17 Semantic-Pragmatic Processing

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Introduction

This chapter will review some of the language comprehension research on sentence- and text-level phenomena. A central question is how we arrive at a meaningful interpretation and more specifically at the interpretation intended by the speaker. A starting point for this is Grice's (1989) theory of meaning, in which he distinguishes two notions of meaning: sentence meaning versus speaker's meaning. The latter is a reconstruction the speaker's potential intentions and often requires the hearer to draw inferences, enrich interpretation, and consider alternative expressions the speaker could have used. Accordingly, sentence and text comprehension pose specific demands on the processing system. For instance during reference processing, one of the core tasks of the processor is to keep track of referents. A referent is a person, object, or concept that is designated by a linguistic expression and to which this expressions refers. For instance, in *Henriette is happy,* the expression *Henriette* refers to a particular individual whose name is Henriette. In ongoing discourse, hearers are confronted with many different referential expressions and the question arises how the processing system manages referents—for example, Henriette may be referred to by *Henriette, she, the girl,* and so on—and which cues guide the process of reference resolution—for example, in the case of referential ambiguity such as in *Tim pinched Tom after he woke up*, where the pronoun *he* can refer to Tim or Tom. Another task of the language processor is to determine what is meant by a particular utterance: the information a speaker intends to communicate to a hearer may not be explicitly articulated, requiring the hearer to perform additional computations to extract the speaker's meaning. For example, a speaker uttering *Some cookies are burned* may in fact imply that *some but not all cookies are burned.* The comprehender's task is to decipher these implicit meaning aspects and determine what the speaker actually meant. In the following examples, reference resolution and

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pragmatic processing will be showcased to illustrate the kinds of computations and inferences required during language comprehension.

What these phenomena have in common is that they can be viewed within a model of communication where speakers and hearers cooperate with each other on the basis of conversational principles (cf. Grice, 1989). Speakers do not only rely on lexically coded meaning and grammatical principles when they produce an utterance, and hearers are aware of the subtle conversational principles that guide speakers' choices. In Grice's seminal work, speaker's meaning is obtained from the general principles of how speakers and hearers utilize language for successful communication. A speaker may use a particular form to be optimally informative, to avoid redundancy or to lower processing effort. A hearer in turn draws inferences to arrive at the speaker's meaning.

Reference resolution

In human communication, referents are introduced and referred back to continuously. For example in the following fable by Aesop in (1) below, the expression *an Arab Camel-driver* introduces a new referent into the mental representation, as well as the expressions *the lading* and *his Camel*.

(1) An Arab Camel-driver having completed the lading of his Camel, asked him which he would like best, to go up hill or down hill. The poor beast replied, not without a touch of reason: "Why do you ask me? Is it that the level way through the desert is closed?" (Aesop, translated by Worthington, 2009)

In subsequent discourse, other referential expressions, such as pronouns (*he, him*) or definite descriptions (*the poor beast*), can be used to reactivate and refer back to these referents. While pronouns or repetitions reactivate a previously introduced referent, expressions like *the poor beast* also activate additional properties about the respective referent. This distinction between new and given information will be discussed in more detail in the next section. Furthermore, speakers choose among different referential forms (pronouns, full noun phrases, etc.) with the aim of optimizing information transfer. They indicate the relative prominence of a referent within the current discourse (by using a particular form, prosodic realization or syntactic structure) and make assumptions about the cognitive status of a referent in the hearer's mind. Typically, a pronoun or null form (if available in the language's repertoire) is used when the referent is prominent and easily accessible for the hearer, and more specified forms are used for less prominent referents (Gundel *et al.*, 1993; Almor, 1999; Ariel, 2001). We return to the issue of referential prominence further below.

Information status

Let's first look at the distinction between new and given referents and its consequences for language comprehension. Traditionally, the given-new distinction has been viewed as a dichotomy (cf. e.g., Chafe, 1976). In languages that have

definiteness marking, the introduction of new referents has been correlated with indefinite marking (e.g., *a camel-driver*) and the reactivation of given referents with definiteness (e.g., *the camel-driver*) (see also Heim, 1982). However, such a rigid differentiation does not account for definite expressions like *the lading* in (1) where the use of the definite determiner indicates that the referent is somehow known to the hearer but the referent also represents a discourse-new entity. It is apparent that *the lading* is semantically associated with *camel-driving* so that an indirect semantic link between the *camel-driver* and the *lading* can be established. It is thus indirectly activated in the mental representation of the hearer and this semantic link licenses the definiteness marking of the referential expression. This latter type of definite expression has obtained numerous labels in the theoretical literature such as bridging, inferrables, associative, and indirect anaphors (Clark, 1975; Prince, 1981b; Heim, 1982; Schwarz-Friesel, 2011). These partly new and partly given entities indicate that givenness must be viewed as a continuum and they represent an important test case for the investigation of the comprehension of information status.

