

Information Sharing
Reference and Presupposition in
Language Generation and Interpretation

Kees van Deemter & Rodger Kibble

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Preface

Academic communities are sometimes separated by artificial boundaries. The linguistic community is no exception: some linguists insist on a theoretical perspective, others prefer a data-oriented or computational approach. It has often been observed that boundaries between disciplines or scientific approaches can become counterproductive if they become rigid; the present volume is an attempt to show what happens when they are taken with a pinch of salt. The papers contained in this volume might be partitioned into the three categories mentioned above, but such a partitioning would tend to obscure existing commonalities. In our view, the most important common element is what we will call *Information Sharing*.

When we express ourselves, we share information. Information sharing involves distinguishing between parts of an utterance that express *given* information (e.g., because the information has been shared before) and parts that express *new* information. Information sharing is crucial to all the papers collected in this book, regardless of their methodology. And even if we look at specific aspects of Information Sharing, such as salience, presuppositionhood, or deixis, the same picture emerges: A reader interested in how *salience* influences the form and position of a referring expression, for example, could consult papers representing each of the three types: she could read the chapters by Hendriks (theoretical), Stevenson, Jordan, and Landragin (data-oriented), or those by Kruijff et al., or Krahmer & Theune (mainly computational). A similar picture would emerge for someone interested in *deixis*: such a person would be equally likely to turn to Roberts, or to Gurney & Klipple (mainly theoretical) as to Paraboni & van Deemter (mainly computational) or Landragin et al. (data-oriented). *Presuppositions* take up a slight different position in this volume, since they are mainly studied from a theoretical perspective (Zeevat) or a data-oriented one (Spenader), but the reader

will have little difficulty finding computational approaches elsewhere (e.g., Johan Bos (2001), "DORIS 2001: Underspecification, Resolution and Inference for Discourse Representation Structures", In Proceedings of ICoS-3, Inference in Computational Semantics.)

A few additional observations may be worth reporting. Firstly, the book contains a large number of papers that address linguistic issues from the perspective of language *generation*. A focus on language generation is manifest not only in each of the computationally oriented chapters, but also in those by Stevenson, Jordan, Landragin et al., and Creswell. Language *interpretation* has long been the dominant perspective in semantics; yet, a majority of the chapters of this volume represent the opposite perspective, asking how and under what circumstances a particular kind of expression can be produced, or how a particular kind of information is best expressed. In generation, the distinction between given and new information is as crucial as it is in language interpretation. This is evident in the generation of referring expressions, for example: when a speaker wants to say something about an object, she has to use properties whose extensions are known by the hearer (i.e., *given* properties), in order to distinguish the target from a set of contextually available (i.e., *given*) 'distractors'. The distinction between given and new lies at the heart of all algorithms in this area, but the papers in this volume (most notably those by Krahmer and Theune and by Creaney) elaborate on it in nontrivial ways, by making givenness a graded notion (i.e., incorporating degrees of salience) and by applying the distinction between givenness and novelty to quantified noun phrases.

Secondly – and relating to the theme of givenness and novelty in a different way – the book counts a large number of new departures. Some of the linguistic phenomena addressed here have received little attention in the literature. This is true, for example, for the work on deixis to properties (Gurney and Klipple: 'I'd like to fly *that* high'), and for the work on emphatic reflexives (Creswell: 'The president *herself* led the discussion'). It is also true for Paraboni and van Deemter's study of document deixis (as in 'The algorithms in *the concluding section of this paper*'), and for Creaney's investigation of the computational generation of quantified noun phrases. In other cases it is mainly the methodology that is new. This holds, for example, for Spenader's chapter, which confronts Van der Sandt's theory of 'presuppositions-as-anaphors' with corpus data, and it is equally true for Jordan's corpus study of referring expressions, as well as Zeevat's application of Optimality Theory to the generation of presupposition triggers. In these latter cases, the subject of study is kept constant, but it is precisely the above-mentioned methodological perspective that the authors bring to bear on this particular subject (i.e.,

theoretical, computational, or data-oriented) that is novel. Although a majority of the chapters focus on the study of nominal expressions, the present collection contains a number of papers (most notably those by Spenader, by Zeevat, by Klipple & Gurney, by Kruijff et al., and by Landragin et al.) that set their eye beyond the noun phrase. The results are interesting, we believe, and we hope that they will prove seminal.

