

7. The processing of pragmatic information in discourse

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1. Introduction

A cognitive view on pragmatics should not only account for a cognitively plausible analysis of pragmatic phenomena from a linguistic point of view, it should also deal with language users' on-line processing, as well as with the cognitive mechanisms and representations involved. This chapter focuses on the psycholinguistic research on mental operations and representations: how do humans process pragmatic information? What is the role of crucial pragma-linguistic characteristics in the cognitive representation people make of the information they have processed? We will focus on issues at the discourse level. After all, people use language to communicate, and even though we sometimes use short messages of one word (*Dirk! Okay, Stop!*) or one sentence (*I declare the games opened.*) to get the message across, language users usually communicate through discourse. The importance of the discourse level for the study of language and linguistics can hardly be overestimated: "Discourse is what makes us human" (Graesser, Millis, and Zwaan 1997). It is not surprising, therefore, that the study of text and discourse has become an increasingly important area over the past decades, in both linguistics and psychology.

2. The connectedness of discourse: cohesion and coherence

Within the field of linguistics, pragmatics and semantics have a significant role to play in the study of discourse. A central objective of linguists working on the discourse level is to characterize discourse connectedness. Linguists have traditionally approached this problem by looking at overt linguistic elements and structures, thereby characterizing it in terms of cohesion (Halliday and Hasan 1976). Connectedness is localized in the discourse itself because of explicit linguistic clues like pro-

nouns referring to previously mentioned subjects, or conjunctions, such as *because*, expressing a causal relation.

It is clear by now that the cohesion approach to connectedness is inadequate (Sanders and Pander Maat 2006, and many others). Instead, the dominant view in the field has come to be that the connectedness of discourse is a characteristic of the cognitive representation of the discourse rather than of the discourse itself (Sanders, Spooren, and Noordman 1992; Graesser, McNamara, and Louwerse 2003). The connectedness thus conceived is often called *coherence*. Language users establish coherence by actively relating the different information units in the text.

Generally speaking, there are two respects in which discourse representations cohere:

1. Referential coherence: smaller linguistic units (often nominal groups) may relate to the same mental referent;
2. Relational coherence: discourse segments (say clauses) are connected by coherence relations like CAUSE-CONSEQUENCE between them.

Although coherence phenomena are of a cognitive nature, their reconstruction is often based on linguistic signals in the text itself. Both types of coherence phenomena under consideration – referential and relational coherence – have clear linguistic indicators that can be taken as processing instructions that the speaker/writer provides to the listener/reader. In this respect, the cohesive ties identified in cohesion accounts have a role to play: they serve as the explicit linguistic signals that help readers and listeners to construct coherence in their mental representations. For referential coherence these are devices such as pronouns and demonstratives, and for relational coherence these are connectives and (other) lexical markers of relations, such as cue phrases and signalling phrases. A major research issue is the relation between the linguistic surface code (what Givón calls “grammar as a processing instructor”, 1992: 5) and cognitive representation of the discourse.

3. Referential coherence

Repeated reference to the same entity often constitutes coherence between discourse segments. This observation has a central position in several theoretical frameworks.

3.1. Varying amounts of activation: accessibility

For instance, a discourse topic may be referred to quite elaborately in the first sentence (e.g. *The well-known linguistics professor from UC Berkeley*), but once the referent has been identified, names (*Sweetser*) and later pronominal forms (*she*) suffice. This is not a coincidence. Many linguists have noted this regularity (e.g. Ariel 1990; Givón 1992; Gundel, Hedberg, and Zacharski 1993). Ariel (1990), for instance, has argued that this type of pattern in grammatical coding should be understood to guide processing. In her *accessibility theory*, “high accessibility markers” use little linguistic material and signal the default choice of continued activation. By contrast, “low accessibility markers” contain more linguistic material and signal the introduction of a new referent.

The accessibility of referential information is one of the most important challenges at the intersection of linguistic and psycholinguistic studies of text and discourse processing (Sanders and Gernsbacher 2004). Linguistic indicators of referential coherence behave according to a systematic pattern: longer linguistic forms (such as full lexical NPs) tend to be used when accessibility to the referents is relatively low, shorter forms (pronouns and zero anaphora) are used when referents are highly accessible. This linguistic theory fits in nicely with a dynamic view of text and discourse processing: when a reader proceeds through a text, the activation of concepts as part of the reader’s representation fluctuates constantly. Making use of reading time paradigm and eye-movement recording, experimental work has indeed shown how activation patterns play a role during on-line processing. Speakers and writers can be considered experts in predicating activation states of recipients. They deploy referring expressions in tune with computed levels of accessibility.

In fact, quite some work has been done in experimental research on text processing, which can be taken to demonstrate the ‘psychological reality’ of linguistic indicators of referential coherence. On-line studies of pronominal reference have re-

sulted in the formulation of cognitive parsing principles for anaphoric reference (cf. Garrod and Sanford 1994; Sanford and Garrod 1994). A classical finding is that it is easier to resolve a pronoun with only one possible referent, and it is easier to resolve pronouns with proximal referents than those with distant ones. As for the time course, eye-tracking studies have repeatedly shown that anaphoric expressions are resolved immediately (e.g., Carpenter and Just 1977; Duffy and Rayner 1990; Arnold et al. 2000).

- (1) a. *The guard mocked one of the prisoners in the machine shop.*
b. *He had been at the prison for only one week.*

In a classical eye-tracking experiment, Carpenter and Just (1977) found that when readers process sentence pairs like (1) and come upon ambiguous pronouns such as *he*, they frequently look back in the text. More than 50% of these regressive fixations land on one of the two nouns in the text preceding the pronoun, suggesting that readers indeed attempt to resolve the pronoun immediately. As for the meaning representation, it has been shown that readers have difficulty understanding the text correctly when the antecedent and referent are too far apart and reference takes the form of a pronoun.

3.2. The interplay of several linguistic factors: Centering Theory

One of the leading theories in the field of referential coherence is Centering Theory (see Walker, Joshi, and Prince 1998 for an overview). Centering Theory makes precise predictions about the referent that is ‘in focus’ at a certain moment in a discourse. It even predicts that the degree of discourse coherence is determined by the extent to which it conforms to Centering *constraints*. Given an utterance in which referential antecedents are presented, Centering Theory predicts the likelihood that an antecedent will be a central referent – which is ‘in focus’ – in the next utterance. The salience of a discourse entity is determined by a combination of syntactic, lexical and contextual factors, such as grammatical role (subject or not), expression type (zero, pronoun or NP), but also its occurrences in the preceding discourse segments.

An illuminating case in point is the resolution of ambiguous pronouns like *he* in (2a).

(2) a. *George hit Al. He...*

Several studies have shown how *grammatical role* seems to be a crucial factor in this resolution process: The referent that is intended by the author is usually the grammatical subject of the preceding sentence (Pander Maat and Sanders 2009). Such a subject preference would lead us to expect a continuation of (2a) as in (2b).

(2) b. *George hit Al. He had been wanting to do this for a long time.*

Brennan, Friedman, and Pollard (1987) and Kameyama (1996) have suggested a ranking in which the subject precedes the object(s) and in which the object(s) in turn rank higher than other grammatical functions; that is, when a referent is placed in subject position, it stands a better chance of being the central referent in the subsequent discourse than when it is an object in the preceding utterance. In a corpus study of oral reports on a basketball game, Brennan (1995) has shown that speakers tend to introduce participants as subject referents more often when they expect this participant referent to remain at the centre of attention than when subsequent events are uncertain. She also points out a difference between the ways in which referents of subject and object NPs are referred to in subsequent utterances: subject participants were more often pronominalized than object participants. Her explanation is that object referents are not yet fully established as the centre of attention, and can more easily be pronominalized after they have filled the subject position once.

The prominence of subject referents has been suggested by other theorists as well. Givón (1992: 10–11; 1995: 65–67) has suggested a similar grammatical hierarchy for what he calls *topicality*, and the corpus-statistical evidence presented in Givón (1995) supports the claim that subject referents are more persistent in subsequent discourse. Arnold (1998) has arrived at similar conclusions. Tomlin (1997) even states that – at least in many European languages – the subject role grammatically encodes topic status, and that the notion of topic by itself is superfluous.

Moreover, the subject preference in the interpretation of pronouns has received empirical support in experimental work testing Centering Theory (Gordon,

Grosz, and Gilliom 1993; Gordon and Scearce 1995; Hudson-D’Zmura and Tanenhaus 1998). For instance, when a subject referent is resumed by means of a name instead of a pronoun, the reading process is slowed down; this phenomenon has been called the ‘repeated name penalty’. In the reading time experiments carried out by Gordon, Grosz, and Gilliom (1993) and the eye-tracking experiments by Kennison and Gordon (1997), this penalty did not occur when the intended referent was in non-subject position.

