Why is the speaker so disfluent?
The role of attribution in the effect of disfluency on comprehension

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Reference comprehension is influenced by disfluency; listeners are biased toward given (already mentioned) objects when the speaker is fluent ("the candle), and new objects when the speaker is disfluent ("thee uh candle"; Arnold et al., 2004). One interpretation is that listeners attribute disfluency to a particular difficulty, e.g., naming difficult-to-name objects, like new objects. We establish that disfluency does indeed cause a bias toward difficult-to-name objects, by showing that it leads to a bias toward novel, abstract objects (e.g., a funny squiggle), compared with familiar objects (e.g., a house). We then ask whether this effect is modulated by alternative plausible causes for disfluency.

Experiment 1 showed participants four objects, e.g., a red squiggle, a black squiggle, a red house, a black house. Eye movements were monitored as participants responded to "Click on {the / thee uh} red {squiggle… / house}". We analyzed looks to targets from 200–1000 ms after the onset of the color word. Listeners looked more to novel targets in the disfluent, but not fluent conditions (Table 1). An off-line experiment used the same instructions. Instructions were truncated before or after the disfluency. Listeners indicated which object they thought the speaker was about to refer to. In the long fragments only, subjects chose the novel target more often in the disfluent, but not fluent conditions (Table 2).

Experiments 2–4 investigated whether the disfluency effect would disappear if the listener thought that the speaker was distracted. That is, would disfluency be attributed to the distraction, not reference to a novel (and hard-to-describe) object? Experiments 2 and 3 spliced in a beep (each in a different location), and subjects were told that the speaker had to press a button when they heard a beep. Experiment 4 spliced in construction noise, and subjects were told that the experiment was about communication in noisy conditions. Half the stimuli had beeps / construction noises; half did not.

In Experiment 5 half the subjects were told that the speaker suffered from object agnosia, and often couldn't identify an object so instead would describe it. Fillers supported this story. If listeners make attributions about difficulty dynamically, known objects should seem difficult, diminishing the novel-known distinction. Each experiment had an online (eyetracking) and offline version.

In offline Experiments 2 (Beeps) and 4 (Construction), distraction did not modulate the disfluency effect. In on-line Experiments 2 and 3 (Beeps), we again found a novel bias for disfluent conditions only, but in both beep and no-beep conditions. Preliminary results for online Experiment 4 (10 subjects) were similar. Thus, the novel bias persists even when distraction provides another plausible cause for the disfluency.

However, the disfluency effect was greatly diminished when the listener thought the speaker had object agnosia (Experiment 5, online and offline). In the agnosia-speaker condition, listeners were led to believe that reference to the known objects was as hard as reference to the novel objects. The reduction of the disfluency novelty effect for agnosia speakers suggests that attribution may underlie the disfluency effect at least partially, and perhaps that interpretations of disfluency depend on global decisions about difficulty for each speaker, rather than momentary distractions.

Table 1. Online Data: % Competitor Looks, 200–1000 msec after onset of color word. (There was a significant disfluency x novelty interaction in all experiments except Exp. 5, where there was a three-way disfluency x novelty x agnosia interaction).

	Disfluent / Known Competitor	Disfluent / Novel Competitor	Fluent / Known Competitor	Fluent / Novel Competitor
Experiment 1	33% (4% SE)	14% (3% SE)	32% (4% SE)	29% (3% SE)
Experiment 2 (Beeps #1)	41% (3% SE)	19% (2% SE)	32% (3% SE)	32% (3% SE)
Experiment 3 (Beeps #2)	35% (2% SE)	23% (2% SE)	33% (2% SE)	35% (2% SE)
Experiment 4 (Construction)	38% (5% SE)	23% (3% SE)	30% (4% SE)	33% (2% SE)
Experiment 5 — Typical Speaker	37% (2% SE)	26% (2% SE)	34% (2% SE)	38% (2% SE)
— Agnosia Speaker	30% (2% SE)	32% (3% SE)	36% (2% SE)	28% (2% SE)

Table 2. Offline Data: % Novel Object Choice, in the "long fragment" conditions

	Disfluent	Fluent
Experiment 1	75% (4.5% SE)	23% (4.2% SE)
Experiment 3 (Beeps #2)	65% (5.8% SE)	26% (4.2% SE)
Experiment 4 (Construction)	63% (5.7% SE)	32% (4.4% SE)
Experiment 5 — Typical Speaker	72% (4.8% SE)	19% (4.5% SE)
— Agnosia Speaker	52% (4.5% SE)	34% (5.5% SE)

Refining the HSPM´s parsing algorithm

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In two self-paced reading experiments we have investigated the parsing algorithm of the HSPM, taking advantage of the fact that the finite verb in German appears in either second or clause-final position. We will adress two dimensions along which parsing algorithms differ. First, how incremental is human parsing? The two main contenders here are structure-driven parsers, attaching each input word immediately to the CPPM, and head-driven parsers, building a phrase only when encountering the head of the phrase. The second dimension concerns the amount of predictions made by the parser, in particular when starting to process an input string.

Our experiments investigated the lexical-category ambiguity of words like "exportierte" (exported) in verb-second and verb-final clauses. Experiment 1 was based on two prior experiments (poster, CUNY 2005) using the same ambiguous words in more complex verb-final clauses. Experiment 1 investigated verb-final clauses as in (1). "Exportierte" is a finite verb in (1a) and an adjective in (1b). Corpus counts showed a 70% verb preference for the 28 ambiguous words used in Experiments 1 and 2. A structure-driven parser will have inserted a VP-node before encountering the ambiguous word, thus expecting a verb at this position. A head-driven parser, in contrast, will not have built up any expectations.

In Experiment 1, 46 participants read sentences as in (1) as well as unambiguous control sentences using a word-by-word non-cumulative self-paced reading procedure. The results show a garden-path effect for adjective but not for verb sentences (Verb, –36 ms; Adjective, 299 ms), thus adding to the existing evidence favoring structure-driven parsing models over head-driven ones.

Experiment 2 investigated main-clauses in which the ambiguous word was either the finite verb in verb-second position (2a) or an adjective within a sentence-initial NP (2b). The same results as for Experiment 1 are expected if the HSPM is a structure-driven parser that predicts a CP/S-node and a finite verb in verb-second-position (=the head of CP) from the outset (with the first word or even before). In contrast, a structure-driven parser that builds only as much structure as necessary to have a completely connected CPPM would only build a PP for the first two words of (2), thus having no expectation concerning the category of the following word.

Seventy-six participants read sentences as in (2) as well as unambiguous control sentences using the same procedure as in Experiment 1. In contrast to Experiment 1, both verb and adjective sentences resulted in garden-path effects (Verb, 51 ms; Adjective, 83 ms; interaction not significant).

In sum, a clear difference between verb-final and verb-second clauses emerged: Verb-final clauses showed a strong preference for the verb reading of the category-ambiguous words whereas no clear preference was found in verb-second clauses. These findings support two conclusions: First, they strengthen the hypothesis that the HSPM works in a structure-driven, strictly incremental way. Second, the HSPM starts the processing of an input string without the prediction of a CP/S-node. Instead, a CP/S-node is inserted into the CPPM only when required by the input.

Examples

(1) Verb-final clauses (embedded clauses; main clause omitted)

(a) dass Max nach Asien exportierte, was sich nicht verkaufte.
that M. to Asia exported what itself not sold
"..., that Max exported to Asia what did not sell."

(b) dass Max nach Asien exportierte Waren oftmals zurücknehmen musste.
that Max to Asia exported goods often take-back had
"..., that Max often had to take back goods exported to Asia."

(2) Verb-second clauses (Main clauses)

(a) Nach Asien exportierte Max, was sich nicht verkaufte.
to Asia exported Max what itself not sold
"Max exported to Asia what did not sell."

(b) Nach Asien exportierte Waren musste Max wieder zurücknehmen.
To Asia exported goods had Max again take-back
"Max had to take back goods exported to Asia."

Going to CUNY — *ah no* — AMLaP in New York: The role of the reparandum in the comprehension of disfluencies

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The role of disfluencies in comprehension is a topic that has only recently received quite a bit of attention (e.g., Ferreira & Bailey, 2004; Bailey & Ferreira, 2005; McGregor, Corley, & Donaldson, 2005), although disfluencies are highly frequent in natural language production, so that the comprehension system is actually forced to deal with them fairly often. According to Bailey and Ferreira, the reparandum in repetitions and corrections introduces lexical content and local syntactic structure which are not fully overwritten by the reparans.

In this paper, we want to extend the data basis by looking at a different language (French) as well as a different kind of construction: repairs involving NPs as in (2). We applied a speeded end-of-the-sentence acceptability decision task. Participants were presented with sentences like (1a, b) and (2a, b) in speeded synthesized speech (rapid auditory presentation, RAP). In half of the sentences *butcher* and *baker* were exchanged to control for plausibility effects. Participants had to judge the acceptability of each sentence right after hearing it. Following Ferreira and Bailey, we predicted that if the reparandum is still lurking in the background, plausibility violations as in (2b) should be less detectable than in (1b). These predictions were confirmed for acceptability judgements as well as judgement times (interactions: p's<.05). Participants judged sentences like (2b) as being more acceptable than (1b). Due to the interference of the reparandum, judgement times for (2b) were increased compared to (1b).

A possible explanation of the effect could be that interference is simply due to lexical priming and does not have anything to do with maintaining parts of the structure that have already been built up. It is also possible that the persistence of the reparandum is not really due to disfluencies but a more general phenomenon that shows up, e.g., for negations as well. We therefore ran a second experiment where we did not look at disfluencies but combined simple sentences as in (1) with negations as in (3).

For the negations we did not find an increase in acceptability as we found for disfluencies and no effect in decision times either. Therefore the persistence of the reparandum is actually specific for disfluencies and not due to lexical priming.

Results

Experiment 1

Inconsistent, repair	1867 ms	39% acceptable

Experiment 2

Consistent, no negation	75% acceptable
Inconsistent, no negation	17% acceptable
Consistent, repair	65% acceptable
Inconsistent, repair	12% acceptable

Examples

(1) a/b. Je dois aller chez le boucher sur le chemin du retour. J'ai besoin de viande / pain.
I will have to go to the butcher on my way home. I need some meat / bread.

(2) a/b. Je dois aller chez le boulanger, *euh non*, le boucher sur le chemin du retour. J'ai besoin de viande / pain.
I will have to go the baker, *uh no*, the butcher on my way home. I need some meat / bread.

(3) a/b. Je ne dois pas aller chez le boulanger mais chez le boucher sur le chemin du retour. J'ai besoin de viande / pain.
I will not have to go to the baker but to the butcher on my way home. I need some meat / bread.

Eye-tracking evidence reveals the moderating role of context on associative priming

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We report three eye-tracking experiments that examined the effect of lexical association in sentences and passages. These experiments were designed to determine the effect on associative priming of creating a discourse model during comprehension in order to understand the priority in processing of discourse level semantic processes and word level semantic processes. Previous eye-tracking studies have suggested that facilitative effects of intralexical priming may be moderated in isolated sentences by factors such as linguistic focus (Morris & Folk, 1998) and clausal boundaries (Carroll & Slowiaczek, 1986), but have not investigated the role of wider semantic context.

In Experiment 1 discourse congruity and lexical association were independently varied in four-sentence stories. Lexical association was determined by existing norms and story congruity was validated using ratings. The sentences containing the critical words were congruous when read in isolation, but in the context of the preceding sentences the words were congruous or incongruous at the discourse level. In the target region, there was a marginal interaction between association and discourse congruence such that effects of association were only found for incongruent words. For the incongruent conditions, associated words produced shorter regression-path durations and rereading times (p's<.05 by subjects and items). Effects of association that were not moderated by discourse congruence were not found until the post-target region, where association led to shorter regression-path and rereading times.

In Experiment 2 the sentences containing the association manipulation were presented in isolation. With this limited context, effects of association on the target word were rapid and robust. Performance on associated targets was facilitated as compared to unassociated targets on skipping rates, first fixation, gaze duration, and regression path (p's<.05 by subjects and items). These effects were strictly localized on the target word and did not extend to the post-target region.

Finally, in Experiment 3 we varied lexical association and the overall cohesiveness of the passage. Critical words were presented in the same congruent passages used in Experiment 1, along with scrambled versions of those passages created by surrounding the sentence containing the target word with unrelated sentences. Association interacted with discourse coherence for both first fixation and gaze duration (p's<.05 by subjects and items) in the target region. Only sentences in scrambled passages showed facilitation due to association between words for first fixation and gaze duration (p's<.01 by subjects and items). No effects of association or interactions between association and coherence were found in the post-target region.

Intra-lexical priming is remarkably robust in tasks examining the processing of words in lists. The current experiments show that it is also very robust when prime-target pairs are in isolated sentences that, while coherent, are not rich in meaning. Intra-lexical priming is sharply reduced or eliminated when prime-target pairs are embedded in coherent, congruous passages. This pattern suggests that construction of a discourse model during the understanding of a coherent passage may preempt or delay bottom-up processes of semantic association that have strong effects when words appear in less meaningful context.

Examples (Critical words are capitalized; associative primes are italicized.)

Congruent Passage – Associated / Unassociated (Experiments 1 & 3)

Keith was arranging the furniture in the lobby of the hotel. He wanted to make sure the room appeared comfortable, but not overly cluttered. Keith was very specific about the placement of the *chairs* and TABLES / LAMPS in the space. The layout was functional and aesthetically pleasing.

Incongruent Passage – Associated / Unassociated (Experiment 1)

Keith wanted the arrangements for his outdoor wedding to be very simple. There would only be seats for the guests and a decorated archway. Keith was very specific about the placement of the chairs and TABLES / LAMPS in the space. The layout was functional and aesthetically pleasing.

Scrambled Passage – Associated / Unassociated (Experiment 3)

Cynthia's new office had a great view of the harbor. The family was hoping Samantha would leave treats at home for them to enjoy. Keith was very specific about the placement of the chairs and TABLES / LAMPS in the space. Suzanne already knew what stores she wanted to visit.

Disfluency in speech affects listeners' linguistic processing and attention: Evidence from event-related potentials

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A growing body of evidence suggests that filled-pause disfluency (e.g., "*er*") in speech has measurable effects on listeners. However, it is unclear whether these effects are linguistic (e.g., Arnold et al., 2004), or attentional (e.g., Fox Tree, 2001). Here we present data from two experiments which used event-related potentials (ERPs) to investigate the effects of filled pauses on listeners' language and attentional systems during the processing of highly naturalistic speech, and subsequent memory tests to assess longer term effects on language representation.

Experiment 1 assessed the effects of disfluency on the language system, using the N400 to index the ease with which a word can be integrated into the context (e.g., Brown et al., 2000). Participants listened to utterances recorded at a natural speaking rate, which ended in predictable or unpredictable target words, and which were fluent or disfluent (including an "*er*" preceding the target, see 1).

(1a) *Predictable* Everyone's got bad habits and mine is biting my [er] **nails**.
(1b) *Unpredictable* That drink's so hot that I've just burnt my [er] **nails**.

The N400 effect (Kutas & Hillyard, 1980), maximal 400ms from word onset over centro-parietal scalp regions, was reduced for unpredictable compared to predictable words in disfluent utterances, suggesting that following disfluency the integration difficulty for unpredictable compared to predictable words is reduced.

Experiment 2 used a similar design to investigate the effects of disfluency on the attentional system, using the mismatch negativity (MMN) and the P3a to index the extent to which attention is engaged. Participants listened to utterances which ended in predictable words (see 1a). However, in 25% of the sentences, the final words were digitally filtered to produce oddball words physically deviant from, but linguistically consistent with their preceding context.

The MMN (maximal at 175ms over central regions) and the P3a (beginning around 300ms at fronto-central sites) were present for oddball compared to non oddball words in the fluent utterances, indexing an increase in attention. However, these effects were eliminated in disfluent utterances, commensurate with the view that attention had already been enhanced (Alho, 1995) by the preceding disfluency.

Following the ERP part of each experiment, listeners took part in a surprise visual recognition memory test for the utterance-final "old" words, which were interspersed with frequency-matched "new" distracters. Words originally encountered in a disfluent context were more likely to be recognised, suggesting that the linguistic and attentional processes engaged during the online processing of disfluency have lasting effects on the representation of words encountered post disfluency.

Taken together, these experiments show that disfluency has immediate effects on both the linguistic and the attentional systems of listeners, which in turn have lasting consequences for language representation.

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Talker variation influences the early moments of lexical access

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Exemplar views of memory (e.g., Goldinger, 1998; Hintzman, 1986) posit that the lexicon consists of all individual traces of words that a person has experienced. It follows from this that non-phonemic information can be used lexically, provided that it covaries with lexical identity. Some of the strongest evidence for exemplar views comes from studies demonstrating that talker variation affects word recognition. However, it remains unclear whether talker-specific information affects post-access decision processes or the early components of word recognition (McLennan & Luce, 2005).

The work presented here examined the time course of lexical activation in the face of a non-phonemic cue: talker variation. We used the Allopenna et al. (1998) visual world eye-tracking paradigm to examine the time course of real-word and artificial-word recognition for words and lexical competitors spoken by the same talker or different talkers. We found that lexical competition can be dampened by consistent talker differences between words that would otherwise be lexical competitors.

In Experiment 1, English cohort word pairs (e.g., *sheep* and *sheet*) were repeatedly spoken by a single talker (male *sheep*, male *sheet*) or by two different talkers (male *sheep*, female *sheet*). Prior to exposure, there was no difference in fixation proportions to same-talker competitors or different-talker competitors, but after 20 exposures to each word (embedded within lists of fillers), there were fewer fixations to different-talker competitors than to same-talker competitors. Moreover, differences in fixations emerged early in the recognition process, with proportion of fixation curves for different and same talker cohorts diverging within 300 ms after word onset.

