANOVA test.
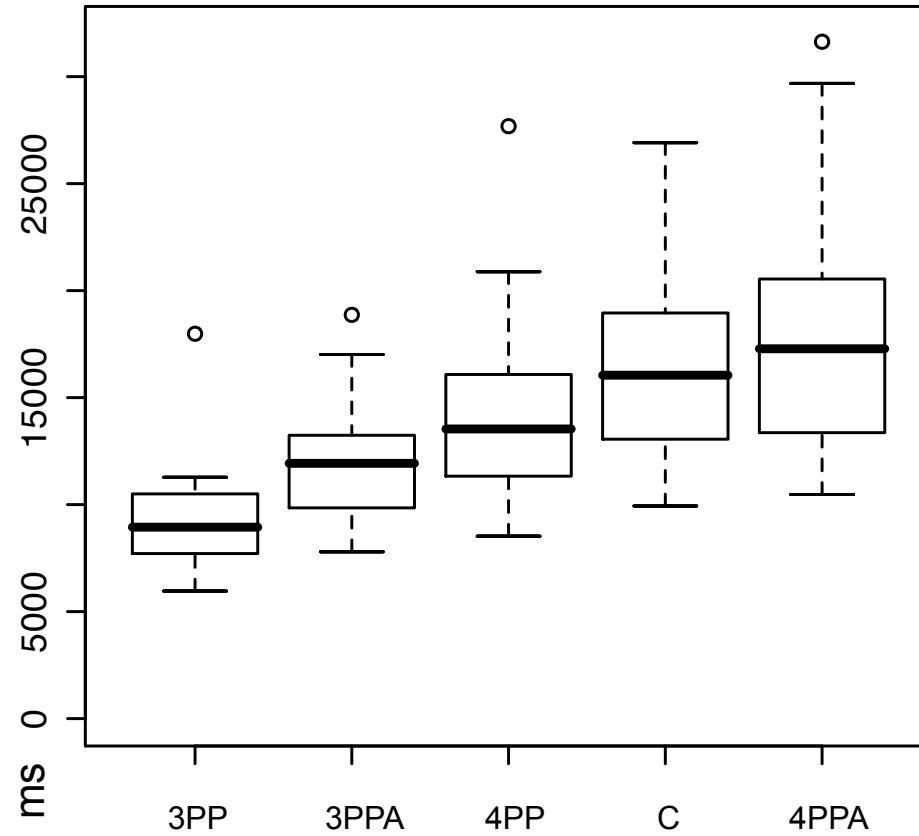
- We can't because the data set doesn't meet some of the assumptions

- The ratio $\sigma_{Max}/\sigma_{Min}$ should be 2 or less, in any case absolutely not higher than 3.

- The $\sigma_{Max}/\sigma_{Min}$ ratio of our data set is higher than 16

Analysis: Production Time

Analysis: Production Time

No Time Limit

Analysis: Production Time

With Time Limit
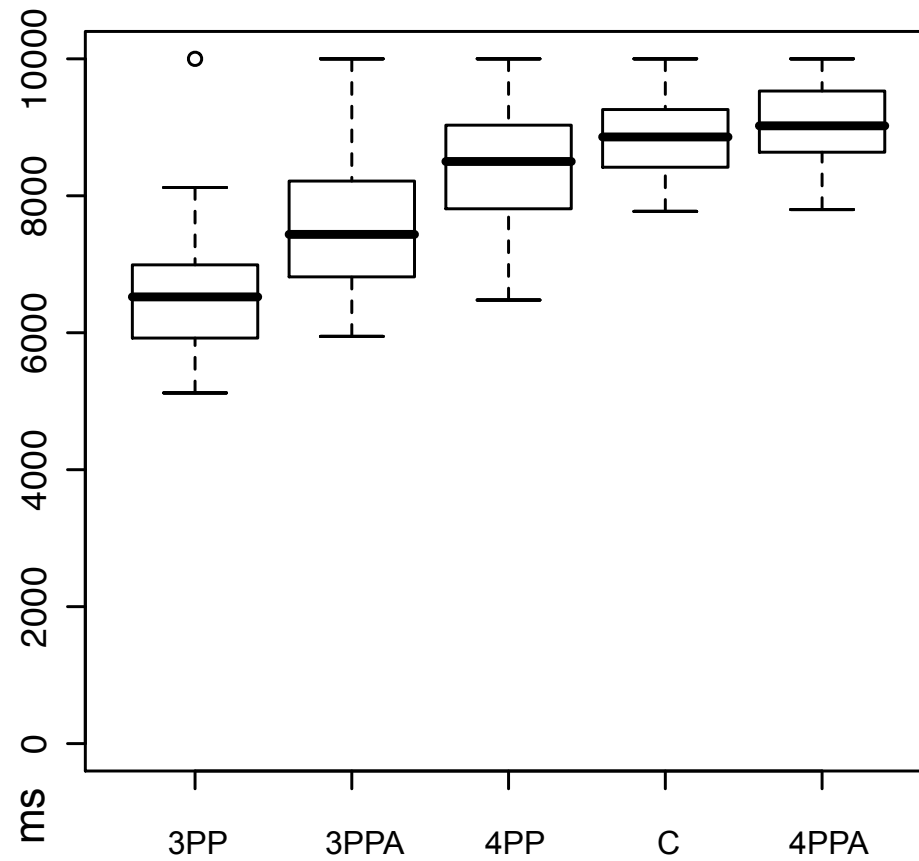
Analysis: Production Time

- We use a non parametric test as a fall-back to prove that there is a significant difference between the production times in the different conditions of the experiment.

- We deal with related samples and therefore we used the Wilcoxon signed rank test

- ... But: how do we deal with the orthogonality of the design underlying our data?