3.3. Topic continuity

Pander Maat and Sanders (2009) conducted corpus studies to assess the plausibility of the theoretical ideas in Centering Theory. They systematically examined the occurrence of potentially ambiguous pronouns in language use in cases like (2). The corpus consisted of newspaper fragments in which *he* is preceded by a sentence presenting two male singular participants. It turned out that next to, among others, *grammatical role* (being a subject), the status of a referent as *discourse topic* also played a significant *independent* role in increasing the chances that a referent is the intended one for a potentially ambiguous pronoun, while *expression type* (NP or not) makes no difference.

Vonk, Hustinx, and Simons (1992) showed the relevance of discourse context for the interpretation of referential expressions in an unexpected way. Sometimes anaphors are more specific than would be necessary for their identificational function (for instance, full NPs are used rather than pronominal expressions: *The recently elected US President and former senator* rather than *Barack Obama* or *he*). The authors convincingly argue that this phenomenon can be explained in terms of the thematic development of discourse: if a character is referred to by a proper name after a run of pronominal references, then the name itself serves to indicate that a shift in topic is occurring. Indeed, readers process these referential expressions differently, as becomes apparent from reading times: it takes them longer to process these unexpected full mentions.

Whereas anaphoric reference modulates the availability of previously mentioned discourse entities, cataphoric devices change the availability of entities for the text that follows. Gernsbacher and Shroyer (1989) have demonstrated readers’

sensitivity to this type of linguistic indicator of reference. The two researchers contrasted cataphoric reference by way of the indefinite *a(n)* versus the definite *this* to refer to a newly-introduced referent in a story. For example, the new referent *egg* was introduced either as *an egg* or as *this egg*. It was hypothesized that the cataphor *this* would signal that a referent is likely to be mentioned again in the following story and that therefore the *this*-cataphor results in a higher activation. Subjects listened to texts and were then asked to continue the text after the critical discourse entity. They appeared to refer sooner and more often to an entity introduced by *this* than by *an*. These and other results show that entities that are marked as a potential discourse topic by *this* are more strongly activated, more resistant to being suppressed in activation, as well as more effective in suppressing the activation of other referents (Gernsbacher and Jescheniak 1995). It is this type of finding that provides the psycholinguistic underpinning for the idea of ‘grammar as a processing instructor’.

3.4. Parsing principles for referential coherence

By now, the results of on-line studies of pronominal reference enable the formulation of cognitive parsing principles for anaphoric reference. Person, number, and gender obviously guide pronominal resolution. More interestingly, data from reading time (Clark and Sengul 1979), eye-tracking (e.g. Duffy and Rayner 1990; Arnold et al. 2000), and priming (McDonald and MacWhinney 1995) studies show that it takes less processing cost to

- resolve pronouns with only one possible referent than pronouns with several;
- resolve pronouns with proximal referents than pronouns with distant ones;
- resolve reference to topical concepts than to less topical ones.

One obvious explanation for these findings is accessibility: anaphors are instructions to connect incoming information with already mentioned referents, and the referent nodes can be more or less accessible. As a result, it takes more or less processing time to understand anaphors.

The overview we have presented so far shows a logical division of labour in the study of referential coherence: (text and discourse) linguists identify the relevant signals that guide the interpretation, develop theories on how the linguistic realization of information systematically varies so as to ‘instruct’ the interpreters, and – ideally – check the validity of their theoretical work in natural language corpora. Psycholinguists develop cognitive theories on how the actual processing occurs and test these theories in psycholinguistic experiments. Such a division of labour is ideal, and we are indeed coming close to realizing this in recent research, which aims at gathering converging evidence from theory, corpus studies and processing experiments. For instance, Ariel (2004) has further elaborated on her Accessibility theory. She describes the linguistic means of reference to discourse entities, and in so doing distinguishes between discourse profiles and discourse functions. She then formulates specific hypotheses she encourages psycholinguists to test. In processing studies, Gernsbacher et al. (2004) used Gernsbacher’s Structure Building Framework to explain new experimental data about readers’ mental representations during narrative comprehension. The researchers specifically investigated whether readers’ access to their mental representations of the main character in a narrative becomes enhanced (producing a ‘benefit’) when the character is re-mentioned, and whether readers’ access to the main character in a narrative becomes weakened or interfered with (producing a ‘cost’) when a new character is introduced. Readers demonstrated increased accessibility to the main character when it was re-mentioned in the narrative, and readers demonstrated reduced accessibility to the main character when a new character was introduced. This work suggests that successful narrative comprehension involves managing mental representations of salient and quite often interfering characters. This study is a convincing example of a dynamic processing theory of accessibility in discourse.

3.5. Markers of topic discontinuity

We have now seen how a global discourse factor like discourse topichood has an important role to play in discourse processing. However, next to topic continuity, there is also such a thing as topic shifts: moving to another topic. Languages have different means of marking topic discontinuity. A fair number of researchers have argued that,

similar to referential expressions, temporal segmentation markers such as *next* and *at two o'clock* should be regarded as signals for a topic shift.

It has been assumed (Bestgen and Vonk 1995, 2000) that language processing relies on strategies of continuity, referred to as the “nextness principle” (Ochs 1979), or “principle of continuity” (Segal, Duchan, and Scott 1991: 32). According to these principles, readers assume by default (following Grice’s Maxim of Relevance) that continuity is maintained, hence interpreting subsequent sentences in a continuous fashion. It follows that if continuity is violated, which occurs in the case of a topic shift, it should be marked in some way (Bestgen and Costerman 1994).

Indeed, many linguists have observed that clause initial adverbials of time and place, such as *one evening*, *at twelve o'clock*, and *at the bar*, function as markers for thematic discontinuity (e.g. Virtanen 1992). In language use, speakers use temporal adverbs like *then* or *next* to introduce important shifts in the narrative (Bestgen and Costermans 1994).

Evidence for the cognitive relevance of temporal segmentation markers comes from psycholinguistic studies that show how overt marking of discontinuity affects processing. Bestgen and Vonk (1995), for example, have demonstrated that temporal segmentation markers reduce the availability of previous information, in both two-paragraph sentences and narrative texts. It turns out that the words preceding continuity markers (*and*) are more accessible than those preceding temporal segmentation markers (*then*), resulting in shorter probe recognition latencies to the former compared to the latter. These results support the idea that temporal segmentation markers function as a signal that prompts the reader to construct a new substructure. As a result, the information from the previous segment becomes less available (Gernsbacher 1990).

Additional evidence comes from a reading experiment by Bestgen and Vonk (2000) in which the effect of initial temporal adverbials on discourse processing was tested by manipulating continuous and discontinuous texts. The authors found that unmarked discontinuous discourses (3a) result in longer processing times of the target sentence (in bold) compared to its continuous (3b) version. This difference was cancelled out by the use of temporal adverbials such as *around eleven o'clock*.

Continuous

- (3) a. *I went into the kitchen to prepare the dinner. I peeled the potatoes.*

*I put the roast in a saucepan. (Around eleven o'clock)
I cut up a slice of cooked ham. I gave it to the cat[...]*

Discontinuous

- (3) b. *This Monday, I got up very late. I had a full breakfast. I decided to go for a trip in the country. I dressed myself warmly. (Around eleven o'clock) I cut up a slice of cooked ham. I gave it to the cat[...]*

If, however, the temporal expression was inserted at the end of the target sentence, it did not lead to such facilitation effects. Moreover, the facilitation was not due to sentence initial adverbials in general. The presence of adverbials like *as usual*, which are assumed not to have a segmentation function, did not affect the processing of discontinuous texts.

In addition to topic continuity, chronological distance between events also has an impact on the on-line processing of a discourse. It has been assumed that, by default, people tend to interpret subsequent events as temporally successive (Chafe 1979). In a strong version of this *iconicity principle*, this preference is taken even further, assuming that the second event is by default interpreted as immediately following the first one.

Evidence for such a preference comes from Anderson, Garrod, and Sanford (1983), who tested the on-line effects of narrative shifts. The results of their study indicated that processing is faster after a temporal adverbial that expresses a small chronological distance between events (ten minutes) compared to those that express a longer distance (seven hours). In addition, words from the text preceding the adverbial were more accessible when the chronological distance expressed by the adverbial was small. The authors explain their data in terms of a *scenario account*. According to this theory, readers interpret a discourse in scenarios. Information within the boundaries of this scenario becomes less accessible when the story moves on beyond those boundaries. Temporal markers that express a longer distance prompt the reader to construct a new event and deactivate the previous one, resulting in longer probe recognition times to information from the previous event. A disadvantage of this account, however, is that it predicts that readers can only make use of the temporal information in well-known scenarios because it relies on world knowledge of the prototypical duration of certain events. In addition, it is not clear why information within the boundaries of a

scenario should be easier to process compared to the same words when the story has moved beyond that boundary. After all, in the former case, the scenario account implies that more information has to be retained in working memory because the scenario is kept activated. This may just as well result in an increased processing load, inducing longer reading times.