Two further experiments used artificial lexicons to examine the integration of talker information into more newly-learned lexical entries, finding effects of larger magnitude. Participants were trained to identify 32–40 novel black-and-white shapes by their corresponding lexical items. Experiment 2 investigated how talker variation modulates neighborhood effects, while Experiment 3 employed longer, more vocalic words.

In Experiment 2, error data suggested an advantage in learning words with high frequency and words with different-talker neighbors. However, gaze fixation data showed an advantage for different-talker targets (more fixations) only when targets were high in frequency and competitors were low frequency cohorts. Rhyme competition was virtually nonexistent in the fixation data, negating the possibility of rhymes as competitors regardless of talker.

In Experiment 3 all words were equated in frequency (identical to high-frequency words in Experiment 2). Error rates were substantially lower for words with different-talker competitors. Correspondingly, gaze fixations showed less competition for different-talker targets, a robust effect that did not differ between cohorts and rhymes. Proportions of fixations to targets reached asymptote much later in this experiment than in Experiment 2, which was in turn slower than Experiment 1.

Overall, this work supports a view whereby the lexicon is composed of entries that contain both phonemic and non-phonemic information, the latter including but not limited to such acoustic properties as fundamental frequency, fundamental frequency variability, and speech rate. Extensions of the artificial lexicon paradigm and developmental implications are discussed.

Effects of disfluency placement and severity on comprehension of garden-path sentences

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Filler disfluencies (e.g., "uh") may affect the operations of the parser by cuing particular syntactic structures (Bailey & Ferreira, 2003). Corpus analyses indicate that disfluencies are more common before complex syntactic constituents (Clark & Wasow 1998). Therefore, an "uh" inside an ambiguous noun phrase in a garden-path sentence (see (1)/(2) below) might cue the parser to build a clause rather than a simple direct object. In contrast, an "uh" after the ambiguous NP should be a miscue, because it predicts a clause and therefore reinforces the misanalysis of the NP as object of the previous clause. Evidence from grammaticality judgments supports these predictions (B&F, 2003). In addition, because disfluencies and environmental sounds were found to be equally effective, it was argued that the parser is sensitive to the placement but not the content of disfluencies. However, while a comparison between disfluencies and noises is useful, a more direct test of the cuing hypothesis would be to compare a stronger to a weaker disfluency — e.g., "uh-uh" to "uh". "Uh-uh" should be more effective, because it is associated with more difficult upcoming material (Fox Tree, 2001). In addition, in previous work the disfluency locations tested were (b) and (c) (see (1) / (2)), but a disfluency is far more likely to occur at the left edge of an NP (position (a)) than after its determiner (Maclay & Osgood, 1959). Therefore, a disfluency at position (a) should be a better cue than one at (b), and both should be better than a disfluency at position (c).

Two experiments were conducted which differed in whether the disfluency "uh-uh" (Experiment1) or "uh" (Experiment 2) was used. In each, the two garden-paths shown in (1)/(2) were examined, and sentences were spoken with no sentence-internal prosodic boundaries but with disfluencies at positions (a), (b), or (c). Participant made acceptability judgments after each sentence. The results provided some support for the cuing hypothesis. The effect of having a disfluency at (c) was greater with the stronger disfluency, and greater for the more severe garden-path. However, performance was the same for positions (a) and (b) — disfluencies in both locations were equally effective, even though disfluencies at (a) are more frequent. This might simply indicate that a disfluency after a determiner is common enough to serve as an effective cue. The finding that the stronger disfluency was more effective suggests that the parser is sensitive to the content of the disfluency, contrary to previous reports. We will also report results from follow-up experiments in which we directly compared the effectiveness of a disfluency versus a prosodic boundary in the (a) and (c) locations to assess how the information values for disfluencies and prosodic boundaries compare. We are also assessing the combined effects of prosody and disfluency, to determine whether the two sources of information interact during normal comprehension. The results will have important implications for theories of auditory sentence comprehension, suggesting that the parser uses not just prosody but any other type of reliable acoustic information to build a structural analysis.

Sample experimental sentences (Ambiguous NP is italicized.)

(1) Pamela hit the fireman and **a** *the* **b** *policeman* **c** had to restrain her.

(2) While the artist painted **a** *the* **b** *king* **c** paced nervously.

Results

	uh uh		*uh*	
Disf Location	Coord (1)	Sub-Main (2)	Coord (1)	Sub-Main (2)
uh the (a)	0.83	0.84	0.83	0.89
the uh (b)	0.90	0.82	0.90	0.82
NP uh (c)	0.63	0.37	0.82	0.48

The influence of lexical factors on word order production

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Most traditional models of language production distinguish two stages of grammatical processing: functional processing, concerned with grammatical function assignment, and subsequently positional processing, concerned with specification of linear word order). There is strong evidence that functional processing is influenced by lexical factors (e.g., Bock & Warren, 1985; F. Ferreira, 1994; Kelly, Bock & Keil, 1986). We report syntactic priming evidence from Spanish that positional processing is also influenced by lexical properties.

Spanish allows both VS and SV word order for intransitive sentences. An initial acceptability-rating task revealed that Spanish speakers prefer verb-subject (VS) order with unaccusative verbs (e.g., *arrive*, *enter*, *leave*) and subject-verb (SV) order with unergative verbs (e.g., *shout*, *dance*, *laugh*) (see also Contreras, 1976). Three experiments used syntactic priming (Bock, 1986), the tendency to repeat syntactic structure across otherwise unrelated sentences, to study Spanish word order preferences in online production. Using computer presentation, participants alternately described pictures and matched descriptions to pictures. In all three experiments we manipulated the word order of the Prime description (SV vs. VS). Experiments 1 and 2 used unergative and unaccusative verbs respectively; we further manipulated whether the same verb appeared in prime and target. In Experiment 3, unaccusative and unergative primes were paired with unaccusative targets to investigate whether priming was greater when verb-type was repeated. Our dependent variable was always the word order that participants produced for a target picture.

All three experiments yielded reliable priming: Participants were more 29% likely to repeat the word order that they had just heard than to produce the alternative word order. In Experiments 1 and 2, this tendency was stronger with a repeated verb (a 'lexical boost', Pickering & Branigan, 1998) (p's$<.001$), but priming was 19% stronger and the lexical-boost twice as large for unaccusative than unergative verbs (p's$<.01$). However, Experiment 3 showed comparable priming whether the prime and target were of the same or different verb-types.

The results offer strong evidence that lexical factors influence the processing of linear word order. Firstly, the choice of verb influences participants' preference for particular word orders. Secondly, word order priming is enhanced when the head is repeated, suggesting links between representations of word order and specific lexical items. Thirdly, lexical preferences for particular word orders influence susceptibility to priming and a lexical boost in production: For unergative verbs, VS order is hard to prime, even with verb repetition, because of the stronger preference for SV order; whereas for unaccusative verbs, VS order is easier to prime because unaccusative verbs prefer this word order.

However, there is no boost to priming when the prime and target are from the same verb-type, suggesting it is the lexical properties of the target that influence processing. This cross-verb-type priming also counters the linguistic argument that different syntactic configurations underlie unergative and unaccusative verbs (e.g., Perlmutter, 1987).

We discuss these findings in the context of models of grammatical processing, which must account for the influence of lexical factors on positional processing.

Processing of adjectives in French as first and second language: Evidence from ERPs

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According to certain models of second language acquisition, grammatical features that are not initially triggered by the native language will not be available to "late" L2 acquirers (cf. the Failed Functional Features Hypothesis, Franceschina, 2001; Hawkins & Franceschina, 2004). In opposition to this claim, others have provided evidence that grammatical competence in a second language is not constrained by the set of features instantiated in the native language and can be fully acquired even by late learners provided sufficient exposure to the second language (Herschensohn, 2000; White, 2003). These opposing models were examined in a series of ERP experiments on gender-concord within the determiner phrase (DP) in French, for late L2 learners whose L1 either has gender concord in the DP (German) or does not (English). Materials (see examples, below) were visually presented in French sentences (600 ms SOA word-by-word presentation). Nouns preceding the critical, post-posed adjectives were selected so that they either shared the same gender across languages or not (e.g., French, 'la clef$_{FEM}$'; German, 'der Schlüssel$_{MASC}$'; the key). Our results for French native speakers revealed that violations of gender concord between the noun and adjective provoked a large P600 effect, in line with results obtained in other languages (Barber & Carreiras, 2003) and in a previous study for the more local determiner-noun gender concord violation (Foucart & Frenck-Mestre, in preparation). We replicated the experiment with German and English advanced learners of French. For German speakers gender concord violations surprisingly produced no effect. These results conflict with those obtained for determiner-noun gender concord violations, which revealed a large P600 effect, suggesting that German-French advanced learners can process grammatical gender in their L2. However, it is important to note that post-posed adjectives do not exist in German, and only pre-posed adjectives agree with the noun (as opposed to attributive adjectives). The results for English speakers were similar to those of native speakers (albeit smaller) despite the fact that their native language does not possess a complex gender system or gender concord. Indeed, these participants showed a significant P600 effect in the case of gender concord violations, although the effect was larger for the marked case (+Fem) than unmarked case (–Fem). The results support the hypothesis that non-native speakers can achieve native-like grammatical processing, even when the L2 is begun later in life (Herschensohn, 2000). However, the results also suggest that native language transfer may hinder processing, as seen in our German L2 learners. The results are discussed in relation to current models of late bilinguals' L2 capacities (van Berkum et al., 2000, Hahne & Friederici, 2001) and previous results obtained for native speakers as concerns gender concord (Barber & Carreiras, 2003; Osterhout & Mobley, 1995; Schmitt, Lamers & Münte, 2002).

Example

Les chaises$_{Fem}$ blanches$_{Fem}$ / *blancs$_{Masc}$ sont dans le jardin.
The white chairs are in the garden.

Word segmentation as word learning: Interactions between statistical cues and word stress in the segmentation of novel, synthesized speech

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Spoken speech contains no clear auditory cues for the boundaries between words, yet within the first year of life, infants have begun to segment individual words from spoken speech (Jusczyk, 2002). One line of research suggests that infants use primarily linguistic cues like word-level stress for segmentation (Yang, 2004). Another suggests that infants use a domain-general statistical learning mechanism to recognize transitional probabilities between adjacent syllables (Saffran, Aslin, & Newport, 1996a; Swingley, 2005). We report an experiment demonstrating that adult learners can segment a novel artificial language with heterogeneous word lengths using statistical mechanisms but likely not transitional probabilities.

Previous studies examined interactions between word-level stress and transitional probabilities using infants (Johnson & Jusczyk, 1999; Thiessen & Saffran, 2003). However, in both of these studies, stress and statistical cues were in conflict. Saffran, Aslin, & Newport (1996b) asked whether both stress and statistical cues could help learners succeed in segmenting an artificial, unsegmented speech stream in which there was either no stress, word-initial stress, or word-final stress. They found that adults could discriminate correct words from non-word foils in all conditions, but that the final stress group was significantly more accurate than either of the other two.

In the current experiment, we exposed 20 adult participants to a novel, synthesized speech stream similar to that used by Saffran et al. but counterbalanced across subjects and generated online. We varied stress and homogeneity of word length: Half the participants heard sequences with no stress and the other half heard word-final stress on every word. These groups were further divided, half hearing six three-syllable words, and half hearing six words with two, three, or four syllables. We evaluated segmentation by giving participants a forced choice between words with two, three, and four syllables and comparable non-words. We found no main effect of stress, but a main effect of word length heterogeneity ($F(1,19) = 14.80$, $p<.001$), and a reliable interaction between these two factors ($F(1,19) = 14.29$, $p<.001$).

Accuracy was not significantly different between homogeneous and heterogeneous word lengths without stress ($p>.99$, Tukey's *t*-test), and there was no main effect of length of tested words ($F(2,19) = 0.75$, $p>.47$). This result replicates prior findings that, in the absence of other information, adults can segment a novel speech stream statistically. However, all current models of statistical segmentation using transitional probabilities predict longer words will be more difficult. This prediction was not supported by our data. In contrast, word-based models (e.g., Brent, 1999) suggest that their greater distinctiveness may make long words easier.

In the stressed condition, participants were more accurate on homogeneous than heterogeneous word lengths ($p<.001$, Tukey's *t*-test). This result suggests that the stress cues present in Saffran et al. (1996b) may have aided in segmentation by providing an isochronous cue drawing attention to the homogeneous word length. We plan to present the results of our study and two controls in progress in support of a view of word segmentation as word learning.

Table 1. Participant accuracy broken down by condition (Mean percent accurate responses).

	Unstressed	Stressed
Homogeneous	72%	86%
Heterogeneous	73%	62%

Choosing anaphoric expressions in production: The role of semantics

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How do language producers choose anaphoric expressions? A general assumption is that the saliency of the antecedent influences the choice of anaphoric expressions (Ariel, 1990; Gundel et al., 1993): People tend to use less explicit anaphoric expressions, such as pronouns, when referring to salient antecedents, whereas more explicit expressions, such as names, are used to refer to less salient antecedents. However, what factors affect saliency is a matter of debate. According to syntactic saliency accounts, saliency is only determined by syntactic factors (Gordon & Scearce, 1995; Grosz et al., 1995), whereas semantic and thematic saliency accounts (Arnold, 2001; Stevenson et al., 1994) claim that semantics also plays a role. Hence, a key question is whether the choice of anaphoric expressions is only affected by syntactic saliency of the antecedent or by semantic factors as well.

We tested these two accounts in three experiments using a written sentence completion method. In Experiment 1, we investigated thematic role saliency (Arnold, 2001; Stevenson et al., 1994) by contrasting stimulus-experiencer with experiencer-stimulus verbs (1). A pretest showed that thematic saliency affected completion preferences: Participants referred to the stimulus much more often than to the experiencer. In the main experiment, we investigated whether thematic saliency also affects the choice of anaphoric expressions. In order to control to which NP participants should refer, an arrow indicated reference to NP1 ("Gary") or NP2 ("Anna"). The results showed a main effect of syntactic saliency on the choice of anaphors: More pronouns (relative to names) were produced to refer to NP1 than to NP2. However, no thematic saliency effect was found: Participants produced as many pronouns to refer to the stimulus as to the experiencer.

Experiment 2 investigated the effects of different connectives in stimulus-experiencer sentences (2). Stevenson et al. (1994) argued that following "because", NP1 should be more salient, whereas NP2 should be more salient following "so". However, the semantics of the connective did not affect the choice of anaphoric expressions (despite the fact that a pretest showed that it did influence how often participants referred to NP1 or NP2). Instead, the results showed an effect of syntactic saliency, as in Experiment 1.

Experiment 3 investigated the effect of animacy. Participants had to refer to either "the hikers" or "the canoes" in (3). In contrast to semantic information related to thematic roles and connectives, animacy did affect the choice of anaphoric expressions: Participants used more pronouns to refer to animate than to inanimate NPs. In addition, there was an effect of syntactic saliency.

To conclude, the experiments showed a robust syntactic saliency effect: Participants used more pronouns (relative to names) to refer to NP1 than to NP2. Animacy of the antecedent also had a strong effect. By contrast, thematic role saliency and semantics of the connective did not affect the choice of anaphoric expressions. We propose that syntactic information and semantic properties of the antecedent such as animacy determine the choice of anaphoric expressions. However, semantic information provided by words other than the antecedent itself has no effect.

Examples

(1) Experiment 1: Stimulus–Experiencer (*scare*) vs. Experiencer–Stimulus (*fear*)

   a. Gary scared Anna after the long discussion ended in a row. This was because …
   b. Gary feared Anna after the long discussion ended in a row. This was because …

(2) Experiment 2: *because* vs. *so*

   a. Gary scared Anna after the long discussion ended in a row, because …
   b. Gary scared Anna after the long discussion ended in a row, so …

(3) Experiment 3: Animate (*the hikers*) vs. Inanimate (*the canoes*)

   a. The hikers carried the canoes a long way downstream. Sometimes, …
   b. The canoes carried the hikers a long way downstream. Sometimes, …

The role of representation in representational noun phrases

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It has long been known that reflexives in noun phrases headed by a "representational noun," e.g., 'a picture of himself,' violate traditional Binding Theory (BT) (Chomsky, 1981; Kuno, 1986) (example 1). There have been two main explanations for this exceptional behavior, one relying on verb based argument structure (Pollard & Sag, 1992; Reinhart & Reuland, 1993), the other syntactic structure (Chomsky, 1986; Davies & Dubinsky, 2003). Here we provide evidence for a third possibility, directly linking the reflexives' exceptional behavior to the representational meaning of their NPs.

(1) John was going to get even with Mary. That picture of himself in the paper would infuriate her as would the other stunts he had planned. (From Pollard & Sag, 1992)

Examples like (2) led Jackendoff (1992, 2002) to suggest that "reference transfer" allows reference to a representation of a person by that person's name (,. a statue of Ringo Starr can be called "Ringo Starr") and that only the true referent can bind the representational reflexive (example 3). Further, Lidz (2001) shows that these reflexives, unlike typical direct object reflexives, can receive coreferential interpretations when elided (example 4).

(2) Ringo Starr saw himself at the museum.

(3) Ringo Starr fell on himself. (Not: The statue of RS fell onto the true RS.)

(4) Ringo saw himself at the museum and Paul did, too
(= Ringo saw the statue of Ringo and Paul saw the statue of Ringo too.)

The reflexives in (2)–(4) have in common with the reflexives in examples like (1) that they all refer to representations of their antecedent. Our question is whether it is the representational use of the reflexives in (1), like (2)–(4), and not the syntactic or argument structure, that allows for the BT-violating behavior.

