Relative clauses that children understand: NP type effects on child processing

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Relative clauses (RCs) have been studied extensively in language acquisition and adult processing. Studies show that both children and adults find object relatives harder than subject relatives [1, 2]. Despite the similar pattern, adult difficulty is taken to reflect the increased processing demands of object relatives [1] while child difficulty is often interpreted as evidence for children's lack of adult-like knowledge of the structure, attributed to under-developed syntax [2] or to the use of non-adult processing heuristics which are abandoned as the parser develops [3]. In this paper, I suggest that children's difficulty reflects *similarity* between the child and the adult parser: children display adult-like processing preferences.

The study focuses on the effect of the NP type appearing inside the relative clause. This factor was shown to influence adult processing: adult difficulty with object relatives is reduced when the embedded NP is a pronoun rather than a Lexical NP [4]. Two experiments demonstrate the influence of this factor on child performance. Together, the experiments show that just like adults children are better at comprehending what they (a) hear more frequently and (b) requires less processing resources. Furthermore, the results suggest that previous assessments of child performance have underestimated children's knowledge by testing them on relative clauses that are especially taxing even for adults.

The first experiment examined the distribution of NP types in child and child-directed speech in Hebrew. The results reveal a very similar distribution: both children and adults rarely produce object relatives with Lexical NPs. The second experiment manipulated the NP type in a comprehension task (full NP: *the monkey that **the girl** fed*, vs. pronoun: *the monkey that **I** fed*). 24 young Hebrew speakers (mean age 4;5) participated in a novel color-question task which required the child to answer questions about the colors of objects while looking at a picture. Questions contained a subject or an object relative clause in the two NP type conditions (Full NP vs. Pronoun), as can be seen in examples (1–4). The results showed a clear effect of NP type: Children's comprehension of object relatives is greatly improved when the object relative contained a subject pronoun (accuracy rises from 69% to 84%, see Table 1), demonstrating an effect of NP type on child processing and indicating previous assessments underestimated child knowledge. Moreover, performance on full NP object RCs was better than other studies testing the same age group in Hebrew, indicating the advantage of the novel task.

To conclude, the study reports similarity between child and adult processing of RCs with regard to NP type: Like adults, children produce more embedded pronouns and like adults, their comprehension improves in the pronoun condition. These similarities suggest the need to re-examine the null-hypothesis in language acquisition studies. Rather than postulating developmental stages (which undoubtedly exist) whenever we find difficulty in child speech, it is necessary to show that the observed difficulty can't be reduced to processing preferences/limitations that are common to children and adults. The discussion will include additional results demonstrating the effect of NP type on RC **production**.

Examples

(1)	What color is the hat of the girl that is feeding the monkey?	Subject NP
(2)	What color is the hat of the girl that the monkey is feeding?	Object NP
(3)	What color is the hat of the monkey that is feeding me?	Subject Pro
(4)	What color is the hat of the girl that I am feeding?	Object Pro

Table 1. Percentage correct performance by Extraction and NP type.

	Subject	Object
Full NP	90%	69%
Pronoun	96%	84%

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Word order and language production in bilinguals: Evidence from syntactic priming

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Studies on syntactic priming strongly suggest that syntactic representations are shared across languages. It is not clear, however, to which level of detail these representations have to be identical in order to be shared. Active and passive structures can be primed across Spanish and English (Hartsuiker, Pickering & Veltkamp, 2004), but not across German and English (Loebell & Bock, 2003), as in (1):

1a. The river was poisoned by the chemical waste.
1b. Der Fluss wurde von dem chemishen Abfall vergiftet.

In the latter experiment priming could have failed to occur because German and English passives have different word orders, and that fairly exact repetition of grammatical structure is necessary for cross-linguistic priming. We investigated whether differences in the word order of Dutch and English noun phrases influence cross-linguistic priming of noun phrases. We used two equivalent structures as primes, with a different order for head and modifier: Head-final structures (2a, 2b) and Modifier-final structures (3a, 3b). Whereas the Head-final NP has the same word order in both languages, the Modifier-final NP has a different word order in English (3a, Adjective-final) and Dutch (3b, Verb-final).

2a. The red sheep.
2b. Het rode schaap.

3a. The sheep that is red.
3b. Het schaap dat rood is.

4a. Het groene huis.
4b. Het huis dat groen is.

Using native Dutch speakers who learned English as a second language, we tested syntactic priming in Dutch, in English as a second language and between Dutch and English. Experiment 1 showed syntactic priming of noun phrase structure in Dutch (cf. Cleland & Pickering, 2003). Noun phrases such as (3b) were more likely after primes with the same structure (4b) than after primes with a different structure, such as (4a). Moreover, the priming effects were larger when the noun was repeated between prime and target (='lexical boost'; Cleland & Pickering, 2003). Experiment 2 showed syntactic priming of noun phrase structure in English (L2). Experiments 3 and 4 investigated cross-linguistic priming (Experiment 3: L1 → L2 and Experiment 4: L2 → L1). An effect of cross-linguistic syntactic priming would provide evidence for shared syntactic structures, regardless of differences in word order. These experiments did not reveal any structural priming, because hardly any Modifier-final NPs were produced. Finally, Experiment 5 compared priming within English and between Dutch and English in a within-subjects design. Again, no cross-linguistic priming was found, though there was reliable within-language priming. The results of these experiments seem to suggest that although structural priming of noun phrases can be found in Dutch (L1) and in English (L2), the effect doesn't transfer across both languages. Given the clear evidence for cross-linguistic priming (e.g., Hartsuiker et al., 2004; Loebell & Bock, 2003; Schoonbaert et al., manuscript in preparation), these results suggest that structural priming between languages requires parallel word order in both languages. This suggests that syntactic representations for different languages are only shared if they use very similar word orders. Hence, we assume that only the structure of Head-final NPs is shared between Dutch and English.

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The complexity of two types of grammatical metaphor

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In this paper, I will report on three reading experiments that examined the processing complexity of two types of grammatical metaphor in Dutch, nominalised infinitives and left-branching constructions. These experiments are part of a research project on the relationship between linguistic and cognitive complexity. The project investigates the hypothesis that this relationship is mediated by genre.

The complexity of grammatical metaphors lies in the assumption that there is a mismatch between the conceptual and linguistic structures. For example, processes (congruently worded as verbs), for instance, may be realized as nouns (see example (1a), a nominalised infinitive), or as adjectival phrases (see example (2), a left-branching construction).

In the literature on text composition, nominalised infinitives and left-branching constructions are often said to render a text complex and inaccessible. However, textual advice on the use of these expressions seems to be predominantly based on intuitions rather than psycholinguistic research and is rarely related to the genre in which they occur, despite the high influence of genre on the use of grammatical metaphor, e.g., Lassen (2003), Halliday and Martin (1993).

The first and second reading experiment that I will report on seem to provide psycholinguistic evidence for the assumption that nominalised infinitives may be inherently more difficult than their congruent equivalents. An example of a nominalised infinitive (1a) and of its congruent counterpart (1b) would be:

(1) De Britse regering heeft zich verantwoordelijk gedragen /
[The British government has itself responsibly behaved]

(a) *door het jarenlang vrij laag houden van de buitenlandse schulden*. /

[*by the for many years relatively low keep_INF of the foreign debts*.]

(b) *door jarenlang de buitenlandse schulden vrij laag te houden.* /

[*by for many years the foreign debts relatively low to keep*.]

In the experiments, journalistic texts were presented clause by clause (as indicated by the slashes in the example) on a computer screen in a self-paced moving window paradigm. Collected reading times were standardized to correct for differences in length between the critical conditions. The data showed that the nominalised infinitives were processed significantly slower than their congruent equivalents, although there was no decline in comprehension and recall performance.

The third experiment that I will report on examines the effects of genre expectations on the processing of nominalised infinitives and left-branching constructions, such as (2):

(2) Gestreefd wordt naar een binnen een tijdsbestek van 10 tot 20 jaar in de richting van het perspectief van het soorteigen gedrag omgebogen houderijsysteem van dieren

[Aimed at is *a within a time span of 10 to 20 years in the direction of the perspective of species-specific behaviour reorganised* system of keeping animals.]

It is hypothesised that readers' expectations about the genre of a text influence the way that text is processed and represented in memory. More specifically, it is expected that nominalised infinitives and left-branching are better processed and comprehended in policy papers than in newspaper articles.

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A blue cat or a cat that is blue? Abstract syntax in young children's noun phrase production

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There is strong evidence that adults tend to repeat syntactic structure in language production: After producing or hearing a *prime* sentence with a particular structure, adults are more likely to use that structure in a subsequent, otherwise unrelated, *target* sentence [1, 2]. Such *syntactic priming* effects are taken as evidence that adult language production involves the retrieval and processing of abstract syntactic representations. But to what extent does young children's production also involve such abstract representations, and how might such representations develop?

Some researchers have suggested that young children do not use abstract syntax; instead, their syntax is tied to particular lexical items [3]. For example, a child may use a particular construction with one head but not with another. If so, then prior production of that construction using one head should not facilitate — syntactically prime — subsequent production of that construction using a different head. Previous studies explicitly examining syntactic priming in young children have found inconsistent results in this regard [4, 5].

We report three syntactic priming studies that examined noun-phrase production in children aged between 2;6 and 4 years. Under the guise of a game of 'snap', the experimenter and a child alternately described picture cards depicting a colored object. On half of the experimental trials, the experimenter described her card using a determiner-adjective-noun (DAN) structure (e.g., *a blue cat*), and on the other half using a noun-relative clause (NRC) structure (e.g., *a cat that's blue*). The child then described his card, before making a match/no-match ('snap') judgement. We examined whether children repeated the structure of the experimenter's prime description in their target descriptions. This novel 'snap' method proved highly effective for investigating spoken syntactic production, with very little data loss.

Experiments 1 (3–4 year-olds) and 2 (2;6–3;6 year-olds) manipulated Prime Structure (DAN vs. NRC), and the Head Noun in prime and target descriptions (Repeated vs. Different). Both experiments showed strong priming in both Repeated-Noun (Priming effect: Exp1: 75%; Exp2: 76%) and Different-Noun conditions (Experiment 1: 53%; Experiment 2: 43%); the effect was significantly stronger in the Repeated-noun conditions (all p's<.05).

Experiment 3 (3–4 year-olds and a control adult group) used only different-noun primes but also included a baseline (bare noun) condition. We again found reliable priming, which was centred on the dispreferred (NRC) construction. Crucially, priming was significantly stronger in the children than in adults (31% vs 7%). Hence children appear more susceptible to the effects of prior syntactic context than adults.

Our results provide striking evidence that children as young as 2;6 years have abstract syntactic representations for at least some constructions. Moreover, these representations are shared between comprehension and production: Merely hearing one exemplar of a structure increases the likelihood of then producing that structure. We interpret our findings with respect to models of adult language production [2, 6], and discuss their relevance to theories of language acquisition.

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Conflict resolution involving coordination constructions

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Investigations of reanalysis phenomena often focus on the resolution of case conflicts or phrase structure revisions. This ERP experiment investigated language processing conflicts arising from a local number incongruency between a verb and an initial argument of a coordination construction (1a, 2a). In fact, this is the first study examining number mismatches that are disambiguated on the DP (instead of the verb). Coordination constructions were further tested in sentences with transitive and intransitive predicates in order to assess the predictive power of verb information for the processing of arguments in coordination constructions. Number mismatches were hence used to investigate local reanalysis processes (subject-verb agreement) as well as local violations of verb-related expectations (transitivity).

In German, verbs can be topicalized, which allowed us to present verb and number information prior to the coordination construction. As a result, there is a local number mismatch between the plural auxiliary and the following singular DP (which is underspecified for case features) in (1a) and (2a), which is subsequently resolved as the entire coordination becomes available. We examined the electrophysiological responses to the encounter of this mismatch and investigated whether the option of a coordination continuation is taken into account during online sentence processing. The transitivity manipulation allowed us to further focus on the available conflict resolution mechanisms, since the number mismatch might affect intransitive predicates at the first DP more severely than transitive predicates that take two arguments and permit a reanalysis towards an object-before-subject order.

ERPs were recorded in a reading study in German (N=20) and conflict resolution involving coordination constructions was examined at the first DP and the coordinating conjunction in sentences as illustrated in (1a vs. 1b) and (2a vs. 2b).

The data reveal that at the first DP (*die Tänzerin*) only the two intransitive constructions registered a difference: the number mismatch between the auxiliary and the first DP in (1a) elicited a left anterior negativity between 300–600ms compared to (1b). In contrast, no electrophysiological difference was observed in (2a) vs. (2b). This suggests that the parser detects subject-verb incongruities promptly in intransitive constructions. However, following a transitive verb, number mismatches are allowed more readily, possibly because the structure can be resolved towards an object-before-subject order.

At the coordinating conjunction *und,* both constructions with a plural auxiliary (1a, 2a) registered a negativity between 450 and 550 ms compared to their counterparts with singular auxiliaries. This finding reveals that the information carried by the conjunction is used at this point to revise the structure towards a coordination reading.

These data indicate that coordination information is not used in a predictive manner to reanalyze a subject-verb incongruity towards a coordination reading (cf. first DP). However, once coordination information becomes available, it is utilized to revise the structure (cf. *und*). Moreover, verb-specific information (transitivity) affects local processing decisions, as revealed by the absence of a mismatch effect on the first DP in transitive constructions. This finding suggests that verb information represents a powerful cue for local conflict resolution involving number mismatches that emerge on the DP.

Examples

(1a)	Geschlafen	haben	die Tänzerin	aus Spanien und	der Sänger	aus Ghana.
	slept	have-PL	the dancer-SG	from Spain and	the singer-SG.NOM	from Ghana
(1b)	*Geschlafen	hat	die Tänzerin	aus Spanien und	der Sänger	aus Ghana.
	slept	have-SG	the dancer-SG	from Spain and	the singer-SG.NOM	from Ghana
(2a)	Geschlagen	haben	die Tänzerin	aus Spanien und	der Sänger	aus Ghana den Manager.
	hit	have-PL	the dancer-SG	from Spain and	the singer-SG.NOM	from Ghana the manager
(2b)	*Geschlagen	hat	die Tänzerin	aus Spanien und	der Sänger	aus Ghana den Manager.
	hit	have-SG	the dancer-SG	from Spain and	the singer-SG.NOM	from Ghana the manager

Do sex and syntax go hand in hand? An alternative account to semantic and contextual effects in the processing of grammatical gender agreement

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The influence of semantic/contextual factors in gender agreement processing has been attested in Romance languages on the basis of a small set of gender-invariant animate nouns (GIANs) (eg. *victim* (feminine)). Sex/gender incongruence affects pronominal agreement in comprehension (Cacciari & Carreiras, 2001; Cacciari et al. 2003) and grammatical agreement in the production of copular-sentences with predicative-adjectives (Vigliocco & Frank, 1999; 2001). The *maximalist hypothesis* (Vigliocco & Frank, 1999; 2001) locates the latter effect in the syntactic process of "phrasal integration", thereby contradicting the linguistic assumption that syntactic computation is blind for semantic information not represented as a lexical *formal feature* (cf. Chomsky, 1995).

This paper aims at providing an alternative account to the interference of semantic/contextual factors in the processing of gender agreement, in which the blindness of the computational system operating in syntactic formulation is preserved. It is argued that the production of a sentence-initial-DP may cause its parsing/closure as a unit. Its lexico-syntactic representation goes into decay after being semantically interpreted/integrated with contextual information, as topic-DPs in discourse. The re-starting of the sentence by means of a resumptive null/overt subject-pronoun determines the way subject-predicative agreement is established. The gender-feature of the pronoun encodes conceptual information concerning the sex of the referent of the antecedent-DP and/or lexico-syntactic information concerning grammatical-gender. Processing conditions determine the likelihood of the latter being accessible to the resumptive pronoun. A series of experiments conducted in Portuguese is intended to illustrate this point.