Zwaan (1996) conducted a set of self-paced reading experiments which provide further evidence for the strong *iconicity principle*. The author manipulated short stories that described events which last longer than an hour but are completed within a day, see example (4). The target sentence, presented here in bold, was an unrelated event that was preceded by temporal markers. These markers varied the chronological distance from the first event from close (a moment later), to intermediate (an hour later), to distant (a day later).

(4) *The grand opening*¹

Today was the grand opening of Maurice's new art gallery.

He had invited everybody in town,

who was important in the arts.

Everyone who had been invited, had said that they would come.

It seemed like the opening would be a big success.

At seven o'clock, the first guests arrived.

Maurice was in an excellent mood.

He was shaking hands and beaming.

*A moment / an hour / a day later, **he turned very pale.***

He had completely forgotten to invite the local art critic.

And sure enough, the opening was very negatively reviewed in the weekend edition of the local newspaper.

Maurice decided to take some Advil and stay in bed the whole day.

Recognition probe: *beaming*

Reading times for the target sentence were shortest in the close condition but the intermediate and the distant condition did not differ from each other. In other words, discontinuity within the time interval of the described events caused a disruption, but the exact duration of the chronological distance did not seem to matter. Also, response

latencies to probe words from the first event significantly increased with chronological distance. Note that although the target sentence *he turned very pale* is not a plausible continuation for *a day later* because the event of turning pale is something that happens in a rather delimited period of time, this does not explain the results. In the case of the marker *an hour later* there is no such infelicity, yet this condition still led to processing difficulties.

Further control experiments excluded the possibility that these results were due to the wording of the temporal markers, differences in base-rate reading times of the temporal phrases or the plausibility of the time shifts. These results thus demonstrate that temporal discontinuity within the time interval of an event also causes processing disruption, which is not predicted by the scenario account. According to Zwaan (1996: 1205) any chronological discontinuity triggers the set-up of a new time interval, which is costly in terms of processing load.

Results like the ones described above form an illustration of how pragmatic information that marks referential coherence and topic continuity affects on-line discourse processing. If a topic discontinuity is left unmarked, readers are faced with substantial processing difficulties. Moreover, chronological distance conveyed by temporal adverbials affects the way in which language users process and represent information. When this distance increases, processing becomes more demanding and memory of preceding information decays.

4. Relational coherence

As stated earlier, a second type of coherence is constituted by *coherence relations* such as additive, causal and contrastive relations (cf. Hobbs 1979; Sanders, Spooren, and Noordman 1992; Kehler 2002), which are also known as *rhetorical relations* (Mann and Thompson 1988; Taboada and Mann 2006).

4.1. Coherence relations and their linguistic markers

Coherence relations are meaning relations connecting two or more discourse segments. A defining characteristic for these relations is that the interpretation of the re-

lated segments needs to provide more information than is provided by the sum of the segments taken in isolation. Examples are relations like CAUSE-CONSEQUENCE, LIST and PROBLEM-SOLUTION. These relations are conceptual and they can, but need not, be made explicit by linguistic markers, so-called connectives (*because, so, however, although*) and lexical cue phrases (*for that reason, as a result, on the other hand*). In pragmatics, the term *discourse marker* is often used to refer to the same items.

Next to the linguistic markers of referential coherence, the lexical markers of relational coherence can be regarded as a second type of ‘processing instructions’ to language users. Although the lexical markers vary from connectives to cue phrases and signalling phrases, and thus vary with respect to the grammatical categories to which they belong, they do have a very similar function when it comes to establishing discourse coherence.

This does not imply that explicit linguistic marking is a prerequisite for coherence, however. As stated earlier, coherence is a cognitive phenomenon, whereas cohesion directly refers to the textual items. Consider example (5), which is perfectly coherent even in the absence of a connective:

(5) *It's raining. My hair is going to be totally messed up!*

4.2. Linguistic markers of relational coherence: connectives and cue phrases

In a cognitive approach to discourse coherence, linguistic markers of coherence relations can be seen as explicit processing instructions on how one part of a text is related to another (Britton 1994; Sanders and Spooren 2007). As such, connectives are assumed to have an *integration function* (Noordman and Vonk 1997). They facilitate the integration of two text segments because they signal the relation between them. Over the past decades, a fair amount of work has studied the contribution of these markers to the on-line processing and the representation of information. Several studies have reported faster processing times for information preceded by a connective and faster recognition times to information followed by a connective.

Haberlandt (1982) observed that readers benefit from the presence of a connective. Using short narratives like (6), the author presented phrases that were pre-

ceded by a connective, such as *therefore*, *so* and *however*, and compared reading times to those for an implicit version of the same clause.

- (6) *The jet had just taken off. The left engine caught fire. The passengers were terrified. They thought the plane would crash. **However**, the pilot made a safe landing.*

The results demonstrated that the first words of the target sentence, *the pilot*, were read faster when it was preceded by a connective. Haberlandt concluded that the connective makes the relation between two clauses explicit, hence explaining the facilitation effect.

However, because the facilitation was found only in the case of the first words following the connective, this effect might just as well reflect another function of connectives. Connectives not only inform about the relation between two text segments, they also tell us something about the structure of the incoming material. This *segmentation function* may have an impact on sentence processing, since we know that the first words of a new sentence are processed more slowly compared to the same words if they do not occur sentence-initially (Haberlandt 1984). A second issue concerns the connection between the clauses without the connective. The example makes it clear that without the connective *however* it is very difficult to relate the two sentences. It is therefore possible that the facilitation effect observed here is not due to the fact that the connective makes the contrast relation explicit, but simply because the connective is a *prerequisite* for constructing the relation at all.

Besides the segmentation and the integration function, another property has been ascribed to connectives. According to Noordman and Vonk (1997), connectives trigger the inference of extra-textual information; this is also referred to as the *inference function*. There is some experimental evidence that suggests that these different functions associated with connectives are cognitively real.

Investigating the processing of sentences such as (7), Millis and Just (1994) found that the presence of the connective *because* initially leads to faster processing, but delays the processing of the final word of the second clause. Moreover, the authors report faster recognition times to a probe word from the previous clause presented at the end of the second segment. According to Millis and Just, these faster

responses are a result of the reactivation of the first clause due to integration processes.

- (7) *The elderly parents toasted their only daughter at the party [because] Jill had finally passed the exams at the prestigious university.*

Probe: *toasted*

Cozijn (2000) studied the different functions of the Dutch connective *omdat* ('because') in a series of eye-tracking experiments. The materials consisted of short expository texts with four introductory sentences followed by a target sentence (8) that was presented either with or without a connective.

- (8) *On his way to work he experienced a long delay, (because) there was a large traffic jam on the highway.*

Reading times for the target sentence were compared across conditions. Like Millis and Just, Cozijn found a speeding-up effect on the words following the connective compared to an implicit version of the same relation. Because the effect was not restricted to the first words, the author concluded that this is not merely a segmentation effect but a reflection of the integration function. In addition, an inference effect was observed. The final words of the second clause were read more slowly in the presence of a connective.

Such integration effects are not limited to connectives per se; they have also been observed when coherence relations are marked by means of signalling devices such as *The problem is* and *Another aspect might be*. Sanders and Noordman (2000) found that such signals speed up the processing of both problem-solution and list relations.

4.3. The role of various coherence relations in discourse processing and representation

But how about the effect of different coherence relations, irrespective of the role of linguistic markers? The idea that coherence relations affect text processing does in-

deed get support from results in processing studies (Sanders and Spooren 2007). Several studies suggest a processing difference between CAUSAL and NON-CAUSAL relations, such as additive ones. For one thing, causally related events in short narratives are recalled more easily than non-causally related events (Black and Bern 1981; Trabasso and Van den Broek 1985). Keenan, Baillet, and Brown (1984) and Myers, Shinjo, and Duffy (1987) demonstrated that the effect of causal connectedness on memory for sentences is greatest for moderate levels of causality. Also, causally related sentences are read faster (Haberlandt and Bingham 1978), and reading times decrease when the causality increases (Keenan, Baillet, and Brown 1984; Myers, Shinjo, and Duffy 1987).

Fewer studies exist for expository text. Sanders and Noordman (2000) embedded a similar text segment in two different contexts. In one case it was a solution to a problem, in the second case the same segment was part of an addition. It was found that PROBLEM-SOLUTION relations lead to faster processing, better verification and superior recall. The authors conclude that the processing of a text segment depends on the relation it has with preceding segments. Such findings illustrate the relevance of causal versus additive coherence relations: causally related information is encoded faster and retrieved better than additively related information, suggesting a strong processing and representational advantage for causal relations.

