Cross-linguistic investigation of argument structure:
experimental and observational research

Lecture II.

Introduction to empirical designs

Elisabeth Verhoeven

Humboldt-Universität zu Berlin

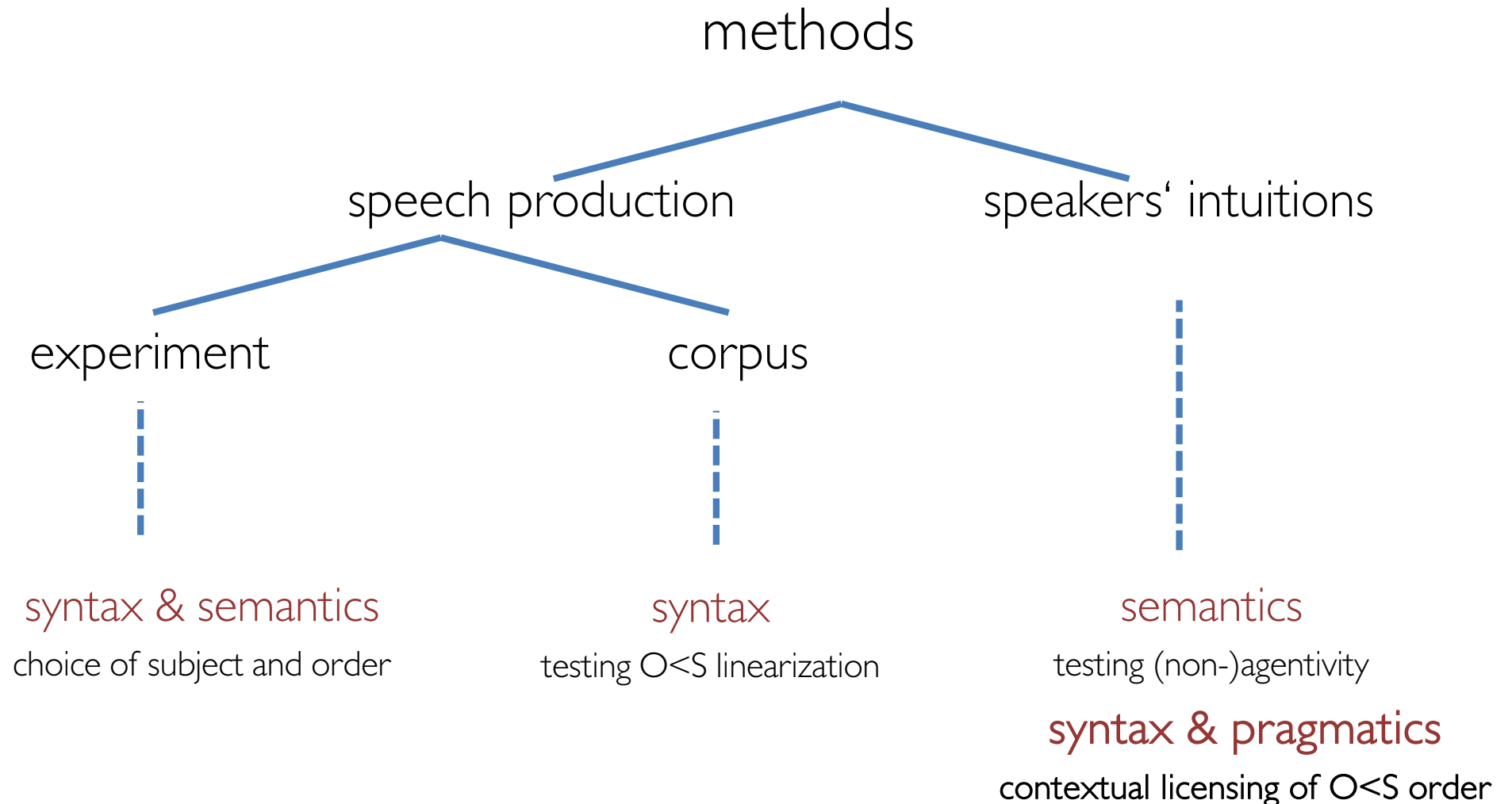elisabeth.verhoeven@cms.hu-berlin.de

Roadmap

Target: Empirical design for

an experimental study on the licensing of object preposing with psych verbs

- Hypotheses

- Factorial design

- Relevant sources of variation

- Outcomes of a factorial design

Methods

Introduction to empirical designs

hypotheses

basic concepts

H_0 Null hypothesis

a statement that we want to reject,

normally the absence of an influence in the phenomenon of interest

H_0 represents a state of knowledge prior to scientific explanations: we observe that the world varies but we do not know why.