Wilcoxon signed rank test

We compare two related groups

Subject	X1	X2
1	78	68
2	30	25
3	52	56
4	84	68
5	64	62
6	45	48
7	22	36
8	72	32
9	78	78
10	64	68
11	50	40
12	50	44
13	24	24
14	64	56
15	90	58
16	40	20

Wilcoxon signed rank test

Calculate the difference between the two groups

Subject	X1	X2	X1 - X2
1	78	68	10
2	30	25	5
3	52	56	-4
4	84	68	16
5	64	62	2
6	45	48	-3
7	22	36	-14
8	72	32	40
9	78	78	0
10	64	68	-4
11	50	40	10
12	50	44	6
13	24	24	0
14	64	56	8
15	90	58	32
16	40	20	20

Mark the **positive** values in order to be able to keep track of them later

Wilcoxon signed rank test

Assume the absolute magnitude of the differences and order them from the smallest to the largest

Subject	X1	X2	X1 - X2	absolute X1 - X2
9	78	78	0	0
13	24	24	0	0
5	64	62	2	2
6	45	48	-3	3
3	52	56	-4	4
10	64	68	-4	4
2	30	25	5	5
12	50	44	6	6
14	64	56	8	8
1	78	68	10	10
11	50	40	10	10
7	22	36	-14	14
4	84	68	16	16
16	40	20	20	20
15	90	58	32	32
8	72	32	40	40

Wilcoxon signed rank test

Rank (1...2...3...4...n...) the ordered values

Subject	X1	X2	X1 - X2	absolute X1 - X2	rank of absolute
9	78	78	0	0	xxx
13	24	24	0	0	xxx
5	64	62	2	2	1
6	45	48	-3	3	2
3	52	56	-4	4	3,5
10	64	68	-4	4	3,5
2	30	25	5	5	5
12	50	44	6	6	6
14	64	56	8	8	7
1	78	68	10	10	8,5
11	50	40	10	10	8,5
7	22	36	-14	14	10
4	84	68	16	16	11
16	40	20	20	20	12
15	90	58	32	32	13
8	72	32	40	40	14

Tied values receive the *average* of their ranks and if there are **differences which give 0** as a result they are *discarded* (e.g. N - 2) before ranking the list

Wilcoxon signed rank test

Put the positive and negative signs back where they belong in the rank

Subject	X1	X2	X1 - X2	absolute X1 - X2	rank of absolute	signed rank
9	78	78	0	0	xxx	xxx
13	24	24	0	0	xxx	xxx
5	64	62	2	2	1	+1
6	45	48	-3	3	2	-2
3	52	56	-4	4	3,5	-3,5
10	64	68	-4	4	3,5	-3,5
2	30	25	5	5	5	+5
12	50	44	6	6	6	+6
14	64	56	8	8	7	+7
1	78	68	10	10	8,5	+8,5
11	50	40	10	10	8,5	+8,5
7	22	36	-14	14	10	-10
4	84	68	16	16	11	+11
16	40	20	20	20	12	+12
15	90	58	32	32	13	+13
8	72	32	40	40	14	+14

Wilcoxon signed rank test

The test statistic (W+) is the sum of the ranks of the **positive differences**

Subject	X1	X2	X1 - X2	absolute X1 - X2	rank of absolute	signed rank
9	78	78	0	0	xxx	xxx
13	24	24	0	0	xxx	xxx
5	64	62	**2**	2	1	*+1*
6	45	48	-3	3	2	-2
3	52	56	-4	4	3,5	-3,5
10	64	68	-4	4	3,5	-3,5
2	30	25	**5**	5	5	*+5*
12	50	44	**6**	6	6	*+6*
14	64	56	**8**	8	7	*+7*
1	78	68	**10**	10	8,5	*+8,5*
11	50	40	**10**	10	8,5	*+8,5*
7	22	36	-14	14	10	-10
4	84	68	**16**	16	11	*+11*
16	40	20	**20**	20	12	*+12*
15	90	58	**32**	32	13	*+13*
8	72	32	**40**	40	14	*+14*

W+ = 86

N = 14

Wilcoxon signed rank test

W+ = 86

N = 14

To determine the significance-levels belonging to the
W+ value, the number of ranked cases is important

With the **W+** and **N**, we can find the belonging

significance in statistical tables, in this case :

two-tailed p = .035

one-tailed p = .018

Wilcoxon signed rank test

More importantly: where do we find the Wilcoxon Signed Rank Test in SPSS?

Tick the box 'Wilcoxon' and select the two groups

Analysis: saving the Orthogonality

Main effect Time:
$(3PP_{NTL}+3PPA_{NTL}+4PP_{NTL}+4PPA_{NTL})-(3PP_{WTL}+3PPA_{WTL}+4PP_{WTL}+4PPA_{WTL})$
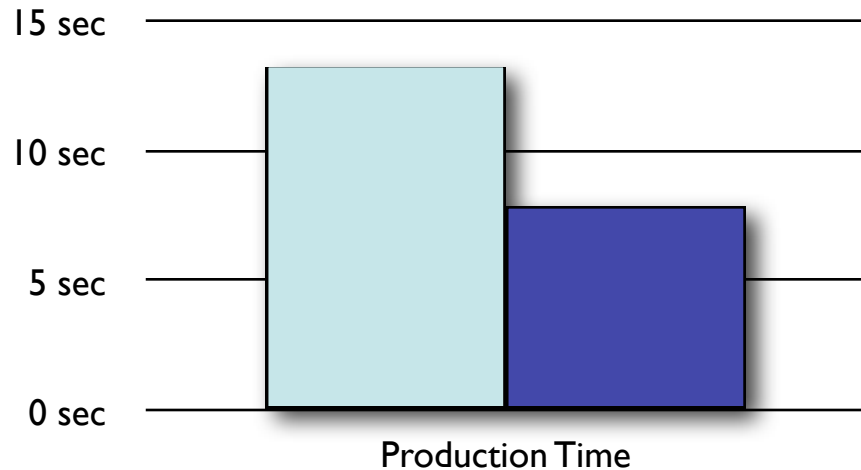
Main effect Length:
$(3PP_{NTL}+3PPA_{NTL}+3PP_{WTL}+3PPA_{WTL})-(4PP_{NTL}+4PPA_{NTL}+4PP_{WTL}+4PPA_{WTL})$