The idea for this book came to us after the 11th European Summer School 'Logic Language and Information' (ESSLLI) in Utrecht in 1999, when three research workshops turned out to be remarkably similar in their scope and purpose. One of the three, which was concerned with the *Generation of Nominal Expressions*, was organized by us. We are grateful to Elisabeth André, Massimo Poesio, and Hannes Rieser (who organized the workshop on *Deixis*), and to Bart Geurts, Manfred Krifka, and Rob van der Sandt (who organized the workshop on *Focus and Presuppositions*). Without their efforts, this book would have lacked its present breadth. Particular thanks are due to Bart Geurts and Paul Piwek for their editorial advice. In addition, we believe that many of the virtues that we would like to see in this volume can be traced back to the multidisciplinary spirit of the yearly ESSLLI, which has grown into so much more than just a summer school. We thank the people who reviewed the papers in this volume during any stage of their bibliographic lives: when submitted to one of the workshops, when submitted for inclusion in the book proposal, and during review of the book itself. In particular (and not counting reviewers who are also contributors to this book), we thank *David Beaver, Robert-Jan Beun, Daniel Buring, Lynne Cahill, John Carroll, Hua Cheng, Judy Delin, Christy Doran, Miriam Eckert, Bart Geurts, Jonathan Ginzburg, Tony Hartley, Petra Hendriks, Renate Henschel, Ruth Kempson, John Lee, Alice ter Meulen, David Milward, Jon Oberlander, Daniel Paiva, Paul Piwek, Massimo Poesio, Richard Power, Ehud Reiter, Rob van der Sandt, Mark Steedman, Matthew Stone, Michael Strube, Marc Swerts, and Jacques Terken* for their reviews.

We hope that, by sharing the information in this volume with CSLI Publications' readership, the different approaches to Information Sharing are brought a small step closer to integration.

Kees van Deemter and Rodger Kibble.

Contents

Contributors ix

Preface xi

- 1 Information Packaging: From Cards to Boxes 1
HERMAN HENDRIKS
- 2 Presupposed Propositions in a Corpus of Dialogue 35
JENNIFER SPENADER
- 3 Explaining Presupposition Triggers 61
HENK ZEEVAT
- 4 Demonstratives as Definites 89
CRAIGE ROBERTS
- 5 The use of emphatic reflexives with NPs in English 137
CASSANDRE CRESWELL
- 6 The Role of Salience in the Production of Referring
Expressions 167
ROSEMARY STEVENSON
- 7 Generation of Contextually Appropriate Word
Order 193
IVANA KRUIJFF-KORBAYOVÁ, GEERT-JAN KRUIJFF AND JOHN
BATEMAN
- 8 Efficient Context-Sensitive Generation of Referring
Expressions 223
EMIEL KRAHMER AND MARIËT THEUNE
- 9 Generating Descriptions Containing Quantifiers:
Aggregation and Search 265
NORMAN CREANEY

- 10 Contextual Influences on Attribute Selection for Repeated Descriptions 295**
PAMELA W. JORDAN
- 11 Towards the Generation of Document-Deictic References 329**
IVANDRÉ PARABONI AND KEES VAN DEEMTER
- 12 Some Observations on Deixis to Properties 355**
ELIZABETH KLIPPLE AND JOHN GURNEY
- 13 Relevance and Perceptual Constraints in Multimodal Referring Actions 391**
FRÉDÉRIC LANDRAGIN, ANTONELLA DE ANGELI, FRÉDÉRIC WOLFF, PATRICE LOPEZ AND LAURENT ROMARY
- Index 411**