So far, we have looked at studies of discourse processing and representation which provide a window on the human mind at work. Studies of language acquisition provide another window on the mind, especially with respect to cognitive complexity. In areas like morphology and syntax, it has repeatedly been argued that less complex structures are acquired before more complex ones. We focus on discourse here. Most children build their first multi-clause discourse before the age of three; instead of uttering one clause at a time, they start producing combined clauses (cf. Clark 2002). At first, the coherence relations between these clauses remain implicit. Later, children learn how to use connectives to make coherence relations explicit. With regard to relational coherence, we may expect the relational categories that are distinguished to be relevant for the way in which children acquire connectives and relations. More precisely, different conceptual categories can be expected to show a different pattern in acquisition (Evers-Vermeul and Sanders 2009). For instance, learning the conceptual relation of causality as well as acquiring the linguistic tools to express it only seems to be possible on the basis of an understanding of simple additive relations:

children have to understand that events can be related, that they can be ordered in time and, subsequently, that the first event, which precedes the second, can be the cause of the second.

Indeed, the hypothesis that cognitive complexity sets the pace for the acquisition (Clark and Clark 1977: 338) of causals seems to fit available data. Both naturalistic and experimental studies of first language acquisition show that additive relations are acquired before causals, and that additive connectives are acquired before causal connectives, which appear at around age two (Clark 2002). More precisely, Bloom et al. (1980) found that English children follow the same route in acquiring coherence relations:

(9) additive < temporal < causal < adversative

Studying the transcripts of spontaneous speech data of twelve Dutch-speaking children in the CHILDES database (MacWhinney 2000), Evers-Vermeul and Sanders (2009) show that the first causal connective (as in their example 10b) does not appear before an additive connective (as in 10a) has occurred.

- (10) a. *Kim is een meisje. **En** jij bent een jongetje he?* (Thomas, 2;8.23)²
'Kim is a girl. And you are a boy, aren't you?'
- b. *Ik heb (een) beetje griep. **Want** ik ben laat gaan slapen.* (Abel, 3;3.8)
'I've got a touch of flu. Because I went to bed late.'

All Dutch children use the additive *en* before they come up with the causal connective *want*. Hence, in terms of first emergence, empirical studies of English and Dutch corroborate the idea that causal relations are more complex than additive relations.

4.4. Connectives and relations that vary in subjectivity

In pragmatics and (text) linguistics, further categorizations of connectives as well as coherence relations have been made between *objective* (content or semantic) relations and *subjective* (or epistemic and speech act, pragmatic) relations. These two types of relations differ with respect to the degree of speaker involvement or, following Lan-

gacker (1990), *subjectivity* (Pander Maat and Sanders 2001; Pander Maat and Degand 2001; Verhagen 2005), and are associated with specific markers. Examples of objective causal markers are *as a result* and *consequently*, examples of subjective markers are *therefore*, *so* and *that's why*. Recently, much (cross-)linguistic work has been done on these categories and on the way in which they are realized in connectives across languages (Stukker, Sanders, and Verhagen 2008). Here, however, our main interest is in the cognitive processes and the representation of these categories of relations and connectives.

There is reason to believe that subjective causal relations are cognitively more complex than objective ones. Subjective relations carry a higher overall degree of uncertainty than objective causals because they involve inferences about causes and effects (Degand and Pander Maat 2003). In addition, in order to understand subjective relations, you need to be able to follow the reasoning of the speaker. Objective causal relations, on the other hand, do not require such inferences, but simply relate two events in the physical world, and as such they may be easier to process. In language acquisition it has been found that children acquire at least some subjective causal relations systematically later than others; for example, corpora of Dutch and English child language data show that subjective causal relations appear later than objective relations in both English and Dutch children (Evers-Vermeul and Sanders 2010), suggesting that the former category can indeed be considered as being more complex. This difference in complexity is paralleled by on-line processing data with adults. Studying on-line text processing in English, Traxler, Bybee, and Pickering (1997) found that subjective causal relations (like 11b) produced longer reading times on the prefinal region, *bit him*, compared to objective causal relations (11a).

- (11) a. *Rick almost died from shock because a poisonous snake bit him on the leg*
b. *Rick was walking in a remote area because a poisonous snake bit him on the leg*

Noordman and de Blijzer (2000) obtained very similar results for Dutch. With a self-paced reading experiment they found that subjective causal relations took more time to process compared to objective relations. Traxler, Bybee, and Pickering propose that the difficulty of these subjective causals is explained by the inferences that readers

have to make in order to establish the relation. Because readers have to infer that the first clause is a speaker's belief rather than a fact in the world, subjective relations would require an extra inference.

One explanation for this processing difference could be that the subjective relations manipulated in such experiments are relatively far-fetched, see for example (11a, b). Another, arguably more interesting one might be that the subjective relation can only be interpreted adequately when readers understand that they are interpreting causal reasoning of the speaker or author (see Sanders, Sanders, and Sweetser [2009] for an account in the framework of Mental Spaces Theory). Once they are aware of this, subjective relations might not be so complex after all (Canestrelli, Mak, and Sanders, submitted).

Moving away from the dominant text type studied – that of informative texts – Kamalski et al. (2008) performed a self-paced reading experiment to test the effects of different markers on processing short persuasive texts. Different types of connectives and cue phrases were manipulated and each experimental item was presented with either a subjective marker or an objective marker, or remained without a marker.

Example (12) illustrates an objective manipulation (a) and a subjective manipulation (b) in this study.

- (12) a. *Such a test will assess students' writing ability, reasoning and computer skills. **Consequently**, the board can ensure that students don't graduate without possessing basic skills.*
- b. *Although some state officials worried that such a test would cause professors to gear their classes toward the test, this will ultimately have a positive effect on the quality of the state college system. **Therefore**, an exit exam for college students needs to be implemented as soon as possible. All students will benefit from such a system.*

In the objective condition, Kamalski et al. found a tendency for speeding-up for the entire clause following the connective. These data were interpreted as reflecting an integration effect without an inference effect since no slow-down could be observed. In the subjective condition an interaction between segment and marker was observed, meaning that the difference between the conditions shows variation with respect to the position in which it is measured. The authors conclude that a subjective marker in-

vokes an integration effect on subsequent material, but results in a slow-down in the final region.

So what could cause readers to slow down when they have encountered subjective coherence markers? The off-line data of this experiment revealed that *only* in the case of subjective markers did subjects give faster responses to questions about the author's intent, for example *to persuade* or *to inform*. This result suggests that readers are more aware of the author's intentions when coherence is marked by subjective markers, which may explain the observed slow-down.

Limitations of this study involve the statistical analysis of the results (see Mulder 2008 for details) and the high degree of variability between the segments for which reading times are measured, due to the experimental set-up. Nevertheless, studies like these suggest that the 'subtle' linguistic categories (subjective versus objective causal relations), as distinguished by text linguists are indeed relevant in text processing as well. Perhaps even more importantly, they show this to be the case in a genre other than that of the well-researched informative text.

4.5. Signalling global text structure

Relational coherence markers are not the only signals that affect the reading and interpretation process. Global coherence marking, such as signals and cue phrases which inform about the organization of a text, may be just as relevant in discourse processing, since they establish coherence as well. It has been consistently reported in the educationally-oriented literature that headings and topic overviews that cue the structure of a text contribute to the retention and retrieval of information and to the way in which the information is processed.

Hyönä and Lorch (2004), for example, investigated the effect of headings on on-line comprehension. Using the eye-movement technique they presented readers with texts in which the presence of headings was manipulated. These headings consisted of noun phrases such as "pandas" and "wind power" which mention the new topic. The results showed that text summaries contained more topics when headings were present. As reported in many other studies (Murray and McGlone 1997; Sanchez, Lorch, and Lorch 2001), the on-line data revealed that reading times of topic sentences are speeded up when they are preceded by a heading.

These data suggest that topic headings can indeed be seen as effective signals that facilitate the on-line comprehension processes. An important limitation to these studies is that little or no attention is paid to the actual wording of these headings. Moreover, many mixed signal studies involve the manipulation of structural and relational signals simultaneously, which makes it rather difficult to say anything independently about the effects of the manipulations (cf. Degand and Sanders 2002).

4.6. Faster processing, sloppy representation?

As we have seen so far, there is substantial evidence that (at least certain types of) connectives and cue phrases speed up the processing of the subsequent information. Still, one could question how faster processing affects the representation of the textual information afterwards. After all, if a given relation is already made clear by overt marking, the language processor has to do less work, which may result in a sloppier representation. Several researchers have investigated this matter; the empirical data so far do not yet provide a decisive picture.

It has been shown in a number of studies that overt marking of coherence relations improves the mental representation of a text. This results in better recall performance (e.g. Lorch and Lorch 1986), more complete summaries (Hyönä and Lorch 2004), faster and more accurate responses to comprehension questions (Millis and Just 1994; Degand and Sanders 2002), faster responses on verification tasks (Sanders and Noordman 2000) and a higher overall quality of recalled information (Meyer, Brandt, and Bluth 1980).

Other results, on the other hand, suggest that such markers do not have this facilitating function. Spyridakis and Standal (1987) found only a limited effect of marking on text comprehension. In addition, some studies report that linguistic markers of coherence relations do not contribute to the *amount* of information that can be recalled.

Sanders and Noordman (2000), as discussed previously, found that overt marking decreased the reading time for both problem solution and list relations, however, this manipulation did not lead to a better recall of the target information as measured with a free recall task.