Main effect Adjectives:
$(3PP_{NTL}+3PP_{WTL}+4PP_{NTL}+4PP_{WTL})-(3PPA_{NTL}+3PPA_{WTL}+4PPA_{NTL}+4PPA_{WTL})$

Analysis: main effect Time

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
AVGnt	31	13359,68	3373,49487	8718,71	23554,42
AVGwt	31	7884,2594	703,36814	6652,21	10000,00

Ranks

		N	Mean Rank	Sum of Ranks
AVGwt - AVGnt	Negative Ranks	31[a]	16,00	496,00
	Positive Ranks	0[b]	,00	,00
	Ties	0[c]		
	Total	31		

a. AVGwt < AVGnt

b. AVGwt > AVGnt

c. AVGwt = AVGnt

Test Statistics[b]

	AVGwt - AVGnt
Z	-4,860[a]
Asymp. Sig. (2-tailed)	,000

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

Analysis: main effect Length
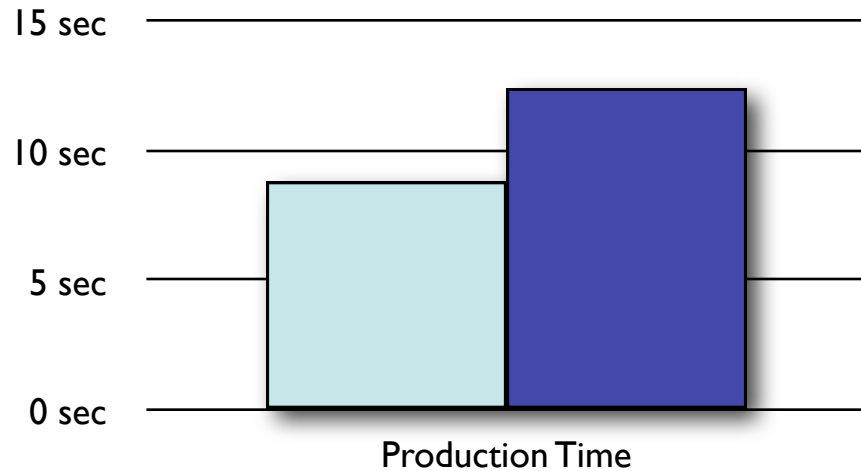
Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
AVG3	31	8846,0914	1506,36689	6447,25	13359,21
AVG4	31	12397,85	2396,17346	8923,67	18847,63

Ranks

		N	Mean Rank	Sum of Ranks
AVG4 - AVG3	Negative Ranks	0[a]	,00	,00
	Positive Ranks	31[b]	16,00	496,00
	Ties	0[c]		
	Total	31		

a. AVG4 < AVG3

b. AVG4 > AVG3

c. AVG4 = AVG3

Test Statistics[b]

	AVG4 - AVG3
Z	-4,860[a]
Asymp. Sig. (2-tailed)	,000

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

Analysis: main effect Adjectives

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
AVGna	31	9525,1505	1778,02369	6831,46	15392,83
AVGwa	31	11718,79	2157,00985	8539,46	16814,00

Ranks

		N	Mean Rank	Sum of Ranks
AVGwa - AVGna	Negative Ranks	0[a]	,00	,00
	Positive Ranks	31[b]	16,00	496,00
	Ties	0[c]		
	Total	31		

a. AVGwa < AVGna

b. AVGwa > AVGna

c. AVGwa = AVGna

Test Statistics[b]