We present the results of two picture verification experiments that tease apart this third explanation from the first two. Experiment 1 tests the claim that while direct object reflexives are interpreted as bound variables (BV), picture NP reflexives can be interpreted as both bound variables and coreferential anaphora in ellipsis constructions (Grodzinsky & Reinhart, 1993). Participants looked at scenes on a monitor while listening to sentences with reflexives that were either the direct object of the verb (OBJ condition, example 5) or the object in a PNP (PNP condition, example 6). Each sentence was matched with each of two scenes. One scene depicted Mike pointing at (a picture of) Mike, and Jose pointing at (a picture of) Jose (BV scene). The other scene depicted both Mike and Jose pointing at (a picture of) Mike (coreferential scene). In addition, half of the trials contained the material in brackets, while the other half involved VP ellipsis. Filler trials were intermixed that did not contain reflexives. Participants had to indicate, by pressing either "Y" or "N," whether the sentence accurately described the scene.

Results: There were significantly more coreferential interpretations (either a "Y" to a coreferential scene, or an "N" to the BT scene) in the PNP condition than the OBJ condition, $p<.05$.

(5) Mike is pointing at himself, and Jose is <pointing at himself>, too.

(6) Mike is pointing at a picture of himself, and Jose is <pointing at a picture of himself>, too.

Experiment 1 showed that elided PNP reflexives are more likely to be interpreted coreferentially than OBJ reflexives when the linguistic and visual stimuli were correlated.

Experiment 2 teases apart the effects of the linguistic and visual stimuli, by using the same scenes as the first, but only using the OBJ sentences like (5).

Results: This experiment reproduced the key result of the first; reflexives that refer to representations of people produced significantly more coreferential interpretations than reflexives that refer to people, $p<.05$. Because this distinction was not realized in the linguistic structure, the two previous structural accounts (Pollard & Sag, 1992; Reinhart & Reuland, 1993; Chomsky, 1986; Davies & Dubinsky, 2003) cannot explain these results. Because the distinction was in the visual scene, and not in the linguistic representation, it could only be instantiated in a "non-linguistic conceptual" representation. Future research will investigate the nature of this instantiation.

Investigating verification procedures for quantified statements

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This paper presents a novel experimental technique ("Self-paced Counting," SPC) designed to gather fine grained timing information about how subjects gather information incrementally in verification tasks that involve counting. We show that this technique can detect different verification profiles for semantically equivalent quantified statements and that evidence of this sort can help distinguish between quantifiers that are said to be indistinguishable in their truth-conditional (TC) import and their compositional commitments.

Formal semantic analyses aim to establish a systematic relation between the TC import of an expression and its syntactic/ combinatorial properties. For instance, the semantics of determiners like *every, most, more than half,* etc. is given in Generalized Quantifier Theory (GQT) as in (1), (2), and (3). How the TC import of determiners affect verification procedures is typically not seen as something that formal semantics needs to account for or that could constrain formal analyses of quantification. Hence determiners pairs like *most* and *more than half* as described in (2) and (3) are indistinguishable within GQT even though their internal composition is quite different. Furthermore, the choice between the two descriptions of their TC import is arbitrary since they characterize exactly the same set of models.

From the standpoint of verification, however, (2) and (3) are quite distinct. In particular, (3) taken literally, calls for determining half the total number of As while (2) doesn't. Instead, (2) requires the comparison of the number of As that are Bs to the number of As that are not Bs. To see whether such a difference in verification strategy exists, we developed SPC. In a typical trial, subjects hear a sentence such as (4a) or (4b) and see two scattered rows of dots that are at first only outlined. As subjects press the space bar the dots are uncovered in increments of 1, 2, or 3 while previously seen dots are masked. We hypothesize that the speed with which subjects move from one frame to the next indicates how fast they integrate the new information relative to a given verification criterion. We support the claim that SPC reliably traces complexity of counting (or estimating quantities) we show that RTs for moving one frame forward into the array are linear functions of n for verifying statements of the form *more than n A B.* In the *most/more than half* experiment we varied pseudo-randomly the total number of dots across target and filler items and the size of dots in a particular color. Results: (N = 20) We analyze RTS only up to Frame 3 where it is not yet known whether the sentence is true and observe two main effects: 1. RTs increase the farther subjects get into the array and 2. RTs for *most* are consistently lower than those for *more than half.* We suggest that this indicates a difference in verification strategy where the strategy for *most* does involves local comparisons at each frame (Are there more blue than non-blue dots?) and keeping track of whether the target color leads while *more than half* involves counting to a criterion derived by (an estimate) of half the number of dots. To explain this difference the theory of quantification needs to be more fine-grained than GQT. In particular, it needs to systematically relate the components of determiners (*more*, *half*, etc.) to the functors used in the description of the TC import of determiners.

Examples

(1) Every (A)(B) = 1 iff $A \subseteq B$

(2) Most (A)(B) = 1 iff $|A \cap B| > |A - B|$

(3) More than half (A)(B) = 1 iff $|A \cap B| > \frac{1}{2}|A|$

(4) a. Most of the dots are blue.
b. More than half of the dots are blue.

The structural preferences of novel denominal verbs

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This study explores the syntactic preferences and processing of one type of lexical innovation — verbs that are derived from nouns, or *novel denominal verbs*. English has many words of this sort, for example *John umpired the baseball game* and *The secretary Xeroxed the memo*, and people readily both create new verbs from nouns and understand their usage. Our fundamental question is how people are able to understand a denominal verb that they have never encountered before, given that there is no existing lexical entry to access for the verb form. Since one of the most important components of a verb's lexical entry is its argument structure, one of the key aspects of this question is whether or not people have argument structure preferences for novel denominal verbs, and if so, where these preferences come from and whether or not they can be influenced by standard manipulations of typicality and prior discourse context. Prior work investigating novel denominal verbs (e.g., Kaschak & Glenberg, 2000; Kelly, 1998) has focused on the meanings that people assign to these forms, but has not independently addressed the contribution of syntactic preferences

As set out in Clark & Clark (1979), concrete denominal verbs fall into a taxonomy including verbs that are Locatums (indicating the location of one thing to another — *to blanket the bed*), Locations (indicating the location of an action — *to ground the plane*), Goals (indicating roles conferred by outside forces — *to orphan*), and Instruments (*to hammer*). In addition, some verbs switch categories depending on the syntactic structure that they are in, in particular whether or not the structure is transitive or intransitive. In our first experiment, we assessed the syntactic preferences of forty novel denominal verbs drawn from the four classes described above (e.g., Locatum — *to tofu*; Location — *to art museum*; Goal — *to pyramid*; Instrument — *to ambulance*). Participants were given the bare form of the verb, and were asked to use it in a sentence of their choice in order to indicate what they thought it should mean. The percentages of intransitive and transitive completions of the verbs were measured. Similar to existing verbs, we found a range of preferences across our items from strongly transitive, to equi-biased, to strongly intransitive. We will examine several hypotheses, including whether these preferences relate to the Clark & Clark taxonomy, whether syntactic structure for novel denominal verbs is borrowed from their "translation" verbs (those the denominal verbs are taking the place of), and whether syntactic preferences are determined by those of the general category of related, already established denominal verbs (e.g., using the preferences of other denominal vehicle verbs to inform the use of *to ambulance*). Furthermore, we will examine the degree to which participants' baseline syntactic preferences can be modified by biasing discourse contexts. The results will inform theories of lexical representation, and help broaden processing accounts to include creative uses of language.

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Interpretation of concealed questions: MEG and eye-tracking data

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Introduction. Psycholinguistic investigations have revealed that noncompositional meanings are costly to compute. To date, two noncompositional constructions have been investigated: complement coercion, which involves a semantic mismatch between an event-selecting verb and a non-event denoting argument (*begin the article*) (McElree et al., 2001), and aspectual coercion, where a punctual verb is converted into a durative predicate (Piñango et al., 1999). Here, we investigate constructions where a question-selecting verb grammatically combines with an entity-denoting NP, as in *she guessed the name of the animal*. Such expressions appear to convey a covert question (*she guessed what the name of the animal was*) and, hence, might involve "extra" processing. We used eye tracking and magnetoencephalography (MEG) to test whether concealed question interpretation is costly.

Materials. Question-selecting verbs were contrasted with non-question selecting verbs in passive sentences (1–2). The critical verbs were matched for lexical level factors as well as in their similarity to the preceding context (LSA measures). In the MEG experiment, we also presented the verbs to the subjects in isolation in order to test whether effects elicited in the sentential context would be present even when the semantically "mismatching" object is absent.

Eyetracking. Consistent with the hypothesis that concealed questions involve a semantic mismatch, concealed questions elicited reliably longer first pass durations at the critical verb ($t(39) = 3.14$, $p = .003$; $t(27) = 2.67$, $p = .01$).

MEG. The eyetracking findings indicate that concealed questions, like complement coercion, are costly to process. However, these findings do not provide a strong basis on which to evaluate whether the cost arises from qualitatively similar operations in the two cases. In an earlier MEG study, we have investigated the neural bases of complement coercion, and found that it elicits increased amplitudes in the Anterior Midline Field (AMF), generated in ventromedial prefrontal cortex (Pylkkänen & McElree, 2005; submitted). If concealed questions involve extra composition similar to coercion, as suggested by type-shifting analyses such as Nathan (in press), they should also elicit increased AMF amplitudes. However, if concealed question interpretation does not involve conversion of an entity into a proposition (e.g., Heim, 1979), effects should not be associated with an AMF generator. Consistent with the latter hypothesis, the AMF showed no effect of question concealment. Instead, concealed questions elicited larger amplitudes in the left temporal M350 source, which in previous studies has been shown to be sensitive to many lexical-level factors (Embick et al., 2001; Pylkkänen et al., 2002, 2003, 2004). Importantly, the M350 effect was dependent on the semantic mismatch between the object and the verb: when the question- and non-question-selecting verbs were presented in isolation (LDT), M350 amplitudes were nearly identical. Thus our results suggest that concealed question interpretation involves a lexical-level operation triggered by a semantic mismatch. Our localization of the processing cost of concealed questions is broadly compatible with the deficit-lesion data of Piñango & Zurif (2001).

Conclusion. This research adds concealed questions to the inventory of constructions requiring some type of additional semantic processing at the sentence level. Although concealed questions share many properties with complement coercion, our MEG results suggest distinct processing mechanisms for the two constructions. Left temporal regions were previously implicated for aspectual coercion in an aphasic study.

Examples

(1) The blueprint of the house was **explained** by the architect. *Concealed Question*
(2) The blueprint of the house was **modified** by the architect. *Control*

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The dual of the twins and the siblings: When is the dual easier to process in Slovene?

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Attraction effects, where a verb erroneously agrees with an intervening ('local') noun rather than the head noun, are well established with plural local nouns [1], as in Example 1. Eberhard [4] proposed a binary distinction between marked plurals and unmarked singulars, but some theories suggest a markedness hierarchy: singular < plural < dual [3]. Harrison et al. [5] exploited Slovene's three-way number distinction to address this question, and found dual heads were more susceptible to errors, and local heads caused more attraction errors, than plurals. Indeed, even languages which have no syntactic distinction between dual and plural number nonetheless show differences between the two [6].

But is it the notion of duality which is error-prone or the syntactic number value itself? In order to explore this, we took advantage of the interesting properties of paired objects in Slovene. Unusually it is the words referring to naturally occurring pairs, e.g., gloves or parents, that do not require the dual, whereas those referring to non-pairs, e.g., scarves or uncles, do (cf. Hebrew and other languages with a vestigial dual).

We compared objects which occur naturally in pairs to those which do not. Previous research [2] has shown that bipartite pluralia tantum (e.g., *scissors*) cause comparable attraction errors to other plural items, despite being grammatically plural but conceptually singular, providing more evidence for syntactic-only influences in attraction errors. Arguably, pairs like *gloves* and *parents* form similarly conceptually ambiguous cases (being conceptually dual but more commonly used in plural form with plural agreement in Slovene). We investigated whether the status of a word as pair or non-pair influenced whether the dual and the plural were more plausible attractors. We presented 72 Slovene speakers with 36 experimental items consisting of a singular head noun postmodified by a relative clause including a local noun which was either a pair or a non-pair, and was presented in either the singular, dual or plural number (Example 2).

Participants repeated the preamble and completed the sentence using a specified verb within a time limit. We measured the rate of correct (singular) agreement compared to agreement errors (dual or plural agreement).

We found attraction effects with both dual and plural local nouns (compared to the singular control). Furthermore, whilst there were plural errors and no reliable difference between pair and non-pair plural local noun attraction rates, there were significant differences in the pairs and non-pairs dual local noun conditions. Although dual agreement is normally dispreferred after a bare pair, thus arguably more marked, there were more dual errors after a dual non-pair than a pair. We interpret our findings to mean that the conceptual association of pair words with the dual (despite the linguistic context) is strong enough to make them less marked in the dual than the non-pairs.

We argue our results provide more evidence that the simple singular / non-singular distinction is too coarse for languages with a more complex system and discuss their implications for incorporating semantics in models of agreement production.

Examples

1. The readiness of our forces are at an all-time low.
2. Otrok, ki ga je / sta ga / so ga nadrl/a/i **starš** / stric / **starša** / strica / **starši** / strici – JEZITI SE
   The child whom the **parent** / uncle / **parents** (dual) / uncles (dual) / **parents** (plural) / uncles (plural) told off – GET ANGRY

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The impact of personal experience on understanding addressees' communication needs

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Audience design is the process of adapting utterances to fit an addressee's perspective. Two experiments explored factors that might help speakers infer how to tailor message form (specifically, word order) to their addressee's needs [1]. Both experiments involved a game in which a Director described colored, patterned picture cards for a Matcher to select from a box. Labeled index card dividers were used to organize the cards into groups by pattern and by color, such that some descriptions would be easier for the Matcher to act upon than others.

In Experiment 1 (32 pairs), Matchers selected cards from two boxes, a "Pattern" box and a "Color" box (labeled 1 and 2). In the Pattern box, cards were grouped together by pattern and then sub-grouped by color. Pattern-first descriptions (e.g., "striped orange circle") for cards from this box allow the Matcher to incrementally narrow their search for the card, without holding the whole description in memory. In the Color box, cards were grouped by color and then sub-grouped by pattern, making color-first descriptions (e.g., "orange striped circle") easier to incrementally map onto the array. Directors' only experience as an addressee in this task came from a short practice session in which they acted as Matcher while the Experimenter described four cards to them. The results suggest that this limited experience was ineffective in promoting audience design with respect to word order. During the experiment, Directors produced about 6% more pattern-first descriptions for cards from the Pattern box than for cards from the Color box, but this effect was not significant (both p's>.05). These results have implications for other studies that failed to find effects of audience design on utterance form, in which speakers had little or no opportunity to discover what would make their utterances easy for the addressee to interpret [e.g., 2; 3; 4].

In Experiment 2 (40 pairs), there was no practice session, but participants looked through the Pattern box before the experiment, and half of the pairs swapped roles (Director versus Matcher) for the second of three games (16 card descriptions per game). All Matchers selected cards from the Pattern box throughout. Directors produced significantly more pattern-first descriptions than color-first descriptions (p's<.001; see Note), and when Directors knew they would not be swapping roles with their partner, they engaged in more audience design during the first game (p's<.01). We suggest that when speakers know they will not have a chance to discover the Matcher's perspective first-hand, they pay more attention to information about that perspective at the start of the experiment, when they are given a chance to look through the card box. It may also be easier to maintain a representation of the addressee's perspective when only one box of cards (hence one array organization) is involved. Taken together, our results suggest that (limited) direct experience as an addressee may be less effective in promoting audience design than an opportunity to reflect on the addressee's communication needs, outside the conversation itself.

Note: Directors produced significantly fewer pattern-first descriptions in a secondary task where word order had no consequences for communicative success, suggesting that Directors really were attending to the Matcher's needs during the card selection task.

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The use of *uh* and *um* in native English-speaking 3– and 4–year olds: Do they know the difference?

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Recent work examining disfluency production in adults suggests that disfluencies are patterned. Clark & Fox Tree (2002) go so far as to suggest that the filler syllables *uh* and *um* are actually words, both of them signalling upcoming speech difficulty, but with *uh* signalling a lesser degree of difficulty than *um*. As such, they are selected for and planned like any other word. This view implies that children actually need to learn how to use fillers appropriately. Indeed, previous work by Van Der Wege & Ragatz (2004) using semi-structured elicitation suggests that children do not produce fillers in an adult-like fashion (i.e., distinguish *uh* from *um*) until 5–6.

However, children produce fillers long before this. The question that emerges, then, is what preschool children are doing with *uh* and *um*. In this study we ask whether there are any patterns of usage that are consistent in the speech of pre-school children, whether or not the patterns are adult-like. Further, if the patterns are not adult-like, we ask whether they suggest that the children are on their way towards learning the correct usage, or are instead doing something completely different that would require substantial reorganization in their representation of fillers before the adult state is reached.

We examined the disfluencies present in the speech of 24 3– and 4–year old children (11 males, 13 females; mean age = 4;2). Samples were collected using a semi-structured elicitation, similar to the task in Van Der Wege & Ragatz (2004). We video-recorded the children while they looked through a picture book and told the story to an experimenter who prompted them when necessary. The speech samples were later transcribed and analyzed. Transcribers noted the presence of pauses and fillers. All transcribed pauses were then measured using Praat sound analysis software for actual length. All analyses were conducted using these measurements.

All of the children produced disfluencies — they paused, restarted, repeated themselves, and produced fillers. However, we found no evidence that the children differentiated *uh* and *um*. This was true when all pauses and fillers were analysed, when only utterance internal pauses were considered, and when we restricted the analyses to only those children who used both *uh* and *um* (N=12). However, there was a pattern in the data: Overall, the pauses that children marked by using either *uh* or *um* before the pause were significantly longer than those left unmarked. Again, this held for multiple different analyses. Thus, the children appear to be marking 'comment-worthy' pauses. These data are consistent with the idea that 3–4 year olds have extracted a basic general meaning for fillers, importantly, one that is appropriate. If this is indeed the case, then what remains for them to do is further differentiate the subtle differences in meaning between *uh* and *um*, rather than a substantial reorganization. Thus, preschool children appear to be well on their way towards controlling *uh* and *um*.