So how can we account for the different results? A number of factors could explain this diverging evidence. The first is that different studies investigate different types of signals. For instance, in many experimental studies, additive, contrastive and causal relations were made explicit and subsequently compared to an implicit version of the same text. It is not clear whether different types of signals have a different impact on text representation.

A second issue is related to the experimental texts used in different studies. In many cases, connectives are plugged in between two sentences without considering the context and the plausibility of the relation. A third concern is that the operationalization of text comprehension varies. It may be the case that not all experimental methods are sensitive enough to tap into the representation of a text. Experiments that have applied the free recall method have failed to report effects of relational marking on comprehension (Meyer 1975; Sanders and Noordman 2000). It may very well be the case that other measures, such as answering and sorting tasks (Kintsch 1998), can provide very different results.

In fact, question-answering may be a more suitable test to assess text comprehension. Degand and Sanders (2002) tested the effects of causal connectives (*want, omdat, doordat*, which are all translated by *because*) and cue phrases (*the reason was, a consequence of this was*) on the comprehension of expository texts in both L1 and L2 of Dutch- versus French-speaking readers. It was found that both groups benefit from causal markers in their first as well as their second language. Overt marking led to higher accuracy on comprehension questions that concerned not only the causal relation but also other aspects of the text. Contrary to what was found in Sanders and Noordman (2000), who used free recall, these data suggest that linguistic signals do improve the representation of information. Clearly, different methods provide different results.

A fourth explanation for the differences between studies concerns the interaction of the text under investigation with reader characteristics. We know by now that readers with a high degree of knowledge about a given topic do not benefit from signals in the way that low-knowledge readers do. McNamara and Kintsch (1996), McNamara et al. (1996) and Kamalski, Sanders, and Lentz (2008) found that high-knowledge readers benefit more from an implicit version of a text. For these readers, explicit marking of local and global coherence results in an inferior representation of the text. In addition, Kamalski et al. (2008) demonstrated that this interaction depends

on the specific text genre that is manipulated. The pattern in persuasive texts differed from that in informative texts. It is still an open question, though, whether and how high-knowledge readers differ from low-knowledge readers when it comes to the on-line processing of information. With respect to topic headings it has been found that facilitation effects are modulated by reader characteristics as well. More advanced readers seem to benefit less from headings, presumably because they already apply systematic topic-processing strategies and do not rely on the instructions provided by these signals (Meyer, Brandt, and Bluth 1980; Sanchez, Lorch, and Lorch 2001). Also, other factors such as readers' goals (Noordman, Vonk, and Kempff 1992) and verbal ability (Meyer, Young, and Bartlett 1989) seem to influence the effects of relational markers.

4.7. Some pitfalls of experimental studies

Our overview demonstrates that a substantial amount of experimental work has been done in order to test the effects of pragmatic markers, such as connectives, on discourse processing. Unfortunately, it is not always possible to draw clear conclusions from such results.

One problem that arises in many experiments concerns the materials used. In a typical set-up, the processing of unmarked relations is compared to a marked version of the same relation. The idea is that, by doing so, researchers are able to measure reading times and eye-movements, or, in recent years, even neural activation, in response to identical target information in both conditions. An important point is that too often those conditions are not really comparable, because of a mismatch between the marker and the relation.

Maury and Teisserenc (2005), for instance, investigated the effects of connectives on the processing of scientific texts. The materials in this study consisted of items in which an implicit causal relation was marked by either a causal connective, an additive connective, or no connective (13). It is irrelevant to discuss all their results, but one outcome was that the additive connective *and* had a negative impact on the processing of the second clause compared to the implicit condition, while *so* only had a marginally facilitating effect. However, it would be wrong to jump to the conclusion that *and* disrupts processing and *so* does not really help either. What the au-

thors have not taken into account is that there is an intricate relation between connectives on the one hand and the properties of the relation on the other. Maury and Teisserenc compared marked relations to an implicit version, and that implicit version is clearly of a causal nature. Although the additive connective *and* allows for a causal interpretation, insertion of this connective changes the interpretation processes compared to its implicit counterpart. In order to draw sensible conclusions about the effect of the connective *and*, the implicit condition has to be of an additive nature as well.³

(13) *The chemist heats the plastic to a high temperature, the plastic spreads over the mould.*

The chemist heats the plastic to a high temperature, so the plastic spreads over the mould.

*The chemist heats the plastic to a high temperature, and the plastic spreads over the mould.*⁴

A more practical limitation to the on-line study of connectives concerns the operationalization of how reading times are measured. The different functions of causal connectives operate on different moments in time. Recall that the integration function leads to an initial speed-up, but that processing slows down at the end of the clause, due to the inference function. When reading times are not measured on the separate words (or phrases), but pooled in total reading times, these processing effects may be evened out.

To sum up, the on- and off-line effects of linguistic markers of relational coherence have been well attested to date. Yet a general problem in some experimental studies is that the text materials are not always adequate. It seems that closer collaboration between experimental psycholinguists on the one hand and (text) linguists on the other might improve this situation. What has become clear so far is that under certain conditions – e.g. readers should not be experts on the text content – readers seem to benefit from coherence signals, even though this effect is not found with all comprehension and recall methods. On-line results show that linguistic markers of coherence usually speed up processing of the immediately following information. An important question is whether it is possible to generalize over connective and relation type. For example, it is clear by now that causal connectives induce an integration effect, because they overtly signal the causal relation that holds between the clauses.

Adversative connectives, on the other hand, seem to be a prerequisite for constructing the relation, because without them, the adversative relation cannot be established in the first place. As such, their function in processing may be very different from that of causal connectives. In addition, the exact type of coherence relations also affects processing speed. Implicit causal relations are processed faster than other types of coherence relations. Therefore, the magnitude of the facilitation due to adversative markers is likely to be much larger compared to causal connectives because implicit causals are already processed relatively quickly. Further theoretical work on the nature of the semantic-pragmatic differences between various types of relations and connectives is needed in order to clarify this discussion. Cognitive Linguistics may have a role to play here, see the final section of this chapter.

5. Exploring some neurocognitive foundations of discourse processing

Recent data from neuroimaging studies involving methods such as fMRI and event related potentials (ERP) form a new and exciting contribution to the investigation of discourse processing. Not only do these techniques inform us about the neural correlates that are involved in the processing of pragmatic information, they also give insights into the exact time course of effects (in the case of ERP) and help us understand why they arise in the first place.

Experimental work on referential coherence includes some nice examples of such studies. Recently it has been demonstrated that the repeated name penalty, as discussed at the beginning of this chapter, is reflected in a clear pattern of neural activation. Almor et al. (2007) used the same items as Gordon, Grosz, and Gilliom (1993) in an fMRI experiment to investigate how repetitive reference affects the neural substrates, see example (14).

- (14) *Susan is really into animals.*
The other day Susan / she gave Betsy a pet hamster.
Susan / she reminded Betsy that such hamsters are
quite shy and need gentle handling.

Question: Does Susan like animals?

It was found that, compared to pronouns, the repetition of names elicited more activation in the left and right intraparietal sulcus, a brain region that has been associated with spatial processing in tasks that also involve the representation of several entities. This finding thus suggests that the repeated name penalty arises because of the increased representational load due to the activation of a new representation. These results fit in nicely with Ariel's Accessibility Theory, as discussed at the beginning of this chapter. In this theory, long linguistic forms are associated with referents that are low-accessible, and should therefore trigger the construction of a new referent.

With respect to global coherence, a few studies using fMRI have investigated the effects of text titles on the neural substrates involved in discourse processing. Both St George et al. (1999) and Martín-Loeches et al. (2008) studied the neural activation involved in the processing of globally coherent paragraphs with a very similar paradigm, but obtained diverging results. The authors manipulated texts that were difficult to understand without a title – a paradigm known since Bransford and Johnson (1972) – and compared the neural activation between paragraphs with and without a title.

In keeping with previous research, Martín-Loeches et al. found that the presence of a title results in higher comprehension rates and better recall of the content of a paragraph. In addition, attempts to achieve global coherence, in the case of the untitled paragraphs, resulted in an increased activation of both hemispheres. However, while St George et al. observed the largest increase in activation in the right hemisphere, Martín-Loeches et al. found that the left hemisphere was primarily involved in the process. The authors suggest that incoherent paragraphs may be read as single sentences, or even as isolated words – an idea in line with the findings of St George, Mannes, and Hoffman (1994), who found an increased N400 effect for all words in a globally incoherent text. This effect has consistently been associated with semantic integration and may reflect the difficulty in relating words and sentences when the reader cannot grasp what the story is about.

It is beyond the purpose of the present chapter to decide upon the exact location of the regions involved in establishing global coherence. Martín-Loeches et al. correctly suggest that the variance may be due to the fact that different narratives can result in different activations. Even though this matter remains unsettled, these studies do illustrate that globally incoherent texts result in a larger amount of brain activation

compared to coherent texts, which reflects the difficulties readers face when presented with incoherence.