	AVGwa - AVGna
Z	-4,860[a]
Asymp. Sig. (2-tailed)	,000

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

Without Adjectives
With Adjectives
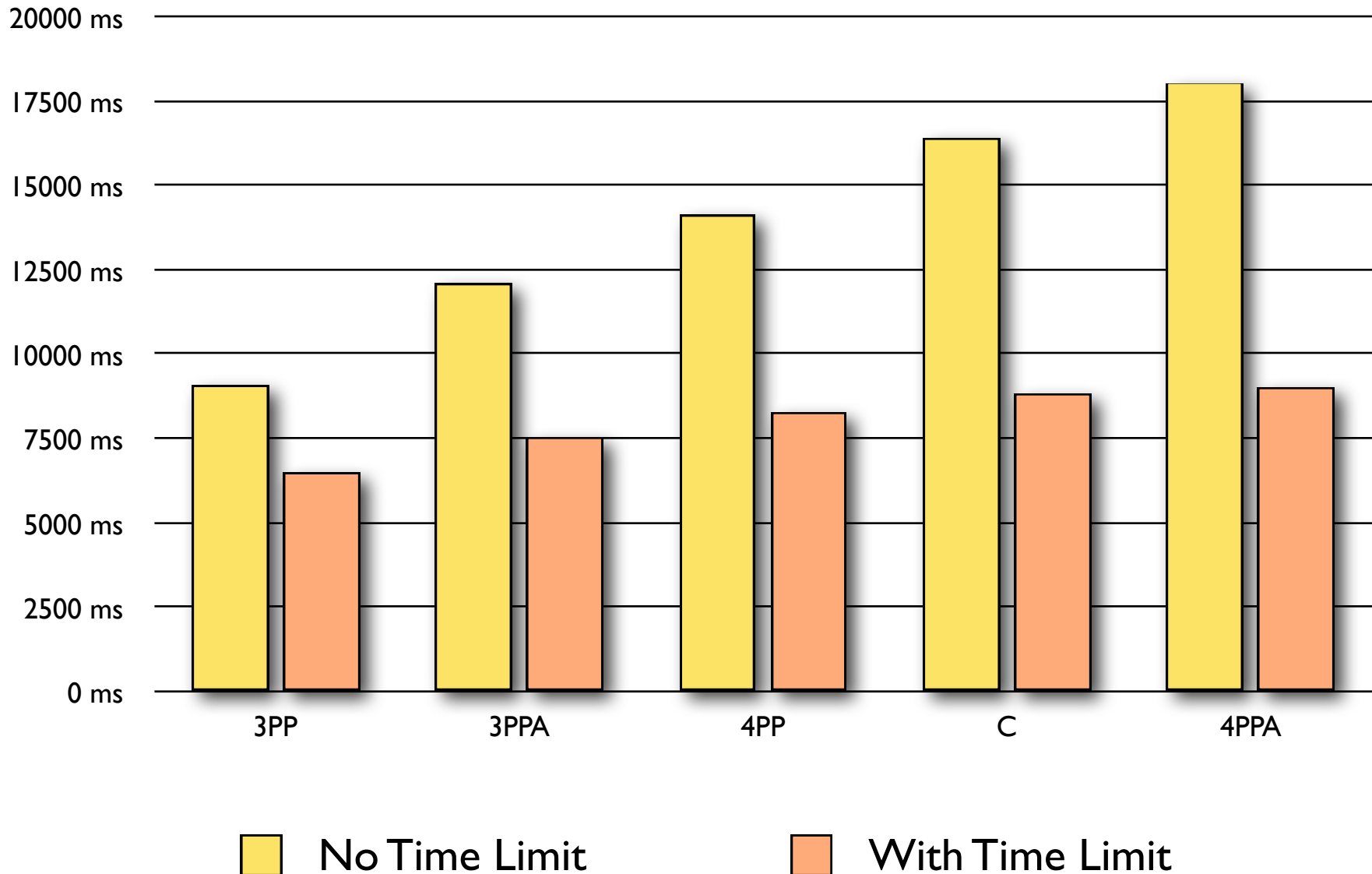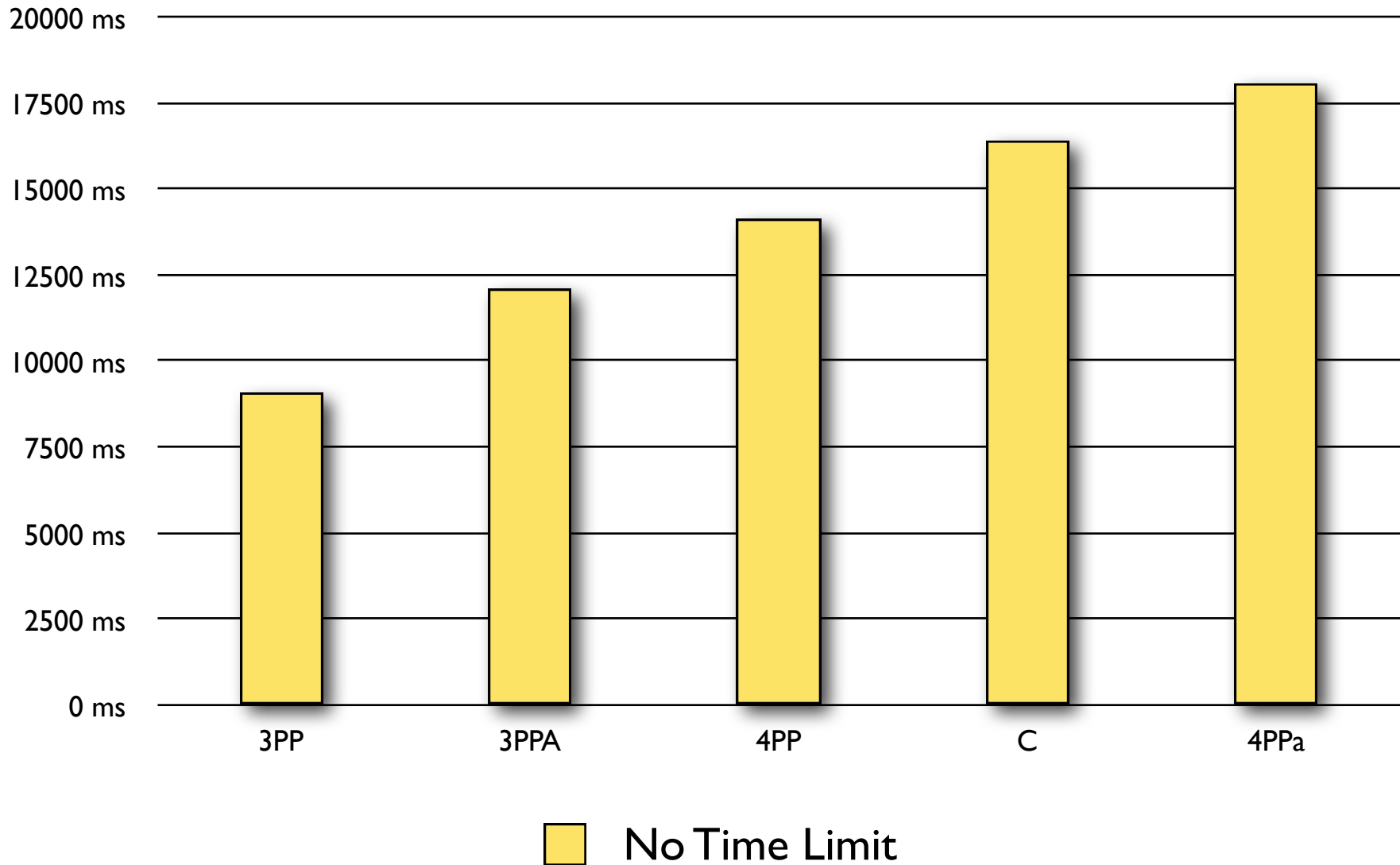
Analysis: Production Time
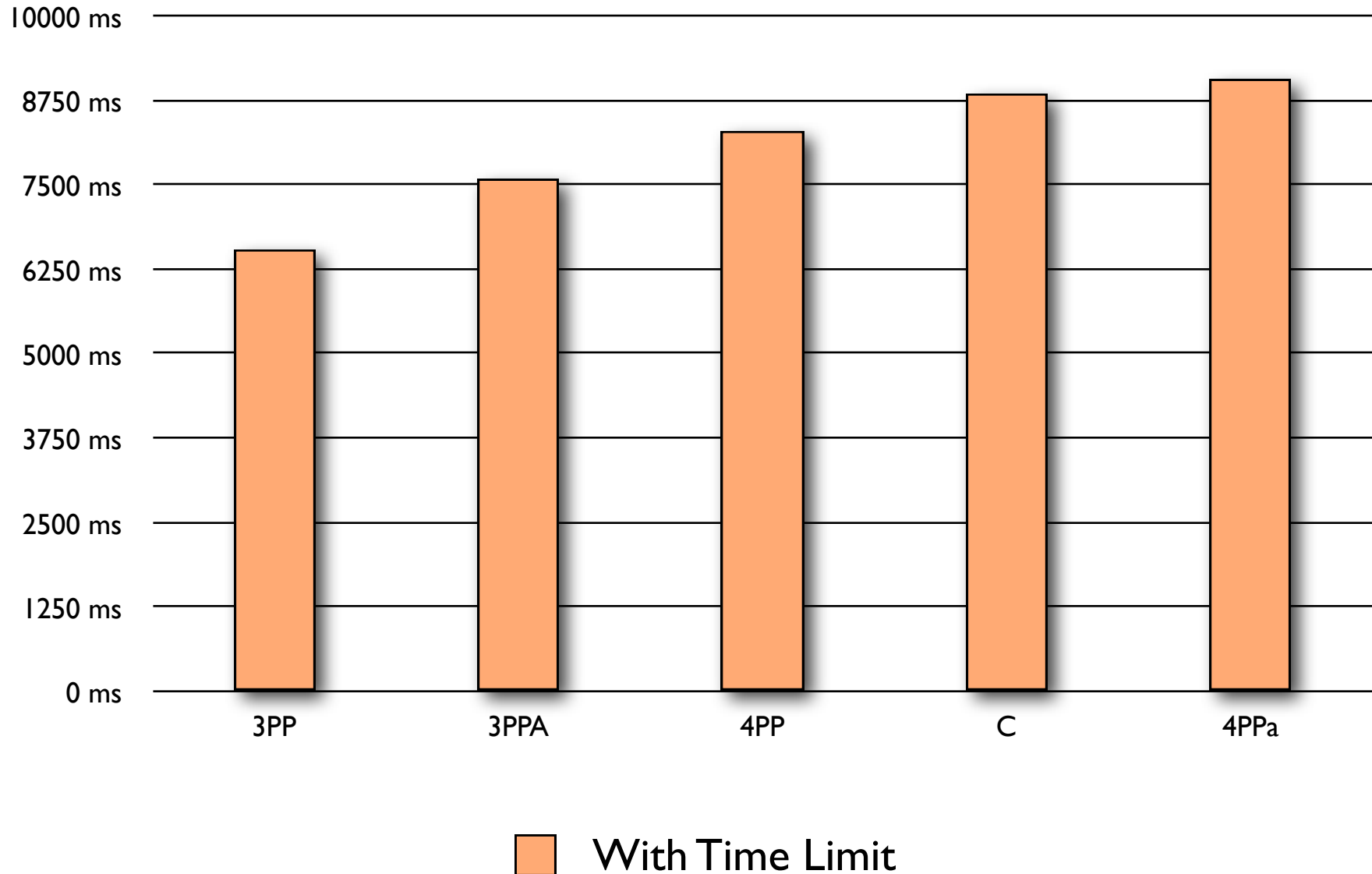
Analysis: saving the Orthogonality

