



# Why Crystal Barrels are Faster than Whiskey Spoons

A Frame-Theoretic Remark to Psycholinguistic Studies of Compounding

Daniel Schulzek, Carina Fueller & Peter Indefrey

Institute for General Linguistics

Heinrich-Heine University Duesseldorf

1

2

## Compounding in the CRC 991

- Cooperation of
  - C05 “Frames and Nominal Word Formation” (PI: Sebastian Löbner)
  - A04 “Accessing Conceptual Information in Language Production and Comprehension” (PI: Peter Indefrey)

## Outline

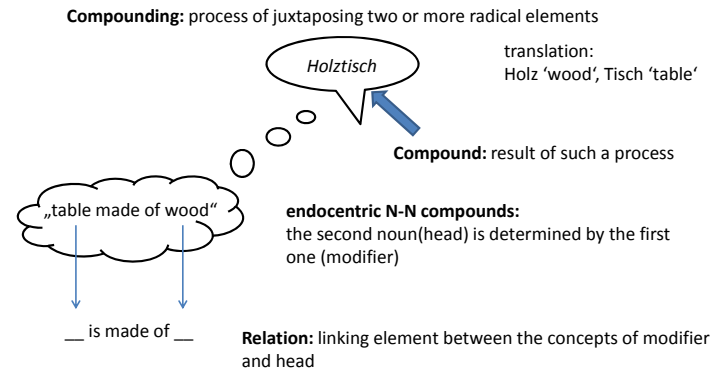
- 1 Compounding in German
- 2 Psycholinguistic Paradigms in Research on Compounding
- 3 Modeling Compound Interpretations in Barsalou Frames
- 4 Empirical Data
- 5 Relation Priming in Frames

3

4

## 1 COMPOUNDING IN GERMAN

## Terminology



5

## Compositionality

- ambiguity of compounds >> interpretation results in a reading

**Example:** *Metallsäge, Metall 'metal' Säge 'saw'*  
 reading 1: "saw made of metal"  
 reading 2: "saw for cutting metal"  
 reading 3: "saw that is stored in in a box made of metal"  
 ...

DEFINITION: The reading of a compound is **compositional** if it can be expressed in terms of the compound constituents. Otherwise the reading is called **opaque**.

**Example for an opaque meaning:** *Augenblick, Auge 'eye' Blick 'look'*  
 reading: "instant"

- focussing on relations in compositional readings

6

## 2 PSYCHOLINGUISTIC PARADIGMS IN RESEARCH ON COMPOUNDING

## Relation-set approach

Assumptions:

- relations are deduced from existing compounds and stored in the lexicon
- interpreting compounds: choosing the most plausible relation

*Holztisch*

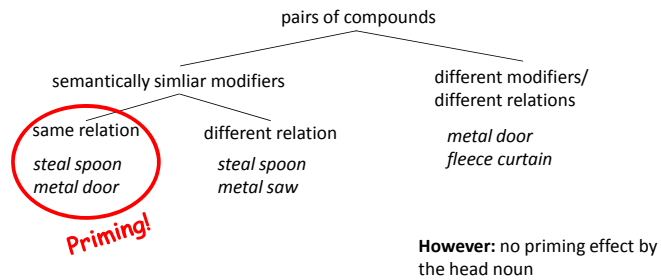


7

8

## Relation priming

- Gagné (2002): Relations can be primed by the modifier

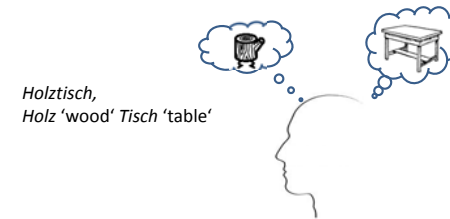


9

## Schema approach

Assumptions:

- activation of schemata by modifier and head
- Interpreting compounds as a special case of concept matching by slot filling



Some results for English compounds (cf. Wisniewski 1996, 1997) :

- Subjects can create more than 20 interpretations on the fly

10

## Comparing the Paradigms

### Relation-set approach:

- motivates why relations can be primed by the modifier +
- is not able to explain how initial relations arise -

### Schema approach:

- explains how initial or new relations arise +
- nearly no experimental support -

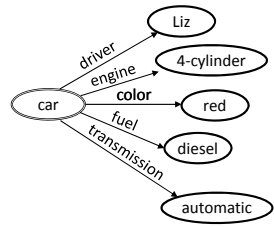
- We need a model which
  - explains how initial relations arise,
  - accounts for why relations can be primed by the modifier,
  - is empirically supported.

