SFB 991

SFB 991
Integriertes Graduiertenkolleg
„Structures of Representation“
an der Philosophischen Fakultät
STORE

HEINRICH HEINE
UNIVERSITÄT DÜSSELDORF

Psycholinguistic evidence for concept types and type shifts

Dorothea Brenner[1]

Peter Indefrey[1,2]

[1]Heinrich Heine University Düsseldorf (http://www.sfb991.uni-duesseldorf.de/en/c03/)

[2]Donders Institute for Brain, Cognition and Behaviour @Radboud University Nijmegen, NL

CTF‘12 – Concept Types and Frames

Düsseldorf, 22-24 August, 2012

Outline

- Theoretical background
  - Assumptions
  - Research questions & hypotheses
- Psycholinguistic experiment
  - Paradigm
  - Method
  - Results
- Summary & research objectives

Psycholinguistic evidence for concept types and type shifts

THEORETICAL BACKGROUND

Theoretical background: CTD

(modified version of Löbner 2011: 307)

	non-unique **[–U]**	unique **[+U]**
non-relational **[–R]**	**sortal – SC** *apple stone moment human* ✓**indefinite** ↱definite ↱possessive	**individual – IC** *pope earth weather Police* ↱indefinite ✓**definite** ↱possessive
relational **[+R]**	**relational – RC** *colleague arm page idea* ✓**indefinite** ↱definite ✓**possessive**	**functional – FC** *mother body age birth* ↱indefinite ✓**definite** ✓**possessive**

✓ congruent determination
↱ incongruent determination

CTD-Assumptions: 1) Underlying CT

- **Concept types (CT)**
  - Conceptual type information of nouns is lexically stored
  - Most nouns have only *one* lexically stored ***concept type*** and corresponding frame specification

  →*underlying concept type*

CTD-Assumptions: 2) Type shifts

- **Concept type & determination type (DT)**
  - Each of the four conceptual types of nouns has a preferred contextual profile (c.f. Löbner 2011), i.e. it is used with a specific ***congruent determination type*** (DT) in correlation with its feature specification.
  - Each mode of determination has certain ***type restrictions*** and requires certain specification of uniqueness and/or relationality.

- **Concept type & incongruent DT**
  - The interpretation of a noun used with an incongruent DT leads to a reanalysis process, so that its referential properties then match the type restrictions of the DT.

  →*conceptual type shifts (CT-shifts)*

CTD-Assumptions: Example

a) Der Papst wohnt in Italien.

(*The Pope lives in Italy*.)

b) Johannes Paul II. war ein freundlicher Papst.

(*John Paul II. was a friendly pope*.)

- ‚Papst' (*pope*) is an IC [+U,+R]
- In a) it is used with congruent determination
- the indefinite article ‚ein' in b) requires a [–U]-concept.
  →incongruence between CT and DT
- the interpretation of b) requires a **reanalysis process**:
  the referential properties of the IC ‚Papst' have to be changed,
  to match the values required by the DT ‚ein'
  →incongruence coerces a CT-shift

Research questions & hypotheses

- **Research questions at hand**
  - Is there any empirical evidence for the cognitive reality of conceptual types, the features of uniqueness & relationality, and CT-shifts?
  - Can we find empirically measurable time differences in the processing of nouns used with congruent vs. incongruent determination?

- **Hypotheses & prediction**
  - If CT-information is lexically stored, *congruent determination* should ***facilitate*** the lexical access of the following noun.
  - If CT-shifts due to *incongruent determination* are additional cognitive processes, they should be time-consuming and ***slow down*** responses.

Psycholinguistic evidence for concept types and type shifts

PSYCHOLINGUISTIC EXPERIMENT: PARADIGM, STIMULI & METHOD

Experiment: Paradigm

- **Paradigm***:* On-line reaction time experiment with German NPs containing a combination of *determiner+noun*

- **Lexical decision task:**
  - Task: „Is the presented stimulus a word or a non-word?“
  - triggers lexical and (flat) semantic processing

- **Modality of stimulus presentation**: auditory

- **Measured variable**: reaction time (RT) via response pad

- **Software:** Presentation® (by Neurobehavioral systems, Inc.)