An interaction is the difference of differences

In a hypothetical scenario where we would have had an interaction on length for the main effect of time, we would have used the following formula before computing the Wilcoxon test statistic:

$(3PP_{NTL}+3PPA_{NTL}-4PP_{NTL}-4PPA_{NTL})-(3PP_{WTL}+3PPA_{WTL}-4PP_{WTL}-4PPA_{WTL})$

Analysis: Extrapositions

Descriptive Statistics

	N	Mean	Std. Deviation
NT_3	25	,4269	,19906
NT_3A	25	,4531	,15627
NT_4	25	,5355	,27426
NT_C	25	,4691	,18528
NT_4A	25	,4661	,23046
WT_3	25	,3532	,22732
WT_3A	25	,4361	,24020
WT_4	25	,4905	,25981
WT_C	25	,4345	,25798
WT_4A	25	,4795	,26289
tNT_3	31	9104,9194	2287,58431
tNT_3A	31	12132,19	2798,94298
tNT_4	31	14129,28	4096,21171
tNT_C	31	16411,18	4260,66288
tNT_4A	31	18072,33	5404,30409
tWT_3	31	6549,4247	952,40346
tWT_3A	31	7597,8333	1002,76396
tWT_4	31	8316,9785	929,82306
tWT_C	31	8853,0215	669,52479
tWT_4A	31	9072,8011	589,08713
Valid N (listwise)	25		

$$\sigma_{max} / \sigma_{min} = 1.75$$

Within-Subjects Factors

Measure: MEASURE_1

time	length	adj	Dependent Variable
1	1	1	NT_3
		2	NT_3A
	2	1	NT_4
		2	NT_4A
2	1	1	WT_3
		2	WT_3A
	2	1	WT_4
		2	WT_4A