Using a self-paced sentence-by-sentence reading task, Haviland and Clark (1974) showed that target sentences containing a directly given (coreferential) expression (*the beer* in (2a)) were read faster than sentences containing an indirectly related expression (2b). These faster reading times demonstrate a processing advantage of given over new/inferred information. Similar results were obtained using a cued recall task, with faster recall rates for given referents (McKoon & Ratcliff, 1980). This processing advantage does not arise from mere repetition of the head noun but reflects facilitation from a coreferent available in the mental representation, which is also supported by studies testing synonymous, coreferring expressions (Yekovich & Walker, 1978).

(2) a. We got some beer out of the trunk. The beer was warm.
    b. We checked the picnic supplies. The beer was warm.

A nuanced understanding of the processing of information status can be obtained using online methods such as event-related brain potentials (ERPs). ERPs represent small voltage fluctuations that reflect spontaneous neural activity that arises in response to cognitive, motor or sensory events. They are time-locked to a stimulus (e.g., a referential expression) and provide a high temporal resolution of the underlying cognitive processes. The activity is measured in a non-invasive manner by means of electrodes positioned on the scalp. Now, ERP studies on direct and indirect anaphors indicate that information status contributes to two discrete processes. Comparing the reading comprehension of a definite expression (*the professor* in (3)) following different context sentences, the indirectly related expression (3b) elicited more processing effort than the coreferential expression (3a).

(3) a. Zoe visited a professor in Berlin. She said that the professor was very inspiring.
    b. Zoe visited a lecture in Berlin. She said that the professor was very inspiring.
    c. Zoe met Patricia in Berlin. She said that the professor was very inspiring.

Time-locked to the onset of the referential expression (*the professor*), this effort was reflected in two effects, a pronounced negative deflection with a peak latency around 400 ms after the onset of the critical expression (so-called N400) and an enhanced Late Positivity between roughly 500–800 ms post-onset (Burkhardt, 2006). These data indicate that the givenness advantage observed in previous offline measures is generated by two discrete cognitive processes. The N400 difference is associated with the effort required for accessing the referent, which is more enhanced when extra inferential work is needed to link *professor* with the previously mentioned *lecture.* The Late Positivity is attributed to processing demands arising from the introduction of a new mental representation. The biphasic pattern and the discreteness of the two processes is corroborated by a third condition in which the definite expression cannot be linked or bridged to previous discourse and is thus discourse- and hearer-new (3c). The ERPs for this condition showed an even more pronounced N400 (3a < 3b < 3c)—that is, more demands when trying to access a referent for the definite expression—and a Late Positivity that has the same amplitude as the indirect anaphor (3a < 3b/c)—suggesting that mental modal updating costs equally accrue for indirect anaphors and new referents.

Chafe (1976) and others observed that information status is also marked prosodically. In West-Germanic languages, given referents are typically deaccented and new referents receive a pitch accent to indicate their information status to the hearer. Again, intermediary prosodic realizations have been reported for different types of indirect anaphors (e.g., part-whole relations or scenario-based relations) (for English and German accent types, respectively, see Pierrehumbert & Hirschberg, 1990; Baumann & Grice, 2006). Building on the production study of Baumann and Grice (2006) who showed that a high falling accent with a low target on the accented syllable (H + L*) is the most appropriate accent type for whole-part relations (e.g., on *the sole* in (4)), it was shown that deviations from this accent pattern were penalized and resulted in processing cost (Schumacher & Baumann, 2010).

(4) Sabine repairs an old shoe. In doing so, she cuts <u>the sole.</u>

Referential prominence

Givenness is one aspect that the processing system uses to determine the relative prominence of a referent. During discourse processing, the system is confronted with an increasing amount of information but has limited resources for storing. It is therefore assumed that referents are stored in a certain ranked order. The notion of prominence may then serve as a relational property between referents that singles out one referent from the set of referents (i.e., the most prominent referential candidate). Two crucial questions arise from this. First, which features contribute to a referent being prominent in discourse? Second, how does the speaker refer to referents of different prominence in the ongoing discourse?