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The sentence-level processing of case markings and word order by L2 learners of German

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The present study adds to the growing body of research examining how second language (L2) learners process sentences in their non-native language (cf. Frenck-Mestre, 2005; Papadopoulou, 2005, for two recent reviews). Under investigation is the extent to which L2 German learners (English L1) rely on case markings, word order, and semantic information when reading German sentences. Case markings present a major challenge to American learners of German, since unlike English, which relies largely on word order to indicate the subject and direct object in a sentence, German uses case endings to mark these grammatical roles.

Adult German learners at the 5th-semester level and above, along with German native speakers, read sentences, such as (1a–1d), and their reading time for each sentence was recorded. Sentences varied according to word order (object-subject vs. subject-object) and whether the subject of the sentence was animate or inanimate (+ANIM vs. –ANIM). All sentences were grammatical and unambiguous, assuming one paid attention to the case markings. After reading each sentence, participants were presented two summary statements and asked to choose the statement that best summarized the original target sentence.

(1) a. Es ist schade, dass den Verkäufer$_{ACC}$ der Preis$_{NOM}$ beeinflusst. [-ANIM, OS]
b. Es ist schade, dass der Preis$_{NOM}$ den Verkäufer$_{ACC}$ beeinflusst. [-ANIM, SO]
c. Es ist schade, dass den Verkäufer$_{ACC}$ der Mann$_{NOM}$ beeinflusst. [+ANIM, OS]
d. Es ist schade, dass der Mann$_{NOM}$ den Verkäufer$_{ACC}$ beeinflusst. [+ANIM, SO]
It is too bad that the price / the man influences the salesman.

German native speakers exhibited no significant differences in comprehension across conditions. This result is not surprising given that the sentences were unambiguous. In contrast, reading times for correctly comprehended OS/+ANIM sentences were significantly longer than for the other three conditions. No other reading time differences were statistically significant.

Results from the L2 German learners present a different story. Intermediate learners had difficulty comprehending sentences containing two animate entities, regardless of word order. Similarly, advanced learners had greater difficulty comprehending sentences containing two animate entities compared to sentences containing only one animate entity. However, among advanced learners there was also an interaction between animacy and word order in that their comprehension of SO/+ANIM sentences was significantly higher than that of OS/+ANIM sentences. Although none of the reading time results from the L2 German learners exhibited statistically reliable differences across conditions, there was evidence that advanced learners' reading times were more sensitive to the manipulation of word order and animacy than those of the intermediate learners.

Results from both the German native speakers and the L2 German learners support claims that animacy may have an impact on the relative processing difficulty of object-subject sentences (e.g., Mak et al., 2003; Traxler et al., 2002). Furthermore, L2 learner comprehension results are in line with the argument put forth by Gordon et al., (2001, 2004) that sentences containing two highly similar NPs present greater processing difficulties than those containing two dissimilar NPs. At the same time, comprehension results from the advanced L2 learners indicate that as proficiency increases, learners become better able to overcome this difficulty by utilizing structural information during processing.

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Word segmentation from continuous speech: The "Foreign Language" effect

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The focus of our study is word segmentation: how language users segment and recognize words from continuous speech. Continuous speech contains no silences between words analogous to the spaces in written text. Language users must thus rely on other cues to find word onsets and recognize words in continuous speech. Understanding continuous speech seems easy, which suggests considerable language user proficiency in segmentation (Kooijman, Hagoort & Cutler, 2005). Crucially, however, this subjective ease is confined to speech in the native language; segmenting speech in other languages is much harder. Non-native listeners often subjectively report that difficulty seems to arise because users of other languages speak ridiculously fast.

In an ERP study, we tested native Dutch-speaking adults, and English-speaking adults without knowledge of Dutch, on segmentation of Dutch. We used an ERP repetition task (Rugg & Doyle, 1994) with a series of familiarization and test phases. In each familiarization phase, subjects heard ten tokens of a low-frequency bisyllabic trochaic Dutch word (e.g., [1]) presented in isolation. In test, they heard eight sentences, of which half contained the familiarized word (e.g., [2]). The other sentences contained another word with similar structure (e.g., [1]). The sentences were constructed in such a way that it was difficult to predict the critical word. Position of the critical word in the sentences was varied. Familiarized versus unfamiliarized status of the word tokens was counterbalanced across participants. EEG was measured during both Familiarization and Test. ERPs were calculated to the first and second word presented in isolation (Familiarization Phase), and to the critical words in the sentences (Test Phase).

The results showed a similar ERP response in Familiarization for Dutch and English adults: a positive repetition effect with a central-posterior distribution, starting at about 300 ms. Thus both participant groups were equally able to recognize that the ten tokens were repetitions of the same word type. In Test, however, the ERP responses for the two groups were different. Dutch adults showed a very fast positive repetition effect, starting as early as 115 ms after word onset. English adults, however, showed a reduced repetition effect, starting much later into the critical word, at 515 ms after word onset. Again, both participant groups detected the occurrence of the familiarized word in the continuous speech context; however, the speed with which the word could be detected was significantly faster for the native listeners.

Even though Dutch and English are highly similar languages, our observation of fast segmentation by Dutch adults, but a reduced and delayed response for English adults, suggests that only the native listeners have the requisite abilities to perform fast segmentation of Dutch sentences. We conclude that the 'foreign language' effect — the impression of faster speech in other languages — arises because segmentation of continuous speech is a process which, as behavioral studies with English, French and Japanese have also shown (Cutler, Mehler, Norris, & Segui, 1986; Otake, Hatano, Cutler & Mehler, 1993), listeners have optimized for application to their native language.

Examples

[1] Examples of isolated words in the Familiarization phases
(1) *hofnar* (court jester); (2) *python* (python); (3) *serre (*conservatory); (4) *krekel* (cricket)

[2] Examples of sentences in a Test phase following familiarization with isolated word (1):
De hofnar maakt weer eens rare grappen. (The court jester sometimes makes weird jokes.)
*Daar zie ik een boze python liggen. (*I can see a nasty python lying there.)
Zonder een hofnar lacht er nooit iemand hier. (Without a court jester no-one here would ever laugh.)
De python ziet er nogal gevaarlijk uit. (The python looks rather dangerous.)

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Differential effects of lexical surface frequency on reading times in syntactic context

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Work in lexical access using single-word tasks like lexical decision (LD) has shown small but significant effects of whole-word or *surface*-frequency on reaction times for morphologically complex words, in addition to the more familiar effects of total or *root*-frequency [1–3]. In the sentence processing domain we often make the simplifying assumption that such low-level effects are too small to impact sentence-level tasks; however, recent work questions this assumption [4–7]. Such findings are important in two ways: 1) they may have methodological consequences for sentence processing studies, and 2) they suggest that sentence-level tasks may be used to examine questions about inflectional processing that are harder to interpret in LD tasks. In the current study we examined surface-frequency effects in a self-paced-reading task for English singular and plural nouns. We show clear effects of surface-frequency on reading times for both.

LD studies have shown slower RTs for English words appearing in their less frequent inflectional form: so-called *singular-dominants* (appearing more frequently in the singular) elicit longer LD times in the plural (sg<pl), while *plural-dominants* show no difference across forms [2, 3]. While these results are suggestive, it's unclear how inflectional morphemes are processed within tasks that only require discrimination between words and nonwords. In sentence contexts, one study found surface-frequency effects, looking at plurals only [7]. Here we looked at the full pattern of surface frequency effects across both singular and plural forms. We also added a third word-type balanced for surface-frequency, allowing us to test for morphological decompositional costs.

69 sentences were created, 23 pairs for each word type (singular-dominant, plural-dominant, equal-frequency), in which the noun always occupied an identical structural position (1a-c). Corpus counts showed the preceding adjective did not predict number on the noun. Word type lists were balanced for root-frequency and length. 38 subjects performed a self-paced-reading task which included one version of each sentence. A 2 x 3 ANOVA on the critical noun and following region combined showed a significant interaction between word-type and number ($F_1(2,37)=5.83$, $p<.01$). Planned comparisons showed singular-dominant words were read more slowly in the plural than the singular ($t_1=2.10$, $p<.05$; $t_2=3.01$, $p<.05$); furthermore, the opposite held for plural-dominants ($t_1=2.50$, $p<.05$; $t_2=2.03$, $p<.05$). The difference between the equal-frequency conditions was non-significant ($t_1<1$, n.s.; $t_2=1$, n.s.), suggesting that if decomposition occurred, it was non-costly.

We find surface-frequency effects of similar magnitudes to effects in lexical tasks (~30 ms) in a simple sentence reading task, and we also find that these effects are present in both singular-dominant and plural-dominant cases. This has important methodological implications for sentence-reading studies that vary inflections, particularly for those that manipulate number (e.g., agreement processing [8]; incremental interpretation [9]. Furthermore, this is the first case in which a significant surface-frequency effect for plural-dominants has been shown, suggesting that tasks including sentence context may be more sensitive to inflectional processing factors. Finally, these results form groundwork for further investigation into interactions between sentence context and low-level lexical processing effects. In a follow-up study currently underway, we examine whether unambiguous cues to noun number (e.g., *these* studios) can actually eliminate the surface-frequency effect (2a–c).

Examples

(1) a. Jean was ecstatic that the tiny studio(s) had been expanded into one gigantic loft. SG-DOM
b. The nurse was glad that the wounded soldier(s) would soon be well enough to leave the hospital. PL-DOM
c. The farmhands decided that the old goat(s) should be given a smaller pasture to graze in. EQ-DOM

(2) a. Jean was ecstatic that this/these tiny studio(s) had been expanded into one gigantic loft. SG-DOM
b. The nurse was glad that this/these wounded soldier(s) would soon be well enough to leave the hospital. PL-DOM
c. The farmhands decided that this/these old goat(s) should be given a smaller pasture to graze in. EQ-DOM

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Semantic compositional processes in the interpretation of *light* verbs

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We examine the hypothesis that compositional processes associated with argument structure are carried out exclusively in the semantic component of language. To this end, we investigate the compositional processes involved in the interpretation of the "light verb construction" (e.g., Jespersen 1954, Jackendoff 1974, Cattell 1984, Grimshaw & Mester 1988, Baker 1989, Culicover & Jackendoff 2005). A verb is "light" when the main thrust of the semantic relations of the predicate that it denotes is found in its object. For example, *Sue made a dash across the road* means SUE DASHED ACROSS THE ROAD. This composed meaning results from the combination of the argument structure of the "light" verb with that of its object. We take this process, which we call "argument sharing," to be purely semantic in nature, and crucially, not represented at the syntactic level.

We test this hypothesis from a processing perspective on the assumption that semantic composition exerts a cost to the comprehension system beyond that observed for syntactic composition (e.g., Piñango 2003). We do so via the dual task interference paradigm. In this task, sentences are presented auditorily to subjects. At a critical point in each sentence, subjects carry out a lexical decision for a visually presented letter string (probe) that is unrelated to the sentence. It is assumed that increased processing demands imposed during the interpretation of some sentences "interfere" with the processes involved in executing the lexical decision task. This interference is reflected by a higher reaction time (RT) to the computationally costly condition with respect to less costly counterparts.

Accordingly, we compare the *light* (1) condition to two conditions lacking argument sharing: *dark* (2) and *heavy* (3). The conditions differ in terms of the presence/absence of an object with argument structure (*light* vs. *dark*) and the presence/ absence of a potentially "light" verb (*light* vs. *heavy*). (Overt) syntactic composition is held constant across conditions. In all conditions, a probe is presented at the end of the matrix object (^).

Our hypothesis predicts that the semantic compositional process of argument sharing leads to increased processing load (as reflected by a higher RT) in the *light* condition with respect to the *dark* and *heavy* conditions. Initial results support this prediction. *Light* sentences elicited a significantly higher RT than both *dark* and *heavy* counterparts ($p<.01$). Crucially, frequency cannot account for this contrast. All conditions were matched for the frequency of the verb and its object. In addition, corpus work reveals that the *light* sense of the verbs used occurs with higher frequency than the *dark* sense.

These results are thus consistent with the view implicit in some, but not all, models of language representation, that the semantic system can carry out compositional processes of its own, independently of the combinatorial powers of syntax.

Examples

(1) (*Light)* Last month, Joseph gave an order ^ to the produce guy who had mixed up all the requests.

(2) (*Dark)* Last month, Joseph gave an orange^ to the produce guy who had mixed up all the requests.

(3) (*Heavy)* Last month, Joseph typed an order^ for the produce guy who had mixed up all the requests.

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Reciprocals, processing and event structure

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The linguistic literature on the semantics of reciprocal expressions (e.g., *each other, one another*) has focused on the wide range of interpretations available to sentences containing these expressions. (For instance, Dalrymple et al. 1998 report five different interpretations of the reciprocal.) At present, little is known about the comprehension of these sentences. How does the processor fix on an interpretation, given the range of possibilities?

Experiments 1 and 2 explore the hypothesis that perceivers prefer reciprocal sentences to describe eventualities that are simultaneous.

It has been claimed that reciprocal sentences with *each other* have a preference for describing one 'general event' (Fiengo & Lasnik 1973). This was tested in Experiment 1, a questionnaire study with a 2 x 2 design. Participants rated *Each other* ('Those spies spotted each other') and *Each the other* ('Those spies each spotted the other') sentences as descriptions of *One-occasion* (1a) vs. *Two-occasion* (1b) contexts. There was a main effect of number of occasions, with higher ratings in the One-occasion context (p's <.05). There was an interaction by items, with the One vs. Two-occasion manipulation having more of an effect on *Each other* than *Each the other* ($F(23)=4.64$, $p<.05$).

All of the items in Experiment 1 involved eventive verbs. Note that while eventive reciprocal sentences like (2a) *can* describe simultaneous events, they need not. In contrast, stative reciprocal sentences like (2b) describe states of affairs that hold simultaneously. A preference for reciprocal sentences to describe simultaneous eventualities predicts that in general, stative reciprocals will be preferred over eventive reciprocals. This was tested in Experiment 2, a speeded acceptability study (48 participants, 20 items). Participants judged the acceptability of sentences with *Eventive* (2a) and *Stative* (2b) predicates. As predicted, statives were accepted significantly more often than eventives ($F(1,47)=6.44$, $p<.05$). The study had a 2 x 2 design; it also addressed a separate question about the effect of the number of entities involved. Thus, the two factors were *Stative vs. Eventive* and *Number* (*two vs. larger number*). The study found main effects of Number and Stative vs. Eventive, but no interaction. (The main effect of Number could be seen as a conceptual complexity effect: Sentences with more than two entities were more difficult (lower acceptability, slower RT, all p's<.05).) Further research is in progress to ensure that the results of Experiment 2 do not simply reflect a complexity difference between statives and eventives, independent of the reciprocal.

Examples

(1) a. The mission was over: the agency spy spotted the foreign spy, and the foreign spy spotted the agency spy.

b. At the crowded train station, the agency spy spotted the foreign spy. And at the art museum, the foreign spy spotted the agency spy.

(2) a. {Two/Five} kids hit each other. (Eventive)

b. {Two/Five} kids liked each other. (Stative)

ERP evidence about the role of plausibility in the comprehension of temporarily ambiguous sentences

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The present study used event-related potentials (ERPs) to investigate the relationship between verb bias and noun plausibility in sentence processing. Garnsey and colleagues (1997, 1998) have demonstrated that English speakers rely on verb-based predictions while reading sentences. Both reading time (1997) and ERP (1998) measures showed that readers were not garden-pathed when a temporarily ambiguous sentence turned out to have the more complex of its possible structures, as long as the verb predicted that complex structure. They were, however, garden-pathed when the sentence structure was inconsistent with verb-based predictions. For sentences with verbs that have a strong bias toward a particular sentence structure, it was clear that verb bias played an influential role in sentence processing. However, the results for verbs that do not have a strong bias are less clear. While readers could use strongly biased verbs to make predictions about the structure of temporarily ambiguous sentences, they may rely on other sources of information in sentences containing an unbiased verb. One such cue is the plausibility of a noun as a direct object for a temporarily ambiguous verb. Unbiased verbs have been investigated only in reading time studies so far, so the present study used ERPs to further examine the relationship between verb bias and noun plausibility. Using unbiased verbs in sentences containing subordinate clauses, we manipulated the plausibility of the noun following the main verb as a possible direct object. Both verb bias and direct object plausibility were determined using a compilation of norming data. During the experiment, participants read sentences that were presented one word at a time. Sentences with nouns that were implausible as direct objects (example (1)) elicited large N400s at that noun, while sentences with plausible direct objects (example (2)) elicited P600s at the disambiguating word. Importantly, there was no P600 effect in sentences with implausible direct objects, indicating that readers rapidly used plausibility to predict likely sentence structures and avoid garden-pathing. These results support models of sentence processing in which multiple cues are used interactively during comprehension, but in which some cues take precedence over others.

Examples

(1) Implausible Direct Object The young boy admitted the stone had broken the window.

(2) Plausible Direct Object The young boy admitted the lie had been his idea.

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Toward a unified model of speech production: Articulatory evidence of cognitive manipulations

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Speech production research generally focuses on either cognitive or articulatory mechanisms. However, few attempts have been made to produce a model that integrates both. This paper details first steps towards producing evidence suitable for simulation in a new unified model of speech production.