H_1 Alternative hypothesis

a statement that we want to confirm,

normally the presence of an influence in the phenomenon of interest

H_1 represents a scientific statement explaining a part of the observed variation.

The empirical design

should offer the crucial data in order to decide whether H_0 or H_1 is true.

contextual licensing of word order

We observe that word order varies:

> *Το ηρεμιστικό αποκοίμισε τον παππού.*

> ‚the tranquilizer put the grandpa to sleep‘

> *Τον παππού τον αποκοίμισε το ηρεμιστικό.*

> ‚the tranquilizer put the grandpa to sleep‘

Based on available knowledge (e.g., *Given-First Principle*), we may hypothesize that the choice of linearization is influenced by the context. Compare:

Κάποιοι ασθενείς δεν μπορούσαν να κοιμηθούν από τη φασαρία...

‚some patients could not sleep because of the noice‘

> (a) ... *Το ηρεμιστικό αποκοίμισε τον παππού.*

> (b) ... *Τον παππού τον αποκοίμισε το ηρεμιστικό.*

contextual licensing of word order

H_0 Null hypothesis

Topic constituents are not more likely than non-topical constituents to appear early in the utterance.

H_1 Alternative hypothesis

Topic constituents are more likely than non-topical constituents to appear early in the utterance.

verb classes

Furthermore, we know that different verbs have different word order properties:

>*Τον παππού τον αποκοίμισε το ηρεμιστικό.*
>
>‚the tranquilizer put the grandpa to sleep'
>
>*Τον παππού τον ενδιαφέρει το ποδόσφαιρο.*
>
>‚the grandpa is interested in football.'

It is claimed that the OS order is preferred for experiencer-object verbs of the *ενδιαφέρει*-type across contexts, i.e., OS can occur without contextual licensing with these verbs.

verb classes

H_0 Null hypothesis

OS orders are not more likely with Exp-object verbs than with canonical transitive verbs.

H_1 Alternative hypothesis

OS orders are more likely with Exp-object verbs than with canonical transitive verbs.

basic concepts

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Introduction to empirical designs

Factorial design

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basic concepts

- Factors

  the dimensions of variation examined in an empirical design

- Dependent variables

  capture the phenomenon that we want to explain

- Independent variables

  are the factors used to explain the behaviour of the dependent variable

- Conditions

  the empirical cases to examine, in a multifactorial design they result from the permutation of factor levels.

Factorial design

Dependent variable

WORD ORDER (categorical factor)

level 0 = SO

Το ηρεμιστικό αποκοίμισε τον παππού.

‚the tranquilizer put the grandpa to sleep'

level 1 = OS

Τον παππού τον αποκοίμισε το ηρεμιστικό.

‚the tranquilizer put the grandpa to sleep'

Level 0 is the *baseline* (the default empirical situation)

Level 1 is the *level of interest*

Factorial design

Dependent variable

WORD ORDER (categorical factor)

level 0 = SO

level 1 = OS

Level 0 is the *baseline* (the default empirical situation)

Level 1 is the *level of interest*

Understanding the behaviour of the dependent variable

means finding the factors that have an influence on the OS/SO ratio, i.e., the determinants of the choice of OS – assuming that SO would appear otherwise.

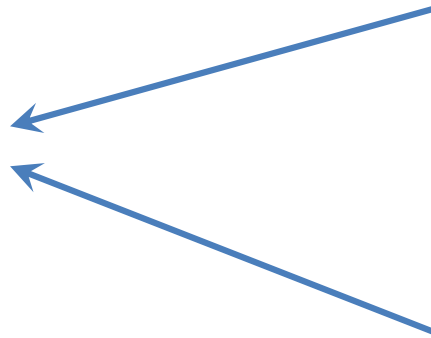# Factorial design

Dependent variable

WORD ORDER

Level 0: SO

Level 1: OS

Independent variables
(or fixed factors)

CONTEXTUAL LICENSING

levels...

VERB CLASS

levels...

Recall: contextual licensing

H_0 **Null hypothesis**

Topic constituents are not more likely than non-topical constituents to appear early in the utterance.

H_1 **Alternative hypothesis**

Topic constituents are more likely than non-topical constituents to appear early in the utterance.

Factorial design

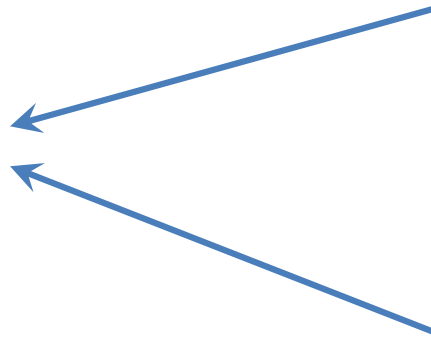Dependent variable

Independent variables
(or fixed factors)

CONTEXTUAL LICENSING

Level 0: non-licensed

Level 1: licensed

WORD ORDER

Level 0: SO

Level 1: OS

VERB CLASS

 levels...