Experiment 1 provides evidence that a nominative-pronoun recovers conceptual information concerning the referent of its antecedent. A self-paced-reading comprehension-task was used with two sentence-stimuli. In the first sentence, the sex bias for the referent of the subject-DP with a GIAN was manipulated (modifiers mentioned male/female and sex neutral clothes). In the second sentence, the gender of a nominative-pronoun was manipulated. A significant interaction between *sex-bias* and *gender* was obtained, supporting the view that pronouns grammatically encode semantic gender. Compatibility between conceptual and lexico-syntactic information creates the optimal processing condition.

Experiments 2–4 used an elicited sentence-production task with auditory preambles — a DP with a GIAN — preceded by background context identifying the sex of its referent. In Experiments 2 and 3, the preamble was prosodically marked as topic. Participants were requested to freely continue the topic (Experiment 2) and to continue it with an overt-pronoun (Experiment 3). In Experiment 4, the preamble was prosodically neutral and participants were requested to repeat it. In the three experiments, a predicative-adjective in unmarked (masculine) form to be included in the produced sentence was visually presented. The dependent-variable was the number of conceptually-congruent agreeing predicative-adjectives. In all experiments, a significant effect of *sex/gender congruence* was obtained. The production of the overt-pronoun in Experiment 3 shows that pronominals tend to encode conceptual information. The magnitude of the effect across experiments suggests that the task conditions affect the accessibility of lexico-syntactic information on gender. The results are compatible with the view that the syntactic-formulator deals with formal features of the lexicon and that the computation of syntactic agreement is not affected by semantic/contextual factors.

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The influence of lexical items on syntactic production: Results of reaction time and sentence type analyses

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An important question within the psycholinguistic literature concerns the relationship between lexical selection and syntactic production. Is it possible, for instance, to influence the production of a passive structure by priming the patient noun of a sentence? If so, can semantic and phonological cues cause such changes?

This question has been addressed in different ways (e.g., Bock, 1986, 1987; Ferreira & Firato, 2002). Bock found that semantic and phonological processing of lexical items did influence syntactic structure. She found effects of semantic facilitation and phonological interference. Research investigating the scope of encoding of phonological and semantic information (e.g., Costa & Caramazza, 2002; Meyer, 1996, Meyer & Schriefers, 1991), has also demonstrated the influence of semantic and phonological information on production, yet in a seemingly contradictory manner. These studies found effects of semantic interference and phonological facilitation. The seemingly conflicting results may be explained by three important differences in study design. First, in Bock's studies, the influence of phonological and semantic information was reflected in the type of syntactic form produced (active versus passive), whereas in the later group of studies, the effect was measured in reaction time (RT) to utterance onset. Secondly, in Bock's studies, but not in others, sentence production was unconstrained. Finally, the studies differed in the stimulus onset asynchrony (SOA) between the presentation of the picture and distractor word. In Bock's studies, it was approximated to be –2000 ms. In the second group of studies the SOAs were controlled and much shorter (e.g., –150 ms, 0 ms, +150 ms).

The present study systematically controlled the above-mentioned factors to clarify the potential influence of lexical items on the production of active versus passive sentences. Using a picture-word interference paradigm, participants were asked to describe a picture involving a transitive verb and two nouns. Responses were measured for both RT to utterance onset and sentence type. The effects of semantic and phonological distractors were compared to unrelated distractors at SOAs of –1000 ms, –150 ms and +150 ms.

Preliminary analysis of the RT data obtained from 38 undergraduates showed a main effect of SOA ($p<.001$), with the RTs from the SOAs of –150 ms and +150 ms being longer than those at –1000 ms. There was no main effect of distractor type and no interaction, which is inconsistent with previous studies of constrained phrase and sentence production (e.g., Meyer, 1996). To make the current data set more similar to previous studies, only RTs from active responses were analyzed in a secondary analysis. Results showed a main effect of SOA ($p<.001$) and a main effect of distractor type ($p<.03$). The latter result, not seen in the full data set, represents an effect of semantic interference relative to unrelated distractors. Phonological distractors did not appear to influence RTs in this sentence production task. Preliminary analysis of the 'sentence type' data showed a main effect of role ($p<.006$), suggesting that when a patient noun was primed, participants were more likely to produce a passive sentence. Testing of more participants is underway. Using an unconstrained sentence task, this research adds to the findings of previous studies and has implications for current models of word and sentence production.

Looking at objects of verbs in dynamic scenes: Effects of verb type and agent motion direction

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Recent research on the interaction between language, vision, and attention has focused on the role of static visual context (real objects or drawing of objects and scenes) in the processing of sentences, as measured by eye-movement behavior (e.g., Altmann & Kamide, 1999; Tanenhaus et al., 1995; Henderson & Ferreira, 2004). Results of the work conducted within this "visual world paradigm" have pointed to the rapid integration of linguistic and visual information during sentence processing. However, sentence comprehension processes occur in scene contexts that are dynamic rather than static. In the present study, we extended this paradigm to realistic dynamic scenes (movies of real-world events) to further understand how linguistic and visual processes interact, and to determine the locus of this interaction.

Eye movements were recorded as participants (N=31) were shown a series of movies of events and listened to sentences related to those events. The main verbs in the sentences were either causative, e.g., *Before making the dessert the cook will crack the egg that is in the bowl*, or perception/psychological verbs, e.g., …*examine the egg*… In addition, agents in the scenes moved/reached either toward the visual referent of the grammatical object of the main verb, e.g., *egg*, away from it, or remained in a neutral position. There were 17 scene types, with three motion conditions, each coupled with one of two sentence types (thus totaling 102 unique stimuli). Acoustic onsets of verbs were synchronized with movie frames corresponding to agent motion onset. We predicted that causatives — which were semantically more restrictive — would trigger more and faster saccades to the target object, e.g., the egg, and thus allow for faster interaction between visual and linguistic representations.

We found a significant main effect of motion context, but only a marginal effect of verb type, in three types of analyses: (A) saccade onset time (SOT; total time taken to launch a saccade to the target) (Motion: F_1, P<.0001; F_2, P<.0001; Verb: F_1, P=.057, F_2, P=.008), (B) number of fixations to target object (e.g., the egg) (Motion: F_1, P<.0001; F_2, P=.0004; Verb: n.s.), and (C) cumulative fixations to target up to 749 ms after verb onset, which was the 50 ms bin corresponding to the mean length of the noun (Motion: F_1, P<.0001; Verb: F_1, P=.0003; interaction: F_1, P<.0001). In pairwise analyses, we found verb effects only in the 'towards' condition, with faster SOTs in the causative condition than in the perception/ psychological condition (t_1, P=.001; t_2, P=.003). In addition, we found that most of the saccades and brief fixations during the initial processing of the event and scene (on average, a window of time of 749 ms, going from the acoustic onset of the verb to the acoustic offset of the noun complement of the verb) were to the region of the agent of the event. Therefore, we found evidence for eye gazes to agents of events but no evidence for anticipatory eye movements to the object referent of the grammatical complement of the verb in dynamic scenes. We suggest that the interaction between visual-contextual and sentence/verb-conceptual information occurs rapidly within conceptual short-term memory.

Relative pronouns as accessibility markers

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Many functional linguistic theories (often called accessibility theories) assume that the form of anaphoric expressions signals how accessible or salient the antecedent is (Ariel, 1990; Gundel, Hedberg & Zacharski, 1993). For example, pronouns signal that the antecedent is highly accessible, whereas NPs and names signal that the antecedent is relatively inaccessible (for experimental evidence, see e.g., Gordon, Grosz & Gilliom, 1993). We argue that relative pronouns also signal how accessible their antecedent is, and that relative clause attachment preferences are affected by the type of relative pronoun: Relative clauses (henceforth RCs) with relative pronouns that signal a highly accessible antecedent preferentially attach to the most accessible NP, but this preference is less strong for RCs with relative pronouns that signal a less accessible antecedent.

We investigated whether different types of relative pronouns affect RC attachment in French. In Experiment 1, we compared *qui* (1) and *lequel/laquelle* (2) in RCs following a 'NP1 of the NP2' structure. NP1 and NP2 had the same gender and number. Participants indicated whether they thought the father or the mason was funny.

(1) Je connais le père du maçon, qui est amusant.
(I know the father$_{NP1}$ of the mason$_{NP2}$ who is funny)

(2) Je connais le père du maçon, lequel est amusant.
(I know the father $_{NP1}$ of the mason $_{NP2}$ who is funny)

Our accessibility account predicts that *qui* RCs should preferentially attach to the most accessible NP (presumably NP1, e.g., Zagar, Pynte & Rativeau, 1997), but this preference should be weaker for *lequel/laquelle* RCs. This is because *qui* is less marked (shorter and more frequent) than *lequel/laquelle*, so *qui* should refer to more accessible antecedents (Ariel, 1990). The results confirmed this: For *qui* RCs, participants strongly preferred NP1 (87% of trials), but this preference was much weaker (70%) with *lequel/laquelle* RCs.

In Experiment 2, we investigated whether the differences in Experiment 1 occurred because the relative pronouns differed in markedness or because they differed in syntactic informativeness (*lequel* is gender and number marked whereas *qui* is not) by comparing *à qui* (3) and *auquel* (4), which are phonologically equally long and fairly similar in frequency, but *auquel* has gender marking, whereas *à qui* does not.

(3) Je connais le père du maçon, à qui la mère écrit une lettre.
(I know the father of the mason to whom the mother is wrote a letter.)

(4) J'accompagne le père du maçon, auquel la mère écrit une lettre.
(I know the father of the mason to whom the mother wrote a letter.)

The results showed a strong preference for NP1, but no difference between *auquel* and *à qui*, contradicting the suggestion in Ariel (1990) that informativeness signals antecedent accessibility.

Together, the experiments suggest that markedness of the relative pronoun affects RC attachment preferences. We claim that the processing of relative pronouns is similar to that of personal pronouns (Hemforth, Konieczny & Scheepers, 2000) and argue that accessibility theories should incorporate relative pronouns as part of their accessibility hierarchy.

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Brain responses to mood anomalies in Spanish

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Event-related brain potentials (ERPs) have been increasingly used by psycholinguists mainly because they provide a continuous measurement of the brain's electrical activity with high temporal resolution and because they respond differently to semantic and syntactic aspects of sentence processing. A central issue in ERP research has been to examine the responses to syntactic and semantic anomalies to study the architecture of the language processor. The study of violations (such as phrase-structure violations, subcategorization violations, gender and number agreement violations, and case violations) has provided valuable information concerning the time at which different sources of information exert their influence during language comprehension.

Other (theoretically relevant) anomalies have received little or no attention. The experiment reported here aims to examine the responses elicited by mood anomalies in Spanish to further study the role of verb-specific information in the early stages of parsing. The information we study is the mood constraints a matrix verb imposes on the subordinate verb. Since subcategorization for a subjunctive (or indicative) sentence complement (SC) is assumed to be a lexical property of verbs, the role of lexical information in parsing can be studied in a novel way by examining the (rapid or late) detection of mood anomalies. Such anomalies were created by using (1) verbs that subcategorize for a subjunctive-SC, and (2) verbs that subcategorize for an indicative-SC, and by manipulating (3) the mood (subjunctive/indicative) of the SC. Thus, ungrammatical sentences were created by presenting a subordinate verb that did not satisfy the mood constraints imposed by the matrix verb. Subjects read sentences such as those in (1).

Whereas verbs such as "aconsejar" (to advise) in (1a–1b) obligatorily require the subjunctive in the SC, verbs such as "prometer" (to promise) in (1c–1d) obligatorily require the indicative in that complement. In (1a) and (1c) the subordinate verb is in the mood required by the matrix verb. In (1b) and (1d) the subordinate verb is not in the mood required by the matrix verb, thus making the SC-alternative ungrammatical. In order to detect these anomalies the parser needs to access and consult the mood constraints stored at the lexical entry of the matrix verb. The experiment aimed (1) to examine whether the parser is sensitive or not to these anomalies, and (2) to examine at which word the anomalies are detected.

The results clearly showed that the ERPs elicited by the ungrammatical verbs were reliably distinct from the ones elicited by their grammatical counterparts. In both types of matrix verbs, ungrammatical subordinate verbs elicited a centroparietal positivity widely distributed over both hemispheres. The experiment, thus, shows that the parser is sensitive to the mood anomalies we studied, and that the detection of the anomalies occurs at the first possible word (the subordinate verb). Moreover, it clearly shows that the processor rapidly accesses and consults the mood information stored at the main verb's lexical entry. This finding is in accordance with the claim — made by lexicalist parsing models — that lexical information plays a crucial role in the early stages of parsing.

Examples

(1) a. María le ha aconsejado a Pedro$_i$ que (*pro*$_i$) llegue (SUBJUNCTIVE) antes de las diez
[Mary has advised Peter$_i$ that (*pro*$_i$) arrive (SUBJUNCTIVE) before ten o'clock]

b. * María le ha aconsejado a Pedro$_i$ que (*pro*$_i$) llegará (INDICATIVE) antes de las diez

c. María$_i$ le ha prometido a Pedro que (*pro*$_i$) llegará (INDICATIVE) antes de las diez
[Mary$_i$ has promised Peter that (*pro*$_i$) arrive (INDICATIVE) before ten o'clock]

d. * María$_i$ le ha prometido a Pedro que (*pro*$_i$) llegue (SUBJUNCTIVE) antes de las diez

Priming of syntactic configurational information

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In a recent paper, Scheepers (2003) showed syntactic priming of the relative clause attachment ambiguity (e.g., "Someone shot the servant of the actress who…" can be completed with an RC that attaches high to "the servant" or low to "the actress"). In a completion task, German participants produced more high attachments in the target when they had just continued a high-attachment prime compared to when they had just continued a low-attachment prime. Based on these results, Scheepers argued that not only lexical subcategorization frames or context-free rules can be primed (Pickering & Branigan, 1998), but also bigger parts of the hierarchical tree configuration.

We further investigated syntactic priming of this configurational information in five similar sentence completion experiments. In Experiment 1, we replicated the RC priming effect in Dutch (like Scheepers, we used gender agreement to force attachment in the primes). Participants produced significantly more high attachments in the ambiguous target (1c) following a high-attachment prime (1a; 46%) than following a low-attachment prime (1b; 35%). In Experiment 2, we showed that syntactic priming can be obtained from primes in the first language to targets in the second language of Dutch-English bilinguals. Participants produced significantly more high attachments in English target sentences (2) following Dutch high-attachment primes (1a, 43%) than following Dutch low-attachment primes (1b, 32%). In Experiment 3, we replicated the syntactic priming effect in English and showed that the hierarchical configuration of the entire sentence did not influence the priming effect. There was a significant 18% priming effect when the NP1-of-NP2-RC construction was in object position in both the prime (3a) and the target (2) and a significant 20% priming effect when the NP1-of-NP2-RC construction was in subject position in the prime (3b) but in object position in the target (2). In Experiment 4, we showed that the syntactic priming effect is not due to priming of modifiers in general, but is specific to RC attachments: RC attachments in the prime (3a) had no effect on PP attachments in the target (4). In Experiment 5, we investigated whether the configuration of the head made a difference and investigated whether 3-site RC attachments could prime 2-site RC attachments. We found that high attachment primes (5a) lead to more high attachments in the target (2) than middle attachment primes (5b), which lead to more high attachments in the target than low attachment primes (5c).

These results have major implications for accounts of syntactic priming (e.g., Chang, Dell, Bock, & Griffin, 2000; Pickering & Branigan, 1998; Scheepers, 2003), experience-based models of sentence processing (e.g., MacDonald, 1998; Sturt, Costa, Lombardo, & Frasconi, 2003; Mitchell, Cuetos, Corley, & Brysbaert, 1995), discourse-based models of syntactic ambiguity resolution (e.g., Frazier & Clifton, 1996; Hemforth, Konieczny, & Scheepers, 2002) and syntactic accounts of bilingualism (e.g., Hartsuiker, Pickering, & Veltkamp, 2004; Loebell & Bock, 2003). More generally, we conclude that the syntactic priming technique is a useful tool to investigate the nature of syntactic representations that people use when they are processing sentences.