Experiment: Stimuli & method

- **Participants**: 96 German native speakers
- **Stimuli**:
  - target nouns: 80 German nouns – 20 nouns of each CT (matched by frequency and number of letters and phonemes)
  - pseudo words: 80 non-words satisfying the phonotactic rules of German
  - each item was combined with each of the four DTs (*indefinite, definite, possessive, none)*

Experiment: Stimuli

Det. Type	**Concept type**			
	sortal [–U][–R]	individual [+U][–R]	relational [–U][+R]	functional [+U][+R]
indefinite	*ein Apfel* an apple	*ein Papst* a pope	*ein Arm* an arm	*eine Mutter* a mother
definite	*der Apfel* the apple	*der Papst* the pope	*der Arm* the arm	*die Mutter* the mother
possessive	*sein Apfel* his apple	*sein Papst* his pope	*sein Arm* his arm	*seine Mutter* his mother
none	*xxxx Apfel*	*xxxx Papst*	*xxxx Arm*	*xxxx Mutter*

Experiment: Method

Each of the 160 trials consisted of 3 subsequent parts:

+ a warning stimulus: „beep“
+ one of the three determiners or the neutral determiner stimulus (realized as 400ms white noise)
+ one of the 80 target words or one of the 80 pseudo words

Psycholinguistic evidence for concept types and type shifts

PSYCHOLINGUISTIC EXPERIMENT: RESULTS

Experiment: Results

1. **Congruence with the features of *uniqueness* & *relationality***
   - *(non)uniqueness and (in)definite determination*
   - *(non)relationality and possessive determination*

2. **Overall congruence: congruent vs. incongruent determination**

Experiment: Referential properties
uniqueness & relationality and determination

	non-unique [**–U**]	conceptually unique [**+U**]
non-relational [**–R**]	**sortal** *apple stone moment human* ✓**indefinite** ↦definite ↦possessive	**individual** *pope earth weather Police* ↦indefinite ✓**definite** ↦possessive
conceptually relational [**+R**]	**relational** *colleague arm page idea* ✓**indefinite** ↦definite ✓**possessive**	**functional** *mother body age birth* ↦indefinite ✓**definite** ✓**possessive**

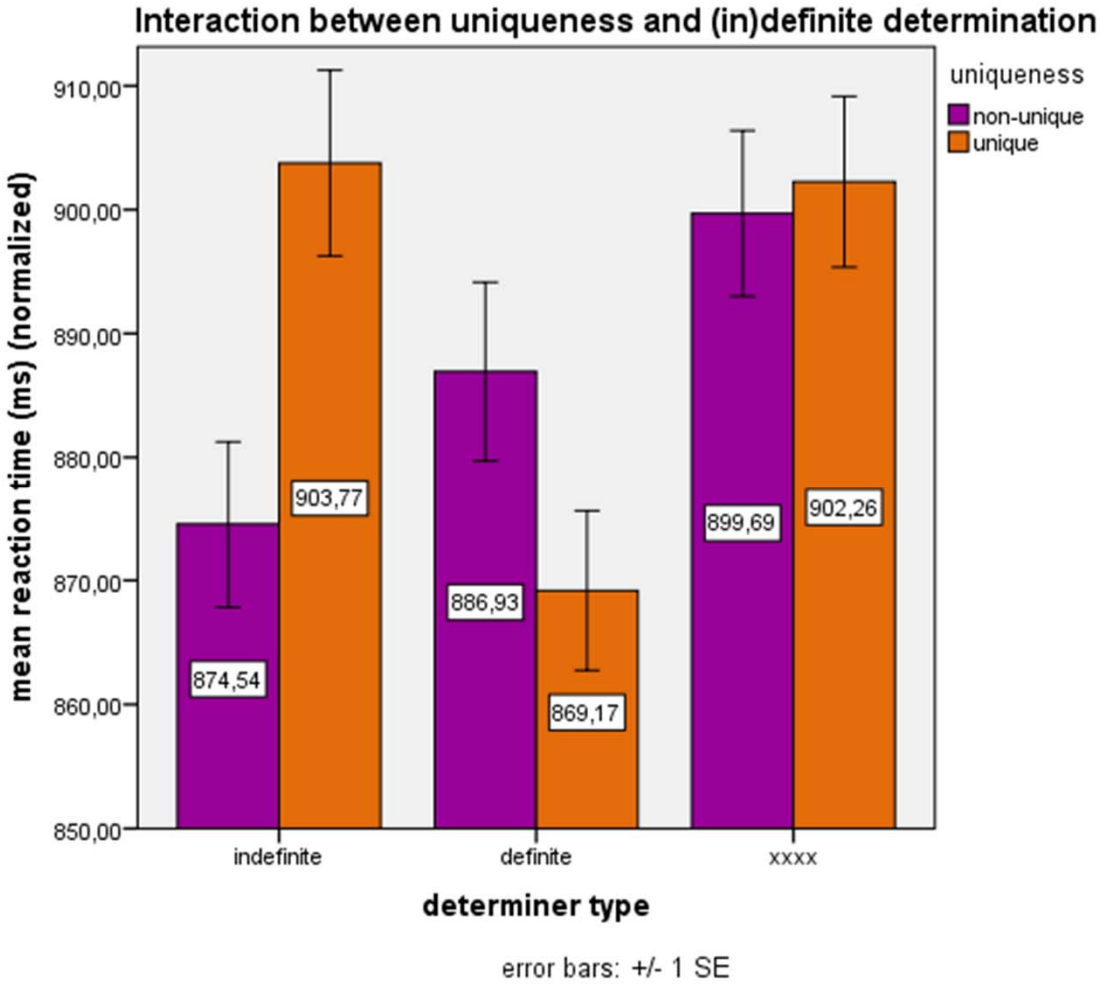
✓ congruent determination
↦ incongruent determination