Recall: verb classes

H_0 Null hypothesis

OS orders are not more likely with Exp-object verbs than with canonical transitive verbs.

H_1 Alternative hypothesis

OS orders are more likely with Exp-object verbs than with canonical transitive verbs.

Factorial design

Dependent variable

Independent variables
(or fixed factors)

CONTEXTUAL LICENSING

Level 0: non-licensed

Level 1: licensed

WORD ORDER
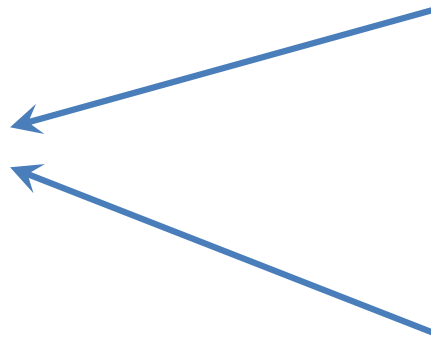
Level 0: SO

Level 1: OS

VERB CLASS

Level 0: canonical causative verbs

Level 1: experiencer-object verbs

experimental conditions

Permutations between the levels of the fixed factors

		CONTEXTUAL LICENSING	
		–licensed	+licensed
VERB CLASS	canonical caus. verbs	condition α	condition γ
	exp-obj verbs	condition β	condition δ

experimental procedure

Welcher der beiden Sätze passt Ihrer Meinung nach besser zum vorgegebenen Kontext?

Was gibt es Neues?
Der Hagel hat den Bauern frustriert. ○

Was gibt es Neues?
Den Bauern hat der Hagel frustriert. ○

Weiter

Progress:

experimental conditions

(α) –licensed & canonical verb

Τί νέα; ‚What‘s new?‘

- *Το ηρεμιστικό αποκοίμισε τον παππού.* (SO)

- *Τον παππού τον αποκοίμισε το ηρεμιστικό.* (OS)
  ‚The tranquilizer put the grandpa to sleep.‘

(β) –licensed & exp-obj verb

Τί νέα; ‚What‘s new?‘

- *Το ποδόσφαιρο ενδιαφέρει τον παππού.* (SO)

- *Τον παππού τον ενδιαφέρει το ποδόσφαιρο.* (OS)
  ‚The grandpa is interested in football.‘

experimental conditions

(γ) +licensed & canonical verb

Κάποιοι ασθενείς δεν μπορούσαν να κοιμηθούν από τη φασαρία...

‚some patients could not sleep because of the noice‘

- *Το ηρεμιστικό αποκοίμισε τον παππού.* (SO)

- *Τον παππού τον αποκοίμισε το ηρεμιστικό.* (OS)

‚the tranquilizer put the grandpa to sleep‘

experimental conditions

(δ) +licensed & exp-obj verb

Κάποιοι στην οικογένειά μας έχουν ιδιαίτερα ενδιαφέροντα...

‚some people in our family have special interests...'

- *Το ποδόσφαιρο ενδιαφέρει τον παππού* . (SO)

- *Τον παππού τον ενδιαφέρει το ποδόσφαιρο*. (OS)

‚The grandpa is interested in football.'

basic concepts

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Introduction to empirical designs

Sources of Variation

_____

Basic concepts

- ## Random Factors

  factors not related to the hypotheses but having an influence on the dependent variable; our result (concerning the fixed factors) should be generalizable for these factors

- ## Latin square designs

  distributing the experimental material between sessions/speakers

- ## Fillers

  distracting speakers

random factors

Random factor 1: Variation between speakers

- We know that individual speakers may have different judgments – especially if the phenomenon at issue involves variation.

- Our target is to obtain statements that are **generalizable across** *speakers*.

- We do not want to know exactly what each speaker thinks about the sentences, we just want to be sure that our result is not the artefact of the intuition of a random individual.

- For this purpose, we need a **sample** of the relevant population. (e.g., population of adult native speakers of Greek)

random factors

Random factor 2: Variation between lexicalizations

- It may be that the *wording of the examples* has an influence on the speakers intuitions.

- Our target is to obtain statements that are generalizable across *lexicalizations*.

- Again: we do not want to know exactly what is the role of each lexical item, we just want to be sure that our result is not the artefact of a random lexical item.