These studies are just a few examples from a rapidly expanding field, which promises to be very significant. So far, we have only a very limited understanding of the neural basis of cognitive pragmatics, partly due to the methodological shortcomings of techniques such as fMRI. For instance, the measurement of changes in blood flow, on which this technique relies, is based on the assumption that this change reflects a change in neural activity. Yet this signal is also affected by factors that have nothing to do with neural activity (see Bartsch and Haller 2009 for discussion). Nevertheless, the contribution of neuroimaging research to the study of cognitive pragmatics is exciting and promising. The rapid developments in the field with respect to the equipment, the software, and the statistics involved will hopefully allow for more reliable and insightful experiments in the near future.

6. Conclusion and future perspectives

When we try to oversee the field of pragmatics and discourse processing in the way in which we have just sketched it, a first key question is: can we generalize about all these different linguistic markers of coherence? Can referential and relational markers really be considered to be related? And can *however* and *because* really be expected to have similar functions? On the one hand, one could argue that all coherence markers have at least one thing in common: by providing explicit information on relational and referential coherence they enable readers to construe text representations. And this effect should be visible during on-line processing as well as in discourse representations.

On the other hand, the various types of coherence markers are likely to have varied effects on the processing and representation of discourse. For instance, we have seen earlier in this chapter that objective causal connectives, expressing real-world causality between events, have a different influence on on-line processing and text representation than subjective markers that express the arguments of the author. Therefore, further research on the differences between the various markers and coherence relations is imperative.

In fact, we have seen how a cognitive approach to coherence relations (Sanders and Spooren 2009) accounts for differences in acquisition, processing and representation between positive and negative and between causal and additive relations in terms of cognitive complexity. However, such an approach does not account for the intuition of the ‘necessity’ of contrastive connectives – as in Haberlandt’s “However, the pilot made a safe landing”. In addition, it does not yet sufficiently account for the differences between objective and subjective relations. Yet Cognitive Linguistics may have a role to play here, because of its determination to provide cognitively plausible analyses of linguistic phenomena.

Fauconnier’s Mental Space framework (Fauconnier 1985, 1994) may be suitable for modelling this type of phenomena. He treats connectives as one type of so-called *space-builders*, that is, linguistic expressions that typically establish new *mental spaces*. Mental Spaces are mental constructs set up to interpret utterances, “structured, incremental sets (. . .) and relations holding between them (. . .), such that new elements can be added to them and new relations established between their elements” (Fauconnier 1994: 16). An example of a connective acting as a space-builder is the *if-then* conditional, as in *If I were a millionaire, my VW would be a Rolls*. An expression like *if p then q* sets up a new mental space *H* in which *q* holds. In other words, *if I were a millionaire* is the space-builder and in this new space my VW from the initial space is identified with the Rolls in the new space.

The theory of mental spaces seems to be particularly compatible to the conceptualization of connectives, and can help to explain the differences in processing. For instance, in this approach connectives are often treated either as elements that block certain inferences (such as *but* and *however*) or as space-builders, i.e. linguistic expressions that typically establish new mental spaces, such as *if-then* conditionals. In recent years, cognitive linguists have shown how the theory of mental spaces can be used fruitfully to clarify the meaning and use of conditionals (Dancygier and Sweetser 2000, 2005) and causals (Sanders, Sanders, and Sweetser 2009; Verhagen 2005).

From a methodological point of view, it can be concluded that the integration of cognitively plausible theories with empirical testing is the ultimate aim rather than a situation that has already been realized (Sanders and Spooren 2007), even though this tendency is clearly visible in book volumes such as *Methods in Cognitive Linguistics* (Gonzalez-Marquez et al. 2007). One way to realize this goal is to proceed with the thorough investigation of corpora of actual language use. Digital corpora

enable researchers to do this on a larger scale than ever, and recent studies show how fruitful statistic and (partly) automatic analyses of corpora can be for the area of causal verbs and connectives, too. Speelman and Geeraerts (2009) is an outstanding example on causative verbs, and on connectives, Bestgen, Degand, and Spooren (2006) have shown the way.

Furthermore, it is especially important to extend corpus research in the direction of spoken discourse. On the whole, the field of corpus-linguistic studies is still largely based on the study of written discourse. There are at least two important questions to consider: to what extent can results be generalized to apply to spoken discourse? And what do the specific insights from the linguistic analysis of spoken discourse add to the picture we have so far? At present, we have only limited results on non-written connective use (Ford 1993; Couper-Kuhlen 1996; Gohl 2000), even though this challenge has recently been taken up by, among others: Sanders and Spooren (2007); Speelman and Geeraerts (2009), Spooren et al. (2010).

Integration of text-linguistic and psycholinguistic insights is a second way to realize the goal of interaction between theory and empirical testing. The sometimes subtle semantic-pragmatic distinctions proposed by linguists, on the one hand, and the processing effects revealed by psycholinguistic research, on the other hand, still need to be linked. For instance, the general processing effects of *because* and *and* have been investigated (e.g. Millis, Golding, and Barker 1995), but there is very little experimental research into the processing instructions encoded by connectives that differ in specificity (e.g. *but* versus *although*, or *dus* versus *daardoor*). Similarly, a few processing studies have been conducted based on linguistically sophisticated analysis of the categories of relations and connectives discussed earlier in this chapter – such as the differences in subjectivity. We believe a closer integration of theoretical and corpus-linguistic work with this type of processing studies would lead to significant further progress in the research field as a whole.

Notes

¹ This is the original experimental text, including commas.

² The notation “2;8;23” stands for age in years;months;days.

³ Millis, Graesser, and Haberlandt (1993) ran into similar problems.

⁴ We only discuss a part of the materials, relevant to our discussion. Each item also included a backward version of the relation marked by *because*.

References

Almor, Amit, David V. Smith, Leonardo Bonilha, Julius Fridriksson and Chris Rorden 2007 What is in a name? Spatial brain circuits are used to track discourse references. *Neuroreport* 18(12): 1215–1219.

Anderson, Anne, Simon C. Garrod and Anthony J. Sanford 1983 The accessibility of pronominal antecedents as a function of episode shifts in narrative text. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology* 35: 427–440.

Ariel, Mira 1990 *Accessing Noun-phrase Antecedents*. London: Routledge.

Ariel, Mira 2004 Accessibility marking: Discourse functions, discourse profiles, and processing cues. *Discourse Processes* 37: 91–116.

Arnold, Jennifer E. 1998 *Reference form and discourse pattern*. Stanford, CA:Stanford University Dissertation.

Arnold, Jennifer E., Janet G. Eisenband, Sarah Brown-Schmidt, S., and John Trueswell 2000 The rapid use of gender information: Evidence of the time course of pronoun resolution from eyetracking. *Cognition* 76: 13–26.

- Bartsch, Andreas J. and Sven Haller 2009 Pitfalls in fMRI. *European Radiology* 19: 2689–2706.
- Bestgen, Yves and Jean Costerman 1994 Time, space, and action: Exploring the narrative structure and its marking. *Discourse Processes* 17: 421–446.
- Bestgen, Yves and Wietske Vonk 1995 The role of temporal segmentation markers in processing. *Discourse Processes* 19: 385–406.
- Bestgen, Yves and Wietske Vonk 2000 Temporal adverbials as segmentation markers in discourse comprehension. *Journal of Memory and Language* 42: 74–87.
- Bestgen, Yves, Liesbeth Degand and Wilbert Spooren 2006 Toward Automatic Determination of the Semantics of Connectives in Large Newspaper Corpora. *Discourse Processes* 41 (2): 175–193.
- Black, John B., and Hyman Bern 1981 Causal coherence and memory for events in narratives. *Journal of Verbal Learning and Verbal Behavior* 20: 267–275.
- Bloom, Lois, Margaret Lahey, Lois Hood, Karin Lifter and Kathleen Fiess 1980 Complex sentences: Acquisition of syntactic connectives and the semantic relations they encode. *Journal of Child Language* 7: 235–261.
- Bransford, John D. and Marcia K. Johnson 1972 Contextual prerequisites for understanding: some investigations of comprehension and recall. *Journal of Verbal Learning and Verbal Behavior* 11: 717–26.

Brennan, Susan E. 1995 Centering attention in discourse. *Language and Cognitive Processes* 10 (2): 137–167.

Brennan, Susan E., Marilyn W. Friedman and Charles J. Pollard 1987 A centering approach to pronouns. In: Proceedings of the 25th Annual Meeting of the Association for Computational Linguistics (ACL-37), 155–162. Stanford: CA.

Britton, Bruce K. 1994 Understanding expository text: Building mental structures to induce insights. In: Morton A. Gernsbacher, ed., *Handbook of Psycholinguistics*, 640–674. San Diego: Academic Press.

Canestrelli, Anneloes R., Willem M. Mak and Ted J. M. Sanders submitted
Causal connectives in discourse processing: How differences in subjectivity are reflected in eye-movements.