11

## 3 EXPLAINING COMPOUNDING IN BARSALOU FRAMES

12

## Barsalou Frames



- Mathematical modeling of frames
- frames are represented as directed graphs, where
    - arcs correspond to attributes
    - nodes correspond to values
  - attributes
    - functions mapping values on values
  - values
    - instantiation of types
    - ordered in a type hierarchy of specification

(cf. Petersen 2007)

13

## Compound Interpretation in Frames

### Thesis:

- Interpretations of compounds correspond to operations on frames.
- These operations result in specific readings.

**Example:** *Holztisch*, Holz 'wood' Tisch 'table'  
reading: "table made of wood"



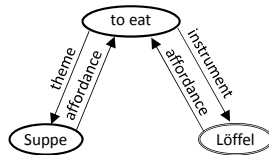
**Example:** *Ketchupflasche*, Ketchup 'ketchup' Flasche 'bottle'  
reading: "bottle that contains ketchup"



14

## Compound Interpretation in Frames

**Example:** *Suppenlöffel*, Suppe 'soup' Löffel 'spoon'  
reading: "spoon for eating soup"



### Further Examples:

*Heckenschere*, Hecke 'hedge' Schere 'shear'  
reading: "shear for cutting hedges"

*Kleiderbügel*, Kleid 'clothes' Bügel 'hanger'  
reading: "hanger for hanging clothes"

15

## Compounding and Conceptual Distance

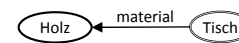
### Thesis

- Interpretations differ in complexity.
- Complexity can be measured in the length of paths in frame graphs.

#### Type 1: Attribute compounds

- modifier frame is directly linked to the head frame

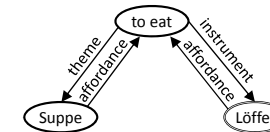
**Example:** *Holztisch*, Holz 'wood' Tisch 'table'  
reading: "table made of wood"



#### Type 2: Frame compounds

- frames of modifier and head are linked by an implicitly given action frame

**Example:** *Suppenlöffel*, Suppe 'soup' Löffel 'spoon'  
reading: "spoon for eating soup"



➤ **Research question:** How can we get empirical support for our frame analysis?

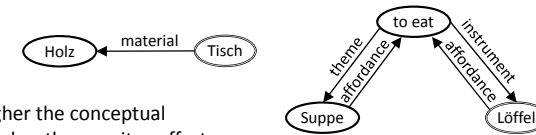
16

## 4 EMPIRICAL DATA

## Hypothesis

**Type 1: Attribute compounds**      **Type 2: Frame compounds**

Representatives      material\_\_object      theme\_\_instrument



- Thesis: The higher the conceptual distance the higher the cognitive effort.
- Aim: measure interpretational processes
- We have to make sure that the investigated compounds are not lexicalized.
- ❖ Hypothesis: The interpretation of frame compounds should take longer than that of occasional attribute compounds.

17

18

## Stimuli

**Condition I** frequently occurring compounds (German compounds with > 130.000 hits on [Google](#))

	Experimental Condition	Control Condition
<b>für</b> 'for'	<b>(a1) Frame compounds</b> <Theme – Instrument> <i>Suppenlöffel</i> Suppe 'soup' Löffel 'spoon' „Löffel für Suppe“ 'Spoon for soup'	<b>(b1) Attribute compounds</b> <Content – Container> <i>Salatschüssel</i> Salat 'salad' Schüssel 'bowl' „Schüssel für Salat“ 'Bowl for salad'
<b>aus</b> 'made of'	<b>(a2) Attribute compounds</b> <Material – Instrument> <i>Plastiklöffel</i> Plastik 'plastic' Löffel 'spoon' „Löffel aus Plastik“ 'Spoon made of plastic'	<b>(b2) Attribute compounds</b> <Material – Container> <i>Glasschüssel</i> Glas 'glass' Schüssel 'bowl' „Schüssel aus Glas“ 'Bowl made of glass'