We manipulated variables at higher cognitive levels and measured their effects on articulatory variation in an error elicitation paradigm, the Word Order Competition Task (Baars & Motley, 1976) using electropalatography (EPG), a technique that measures tongue to palate contact across time. Speakers were probed to speak rapidly presented word pairs out loud in the order they were presented. In an attempt to elicit errors, speakers were occasionally probed to speak non-word target pairs in the reverse order. The targets were manipulated to yield either real-word outcome or non-word outcome phonological exchange errors. All target pairs included both an alveolar (t or d) and velar (k or g) onset.

A multi-dimensional scaling technique (McMillan & Corley, 2005) was used to calculate articulatory contact variation between each onset within target non-word pairs. A 2×2 ANOVA with lexicality of outcome and place of articulation factors revealed a significant main effect for place of articulation ($p<.005$), whereby intended alveolar contact was more variable than intended velar contact. This result is consistent with a dynamic account of tongue movement, where there is more variability in tongue-tip movement than tongue-dorsum movement.

We additionally observed a marginal lexicality of outcome main effect ($p=.057$) in which potential real-word outcome errors yielded more tongue contact variation than potential non-word outcome errors. Increased articulatory variation can be interpreted as an attraction toward lexical errors at an earlier stage of speech planning, which results in less accurate articulatory level targets. Moreover, we also observed a marginally significant place of articulation by lexicality of outcome interaction ($p=.055$), in which lexicality of outcome only affected articulatory variation for velar onsets. This interaction could be the result of lexical outcome induced articulatory variation being less apparent in alveolar articulations relative to velar articulations, due to higher overall alveolar articulatory variation.

Typically, cognitive models of speech production only make predictions at the phonological level. In this paper we have measured the effects of higher level cognitive planning on lower articulatory levels of production. With the approach detailed and the results uncovered, we hope to lay a foundation for a corpus of evidence to be simulated in a new unified model of cognitive and articulatory speech production.

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Performing a syntactic analysis of spoken sentences without a lexicon

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The phonological bootstrapping hypothesis (Morgan, 1986) postulates that a purely phonological analysis of the speech signal may allow infants to acquire, among other things, some aspects of the syntax of their maternal language. We investigated the use of two different cues, phonological phrase boundaries and function words, that may allow listeners (infants as well as adults) to build a syntactic structure of spoken sentences: Phonological phrase boundaries would delimit syntactic units, while function words would label these units.

To investigate syntactic processing, and to simulate language acquisition, we tested adults on *Jabberwocky* sentences, where function words and prosodic information were preserved, but all content words were replaced by non-words. We created two experimental conditions:

- *"With function word" condition*: Target words were directly preceded by a function word, as in "[une **bamoule**] [dri se froliter] [dagou]" (brackets indicate phonological phrase boundaries — the target word "bamoule" is a noun), and "[tu **bamoules**] [saman ti] [à mon ada]" (where the target word "bamoule" is a verb)
- *"Without function word" condition*: Target words were not directly preceded by a function word; sentence beginnings differed only by their prosodic and syntactic structures, as in "[une cramona **bamoule**] [camiche dabou]" (for the noun target) versus "[une cramona] [**bamoule** muche] [le mirtou]" (for the verb target).

French adults performed an abstract word detection task: Targets were specified with their syntactic category (infinitive form to detect a verb / "article + noun" to detect a noun). Each sentence (noun and verb) was presented with both targets (noun and verb, balanced across participants). If a given participant was asked to detect a verb target, he had to respond to the verb sentence, and refrain from responding to the noun sentence (and vice-versa for the detection of a noun target).

Our results indicate that participants perfectly used the presence of function words ("with function word" condition). In more than 90% of the cases, a non-word preceded by an article was interpreted as a noun, whereas it was considered as a verb when preceded by a pronoun. The joint use of prosodic cues and function words ("without function word" condition) was as informative. When a prosodic boundary was placed before the target word (verb sentences), participants gave 90% verb responses (when a prosodic boundary was not available before the target, in noun sentences, they failed to do the task).

Thus, function words and prosodic boundaries allow listeners to start building a syntactic structure for spoken sentences. French adults used phonological phrase boundaries to define syntactic boundaries; they used function words to label these syntactic constituents (noun phrase, verb phrase) and infer the syntactic category of target words. Young infants in their second year of life, who do not yet know many content words, but may well have access to function words and prosodic boundaries, may thus also be able to perform this kind of syntactic analysis.

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Disfluencies affect subsequent word processing

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There has recently been increased interest in the role that disfluencies play in speech comprehension (e.g., Fox Tree, 2001; Brennan & Schober, 2001). Fox Tree showed that people were faster at identifying an upcoming word after a short filler (e.g., 'uh'), than when no disfluency occurred. This effect was not found for longer fillers (e.g., 'um'). Fox Tree suggests that short fillers only may focus the listener's attention, so they respond faster. Other research suggests that longer fillers ('ums') may also facilitate processing (Corley & Hartsuiker, 2003).

We present three change detection studies that investigate the effects of short and long filled pauses. In the text-change procedure, participants hear a short passage, and then hear it again. ,A small change may be present in the second exposure. Whether these changes are noticed is sensitive to factors that influence the amount of attention paid to different parts of a text (Sturt et al., 2004). Materials like (1) were recorded such that they could contain an optional 'uh' before critical words (Experiment 1, Part 1), or an optional 'um' (Experiment 1, Part 2). Furthermore, on the second presentation, the materials may contain a change of critical word to either a semantically related or unrelated word.

(1) Did you hear on the news today about the hill walkers? Apparently two men are missing in the Glenshee [uh / um / no filled or unfilled pause] district near Braemar up in the Highlands. It's about this time of year that lots of walkers get lost.

Slashes indicate options. Here "district" changes to either "region" (similar) or "mountains" (distant).

Part 1 and Part 2 were run in tandem, with participants being allocated to either condition. Results were similar for these studies. More correct detections of changes occurred after disfluencies. Additionally there were more correct detections for semantically unrelated changes than for related changes, and there was an interaction between relatedness and disfluency such that disfluency increased the detection rate of related changes more than it did unrelated. There were no differences in these effects as a function of type of disfluency.

In Experiment 2, the disfluencies were digitally replaced by pauses consisting of sampled background noise. The length of these pauses was matched exactly to the length of the 'uhs' or 'ums' of the original materials. The pattern of the results was essentially the same as those of Experiment 1.

We conclude that the disfluencies examined appear to boost the processing resources allocated to the word following the disfluency. Secondly, we found no evidence for a functional difference between *uh* and *um*, as proposed by Fox Tree, or indeed, between filled and unfilled pauses of matched durations. Finally, the pattern of results is consistent with that observed for manipulations of focus (e.g., Sturt et al., 2004), but different from that which would be expected if a disfluency reduced subsequent processing load (Sanford et al., 2005).

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When do shifts in aspectual interpretation occur?

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Within a sentence aspectual interpretation (AI) is underspecified, since it depends on semantic properties of the verb, the object, and adverbial phrases, and their structural position. For example, *John wrote* does not imply an inherent temporal boundary and therefore is atelic, but adding the object *a check* shifts AI to telic, adding the adverb *everyday* shifts it back to atelic, etc. For an incremental processor, the effect of adding such phrases is that it must change AI frequently. If each change in AI incurs a processing cost (e.g., Pinango et al., 1999; Todorova et al., 2000), there may be pressure to delay AI until all phrases have been processed.

Yet, properties such as morphological number of the object strongly predict AI. In addition, since verbs that tend to be delimited appear in a smaller range of syntactic contexts (Rappaport & Levin, 1998), they may accurately predict AI. These possibilities suggest that incremental AI sometimes may be more efficient than delayed AI.

We discuss the following questions:

Are verb semantics and object number statistically related to AI? A corpus analysis indicates that verb semantics predicts sentence telicity for both delimited and non-delimited verbs, whereas object type is predictive only for delimited verbs.

Does number marking of the object have a greater effect on processing load than verb semantics or object number-induced coercion of verb semantics? A monitoring experiment shows that object type affects monitoring but object-number induced shifts in AI do not.

Do story comprehenders have better access to the content of (foregrounded) telic sentences only after a delay? A probe recognition experiment shows that object type affects immediate probe recognition, whereas a shift in AI affects delayed probe recognition.

Does aspectual information from discourse context influence aspectual processing at the earliest possible point in a target sentence? A self-paced reading study suggests not. Examples appear below (cf., Slabakova, 2001). The earliest point at which aspectual re-interpretation could occur is on the determiner in the object phrase, not the noun. Since the determiner appears prior to the end of the clause, a contextual effect on the determiner would indicate aspectual re-interpretation prior to the clause boundary. The results showed that context did not interact with morphological information until the final noun.

We assume that when the task requires a response within the sentence (monitoring and single word self-paced reading experiments), it assesses early processing, but when it requires a response after the end of the sentence (probe recognition experiment), it assesses late processing. Thus, the results suggest that the processor engages in early semantic interpretation based on explicit morphological cues that are correlated with AI but it derives a full AI from the complete syntactic representation for integration with discourse context. The late semantic interpretation of a sentence follows a syntactic representation of its logical form. This view is consistent with previous processing studies (e.g., Dickey, 2001) and with linguistic theories that claim that a detailed syntactic representation is necessary for semantic interpretation.

Examples

Penny took care of her children for one day. She made them a picnic lunch.
Penny took care of her children for one day. She made them some picnic lunches.
Penny took care of her children for several days. She made them a picnic lunch.
Penny took care of her children for several days. She made them some picnic lunches.

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Visually mediated speech production in English and Russian

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In a set of experiments we analyzed the time-course of speech related gaze patterns during the production of English and Russian transitive sentences. There were two consecutive tasks to perform: (1) to name the single referents not involved in action; (2) to describe extemporaneously simple transitive interactions between the same referents. The participants' narrative recordings were time-locked to their eye-tracking data. To avoid effects of salience, the entities were controlled for size, color, animacy, and the position of referent presentation (i.e., left or right).

The data were analyzed in terms of the syntactic structure, the order and the time-course of eye fixations, and the speech onset latencies.

The data analysis revealed differences between the two languages. The speech onset latencies for Russian were on average 330 msec longer than for English during both naming and event description stages. This delay may be due to longer syllabic structure of words used by Russian speakers (2.5 vs. 1.8 syllables). We measured the *eye-voice span* (Griffin & Bock 2000) — the temporal distance between the last fixation to the referent area and the onset of the corresponding name. During the naming stage, the eye-voice spans were comparable between the languages (circa 370 ms) as the retrieved name was always in the nominative case in both languages. However, during the event description stage the average eye-voice span in Russian (798 ms) was significantly longer than in English (551 ms). This may reflect the differences in the syntactic formulation between the two languages: Russian speakers need to entertain a larger inventory of word order options and use case marking to organize their sentences while English speakers are more restricted in their choices.

On the other hand, English and Russian revealed important similarities. In both languages, canonical SVO was preferred in over 95% of trials. It seems plausible that in the absence of other cues, the referent's agenthood was used as a starting point cue and drove assignment of the grammatical subject. The resulting syntactic structure was mirrored by the pattern of fixations: participants looked at the referents shortly before producing their names. Such incremental production is similar to that reported by Griffin & Bock (2000). Interestingly, the production-related gazes were preceded by a separate sequence of short fixations, which consistently proceeded from the event to the agent and, finally, to the patient. We argue that such first-pass scanning reflects rapid apprehension of the event. Initial gazes to the event area may allow speakers to quickly extract information about the referents' roles. The subsequent switch of attention to the agent suggests that the resulting descriptions were biased by the event apprehension toward an agent-initial SVO. In contrast to the eye-voice span data, the durations of the rapid apprehension gazes were comparable between the two languages prompting, at least in part, a non-linguistic explanation of this process. However, the gazes to the patient were significantly delayed compared to the gazes to the event and the agent, more so for Russian speakers. This may indicate that (1) rapid apprehension and subsequent sentence preparation processes overlap so that formulation of the sentence begins before the apprehension of the event is completed, or that (2) some linguistic information is being encoded already during the initial apprehension.

The gender congruency effect in bare noun production in Spanish

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Previous research in syntactic gender congruency effects has indicated that German and Dutch speakers exhibited priming effects in the production of noun phrases (La Heij, Mak, Sander & Willeboordse 1998; Schriefers 1993; Schriefers & Teruel 2000), whereas speakers of Spanish and Italian showed no such effects (Miozzo & Caramazza 1999; Costa, Sebastián-Gallés, Miozzo & Caramazza 1999). Until recently, the production of bare nouns had only been examined in Dutch (La Heij, et al. 1998) and no effect was found. It was concluded that gender information is only accessed when specifically required for the selection of agreement morphemes. Cubelli, Lotto, Paolieri, Girelli, and Job (2005), however, found an inhibitory gender congruency effect for bare noun production in Italian. The goal of the current experiment was to determine if such an effect could be elicited in Spanish.

The current experiment examined the production of bare nouns and noun phrases (NPs) by native Spanish speakers within the picture-word interference paradigm, in which subjects named a picture accompanied by a distractor word which was either gender congruent or incongruent with the target. Congruency effects were determined by naming latencies. An analysis of the data showed that there was no gender congruency effect in bare noun production. Naming latencies in the two conditions were virtually identical ($F(1,15) = 0.017$, $p > 0.90$). In addition, separate analyses were performed on target words of each gender (masculine and feminine) and no gender specific effect was found. As predicted, there were no congruency effects for NP production.

The fact that, in bare noun production, Spanish behaves like Dutch rather than Italian indicates that there is a critical difference between Spanish and Italian relating to gender access. When discussing the role gender in lexical access, the operative models are WEAVER ++ (Roelofs 1992) and the Independent Network model (Caramazza 1997). These models predict no gender congruency effects for bare noun production. They also predict no effect in NP production in Spanish and Italian due to factors relating to determiner selection. To account for their data, Cubelli et al. (2005) proposed the Double Selection model in which gender-marked syntactic representations compete, resulting in the selection of the gender marking morpheme (a vowel) which is either transparently or opaquely gender marked. While most nouns in Italian end in such a vowel, Spanish permits consonant-final words which have no overt gender-marking so there are far fewer nouns that require the selection of a gender inflected vowels. Due to this morphological difference, the Double Selection model is not applicable to Spanish and it follows that Spanish speakers show no effect in bare noun production.

In conclusion, the fact that no gender congruency effects were found indicates that gender is not accessed in bare noun production in Spanish. These findings are consistent with the predictions of the WEAVER++ and Independent Network models. The Double Selection model does not apply to Spanish due to its nominal morphology.

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The repeated-name penalty observed in reference to concrete objects

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In both reading and conversation, objects and people can be referred to in a variety of ways such as proper names (e.g., *Jane*), definite descriptions (e.g., *the baseball*), and pronouns (e.g., *she*, *it*). Research on the processing of referential expressions in reading has shown that when the referent is salient, pronouns are processed faster than full references (Gordon et al., 1993). This *Repeated Name Penalty* (RNP) was first reported by Gordon et al. (1993) in a series of self paced reading experiments comparing proper names and pronouns. Gordon et al. (1993) explained the RNP as the result of an extra processing stage required to integrate information into the discourse representation when a repeated reference is used. Later research extended the RNP to definite descriptions (Almor, 1999) and has attributed the RNP to memory interference. Although both explanations apply to language processing in general, all the empirical evidence to date has been based on reading paradigms in which the referents were introduced by the text. No previous study measured referential processing in the context of concrete referents as is the case in many real instances of language use.

We report three experiments that tested whether the RNP could be elicited in the context of concrete referents. All three experiments were presented to participants as memory tasks and involved conditions where discourses referred to pictorial displays adapted from Yee and Sedivy (in press). In Experiment 1, participants read two sentence instructions similar to the instructions used by Yee and Sedivy and then performed the actions on the pictorial display using the computer mouse. The first sentence included instructions like "Click on the peach four times." The second and critical sentence instructed participants to either "Click on the peach five times" (repeated condition), "Click on it five times," (pronoun condition), or "Click on the shoe five times" (new referent condition). This experiment found repeated name facilitation such that sentences in the repeated condition were read faster than those in the pronoun condition. Sentences in the new referent condition were read the slowest. In Experiment 2, participants saw the pictorial display first and then read two sentence descriptions referring to the display that they judged as true or false. The conditions were similar to Experiment 1 except that the critical reference was in the subject position of the second sentence (e.g., The peach was next to the shoe. The peach/it/shoe was in the upper right corner.). This experiment found similar results to Experiment 1. Experiment 3 used the same design as Experiment 2, except the critical sentence was the third sentence in the discourse. The second sentence focused the referent using a pronoun. (e.g., The peach was next to the shoe. It was in the upper right corner. It was below the sock./The peach was below the sock./The sock was below the peach.) This experiment found a RNP in that the pronoun condition was processed faster than the other conditions. These results show that the RNP, when referring to concrete objects, is similar to when the referents are introduced by the text. These results thus reinforce earlier theoretical claims and extend them to cases of reference to concrete objects.

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Semantic plausibility effect on the integration of direct and indirect complements: Behavioral and electrophysiological evidence

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Behavioral studies suggest that the integration of adjuncts is more dependent on world-knowledge than that of arguments (e.g., Speer and Clifton, 1998). Here, we test the hypothesis that world-knowledge plays an important role in adjunct integration and syntactic knowledge in argument integration, studying the influence of argument structure and plausibility on lexical integration in simple active sentences using a lexical decision experiment and an event-related potential (ERP) experiment with 64 channels.

Sentence stimuli were manipulated in terms of plausibility and argument status, e.g., *The pupil had studied every night* (Adjunct-High Plausible), *The pupil had studied every month* (Adjunct-Low Plausible), *The pupil had studied every article* (Argument-High Plausible), *The pupil had studied every film* (Argument-Low Plausible), *The pupil had studied every sadness* (Odd). In the behavioral pilot experiment we presented verbal sentences and asked subjects to make a lexical decision on the last word of the sentence (target word). Facilitation effect was considered and calculated subtracting the RTs in the Odd condition from each experimental condition. A main effect of plausibility emerged: The facilitation effect was larger for high and low plausible complements; besides, the facilitation effect was smaller for arguments than adjuncts. Importantly, the effect of plausibility was larger for adjuncts compared to arguments.