Carpenter, Patricia A. and Marcel A. Just 1977 Integrative process in comprehension. In: David LaBerge and S. Jay Samuels (eds.), *Basic Processes in Reading: Perception and Comprehension*, 217–241. Hillsdale NJ: Erlbaum.

Chafe, Wallace (ed.) 1979 *The Flow of Thought and the Flow of Language. Syntax and Semantics*. New York: Academic Press.

Clark, Eve V. 2002 *First language acquisition*. Cambridge: Cambridge University Press.

Clark, Herbert H. and Eve V. Clark 1977 *Psychology and Language; An Introduction to Psycholinguistics*. New York: Harcourt Brace Jovanovich.

Clark, Herbert H. and C. J. Sengul 1979 In search of referents for nouns and pronouns. *Memory and Cognition* 7: 35–41.

Couper-Kuhlen, Elizabeth 1996 Intonation and clause combining in discourse: The case of because. *Pragmatics* 6: 389–426.

Cozijn, Reinier 2000 *Integration and inference in understanding causal sentences*. Ph.D. dissertation, Tilburg University.

Dancygier, Barbara and Eve Sweetser 2000 Constructions with if, since, and because: Causality, epistemic stance, and clause order. In: Elisabeth Couper-Kühlen and Bernd Kortmann (eds.), *Cause, Condition, Concession and Contrast: Cognitive and Discourse Perspectives*, 111–142. Berlin: Mouton de Gruyter.

Dancygier, Barbara and Eve Sweetser 2005 *Mental Spaces in Grammar: Conditional Constructions*. Cambridge: Cambridge University Press.

Degand, Liesbeth and Henk Pander Maat 2003 A contrastive study of Dutch and French causal connectives on the Speaker Involvement Scale. In: Arie Verhagen and Jeroen van de Weijer (eds.), *Usage Based Approaches to Dutch*, 175–199. Utrecht: LOT.

Degand, Liesbeth and Ted Sanders 2002 The impact of relational markers on expository text comprehension in L1 and L2. *Reading and Writing* 15: 739–757.

Degand, Liesbeth, Nathalie Lefèvre and Yves Bestgen 1999 The impact of connectives and anaphoric expressions on expository discourse comprehension.

Document Design 1: 39–51.

Duffy, Susan A. and Keith Rayner 1990 Eye Movements and Anaphor Resolution: Effects of Antecedent Typicality and Distance. *Language and Speech* 33: 103–119.

Evers-Vermeul, Jaqueline and Ted Sanders 2009 The emergence of Dutch connectives; how cumulative cognitive complexity explains the order of acquisition. *Journal of Child Language* 36: 829–854.

Evers-Vermeul, Jaqueline and Ted Sanders 2010 Discovering Domains – on the acquisition of causal connectives. *Journal of Pragmatics* 43 (6): 1645–1662.

Fauconnier, Gilles 1985 *Mental Spaces*. Cambridge MA: MIT Press.

Fauconnier, Gilles 1994 *Mental Spaces: Aspects of Meaning Construction in Natural Language* (2nd ed.). Cambridge, MA: Bradford.

Ford, Celia E. 1993 *Grammar in Interaction: Adverbial Clauses in American English Conversations*. Cambridge: Cambridge University Press.

Garrod, Simon C. and Anthony J. Sanford 1994 Resolving sentences in a discourse context: How discourse representation affects language understanding. In:

Morton A. Gernsbacher (ed.), *Handbook of Psycholinguistics*, 675–698. San Diego: Academic Press.

Gernsbacher, Morton A. 1990 *Language Comprehension as Structure-building*. Hillsdale, NJ: Erlbaum.

Gernsbacher, Morton A. and Joerg D. Jescheniak 1995 Cataphoric devices in spoken discourse. *Cognitive Psychology* 29: 24–58.

Gernsbacher, Morton A. and Suzanne Shroyer 1989 The cataphoric use of the indefinite this in spoken narratives. *Memory & Cognition* 17: 536–540.

Gernsbacher, Morton A., Rachel R. W. Robertson, Paola Palladino and Necia K. Werner 2004 Managing mental representations during narrative comprehension. *Discourse Processes* 37:145–164.

Givón, Talmy 1992 The grammar of referential coherence as mental processing instructions. *Linguistics* 30: 5–56.

Givón, Talmy 1995 Coherence in text vs. coherence in mind. In: Morton Ann Gernsbacher and Talmy Givón (eds.), *Coherence in Spontaneous Text*, 59–115. Amsterdam: John Benjamins.

Gohl, Christine 2000 Causal relations in spoken discourse: Asyndetic constructions as a means for giving reasons. In: Elizabeth Couper-Kuhlen and Bernd Kortmann (eds.), *Cause, Condition, Concession and Contrast: Cognitive and Discourse Perspectives*, 35–56. New York: Mouton de Gruyter.

González-Márquez, Mónica, Irene Mittelberg, Seana Coulson and Michael J. Spivey (eds.) 2007 *Methods in Cognitive Linguistics*. Amsterdam: John Benjamins.

Gordon, Peter and Kimberly A. Searce 1995 Pronominalization and discourse coherence, discourse structure and pronoun interpretation. *Memory and Cognition* 23: 313–323.

Gordon, Peter, Barbara Grosz and Laura Gilliom 1993 Pronouns, names and the centering of attention in discourse. *Cognitive Science* 17: 311–347.

Graesser, Art C., Daniel S. McNamara and Max M. Louwerse 2003 What do readers need to learn in order to process coherence relations in narrative and expository text. In: Anne P. Sweet and Catherine E. Snow (eds.), *Rethinking Reading Comprehension*, 82–98. New York: Guilford Publications.

Graesser, Arthur C., Keith K. Millis and Rolf A. Zwaan 1997 Discourse comprehension. In: Janet Spence, John Darley and Donald Foss (eds.), *Annual Review of Psychology* 48: 163–189. Palo Alto, CA: Annual Reviews.

Gundel, Jeannette, Nancy Hedberg and Ron Zacharski 1993 Cognitive status and the form of referring expressions in discourse. *Language* 69: 274–307

Haberlandt, Karl 1982 Reader expectations in text comprehension. In: Jean F. Le Ny and Walter Kintsch (eds.), *Language and Comprehension*, 239–249. Amsterdam: North Holland

- Haberlandt, Karl 1984 Components of sentence and word reading times In: David E. Kieras and Marcel A. Just (eds.), *New Methods in Reading Comprehension research*, 219–251. Hillsdale, NJ: Erlbaum.
- Haberlandt, Karl, and George Bingham 1978 Verbs contribute to the coherence of brief narratives: Reading related and unrelated sentence triples. *Journal of Verbal Learning and Verbal Behavior* 17: 419–425.
- Halliday, Michael A. K. and Ruqaiya Hasan 1976 *Cohesion in English*. London: Longman.
- Hobbs, Jerry R 1979 Coherence and coreference. *Cognitive Science* 3: 67–90.
- Hudson-D’Zmura, Susan and Michael K. Tanenhaus 1998 Assigning antecedents to ambiguous pronouns: The role of the center of attention as the default assignment. In: Marilyn Walker, Aravind Joshi and Ellen Prince (eds.) *Centering Theory in Discourse*, 199–226. Oxford: University Press.
- Hyönä, Jukka and Robert F. Lorch 2004 Effects of topic headings on text processing: Effects from adult readers’ eye fixation patterns. *Learning and Instruction* 14: 131–152.
- Kamalski, Judith, Ted Sanders and Leo Lentz 2008 Coherence marking, prior knowledge and comprehension of informative and persuasive texts: Sorting things out. *Discourse Processes* 45: 323–345.

Kamalski, Judith, Leo Lentz, Ted Sanders and Rolf Zwaan 2008 The forewarning effect of coherence markers in persuasion: off-line and on-line evidence. *Discourse Processes* 45: 545–579.

Kameyama, Megumi 1996 Indefeasible Semantics and Defeasible Pragmatics. In: Kanazawa, Makoto, Christopher Piñon, and Henriëtte de Swart (eds.), *Quantifiers, Deduction, and Context*, 111–138. Stanford CA: CSLI.

Keenan, Janice M., Susan D. Baillet and Polly Brown 1984 The effects of causal cohesion on comprehension and memory. *Journal of Verbal Learning and Verbal Behavior* 23: 115–126.

Kehler, Andrew 2002 *Coherence, Reference, and the Theory of Grammar*. Stanford, CA: CSLI Publications.

Kennison, Sheila.M. and Peter C. Gordon 1997 Comprehending referential expressions during reading: Evidence from eye tracking. *Discourse Processes* 24: 229–252.

Kintsch, Walter 1998 *Comprehension: A Paradigm for Cognition*. Cambridge: Cambridge University Press.

Langacker, Ronald W. 1990 Subjectification. *Cognitive Linguistics* 1: 5–38.