Experiment: Interaction of *uniqueness* and (in)definite determination

	non-unique [**–U**]	unique [**+U**]
non-relational [**–R**]	**sortal** *apple stone moment human* ✓**indefinite** ↦definite ↦possessive	**individual** *pope earth weather Police* ↦indefinite ✓**definite** ↦possessive
relational [**+R**]	**relational** *colleague arm page idea* ✓**indefinite** ↦definite ✓**possessive**	**functional** *mother body age birth* ↦indefinite ✓**definite** ✓**possessive**

✓ congruent determination
↦ incongruent determination

Experiment: Results for interaction of *uniqueness* and (in)definite determination



Effects:

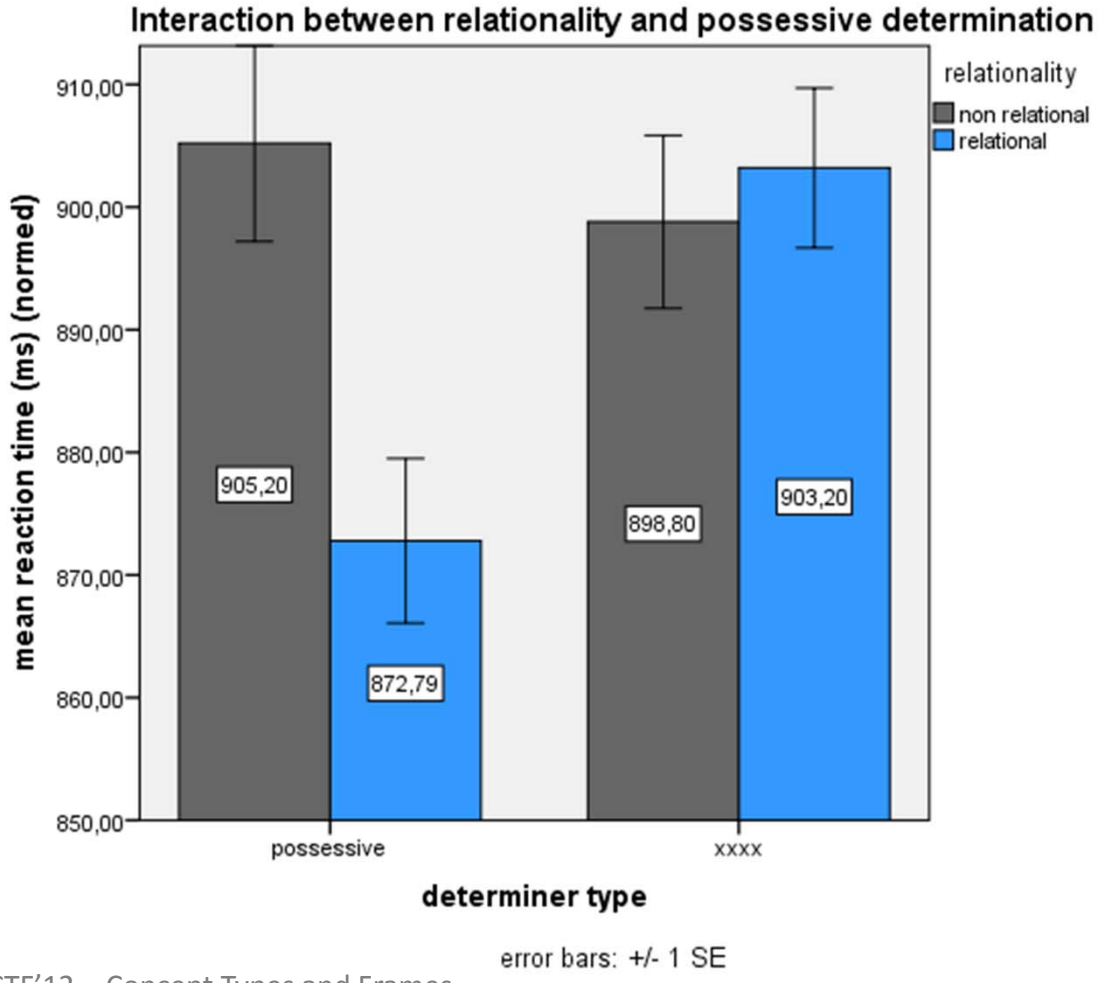
- significant interaction effect between determination & uniqueness (F(94)=9.47, p=.00)
- post-hoc comparisons show:
  - significant **facilitation** of [+U]-nouns by definite DT
  - significant **facilitation** of [–U]-nouns by indefinite DT
  - **No difference** between indefinite determination vs. none for unique nouns

Experiment: Interaction of *relationality* and possessive determination

	non-unique [**–U**]	unique [**+U**]
non-relational [**–R**]	**sortal** *apple stone moment human* ✓**indefinite** ↦definite ↦possessive	**individual** *pope earth weather Police* ↦indefinite ✓**definite** ↦possessive
relational [**+R**]	**relational** *colleague arm page idea* ✓**indefinite** ↦definite ✓**possessive**	**functional** *mother body age birth* ↦indefinite ✓**definite** ✓**possessive**

✓ congruent determination
↦ incongruent determination

Experiment: Results for interaction of *relationality* and possessive determination



Effects:

- significant interaction effect between determination & relationality (F(95)=8.476, p=.00)
- post-hoc comparisons show:
  - significant **facilitation** of [+R]-nouns by possessive DT
  - (trend for) **inhibition** of [–R]-nouns by possessive DT

  →results cannot be explained by mere gender effect!

Experiment: Results

1. **Congruence with the features of *uniqueness* & *relationality***
   - *(non)uniqueness and (in)defninite determination*
   - *(non)relationality and possessive determination*

2. **Overall congruence: congruent vs. incongruent determination**
   - **simple congruence (1 feature)** – type restrictions of determiners concern one of the two features: (in)congruence with respect to one feature of the noun.
   - **graded congruence (2 features)** – type restrictions of determiners concern both features: full (in)congruence with respect to both, partly (in)congruence with one of the two.