An inverse relation between the prominence of a referent in the mental representation and the explicitness of a particular form used by the speaker has been

proposed in linguistic research (Gundel *et al.*, 1993; Almor, 1999; Ariel, 2001). Accordingly, the speaker chooses an unstressed pronoun or null form when referring to the most prominent referent in the current set and uses a more complex form when referring to a less prominent entity (for an overview over speakers' choices in language production see Arnold, 2010). The hearer in turn uses these form-specific constraints during reference tracking.

A theory that seeks to implement some of these insights is Centering Theory, which predicts that the most prominent entity in prior discourse is picked up by a pronoun, where prominence is a function of grammatical role in English (Grosz *et al.*, 1995). This prediction is borne out by a self-paced sentence-by-sentence reading study, where the use of the proper name (*George*) evoked longer reading times in (5) in contrast to the use of the less explicit pronominal form (Gordon *et al.*, 1993). Processing costs for the more specified expression were also observed for other forms such as repeated definite descriptions vs. pronouns and in ERP studies (e.g., Almor, 1999; Swaab *et al.*, 2004).

(5) George jumped out from behind a tree and frightened Debbie. He was surprised at her hysterical reaction. <u>He/George</u> never thinks about how others might feel.

Findings like these make personal pronouns viable candidates for assessing the role of different factors on reference resolution. Such an endeavor allows for three different kinds of outcomes: i) a single feature may be identified that determines referential prominence, ii) multiple weighted features may interact with each other, or iii) form-specific mappings may apply. The first scenario can be discarded on the basis of language processing data that reveal interactions between prominence-lending features. Numerous features have been reported to contribute to a referent's prominence, including morphosyntactic features (see also the contribution by Nicol and Barss, this volume), grammatical function, linear order, distance, agentivity, animacy, topicality, givenness, coherence structure (Clark & Sengul, 1979; Chambers & Smyth, 1998; Arnold *et al.*, 2000; Kehler *et al.*, 2008; Schumacher *et al.*, 2016, among many others). One challenge for this line of research is that some of the features are tightly connected, for instance subject, topic, given, animate, and agent are often aligned, which renders the disentanglement of features rather difficult. Moreover, the question of which features influence reference resolution and how they interact with each other has only partially been answered since experimental research cannot assess the entire inventory of factors in a single study. As a result, we only have a partial understanding of prominence constraints. Note however that most of this research has been carried out with contexts that make available two competing referential candidates. In more elaborate texts, topics appear to be privileged candidates for prominence (e.g., Kaiser & Trueswell, 2008). There also seems to be an asymmetry in the interpretive preferences for different types of referring expressions as suggested by form-specific accounts. This is certainly the case for reflexives (versus pronouns) that are subject to locality constraints (e.g.,

Burkhardt, 2005; Kaiser *et al.*, 2009) but it has also been proposed for personal vs. demonstrative pronouns in English and Finnish (Brown-Schmidt *et al.*, 2005; Kaiser & Trueswell, 2008).

In addition to the choice of referential forms, the speaker can use prosodic cues to give the hearer clues about the status of a referent. We have already discussed one example for this in (4) with regard to different prosodic realizations of the degree of givenness. Another example are personal pronouns that may come in stressed or unstressed form, with the former being the more specified form, which indicates that the privileged referent is not the intended target. This was confirmed by a referent identification study that presented pronouns with and without contrastive stress in contexts such as (6) (Balogh, 2004).

(6) Excited by their costumes for the Halloween play, some of the third graders started rough-housing back stage. An alien pinched an acrobat just behind the curtain and a ghost pinched her/HER near the backdrop. Soon the whole audience heard the giggling back stage.

In the unmarked, unaccented form, the pronoun was taken to refer to the *acrobat* in the majority of cases (which is explained by effects of parallel sentence structure between the two conjoined clauses; e.g., Chambers & Smyth, 1998; Streb *et al.*, 1999). When the pronoun received a pitch accent, interpretive preferences shifted to *the alien.*

Balogh (2004) followed up on this finding with a cross-modal lexical decision priming task which probes referential processes in real-time. In this paradigm, participants perform two tasks: they listen to texts like (6) and make a lexical decision to a visually presented probe word (word vs. non-word decision). This word is presented right after pronoun-offset and is either semantically related to one of the antecedents (e.g., *space* for *alien, circus* for *acrobat*) or unrelated (length and frequency controlled *union* or *subway* for (6)). Priming describes a mechanism by which the activation of a related word shows facilitation, that is, faster lexical decision times. Applied to pronoun resolution, the preferred referential candidate should evoke a priming effect (Nicol & Swinney, 1989). The data showed that for (6) with an unaccented pronoun, only the probe word related to *acrobat* showed faster reaction times; in contrast, with the accented pronoun, a priming effect occurred for the word related to *alien*. This confirmed the referential choices made offline and further revealed that referential decisions are made immediately at the pronominal expression.