Information Packaging: From Cards to Boxes

HERMAN HENDRIKS

This paper is organized as follows. First, in Section 1.1, an outline is given of the theory of information packaging—i.e., the structuring of propositional content in function of the speaker's assumptions about the hearer's information state—as it is presented by Vallduví (1992, 1993, 1994). Vallduví identifies the informational primitives *focus* and *ground*, *link* and *tail*, adapted from the traditional pragmatic focus/ground and topic/comment approaches, and concludes—as is explained in Section 1.2—that the exploitation of information states of hearers by the information-packaging strategies of speakers reveals that these states have at least the internal structure of a system of file cards along the lines of Heim (1982, 1983). Links, which correspond to what are traditionally known as topics and which are typically marked by L+H* pitch accents in English, say *where*—on which file card—the focal information goes, and tails indicate *how* it fits there. This conclusion is challenged in Section 1.3, where it is argued that it begs the question. *If* file card systems are assumed, *then* the information-packaging strategies do seem to contribute to efficient information exchange. The question, however, is whether this assumption itself is justified. Moreover, it will be shown that the idea that links specify a locus of update in information states that are systems of file cards is problematic for various reasons. Therefore, Section 1.4 offers an alternative account in terms of the discourse representation structures of Discourse Representation Theory (see Kamp

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1981, Kamp and Reyle 1993), which are ontologically less committed than the 'dimensionally richer' file card systems, since discourse representation structures do not come with locations. The latter aspect raises the question what purpose links *do* serve if they do not serve to specify a locus of update: a different perspective on the function of links is required. According to the perspective offered in Section 1.4, linkhood—and hence L+H* pitch accent in English—serves to signal non-monotonic anaphora: the discourse referent Y of a link is anaphoric to an antecedent discourse marker X such that $X \not\subseteq Y$. This hypothesis affects a wide range of phenomena. In addition to its contribution to an analysis of (non-)association with focus, it is shown to subsume 'non-identity' anaphora, contrastive stress, correction, pronoun referent resolution, and restrictiveness of relatives and adjectives. In Section 5, finally, it is pointed out that the account of links given here is consistent with and can actually be considered a partial execution of the intonational-informational research program that is outlined in Pierrehumbert and Hirschberg (1990).¹

1.1 Information Packaging

The notion of information packaging is introduced in Chafe (1976), where the phenomena at issue are said to 'have to do primarily with how the message is sent and only secondarily with the message itself, just as the packaging of toothpaste can affect sales in partial independence of the quality of the toothpaste inside' (Chafe 1976: 28).

The basic idea is that speakers do not present information in an unstructured way, but that they provide a hearer with detailed instructions on how to manipulate and integrate this information according to their beliefs about the hearer's knowledge and attentional state: 'to ensure reasonably efficient communication, [t]he speaker tries, to the best of his ability, to make the structure of his utterances congruent with his knowledge of the listener's mental world' (Clark and Haviland 1977: 5).

On all levels the crucial factor appears to be the tailoring of an utterance by a sender to meet the particular assumed needs of the intended

¹The present paper is a merged, updated and extended version of 'Links without Locations' and 'Information Packaging: From Cards to Boxes', which appeared in P. Dekker and M. Stokhof (eds.), *Proceedings of the Tenth Amsterdam Colloquium*, Institute of Language, Logic and Computation, University of Amsterdam, pp. 339–358, and in T. Galloway and J. Spence (eds.), *Proceedings of Semantics And Linguistic Theory VI*. CLC Publications, Ithaca, New York, pp. 75–92, respectively. Section 1.3 of the present paper is largely based on joint work of Paul Dekker (ILLC/Department of Philosophy, University of Amsterdam) and the author, who would like to thank Paul Dekker, Elisabet Engdahl, Fritz Hamm, Sieb Nooteboom, Tanya Reinhart, Enric Vallduví and two anonymous referees for cooperation, discussion and stimulation.

receiver. That is, 'information packaging in natural language reflects the sender's hypotheses about the receiver's assumptions and beliefs and strategies' (Prince 1981: 224).

For instance, sentences such as (1.1) and (1.2) are truth-conditionally equivalent in that they express the same proposition, but each of them 'packages' this proposition in a prosodically different way:²

(1.1) *The **teacher** loves ICE CREAM*

(1.2) *The **teacher** LOVES ice cream*

Typically, speakers will use (1.1) if the hearer at the time of utterance knows nothing about or is not attending to the teacher's relation to ice cream, while they will use (1.2) if the hearer at the time of utterance knows that there exists a relation between the teacher and ice cream, is attending to this relation, but does not know what it is.