- For this purpose, we need a **sample** of lexical expressions with the crucial structure:

random factors

Random factor 2: Variation between lexicalizations

For this purpose, we need a **sample** of lexical expressions with the crucial structure:

Το κοστούμι εμπόδιζε τον ακροβάτη.

Το ταξί παρέλαβε τον τερματοφύλακα.

Οι ασκήσεις βελτίωσαν τον ακοντιστή.

Η πινακίδα προειδοποίησε τον φορτηγατζή.

Η στολή προστάτεψε τον δύτη.

random factors

Random factor 1: Variation between speakers

Random factor 2: Variation between lexicalizations

It is established since Clark 1973 to design empirical studies that control these two dimensions of variation. But it may be that for particular empirical questions different settings are more appropriate.

Latin square design

- Imagine that you have 4 experimental conditions
- You want to elicit 4 repeated observations per speaker^condition. In order to use each lexicalization once, you need 16 different lexicalizations.
- Your entire material will contain 4 (conditions) x 16 (lexicalizations) = 64 experimental elements.
- If you add fillers (see below), you would end up with a very LONG experiment.
- However, we do not present the entire material to every speaker, each speaker will see each lexicalization once.

Latin square design

speaker:	1	2	3	4	...	16
item: 1	1A	1B	1C	1D		
2	2B	2C	2D	2A		
3	3C	3D	3A	3B		
4	4D	4A	4B	4C		
5	5A	6B	7C	8D		
…	…	…	…	…		
16	16D	16A	16B	16C		