Differences in interpretive preferences have also been observed for other comparisons of referential forms such as unmarked personal pronouns vs. more specified demonstrative pronouns. Characterizations typically state that the demonstrative is the marked choice and excludes the most prominent referent (e.g., Comrie, 1997). Brown-Schmidt and colleagues (2005) investigated instructions like (7) and found that the personal pronoun (*it*) showed an interpretive bias for the initially introduced entity (*the cup*), while the demonstrative *that* was preferable resolved toward the composite (*the cup on the saucer*).

(7) Put the cup on the saucer. Now put it/that over by the lamp.

In German, demonstrative pronouns can also refer to animate referents and are typically used to indicate that the most prominent referent does not qualify as a referent. Previous research has suggested an anti-subject or anti-topic bias for the demonstrative in German (e.g., Bosch & Umbach, 2007). Schumacher *et al.* (2016) elicited the referential preferences for the personal pronoun *(er*) and the demonstrative pronoun (*der*) in sentence completion and referent selection tasks. They used two types of verbs in order to disentangle the contribution of grammatical role and thematic role on reference resolution. Active accusative verbs as in (8) canonically unite the highest grammatical and thematic role on one argument (*the magician* is the subject and the agent). Dative experiencer verbs as in (9) cross these two features, that is, *the singer* represents the highest thematic role (here the experiencer role) but is the grammatical object, while *the dancer* holds the highest grammatical role (subject) but the lower thematic role (stimulus). Note also that (9) reflects the basic argument order in connection with dative experiencer verbs.

(8) Der-NOM Zauberer wollte den-ACC umarmen. Aber er/der war viel zu klein.
The magician wanted to hug the doctor. But he-PPRO/he-DEM was way to small.

(9) Dem-DAT Sänger ist der-NOM Tänzer aufgefallen. Aber er/der will die Feier sehen.
The singer has noticed the dancer. But he-PPRO/he-DEM wants to watch the ceremony.

The investigation of interpretive preferences following contexts with dative experiencer verbs makes it possible to determine whether grammatical function or thematic role is the guiding cue during pronoun resolution. The studies registered robust preferences of the personal pronoun for the highest thematic role (*the magician* in (8) and *the singer* in (9)) and a complementary preference of the demonstrative for the lower thematic role (*the doctor* in (8) and *the dancer* in (9)).

Referential prominence can be further mediated by syntactic structure. Concerning information status, cross-linguistic data reveal that speakers tend to place given information before new information (given-new ordering). In languages with flexible word order (e.g., Finnish), the given-new linearization preference may give rise to object-initial constructions. Thus when confronted with an initial, previously introduced object, hearers subsequently expect a new referent. Measuring eye movements on a visual display during auditory comprehension (in Finnish), participants showed anticipatory looks toward the new referent even before the referential expression had been articulated (Kaiser & Trueswell, 2004). For example for (10), there was a visual display showing a doctor, a nurse and a patient.

(10) On the hospital reception desk are leaning a doctor and a nurse, and it is almost two o'clock. After a moment,

a. doctor–*object* glances-at patient–*subject*. (=The patient glanced at the doctor.)
b. doctor–*subject* glances-at patient–*object*. (=The doctor glanced at the patient.)
This patient is holding a pair of scissors.

Crucially, the context sentence mentioned only two referents (*doctor, nurse*) rendering these two discourse-given. Using the object-initial structure (which is clearly indicated by case morphology in Finnish) (10a) may be understood as a means to express given-new ordering and accordingly a discourse-new entity (*patient*) should be expected rather than a previously given entity (*nurse*). Indeed, anticipatory looks to the unmentioned entity (*patient*) were observed after verb offset and crucially before the acoustic information of the second nominal expression could have been processed. This suggests that hearers use the given-new ordering to make incremental decisions as the sentence unfolds. In the canonical subject-initial ordering (10b), no such predictions were derived.