Apparently, speakers are sensitive to such differences in the hearer's knowledge and attentional state, and hearers rely on this: 'speakers not using this device systematically give their listeners a harder time' (Nootboom and Terken 1982: 317).

Truth-conditionally equivalent sentences which encode different information packaging instructions are not mutually interchangeable *salva felicitate* in a given context of utterance: for example, of the above sentences, only the first one is a felicitous answer to the question *What does the teacher love?* It is this context-sensitivity that has traditionally placed information packaging within the realm of pragmatics, where two influential approaches can be distinguished, the 'topic/comment' approach and the 'focus/ground' approach.

According to the focus/ground approach, sentences consist of a 'focus' and a 'ground'.³ The focus is the informative part of the sentence, the part that (the speaker believes) makes some contribution to the hearer's mental state. The ground is the non-informative part of the

²*Italics* are used for unaccented expressions; SMALL CAPS for expressions that bear a H* pitch accent; and **boldface** is used for expressions that bear a L+H* pitch accent. This is the terminology of Pierrehumbert (1980). H* accent and L+H* accent are called A accent and B accent, respectively, in Jackendoff (1972). Occasionally, when the prosody of an example sentence is irrelevant for the discussion, it will be rendered in non-italic non-boldface lower case.

³The ground is also known as 'background', as 'presupposition' and as 'open proposition'. In phonology, the term 'focus' is often used for intonational prominence. That is, any constituent which bears pitch accent is said to be a focus. Although in general, (part of) the informational focus is marked by prosodic prominence, not every accented constituent is a focus in the informational sense. In particular, accented constituents may also be topics/links.

sentence, the part that anchors the sentence to what is already established or under discussion in (the speaker's picture of) the hearer's mental state. Although sentences may lack a ground altogether, sentences without focus do not exist.

The topic/comment (theme/rheme) approach splits the set of subexpressions of a sentence into a 'topic', the—typically sentence-initial—part that expresses what the sentence is about, and a 'comment', the part that expresses what is said about the topic. Topics are points of departure for what the sentence conveys, they link it to previous discourse. Sentences may be topicless: so-called 'presentational' or 'news' sentences consist entirely of a comment.

In Reinhart (1982), it is argued that the dimension of 'old'/'new' information is irrelevant for the analysis of sentence topics. Instead, the notion of 'pragmatic aboutness' is defined in terms of the organization of information. The set $PPA_{(S)}$ of Possible Pragmatic Assertions that can be made with a sentence S expressing proposition φ is defined as follows:

$$(1.3) \quad PPA_{(S)} = \{\varphi\} \cup \{\langle a, \varphi \rangle \mid a \text{ is the interpretation of an NP in } S\}$$

A pragmatic assertion $\langle a, \varphi \rangle$ is assumed to be *about* a . The possibility for an NP interpretation a to serve as the topic of a pragmatic assertion $\langle a, \varphi \rangle$ is subject to further syntactic and semantic restrictions, cf. footnote 10 below.

Notice, by way of example (adopted from Dahl 1974), that the sentence *The teacher loves ICE CREAM* gives rise to parallel topic/comment and ground/focus partitions as indicated in (1.4) if it answers the questions *What about the teacher?* *What does he feel?*, whereas it induces the partitions specified by (1.5) in the interrogative context *What about the teacher?* *What does he love?*

(1.4)

topic	comment
<i>The teacher</i>	<i>loves ICE CREAM</i>
ground	focus

(1.5)

topic	comment
<i>The teacher</i>	<i>loves ICE CREAM</i>
ground	focus

The fact that the two informational articulations correspond to different partitions in (1.5) shows that neither of them is by itself capable of capturing all the informational distinctions present in the sentence. Therefore, the two traditional binomial articulations of focus/ground

and topic/comment are conflated into a single trinomial and hierarchical one in Vallduví's account of information packaging (1992, 1993, 1994). The core distinction is the one between new information and anchoring, between focus and ground. In addition, the ground is further divided into the 'link', which corresponds approximately to the topic in the traditional topic/comment approach,⁴ and the 'tail'.⁵ In a picture:

(1.6) >>

topic	comment		'aboutness'
link	tail	focus	
ground		focus	'old'/'new'

Given this articulation, the answer *The teacher loves ICE CREAM* to the questions *What about the teacher?* *What does he love?* will receive the following analysis:

(1.7)

<i>The teacher</i>	<i>loves</i>	ICE CREAM
link	tail	focus
ground		focus

Roughly speaking, the different parts—focus and ground, link and tail—of a sentence *S* have the following informational functions in Vallduví's theory. The focus encodes I_S , the *information* of *S*, which can be metaphorically described as ϕ_S , the proposition expressed by *S*, minus K_h , the information (the speaker presumes) already present in the hearer's information state. The ground performs an *ushering* role—it specifies the way in which I_S fits in the hearer's information state: links indicate *where* I_S should go by denoting a location in the hearer's information state, and tails indicate *how* I_S fits there by signaling a certain mode of information update.

Of course, talking about ushering information to some location in the hearer's information state presupposes that this information state has some sort of internal structure. In this respect, Vallduví purports to agree with Heim that there has to be some additional internal structure in the hearer's model of the common ground that plays an important role in natural language interpretation, even if this internal structure

⁴To the extent that links correspond to the *topic* in the traditional topic/comment distinction, Vallduví's theory is quite similar to the analysis of sentence topics presented in Reinhart (1982), in whose formalization of a pragmatic assertion of φ about *a* as $\langle a, \varphi \rangle$ the topic *a* could be construed as a kind of 'locus of update' for φ (see below). The two approaches differ in that Reinhart allows assertions without a 'locus of update' (since also $\varphi \in \text{PPA}_{(S)}$) and topics that express new information.

⁵The hierarchy does not imply constituency or (even) continuity. In particular, the two parts (link and tail) of the ground may not constitute a linear unit at the surface. Moreover, sentences may have more than one link, and more than one element may constitute the tail.

is of tangential relevance in truth value computation. 'It is this internal structure of information states which is, in fact, crucially exploited by the different information-packaging strategies used by speakers in pursuing communicative efficiency' (Vallduví 1994: 7).

1.2 Files in Focus

In fact, Vallduví takes the metaphor of Heim's file change semantics (1982, 1983) literally, in that he assumes that the information in the hearer's model is organized in files, i.e., collections of file cards. Each file card represents a discourse entity: its attributes and its links with other discourse entities are recorded on the card in the form of conditions. Such a discourse entity may be known to the hearer but not salient at the time of utterance, it may be salient at the time of utterance, it may be completely new to the hearer, it may be inferable from what the hearer knows, etc. Discourse entities mediate between referring expressions (noun phrases) and entities in the real world: indefinite noun phrases prompt hearers to create a new file card, and definite noun phrases incite them to retrieve an already existing file card. Both definites and pronouns denote already existing file cards, but pronouns denote salient file cards, whereas (other) definites refer to non-salient ones. File change comprises the above aspects of file card management, but it also involves content update, i.e., the incorporation of information conveyed by a given sentence into records on novel and familiar file cards, and this is where Vallduví lets information packaging come in. Links are associated with so-called GOTO instructions. In file change semantics, the target location of such a declaration is a file card *fc*. A tail points at an information record—normally a (possibly underspecified) condition—on such a file card, $\text{RECORD}(fc)$, and indicates that it has to be *modified* (or further specified) by the focus information I_S of the sentence. The associated instruction type is called UPDATE-REPLACE. In the absence of a tail, the focus information I_S of a sentence is simply *added* at the current location. The associated instruction type is called UPDATE-ADD.