Examples

(1) a. De politie ondervroeg de veroorzaakster van het ongeval die…
[The police interrogated the causer (NON-NEUTER) of the accident (NEUTER) that (NON-NEUTER)...]

b. De politie ondervroeg de veroorzaakster van het ongeval dat…
[The police interrogated the causer (NON-NEUTER) of the accident (NEUTER) that (NEUTER)...]

c. Jan ontmoette de bazin van de bediendes die...
[John met the boss (NON-NEUTER) of the employees (NON-NEUTER) that (NON-NEUTER)...]

(2) John met the boss of the employees who…

(3) a. The audience applauded (the director of the play who…) / (the play of the director who…)
b. The director of the play who… / The play of the director who…

(4) The employees of the storeowner with…

(5) a. The guests disliked the chef of the restaurant of the hotel who…
b. The guests disliked the menu of the chef of the restaurant who…
c. The guests disliked the menu of the restaurant of the chef who…

Inclusiveness and the Small World Requirement: Singling-out entities from plural sets

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The requirements of the definite article have long been a subject of debate. One Uniqueness account, offered by Hawkins (1978, 1991), claims that by referring to p-sets, pragmatic sets generated by discourse and situation context, uniqueness of the definite article can be determined. In addition, Hawkins claims that within a given P-set, a definite NP must satisfy Inclusiveness, referring to the 'totality of entities that satisfy the description of the NP' (Hawkins 1991). The experiments in the current study consider contexts where multiple entities of the same type are implied, yet where only one entity is denoted by the definite DP. Such contexts violate the Inclusiveness account if you assume the current P-set contains the entire set of implied entities.

In contrast to Inclusiveness, the Small World Requirement proposed here claims that a hearer will consider a discourse-new entity introduced with the definite article felicitous when the target entity is *more relevant than all others of its type* within current discourse context. This requirement stresses relevance over uniqueness, and in so doing predicts that it should be acceptable to violate Inclusiveness if relevance for a particular entity can be established within the current P-set.

In Experiment 1, participants supplied answers in a fill-in-the-blank written completion study, giving either the definite or indefinite article as a response. It was assumed that participants would supply the definite article in conditions that met the requirements of definiteness, and the indefinite in conditions that did not. In Conditions A and B, the target entity was the most relevant by virtue of it being the only inferable entity of its type. In Condition A, target entities were linked anaphorically to pre-established discourse referents, while target entities in Condition B were simply inferable. In both conditions the definite article was almost universally preferred (92.5% and 100%, respectively). In Condition C, the target entity was a member of an implicit plural set, but context was only partially adequate to single it out as the most relevant of its type. Choice of the definite article was greatly reduced (26.3%). In Condition D, the target entity was relevant to the context, but was no more relevant than any others of its type. Choice of the definite article was almost non-existent (1.3%).

In Experiment 2, participants were asked to rate on a 5-point scale the felicity of two-sentence pairs in which the definite article denoted a single entity in contexts where multiple entities of that type were inferable. In Condition A, context made one entity clearly more salient than others of its type. In Condition B, multiple entities were equally salient. Items were rated significantly more felicitous in Condition A than in Condition B (overall means 3.6 to 2.4, respectively; $p<.001$).

The findings of both Experiments 1 and 2 support the Small World Requirement, and show that inclusiveness can be violated in situations where one entity is more relevant than others of its type.

Examples

A. When Joe proposed, he gave Sally a ring set with a large gem. Experiment 1
____ diamond was nearly flawless.

B. Ron swept the office.
____ broom was starting to wear out.

C. Bernie parked and walked towards the large central bank.
____ teller was sitting outside on a cigarette break.

D The professor looked at the front row of her crowded classroom.
____ student was asleep.

A. Juan drove up to the busy tollbooths. The toll taker was rude. Experiment 2

B. * Juan looked at the busy tollbooths. The toll taker was rude.

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Mouse-tracking the visual world: Streaming *x,y* coordinates imply continuous interaction during on-line language processing

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Continuous nonlinear trajectories recorded from the streaming *x,y* coordinates of computer-mouse movements can serve as an informative indicator of the cognitive processes underlying spoken word recognition (Spivey, Grosjean, & Knoblich, 2005). Mouse movements are continuous, thus allowing a truly graded response pattern to emerge, should it exist. And whereas self-paced reading affords 2–3 data points (RTs) per second, and eye-movement data allows for approximately 2–4 data points (saccades) per second, "mouse-tracking" yields somewhere between 30–60 data points per second, depending on sampling rate. Finally, the *x,y* coordinates can be easily time-locked to the exact millisecond in a sound-file at which they were recorded, yielding remarkable temporal sensitivity.

We exploited the continuous nature of mouse-movement trajectories to explore various aspects of sentence processing in relation to the visual-world paradigm (Tanenhaus, Spivey-Knowlton, Eberhard & Sedivy, 1995).

(1a) Put the apple on the towel in the box.

(1b) Put the apple that's on the towel in the box.

In example (1), the PP *on the towel* can be initially interpreted as a destination (or Goal) for the referring expression *the apple*, thus attaching to the verb *Put* (VP-Attachment). Alternatively, it could be interpreted as modifying the referring expression (NP-attachment). In displays where the apple is already on a towel, and the second towel and the box are each empty, the sentence is disambiguated in favor of VP-attachment at the onset of the second PP. The unambiguous version (1b) serves as a control condition.

Participants heard 16 critical sentences like those in (1), producing a 2 (visual context: 1 versus 2 referents) x 2 (sentence: ambiguous vs. unambiguous) within-subjects design. The on-screen displays contained either one referent (e.g., one apple) or two referents (e.g., two apples). In the critical instructions, the object to be moved always appeared in the top-left portion of the screen and the correct destination always appeared in the bottom-right. In the104 filler instructions, a wide variety of objects and trajectories were included to prevent routinized anticipatory movements. At the onset of each display, participants first heard "Place the cursor at the center of the cross," followed by three object-movement instructions. In the 16 critical displays, the critical instruction was first. Streaming *x,y* coordinates, sampled at ~36 Hz, were recorded during the movement of the referent to its destination.

For analysis, the beginning of each trajectory was aligned to a common starting point, and then time-normalized to 101 time-steps for averaging (Spivey et al., 2005). Averaged trajectories from the two-referent ambiguous and unambiguous sentences never significantly diverged from one another (all p's>.05). However, in the one-referent context, the averaged trajectory from the ambiguous sentences curved toward the incorrect destination, diverging significantly from the averaged trajectory from the unambiguous sentences through time-steps 21 to 83 (p's<.05).

Supplementing the semi-continuous data collected through eye-tracking (Spivey, Tanenhaus, Eberhard & Sedivy, 2002), we provide, here, continuous mouse-movements indicating further evidence for visual context influencing real-time syntactic ambiguity resolution. Additional distributional and complexity measurements provide insight into questions regarding serial versus parallel processing, the degree of interactivity accommodated by the comprehension system, and the time-course of constraint influence.

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Pronouns without antecedents: The processing cost of "Institutional *They*"

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Research in psycholinguistics has shown that, in general, a processing cost is observed where pronouns do not have antecedents (e.g., Sanford, Garrod, Lucas & Henderson, 1984). The present studies explore a phenomenon that we shall refer to as the "Institutional *They*", for example, *On the train, they served really bad coffee,* where there is no explicit antecedent, but rather in which some unspecified but constrained individual or set of individuals is referred to by a plural pronoun. Such uses typically refer in some way to agents from some sort of public institution. These cases are interesting because they are prevalent in literature and in everyday speech, and yet, on the face of it, they should pose a processing problem because pronouns do not typically occur out of the blue, but are usually coreferential with some normally explicit antecedent. In two eye-tracking experiments, we tested the proposal that the "Institutional *They*" will carry no processing cost, while the use of a singular pronoun in the same context will carry a measurable processing cost.

Experiment 1 used materials such as (1). In the initial sentence, an event was depicted, in which a situation-specific agent (singular or plural) was either introduced explicitly, or left implicit. The events described were stereotyped situations (e.g., travelling on an aeroplane) in which there was a readily inferable agent (in both singular and plural cases). The second sentence included a singular (*he/she*) or plural (*they*) pronoun. If there is no processing cost associated with "Institutional *They*", then for sentences containing *they* we predicted no difference in reading times regardless of whether or not there was an explicit antecedent for the pronoun. In contrast, for sentences containing singular pronouns we expected longer reading times for sentences with no antecedent, as previous studies have shown that *he* and *she* trigger an immediate search for an antecedent (Garrod, Freudenthal & Boyle, 1994).

First-pass, regression path, and total reading times for Region 3 (the region immediately following the pronoun) showed that for *he/she* sentences, reading times were longer when there was no explicit antecedent, but there were no reliable differences between sentences that did and did not have an explicit antecedent for sentences containing *they*. These findings were supported by the results from a second eye-tracking study in which the target sentence was standardised such that the critical region was always an adverb, and the named character (e.g., *John*) was removed from the first sentence to prevent any possibility of the bonding of an antecedentless singular pronoun to the character in the first sentence (see example sentence 2).

Differences emerged at the post-pronoun region in both experiments, suggesting that the search for an antecedent was underway immediately following a singular pronoun, but not after encountering a plural pronoun. Thus, processing of the antecedentless "Institutional *They*" appears to be relatively cost-free. We suggest that in these cases, an underspecified (type-level) agent is assumed, which is "good-enough" for the situation, but no token-level realisation is sought.

Examples

1. John was pleased with the in-flight meal he got [from the staff/stewardess].$_1$/

   In fact, [they/she] $_2$/ presented it $_3$/ courteously as well. $_4$/ He made a note to travel with this company again.$_5$/

2. The in-flight meal I got [from the staff/stewardess] was more impressive than usual.$_1$/ In fact, [they/she] $_2$/ courteously $_3$/ presented the food as well. $_4$/ I made a note to travel with this company again.$_5$/

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The role of prominence in pronoun resolution: Availability versus accessibility

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We used speed-accuracy tradeoff (SAT) modeling to ascertain what kinds of memory structures underlie cognitively prominent antecedent representations. Prominence can be due to an antecedent's representation being more *available* or more *accessible* in memory. Prominent antecedents might be retrieved with greater probability than less active representations (availability), due to strength of the antecedent representation or the quality of retrieval cues at the pronoun. It might also be retrieved more quickly than other concepts (accessibility), due to a qualitatively different form of representation, such as being actively maintained in focal attention (McElree, 2001, 2006).

We used syntactic clefting structures to increase the prominence of an antecedent (Almor, 1999; Foraker, 2004). Participants judged the acceptability of a short discourse, entering multiple judgments over the time that they read the second sentence and fully processed the passage. The first sentence clefted one of two possible noun phrase (NP) antecedents. The second contained a pronoun that was gendered (*he*/*she*) or non-gendered (*it*), coreferring with either the clefted entity or the nonclefted one. In Experiment 1 *he* coreferred with NP1 and *it* coreferred with NP2, and in Experiment 2 the antecedent positions were switched. We fitted participants' judgments in each condition to a best-fit timecourse function, which contained separate parameters indicating availability (asymptotic acceptability judgments) and accessibility (overall rate of resolution, and intercept—time point when acceptability judgments rise above chance).

In both experiments, clefting increased the availability of an antecedent representation, but not its accessibility. Clefting made an antecedent representation more distinctive in working memory, but did not contribute to active maintenance. Prominence, in the case of clefting, is not due to cognitive focus. We also found that the *he*-pronoun conditions produced greater availability than the *it*-pronoun conditions. Because this effect was found when *he* referred to either NP1 or NP2, the gendered pronouns are largely driving the increased availability of the antecedent. *He* is more likely to pick out and resonate with its antecedent than *it*, probably because of less ambiguous reference and a unique function.

In Experiment 1, *he*-pronoun conditions showed faster resolution than *it*-pronoun conditions. However, this timecourse advantage disappeared in Experiment 2, when the surface position of the antecedents was switched. We suggest that in Experiment 1 the more ambiguous *it*-pronoun produced slower resolution when it coreferred with a discourse-backgrounded antecedent, and in Experiment 2, ambiguity was tempered by foregrounding the intended referent.

Experiment 3 adapted the materials from Experiment 1 for eye-tracking to (a) confirm the validity of the clefting advantage found in SAT modeling, and (b) to investigate whether the *it*-pronoun produced ambiguity-like effects. First, we found support for the clefting advantage with SAT, as clefted conditions were read more easily, reflected in several "late" eye-tracking measures. Second, we found that *it*-pronouns produced more first-pass regressions following the pronoun, but the difficulty was short-lived. This finding is consistent with *it* being temporarily ambiguous, and that further information at the verb resolved the interpretation of the pronoun.

Examples

Coreference is indicated with italics or underlining, as appropriate.
Unacceptable continuations are indicated with #.

Experiment 1

It was *the ardent boyfriend* who contemplated the engagement ring.
What *the ardent boyfriend* contemplated was the engagement ring.

He stared. (# He sparkled.)
It sparkled. (# It stared.)

Experiment 2

It was the engagement ring that captivated *the ardent boyfriend*.
The one whom the engagement ring captivated was *the ardent boyfriend*.

It sparkled. (# It stared.)
He stared. (# He sparkled.)

Gaze alignment of interlocutors in conversational dialogues

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Eye-tracking has been a successful and valuable tool for the investigation of on-line processes of language comprehension and language production (e.g., Griffin & Bock, 2000; Tanenhaus et al., 1995). However, the application of eye-tracking to the investigation of dialogue mechanisms has so far been limited to experiments that examine eye-movements of either the speaker or the listener in isolation (e.g., Brown-Schmidt et al., 2004; Richardson & Dale, 2004). Even offline dialogue experiments investigating, e.g., priming effects, usually involve only one "real" participant while their interlocutor is a confederate of the experimenter (e.g., Haywood et al., 2003). In order to test predictions coming from dialogue models (e.g., Pickering & Garrod, 2005) and provide the kinds of evidence necessary for their further development, experimental methods that directly examine behaviour of participants actually engaged in a conversation are needed. Additionally, measures established in monologue need to be compared with their dialogue processing counterparts.

We present analyses of eye-movement data recorded from two interlocutors simultaneously, i.e., in our experiments, we recorded eye-movement patterns for dialogue partners in parallel (no confederate). In two experiments, pairs of participants were seated in front of two head-mounted eye-trackers, separated by a head-high dividing wall. Participants saw identical computer displays showing nine objects arranged in a 3 x 3 grid. In Experiment 1, we asked participants to take turns in formulating simple sentences containing three objects from the screen (Example 1). In Experiment 2, participants were asked to build their sentences such that they formed a little story. Eye-movements and speech were recorded for both participants.

As a first analysis, we compared our findings with existing measures of eye-voice span (Griffin & Bock, 2000) and voice-eye span (Tanenhaus et al., 1995). We defined an eye-eye span as the time difference between the last fixation by the speaker to a referent before the onset of the respective referring expression and the first fixation by the listener to the same referent after the respective referring expression. We computed this measure on an item-by-item basis. This span proved longer than the sum of the two monologue components would suggest. Furthermore, it was shorter at later than at earlier stages of the experiment, and dependent on the type of instruction given (shorter in Experiment 2). In order to cover larger parts of the dialogue (e.g., sentences, stories), we simply compared the proportions of listener and speaker fixations and their change. We also applied cross-recurrence quantification (cf. Richardson & Dale, 2004) to the eye-movement data.

We will present the relation of listener and speaker eye-movements and, importantly, the changes in this relation over the course of a dialogue by means of the results of the above-mentioned measures. We will also discuss their applicability to expressing the mechanisms at work in dialogue.

Bilingual spoken language comprehension: Understanding linguistic architecture within real-time processing

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Until recently, research on bilingualism has primarily focused on understanding how language-specific lexicons interact during production but far less attention has been given to the process of spoken language comprehension. Questions here move from understanding the selection of a correct lexicon to exploring the patterns of activation and inhibition in language-specific lexical items. Spivey and Marian (1999) recently found evidence that spoken word recognition is not limited to activation of the language being used. When bilinguals were presented with monolingual Russian instructions to pick up a target (*marka*-STAMP), they made increased eye movements towards a between-language phonological competitor in English (*marker*). However, while these findings suggest that bilingual lexical access is initially language-independent, it does not address how representations from the irrelevant language are eventually suppressed. One hypothesis is that a phonological representation from one language simultaneously activates lexemes in both languages but that word-forms of the irrelevant languages are inhibited prior to lemma access to prevent activation of semantic and syntactic features of the word. Alternatively, it is possible that lexeme and lemma representations of both languages are activated but that eventual word recognition occurs through a process of competitive input matching rather than through any direct inhibition. (N.B. Spivey and Marian (1999) measured phonological activation via eye-movements to a word's referent. While this is consistent with lemma activation, it is possible that lexemes may have been associated with the referents by the subjects' spontaneous mental labeling of the visible objects).