Other ordering constraints following from the prominence cues introduced above affect referent linearization as well (cf. e.g., Bornkessel-Schlesewsky & Schlesewsky, 2009). Topicality (i.e., what an utterance is about; Reinhart, 1981) is one of the features influencing word order, because topics most often occur sentence-initially. Topicality typically presupposes the givenness of the respective referent but may be more restrictive in certain languages, like Mandarin Chinese, where the ideal topic combines features of givenness, agentivity, and animacy (Givón, 1983). A series of ERP studies revealed position-specific effects during the processing of referential expressions, indicating that entities in topic and non-topic positions are subject to distinct constraints. For Mandarin Chinese, referents in sentence-medial position confirmed the effects of givenness reported above for German (biphasic N400-Late Positivity for indirectly related referents compared to given referents; Burkhardt, 2006). Importantly, sentence-initial referents were processed on the basis of constraints on topicality, with a penalty for inanimate referents as well as for referents that induce a topic shift (Hung & Schumacher, 2012, 2014). In these studies, differences in the Late Positivity were observed when a less prominent referent occurred in topic position. This effect is taken to reflect the assessment of constraints on information packaging.

So far, this section has looked at the "backward" orientation of referential expressions, that is a pronoun or definite expression links up with a referent in prior discourse. However, referential expressions also carry a forward potential. The speaker can signal the hearer whether a certain referent is maintained in future discourse or whether a shift in the referential prominence ranking will occur. Demonstratives are powerful means to indicate such a shift and certain indefinites also have an anticipatory function (for so-called indefinite *this* see Prince, 1981a). By using these referential forms, the speaker provides a cue about the future status of the respective referent, that is, whether it is likely to be rementioned in the particular discourse or even to assume topic status. This forward-looking function has been tested via a story completion task (Gernsbacher & Shroyer, 1989). Participants heard the beginning of a prerecorded story like (11) and were asked to continue this story for 20–30 seconds.

(11) I went to the coast last weekend with Sally. We'd checked the tide schedule and we'd planned to arrive at low tide 'cuz I just love beachcombing. Right off, I found three whole sand dollars. So then I started looking for agates, but I couldn't find any. Sally was pretty busy too. She found this egg/an egg….

A regular indefinite (*an egg*) evoked only few resumptions of the particular referent but indefinite *this* elicited frequent referrals in subsequent discourse, which were also realized by less specified referential forms. Comparable data were reported for German indefinite *this* (Deichsel & von Heusinger, 2011) and for the forward-orientation associated with the demonstrative pronoun *der* in German (Schumacher *et al.*, 2015). This indicates that referential choices also convey information about the developing discourse.

This section tried to demonstrate how manifold the speaker's referential decisions are and how sensitive the hearer's mind is to these reference tracking cues. Prosodic, syntactic, semantic, and form-specific features contribute to the management of referents in ongoing discourse and they are used to guide the identification of the coreferent as well as provide cues for the makeup of the unfolding discourse. In the next section, we turn to examples of meaning constitution that involve implicit meaning constituents.

Inferences

In Gricean pragmatics, speaker's meaning reflects the reconstruction of the speaker's (potential) intentions. The speaker attempts to make a contribution that is true, informative, relevant, and perspicuous and very often exploits these principles to implicate meaning. The hearer is expected to detect the exploitation or flouting of a conversational principle and infer the speaker's meaning. There is often a trade-off between saying as much as one can and saying no more than required (cf. Horn's Q- and R-Principle; Horn, 1984). A waiter uttering for instance (12) (from Nunberg, 1979) does certainly not mean that the food item is sitting at the table but rather intends to refer to the ham sandwich orderer or eater. The waiter only uses this shortcut to refer to the customer when he assumes that the addressee is able to draw the relevant inference. We will return to this case of meaning shift in the next section.

(12) The ham sandwich is sitting at Table 20.

Similarly, the speaker of (13) may implicate that some but not all students fell asleep. By using the scalar term *some*, she signals that she has no reason to use the stronger, more informative term *all* (Horn, 1972). Note however that scalar implicatures can be canceled (*Today some students fell asleep, in fact all of them did.*). The processing of implicatures will be reviewed below.

(13) Today some students in my class fell asleep.

Meaning extension

The example from (12) is a case of referential transfer and therefore serves as a nice link between research on reference and inferences. It essentially describes a communicative situation in which the principles of perspicuity and brevity are in conflict. The waiter could also say (12′) but in the microcosm of the restaurant setting this amount of information is not required since what a customer has ordered emerges as a salient property and therefore (12) is a more economical way of referring.

(12′) The woman who ordered the ham sandwich is sitting at Table 20.