Between-Subjects Factors

		N
Span	H	11
	L	13
	M	1

Analysis: Extrapositions

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	time	length	adj	Type III Sum of Squares	df	Mean Square	F	Sig.
time	Linear			,007	1	,007	,221	,643
time * Span	Linear			,026	2	,013	,386	,684
Error(time)	Linear			,740	22	,034		
length		Linear		,162	1	,162	6,161	,021
length * Span		Linear		,017	2	,009	,330	,722
Error(length)		Linear		,580	22	,026		
adj			Linear	,099	1	,099	2,495	,129
adj * Span			Linear	,154	2	,077	1,951	,166
Error(adj)			Linear	,869	22	,039		
time * length	Linear	Linear		,023	1	,023	,845	,368
time * length * Span	Linear	Linear		,095	2	,047	1,750	,197
Error(time*length)	Linear	Linear		,597	22	,027		
time * adj	Linear		Linear	,006	1	,006	,108	,745
time * adj * Span	Linear		Linear	,002	2	,001	,022	,978
Error(time*adj)	Linear		Linear	1,221	22	,055		
length * adj		Linear	Linear	,017	1	,017	,882	,358
length * adj * Span		Linear	Linear	,005	2	,003	,137	,873
Error(length*adj)		Linear	Linear	,421	22	,019		
time * length * adj	Linear	Linear	Linear	,085	1	,085	2,054	,166
time * length * adj * Span	Linear	Linear	Linear	,186	2	,093	2,251	,129
Error(time*length*adj)	Linear	Linear	Linear	,910	22	,041		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	14,199	1	14,199	69,222	,000
Span	,184	2	,092	,449	,644
Error	4,513	22	,205		

Analysis: Extrapositions

Normal Q-Q Plot of RESIDUALS
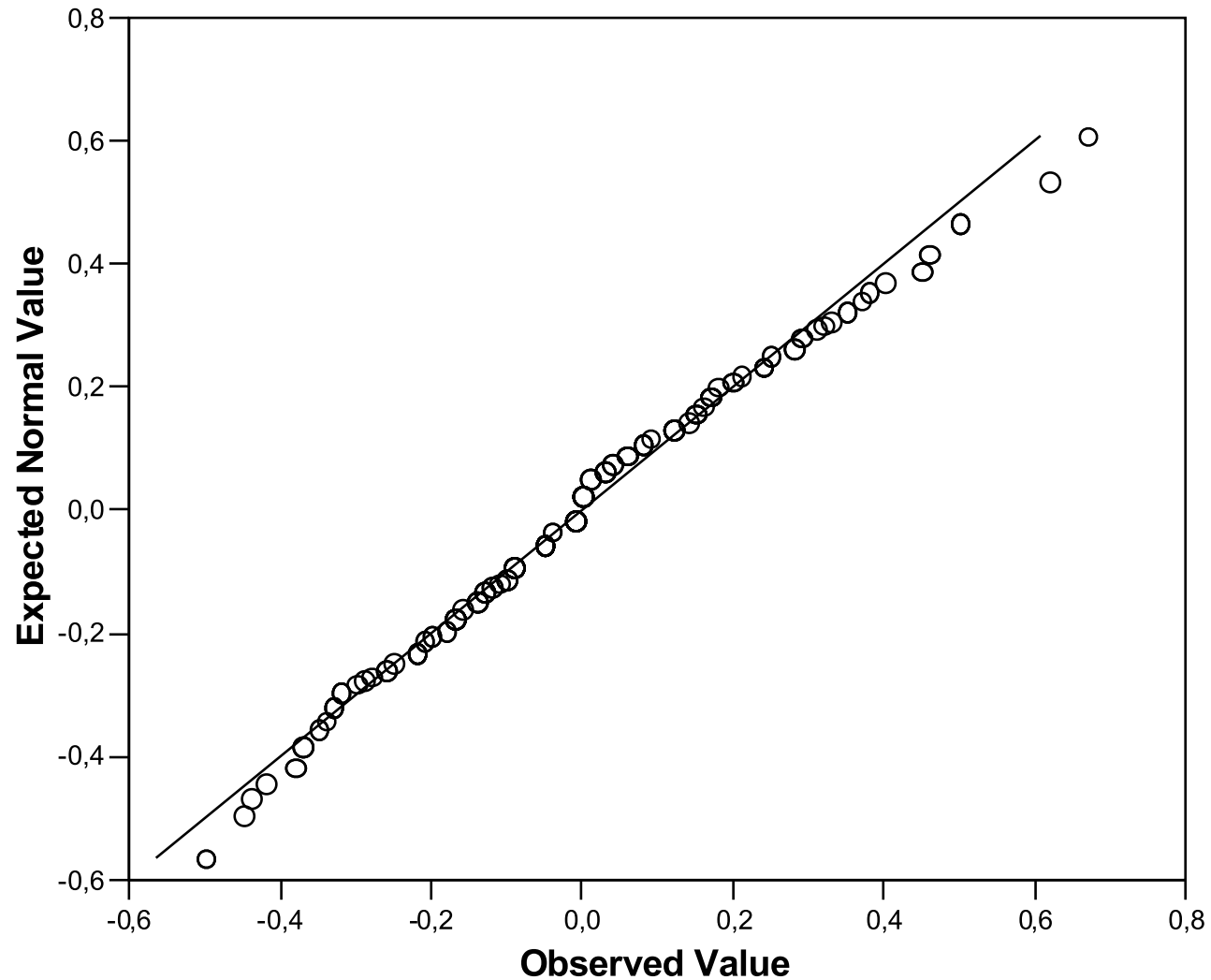
Analysis: Extrapositions

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	time	length	adj	Type III Sum of Squares	df	Mean Square	F	Sig.
time	Linear			,047	1	,047	1,463	,238
Error(time)	Linear			,766	24	,032		
length		Linear		,286	1	,286	11,467	,002
Error(length)		Linear		,598	24	,025		
adj			Linear	,003	1	,003	,060	,808
Error(adj)			Linear	1,023	24	,043		
time * length	Linear	Linear		,011	1	,011	,378	,544
Error(time*length)	Linear	Linear		,692	24	,029		
time * adj	Linear		Linear	,041	1	,041	,812	,377
Error(time*adj)	Linear		Linear	1,223	24	,051		
length * adj		Linear	Linear	,112	1	,112	6,317	,019
Error(length*adj)		Linear	Linear	,426	24	,018		
time * length * adj	Linear	Linear	Linear	6,722E-06	1	6,722E-06	,000	,990
Error(time*length*adj)	Linear	Linear	Linear	1,096	24	,046		