Sentences may lack links and tails (recall that the focus is the only non-optional part of a sentence), so the following four sentence types can be distinguished:

- (1.8)
- a. link-focus
 - b. focus
 - c. focus-tail
 - d. link-focus-tail

The respective sentence types in (1.8) are associated with the (compound) instruction types in (1.9):

- (1.9) a. $\text{GOTO}(fc)(\text{UPDATE-ADD}(I_S))$
 b. $\text{UPDATE-ADD}(I_S)$
 c. $\text{UPDATE-REPLACE}(I_S, \text{RECORD}(fc))$
 d. $\text{GOTO}(fc)(\text{UPDATE-REPLACE}(I_S, \text{RECORD}(fc)))$

The sentence and instruction types in (1.8) and (1.9) can be illustrated with the following examples, where links, tails and foci are specified by means of [L...], [T...] and [F...] brackets, respectively, and accented expressions in foci and links are—as above—written in small caps (representing H* pitch accent) and boldface (for L+H* pitch accent), respectively:

- (1.10) a. link-focus: [L *The boss*][F *hates* BROCCOLI]
 $\text{GOTO}(fc)(\text{UPDATE-ADD}(I_S))$
 b. focus: [F *He always eats* BEANS]
 $\text{UPDATE-ADD}(I_S)$
 c. focus-tail: [F *He is* NOT][T *dead*]
 $\text{UPDATE-REPLACE}(I_S, \text{RECORD}(fc))$
 d. link-focus-tail: [L *The boss*][F *HATES*][T *broccoli*]
 $\text{GOTO}(fc)(\text{UPDATE-REPLACE}(I_S, \text{RECORD}(fc)))$

As regards the first example, suppose that a newly appointed temp is ordering dinner for the boss and asks the executive secretary whether there is anything that he should know about the boss' taste. The executive secretary gives the following answer:

- (1.11) [L *The boss*][F *hates* BROCCOLI]

Example (1.11) is a link-focus* construction, and as such it is associated with a $\text{GOTO}(fc)(\text{UPDATE-ADD}(I_S))$ instruction. The link subject *the boss* specifies a locus of update *fc*, viz., the card representing the boss—card #25, say. The focus verb phrase *hates broccoli* specifies the information I_S that has to be added to this card. Suppose that broccoli is represented by card #136. Then, passing over some formal details, the $\text{UPDATE-ADD}(I_S)$ instruction associated with the focus *hates broccoli* amounts to adding the condition 'hates(25,136)' to the locus of update, i.e., the boss' card #25. Moreover, the record ' $\boxed{\mapsto 25}$ ', a pointer to the locus of update, is added to card #136, rendering the condition 'hates(25,136)' on card #25 'accessible' from card #136. Vallduví says that this linking mechanism, which designates a unique location for content update, is 'much more efficient' than straightforward multiple

recording of information on cards.

25		136		25		136	
boss(25)		broccoli(136)	⇒	boss(25)		broccoli(136)	
				hate(25,136)		↪ 25	

(1.12) [F *He always eats BEANS*]

Example (1.12), an all-focus construction, is associated with a simple UPDATE-ADD(I_S) instruction. Here, this instruction involves the addition of the focus information I_S that the value of the current card always eats beans. That is: if it is interpreted immediately after example (1.11) and if its adverbially modified transitive verb phrase is left unanalyzed for simplicity, it amounts to adding the condition 'always eats beans(25)' to card #25.

The presence of a tail in a sentence signals a mode of update different from the straightforward UPDATE-ADD(I_S) instruction. A tail indicates that a (possibly underspecified) record on a file card has to be replaced (or specified further). The material in the tail serves the purpose of determining *which* record. Suppose, for example, that (1.13) is a reaction to the statement *Since John is dead, we can now split his inheritance*:

(1.13) *I hate to spoil the fun, but* [F *he is NOT*][T *dead*]

With this focus-tail example, the speaker instructs the hearer to replace the record on the current locus of update—card #17, say, for John—expressing that the value of card #17 is dead by one saying that he is not dead. In short, the tail serves to highlight a condition on file card #17, the one saying its value is dead. This condition is then modified in the way specified by the material in the focus.

In addition to the option of replacing a record on a file card, there is the possibility of further specifying an underspecified record, something which is assumed to be going on in the link-focus-tail example (1.14) given below. Suppose now that the newly appointed temp asks the executive secretary whether it was a good idea to order broccoli for the boss, and that the executive secretary gives the following answer:

(1.14) [L *The boss*][F *HATES*][T *broccoli*]

The idea is that the temp has an underspecified record on his card for the boss, which says that the boss has some attitude towards broccoli. The lack of information about the nature of this attitude is reflected by the record 'ATT', and it is this record which is replaced by 'hate' after