We then recorded ERPs in a second sample of subjects, using a much larger set of different sentences. The amplitude of the N400 component — a marker of semantic integration, e.g., Kutas & Federmeier (2000) — was monitored. Subjects listened to oral sentences whose internal complement was either a high or low plausible argument or a high or low plausible adjunct or, for the odd condition, a semantically unrelated word (baseline). The N400 effect was calculated by subtracting the amplitude of the component measured from the onset of the nouns in adjuncts or arguments in each condition from that obtained in the Odd condition at centro-parietal electrodes.

Congruently with behavioral study, we found a significant main effect of plausibility: The amplitude of N400s for the High Plausible condition was more reduced compared to the Low plausible condition; besides a significant main effect of syntactic status was found: The amplitude of N400s for the Adjunct condition was more reduced compared to the Argument condition. Interestingly, we also found a significant interaction between plausibility and syntactic status: The amplitude of N400s was more reduced for the High plausible sentences than the Low plausible sentences only in adjuncts, and there was no amplitude difference between the high- and low-plausible sentences in arguments.

On the whole the results are in the accordance with the findings in literature coming from self-paced reading and eye-tracking techniques: The ease of integration of adjuncts is more dependent on world-knowledge — indexed by plausibility — than that of arguments (e.g., Speer and Clifton, 1998). This demonstrate that the integration of arguments relies more on grammatical (at least, lexically specified) knowledge, whereas the interpretation of adjuncts is more dependent on world-knowledge.

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Unaccusatives in ellipsis: Processing of covert material

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To comprehend a sentence with discontinuous dependencies, an overt or covert reference-seeking element must be linked to a non-adjacent position containing a co-referent (i.e., the antecedent). Several studies have revealed that the linking of these two non-adjacent positions occurs at or near the position to which the antecedent co-refers (e.g., the gap or overt anaphor). Yet, it is still unclear why certain referents are found to be reactivated immediately at the point where they are licensed (e.g., with *wh*-traces and overt elements such as anaphors), whereas others are found activated downstream (e.g., NP-traces, PRO). And, it is unclear how some lexical properties that have well-known effects on syntax influence the time-course of processing discontinuous dependencies.

This study aimed to do the following: To better characterize the processes underlying co-reference in Verb Phrase (VP) Ellipsis, a covert discontinuous dependency; and to tackle psycholinguistic issues about the functioning of the processor by examining the factors that might influence the online computation of an interpretation. VP-Ellipsis is interpreted by establishing co-reference between the elided position (*did___ too*) in the second clause and the VP from the first clause (1; see example [a]). That is, the object in the VP (e.g., a *tie*; and any referential dependency it enters into) has been found to be reactivated in the second clause. In the present study we looked at the processing of (non-alternating) unaccusative verbs in ellipsis (example [b]). Unaccusative verbs show reactivation of their subject after the verb, contrary to unergative verbs which do not [2]. A syntactic characterization of the difference between the two verb types postulates that the subject of unaccusatives (but not of unergatives) is generated as an object, leaving a trace or copy after the verb in the surface form [3, 4]. We exploited this lexical property of unaccusative verbs to determine what material gets reconstructed at the elided position in ellipsis, and at what point in time [b].

We used cross-modal lexical priming, placing probes at one of three strategic points throughout our sentences (pre-elision, elision, post-elision sites). Briefly, we found differential reactivation patterns for unaccusative vs. unergative verbs. With unaccusatives, the subject of the second clause (e.g., *the child*) was reactivated at the elided position, and we found that the first-clause subject (e.g., *the dog*) was also reactivated in the second clause. This pattern is unlike that found with other verb types, where subjects are not reactivated in ellipsis constructions [5]. These patterns suggest that the unaccusativity property (however characterized) is recognized by the processor and is carried over to the elided position in the second clause.

Based on the time course of these reactivations, we interpret our results in terms of visibility, the role of lexical properties in processing, and the impact of the nature (overt or covert) of the material. We will also discuss these results in terms of the theoretical distinction between traces and deleted copies.

Examples

[a] The policeman bought a tie, and the fireman did too, according to the clerk.

[b] The dog [disappeared <dog>] $_{VP}$ and the child did [disappear <?>] $_{VP}$ too, much to the family's dismay.

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Deconstructing discourse: A PET study of narrative production

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Purpose. Narrative production is an appealing topic of investigation from a linguistic-theoretical perspective because it incorporates all of the levels of linguistic capacity and performance from phonetics to pragmatics. It is also relevant to studies of aphasia and traumatic brain injury (e.g., Davis & Coelho, 2004), as each level can be selectively impaired. The purpose of this neuroimaging study was to examine separate components of language within spontaneous narration, by linking specific linguistic variables to changes in regional Cerebral Blood Flow (rCBF) as measured by Positron Emission Tomography (PET).

Methods. Eighteen healthy, right-handed volunteers (7 women, 11 men, mean age 35 years) produced unrehearsed narratives while undergoing PET scans performed using a Scanditronix PC2048–15B tomography machine (Uppsala, Sweden), with an axial and in-plane resolution of 6.5mm. Each scan required that 30mCi of H215O be injected intravenously. The 18 resultant PET images were motion-corrected and intensity-normalized using MEDx v3.43 (Medical Numerics, Inc. Sterling, Virginia), and smoothed and spatially normalized with Statistical Parametric Mapping software (SPM 99, Wellcome Department of Cognitive Neurology, London UK).

Tape-recordings of the 18 narratives, each approximately 35 seconds in duration, were assessed according to these measures: Speech Rate, Fundamental Frequency Range, Type-Token Ratio, # Proper Names, Mean Length of Utterance (MLU), # Clauses, Fluency, and Narrative Cohesion.

Behavioral results. On average, subjects' narratives consisted of 5 complete sentences, with 13 words and 2 clauses per sentence. Mean rate was 4 syllables/sec. Mean Narrative Cohesion score was 5.11, ranging from 1 (weak cohesion) to 9 (strong cohesion) (see Chapman et al., in press). Cross-correlations of the linguistic measures revealed that MLU, Speech Rate and # Clauses were highly linked, as were # Clauses and Type-Token Ratio

PET results. Linear regression of a measure with PET imaging data was performed with MEDx 3.4.3 on the 18 brain images with the 18 scores derived from each measure. Resultant *z*-maps thresholded at 1.96 showed that the following measures correlated largely with left-hemispheric brain activity: Speech Rate (frontal, temporal, occipital areas), Type-Token Ratio (temporal, occipital areas), # Proper Names (frontal), MLU (temporal) and Clauses (frontal, temporal, parietal areas). Areas that correlated with Fundamental Frequency Range and Narrative Cohesion were predominantly medial (limbic) and right frontal. Fluency correlated with bilateral activation in occipital, temporal, and parietal lobes and in medial (limbic) structures.

Discussion. These results suggest that separate components of language production can be related to distinct areas of brain activation, in a natural rather than contrived metalinguistic task. They suggest the localization of phonological and syntactic computation and lexical retrieval in left cortical areas, episodic memory and selection in bilateral parietal areas, and imagery in bilateral occipital areas. Right frontal areas are the substrate for intonation and event ordering, and medial structures (e.g., anterior cingulate) are crucially involved in causal ordering and theory of mind processes. These findings complement those of the rare neuroimaging studies of narrative production (e.g., Braun et al., 2001), mirror those of comprehension (Xu et al, 2004), and agree with the lesion literature on discourse deficits (Mar, 2004).

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Processing of ironic and non-ironic sentences examined with ERPs

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Irony is one of the most frequently used forms of figurative language and plays an important role in our daily communication. To comprehend ironic sentences additional, i.e., contextual and pragmatic, information is necessary. This suggests a more demanding processing than literal language understanding. Controversial findings from behavioral studies (Gibbs 1999, 2002; Giora & Fein 1999; Schwoebel et al. 2000) yield in three different views of irony processing differing in their time course of context influence. In the standard pragmatic model (Grice 1975), context effects are only assumed after literal (non-ironic) meaning activation of ironic sentences leading to a semantic integration problem into the previous context, which results in further inferential processes. In contrast, the direct access view (Gibbs 2002) assumes an initial context influence on lexical access, which allows a direct comprehension of the context relevant (i.e., ironic) meaning without an incompatibility phase. A third view, the graded salience hypothesis (Giora 2002), predicts a simultaneous computation of lexical and contextual information. During lexical access the most salient (i.e., most frequent and conventional) meaning is activated initially and since context is processed in parallel, it can immediately be effective on the availability of meanings. If the salient meaning is not in accordance with context information, this incompatibility would slow down comprehension processes. In order to examine when and how ironic and non-ironic sentence processing differs, electrophysiological evidence is presented. According to the standard pragmatic model and the graded salience hypothesis, an integration problem of ironic sentences into a foregoing context should lead to an N400 at the critical word. If processing of both sentence types is due to initial contextual constraints (i.e., direct access view), no irony related ERP effect should be present.

In Experiment 1, event-related brain potentials (ERPs) were recorded from adults listening to ironic and non-ironic discourses. Target sentencessuch as *That's really rich* achieved an ironic meaning in negative contexts (i.e., receiving a very small dish in a restaurant), and a non-ironic meaning in positive contexts (i.e., receiving an opulent dish). ERPs on the sentence final word revealed no irony-related N400 effect, but a long lasting anterior negativity that started around 100 ms and posterior positivity between 500–900 ms. The posterior positivity in the absence of an N400 effect was replicated in a second experiment, in which stimuli were presented visually. The absence of an N400 effect is inconsistent with the assumptions of the standard pragmatic model, as well as the graded salience hypothesis. The semantic integration of both literal and less salient, ironic meanings (as presented in the experiments) was effortless. The results do also not endorse the direct access model because differences in ERPs at the end of target sentences were found. The posterior positivity elicited in ironic discourses could be interpreted as reflecting pragmatic processes, e.g., evaluating the intended utterance meaning. Such evaluation may have caused more demanding inferential processes and suggests that additional processes seemed to be involved in a complete understanding of irony.

Magnitude estimation as a tool for the study of processing difficulty

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Magnitude Estimation (ME) has been used to investigate grammaticality (Bard et al., 1996), but rarely to measure processing difficulty as such (cf. Keller, 2003). In this study, three experiments are reported that investigated whether ME is indicative of processing difficulties due to local syntactic ambiguity and Center-Embedding (CE) effects. First, sentences from an eye-movement experiment (Frazier et al., 1982) were used, which reflected a difference in two factors: Minimal Attachment (MA) and Length of the ambiguous NP (italics).

(1) Long, MA I wonder if Tom heard *the latest gossip about the new neighbors*.
(2) Long, Non-MA Tom heard *the latest gossip about the new neighbors* wasn't true.
(3) Short, MA I wonder if Tom heard *the gossip*.
(4) Short, Non-MA Tom heard *the gossip* wasn't true.

Fifteen participants estimated complexity of these sentences in relation to a reference sentence (modulus) — a mild GP (as in Meseguer et al., 2002). Results show that both MA and length significantly affected estimations of complexity, without an interaction. However, in Frazier & Rayner (1982), reanalysis only affected total reading time per letter in *long* sentences. Thus, the results replicate F&R's findings but are more systematic, in that ME reliably measures MA effects independent of length. The second and third experiment were conducted to test the reliability of ME in establishing difficulty of center-embedded constructions, and test theoretical predictions proposed in the literature.

Miller and Chomsky (1963) contended that a higher number of CEs increases difficulty, predicting (5) = (7) = (8) > (6) > (9). Rosenbaum and Kim (1976) argued that higher number of CEs and relative clauses led to higher difficulty in people's judgment of sentences, predicting (5) > (6) = (7) > (8) > (9). Thematic head-driven parsing (based on Pritchett, 1992) predicts that the complex NP island status of the most embedded clause increases difficulty, predicting (5) = (6) > (7) = (8) = (9).

(5) Two CEs, two object relativizations (complex NP):
The reporter who the senator who John met attacked disliked the editor.
(6) One CE, two objects relativizations (complex NP):
The warden forwarded the demand that the prisoner that the social worker visited made.
(7) Two CEs one object relativization:
The report that the prisoners that the social worker visited ran away was alarming to many citizens.
(8) Two CEs, no object relativizations:
The disclosure that the report that the prisoners ran away was true alarmed many citizens.
(9) Sequential (no CE, no object relativization):
The naughty boy threw the stone that hit the window that the neighbor fixed the day before.

Thirty subjects estimated difficulty in proportion to a sequential modulus. Statistical analysis of the results shows (5) = (6) > (7) = (8) = (9), confirming predictions based on thematic parsing.

ME is a reliable indicator of sentence processing difficulty and CE effects. The technical ease of ME, which can be used over the internet reaching many subjects, makes it an accessible tool for studying processing effects - it is an experimental method in its own right.

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Effects of semantic similarity in facilitation and interference experimental paradigms

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Semantic effects have often been used as a tool for uncovering the process involved in accessing semantic information and the nature of semantic representations, both in the monolingual and the bilingual domain. Despite its wide use, to our knowledge, no studies have been reported that examine the pattern of these effects using different tasks, languages and experimental paradigms. In order to gain a better understanding of the semantic effects, and its implications for bilingual lexical models, the aim of the four experiments we report in this paper was to investigate these effects in two semantic decision tasks, both within- and between-languages, manipulating semantic relatedness. Specifically, Experiments 1 and 2 used an unmasked priming paradigm where the prime was presented for 250 ms, followed by the target presented for 1000 ms. Within this paradigm, facilitation is generally obtained when the prime is semantically related to the target. In Experiment 1, prime and target pairs were in the same language (Spanish) and in Experiment 2 the prime appeared in Catalan and the target in Spanish. These two experiments used a semantic categorization task in which participants were asked to determine if the target word was a concrete word. Experiments 3 and 4 employed a synonym decision task and an interference paradigm. In this case, the two words of the pair were presented sequentially for 500 ms each. Participants had to decide if the two words had the same meaning. In the interference paradigm, the critical responses are those given to the non-synonym, but semantically related, word pairs (i.e., the NO responses). Experiment 3 tested interference effects within the same language (Spanish) and Experiment 4 across languages (Catalan-Spanish). In the four experiments, the same set of semantically related word pairs was used. The words of each pair were always coordinates of the same category and were not associatively related. In each of the experiments there were in total three experimental conditions: (a) a very close semantic relation (e.g., *donkey-horse*); (b) a close semantic relation (e.g., *donkey-bear*); and (c) an unrelated control (e.g., *donkey-Sunday*). The degree of semantic relatedness between very close and close word pairs was established in terms of featural similarity, using a similarity rating task and a feature generation task (Sánchez-Casas, Ferré, García-Albea, & Guasch, in press). The results showed evidence of semantic facilitation effects in the priming paradigm in the two semantic relations. However, interference effects were only found when the semantic relation was very close. In the two paradigms the pattern of effects was the same within- and between-languages, suggesting that what is relevant in determining the pattern of semantic effects is the experimental paradigm used and not the languages involved. This set of findings can be accounted by both the bilingual interactive activation model (Dijkstra & van Heuven, 1998) and the distributed lexical/conceptual feature model (Kroll & De Groot, 1997), but they need to address the theoretical implications of the reported different sensitivities of the two paradigms (facilitation and interference) to the effects of semantic similarity.

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Interference and memory overload during parsing of grammatical and ungrammatical embeddings: Cross-linguistic evidence for encoding and retrieval interference

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Similarity-based interference (SBI) and memory overload are two factors that are known to affect sentence processing. Several studies have characterized memory overload as an artefact primarily of SBI (Lewis 1993), while others have argued for high memory complexity associated with the number of predictions of current incomplete dependencies (Gibson 1998, 2000). In order to distinguish between effects caused by similarity-based interference and high memory complexity, we compared unacceptable double-center embedded sentences in which the three NPs preceding the verbs were either all human or the second NP was inanimate. This factor was contrasted with allegedly easier but ungrammatical center embeddings (where the second VP was missing), resulting in a 2 x 2 design.

We run a self-paced reading study with the above design in English and German. Before that we conducted two self-paced reading studies with both languages to ensure that the first two human referring NPs were equally plausible as agent of the matrix verb.

(1) English The craftsman who the carpenter/pillar that the peasant carried (hurt) supervised the apprentice.

(2) German Der Anwalt, den der Zeuge/Saebel, den der Spion betrachtete, (schnitt), ueberzeugte den Richter.
[The lawyer who the witness/sword that the spy looked at (cut) convinced the judge]

SBI and the incomplete dependency hypothesis together furnish the following predictions:

(a) SBI predicts relatively greater processing difficulty at the first verb if all NPs previously seen are animate, since the verbs' retrieval cues all involve a choice between three human argument NPs;

(b) Incomplete dependency-based theories predict greatest processing load at the second verb in the three-verb conditions: The most costly syntactic prediction is forgotten due to its high memory complexity (Gibson & Thomas 1999).

Two self-paced reading experiments run in German and English not only show support for a retrieval interference effect at the first verb, but also similarity-based interference during the creation of memory traces at the third NP: encoding interference (Lewis and Vasishth 2005).

Interestingly, memory overload effects as predicted by Gibson and Thomas (1999) were observed at the final verb in grammatical sentences, but only in English. In German, the opposite effect is seen: subjects had greater difficulty processing the final verb in ungrammatical sentences. We speculate that the higher frequency of head-final structures allows German speakers to maintain predictions of upcoming verbs much better than English speakers, a fact that is consistent with existing asymmetries in research on prediction-based facilitation in head-final languages like German, Japanese and Hindi versus head-initial languages like English (Konieczny 2000; Vasishth 2003; Nakatani & Gibson 2004; Grodner & Gibson 2005).