Experiment: simple congruence (1 feature)

„The properties that distinguish the types of nouns, that is, uniqueness and relationality, correspond to types of determination and reference. Clearly, **uniqueness is linked to defniniteness, and relationality to possessive determination**.“ (Löbner 2011:287, 307)

- definite determination → [+U]
- indefinite determination → [–U]
- possessive determination → [+R]

Experiment: simple congruence (1 feature)

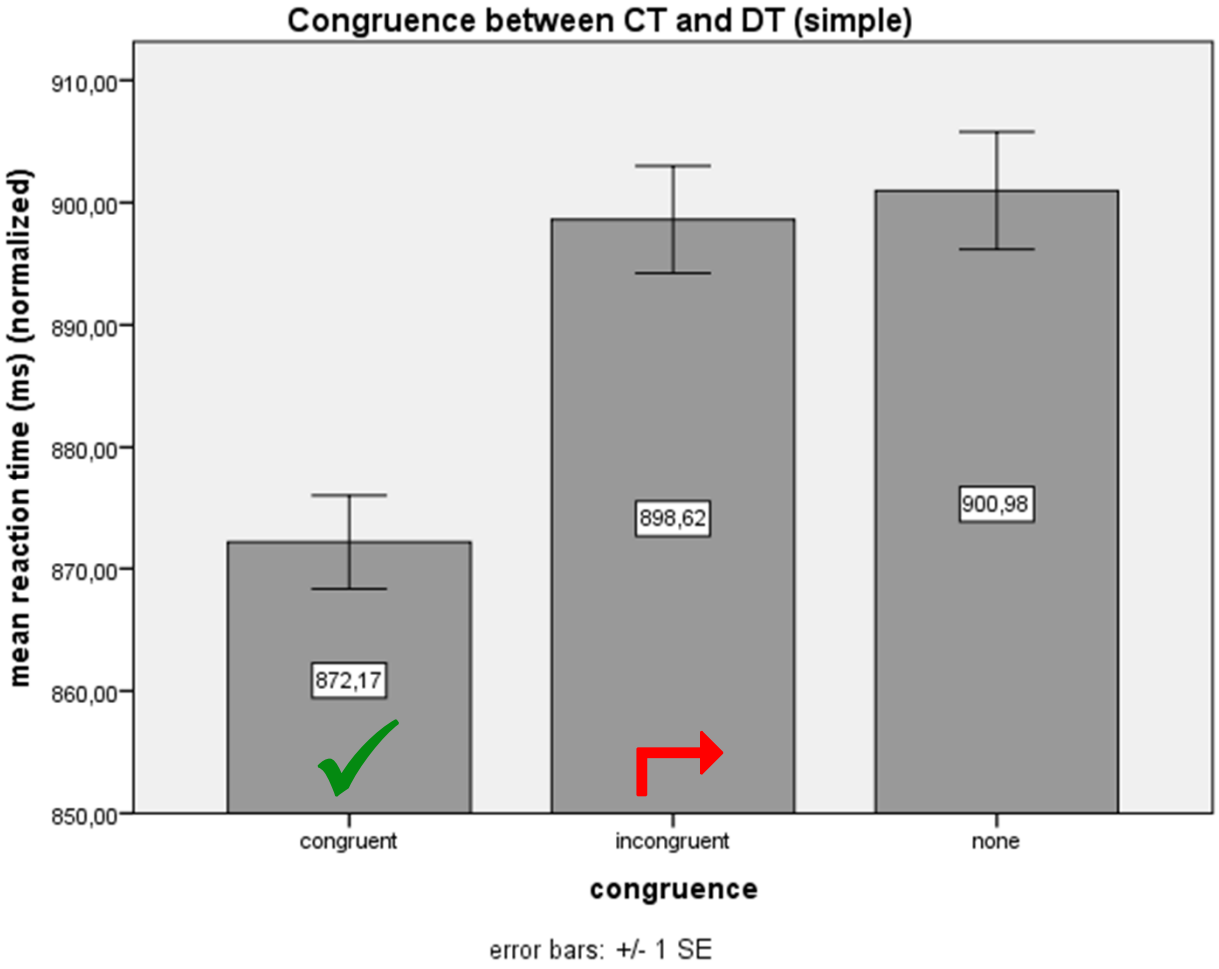
	non-unique [**–U**]	unique [**+U**]
non-relational [**–R**]	**sortal** ✓**indefinite** ↦definite ↦possessive	**individual** ↦indefinite ✓**definite** ↦possessive
relational [**+R**]	**relational** ✓**indefinite** ↦definite ✓**possessive**	**functional** ↦indefinite ✓**definite** ✓**possessive**