19

## Stimuli

**Condition II** occasional compounds (German compounds with < 55 hits on [Google](#))

	Experimental Condition	Control Condition
<b>für</b> 'for'	<b>(a1) Frame compounds</b> <i>Whiskylöffel</i> Whisky 'vol. 40%' Löffel 'spoon' „Löffel für Whisky“ 'Spoon for whisky'	<b>(b1) Attribute compounds</b> <i>Softschüssel</i> Saft 'juice' Schüssel 'bowl' „Schüssel für Saft“ 'Bowl for juice'
<b>aus</b> 'made of'	<b>(a2) Attribute compounds</b> <i>Kristalllöffel</i> Kristall 'crystal' Löffel 'spoon' „Löffel aus Kristall“ 'Spoon made of crystal'	<b>(b2) Attribute compounds</b> <i>Titanschüssel</i> Titan 'titanium' Schüssel 'bowl' „Schüssel aus Titan“ 'Bowl made of titanium'

20

What did we expect?

	Experimental Condition	Control Condition
C1: frequent compounds	(a1) Frame compounds <Theme – Instrument> <i>Suppenlöffel</i> <i>Suppe</i> 'soup', <i>Löffel</i> 'spoon'	(b1) Attribute compounds <Content – Container> <i>Salatschüssel</i> <i>Salat</i> 'salad' <i>Schüssel</i> 'bowl'
	(a2) Attribute compounds <Material – Instrument> <i>Plastiklöffel</i> <i>Plastik</i> 'plastic' <i>Löffel</i> 'spoon'	(b2) Attribute compounds <Material – Container> <i>Glasschüssel</i> <i>Glas</i> 'glass' <i>Schüssel</i> 'bowl'
C2: occasional compounds	(a1) Frame compounds <Theme – Instrument> <i>Whiskyloffel</i> <i>Whisky</i> 'whisky' <i>Löffel</i> 'spoon'	(b1) Attribute compounds <Content – Container> <i>Saftschüssel</i> <i>Saft</i> 'juice' <i>Schüssel</i> 'bowl'
	(a2) Attribute compounds <Material – Instrument> <i>Kristalllöffel</i> <i>Kristall</i> 'crystal' <i>Löffel</i> 'spoon'	(b2) Attribute compounds <Material – Container> <i>Titanschüssel</i> <i>Titan</i> 'titanium' <i>Schüssel</i> 'bowl'

No difference in reaction times

Longer reaction times for frame compounds

No difference in reaction times

21

Method & Procedure

Pretest: **Plausibility rating** of the Paraphrases by 80 students with German as their only native language

Subjects: **30** right-handed native speakers of German

Design: **online, within-subjects**

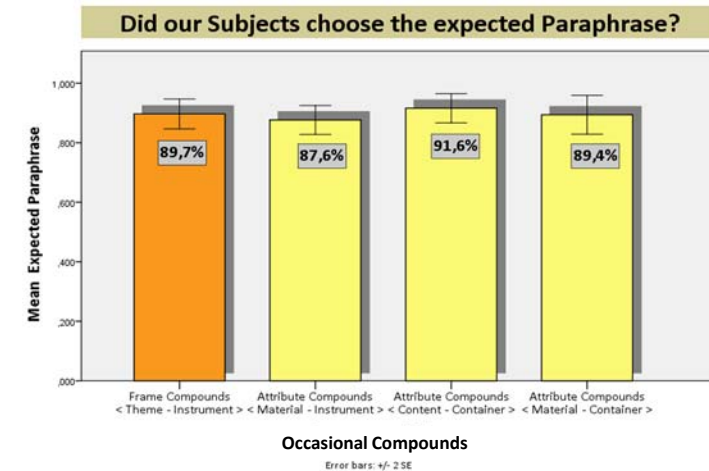
Procedure: **forced choice paradigm**

- visual presentation of the compounds on a computer screen in a sound attenuated booth at the reaction time lab of the HHU
- pseudo-randomized order of the stimuli to avoid relation-priming effects as shown by Gagné (2002)