In sum, these experiments suggest that (i) interference has a finer structure than hitherto assumed: encoding and retrieval interference occur at different points; (ii) the memory overload hypothesized by Gibson and Thomas (1999) is completely distinguishable from interference effects, suggesting that the two apply additively, (iii) memory overload is modulated cross-linguistically by prior frequency (in this case, of head-final structures).

"Where was I?" A psycholinguistic investigation of interruptions to language production

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When people speak to each other in dialog, the speech stream of one speaker is sometimes broken off, or interrupted, by the speech stream of another. When the result of the overlap between speech streams is that the interrupting interlocutor temporarily "takes the floor", it is often difficult for the interrupted interlocutor to return to the interrupted content. Hence, interruptions pose an interesting problem from the speaker's perspective: how do speakers keep track of where they were before being interrupted? This process has been termed *bookkeeping* (Levelt, 1989). Three experiments were carried out in order to begin to investigate this untapped issue from a psycholinguistic perspective. Experiment 1 used a semi-natural dialog in which a confederate participant interrupted at predetermined narrative junctures. Interruption types were manipulated, and resumption difficulties were measured in order to investigate what types of interruption are more (or less) disruptive to speakers' bookkeeping abilities. Experiments 2 and 3 investigated whether similar bookkeeping processes exist for syntactic planning during sentence production. The two approaches are intended to lay the groundwork for a program of research on conversational interruptions.

Theories of alignment in dialog (Pickering & Garrod, 2004) should predict that cooperative interruption types should be more disruptive to speakers than competitive types. In Experiment 1, speakers described movie clips and a confederate interrupted at predictable points in the description with four different types of interruptions. Two types were cooperative: The confederate either attempted to make sure something was correctly understood, or to clarify some ambiguity. The other two types were competitive: They altered the purpose of discourse either by digressing within the framework of the topic, or by introducing a topic that had no relevance to the task and topic at hand. Several measures of resumption difficulty, including resumption lag, errors, and disfluencies, showed main effects of interruption type. However, the pair-wise comparisons did not support the alignment hypothesis: Clarifying interruptions (a cooperative type) were just as disruptive as the most irrelevant competitive interruptions. The other two interruption types were equally non-disruptive. These results suggest that different properties of interruptions do carry different costs to bookkeeping, but they also suggest that other factors (such as attention) are at least as important as alignment.

Speakers in Experiments 2 and 3 were interrupted by grammaticality or arithmetic judgment tasks during the production of two-clause sentences. When interruption length was properly controlled, modality had no effect. This implies that bookkeeping processes may be domain-general memory phenomena. The location of the interruption during sentence production was also manipulated: Interruptions could occur during the first clause, between clauses, or during the second clause. Analyses of resumption lag data showed that interruptions are most disruptive at the earliest positions in sentence production. These results support theories of strategically non-incremental grammatical encoding (e.g., Ferreira & Swets, 2002). Resumption error data revealed that errors were reduced when participants were interrupted at clause boundaries rather than in the middle of clauses. We conclude that the clause is a unit of sentence-level bookkeeping (Bock & Cutting, 1992).

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The semantic typology of gradable adjectives: Experimental evidence from adult and child language

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Kennedy and McNally (2005) distinguish between 'relative' gradable adjectives (*big, long*), which use open scales and have context-dependent standards of comparison, and 'absolute' gradable adjectives, which have closed scales and standards that are fixed to maximal (MAX-A; *full*) or minimal (MIN-A; *spotted*) degrees (cf. Rotstein and Winter's (2004) 'total' vs. 'partial' GAs). This paper provides experimental evidence that these distinctions are encoded as differences in the conventional meanings of gradable adjectives (GAs) both in adults and in children as young as three.

Children (N=60) and adults (N=48) participated in a Presupposition Assessment Task in which participants were presented with two objects accompanied by a request using a singular definite description (*Give me the ADJ one*). When presented different-sized cubes and asked for *the big one*, participants chose the bigger cube, regardless of whether it was independently judged big. This indicates that both adults and children assign a relative meaning to *big* ('has a size above contextual standard *c*'), and shift the contextual standard to accommodate the NP's existence and uniqueness presuppositions (*c* is fixed to make *big* is true of just one object).

In contrast, requests involving objects with different numbers of spots were accepted only if one object had zero spots, and rejected when both objects had different non-zero amounts of spots. This follows if *spotted* has MIN-A semantics ('has at least one spot'): the uniqueness presupposition fails in the second case. Similarly, participants accepted requests for *the full one* when just one container was maximally full, and rejected requests when the containers had different, non-maximal degrees of fullness. This follows from the MAX-A semantics of *full* ('maximally full'): in the second case, the existence presupposition fails. Identical results were obtained for *bumpy* (MIN-A) and *straight* (MAX-A).

Though children and adults were the same with MIN-As, they differed slightly with MAX-As: Children sometimes gave the fuller/straighter of two non-(full/straight) items when asked for *the full/straight one*, though they were more likely to respond appropriately if they had already seen the maximal standard (1). Examining the delay between the first look to and the first touch of the target object, we found that children took longer to select the fuller of two non-full objects than the full one in the full/non-full pair (2). These facts follow if children have greater tolerance for imprecision than adults. Under Lasersohn's (1999) theory of 'Pragmatic Halos', the asymmetry between MAX-As and MIN-As arises because only the semantics of the former (maximality) allows for construction of a pragmatic halo, the set of alternative meanings on which imprecision is based. Children's RTs reflect the processing involved in building the pragmatic halo and the decision about whether the container is close enough to full to be treated as such to satisfy the speaker's request. Relative adjectives do not show the same latency because their conventional meanings already allow for standard shifting, and imprecision does not come into play. These results confirm a three-way semantic distinction between relative, MAX-A, and MIN-A GAs.

Endnotes

(1) In the Presupposition Assessment Task (PAT), participants were predicted to accept the request *Give me the ADJ one* when there was such an object fitting the description, reject it when both objects did, or reject it when neither object did. While children and adults patterned similarly (mostly at or near ceiling) for both control and test (relative, absolute) stimuli, accepting or rejecting as anticipated, children frequently identified the fuller member of the non-full/non-full pair and the straighter of the bent/bent pair (50.5% of the time). They were significantly less likely to do this when the maximal degree pair was presented earlier in the sequence (22.2% versus 71.0% of children).

(2) Children's PAT experimental sessions were videotaped. By measuring the difference between the first look to and the touch of the stimulus identified as the ADJ one, we found evidence that children who identified the *fuller* member of the non-full/non-full pair as *the full one* took significantly longer to do so than when they identified the *full* member of the full/non-full pair (1.123 sec versus 0.811 sec), and than when they identified the *bigger* of two cubes as *the big one*, regardless of whether the cubes had previously been judged as big (0.655 sec) or small (0.639 sec).

Can we simulate negation? The simulation effects of negation in English intransitive sentences

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WITHDRAWN

Recent accounts of language comprehension propose that sentences are understood by constructing perceptual simulations of described events. Evidence for this view comes from results showing that processing language about scenes with particular perceptual properties selectively facilitates or inhibits visual processing of perceptually similar scenes, and vice versa (Zwaan et al., 2002; Richardson et al., 2003; Kaschak et al., 2004; Bergen, 2005). Negation poses a particular challenge to simulation-based models of comprehension, because it is impossible to imagine the negation of a scene — it is only possible to imagine an alternative perceptual configuration. In this study, we used the methodology from Bergen (2005) to investigate whether language understanders perceptually simulate the content of negated sentences. We found that processing negated sentences selectively facilitates visual object processing.

Previous studies of negation processing have investigated whether and when comprehenders construct internal representations of the counterfactual situation (i.e., the scene negated by the statement) or the factual situation. Evidence to date indicates that the comprehension of negation consists of a multi-stage process, including 1) processing of the counterfactual situation, then 2) suppression of the counterfactual situation, and finally 3) adoption of a possible factual interpretation (Just & Carpenter, 1976; MacDonald & Just, 1989; Kaup, 2001; Hasson & Gluksberg, 2004).

We based our investigation on Bergen (2005), who found that visual imagery triggered by up- and down-related intransitive sentences (like *The roof creaked* versus *The cellar flooded*) interfered with visual perception. Each trial consisted of a fixation cross (1000 ms), followed by a spoken intransitive sentence, then an ISI of 200 ms, and finally a circle or a square appearing in the top, bottom, left or right quadrant of the screen for 200 ms. The subjects categorized the visual object as a circle or square by button press.

The inhibitory effect they observed was argued to result from 1) sentence processing and visual processing making use of overlapping neural resources, and 2) the simulation evoked by the sentences not being integratable with the visual stimulus. We used negated sentences ('The *cellar* (down-noun) didn't flood', 'The *roof* (up-noun) didn't creak', 'The glass didn't *fall* (down-verb)', 'The dolphin didn't *soar* (up-verb)'). To capture early processing we used a 200 ms ISI, based on Bergen (2005), and to capture late processing we used a 500 ms ISI (Hasson & Gluksberg, 2004: 20).

Our results show a significant interaction effect where visual object categorization was faster when object location matched the location indicated by the noun [200 ms: $F_1(1,13)=46.33$, $p<.01$; 500 ms: $F_1(1,15)=10$, $p<.01$], but only at 200 ms when indicated by the verb [200 ms: $F_1(1,9)=6.87$, $p<.05$; 500 ms: $F_1(1,9)=2.74$, $p<.13$]. A possible explanation for this facilitation effect (contrasted with the inhibition found by Bergen) is that factual scenes that are simulated in response to negated sentences are less detailed; this allows visual stimuli to be more easily integrated with those simulated scenes (Kaschak et al., 2004). More broadly, this compatibility effect suggests that processing negated sentences does indeed result in mental imagery.

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Processing of garden-path sentences is impaired at longer phrase durations

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In everyday life, we usually can not control the speed of speech we perceive. However, in laboratories, the performance of sentence processing has been studied mainly with methods involving self-paced reading and eye movement measurements, and little has been known about our performance under the condition that readers can not control the speed of inputs (we call it "forced-paced" or "experimenter-paced" reading method). In this study, we focused on the processing of garden-path sentences using forced-paced reading method, and examined the temporal properties of sentence representations and its effect on sentence processing.

In the first experiment, we examined the accuracy of sentence processing while varying the duration of each sentence. We used Japanese garden-path sentences, each consisting of six phrases (Example 1). In each trial, phrases were presented sequentially with a moving window method. The duration of each phrase was varied in six steps (133, 183, 250, 333, 1000, 3000 ms). The duration was fixed within each trial. At the end of each stimulus presentation, participants were asked to answer the question about the content of stimulus sentence was exposed with a 2AFC method. We also used normal sentences, which do not incur reanalysis of tree structure, as control stimuli (Example 2). The experiment was conducted by sessions. In each session, each of the six duration values was repeated four times for each sentence type with a randomized order. Each participant conducted five sessions.

It was found that for normal sentences, the correct response rate increased monotonically as duration increased. However, for garden-path sentences, correct response rates increased as duration increased and peaked at either 250 or 333 ms, then decreased. (The correct response rate for garden-path sentences at 3000 ms was significantly lower than those at 333 and 1000 ms. On the other hand, there were no significant differences after 250 ms.)

These results indicated that longer presentation might impair memory of phrases or inhibit sentence representation in the garden-path condition which resulted in a decline of correct rate at longer durations. So we examined this possibility in a separate experiment. The methods were basically the same as for the previous experiment, except for using a phrase recognition task. It was found that the mean correct rate showed no decline at longer durations. Thus, memory of phrases was not impaired at longer durations. The differences of correct rates between two sentence types at longer durations indicate that temporary sentence representations built by dynamic reanalyses of syntactic structure may be fragile and have a finite lifetime.

Examples

(1) Garden-path sentence

Haruyo-ga	kodomo-o	sukutta	Harumi-ni	hagaki-o		okutta.
Haruyo-NOM	child-ACC	saved	Harumi-DAT	postcard-ACC		sent

'Haruyo sent a postcard to Harumi, who saved a child.'

For Experiment 1, two kinds of questions are used, e.g.,
‘{ Haruyo / Harumi } saved a child’; ‘{ Haruyo / Harumi } sent a postcard’.

(2) Control sentence

Haruyo-ga	kodomo-o	sukutta	wadai-ni	Harumi-ga	hazunda.
Haruyo-NOM	child-ACC	saved	news-DAT	Harumi-NOM	be delighted

'Harumi was delighted at the topic that Haruyo saved a child.'

Bilingual visual word recognition in a sentence context: Evidence from eyetracking

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This study on bilingual visual word recognition investigated the recognition of cognates (words with identical meanings and similar spellings across languages, e.g.,the English-Dutch translation pair *banana–banaan*) in a sentence context. Previous studies using cognate words presented in isolation found that native-language (L1) cognates are recognized faster than control words (e.g., Van Hell & Dijkstra, 2002). This strongly suggests that L1 words presented to bilinguals meeting a certain level of L2 proficiency, also activate lexical information from a L2 (and even L3) language that is not necessary for the task at hand. Such an observation is compatible with a fundamentally language nonselective theory of lexical access in bilinguals.

In previous work, we replicated the cognate facilitation effect in isolated word recognition with Dutch-English bilinguals. Degree of orthographic overlap was manipulated by including identical (e.g., *ring–ring*; cognates that have identical spellings across languages) and nonidentical cognates (e.g., *ship–schip*; cognates that have similar spellings across languages) in the stimulus materials. The results showed larger cognate facilitation for identical cognates. In another experiment, the same set of cognates and control words were presented as the final words of a neutral (low predictability) sentence (e.g., Hilda was showing off her new *ring – coat*; *ring* is a Dutch-English cognate) using rapid serial visual presentation. The sentence context preceding the critical stimuli was identical for both conditions, and participants had to perform an English lexical decision task on the final word. Again, RTs were shorter for cognates than for control words with larger effects for identical cognates. In a follow-up study, cognates and control words were presented as the middle words of neutral sentences. A similar cognate facilitation effect was found for self-paced reading times, although this effect interacted with the degree of cross-lingual overlap of the cognates.

In the current study, the goal was to extend these previous findings. Using the eyetracking methodology, we investigated whether the cognate facilitation effect can also be observed in the fixation times of cognates appearing in low-constraint sentences. This approach allows for normal reading and does not require intervening tasks that may disrupt the reading process. The evidence from our previous work suggests that the presence of a sentence context does not fundamentally change the degree of language selectivity of lexical access in visual word recognition by bilinguals. An interpretation of the results is given within the framework of the BIA+ model of bilingual word recognition (Dijkstra & Van Heuven, 2002).

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ERP signatures in language-impaired children reveal a domain-specific neural correlate for syntactic dependencies

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Grammar is an exclusively human and complex ability (1, 2). However, considerable controversy surrounds whether neural circuitry subserving grammar is common to human cognition or whether it is unique to language. This debate transcends the fields of sentence processing and language impairments. With respect to sentence processing it concerns the specificity and uniqueness of syntactic vs. semantic systems and their relations to more general cognition. Grammatical-specific language impairment (G-SLI) is a disorder of language acquisition- specifically grammatical acquisition (3). These individuals with G-SLI continue to make grammatical errors into adulthood (3). With respect to G-SLI the debate surrounds whether it is caused by a domain-general deficit in auditory processing speed or capacity (4, 5), or whether the impairment is to a domain-specific system devoted to grammar itself (3). The nature of G-SLI can elucidate whether neural circuitry subserving grammar is common to human cognition or unique.

Electrophysiological, event-related measurements can differentiate neural systems that appear to be automatic, fast and specific to grammatical (syntactic) processing — "Early Left-Anterior Negativity" (ELAN) (6) — from systems not specific to grammar or even language; such as an anterior or central positive response around 600 ms (P600), often associated with structural syntactic re-analysis of sentences (6–9) and a posterior negative electrical response around 400 ms (N400) associated with semantic processing (10). We used this technique to differentiate neural systems associated with sentence processing.

We presented 18 10–21 year-old participants with G-SLI, 18 age matched, and 20 younger language control groups and 20 adults with questions containing syntactic violations and sentences containing semantic violations. We manipulated the animacy property of the first noun following a verb so that in Experiment 1 it created the syntactic violation/control, and Experiment 2 the semantic violation/control. Crucially, the syntactic violation relied on a structural syntactic dependency between two non-adjacent elements in the sentence which pre-testing indicated would be perceived (perhaps momentarily) as a violation (Wh-word-noun: *Who did Barbie push the clown into the wall?*). In contrast, the semantic violation relied on purely lexical semantic restrictions of the preceding verb (*Barbie bakes the people in the kitchen*). ERPs to nouns (*clown/people,* violations*, vs. car/cake,* controls) were recorded.

We found evidence for a selective impairment to grammatical processing in G-SLI. The brain's automatic detection response to syntactic violations, reflected electrically as the ELAN, was elicited in all control groups and adults, but not the G-SLI group. In contrast to the controls, the G-SLI participants exhibited an N400 to the syntactic violations, indicating that they were compensating for their syntactic deficit semantically. However, the G-SLI group, like the control and adult groups, exhibited a normal P600 to the syntactic violations and an N400 to semantic violations. Our results, showing dissociation between the ELAN (missing) and P600 (normal) when processing the same word in a sentence in the G-SLI individuals, strongly indicate that these two components reflect different computations in syntactic processing (6). These data provide electrophysiological measures for a developmental, domain-specific grammatical deficit and indicate that at least one neural circuitry associated with grammar is a unique system in the functional architecture of the human brain.