Latin square design

Liste 1	Liste 2	Liste 3	Liste 4
<id:acc_t_it1_can_non>Τι νέα;</id> <id:acc_t_it1_can_non_SO>Το κοστούμι εμπόδιζε τον ακροβάτη.</id> <id:acc_t_it1_can_non>Τι νέα;</id> <id:acc_t_it1_can_non_OS>Τον ακροβάτη τον εμπόδιζε το κοστούμι.</id>	<id:acc_t_it3_can_non>Τι νέα;</id> <id:acc_t_it3_can_non_OS>Τον δύτη τον προστάτεψε η στολή.</id> <id:acc_t_it3_can_non>Τι νέα;</id> <id:acc_t_it3_can_non_SO>Η στολή προστάτεψε τον δύτη.</id>	<id:acc_t_it5_can_non>Τι νέα;</id> <id:acc_t_it5_can_non_SO>Το ηρεμιστικό αποκοίμισε τον παππού.</id> <id:acc_t_it5_can_non>Τι νέα;</id> <id:acc_t_it5_can_non_OS>Τον παππού τον αποκοίμισε το ηρεμιστικό.</id>	<id:acc_t_it7_can_non>Τι νέα <id:acc_t_it7_can_non_OS> φάρμακο.</id> <id:acc_t_it7_can_non>Τι νέ <id:acc_t_it7_can_non_SO> οδηγό.</id>
<id:acc_t_it9_can_non>Τι νέα;</id> <id:acc_t_it9_can_non_OS>Την μητέρα την ξύπνησε ο συναγερμός.</id> <id:acc_t_it9_can_non>Τι νέα;</id> <id:acc_t_it9_can_non_SO>Ο συναγερμός ξύπνησε την μητέρα.</id>	<id:acc_t_it11_can_non>Τι νέα;</id> <id:acc_t_it11_can_non_SO>Το ταξί παρέλαβε τον τερματοφύλακα.</id> <id:acc_t_it11_can_non>Τι νέα;</id> <id:acc_t_it11_can_non_OS>Τον τερματοφύλακα τον παρέλαβε το ταξί.</id>	<id:acc_t_it15_can_non>Τι νέα;</id> <id:acc_t_it15_can_non_SO>Η φιλοδοξία κατέστρεψε τον τραγουδιστή.</id> <id:acc_t_it15_can_non>Τι νέα;</id> <id:acc_t_it15_can_non_OS>Τον τραγουδιστή τον κατέστρεψε η φιλοδοξία.</id>	<id:acc_t_it15_can_non>Τι ν <id:acc_t_it15_can_non_SO> τον τραγουδιστή.</id> <id:acc_t_it15_can_non>Τι ν <id:acc_t_it15_can_non_OS> κατέστρεψε η φιλοδοξία.</i
<id:acc_t_it17_can_non>Τι νέα;</id> <id:acc_t_it17_can_non_SO>Το φαγητό δηλητηρίασε τον πιλότο.</id> <id:acc_t_it17_can_non>Τι νέα;</id> <id:acc_t_it17_can_non_OS>Τον πιλότο τον	<id:acc_t_it19_can_non>Τι νέα;</id> <id:acc_t_it19_can_non_SO>Οι ασκήσεις βελτίωσαν τον ακοντιστή.</id> <id:acc_t_it19_can_non>Τι νέα;</id> <id:acc_t_it19_can_non_OS>Τον ακοντιστή τον	<id:acc_t_it23_can_non>Τι νέα;</id> <id:acc_t_it23_can_non_SO>Η πινακίδα προειδοποίησε τον φορτηγατζή.</id> <id:acc_t_it23_can_non>Τι νέα;</id> <id:acc_t_it23_can_non_OS>Τον φορτηγατζή τον	<id:acc_t_it23_can_non>Τι ν <id:acc_t_it23_can_non_OS> προειδοποίησε η πινακίδα.</i <id:acc_t_it23_can_non>Τι ν <id:acc_t_it23_can_non_SO
<id:acc_t_it25_can_non>Τι νέα;</id> <id:acc_t_it25_can_non_OS>Τον επιθετικό τον τύφλωνε ο ήλιος.</id> <id:acc_t_it25_can_non>Τι νέα;</id> <id:acc_t_it25_can_non_SO>Ο ήλιος τύφλωνε τον επιθετικό.</id>	<id:acc_t_it27_can_non>Τι νέα;</id> <id:acc_t_it27_can_non_SO>Η βελόνα τρύπησε τον μικροβιολόγο.</id> <id:acc_t_it27_can_non>Τι νέα;</id> <id:acc_t_it27_can_non_OS>Τον μικροβιολόγο τον τρύπησε η βελόνα.</id>	<id:acc_t_it31_can_non>Τι νέα;</id> <id:acc_t_it31_can_non_SO>Οι πρόβες εξάντλησαν την πρωταγωνίστρια.</id> <id:acc_t_it31_can_non>Τι νέα;</id> <id:acc_t_it31_can_non_OS>Την πρωταγωνίστρια την εξάντλησαν οι πρόβες.</id>	<id:acc_t_it31_can_non>Τι ν <id:acc_t_it31_can_non_SO> πρωταγωνίστρια.</id> <id:acc_t_it31_can_non>Τι ν <id:acc_t_it31_can_non_OS> εξάντλησαν οι πρόβες.</id>
<id:acc_t_it7_can_lic>Οι περισσότεροι ταξιδιώτες δεν έγιναν ακόμα καλά.</id> <id:acc_t_it7_can_lic_SO>Το φάρμακο βοήθησε τον οδηγό.</id> <id:acc_t_it7_can_lic>Οι περισσότεροι ταξιδιώτες δεν	<id:acc_t_it1_can_lic>Η ομάδα του τσίρκο δεν αντιμετώπισε προβλήματα στην παράσταση.</id> <id:acc_t_it1_can_lic_OS>Τον ακροβάτη τον εμπόδιζε το κοστούμι.</id> <id:acc_t_it1_can_lic>Η ομάδα του τσίρκο δεν	<id:acc_t_it3_can_lic>Τα περισσότερα μέλη της ομάδας διάσωσης τραυματίστηκαν.</id> <id:acc_t_it3_can_lic_SO>Η στολή προστάτεψε τον δύτη.</id> <id:acc_t_it3_can_lic>Τα περισσότερα μέλη της ομάδας	<id:acc_t_it5_can_lic> Κάπο ήταν αδύνατον να κοιμηθού υπήρχε.</id> <id:acc_t_it5_can_lic_OS>Το το ηρεμιστικό.</id>
<id:acc_t_it15_can_lic>Τα υπόλοιπα μέλη του συγκροτήματος δεν επηρεάστηκαν από την	<id:acc_t_it9_can_lic>Σχεδόν όλη οικογένεια κοιμήθηκε ήρεμα.</id>	<id:acc_t_it11_can_lic>Τα υπόλοιπα μέλη της ομάδας περίμεναν το πούλμαν να τα παραλάβει.</id>	<id:acc_t_it13_can_lic>Οι π χρεωκόπησαν.</id>

fillers

- fillers are test items that are not relevant for the hypothesis
- the fillers distract the participants from the purposes of the experiment
- fillers must run under the same experimental instruction (otherwise the purposes of the different parts of the material are transparent.
- The recommended proportion is *1 target: 3 fillers*.

fillers

Έχεις κανένα νέο;

- Λένε ότι τη σύλληψη την οργάνωσε ο ηλεκτρολόγος.
- Τη σύλληψη λένε ότι την οργάνωσε ο ηλεκτρολόγος.

Τί είδες;

- Από το δέντρο έπεσε ένας ιερέας.
- Ένας ιερέας έπεσε από το δέντρο.