Previous work exploring lexical access within monolinguals provides a framework for understanding this process in bilinguals. Yee and Sedivy (2001) found evidence of lexeme-to-lemma activation from within-language phonological associates. Participants were instructed to select a target (*logs)* but made increased looks to a competitor (*key)* that was semantically related to an absent phonological associate (*lock)*. The current study modifies this task to explore whether phonological representations from both languages proceed to semantic activation. French-English bilinguals were instructed to select an English target (*sheep*) when presented with a display that contained a competitor (*leash*). This item was semantically related to a phonological associate in the irrelevant language (*chien*-DOG). If between-language phonological activation (*sheep* to *chien*) activates semantic representations, then subjects should make increased looks to *leash*. Alternatively, if irrelevant language lexemes are inhibited after phonological activation, then we would expect no increase in eye-movements to the between-language semantic competitor.

Experiment 1 replicated within-language priming in monolingual English speakers ($p < .05$). This semantic activation was time-locked to the period of phonological ambiguity (***LO***—*g*). In Experiment 2, we found a similar trend between languages ($p=.10$). Bilinguals looked more at between-language semantic competitors than unrelated control items. However, between-language semantic activation appeared shortly after the period of phonological ambiguity (*shee*—***P***). These results provide preliminary evidence that, even in a monolingual environment, lexemes and lemmas are activated in both languages. Our findings suggest that an irrelevant language is not actively inhibited during bilingual spoken-language comprehension and strongly favor a unitary model of lexical competition that incorporates candidates from both languages.

(In)dependence of lexical and syntactic production: *that*-reduction and omission in spontaneous speech

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Extending current models of lexical production and syntactic production to natural speech demands a nuanced understanding of their architectural similarities and differences. Consider phonetic reduction [1] and syntactic omission [2, 3] of the word *that* in spontaneous speech. Both are sensitive to probabilistic information: *that* in a relative clause (1) is both more reduced [1] and more likely to be omitted [5] when predictable. Furthermore, both reduction and omission are less likely in disfluent contexts. Such strong similarities between lexical and syntactic production are striking. To test the (in)dependence of these two, we conducted the first integrated study investigating reduction and omission on the same data set, while simultaneously controlling phonetic and syntactic factors.

(1) The only crime [(*that*) we really see] is, uh, just the kids being malicious.

We extracted 3,465 relative clauses (RCs) from the Switchboard conversation corpus, of which 1,454 (42%) contained *that*. For each RC, we annotated the factors known to influence *that*-omission (e.g., RC length) or *that*-reduction (e.g., speech rate, phonological environment of *that*). Including these factors and random subject effects, we ran regression models testing the effects of predictability and disfluency on both *that*-reduction and *that*-omission.

CONTROL FACTORS mirror earlier studies (all p's<.03): e.g., *that*s of older speakers are longer, as are *that*s of women; *that*s of long/complex RCs are omitted less often. Phonological control factors affecting reduction did not affect omission.

DISFLUENCIES affect *that* omission and reduction in similar but crucially different ways. On the one hand, *that* is both longer and omitted less often if it is immediately preceded or followed by a disfluency (filled pause, silence, or speech interruption). However, while the effect on *that*-reduction is limited to immediately surrounding disfluencies, *that*-omission is also affected by disfluencies later in the RC. T his supports accounts associating *that*-omission with processing complexity [3, 4, 6] and is consistent with the claim that *that*-omission is syntactic [2, 3]. Corroborating these conclusions, we find that omission but not reduction is less likely if the RC is long and if the RC subject has low accessibility. Generally, these results suggest that omission is affected by properties of the wider (syntactic) context, whereas reduction is mostly affected by local factors.

PREDICTABILITY also affects both reduction and omission, but again in different ways. High conditional probability of an RC given its first word (*we* above) significantly reduces the relativizer (p<.005). Consistent with [1], the conditional probability of an RC given the preceding word (*crime* above) has no significant effect on *that*-reduction. The opposite pattern is observed for *that*-omission. The more predictable an RC is given the preceding word, the more likely is *that*-omission (p<.0001). No effect of predictability given the first word in the RC was detected for omission.

In conclusion, the results suggest that both word production and syntactic production are affected by predictability and disfluencies. Phonetic reduction is more influenced by local constraints, while syntactic omission has longer distance constraints. This suggests that reduction and omission, while subject to similar processing mechanisms, are phenomena at different levels of linguistic representation.

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The effect of referential processing on the use of verb information during sentence processing

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The research revisited prior results reported by Clifton, Kennison and Albrecht (1997) that showed no role for verb information in the resolution of a following pronoun. The results were surprising given the number of prior studies demonstrating effects of verb type on sentence processing (See MacDonald, Pearlmutter & Seidenberg, 1994). In Clifton et al.'s (1997) experiment, reading time was measured on sentences containing either verbs used most frequently with human direct objects or verbs used most frequently with inanimate direct objects (e.g., convinced and needed, respectively). Verbs were followed by the ambiguous pronoun her, e.g., *I saw her* (NP) vs. *I saw her purse* (specifier), or the unambiguous pronouns *him* or *his*. In the experiment, sentences did not contain an antecedent for the pronoun. Clifton et al. (1997) suggested that the failure to observe an effect of verb type on reading time may have been due to the types of verbs being compared. Prior research typically compared verbs differing in the usage frequency of different syntactic frames. The verbs tested by Clifton et al. (1997) differed in the usage frequency of different semantic types of the same syntactic frame.

In the present research, a series of experiments supported an alternative account. The results demonstrated that the extent to which verb type influenced reading time on a following pronoun (and subsequent sentence regions) was determined by the referential context, specifically whether the pronoun was successfully resolved as co-referent with an antecedent. In Experiment 1, reading time was measured on conditions tested by Clifton et al. (1997); however, in all sentences, pronouns were preceded by a salient antecedent. The results indicated that the type of verb type in the sentence significantly influenced reading time on the pronoun and following regions. The results also revealed processing differences for conditions containing the ambiguous pronoun *her* and the unambiguous pronouns *him* and *his*, a difference that was not observed by Clifton et al. (1997). In Experiments 2 and 3, reading time was compared on sentences containing specifier pronouns (Experiment 2) or NP pronouns (Experiment 3) preceded by one of the two verb types. In both experiments, the availability of an antecedent was also varied. The results of both Experiments 2 and 3 showed that the referential context influenced the extent to which verb type influenced processing and the extent to which there were processing differences on pronoun *her* versus *him* and *his*.

These results suggest that when coreference cannot be achieved during comprehension interpretative processing on a pronoun may be more shallow, involving to a lesser degree the lexical information associated with a preceding verb, than when coreference can be achieved. In recent research, Ferreira (2003) has argued that readers may engage in "good enough" or shallow processing during comprehension. The present research demonstrates at least one factor, specifically referential processing, that can influence when readers carry out shallow interpretative processing.

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Are object relatives really so hard? Children process syntax with multiple constraints

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English-speaking children hear more object-extracted relative clauses (RCs) than subject-extracted RCs in their input (Diessel, 2004), yet empirical studies show that they find object-extracted RCs more difficult to process. In this paper we present the results of two corpora and two empirical studies conducted in two languages (English and German). The results show that object RCs are not harder than subject RCs when experimental sentences closely match patterns found in the input.

In the corpora studies we investigated whether two constraints found to affect adults' parsing of object relatives: (i) animacy of the head noun (animate-inanimate), and (ii) the discourse status of the subject of the RC (old/pronoun-new/lexical NP), are also disproportionately attested in children's speech and in their input. Following results reported in the adult literature (e.g., Mak, Vonk & Schriefers, 2002; Warren & Gibson, 2002), children in both languages used and heard more object relatives containing (a) more inanimate head nouns, and (b) more subject NPs within the RC where the NP encoded discourse old information.

We then conducted two experimental studies, one in English and one in German. Ninety-seven 3- and 4-year-old children participated in a sentence repetition task. They were required to repeat object RCs manipulated for (i) animacy of the head NP (animate versus inanimate), and (ii) discourse status of the subject within the RC (pronoun versus lexical NP). Children were also tested on subject relatives and less complex fillers. All test sentences were matched for length. The dependent variable was the proportion of correct repetitions. The results for the object RCs showed that the children processed these sentences in accordance with the constraints identified in the adult literature and in our corpora studies: for both languages there were main effects of animacy of the head noun and discourse status of the subject NP within the RC, and an interaction between these two variables. These results reflected the fact that children produced more exact repetitions when object RCs contained an inanimate head and/or a discourse-old subject NP (i.e., a pronoun) within the RC. Performance in both languages was best when both of these conditions were met. Children's performance on object RCs was then compared to their performance on subject RCs. For the English-speaking children there was no difference between their performance on subject RCs and object RCs when the object RCs contained discourse old information in the subject slot of the RC (animacy was collapsed for this analysis). The German-speaking children performed better on the object RCs that contained discourse old information in the subject slot of the RC than on subject RCs. We argue that this cross-linguistic difference reflects word order differences in the two languages.

Overall, the results suggest that object RCs are not always more difficult than subject RCs. The children were sensitive to the same constraints as adults, and the results held across two languages. This identifies a degree of continuity between the adult and child parser, supporting a multiple constraints approach to processing in development.

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Priming vs. contingency learning accounts of structural priming effects in comprehension

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Structural priming has been observed in both production (e.g., Bock et al., 1990) and comprehension (e.g., Branigan et al., 2005). In comprehension, structural priming is often demonstrated by reductions in the amount of garden pathing elicited by a structural ambiguity (e.g., Traxler et al., 2005). A striking difference between production and comprehension structural priming is that only in comprehension is verb repetition across primes and targets necessary. We present two moving-window, self-paced reading studies that extend apparent structural priming in comprehension to the Direct Object (DO)/Sentential Complement (SC) ambiguity and explore why verb repetition is required for priming in comprehension, specifically whether they serve as contingent cues that signal a particular structure.

In both experiments, readers saw the same experimental items, consisting of either a DO (1a) or SC (1b) prime sentence followed by either an ambiguous SC (1c) or unambiguous SC (1d) target. Main verbs were repeated across prime-target pairs and were always strongly biased toward a DO completion. In Experiment 1, there was no verb repetition in filler sentences. In Experiment 2, some contiguous filler sentences shared verbs but did not otherwise overlap structurally (e.g., 2). If the processing of SC primes facilitates the processing of ambiguous SC targets, faster reading in ambiguous target disambiguating regions (e.g., *would get*) would be predicted relative to when they follow DO primes. Additionally, the filler manipulation in Experiment 2 should not change this pattern. However, if verb repetition between primes and targets leads to the learning of a contingency — namely, that a target sentence with a repeated verb will always be an SC, then we should predict reductions in garden pathing following both SC and DO primes in Experiment 1 and no reductions in garden pathing in Experiment 2. This is because the shared verb fillers disrupt the learning of this contingency.

Experiments 1 and 2 confirmed the contingency learning hypothesis. As Table 1 shows, while overall there was a main effect of prime type in Experiment 1, this effect disappeared in the second half of the experiment because reading times for ambiguous targets following DO primes got faster. Garden path reductions were not observed in either first or second halves of Experiment 2 for ambiguous targets. Crucially, structural priming interacted with experiment.

We observed apparent structural priming using the DO/SC ambiguity in Experiment 1. However, contingency learning seems to provide a better overall account of results across experiments. Specifically, even though "structural priming" was observed in the first half of Experiment 1, this garden path reduction effect was observed for BOTH SC and DO prime conditions in the second half of Experiment 1. In short, across experiments readers were sensitive to the probability that a repeated verb signals an SC in a target sentence with a repeated verb. We will discuss the generalizability of a contingency learning account for structural priming effects in comprehension and whether our results can be accommodated by current lemma activation (Pickering et al., 1998) and implicit procedural learning (Bock & Griffin, 2000) accounts of structural priming.

Examples

(1) a The family doctor | warned | the patient | about the dangers | of smoking.

b. The family doctor | warned | the patient | would need | an urgent surgical operation.

c. The security staff | warned | the spectators | would get | really rowdy.

d The security staff | warned | that | the spectators | would get | really rowdy.

(2) a. The businessman ***woke up*** late because he did not set his alarm before he went to bed.

b. The bugle's call ***woke up*** the soldiers at six o'clock in the morning.

Table 1. Disambiguating region reading times (ms) for ambiguous and unambiguous targets following SC and DO primes in 1st and 2nd halves of Experiments 1 and 2.

	Experiment 1				Experiment 2			
	1st Half		2nd Half		1st Half		2nd Half	
	DO	SC	DO	SC	DO	SC	DO	SC
Ambiguous Target	696	623	565	557	595	587	565	549
Unambiguous Target	586	570	519	495	535	530	513	529

Effects of "blank screen" and disappearing events on the greater relative importance of depicted events

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A recent visual-worlds study of German OVS sentences compared the use of stored knowledge and depicted events for the anticipation of agents, providing evidence that depicted events have a greater importance for incremental comprehension than stereotypical knowledge. Following the sentence-initial patient noun phrase, the verb ('spies-on') singled out two different agents in the scene: one qualified as the likely agent purely by verb-based stereotypical knowledge (e.g., a detective affords spying, 1a), the other one through a depicted but non-stereotypical action (e.g., wizard-spying, 1b). For (1a/b) attention in the scene after hearing the verb and prior to the second noun phrase revealed that people anticipate the agent of a depicted, non-stereotypical event more than an agent identified as relevant by stereotypical knowledge. Conditions (2a/b) confirmed that both stereotypical knowledge and depicted events were used effectively when the verb made only one of these available for anticipation.

One issue regarding the interpretation of these results is whether the co-presence of the depicted events during comprehension is essential. Alternatively, the priority of depicted events may depend on their discourse availability: It has been shown, for example, that an event that is ongoing in a discourse context is more accessible than a completed event (Zwaan et al., 2000). Two eye-tracking experiments addressed this issue by varying the presentation of scene information.

Experiment 1 relied on the same materials as the original study, but changed scene presentation. Instead of concurrent scene-utterance presentation, the scene disappeared after a viewing time of 7000 ms, and before utterance onset. Gaze in the "blank screen" (Altmann, 2004) was then monitored during utterance presentation. There was no additional task. Analyses of 32 participants replicated the time-course and gaze patterns of prior studies. For (1a/b), people anticipated the agent of a depicted, non-stereotypical event (wizard-spying) more often than an agent identified as likely by stereotypical knowledge. Conditions (2a/b) replicated that each of these two informational sources is successfully used independently. This suggests that visual co-presence of the scene/event is not a necessary condition for the priority of depicted events.

While the blank-screen presentation varied the visual presence of depicted events, Experiment 2 varied their situational availability by emulating through scene presentation that the depicted events had been completed: We briefly depicted the actions, then removed them, and showed only the characters (and their stereotypical affordances) during utterance presentation. Analyses based on 32 participants revealed that while both depicted action and stereotypical information were still effectively used when they uniquely identified a relevant agent (2a/b), there was no preference for either depicted events or stereotypical thematic role knowledge when the verb ambiguously identified two relevant agents (1a/b) (p's > 0.14).

These findings suggest that visual co-presence of depicted events is not in itself necessary to explain the greater relative importance of depicted events. Rather, these findings are compatible with studies showing the greater accessibility of ongoing versus completed events in a prior discourse context.

Examples

(1) a. Den Piloten bespitzelt gleich der Detektiv.
The pilot (PATIENT) *spies-on soon the detective* (AGENT).
'The detective will soon spy on the pilot.'

(1) b. Den Piloten bespitzelt gleich der Zauberer.
The pilot (PATIENT) *spies-on soon the wizard* (AGENT).
'The wizard will soon spy on the pilot.'