Analysis: Time & Extrapositions
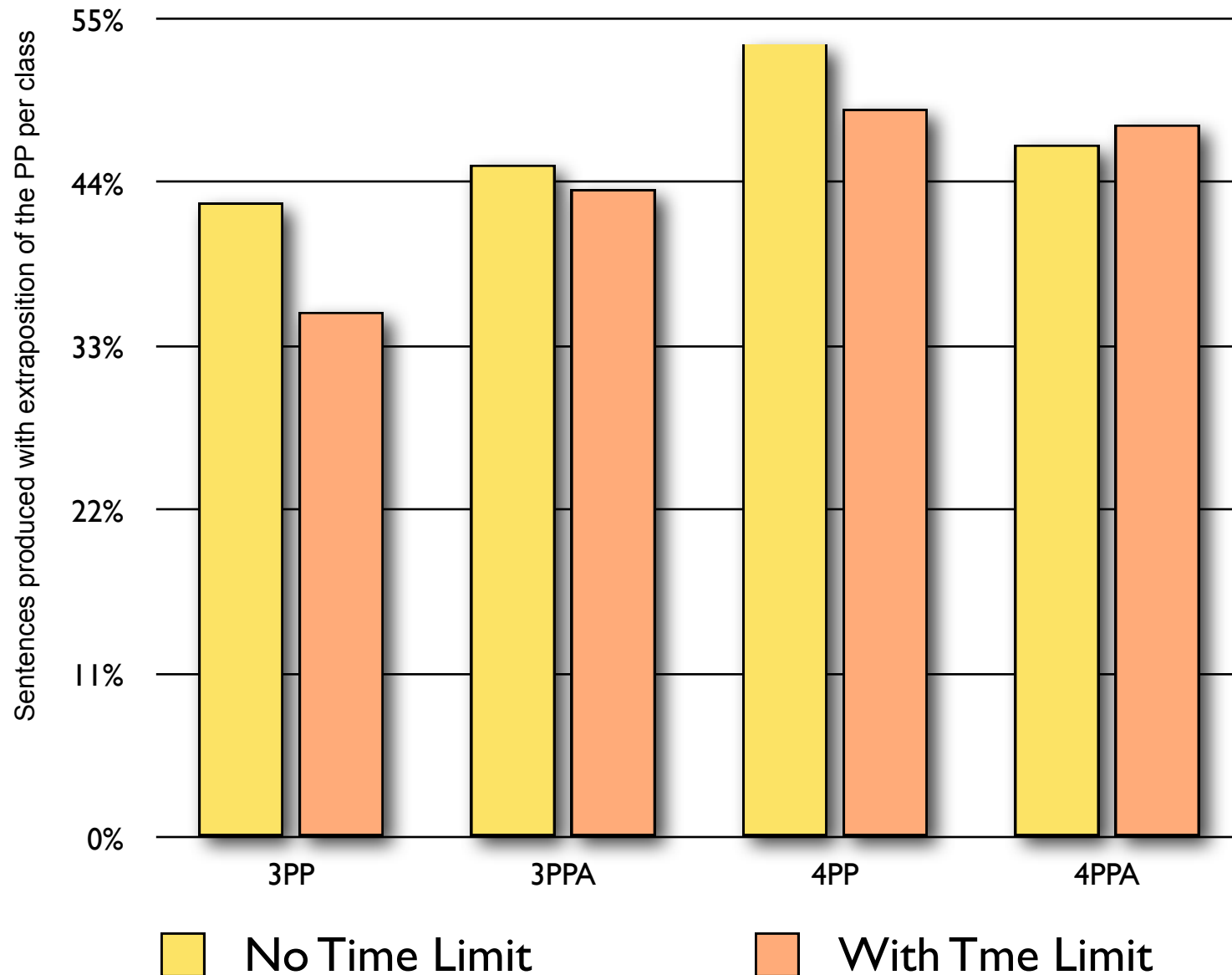
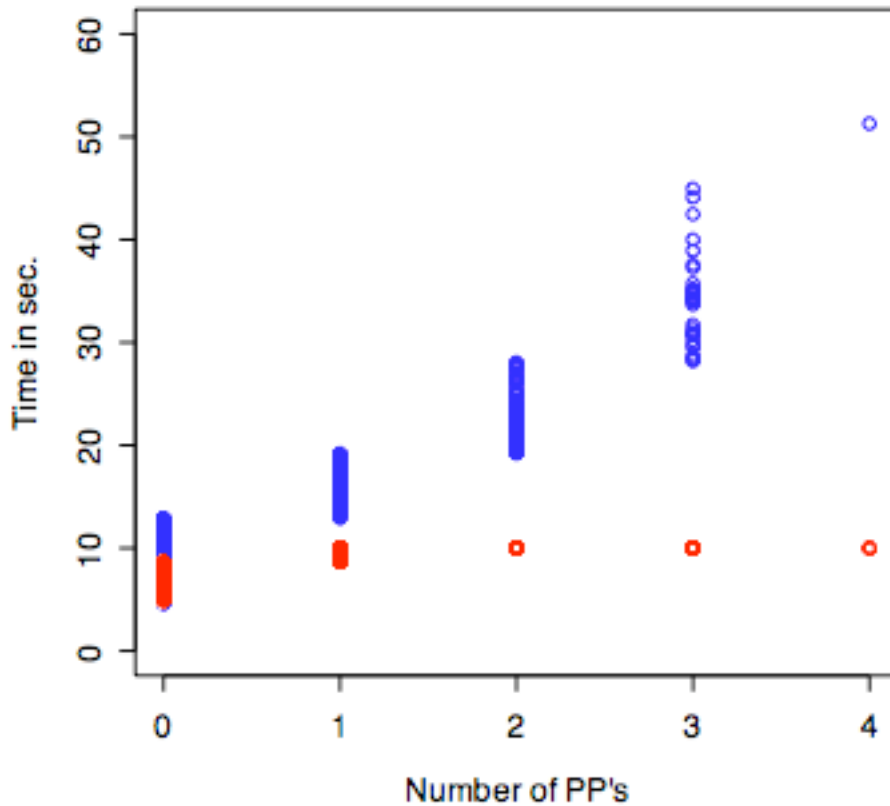## Production time and amount of the extrapositions in the sentences correlate