Πολλοί πεζοί είναι δυσαρεστημένοι με τις εξελίξεις.

- Ακούστηκε ότι τα πεζοδρόμια θα γίνουν ποδηλατόδρομοι.
- Ποδηλατόδρομοι ακούστηκε ότι θα γίνουν τα πεζοδρόμια.

Latin square design with fillers

item:	speaker:	f/t	1	2	3	4	...	16
	1	target	1A	1B	1C	1D		
	x	filler	F1	F1	F1	F1		
	x	filler	F2	F2	F2	F2		
	x	filler	F3	F3	F3	F3		
	2	target	2B	2C	2D	2A		
	x	filler	F4	F4	F4	F4		
	x	filler	F5	F5	F5	F5		
	3	target	3C	3D	3A	3B		
	x	filler	F6	F6	F6	F6		
	x	filler	F7	F7	F7	F7		
	x	filler	F8	F8	F8	F8		
	x	filler	F9	F9	F9	F9		
	4	target	4D	4A	4B	4C		
	x	filler	F10	F10	F10	F10		
	x	filler	F11	F11	F11	F11		
	x	filler	F12	F12	F12	F12		
	x	filler	F13	F13	F13	F13		
	...	...	...	...	...	...		
	16	16D	16D	16A	16B	16C		

Basic concepts

- ## Random Factors

  factors not related to the hypotheses but having an influence on the dependent variable; our result (concerning the fixed factors) should be generalizable for these factors