(2) a. Den Piloten verzaubert gleich der Zauberer.
The pilot (PATIENT) *jinxes soon the wizard* (AGENT).
'The wizard will soon jinx the pilot.'

(2) b. Den Piloten verköstigt gleich der Detektiv.
The pilot (PATIENT) *serves-food-to soon the detective* (AGENT).
'The detective will soon serve food to the pilot.'

Scene: wizard-spying → pilot ← detective-serving-food

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Where is the action? An eyetracking study investigating the description of photorealistic events

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In two eyetracking experiments, we examine first fixations as indicators of allocation of attention and cognitive processing before speech onset and find differences in fixation patterns for the linguistic tasks of naming and of sentence production.

Recent eyetracking studies of scene description have found an initial fast scene apprehension phase, which is followed by a slower formulation phase in which fixating an object precedes naming it (e.g., Bock et al., 2003). The apprehension phase presumably serves to extract the gist of the scene, and has been linked to the formulation of the verb in sentence production (Griffin & Bock, 2000; Repp & Sommer, 2003; Dobel, Meyer & Levelt, in prep.).

Experiment 1 therefore served to determine the relevant parts of a scene for the isolated task of producing a verb, as opposed to a proper name. Our stimulus material was as naturalistic as possible: it consisted of video stills recorded in natural surroundings, in which four actors performed actions which in German would be described using intransitive, transitive and ditransitive verbs. Participants were asked to name either the agent depicted in an action scene, or the action being performed. Actions consistently took longer to name than agents, and speech onset latencies depended on the complexity of the verb. Viewing patterns prior to speech onset differed clearly for the two tasks, right from the very first fixation into the scene: when producing an agent's name, participants focussed almost exclusively on the agent's head; when producing a verb, their fixations concentrated on an area which we call the *action region*. This verb-specific region comprises those parts of the agent's body most relevant to the action. We also found it to include the manipulated object in the transitive and ditransitive conditions.

The possibility of using fixations in clearly delineated regions of a scene as indicators of syntactic encoding allowed us to examine the importance of determining the verb and its argument structure for initiating the process of sentence formulation. Experiment 2 used the same stimulus material, but participants were asked to describe the scene using a complete SVO-sentence (e.g., *Thomas is serving Tanya some coffee*). Fixation patterns showed no evidence for initial processing of verb-related information: fixations concentrated on the agent's head, as in the naming agents condition of Experiment 1. We take this to show that participants begin formulating the first sentence component (the agent's name) as soon as they see the image, before attending to the content and argument structure of the verb.

This could be due to the fact that agents in action scenes are generally recognised extremely quickly (Dobel, Gumnior, Bölte, & Zwitserlood, submitted), and may almost automatically be selected as the starting point of a descriptive sentence and/or in the subject role (Segalowitz, 1982). One important difference between our study and those which find initial verb-related fixations is our naturalistic stimulus material, which may actually be processed more efficiently by the visual system than traditional line drawings (Braun, 2003; Henderson & Ferreira, 2004).

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Last resort gap strategy in processing long-distance dependencies

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In languages with postnominal relative clauses, such as English, the filler always precedes its associated gap (1). Therefore, this displaced argument, along with relative pronoun, strongly signals the presence of a relative clause and the parser actively predicts a possible gap position (Frazier and Clifton, 1989).

In SOV languages with prenominal relative clauses (RCs), gaps precede fillers (3). If the language also allows null arguments, as in Korean, there is a temporary structural ambiguity between *pro*-drop and relative clauses. The absence of an argument in an RC may temporarily be processed as *pro* rather than trace until the parser reaches the disambiguating head noun position. For example, even when the embedded predicate is marked with a relativization marker, the sentence structure (2) is ambiguous between relative (3) and *pro*-drop clauses (4).

Therefore, unlike English-type languages with an active filler strategy, in languages like Korean a preceding gap does not necessarily predict a filler. To explore how this factor affects the processing of the long-distance filler-gap dependency in a relative clause, two reading time studies were conducted.

Experiment 1 compares adjunct clauses with subject/object *pro*, and RCs with subject/object trace (5) (4 conditions, N=19 per condition, 23 subjects). The results show a processing advantage of subject gaps over object gaps, in both the *pro* and trace conditions. They also show a difference in the time course of processing *pro* vs. trace. In the *pro* condition, the subject/object processing asymmetry emerges at the embedded verb position and continues at the coindexed matrix subject position. In contrast, in the trace condition, the subject/object processing asymmetry is not observed until the head noun position.

We argue that the different time course of processing *pro* vs. trace is due to temporary structural ambiguity. For the *pro* condition, disambiguation occurs at the embedded predicate marked with an adjunct suffix. For the trace condition, disambiguation occurs at the head noun. Based on the results, we propose a last resort gap strategy: Avoid postulating a gap unless the sentence is otherwise ungrammatical, or until the point of structural disambiguation has been reached.

Experiment 2 further tests the last resort gap strategy by comparing sentential complement clauses without fillers and relative clauses with fillers associated with preceding gaps (6) (2 conditions, N=40 per condition, 35 subjects). The results show a processing advantage of sentential complement clauses over relative clauses at the head noun/fact NP position and the sentence-final main verb. This implies that the parser avoids postulating filler-gap dependencies in filling the argument structure slots of a predicate.

Presumably the parser avoids relating discontinuous syntactic positions in the interest of minimizing working memory costs. Aside from relative and adjunct clauses containing a coindexed gap, Korean also has gap-filler dependencies in control constructions. However, Korean also has filler-gap dependencies in wh-questions. We argue that filler-gap dependencies require a first resort gap strategy, as in English, and conclude by comparing these first and last resort strategies.

Examples

(1) The reporter$_i$ who$_i$ ___$_j$ attacked the senator admitted the error.

(2) ____ Tom-Acc meet-REL.... '(Someone) meet Tom...'
(3) [t$_i$ Tom-Acc meet- REL] teacher$_j$-Nom... 'The teacher who met Tom...'
(4) [*pro* Tom-acc meet- REL] fact-Nom... 'The fact that (someone) met Tom...'

(5) i. [__$_j$ senator-ACC attack-REL] the reporter$_i$ admitted the error. SR
ii. [senator-NOM __$_j$ attack-REL] the reporter$_i$ admitted the error. OR
iii. [*pro*$_i$ the senator-ACC attacked-because] the reporter$_i$ admitted the error. Subject *pro*
'Because (he) had attacked the senator, the reporter admitted the error.'
iv. the senator-NOM *pro*$_i$ attacked-because] the reporter$_i$ admitted the error. Object *pro*
'Because the senator attacked (him), the reporter admitted the error.'

(6) i. [__$_j$ senator-ACC attack-REL] the salam$_i$ -NOM$_i$ became known. SR (with filler)
'The person who attacked the senator became known.'
ii. [__$_j$ senator-ACC attack-REL] the fact-NOM$_i$ became known. Fact-NP (without filler)
'The fact that (somebody) attacked the senator became known.'

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One and one makes singular agreement

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Several lines of research on subject-verb agreement suggest that the notional number of a subject noun phrase influences verb agreement. Variations in agreement with conjoined subjects are often called upon in support of this notional hypothesis, although little is known about the agreement properties of conjunctions (e.g., "cats and dogs", "Dick and Jane"). Normally, conjunctions are argued to require plural verbs, and a corpus search based on 3410 English sentences from the World Wide Web (hand-coded to screen for non-native and non-standard influences) confirmed that plural agreement is the typical pattern. However, singular agreement did occur (in 23% of the conjunctions) and was most prevalent when both conjoined nouns were singular (81% of all singulars produced). Singular agreement was most likely with deverbal mass conjuncts, less likely with simple mass conjuncts, and least likely with singular count conjuncts (see Table 1). One interpretation of this pattern is that conjunctions of mass and deverbal nouns, having less enumerable referents than regular count conjuncts, increase the likelihood of singular agreement. This would be consistent with the notional hypothesis.

We evaluated the notional account experimentally, in competition with a grammatical account, using preverbal conjoined subjects in English. The experiment used a fragment completion task in which participants heard, repeated, and completed a conjoined subject noun phrase as a full sentence, requiring the production of a verb. The conjoined nouns were always singular and of the same type, including simple mass (e.g., "the tea and coffee"), simple count (e.g., "the name and address"), deverbal mass (e.g., "the singing and dancing") and deverbal count nouns (e.g., "the operation and recovery"). The notional expectation was that the simple mass conjuncts, which tend to refer to non-individuated (and hence, non-enumerated) entities (Middleton et al., 2004) would elicit more singular verbs than simple count conjuncts, whose referents are typically distinct individuals; conjunctions with even less enumerable referents (the referents of the deverbal nouns) should elicit correspondingly more singular agreement. The alternative, grammatical hypothesis was that mass nouns bear singular specifications that interfere with their pluralization and promote singular number on agreement targets (Levelt, 1989). This predicts no differences between simple mass and deverbal mass nouns in the elicitation of singular agreement with their conjunctions. The first finding was that mass conjuncts elicited fewer plural verbs than the simple count conjuncts, consistent with both the notional and grammatical hypotheses. However, the deverbal conjuncts led to significantly fewer plural verbs than the simple count and mass conjuncts, in contradiction to the grammatical singular-specification hypothesis. Instead, the results suggest that agreement with conjunctions shows more graded sensitivity to the number properties of the conjunctions' referents. Overall, the results support the existence of a notional contribution to subject-verb number agreement in English.

Table 1. Examples and percentages of singular agreement with singular conjuncts from the World Wide Web

Conjunct Type	Example	Average Singular Agreement
Count	The *month* and *day* that a health benefits plan first goes into effect becomes its anniversary date… (www.cigna.com)	17%
Mass	Any *principal* and *interest* on the notes is payable, at CMGI's option… (www.news.moneycentral.msn.com)	33%
Deverbal	*Selecting* and *double-clicking* on the entry within the alarm log launches… (www.cisco.com)	66%

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The role of animacy in Japanese relative clause production

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In language production, the preference to locate animate nouns in early clause positions, with resulting active vs. passive sentence structure, has been attributed to animacy promotion mechanism: That the inherent conceptual salience of animates increases their accessibility during planning (Bock and Warren, 1985). This mechanism is not, however, straightforwardly applicable in relative clauses (RCs), where the position of the head noun (e.g., *girl, ball* in Examples 1–2) is initially fixed independent of the active vs. passive structure of the RC.

In a previous RC production study (Gennari, Mirković & MacDonald, 2005), participants viewed pictures depicting actions with an inanimate theme (e.g., a boy kicking a ball) or an animate patient (a boy kicking a girl) and produced active object relative or passive relative clauses in response to questions about the pictures (*What's orange?, Who is wearing blue?*). English-, Spanish- and Serbian-speaking participants all produced more passive Object RCs (ORCs) for animate themes than inanimate themes. Gennari et al. hypothesized that competition or interference between two conceptually similar entities (e.g., the boy and girl in the picture of a boy kicking a girl) during production planning leads to passive choices, which in English include demoting or dropping of relative clause nouns. This demotion tends to yield more passive structures with animate heads like (2), including agent-dropped passives in which the agent noun is phonologically nullified.

Japanese provides an interesting test of the noun interference hypothesis, because active and passive ORCs differ only in case marking and do not differ in word order (see Examples 3–4). If animacy affects syntactic structure solely through word order, then animacy manipulations should have a different effect in Japanese, where word order does not vary, than in languages where actives and passives vary in word order.

We used Gennari et al.'s method to test Japanese participants' ORC production in picture description tasks. In Experiment 1, conducted in Japan, participants (N=7) provided written answers to questions about the pictures. Responses were coded as Active Relatives, Passive Relatives or Other. The rate of Other responses did not differ across levels of animacy. As in Gennari et al., participants produced more passive relatives when RC head was animate than when it was inanimate, $F(1, 6) = 16.62$, $p<.007$. In Experiment 2, native Japanese speakers living in the US (N = 6, to date) provided spoken responses. Again there was a large effect of head animacy on rate of passive RC production, $F(1, 5) = 16.76$, $p=.009$, but not on the rate of Other responses.

These results are incompatible with the previous account, and suggest that active/passive choices are not (or not solely) driven by word ordering mechanisms. We will discuss alternative accounts, including the role of conceptual factors in structure choice.

Examples

	Animate-Head RCs	Inanimate-Head RCs
(1)		The ball (that) the boy is kicking
(2)	The girl (who is) being kicked by the boy	The ball (that is) being kicked by the boy
(3)	Otokonoko-ga ke-tte-iru oNnanoko boy-NOM kick-Pres-Prog girl 'girl boy is kicking'	Otokonoko-ga ke-tte-iru boru boy-NOM kick-Pres-Prog ball 'ball boy is kicking'
(4)	Otokonoko-ni ker-are-te-iru oNnanoko boy-by kick-Pass-Pres-Prog girl 'girl being kicked by boy'	Otokonoko-ni ker-are-te-iru boru boy-by kick-Pass-Pres-Prog ball 'ball being kicked by boy'

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Structural priming within a foreign language

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Production studies in monolingual speakers (e.g., Bock & Loebell, 1990) and also in bilingual speakers (e.g., Hartsuiker et al., 2004) report the phenomenon of structural priming, demonstrating that abstract syntactic structures influence speakers' subsequent production. In contrast, the nature of the structures learned as a foreign language by monolinguals has not been fully investigated. We present a study that demonstrates structural priming within structures that exist only in one's foreign language, and discuss its implications for the nature of foreign structures.

We tested structural priming in English dative sentences with Japanese learners of English. Participants were all Japanese college students who had lived in Japan most of their lives and learned English as a foreign language in Japanese junior high schools and high schools. Such participants were chosen because English is structurally different from its Japanese counterpart due to the difference in word-order and head direction. The syntactic structures of English dative sentences do not exist in Japanese.

(1) English dative structures

a. Prepositional Object sentence (PO)
[$_S$ The saleslady [$_{VP}$ [$_V$ gave] [$_{NP}$ the receipt] [$_{PP}$ to the customer]]].

b. Double Object sentence (DO)
[$_S$ The saleslady [$_{VP}$ [$_V$ gave] [$_{NP}$ the customer] [$_{NP}$ the receipt]]].

(2) Japanese dative structure in canonical order

[$_S$ Tenin-wa [$_{VP}$ [$_{NP}$kyaku-ni] [$_{NP}$ryoosyuusyo-o] [$_V$ ageta]]].
saleslady-TOP customer-DAT receipt-ACC gave

The questionnaire was created following the paradigm of Pickering and Branigan (1998). In the questionnaire, participants were asked to complete English sentence fragments as they saw fit. The prime fragments were either a Prepositional Object (PO) structure or a Double Object (DO) structure, which continued up to the NP after the past tense ditransitive verb. The role of the NP (THEME or GOAL) controlled the participants' completion as a PO or DO structure. The target continued up to the ditransitive verb, leaving flexibility of the completion within the VP. Half of the thirty-two prime-target pairs had the same verb in the prime and target fragments, and half had different verbs in the prime and target. How often the participants completed the target sentence in the same structure as the prime was measured.

Three-way ANOVA showed that there was a significant interaction between the prime completion type and the target completion type ($F_1(1,62)=5.13$, $p<.05$, $F_2(1,35)=27.9$, $p<.01$). Means contrasts showed that subjects produced more PO completions following PO primes (both *p's*<.05). Subjects also produced more DO completions following DO primes, but the subject analysis did not reach significance ($F_1(1,62)=1.41$, $p>.20$, $F_2(1,35)=13.9$, $p<.01$). Two-way ANOVA for the two levels of verb sameness revealed that when the verb is the same, subjects completed the fragments more often as PO structures following PO primes, and more often as DO structures following DO primes ($p<.02$). However no priming was observed if the verb in the prime was different from the target ($p>.05$). The results suggest that Japanese learners of English store English structures in a lexically-based manner, rather than as abstract syntactic forms.