✓ congruent determination
↦ incongruent determination

Experiment: simple congruence (1 feature)

Det. Type	**Concept type**			
	sortal [–U][–R]	individual [+U][–R]	relational [–U][+R]	functional [+U][+R]
indefinite	*ein Apfel* an apple	*ein Papst* a pope	*ein Arm* an arm	*eine Mutter* a mother
definite	*der Apfel* the apple	*der Papst* the pope	*der Arm* the arm	*die Mutter* the mother
possessive	*sein Apfel* his apple	*sein Papst* his pope	*sein Arm* his arm	*seine Mutter* his mother
none	*xxxx Apfel*	*xxxx Papst*	*xxxx Arm*	*xxxx Mutter*

Experiment: Results simple congruence (1 feature)



Effects:

- highly significant overall congruence effect (F(94)=12,85; p= .00)
- Post-hoc comparison shows:
  - significant facilitation by congruent vs. incongruent DT.
  - no difference between incongruent vs. no determination.

    → results cannot be explained by mere gender effect of determination

Experiment: graded congruence (2 features)

„[The] three elementary types of determination [**indefinite**, **definite** and **possessive** determination] are in harmony with **sortal**[–U][–R], **individual** [+U][+R] and **functional** [+U][+R] nouns, respectively. There is however no simple type of determination in harmony with relational [–U][+R] nouns […].“ (Löbner 2011:306)

- indefinite determination → [–U][–R]
- definite determination → [+U][–R]
- possessive determination → [+U][+R]

Experiment: graded congruence (2 features)

	non-unique [**–U**]	unique [**+U**]
non-relational [**–R**]	**sortal** **indefinite** definite possessive	**individual** indefinite **definite** possessive
relational [**+R**]	**relational** indefinite definite possessive	**functional** indefinite definite **possessive**

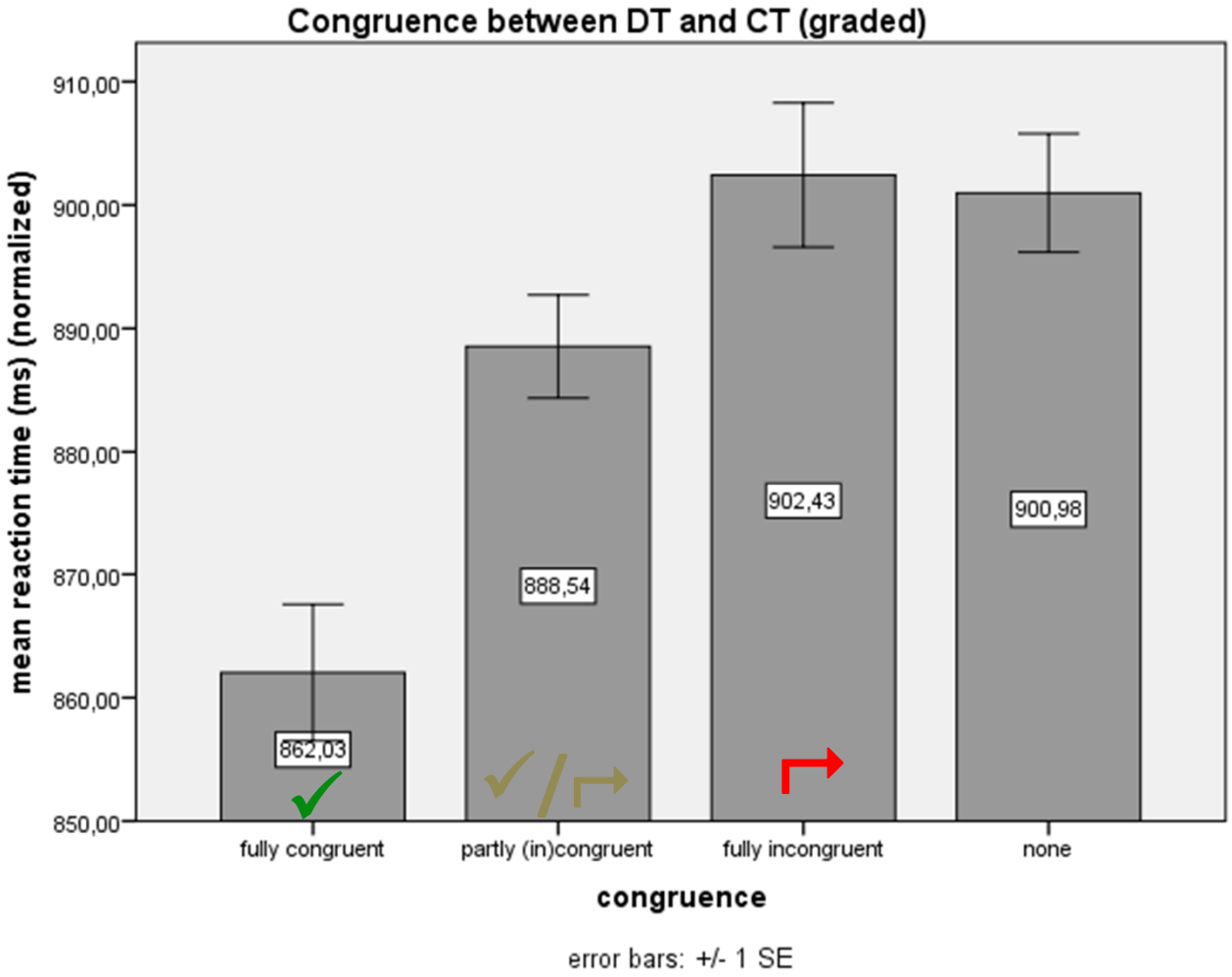
fully congruent partly (in)congruent fully incongruent