- ## Latin square designs

  distributing the experimental material between sessions/speakers

- ## Fillers
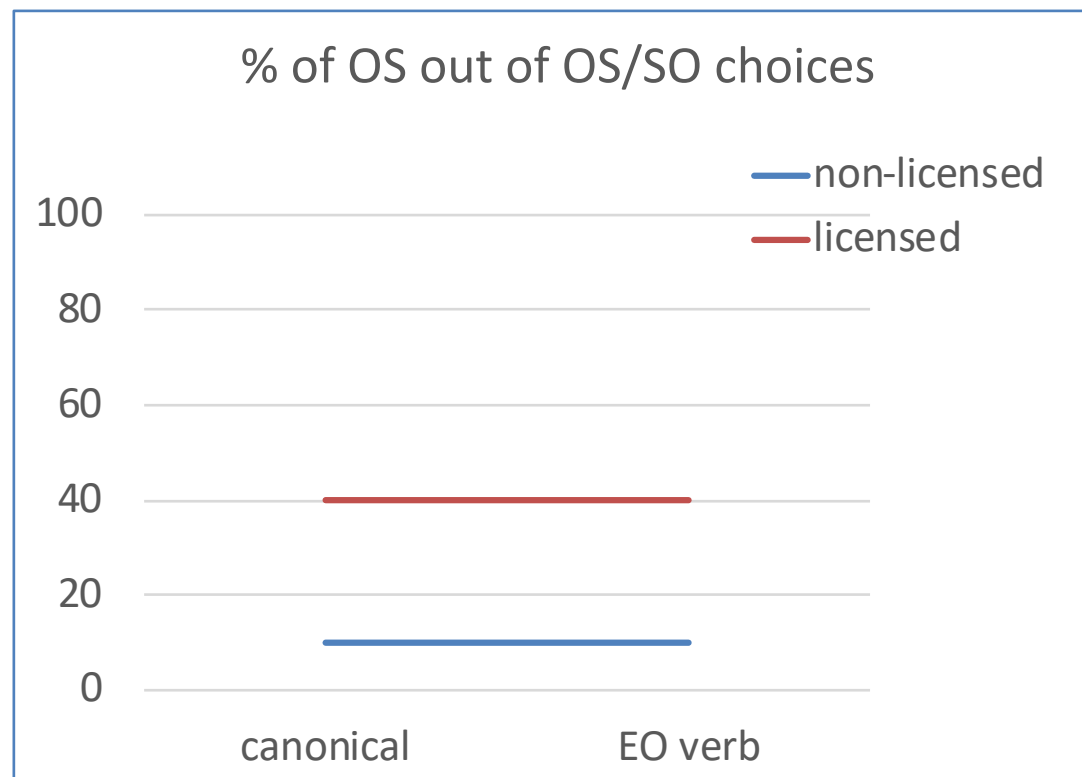
  distracting speakers

Introduction to empirical designs

Outcomes of a factorial design

Basic concepts

- main effects

  effects of certain factors

- interaction effects

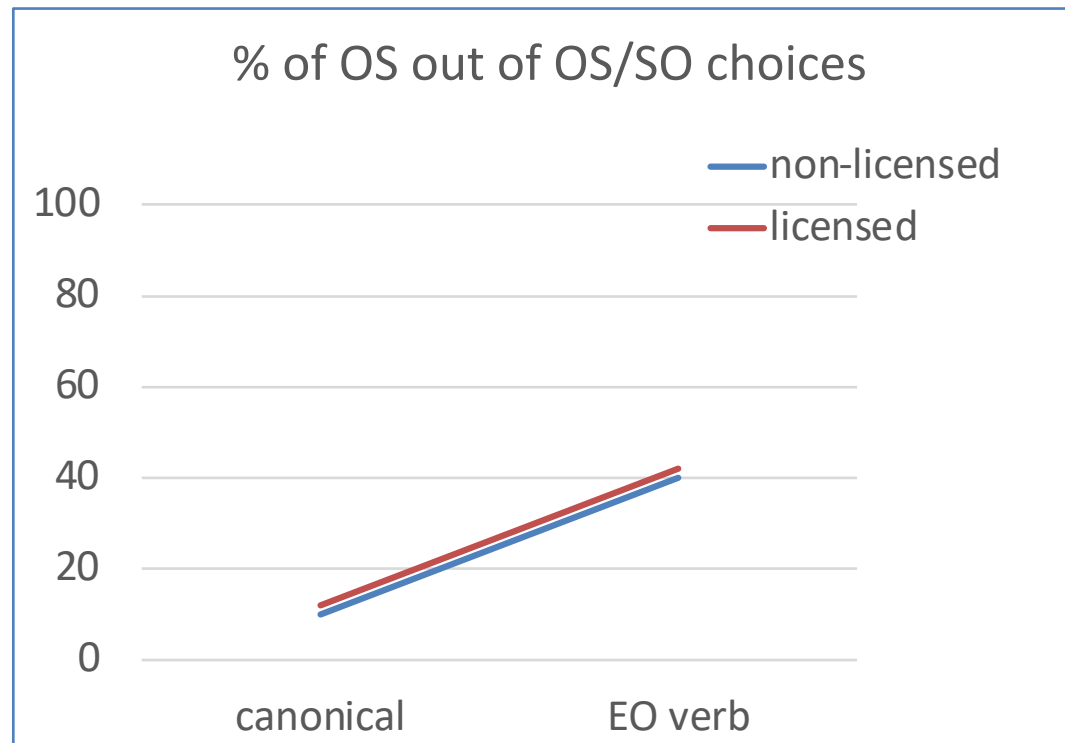 factorial effects that depend on the level of other factors

possible outcome I

- the factor CONTEXTUAL LICENSING has a main effect.
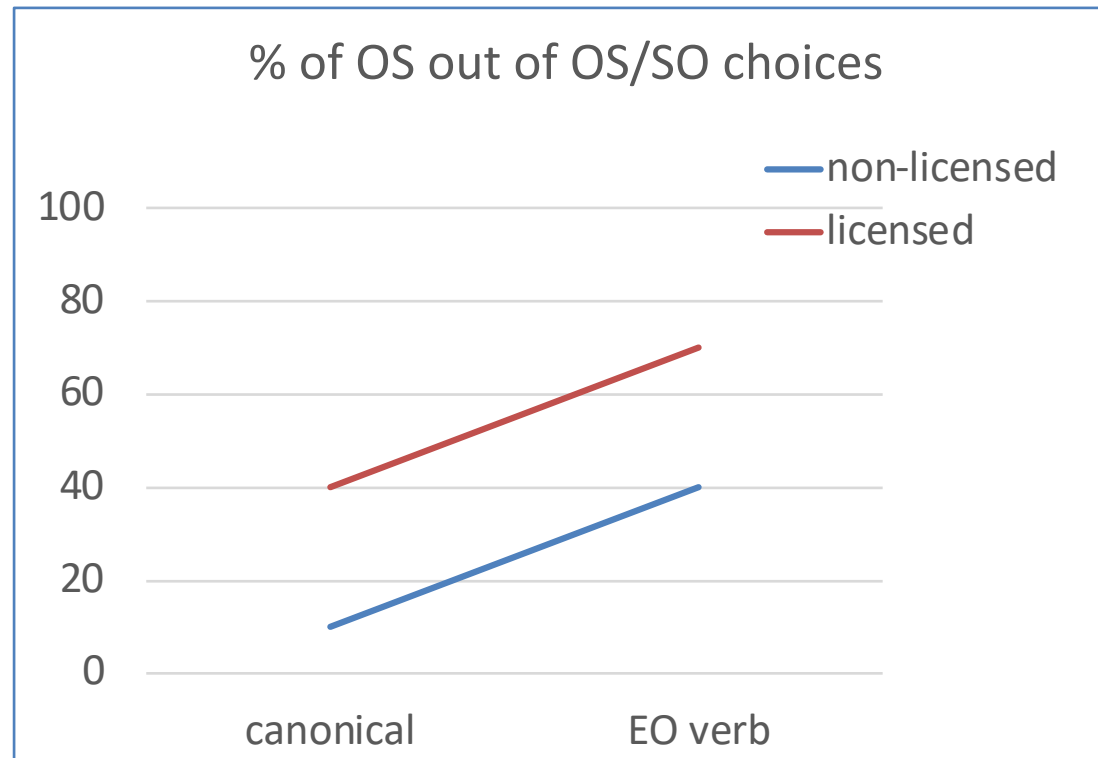- the factor VERB CLASS does not have a main effect.