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The influence of thematic role assignment on structural priming

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Structural priming studies demonstrate that prior exposure to a particular sentence structure leads speakers to reproduce the same structure in subsequent utterances. Early research suggested that this phenomenon is insensitive to variations in the thematic roles within the message. However, more recent work has shown that the mapping of thematic roles to functional positions can be primed when the structural configuration of the formulation alternatives is the same (Chang, Bock & Goldberg, 2003). The locus of the thematic mapping effect was attributed to early, pre-lexical, processing stages. The present study has two goals. First, it addresses whether thematic role assignment can influence structural priming when the formulation alternatives are structurally distinct. Second, it addresses whether the influence of thematic role mapping involves a lexical component.

The present study concentrated on the active/passive alternation in English (Experiment 1) and Dutch (Experiment 2). Both English and Dutch have active and passive alternates; Dutch additionally has flexible word order allowing structural alternatives not found in English. Primes in Experiment 1 consisted of two types of intransitive sentences, unaccusatives (see (1)), and unergatives (see 2); all prime sentences had animate subjects. Primes in Experiment 2 consisted of single unaccusative and unergative verbs rather than full sentences. In both experiments, participants read the primes aloud. After reading the primes aloud, speakers saw target pictures of two-participant events. Half of the target pictures had animate patients and half inanimate patients. Thus, speakers could not use the structure of the prime sentence or the subcategorization frame of the prime verb for their target descriptions. The dependent measures were the thematic and syntactic structure of the target descriptions.

Both unaccusative and passive verbs map the patient role to the subject position while unergative and active transitive verbs map the agent role to the subject position (Levin & Rappaport Hovav, 1995). If unaccusative primes influence speakers to produce more passive or patient-first picture descriptions than unergative primes, then this effect can be taken as evidence for an extended influence of thematic role mapping in structural priming. Furthermore, if the effect is observed for single verb primes as well as sentence primes, lexical involvement in the priming process will also be implicated.

When sentence primes were presented, English speakers produced more passive picture descriptions following unaccusative sentences than following unergative sentences. When single verbs were presented, Dutch speakers produced significantly more patient-first sentences (passives and OVS structures) following unaccusative verbs than following unergative verbs.

Most speech production theories do not include movement as a theoretical assumption (e.g., Bock & Levelt, 1994). Thus, an alternative explanation that hinges on the syntactic differences between unaccusative and unergative sentences seems unlikely. The current results therefore provide further evidence that thematic mapping can play a role in structural priming, even when the syntactic structures of the formulation alternatives differ. Additionally, as the primes in Experiment 2 consisted of single verbs, not sentences with instantiated mappings, the results speak for the involvement of lexical semantics rather than (or in addition to) general event semantics.

Example

(1) The ship's crew drowned.

(2) The young couple eloped.

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Do speakers repeat syntactic structures for their addressees?

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Syntactic priming is the well-known tendency for speakers to produce syntactic structures they have just processed. For example, hearing *prepositional dative* structures ("The waitress gives a cup to the clown") elicits subsequent productions that are also prepositional datives ("The ballerina offers an apple to the doctor"), whereas hearing *double-object* structures ("The waitress gives the clown a cup") instead elicits subsequent productions that are also double objects ("The ballerina offers the doctor an apple"; Bock, 1986; Branigan et al., 2000). Syntactic priming might be *implicit learning* within speakers (Chang et al., 2005), whereby processing the prime strengthens the prime's syntactic representation, subsequently eliciting such structures again. Or, syntactic priming might be *alignment* between interlocutors (Pickering & Garrod, 2004), whereby speakers use structures their interlocutors previously used to promote successful communication between them. If the alignment mechanism operates by constructing a *model of the listener* (e.g., Clark, 1996), then speakers might be sensitive specifically to whether their addressees processed prime structures; when addressees have not processed primes, priming should be diminished, because addressees will derive no communicative benefit from repetition of the structure. We term this *addressee-driven* priming. A more egocentric account, in contrast, predicts that priming effects should be independent of whether speakers' addressees processed primes, but should be observed whenever speakers process primes. We term this *speaker-driven* priming.

These predictions were tested in a modified confederate-priming task (Branigan et al., 2000). In each session, two subjects, a confederate, and an experimenter described pictures to each other to be picked out. Subjects were primed by descriptions from the confederate or experimenter, and produced targets back to the confederate or experimenter. Participants described pictures by writing notes to each other, so that no one overheard descriptions not intended for them. One subject in each session participated in a dialogue; she or he got priming descriptions from the confederate, then provided target descriptions back to that same confederate. The other subject participated in two monologues; she or he got priming descriptions from the confederate, and then provided target descriptions to the experimenter. With this design, monologue subjects produced targets for addressees who never processed the corresponding primes. Therefore, to the extent that priming is addressee driven, monologue subjects should exhibit less priming than dialogue subjects.

Dialogue subjects exhibited a significant 31% priming effect, producing 75% prepositional dative targets after prepositional dative primes versus 44% after double-object primes. Monologue subjects exhibited a similar significant priming effect of 41%, producing 75% prepositional datives targets after prepositional dative primes versus 34% after double-object primes. Thus, monologue subjects did not show any less priming than dialogue subjects. This supports a speaker-driven account of syntactic priming, such as the implicit-learning account or a version of the alignment account that does not require keeping track of the processing experiences of the listener.

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Measuring referential processes in sentences and discourse

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The *repeated name penalty* (RNP) is the slower reading of repeated references in comparison to pronouns when the antecedent is salient than when it is not. This effect was originally demonstrated in multiple sentence discourses (Gordon et al., 1993) but was later reported to also occur within sentences (Gordon, et al., 1999). Although this effect has only been demonstrated behaviorally using measures based on reading times of whole sentences and sentence fragments, a recent ERP study of intra-sentential reference by Swaab et al. (2004) attributed an increase in N400 to a coreferentially repeated name when the antecedent was focused in a task involving rapid presentation of single words to the RNP. This is surprising because all existing explanations of the RNP attribute this effect to a relatively late integrative stage in discourse processing and not to the lexical processes that are known to affect the N400. However, because the RNP has not been previously demonstrated in paradigms involving the presentation of single words, it is not clear whether the increase in N400 Swaab et al. found truly reflects an RNP. To address this concern we conducted a series of two experiments in which we examined the effect of antecedent salience on reference processing within and across sentences using a word by word self paced reading paradigm.

Experiments 1 and 2 used the items from Swaab et al. (2004) but also added a discourse condition that involved cross-sentence relations. These items used conjunction to manipulate antecedent salience (Gordon et al., 1999). Experiment 1 (N = 51) investigated the effect of salience on the processing of repeated names and Experiment 2 (N = 53) investigated the effect of salience on the processing of pronouns. A sample item in all four conditions is:

(1) Sentence — Salient Antecedent:
"Louis went to see a movie after Louis/he finished taking final exams."

(2) Sentence — Non Salient Antecedent:
"Louis and Grace went to see a movie after Louis/he finished taking final exams"

(3) Discourse — Salient Antecedent:
"Louis went to see a movie. He finished taking final exams and wanted to relax."

(4) Discourse — Non Salient Antecedent:
"Louis and Grace went to see a movie. He finished taking final exams and wanted to relax".

In both experiments participants read the anaphor (*Louis* in Experiment 1 and *he* in Experiment 2) faster in the salient condition than in the non salient condition in both sentence and discourse, thus showing a repeated reference advantage instead of an RNP. In both experiments, reading times were also faster in the sentence condition than in the discourse condition but there was no interaction between salience and item type (sentence vs. discourse). Because the sentence conditions were previously found to elicit the RNP (Gordon et al., 1999) we interpret our results as showing that the RNP is not measurable in single word paradigms, possibly because these paradigms are not sensitive to integrative discourse processes. This interpretation is compatible with current theories of the RNP which attribute it to a relatively late stage in processing that involves discourse integration (Gordon et al. 1999, Almor, 1999) but presents the question of what does the N400 increase reported by Swaab et al. show.

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Dimensions of agreement violation in Hindi: An ERP study

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Previous ERP research has shown that electrophysiological activity shows qualitative differences in response to different types of unexpected linguistic material, and also varies quantitatively as specific linguistic dimensions are manipulated. For example, N400 amplitude covaries with cloze probability (Kutas & Hillyard, 1984) and P600 amplitude covaries with verb subcategorization frequency (Osterhout et al., 1994). A recent study showed that N400 amplitudes differ for words that are equally unlikely yet differ in degree of semantic feature overlap with the expected word (1); greater overlap elicits a reduced N400 (Federmeier & Kutas, 1999). This feature-overlap advantage has been taken to reflect priming of the features of the expected target based upon context. We present results from an ERP study of Hindi that varies the degree of feature overlap in the domain of morphosyntax, and show that there is no feature-overlap advantage for grammatical agreement.

Hindi future tense morphology is well suited to exploration of these questions, since it preserves a complete paradigm in which all verb forms are inflected for person, number, and gender, with little syncretism. This makes it possible to vary both the nature and the number of mismatching agreement features across conditions. Experimental materials included one grammatical condition and four violation conditions (2). The violations covered number, gender, number+gender, and person+gender. Critical verbs appeard in embedded clauses, in order to avoid end-of-sentence wrap-up effects. 150 sets of 5 items were distributed across 5 lists in a Latin Square design and mixed with 300 filler items. 19 native speakers of Hindi read sentences presented in *Devanagari* script in an RSVP paradigm (650ms SOA) with sentence-final acceptability judgments, while EEG was recorded at 30 scalp electrodes. Statistical comparison at the critical verb showed that agreement violations elicited no LAN but a clear P600 response in all conditions [600–800ms interval, $F(1,18) = 11.066$, $p<.001$]. P600 amplitudes were matched for the gender, number, and gender+number violations. Only the person+gender violation elicited a larger amplitude P600. Thus, P600 amplitudes follow the hierarchy in (3).

We draw two conclusions from these results. First, the similar responses to the gender, number, and gender+number violations suggest that the degree of feature overlap with an expected form yields no advantage (i.e., no P600 amplitude reduction) in the domain of morphosyntax, contrasting with findings for the N400. This contrast provides a basis for interesting future studies on the source of the difference, which may reflect differences in feature priming, lexical decomposition, or featural syncretism. Second, we consider the larger amplitude P600 in the person+gender condition to reflect the specific contribution of the person feature. This is consistent with previous findings that violations of different individual agreement features can elicit different amplitude P600s (Barber & Carreiras, 2003), and may reflect the more distinctive phonological form of person agreement in Hindi, or may reflect a processing correlate of the typology of agreement features, where person is the most salient feature cross-linguistically (Noyer, 1992; Harley & Ritter, 2002).

Examples

(1) They wanted to make the hotel look more like a tropical resort. So, along the driveway they planted rows of {palms, pines, tulips}. (Federmeier & Kutas 1999)

(2) *Control* Haalanki vo **sarfiraa** sangitkaar gaanaa **gaayegaa** lekin...

Although that **crazy.masc** musician song **sing.fut.3rd.sing.masc** but...
'Although that crazy musician will sing a song...'

Incorrect gender	**gaayegii** lekin... **sing.fut.3rd.sing.fem** but...
Incorrect number	**gaayengee** lekin... **sing.fut.3rd.plur.masc** but...
Incorrect number/gender	**gaayengii** lekin... **sing.fut.3rd.plur.fem** but...
Incorrect person/gender	**gaayuungii** lekin... **sing.fut.1st.sing.fem** but...

(3) Control < Gender, Number, Gender & Number < Person & Gender

Empty category interpretation overrides Minimal Attachment in Chinese

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Overview. This study is one component of an investigation of how the interpretation of an empty category (EC) interacts with structural ambiguity resolution in Chinese sentence processing. Results of a written sentence completion task indicate that the processor may override Minimal Attachment in return for greater ease of interpreting an EC.

Materials. Some Chinese sentence fragments are structurally ambiguous, and the meaning of an EC in them is also ambiguous. Several factors underlie these complex ambiguities. First, Chinese is a null-subject language. Second, a relative clause precedes the head noun it modifies. Third, a clausal subject has no complementizer. Example (1) shows that a fragment with an overt subject and a verb can be continued as a main clause as in (1a), or a clausal subject as in (1b), or a relative clause as in (1c). Example (2) illustrates that a fragment with an EC and a verb can be continued in the same three ways. Thus, (1) and (2) exhibit the same structural ambiguities, and differ only in the presence/absence of an EC.

Predictions. For fragments with an overt subject, the main clause analysis was predicted to be preferred because it is structurally simplest. However, for fragments with an EC, presented in isolation with no preceding discourse, the main clause analysis offends the requirement that a matrix clause null subject needs a discourse antecedent. By contrast, the subordinate clause analyses (clausal subject or relative clause) provide a reference for the EC: either a referent will occur later in the sentence, or the null subject can naturally take arbitrary reference (pro_{arb}). Hence, in resolving this ambiguity, the processor must either adopt a simpler structure but violate the discourse requirement, or else adopt a more complex structure that violates the structural principle. The sentence completion task employed fragments like (2) to investigate how native speakers of Mandarin Chinese resolve the interplay of structural and EC ambiguities, using fragments like (1) as the baseline.

Results. Main clause continuations were significantly more frequent for fragments like (1) than for fragments like (2) (92% vs. 38%, N=18, p<.001). Participants frequently chose the clausal subject analysis (43%) for (2), and less often the relative clause analysis (3%). (Relative clauses may have been disfavored by Minimal Attachment, or by their head-final configuration.) These findings are construed as showing that EC interpretation can outweigh tree-building, and/or that a discourse constraint can outweigh a structural economy constraint (cf. Crain & Steedman, 1985).

Information content. The fragments with ECs conveyed less information than those with a lexical subject, so it might be argued that they were continued with more complex structures because of a tendency to compensate by adding more information in the completion. Hence, the sentence completion task also included fragments like (3) and (4), in which an adverb in (4) carries much the same information as the overt subject in (3). The results for (3–4) closely mirrored those for (1–2). Therefore, the factor that competes with Minimal Attachment does appear to be ease of EC interpretation, not informativeness.

Examples

(1) NP V … Example: Mali zhengli… (*Mary tidied*…)

a. NP V NP. (e.g., *Mary tidied the room.*)
b. [NP V NP] V NP. (e.g., *That Mary tidied the room pleased her father*.)
c. [NP V e_i] de* NP_i V NP. (e.g., *The room that Mary tidied was the kitchen*.)

* *de* is an end-marker of nominal modifiers.

(2) *e* V … Example: Zhengli… (*Tidied*…)

a. *e* V NP. (e.g., *Someone tidied her room*.)
b. [*e* V NP] V NP. (e.g., *To tidy one's room needs patience*.)
c. [e_i V NP] de* NP_i V NP. (e.g., *The person who tidied the room loves Mary*.)

(3) Daduoshu ren zhengli…
most people tidy

(4) *e* Changchang zhengli…
often tidy

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Real-time processing of Japanese exclamatives and the strength of locality conditions

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Previous studies on Japanese sentence processing have demonstrated a locality bias in the comprehension of questions: after encountering a *wh*-phrase, readers expect to encounter a licensing Q-particle at the first grammatically available verb position (Typing Mismatch Effect: Miyamoto & Takahashi, 2003; Aoshima et al. 2004). This study investigates the interaction of this locality bias with grammatical constraints, using the Japanese exclamative expression *nante*, which may itself appear in embedded clauses, but only allows a main clause licenser. Results of our sentence completion task and self-paced reading task indicate that speakers will go to great lengths to provide a local licenser for the exclamative, but are able to do so without sacrificing grammatical accuracy.

The expression *nante* strongly signals an exclamative phrase. Like other *wh*-expressions in Japanese, *nante* must be licensed by verbal particles (e.g., *noda(roo)*). Unlike other *wh*-expressions, however, the licensor of *nante* can only appear in a main clause. From the perspective of on-line processing, this grammatical requirement creates a potential conflict with the independently established bias for *wh*-expressions to find a local licenser.

In Experiment 1 we investigated how this conflict is resolved using a sentence fragment completion task (N=20), which compared completions of fragments containing *nante* in the main or subordinate clause. Completions of the subordinate-clause condition (1) showed a strong bias to produce local licensing particles inside the subordinate clause (95.8%). The subordinate clauses were frequently completed as quotations, which inherit all the properties of main clauses, thereby allowing local licensing of *nante* with no violation of any grammatical requirements. The main-clause condition (2), on the other hand, was rarely completed with the particles in the subordinate clause (12.0%), the particles instead being placed at the end of the main clause. This showed that participants generated a licensing particle for *nante* at the first grammatically possible position, rather than following a grammar-blind local licensing strategy.