22

Suppenlöffel

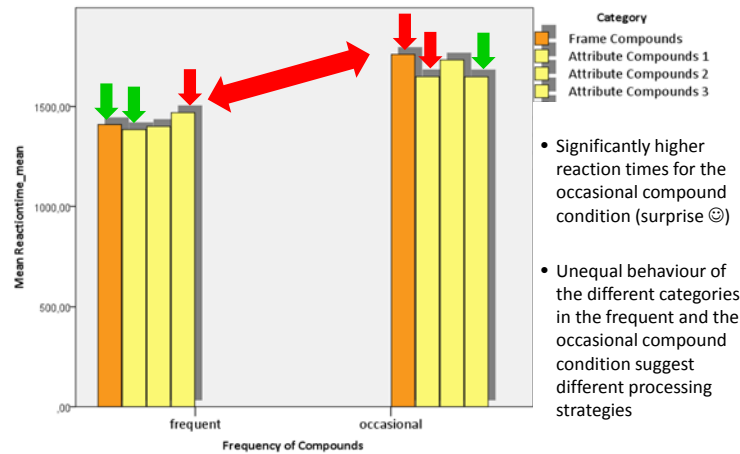
Löffel aus Suppe
Löffel für Suppe



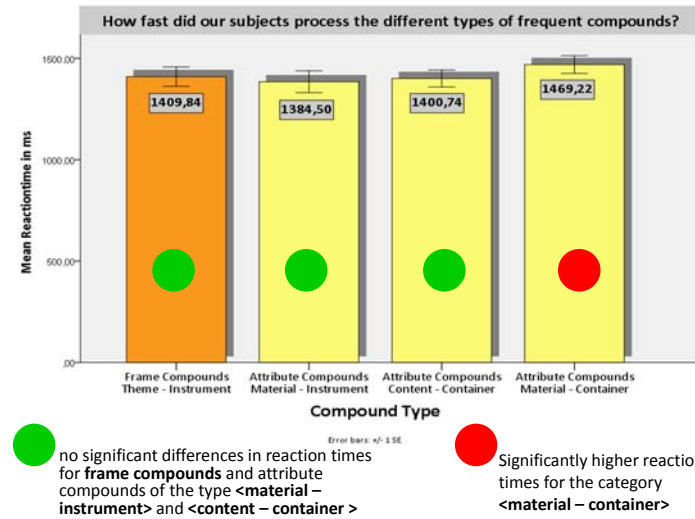
- Subjects chose significantly more often the expected paraphrase ( $p < .01$ )
- The distribution of unexpected paraphrases did not differ for the four categories