% of OS out of OS/SO choices

possible outcome 2

- the factor VERB CLASS has a main effect.
- the factor CONTEXTUAL LICENSING does not have a main effect.

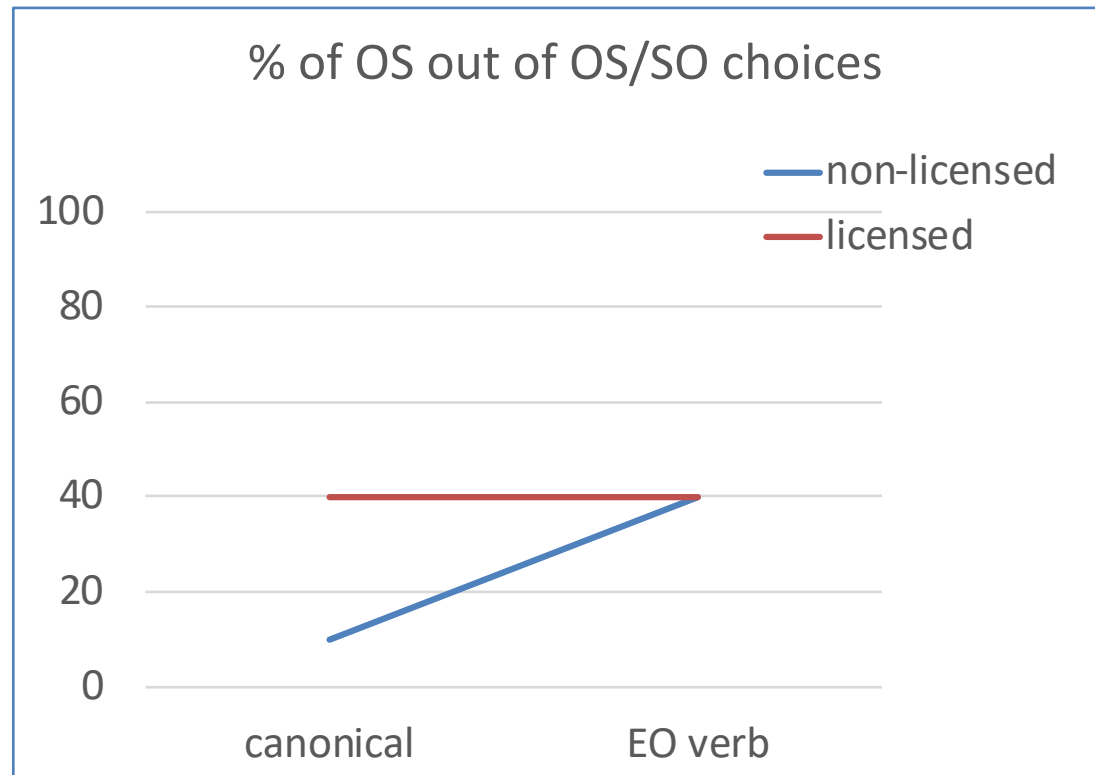**% of OS out of OS/SO choices**

— non-licensed
— licensed

possible outcome 3

- the factor VERB CLASS has a main effect.
- the factor CONTEXTUAL LICENSING has a main effect.
- both effects are cumulated.

% of OS out of OS/SO choices

legend:
— non-licensed
— licensed

x-axis: canonical, EO verb
y-axis: 0, 20, 40, 60, 80, 100

possible outcome 4

- the factors interact:
- the factor CONTEXTUAL LICENSING has a main effect only within a level of the factor VERB CLASS (with canonical verbs).

Basic concepts

- main effects

  effects of certain factors

- interaction effects

  factorial effects that depend on the level of other factors

Introduction to empirical designs

Do you want to learn what happened?

Literature

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