What are the processing consequences of using a salient property to refer to a person? An ERP study revealed that the comprehension of an expression that indicates reference transfer (*the hepatitis in* (14a)) was more costly than its unshifted control (14b) (Schumacher, 2011). Specifically, it evoked a Late Positive potential, which has already been discussed above for referent management. This is taken to indicate that the representation of *hepatitis* is reconceptualized into a mental representation denoting the person who has hepatitis, and this results in processing costs.

(14) a. The doctor asks his assistant who had called. The assistant responds that the hepatitis had called.
b. The doctor asks his assistant what it is that concerns so many people. The assistant responds that the hepatitis concerns so many people.

(15) a. The ham sandwich wants a coke and #has gone stale.
b. The ham sandwich wants a coke and asks for the check.

The notion of reconceptualization is supported by the coordination diagnostic which demonstrates that the original denotation is no longer available once the shift has taken place. In (15a) (from Copestake & Briscoe, 1995), *the ham sandwich* is shifted to the ham sandwich eater in the first clause and the person-denotating referent is then picked up in the second conjunct yielding an infelicitous utterance (*the ham sandwich eater has gone stale*). Coordination is however possible in (15b) where the person-denotation is intended in both clauses (*The ham sandwich eater wants a coke and the ham sandwich eater asks for the check.*)

These observations have been extended to other cases of meaning transfer (also termed metonymy) including container-for-content (*Tim drank the goblet* versus *Tim dropped the goblet*) and animal-for-statue (*the stone lion* versus *the tired lion*), which also engendered a Late Positivity (Schumacher, 2013). Interesting, not all kinds of meaning shift give rise to such a positivity. Content-for-container (*Ann put the beer in the fridge* versus *Ann drank the beer in the fridge*) and producer-for-product alternations (*Luise read Goethe* versus *Luise met Goethe*) do not show any ERP effects (Schumacher, 2013; Weiland-Breckle & Schumacher, 2017). The different processing profiles among metonymic expressions may be explained on the basis of the

conventionality of the meaning shift. The latter two types of alternations occur more frequently in daily conversation and may therefore have become part of lexically coded meaning, while the former cases require more contextual support and a higher amount of inferencing to arrive at the intended meaning. This is supported by eye-tracking research that also reports no differences for producer-for-product alternations and other conventional uses such as place-for-event (*A lot of Americans protested during Vietnam* versus *visited Vietnam*) or place-for-institution (*That woman answered to the convent* versus *These businessmen purchased the convent*) (Frisson & Pickering, 1999, 2007).

Another kind of meaning extension has been investigated widely in the psycholinguistic research where the selectional restriction of the predicate requires a type shift from an object-denoting entity to an event. (16) illustrates this so-called complement coercion, where the predicate (*began*) requires a complement of the type event but is confronted with an entity.

(16) a. The girl began the book.
b. The author began the book.
c. The girl read the book.

This feature mismatch is resolved by the hearer by inferring some kind of activity that can be performed with the book, which typically elicits *reading the book* in (16a) and *writing the book* in (16b). Reading time and eye-tracking studies indicate that the computation of complement coercion evokes extra processing demands compared to a control condition (16c) (McElree *et al.*, 2001, 2006; Traxler *et al.*, 2002). This cost is attributed to structure building processes associated with the type shift. This is further supported by type shifting demands at the phrasal level: Frisson and colleagues (2011) report processing demands for the comprehension of *the difficult mountain* (versus *the difficult exercise*), where the event-modifying adjective triggers a type shift from the entity *mountain* to an event-denotation (such as *the mountain that is difficult to climb*).

Where does the extra event information come from that is required for the type shift? Some researchers have proposed the lexicon as the source, others more general inferences and world knowledge. The lexical approach assumes that fine-grained representations specifying formal and functional properties of concepts guide interpretive processes (cf. Pustejovsky, 1995 on qualia representations that detail the makeup of lexical entries). Accordingly, the lexical entry of *book* specifies its formal and constitutive properties, its function (*being read*, telic role) and its genesis (*being written*, agentive role). Some initial support for the lexical view is provided by corpus data that indicated that the majority of complement coercion cases could be resolved by telic or agentive role information of the complement noun (Lapata *et al.*, 2003). However, a follow-up sentence completion study registered over 35% of responses that could not be accounted for in terms of qualia structure indicating that qualia structure alone cannot account for the interpretive processes. This suggested that context had an impact on the choice of inferred event. The pragmatic approach thus assumes that

general inferencing leads to event recovery (de Almeida & Dwivedi, 2008; Katsika *et al.*, 2012).