Lorch, Elisabeth P. and Robert F. Lorch 1986 The on-line processing of summary and importance signals in reading. *Discourse Processes* 9: 489–496.

- MacWhinney, Brian 2000 *The CHILDES Project: Tools for Analyzing Talk*. Mahwah, NJ: Lawrence Erlbaum
- Mann, William C. and Sandra A. Thompson 1988 Rhetorical structure theory: towards a functional theory of text organization. *Text* 8: 243–281.
- Martín-Loeches, Manuel, Pilar Casado, Juan. A. Hernández-Tamames and Juan Álvarez-Linera 2008 Brain activation in discourse comprehension: A 3t fMRI study. *NeuroImage* 41: 614–622.
- Maury, Pascale and Amélie Teisserenc 2005 The role of connectives in science text comprehension and memory. *Language and Cognitive Processes* 20: 489–512.
- McDonald, Janet L. and Brian James MacWhinney 1995 The time course of anaphor resolution: Effects of implicit verb causality and gender. *Journal of Memory and Language* 34: 543–566.
- McNamara, Danielle S. and Walter Kintsch 1996 Learning from texts: Effects of prior knowledge and text coherence. *Discourse Processes* 22: 247–288.
- Meyer, Bonnie J. F. 1975 *The Organization of Prose and its Effects on Memory*. Amsterdam: North-Holland.
- Meyer, Bonnie J. F., David M. Brandt and George J. Bluth 1980 Use of top-level structure in text: Key for reading comprehension in ninth-grade students. *Reading Research Quarterly* 16: 72–103.

Meyer, Bonnie J. F., Carole J. Young and Brendan J. Bartlett 1989 *Memory Improved: Enhanced Reading Comprehension and Memory Across the Life Span Through Strategic Text Structure*. Hillsdale, NJ: Lawrence Erlbaum.

Millis, Keith K. and Marcel A. Just 1994 The influence of connectives on sentence comprehension. *Journal of Memory and Language* 33: 128–147.

Millis, Keith K., Jonathan M. Golding and Gregory Barker 1995 Causal connectives increase inference generation. *Discourse Processes* 20: 29–49.

Mulder, Gerben 2008 *Understanding Causal Coherence Relations*. Universiteit Utrecht: LOT

Murray, John D. and Chadd. McGlone 1997 Topic overviews and the processing of topic structure. *Journal of Educational Psychology* 89: 251–261.

Myers, Jerome L., Makiko Shinjo and Susan A. Duffy 1987 Degree of Causal Relatedness and Memory. *Journal of Memory and Language* 26: 453–465.

Noordman, Leo G. M. and Femke De Blijzer 2000 On the processing of causal relations. In: Elisabeth Couper-Kühlen and Bernd Kortmann (eds.), *Cause, Condition, Concession and Contrast: Cognitive and Discourse Perspectives*, 35–56. New York: Mouton de Gruyter.

Noordman, Leo G. M. and Wietske Vonk 1997 The different functions of a conjunction in constructing a representation of the discourse. In: Jean Costermans and Michel Fayol (eds.), *Processing Interclausal Relationships. Studies in the Production and Comprehension of Text*, 75–93. New Jersey: Lawrence Erlbaum Associates.

Noordman, Leo G. M., Wietske Vonk and Henk J. Kempff 1992 Causal inferences during the reading of expository texts. *Journal of Memory and Language* 31: 573–590

Ochs, Elinor (ed.) 1979 *Planned and Unplanned Discourse*. (Syntax and Semantics XII: Discourse and syntax.) New York: Academic Press.

Pander Maat, Henk and Liesbeth Degand 2001 Scaling causal relations and connectives in terms of speaker involvement. *Cognitive Linguistics* 12: 211–245.

Pander Maat, Henk and Ted Sanders 2001 Subjectivity in causal connectives: An empirical study of language in use. *Cognitive Linguistics* 12: 247–273.

Pander Maat, Henk and Ted Sanders 2009 Local and global determinants of forward prominence of discourse referents: two corpus studies. *Linguistics* 47: 1273–1319.

Sanchez, Rebecca P., Elizabeth P. Lorch and Robert F. Lorch 2001 Effects of headings on text processing strategies. *Contemporary Educational Psychology* 26: 418–428.

Sanders, Ted and Morton A. Gernsbacher 2004 Accessibility in discourse and text processing. *Discourse Processes* 37: 79–89.

Sanders, Ted J. M. and Leo G. M. Noordman 2000 The role of coherence relations and their linguistic markers in text processing. *Discourse Processes* 29: 37–60.

Sanders, Ted and Henk Pander Maat 2006 Cohesion and Coherence: Linguistic approaches. In: Keith Brown (ed.), *Encyclopedia of Language and Linguistics*, Volume 2. London: Elsevier.

Sanders, Ted J. M. and Wilbert Spooren 2007 Discourse and text structure. In: Dirk Geeraerts and Hubert Cuykens (eds.), *Handbook of Cognitive Linguistics*, 37–60. Oxford: Oxford University Press.

Sanders, Ted and Wilbert Spooren 2009 Causal categories in discourse – Converging evidence from language use. In: Ted Sanders and Eve Sweetser, *Causal Categories in Discourse and Cognition*, 205–246. Berlin: Mouton de Gruyter.

Sanders, Ted and Eve Sweetser (eds.) 2009 *Causal Categories in Discourse and Cognition*. Berlin: Mouton De Gruyter

Sanders, Ted, José Sanders and Eve Sweetser 2009 Causality, cognition and communication: a mental space analysis of subjectivity in causal connectives. In: Ted Sanders and Eve Sweetser, *Causal Categories in Discourse and Cognition*, 19–61. Berlin: Mouton de Gruyter.

Sanders, Ted, Wilbert Spooren and Leo Noordman 1992 Toward a taxonomy of coherence relations. *Discourse Processes* 15: 1–35.

Sanford, Anthony J. and Simon C. Garrod 1994 Selective processes in text understanding. In: Morton A. Gernsbacher (ed.), *Handbook of Psycholinguistics*, 699–720. New York: Academic Press.

Segal, Erwin M., Judith F. Duchan and Paula J. Scott 1991 The role of inter-clausal connectives in narrative structuring: Evidence from adults' interpretations of simple stories. *Discourse processes* 14: 27–54.

Speelman, Dirk and Dirk Geeraerts 2009 The role of concept characteristics in lexical dialectometry. *International Journal of Humanities and Arts Computing* 2: 221–242.

Spooren, Wilbert, Ted Sanders, Mike Huiskes and Liesbeth Degand 2010 Subjectivity and causality: A corpus study of spoken language. In: Sally Rice and John Newman (eds.), *Empirical and Experimental Methods in Cognitive/Functional Research*. Chicago: CSLI/University of Chicago Press.

Spyridakis, Jan H. and Timothy C. Standal 1987 Signals in expository prose. *Reading Research Quarterly* 22: 285–298.

Stukker, Ninke, Ted Sanders and Arie Verhagen 2008 Causality in verbs and in discourse connectives. Converging evidence of cross-level parallels in Dutch linguistic categorization. *Journal of Pragmatics* 40: 1296–1322.

St George, Marie, Suzanne Mannes and James E. Hoffman 1994 Individual differences in inference generation: An ERP analysis. *Journal of Cognitive Neuroscience* 9: 776–787.

St George, Marie, Marta Kutas, Antigona Martinez and Marty I. Sereno 1999 Semantic integration in reading: engagement of the right hemisphere during discourse processing. *Brain* 122: 1317–1325.

Taboada, Maite and William C. Mann 2006 Applications of Rhetorical Structure Theory. *Discourse Studies* 8: 567–588.

Tomlin, Russell S. 1997 Mapping conceptual representations into linguistic representations: The role of attention in grammar. In: Jan Nuyts and Eric Pederson (eds.) *Language and Conceptualization*, 162–189. Cambridge: Cambridge University Press.

Trabasso, Tom, and Paul Van den Broek 1985 Causal thinking and the representation of narrative events. *Journal of Memory and Language* 24: 612–630.

Traxler, Matthew J., Micheal D. Bybee and Martin J. Pickering 1997 Influence of connectives on language comprehension: Eye-tracking evidence for incremental interpretation. *The Quarterly Journal of Experimental Psychology* 50: 481–497.

Verhagen, Arie 2005 *Constructions of Intersubjectivity. Discourse, Syntax, and Cognition*. Oxford: Oxford University Press.

Virtanen, Tuija 1992 Discourse functions of adverbial placement in English. Åbo: Åbo Akademi University Press.

Vonk, Wietske, Letticia G. M. M. Hustinx and Wim H. G. Simons 1992 The use of referential expressions in structuring discourse. *Language and Cognitive Processes* 7: 301–333.

Walker, Marilyn, Aravind Joshi and Ellen Prince (eds.) 1998 *Centering Theory in Discourse*. Oxford: Clarendon Press.

Zwaan, Rolf 1996 Processing narrative time shifts. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 22: 1196–1207.