Correlations

		Number of extraposed PP's	Sentence Production Time
Number of extraposed PP's	Pearson Correlation	1	,094**
	Sig. (2-tailed)		,000
	N	1477	1477
Sentence Production Time	Pearson Correlation	,094**	1
	Sig. (2-tailed)	,000	
	N	1477	1860

**· Correlation is significant at the 0.01 level (2-tailed).

Analysis: Time & Extrapositions

Analysis: Time & Extrapositions
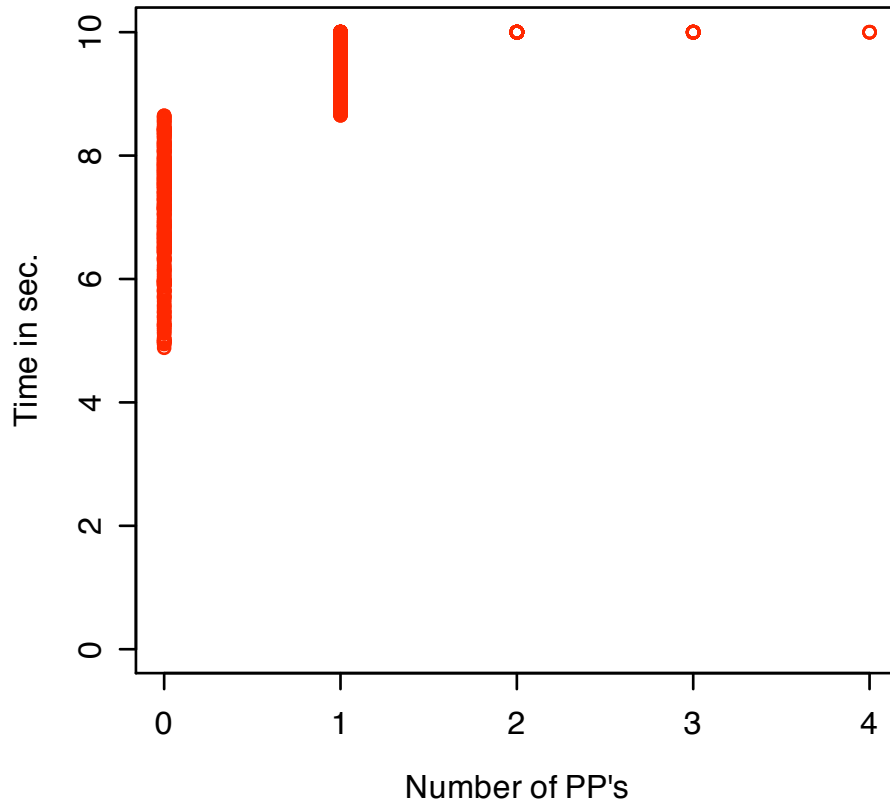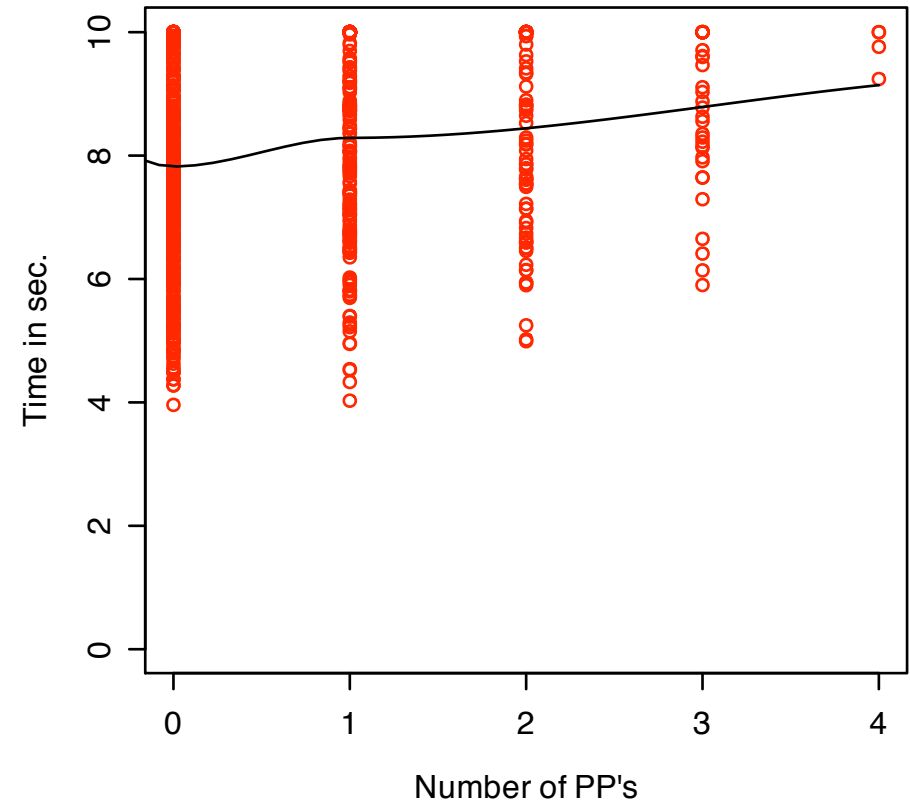
Conclusion

Work in progress:

- Complete the latin square
- Transcribe the sentences produced
- Statistical analysis of the Check vs. the 4PPA
- Statistical analysis of the kind of PP's extraposed
- Many more exploratory statistics possible...
  - NTL version + WTL version of 8 sec.
  - Topicalized PP's within our actual dataset
  - Any suggestion?