Another kind of coercion process requires the extension of the aspectual domain. In so-called aspectual coercion, a feature mismatch arises from the punctuality of the verb (*jump*) and the durativity expressed by a temporal modifier (*for an hour*). The implied meaning of (17a) is that the tiger jumped repeatedly because *jumping* is an activity with an inherent punctual beginning and end point, which should be incompatible with a temporal modifier that expresses a time span. Reading time studies reported processing costs for this aspectual extension in comparison to a control condition with a temporally unbounded verb (17b) (Piñango *et al.*, 1999; Brennan & Pylkkänen, 2008).

(17) a. The tiger jumped for an hour.
b. The tiger slept for an hour.

An alternative explanation of the increased reading times for (17a) could be that the processing of iterative events is generally more costly. This was tested by Todorova and colleagues (2000) who compared coercion cases with singular objects (*a large check,* 18a) with a case in which bare plural objects (*large checks,* 18b) overtly license iteration and are hence exempt from coercion. Using a stop-making-sense task, rejection rates as well as reading times were larger for (18a) than (18b) at the temporally unbounded modifier (*for many years*). This suggests that the observed costs are not due to iteration per se.

(18) a. Even though Howard sent a large check to his daughter for many years, she refused to accept his money.
b. Even though Howard sent large checks to his daughter for many years, she refused to accept his money.

The phenomena reviewed so far in this section can be described in terms of the interplay of the conversational principles of brevity and clarity according to which speakers do not say more than they must. Other cases of the extension of an entity or event can be found in rhetorics, most notably metaphor, which is viewed as an exploitation of the principle of truthfulness conjoined with brevity. When Shakespeare's Romeo utters *Juliet is the sun*, the hearer infers some kind of mapping of the involved concepts to arrive at the intended meaning. Another case is approximation: when we here that *France is a hexagon*, we need to minimally adjust the concept of a hexagon to arrive at the shape of France. The psycholinguistic literature on metaphor is extensive and will not be reviewed here. But it should be pointed out that the different types of meaning extensions have typically been investigated in isolation, with a few notable exceptions. Comparison of complement coercion and producer-for-product metonymy revealed processing demands for the former only (McElree *et al.*, 2006). Different processing profiles were observed for metaphor and metonymy (e.g., Gibbs, 1990; Weiland *et al.*, 2014) and for metaphor, metonymy and approximation (Bambini *et al.*, 2013). Future research should

systematically highlight commonalities and differences and identify core mechanisms shared during meaning constitution across different phenomena.

Implicature

In the previous section, we looked at implied meaning arising during composition at the syntax-semantics interface. This section will now focus on inferences at a more global level where the sentences satisfy grammatical constraints and the speaker's intention must be inferred from the conversational setting. Scalar implicatures like (13) (*Today some students in my class fell asleep*.) are the most extensively investigated cases of generalized conversational implicatures, that is, pragmatic inferences arising from a general property such as the availability of a scale like <some, all>. This scale reflects the degree of informativeness of the terms and it is assumed that a speaker who chooses the weaker form (*some*) implicates that she has not sufficient information to use the stronger form (Horn, 1972). As a consequence, (13) is taken to implicate *Some but not all of the students in my class fell asleep.*

How are these implicatures processed? Bott and Noveck (2004) found that pragmatic inferencing results in processing costs. They tested sentences like (19) and instructed participants in one session to interpret *some* as *some but not all* (pragmatic condition) and in another session to interpret it as *some and possibly all* (logical condition).

(19) Some elephants are mammals.

Response latencies were longer and accuracy was lower for the pragmatic condition. In another study without this instruction, some participants responded pragmatically (i.e., considered (19) false) and some responded logically (i.e., evaluated (19) true). Their responses also confirmed the processing difference between pragmatic and logical interpretations. Chevallier *et al.* (2008) generalized these findings to another type of scalar implicature by investigating the interpretation of *or*, which comes with an exclusive reading (*flowers or champagne → either flowers or champagne, but not both*) or an inclusive reading (*flowers or champagne → flowers and champagne*). The more informative (exclusive) meaning evoked more processing effort.

Are scalar inferences drawn automatically? Some pragmatic theories assume that the scalar implicature arises automatically (i.e., *some means not all*) but can be canceled subsequently if required by the context (*some, in fact all*) (Levinson, 2000; Chierchia, 2004). Others argue that only the contextually relevant meaning is computed (Sperber & Wilson, 1986). This makes contrary predictions for the time-course of implicature processing. Take for instance example (20) from Breheny *et al.* (2006).