In Experiment 2 (n=36), we investigated whether the locality bias would be observed in a self-paced reading task with four closely matched conditions that differed only in the position of the exclamative particles *noda* (either at the main/subordinate clauses) and the presence of an exclamative phrase (either *nante* or *totemo* 'very'). We found that the locative PP regions that immediately followed the embedded verb+complementizer region was read more slowly in the *nante*/declarative complementizer condition (4) than in the *nante*/exclamative particle condition (3), despite the lower frequency of the exclamative particle. The reading time difference is likely due to the immediately preceding verb, which is the only difference between two conditions. Such slow-down effects were not observed in the *totemo* conditions. Results indicate that upon encountering *nante*, readers prefer to license it at the closest grammatically allowed verb position.

Taken together, the results show that the local licensing bias observed in the comprehension of *wh*-questions extends to *wh*-exclamative sentences, further indicating that that the bias is so strong as to require creative strategies, such as the generation of quotations, in order to reconcile locality with grammatical requirements.

Examples

Experiment 1: Off-line sentence fragment completion task

nante = 'exclamative'; totemo = 'very'

(1) totemo Adj N-NOM [NP-NOM [nante Adj N]-DAT … [sub.clause-cond.]
(2) nante Adj N-NOM [NP-NOM [totemo Adj N]-DAT … [main.clause-cond.]

Experiment 2: On-line self-paced reading, $F_1(1,35)=4.47$, $p<.05$; $F_2(1,20)=9.87$, $p<.01$

sono intyoo-wa	sinzinno	isya-ga	nante-tosioita-kanzya-ni …
the chief.doctor-TOP	new	doctor-NOM	EXC-old-patient-DAT

(3) konnanna syuzyutu-o suru-**noda**-to byooin-no rizikai-de okotteiru
difficult operation-ACC do-**EXC**-C hospital-GEN meeting-at get.mad
'The chief doctor was angry what an old patient the young doctor performs a difficult operation to at the hospital meeting.'

(4) konnanna syuzyutu-o si-**teiru**-to byooin-no rizikai-de okotteiru-noda
difficult operation-ACC do-**TEIRU**-C hospital-GEN meeting-at get.mad-NODA
'What an old patient the chief doctor was angry that the young doctor performs a difficult operation to at the hospital meeting.'

Mapping event perception onto language: Evidence from eye movements

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Does the way one's language encodes the world affect how one sees the world? Even though this question has generated much controversy, the interface between perception and language has remained inaccessible to standard methods of psychological research. Here we use a novel technique to investigate this issue by monitoring eye movements to event components by speakers of different languages. Since eye fixations approximate the allocation of attention under normal viewing conditions, they allow us to test whether dimensions of experience that can most naturally find their way into one's native language become cognitively more salient.

We focus on motion, an area characterized by considerable typological variability (Talmy, 1985). Some languages (such as English) typically encode the manner of motion in the verb, and place information about the path of motion in a modifier position. Other languages (such as Greek) typically do the opposite, encoding the path in the verb, and the manner in an optional position. This gives rise to different descriptions of the same motion scene:

(1) A man is skating [over to a snowman]. ENGLISH

(2) Enas andras plisiazi ena xionanθropo [me patinia]. GREEK
a man is approaching a snowman [with skates]

We recorded eye movements from Greek and English speakers as they watched simple clip art animations depicting motion events. Subjects had to perform either a linguistic task (i.e., describe aloud the video after it had finished), or a nonlinguistic task (i.e., study the video for a later image recognition test). Results show considerable differences in how Greek and English speakers visually interrogate unfolding events during the linguistic task. In this task, participants looked first to the regions that their language routinely encodes in the main verb: Greeks projected the path, looking first to the Goal (e.g., the snowman) whereas English speakers looked to the Manner/Instrument (e.g., the skates). In the nonlinguistic task however, eye movements were nearly identical for both language groups during event perception. Differences did emerge late though, at the end of each trial when participants began preparing for the recognition task: Greek speakers were concerned about studying the Manner whereas English speakers were concerned about studying the Goal. This effect suggests that when committing perceptions to memory, linguistic representations are engaged — hence individuals interrogate those aspects of the scene that they could not easily map onto accessible semantico-syntactic forms.

These findings offer the first cross-linguistic demonstration of the rapid effects of preparation for language production on how people allocate visual attention to event components (cf. Griffin & Bock, 2000; Levelt, 1989): where languages differ from each other in how they encode event structure, this difference shows up in how speakers interrogate events during speech planning. Linguistic resources can be used even when people do not speak to support the encoding of declarative/linguistic memories. Crucially, however, event perception itself is largely independent of language-specific pressures on message preparation: when inspecting the world freely, people are alike regardless of the language they speak.

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Distributional information and referential constraints affect on-line processing of pronominal relative clauses

WITHDRAWN

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Recent studies [1, 3] have shown facilitation in processing of object-relative (OR) clauses when the embedded noun phrase (NP_2) is a first-/second-person pronoun (i). Local dependency theory (LDT) [3] and similarity-based approaches [1] have been proposed to account for the data. Here we investigate the influence of distributional information on the processing of RCs in which NP_2 is a third-person pronoun, while varying the nature of referential constraints.

An analysis of the ANC corpora revealed an overwhelming majority of pronominal OR constructions (i, iii, v) compared to pronominal SRs (ii, iv). This bias suggests that distributional information might provide an additional factor affecting the processing of pronominal ORs. In particular, we found that 77% of RCs with embedded third-person pronouns were OR constructions.

Distribution-based accounts predict pronominal ORs to be facilitated by frequency compared to pronominal SRs both in null contexts (ii, iii) and when the referent is given (iv, v). In contrast, LDT theory [3] predicts that 1) structural integration is more costly in ORs compared to SRs with embedded third-person pronouns, and 2) processing difficulty should be reduced when the referent is included compared to null context conditions.

Experiment 1 is a self-paced reading task conducted on ORs/SRs in which NP_2 was a non-referring third-person plural pronoun (*they/them*) (ii, iii). Mean RTs for the main verb (*offered*; ii, iii) were not significantly different across conditions (M=415 ms in ORs, and M=429 ms in SRs) (p's > .2). Repeated measures ANOVA across the region comprising the two words after the relative pronouns (*telephoned them/ they telephoned*) revealed no difference across conditions (mean across the two words: 376 ms in ORs, and 387 in SRs), $F_1(1, 40)=2.88$, $p=.09$; $F_2(1, 14)=2.24$, $p=.16$.

Experiment 2 was identical to Experiment 1, except that referents for the third-person pronouns were included in the materials (iv, v). RTs for the main verb did not differ significantly across conditions (M=425 ms in ORs, and M=432 ms in SRs). Repeated measures ANOVA across the region comprising the two words after the relative pronoun revealed a robust effect of RC-type condition, indicating that OR clauses were read faster (mean across the two words: 341 ms in ORs, and 373 ms in SRs), $F_1(1, 28)=6.2$, $p=.019$; $F_2(1, 14)=5.9$, $p=.029$. Importantly, materials were controlled for plausibility effects.

Three main results are discussed in the light of current theories: First, RTs were smaller in Exp. 2, indicating facilitation by inclusion of referential information. This is consistent with previous claims [2, 3]. Second, the results in Experiments 1 and 2 are not expected under storage-resource approaches [1, 3] in that they predict SRs to be easier. This suggests that distributional constraints contribute to the facilitation of OR processing, a hypothesis strongly supported by Experiment 2 in which ORs were read significantly faster across the embedded region. Finally, our findings suggest an interaction between distributional and referential constraints in which the inclusion of reference appears to have amplified the effects of distributional information.

Examples

(i) The lawyer that you/I called solved the case (OR)

(ii) The landlord that *telephoned them* offered a nice apartment (SR)

(iii) The landlord that *they telephoned* offered a nice apartment (OR)

(iv) According to the students, the landlord that *telephoned them* offered a nice apartment (SR)

(v) According to the students, the landlord that *they telephoned* offered a nice apartment (OR)

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Semantic and morphophonological interference in the production of agreement errors: The role of a monitoring parser

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Agreement processing is taken to occur during grammatical encoding (Bock & Levelt, 1994). A number of studies have investigated whether information from a conceptual message level and morphophonological information stemming from a "local noun" (in a PP modifier) would interfere in subject-verb agreement (see Vigliocco & Hartsuiker, 2002, for a review). *Distributivity* appears to be a semantic factor affecting the production of agreement errors (Eberhard, 1999; and a series of studies by Vigliocco and colleagues, cf. Vigliocco & Hartsuiker, 2002). As for morphophonological effects, neither the phonological properties nor the mere presence of a number affix in the local noun would sufficiently explain interference (Bock & Eberhard, 1993; Bock & al., 2001). The visibility of morphophonological information cannot, however, be completely disregarded. Number inflected nouns have been shown to induce more errors than irregular plurals in particular contexts (Haskell & MacDonald, 2003) and morphological markedness has affected the production of attraction errors in Italian (Vigliocco et al., 1995). In this paper, two production experiments conducted in Portuguese are reported. In the first, the following variables were manipulated: *distributivity* (distributive/non-distributive subject), *number of the local DP* (singular/plural), and *form of the local noun* (number variant/invariant). The distributive singular condition with the operator *cada* (each) allowed for the semantic effect of *distributivity* to be dissociated from an effect of morphological markedness (*a chave de cada porta* / *das portas*; the key of each door / of the doors). If *distributivity* affects the grammatical encoding of the message, more errors would be obtained in the distributive condition regardless of morphological markedness. Singular invariant nouns with an *–s* ending in Portuguese allowed for an effect of morphological markedness to be dissociated from the phonological form of the local noun. If the *form of the local noun* affects number agreement, more errors would be expected in the singular invariant (*ônibus* (sing/plural); bus/es) than in the singular variant (*carro*(*s*); car/s) condition. *Number of the local DP* was the only main effect obtained and there was no significant interaction. It appears that it is morphological markedness rather than the form of the local noun that induces attraction errors since no difference was obtained between the effect of variant/invariant singular local nouns. As for *distributivity*, a post-hoc t-test showed a significant difference between the singular distributive condition (with the distributive operator) and the plural distributive condition with more errors in the latter. Experiment 2 tested for the effect of *distributivity* with morphologically marked local DPs by making the subject DP heavier with the addition of a PP (*a chave das portas de madeira*; the key of the doors of wood)). *Distributivity* had a highly significant effect. This effect associated with morphological markedness suggests that it is the representation generated by a monitoring parser acting upon the subject DP just articulated that gives rise to both a morphophonological and a semantic effect upon the expression of subject-verb agreement.

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Aspectual effects on pronoun interpretation

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The question of whether pronouns are interpreted based primarily on surface-level morphosyntactic cues (subjecthood, recency, parallelism) or as a byproduct of deeper discourse-level processes and representations (inference, event structure) remains unresolved in the literature. These two views come together in a sentence-completion study by Stevenson et al. (1994; see also Arnold 2001), in which ambiguous subject pronouns in passages such as (1) were resolved more frequently to the (*to*-phrase object) Goal of a previous transfer-of-possession event rather than the (matrix subject) Source. Stevenson et al. considered two explanations for this result: a thematic-role-level preference for Goals over Sources, and a deeper event-level bias toward focusing on the end state of transfer events, where the Goal entity is presumably more central than the Source. To tease these hypotheses apart, we designed an experiment in which completions for passages like (1) were compared to versions with the imperfective verb form as in (2). The thematic role relations are equivalent between the two versions, but the imperfective, by describing an event as an ongoing process, is incompatible with a focus on the end state of the event.

(1) COMPLETED EVENT (PERFECTIVE): $John_{SOURCE}$ handed a book to Bob_{GOAL}. He _____.

(2) INCOMPLETE EVENT (IMPERFECTIVE): $John_{SOURCE}$ was handing a book to Bob_{GOAL}. He _____.

A similar percentage of Goal interpretations for (1) and (2) would therefore support the thematic role preference, whereas a greater number of Source interpretations for (2) would support the event structure hypothesis.

Method: Monolingual English speakers (N=48) wrote continuations for 21 passages similar to (1) and (2). The setup sentences contained a transfer-of-possession verb with the Source as the matrix subject and the Goal as the object of a *to*-phrase, followed by an ambiguous pronoun prompt. (An additional 29 distractors were all non-transfer verbs, with adverbs, proper nouns, and unambiguous pronouns as prompts). Each participant saw half the sentences in the perfect and half in the imperfect. Judges determined the participants' pronoun interpretations in light of the story context and the elicited continuation.

Results: As predicted by the event structure hypothesis, sentences in the imperfect yielded significantly more Source resolutions than those in the perfect ($F=50.622$, $p<.0001$). For the imperfective prompts, 70% of pronouns resolved to the Source compared to 51% for the perfective. (13% of the continuations were judged to be ambiguous and set aside, but either interpretation for these still resulted in a significant effect.) Further, for sentences in the perfect, a source preference emerged for verbs describing a transfer event that has neither co-located event participants nor a sense of guaranteed transfer (examples: *send, mail, fax*), whereas Source/Goal interpretations were at chance for perfective verbs with co-located participants (examples: *throw, kick, toss*) or guaranteed transfer (examples: *hand, give, pass*).

Conclusion: Participants' interpretations of ambiguous pronouns appear to reflect deeper event-level biases rather than superficial thematic role preferences. We situate these results within a broader model of discourse coherence and reference that makes additional predictions about the contextual circumstances in which such event-level biases would be expected to arise.

Mismatch of social rank features elicits syntactic positive shift: An ERP study of Japanese honorific constructions

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Goal: One of the most challenging goals of the cognitive neuroscience of language is to answer the question of how astounding diversity among languages can be processed by the common neural resources for human linguistic computation. It has been widely documented in the literature that P600 or a syntactic positive shift (SPS) is elicited by gender/number feature mismatch in European languages (Osterhout & Halcomb, 1992; Hagoort, Brown & Groothusen, 1993). We conducted an ERP experiment on 'social rank' features in Japanese, a typologically different language that lacks gender/number features found in European languages, to examine whether mismatch of social rank features elicits an ERP component equivalent to P600 or SPS.

Japanese Honorific Constructions: Honorific constructions in Japanese are claimed to involve matching of social rank features similar to gender/number features in European languages (Mikami, 1970; Harada, 1973). Honorific predicates consist of a honorific prefix and verb stem, and are suffixed with particular auxiliary verbs: V-*ni-naru* requires a socially higher ranked subject NP, while V-*suru* requires a socially higher ranked object NP (with respect to the speaker). Inoue and Osterhout (2005) observed that an N400 was elicited when readers encountered mismatched honorific predicates: A socially higher ranked subject NP with an object honorific predicate. A potential confound in their result is that the presence of a socially higher ranked NP must yield a strong lexical expectation for a particular auxiliary verb. The ERP response observed in their experiment might thus be caused not by feature mismatch, but rather due to dissatisfaction of lexical expectation, which has been known to elicit N400 (Kutas & Hillyard, 1984).

Methods: To avoid this potential confounding factor, we used the nominal honorific construction that does not contain auxiliary verbs. The mismatch condition (1) contained a socially lower ranked genitive NP immediately followed by a nominal head with the honorific prefix. The control condition (2) contained a socially higher ranked genitive NP. EEG was recorded from nineteen scalp positions while participants (N=12) conducted an appropriateness judgment task on the auditorially presented materials.

Results: A statistically significant positive shift was observed at the centro-parietal electrodes in the honorific mismatch condition 1100–1400ms after the presentation of the critical word, relative to the control condition. Although the timing of positive shift is substantially delayed compared to P600/SPS, the scalp distribution of this component and characteristics of violation suggest that the similar processing resources are utilized in the computation of both gender/number features in European languages and social rank features in Japanese. The delay in response compared to P600/SPS in gender/number feature mismatch can be attributed to some extra computation, e.g., pragmatic or sociolinguistic, that is absent in the computation of highly grammaticalized features such as gender or number. The overall result suggests the interesting possibility that similar computational resources can be recruited in superficially quite different domains cross-linguistically.