Experiment: graded congruence (2 features)

Det. Type	**Concept type**			
	sortal [–U][–R]	individual [+U][–R]	relational [–U][+R]	functional [+U][+R]
indefinite	*ein Apfel* an apple	*ein Papst* a pope	*ein Arm* an arm	*eine Mutter* a mother
definite	*der Apfel* the apple	*der Papst* the pope	*der Arm* the arm	*die Mutter* the mother
possessive	*sein Apfel* his apple	*sein Papst* his pope	*sein Arm* his arm	*seine Mutter* his mother
none	*xxxx Apfel*	*xxxx Papst*	*xxxx Arm*	*xxxx Mutter*

fully congruent partly (in)congruent fully incongruent

Experiment: Results graded congruence (2 features)



Effects:

- significant **overall congruence** effect (F(93)=10.961, p=.00)
- post-hoc comparisons show:
  - significant **facilitation by double congruent** determination (compared to any other)
  - **no** difference between incongruent vs. no determination

→ results cannot be explained by mere gender effect of determination

Psycholinguistic evidence for concept types and type shifts

SUMMARY & RESEARCH OBJECTIVES

3. Summary & research objectives

- Results show evidence for
  - the cognitive reality of the distinction of the four concept types by the two referential properties [±U] and [±R]within the CTD
  - Interaction of features/concept types and determination: congruent determination facilitates the processing of nouns

- Further questions and research objectives
  - simple or graded congruence?
  - differences in the data depending on modality of speech perception?
  - processing stage (lexical or post-lexical)?
  - mechanisms & time course of processing conceptual information?

References

Bölte, J. & Connine, C. M. (2004). Grammatical gender in spoken word recognition in German. *Perception & Psychophysics* 66, pp. 1018-1032.

Goldinger, S. D. (1997). Auditory lexical decision. In: Grosjean, F. & Frauenfelder, U. H. (Eds.). *A guide to spoken word recognition paradigms*. [Language and Cognitive Processes, 11, 559 - 567.]

Löbner, S. (2011). Conceptual Types and Determination. *Journal of Semantics* 28, pp. 279-333.

Vigliocco, G., Vinson, D., Indefrey, P., Levelt, W. J. M., & Hellwig, F. (2004). Role of grammatical gender and semantics in German word production. *Journal of Experimental Psychology: Language, Memory, and Cognition* 30, pp. 483-497.

Neurobehavioral Systems, Inc. (2012). Presentation®, a stimulus delivery and experimental control program for neuroscience. Online: [www.neurobs.com].