24

# Results

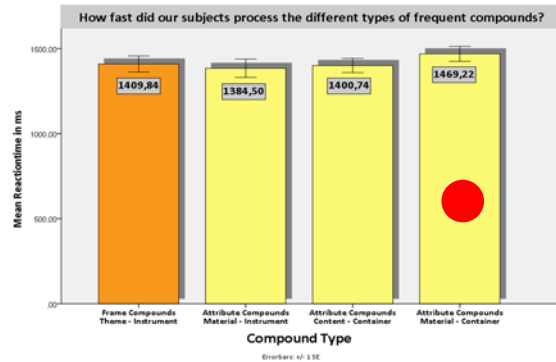


25



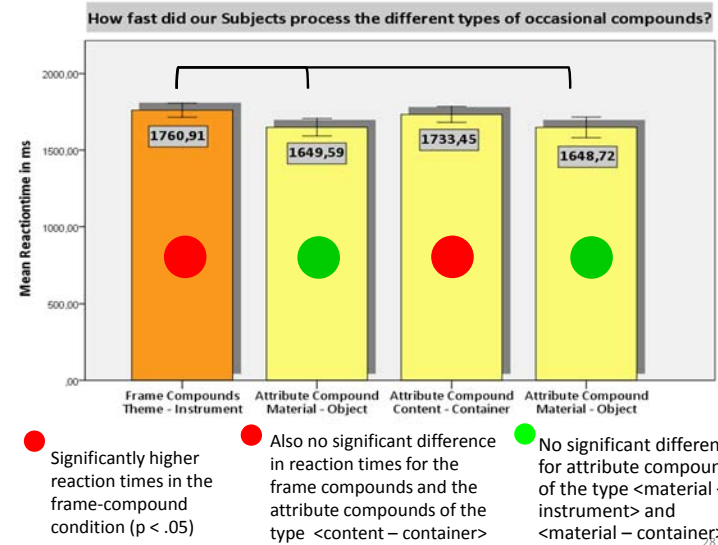
26

## Explanation: Frequency Effect

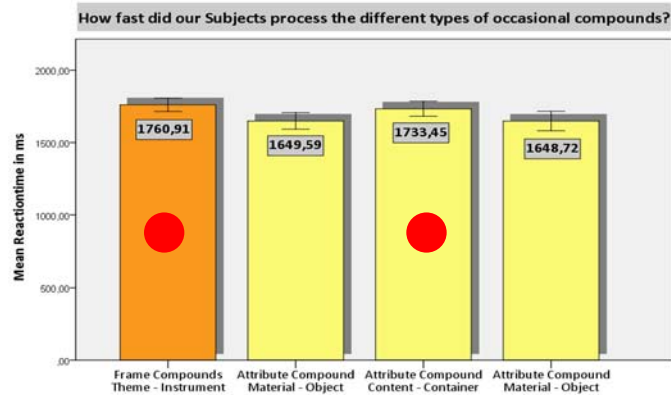


A look into the Leipzig Corpora Collection (LCC) reveals, that compounds of this type are considerably less frequent in German

27



## Explanation: A Categorical Error



A closer look at the two types of compounds reveals that we most likely modelled a different reading than is normally preferred unfortunately both readings can be expressed by the paraphrase *für* 'for'

29

## Categorical Error

- Error in defining the preferable reading

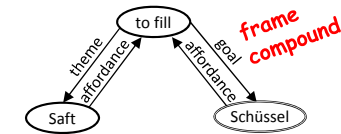
**reading 1:** "container that contains sth."  
**vs.**  
**reading 2:** "container that is made for filling it with sth."

**Example:** *Saftschüssel*, *Saft* 'juice' *Schüssel* 'bowl'

**reading 1:** "bowl that contains juice"



**reading 2:** "bowl that is made for filling it with juice"



30

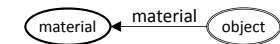
## Analogy Interpretations in Frames

- **Question:** How is it possible that relations can be primed (as Gagné 2002 demonstrated)?
- Solution builds on type hierarchies of values

- Analogy interpretation

- generating templates by value modification
- interpretation of new compounds by slot filling

**Example:** *Holztisch*, *Holz* 'wood' *Tisch* 'table'



**Example:** *Stahltür*, *Stahl* 'steal' *Tür* 'door'

32

## 5 RELATION PRIMING IN FRAMES

31



## Summary & Outlook

- Barsalou frames offer a tool to make predictions about the complexity of interpretational processes.
- Frame compounds may reflect greater conceptual distance and therefore greater cognitive effort which result in higher reaction times.
- Frames give rise to a schema approach on compounding in which the phenomenon of relation-priming can be explained.
- Open question: Are the compounds of the type content\_\_container frame compounds?

33

## More on...

- Compounding in Frames
- Empirical Research on Language and Frames

- Conceptual Distance

Talk: "Does metonymy bridge conceptual distance?"  
by Anselm Terhalle & Peter Indefrey  
(thursday, 11.30 in lecture hall 5F)

34

## References

- Barsalou; Lawrence (1992): Frames, Concepts, and Conceptual Fields. In Lehrer, Adrienne; Kittay, Eva F. (eds.): *Frames, Fields, and Contrasts. New Essays in Semantic and Lexical Organisation*. Hillsdale, NJ: Erlbaum, p. 21 – 74.
- Gagne, Christina L. (2001). Relation and lexical priming during the interpretation of noun–noun combinations. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 27: 236–254.
- Gagne, Christina L. (2002). Lexical and Relational Influences on the Processing of Novel Compounds. *Brain and Language* 81: 723–735.
- Gagne, Christina L., and Shoben, Edward J. (1997). Influence of thematic relations on the comprehension of modifier-noun combinations. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 23: 71–87.
- Petersen, Wiebke (2007): Representation of Concepts as Frames. In: Latvijas Universitate (ed): *The Baltic International Yearbook of Cognition, Logic and Communication*. Manhattan KS: New Prairie Press (3), pp. 151 – 170.
- Wisniewski, Edward J. (1996). Construal and similarity in conceptual combination. *Journal of Memory & Language* 35, 434–453.
- Wisniewski, Edward J. (1997). When Concepts Combine. *Psychonomic Bulletin & Review* 4: 167–183.

35