(20) a. Mary asked John whether he intended to host all his relatives in his tiny apartment. John replied that he intended to host some of his relatives. The rest would stay in a nearby hotel.

b. Mary was surprised to see John cleaning his apartment and she asked the reason why. John told her that he intended to host some of his relatives. The rest would stay in a nearby hotel.

In (20a) the context makes available the entire set (*all his relatives*) and therefore strengthens the scalar implicature (*some but not all*). In turn (20b) does not evoke the scalar relation <some, all> explicitly, hence whether the reading *some maybe all* or *some but not all* is the intended meaning is not immediately relevant. The Neo-Gricean account (Levinson, 2000; Chierchia, 2004) predicts that scalar inferences are drawn automatically and their annulation during context updating exerts costs. Hence, reading times of the scalar term (*some of his relatives)* should be slower for (20b). Relevance Theory (Sperber & Wilson, 1986) predicts costs for contextually required scalar implicature, hence slower reading times for (20a). Self-paced reading time measures demonstrate that the scalar term is read significantly slower in (20a) compared to (20b) (Breheny *et al.*, 2006). This was further confirmed by reading times of the following anaphoric expression (*the rest*), which showed longer latencies for (20b), indicating that the underlying scale has not been activated yet but must be computed at the anaphor to find a referent for the set relation. This suggests that scalar inferences are not generated automatically and consume processing resources when contextually required. For similar findings on scalar inferences see Huang and Snedeker (2009); but there is also growing evidence from time-sensitive eye-tracking showing rapid emergence of inferences and an intricate interaction with other factors (Sedivy *et al.*, 1999; Grodner *et al.*, 2010; Breheny *et al.*, 2013).

Another type of implicature, particularized conversational implicature, has received only scarce attention in the psycholinguistic literature. Particularized implicatures arise in certain contexts and rely on common ground between the interlocutors. For example, the speaker's meaning of *It's hard to give a good presentation* in (21) differs dramatically as a function of context (21a-c).

(21) Nick and Paul are taking the same history class. Students in this class have to give a 20 minute presentation to the class on some topic. Nick gave his presentation
   a. and then decided to ask Paul what he thought of it.
   b. and it was truly terrible. He decides to ask Paul what he thought of it.
   c. and it was excellent. He decides to ask Paul what he thought of it.
      Nick: What did you think of my presentation?
      Paul: It's hard to give a good presentation.

In indirect reply (Paul's response), the speaker exploits the principle of relevance and the hearer's task is to identify the contextually relevant meaning of the indirect reply. Holtgraves (1998) investigated the interpretation of indirect answers in stories like (21) and first asked participants to paraphrase what Paul meant. The answers revealed a majority of indirect interpretations, that is, the implicature was generally drawn, with many negative connotations (e.g., *Paul did not like the presentation.*). The negative bias of the inferences can be explained with reference to the

principle of politeness from which it can be inferred that an indirect reply is motivated by the speaker's attempt to be considerate and to save the face of the conversational partner (Brown & Levinson, 1987). This in turn predicts that the indirect answer is not warranted in the positive context (21c) and should therefore create some kind of mismatch. This was confirmed by a second study that measured reading times on the indirect reply as well as on a subsequent paraphrase of Paul's intention, which were reliably longer for the positive context (21c) relative to the other two contexts (21a/b).

Conclusion

Meaning has different facets and mastering lexical meaning alone does not suffice for successful communication. Rather, deciphering the communicative intention of the speaker is a core task of the hearer who is faced with numerous unarticulated meaning constituents and assumptions. "Reading between the lines" is therefore an essential skill of the hearer, which is mediated by general conversational principles that guide speaker-hearer interaction. The hearer thus assumes that the speaker seeks to be informative, relevant, clear, truthful for the course and purpose of the conversation and obeys social principles (i.e., politeness/face management). The principle of informativeness is central to many of the phenomena discussed in this chapter, such as referential choices or scalar inferences. Informativeness is an instantiation of the principle of economy and least effort (cf. speaker's and hearer's economy in Zipf, 1949) and may be derived from a more general cognitive constraint. As experimental research of semantic and pragmatic processing advances, researchers should strive to develop a general model of meaning constitution that looks at the different phenomena of semantic and pragmatic processing in a unified manner.

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