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Processing constraints on negative and positive polarity

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Previous experimental research on negative polarity items (NPIs) shows that NPI-licensors like "no man" in (1a) must be retrieved at the NPI by a cue-based retrieval process (Vasishth, Drenhaus, Saddy & Lewis 2005): The NPI sets two retrieval cues, an NPI-licensor that also c-commands it. One consequence of the cue-based retrieval explanation is that licensors in illicit structural locations like (1c) can accidentally get retrieved due to a partial match with an NPI licensor (here, *keinen Bart*). Speeded grammaticality judgements show that grammatical (1a) and ungrammatical (1b) are rapidly processed, but the intrusive-licensor condition (1c) is processed more slowly and causes more incorrect judgements.

Cue-based retrieval assumes that in the intrusive licensor condition a penalty is incurred due to a partial match between the NPI's need for a licensor that is also in a c-commanding position. This account is consistent with previous work on Evoked Response Potentials: An N400 and a P600 is observed at the NPI in conditions (1b) and (1c). However, one important question arises: Can cue-based retrieval processes be detected in other experimental paradigms? It is vital to establish whether cue-based retrieval effects appear robustly in paradigms more closely approximating normal modes of comprehension. Towards this end, an eyetracking study investigated the same stimuli as in (1). The moment-by-moment predictions of the cue-based retrieval theory for the NPI conditions differ from the speeded judgement tasks because normal reading allows, e.g., parafoveal processing and opportunities for regressions and prolonged fixations.

Predictions for NPIs: (i) legal licensors (1a) would be rapidly retrieved; (ii) intrusive licensors (1c) would consume the greatest processing time due to a mismatch penalty; (iii) in the no-licensor condition (1b), an error would immediately be raised at the NPI because of a failure to find the licensor, resulting in longer reading times. In addition to the NPI conditions, positive polarity items (PPIs) were also investigated in the same experiment. Pre-theoretically, PPIs require that no NPI-licensor be present (cf. Ladusaw 1979, Krifka 1992, Szabolcsi 2004). Assuming that a PPI's retrieval cues ask for a c-commanding element that does not have the NPI-licensing property, the no-licensor and intrusive-licensor condition are both predicted to be fastest and the licensor condition slow.

The NPI results showed a fast (total) reading time in the licensor condition and slow reading times in the other two conditions. Surprisingly, the PPI results showed a fast reading time in the no-licensor condition, intermediate reading time in the intrusive condition, and slowest reading time in the licensor condition. The PPI results thus show an intrusion effect, just as NPIs do. A subsequent self-paced reading study also replicates the intrusion effect for PPIs.

Thus, although NPI results are therefore consistent with a cue-based retrieval explanation, the PPI results provide only partial support for the idea that their retrieval cues search for a c-commanding element that is not an NPI licensor.

Examples

(1) a. Kein Mann, [der einen Bart hatte,] war jemals glücklich
No man who a beard had was ever happy
No man who had a beard was ever happy.

b. * Ein Mann, [der einen Bart hatte,] war jemals glücklich
A man

c. * Ein Mann, [der keinen Bart hatte,] war jemals glücklich
no beard

(2) a. * Kein Mann, [der einen Bart hatte,] war durchaus glücklich
No man who had a beard was certainly happy.

b. Ein Mann, [der einen Bart hatte,] war durchaus glücklich
c. Ein Mann, [der keinen Bart hatte,] war durchaus glücklich

Data Tables

NPI	TOTAL RTS	PPI	TOTAL RTS
(1a)	564	(2a)	571
(1b)	705	(2b)	424
(1c)	701	(2c)	477

Effects of building and maintaining syntactic predictions on eye-movements in reading

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There is considerable evidence that syntactic prediction plays a role in language comprehension. Syntactic predictions have been shown to moderate the severity of garden path effects (Staub & Clifton, in press) as well as the duration of eye-fixations on an upcoming word.

Chen, Gibson & Wolf (2005) provided evidence that maintaining incomplete syntactic predictions during processing is costly and slows processing. This raises the question of whether only maintenance is costly, or whether instantiating a prediction also has a cost. In a cross-modal lexical decision task, Shapiro, Zurif and Grimshaw (1987) found no evidence of more processing on verbs that project more arguments, but the argument structures of their verbs were not empirically verified. Warren and Grodner (2004) found evidence of increased eye-movement disruption at positions where syntactic predictions were instantiated, but different numbers of syntactic predictions were being maintained at these points of instantiation.

In the current experiment (N=33), a DPI eye-tracker monitored participants reading sentences with either a ditransitive verb, an optionally ditransitive verb, or a transitive verb. The length and frequency of the verbs were matched. Completion norms requiring participants to finish a name-verb fragment as a sentence (e.g., "Ed mentioned…") determined the number of arguments predicted at each verb. The proportion of total completions that included two post-verbal arguments was computed. This proportion was based on nine or more completions for 78% of verbs, but minimally five. The ditransitive verbs had a ditransitivity proportion of .73, optional ditransitives .42, and transitives .05. These proportions were all reliably different.

Verbs were a minimum of five characters long and appeared a few words into the sentence. All words except the verb were the same across conditions until after the direct object. Half the optionally ditransitive verb conditions were completed with two arguments and half with one.

No early eye-movement measures on the verb were predicted by its argument structure. However, the duration of the first fixation made after leaving the verb (spillover) was reliably positively correlated with the verb's ditransitivity proportion. There were also reliable positive correlations of ditransitivity proportion with first fixation duration and regression path duration on the direct object.

The verb spillover effect provides eye-movement evidence that there is a cost to instantiating predictions of upcoming syntactic structure, and that this cost grows as more predictions are built. In the EZ Reader model of eye-movement control (Reichle, Rayner & Pollatsek, 2003), an effect of this latency would reflect a cost incurred during or shortly after lexical access of the verb. The effects in the regression measures on the direct object suggest that maintaining unsatisfied predictions is costly, consistent with previous self-paced reading findings.

Examples (Symbol / delimits analysis regions)

Ditransitive	During the semester Ed/ awarded/ a partial scholarship/ to his best student.
Optional Ditransitive	During the semester Ed/ mentioned/ a partial scholarship/ to a good student.
Transitive	During the semester Ed/ discovered/ a partial scholarship/ and applied for it.

Top-down anticipation versus bottom-up lexical access: Which dominates eye movements in visual scenes?

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It is well established by now that eye movements to displayed objects can reveal processing mechanisms both on sentence and word level. Eye-movement studies have, for example, confirmed phonological competitor activation in spoken-word recognition ([1], i.e., objects with names that overlap in onset with the name of a target object are fixated more than objects with unrelated names); subsequent studies found that cohort activation is further modulated by lexical frequency ([2], i.e., high frequency competitors are fixated more than low frequency competitors) and by semantic information from preceding verbs ([3], i.e., verb constraints on following subject noun phrases can eliminate cohort activation). The present eye-movement studies investigated the interaction of bottom-up lexical frequency effects with anticipation effects from verb constraints in German.

Experimental displays showed a human being (*Frau*, 'woman'), a low frequency object (*Bluse*, 'blouse'), a high frequency object similar in onset (*Blume*, 'flower'), and a distractor object (*Wolke*, 'cloud'). Sentences accompanying the displays started with a subject NP, followed either by a restrictive (a) or non-restrictive (b) main verb in present tense, and a second NP referring to the low frequency object. In a control condition, the displayed high frequency object was replaced by an object that was phonologically different from the other objects. Neither did subject NPs bias towards particular object NPs nor did the gender marking of articles in the second NP exclude upcoming arguments, since objects in a display always shared gender. The restrictive verb, however, strongly biased towards the low frequency object. In rating and naming tests, the goodness of the pictures and the high agreement between listeners' responses and intended names was established.

(a) Die Frau bügelt die Bluse.
The woman is ironing the blouse.

(b) Die Frau sieht die Bluse.
The woman is seeing the blouse.

Twenty-four German listeners fixated pictures of cohort competitors more than pictures of unrelated distractors when the verb was non-restrictive. When the verb was restrictive, however, cohort activation was eliminated (i.e., no more looks to cohort competitors than unrelated distractors). Looks to the target in restrictive trials started to increase with the onset of the article in the object NP. Considering the delay of approximately 200 ms between the planning and launching of eye movements, this suggests that fixations were planned during the verb. This differs from [3] who found an increase in target fixations only after noun onset. The finding is more in line with [4] who found that listeners use verb information to anticipate upcoming objects in sentences. A comparison with the control condition indicated that activation of the object NP was not modulated by the presence of a high frequency cohort competitor. In a second experiment, we presented the same displays to another 20 German listeners, instructing them to click on either the low frequency object (e.g., 'Click on the blouse') or the high frequency object (e.g., 'Click on the flower'). Listeners fixated high frequency objects more than low frequency objects, thereby replicating [2], who had observed a frequency effect for cohort activation with this task. We consider the implications of the dominance of selectional restrictions in guiding eye movements to the object referent, including task specific demands and contextual effects.

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On still being led down the kindergarten-path: Children's use of context in processing structural ambiguities

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In ambiguous constructions containing two prepositional phrases (1) adults can avoid incorrectly contemplating a destination interpretation, e.g., that the frog is to be moved to the napkin, in a context that supports the (correct) modifier interpretation, e.g., two frogs, one of which is already on a napkin (Tanenhaus et al., 1995).

1. Put the frog on the napkin* in the box

In contrast, Trueswell and colleagues (1999) demonstrated that young children cannot avoid assigning the incorrect destination interpretation, even in a two referent context.

Meroni and Crain (2003) challenged this finding using an 'act-out' study, demonstrating that five year olds avoid being led down the garden path with the simultaneous introduction of two relatively minor experimental manipulations. In order to prevent acting out in 'order of mention' (rather than conceptual order) delayed responding was enforced. The pragmatic inference that one frog is more salient than another was also blocked by placing both frogs on different coloured napkins. These two simple manipulations resulted in adult-like performance in a two-referent context. However, no direct comparison was made between one- and two-referent scenes. Furthermore, it is clearly of theoretical importance to understand whether children's performance in the Trueswell study stems from an incorrect pragmatic inference, or from an inability to inhibit incorrect responses once initiated (and whether these two factors may have an additive effect).

The present study seeks to extend Meroni & Crain's work with 60 children (20 in each of the following age groups: 4–5 years, 7–8 years and 10–11 years old). Their procedure is systematically compared with that used by Trueswell et al., with the addition of two further conditions examining each manipulation systematically in order to ascertain which change is responsible for the observed improvement. One and two referents were presented in each of the four conditions resulting in a fully crossed design. Furthermore, the developmental time course of referential sensitivity was explored.

Unexpectedly, Meroni & Crain's findings were not replicated and children's performance did not improve in the two-referent context, with performance in both conditions at chance level. Findings mirrored those of Trueswell et al., and there was not a main effect of procedure-type. The findings presented provide further support for the claim that children aged 4–5 are not able to make use of the referential principle under these circumstances, suggesting that context is easily over-ridden — possibly by strong verb biases when presented with verbs like 'put' (see Snedecker & Trueswell, 2004) and by response biases. However, by age 7 children begin to over-ride these biases demonstrating adult-like competence (consistent with Trueswell et al., 1999). One explanation for these contradictory results may stem from the fact that Meroni & Crain's experimental sentences were presented in a brief discourse context; not used in the present study or by Trueswell et al. The possibility that their findings may arise from this methodological change (rather than their experimental manipulations) is explored. The theoretical and methodological implications of this and other explanations are discussed. Ultimately, this study provides further converging evidence that, under some specific circumstances, young children do not utilise referential information to the same extent as adults. Further investigation is now underway in order to establish exactly what these circumstances are.

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Anticipation vs. integration of syntactically infrequent but semantically obligatory arguments

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Argument information encoded in verbs has been found to promote the anticipation of upcoming entities in visual world paradigms (Altmann & Kamide, 1999) and to facilitate the integration of displaced wh-fillers before syntactic gaps are encountered (e.g., Boland et al., 1995). Furthermore, Koenig et al. (2003) and Conklin et al. (2004) observed faster *wh*-filler integration when a filler's instrument or source role is encoded as a semantic argument than as a semantic adjunct, even when these argument fillers are syntactically optional and do not differ in frequency of occurrence from adjunct fillers. However, the degree to which semantic argument effects depend on the presence of an overt cue (e.g., *wh*-fillers) for an upcoming gap or constituent is unknown. Our two self-paced, moving window studies with an incremental judgment task showed that semantically obligatory, but syntactically optional, instrument and source argument information facilitated the integration of non-displaced postverbal PPs, only after an overt cue for the instrument or source PP was introduced.

Experiments 1 and 2 compared PP reading times (RTs) and judgments for sentences whose verbs did or did not semantically encode an instrument (e.g., *wipe* vs. *dry*), or source location (e.g., *deduct* vs. *count*), as in (1) and (2) respectively. Sentences included seven regions (R), indicated by '|.' We examined anticipation and integration hypotheses. If the semantic encoding of an instrument or source argument leads readers to anticipate an instrument or source PP that is infrequently expressed, then semantic argument effects (i.e., faster RTs for argument verb sentences) should emerge at the preposition region (i.e., R4 in (1) and R3 in (2)). However, the semantic cue provided by verbs may not be sufficiently strong to warrant anticipation of a PP. Instead, readers might require an overt cue, supplied by a preposition, to guarantee the PP's occurrence. In this case, argument effects should emerge at the prepositional object region (i.e., R5 in (1) and R4 in (2)).

For both experiments, sentences in both conditions were judged to be fully acceptable. However, significant RT differences were observed in both experiments. Specifically, semantic argument effects were observed only at the prepositional object region, supporting the integration hypothesis. These results are unlikely to be due to differences in co-occurrence frequencies of our verbs and instrument PPs or source PPs, since two preliminary corpus studies showed that these co-occurrence frequencies did not correlate with RTs.

These results suggest that in the absence of early or particularly salient cues, a verb's semantic argument structure is not sufficiently powerful to lead readers to anticipate PPs that rarely occur. However, the argument information can serve as a source of information that can facilitate the integration of these constituents. Follow-up studies without incremental judgments are underway to address concerns about the stop-making-sense reading paradigm. Potential constraints on the interpretation of these results will be discussed.

Examples

(1) 1**|** The mother 2**|** wiped/dried 3**|** the tiny baby's hands 4**|** with 5**|** a paper towel 6**|** very 7**|** quickly.

(2) 1**|** The large sum of money 2**|** was deducted/counted 3**|** from/in 4**|** the bank 5**|** early 6**|** this morning.

Table 1. Mean RTs (ms) for Regions 2–6 for Experiments 1 (*wipe* vs. *dry*) and 2 (*deduct* vs. *count*).

		Verb (R2)	(R3)	(R4)	(R5)	(R6)
Experiment 1	Argument (*wipe*)	788	1211	547	**687**	520
	Adjunct (*dry*)	811	1231	553	**797**	577
Experiment 2	Argument (*deduct*)	1039	588	**732**	599	925
	Adjunct (*count*)	985	564	**829**	614	1102

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Early effects of morphological complexity in visual word processing: An MEG study

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INTRODUCTION. Electrophysiological studies of the time course of syntactic processing suggest that initial syntactic structure is built prelexically at 100–300ms [1]. The evidence for this is that word category violations elicit an early left anterior negativity (ELAN). As word category depends on morphology, an early response to category violations implies early processing of morphology, a view originally suggested by [2], and supported by recent behavioral studies [3]. It is unclear, however, what the violation data entail about processing in normal circumstances.

In this study, we used magnetoencephalography (MEG) to seek evidence of early morphological decomposition independently of violations. Our results show that morphological processing occurs in a time window that is consistent with the ELAN literature.

EXPERIMENT 1. We manipulated morphological complexity, semantic transparency and surface frequency (LDT). All critical stimuli ended with the letters 'er' (Examples 1) and were matched for length, orthographic factors, syntactic category and stem frequency (when relevant).

Previous MEG studies have shown that the earliest MEG activity that is sensitive to letter-string processing is the M170 component [4]. The M170 field is generated in the fusiform gyri bilaterally. The right hemisphere (RH) source is thought to be specifically tuned to face processing, whereas the left hemisphere (LH) source is the locus of letter-string specific effects. Given this background, we hypothesized that the earliest component that might be sensitive to morphological complexity is the LH M170 source.

Consistent with early prelexical decomposition, we found larger M170 amplitudes for both transparent and opaque morphologically complex forms. However, interestingly, this M170 effect was *right* lateralized, i.e., opposite in lateralization to previously reported letter string effects.

EXPERIMENT 2. Experiment 2 was designed to rule out an alternative explanation of the result of Experiment 1 in terms of stem lexicality. Our stimulus presentation was via binocular goggles and therefore the left half of the stimulus was projected to the right visual cortex and the right half to the left visual cortex. Thus the right-lateral M170 effect of Experiment 1 may have been due to the RH "seeing" a word in ***farm**er* and ***draw**er* but not in ***wint**er*. To test for this possibility, we used prefixes (Examples 2), which, under this hypothesis, should produce a left-lateralized effect.

Consistent with the hypothesis that the RH M170 source is sensitive to morphological complexity, Experiment 2 replicated the RH result of Experiment 1. However, for prefixes, the LH M170 source *also* showed larger amplitudes for complex forms. This suggests that the RH M170 effect of Experiment 1 may have been a combined effect of morphological complexity and stem lexicality.

CONCLUSION. Our results show that the RH M170 source is sensitive to morphological complexity irrespective of the linear ordering between a stem and an affix. Early processing of visual word forms has previously been thought to be confined to the left fusiform gyrus but our results suggest a crucial role for the right hemisphere. Importantly, these results establish a starting point for further investigations of the neural bases of early syntactic parsing outside the violation paradigm.

Examples (Experiment 1)

No Suffix	No Suffix (*–er* orth.)	Opaque	Transparent
curtain	*feather*	*sweater*	*painter*

Examples (Experiment 2)

No Prefix	No Prefix (*re–* orth.)	Prefix
rotate	*resume*	*refill*

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