Examples

(1) Sample of stimuli for the mismatch condition (critical word in italics)

Watashitachi-no	*go-shuppatsu-ga*	okure-ta.	'Our departure was late.'
Our	honorific prefix-departure	was late	

(2) Sample of stimuli for the control condition (critical word in italics)

Sensei-no	*go-shuppatsu-ga*	okure-ta.	'The teacher's departure was late.'
Teacher's	honorific prefix-departure	was late	

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Gender and discourse prominence in Korean EFL learners' on-line processing of English reference

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This study investigates how Korean learners of English (L2ers) process referential expressions in English, which has a typologically different referential system from their L1. In Korean, zero pronouns are used to encode topic-referring noun phrases and pronouns are infrequent, while English prefers pronouns to refer to the topic (Givon 1983). In the two languages, thus, zero and overt pronouns differ in their referential properties and their behaviors to discourse-pragmatic factors (Goldon et al 1993, Kim 2003). In addition, the gender-neutral third person pronoun *kay* 's/he' is used in colloquial Korean, whereas English pronouns convey gender information. This study examines whether Korean L2ers are sensitive to discourse-pragmatic principles on English reference resolution, whether they can use gender information to resolve pronoun reference, and whether there are any differences between L1 and L2 processing strategies.

Ten Korean L2ers participated in preferential looking tasks in which they looked at a series of pictures while listening to short stories describing them. Two characters were shown during context sentence(s). During the following test sentences one character appeared in a picture on the left side of the screen, and one on the right (see examples 1–3). In Experiments 1 and 2, the subject of the test sentences referred to either the first, more accessible character (a grammatical subject in the context in Experiment 1, a topic in Experiment 2), or the second, less accessible character (the oblique). In Experiment 3, the grammatical object of the test sentences referred to either a character with the same grammatical function (the object) or a different one (the subject). These referential expressions were realized either as a repeated lexical noun or a pronoun. In half the items the two characters were the same gender, in the other half they differed. In the same-gender condition pronoun subjects/objects were ambiguous until disambiguating word(s) (underlined in the examples) plus pictorial information established the referent of the pronoun. The participants' eye movements to the story characters were coded fame by frame.

The L2ers' eye-fixation patterns indicate that they were sensitive to subject or 1st-mentioned NP bias and topic prominence (initially showing more fixations on the subject/topic than the oblique in Experiments 1 and 2) but did not employ functional parallelism (they did not give more looks to the character established as an object in the context in Experiment 3). In addition, gender was a more effective cue than the discourse factors in initial pronoun resolution: participants quickly looked at the target when the gender distinguished the two characters, even when the competitor was pragmatically more salient (the 1st-mentioned NP or a topic). They, however, did not show native-like eye-movements with respect to the repeated-named penalty, which is observed in English (Chambers and Smyth 1998): the L2ers needed more time to find referents of pronouns than those of noun phrases. The results indicate that the L2 learners can integrate different information sources such as lexical-semantic cues and discourse-pragmatic cues during on-line processing (constraint-based model, Spivey & Tanenhaus 1998) although their processing system is not native-like.

Examples

(1) Experiment 1, Subject Continuity

Context	Mickey is going to the mountains with Pooh now.
Test Sentences	Mickey / Pooh / He is catching something in the mountain.
	Look, he is catching a rabbit / butterfly. Where is the rabbit / butterfly?

(2) Experiment 2, Topic Continuity

Context	Minnie is going to school with Betty.
	She is studying with Betty in the classroom.
Test Sentences	Minnie / Betty / She is drawing a picture now.
	Look, she is drawing a flower / house. She draws well.

(3) Experiment 3, Object Continuity

Context	The friends are fighting on the street.
	Donald hit Pooh.
Test Sentences	Then, Mickey hit Donald / Pooh / him.
	Look, he hit his head / shoulder. That must hurt a lot.

An ERP study of phi-features in Spanish

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According to the Feature Hierarchy hypothesis, morphological features are organized hierarchically, so they encode conceptual features with different degrees of cognitive significance that makes clear predictions for sentence processing. That is, if a language possesses a feature, then it must have all the ones above it in the hierarchy. Thus, if it possesses the feature of gender, it must also have number and person. The implication of this is that, in some sense, person is more important/basic to language than number and gender, because it is universal, i.e., it occurs across languages independently of the other two. Next in 'importance' comes number and last gender (e.g., Person > Number > Gender). The goal of present study was to investigate whether two morphological phi-features such as Person and Number play a different role in the agreement process using Event-related potentials (ERPs).

Electrophysiological measures were collected from Spanish speakers while they read sentences in which either Person, or Number or both Person and Number agreement relationships were manipulated. If hierarchical organization of phi-features is a direct reflection of their relative degrees of 'cognitive significance', with features higher on the hierarchy being more cognitively significant or salient than the ones below, then feature strength should be reflected on the LAN/P600 pattern amplitude. Only first and second person pronouns/verb-forms and plural and singular were varied systematically and counter-balanced across subjects in the experiment. Violation of Person (VP, e.g., *Tú juego en el patio* [You $_{2ndPerSing}$ play $_{1stPerSing}$ in the backyard]), Number (VN, e.g., *Nosotros juego en el patio* [We $_{1stPerPl}$ play $_{1stPerSing}$ in the backyard]) and both Person and Number agreement (VPN, e.g., *Ustedes juego en el patio* [You $_{2ndtPerPl}$ play $_{1stPerSing}$ in the backyard) were employed as experimental conditions and filler stimuli were also included.

All Phi-features disagreements elicited a left anterior negativity (LAN) and a P600 pattern effects. Significant larger LAN/P600 effects were elicited by VP, VN and the combined VPN disagreement with respect to the control condition. The onset of the P600 elicited by VPN appeared earlier in latency than the other two experimental conditions. These results suggest that agreement violations are automatically detected during the first syntactic integration analysis for each of the two features or its combination. Mechanisms of reanalysis or repair processes seem to be also similar for each of the two features when computed separately. However, they are triggered earlier when the violation is driven by the combination of the two features. Given that there were no significant amplitude differences between conditions (VP, VN and VPN) and the Feature Hierarchy Hypothesis assumes different degrees of 'cognitive significance' for Phi-features, then there are no evidences to support this hypothesis in the present experiment and also this could challenge the Feature Hierarchy Hypothesis.

Optionality in comparative production

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Why do grammatical options exist in a language? Having to choose between different ways of expressing a given meaning (e.g., the dative alternation, or *-er* versus *more* comparatives) might make production and comprehension more difficult. Alternatively, grammatical options might offer certain advantages (Bock, 1982). Corpus analyses by Mondorf (2003) found that, for adjectives that alternate in comparative form (e.g., *angrier ~ more angry*), the *more* variant tends to occur more often in syntactically complex environments; there is also weaker evidence that *more* is preferred when an adjective's sense is semantically abstract. Mondorf suggests that, in these cases, speakers use the *more*, rather than the *–er* variant, to aid listeners by simplifying parsing, and by warning of upcoming complexity.

This notion is perfectly reasonable given evidence that speakers choose between syntactic alternatives based on a consideration of listener needs (Temperley, 2003). However, listeners' needs may not be the most relevant. For example, Ferreira and Dell (2000) show that speakers choose between syntactic alternatives based on their own processing demands, and not on listener-based factors. These two lines of conflicting evidence suggest that speakers might choose between morphological alternatives (*-er* and *more*) based either on listener-based factors, or on their own processing needs.

In the current experiment, we used a series of prompts to manipulate the syntactic or semantic complexity of sentences that speakers produced. Syntactically complex prompts, e.g., (1), including the bracketed material, elicited syntactically complex sentences like *The cop was angrier / more angry to hear the news than the sailor,* whereas syntactically simple prompts, e.g., (1), without the bracketed material, elicited syntactically simple sentences such as *The cop was angrier / more angry than the sailor.* Prompts that were semantically complex (see (2)) elicited sentences like *Macs are friendlier / more friendly than PCs*, while semantically simple prompts (3) elicited sentences such as *Golden Retrievers are friendlier / more friendly than Pit Bulls.* Semantic complexity was determined in a prior norming study. Additionally, we manipulated the communicative environment: half of our speakers addressed another participant; no listeners were present for the other half.

We found that speakers produced *more*-comparatives more often in complex sentences (53.3%) than in simple sentences (45.5%), across both syntactic and semantic manipulations. This pattern did not differ based on communicative environment. These results suggest that as speakers' processing loads increase — either from having to plan a syntactically more complicated utterance, or having to use an adjective sense that is more abstract — they are increasingly likely to revert to the *more* variant. This may occur for several reasons: because production of the *more* variant is more likely to result in a felicitous utterance, because *more* provides additional time for utterance production, or because speakers find it beneficial to avoid morphological affixation. However, that the pattern of increased *more* use was not magnified when a listener was present suggests that speakers do not strategically use the *more* variant to assist listeners (although listeners may still derive benefits from its use). Instead, speakers choose between morphological alternatives based on the demands of their own production processes.

Examples

(1) *Syntactic manipulation* (complex with bracketed material, simple without)
The Village People were upset. 16% of fans thought the sailor was angry [to hear the news].
76% of fans thought the cop was angry [to hear the news].

(2) *Semantically complex* (abstract)
Computer programmers were surveyed about user accessibility. 15% said that PCs are friendly.
80% said that Macs are friendly.

(3) *Semantically simple* (concrete)
Dog owners were asked about unique breeds. 15% said that Pit-bulls are friendly.
80% said that Golden Retrievers are friendly.

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Grammatical gender priming within and between semantic categories

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The present experiments are based upon findings from speech errors (Vigliocco, Vinson, Indefrey, Levelt, & Hellwig, 2004), showing that semantic substitution errors tend to preserve grammatical gender if the target utterance requires the production of a gender-marked element. This gender preservation effect can be taken as evidence that syntactic frames feed back activation to all nouns matching the gender marking of the syntactic frame. This proposal was tested in a primed picture naming task with Dutch participants. The experiments systematically varied whether prime and target noun belonged to the same semantic category or to different semantic categories, and whether they belonged to the same gender class or different gender classes.

Three experiments were conducted. In all of them the question of interest was if there was an interaction of gender class and semantic category membership. Experiment 1, participants had to name pictures with Dutch bare nouns, for example, "pig" (prime) – "horse" (target) (same category, same gender), "cow" – "horse" (same category, different gender), "bed" – "horse" (different category, same gender), "chair" – "horse" (different category, different gender) (here, examples are given in their English translation). Reaction times were measured on the target noun ("horse" in the examples). No interaction of semantic category membership and gender class of the prime was observed in bare noun naming (Experiment 1). In Experiment 2, participants named the same pictures with determiner noun phrases, for example, "the pig" – "the horse". An interaction of semantic category and gender class was observed: Noun phrases were named faster after a prime from a different semantic category and a different gender class than after a prime from a different semantic category and the same gender class. No such effect was observed for primes and targets from the same semantic category. This result was unexpected, and sequential cueing (Sevald & Dell, 1994) is discussed as one explanation why repetition of the same determiner form might inhibit retrieval of the target noun phrase. Finally, in Experiment 3, participants named the primes with indefinite determiners, color adjectives and the noun, and the targets with definite determiners and the noun, for example "a red pig" – "the horse". In this case, the inflection of the color adjective contains the information about the prime's grammatical gender. There was again an interaction of semantic category membership and gender class: When the specific gender-marked elements of the prime were not repeated in the target noun phrase, reaction times were faster for targets after a prime of the same semantic category and the same gender class than for targets after a prime of the same semantic category and a different gender class. No such difference was observed for primes and targets from different semantic categories.

The findings support an account with feedback from syntactic frames marked for gender. The feedback spreads to all nouns belonging to this gender class. It is discussed why the effects of this feedback activation only surfaced for nouns belonging to the same semantic category.

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Weak definites: Evidence for a new class of definite NP interpretation

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Felicitous use of a definite article in a noun phrase is assumed to carry a uniqueness condition; the entity being referred to, or introduced, should be uniquely identifiable (e.g., Roberts, 2003). However, Carlson (2003) notes that some nouns when paired with a definite article allow an "indefinite" reading. For example, consider "John heard about the riot on the radio, and Mary did too". John and Mary have heard about the same riot, but not necessarily on the same radio, or even the same station.

We examined three questions about how such "weak" or "indefinite" definites are processed: Do naïve subjects treat regular and weak definites differently? If so, is this distinction reflected in online processing? And, do weak definites differ from indefinites?

In Experiment 1 speakers read a background statement ("At breakfast, Samantha read the *New York Times*. Across the table from her, Frances was reading the *Democrat and Chronicle*."), then judged whether a summary sentence ("Samantha read the newspaper, and Frances did too.") acceptably characterized that statement. The summary was judged as acceptable more often for nouns with weak definite readings ("the newspaper") compared to regular nouns ("the book"), 73% versus 24%, respectively.

Experiments 2 and 3 used visual-world eye-tracking (Tanenhaus et al., 1995). This methodology provides a continuous measure during the referent selection process, allowing us to obtain information about the possible referents participants consider before making their final choice. In Experiment 1, participants saw pictures of an event while hearing a description. A participant might hear, "During his coffee break, Marcus read the newspaper" while viewing a scene including Marcus and a newspaper, followed by an elided sentence where a second character was about to participate in a similar event ("If she gets a chance, Amy will too"). Participants were more likely to choose a new versus the old token of the noun (i.e., a newspaper <u>not</u> depicted in the scene with Marcus) for nouns with a weak definite reading ("the newspaper") than when it does not ("the book"). Similar effects appeared in eye movements; participants were more likely to look at the new token for the weak definites.

In Experiment 3 participants viewed displays that contained a singleton token (one newspaper), two tokens presented as a group (two newspapers), and a human actor while hearing a sentence describing an event that was about to happen ("After she finishes her breakfast, Lydia will read the newspaper"). Participants clicked on the item most likely to be involved in the event. As predicted, participants selected a member of the group (i.e., a non-unique entity) more often for weak indefinites. For indefinites ("If he gets hungry, Charlie will take a banana.") both the selection data and the eye pattern patterned differently than for either regular and weak definites.

We conclude that there is a class of nouns that can appear in definite noun phrases without necessarily presupposing uniqueness; however, they do not behave like indefinite noun phrases. Our continuing research investigates what contextual constraints, e.g., the absence of modification, allow these nouns to have a weak definite reading, and what other constructions, such as the habitual gerundive, might behave in similar ways.

Syntactic priming effects in the processing of a head-final language

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In this study, we will report that not only the information about argument structure triggered by the verb but also word order information must contribute to syntactic priming effects in sentence comprehension. Previous studies in English reported that syntactic priming effects are entirely lexically dependent (e.g., Arai et al., 2005), but it is not clear whether syntactic factors indeed contribute to the priming effects, since English is a head-initial language. In English, it is possible that the priming effects might be induced by the repetition of an identical verb because its semantic information may create a strong bias for the particular argument structure, and the following word order of objects does not contribute to the priming effects. If so, the effects should not be sensitive to the structure of target sentences. However, there is another possibility: the effects are caused by the repetition of particular syntactic structures independent of the bias from the verb and the effects may differ depending on the target sentence's structure. The purpose of this study is to clarify these possibilities by examining Japanese sentences with SOV and OSV orders. In a head-final language like Japanese, the objects in a sentence appear before the verb. Thus, verbs cannot create a strong bias for the upcoming materials in sentence processing. For this reason, if we observe facilitation effects in Japanese and if the effects are influenced by the structure of target sentences, it can be suggested that a syntactic factor is contributing to the priming effects.

Sixty native speakers of Japanese participated in each of two cross-modal priming experiments. An auditory prime was presented through a headset immediately before the presentation of each target. The participants were asked to press a button as soon as they read the visually presented target sentences, and reaction times were measured. Target and prime sentences were either matched or mismatched with respect to their word orders and whether the verb was repeated or not (see 1–5).

In Experiment 1, SOV sentences were used for target sentences to investigate whether priming effects are observed. A 2 (congruent or incongruent word order) x 2 (with or without verb repetition) ANOVA showed only a significant main effect of verb repetition. These results seemed to support that the priming effect might be induced only by the repetition of identical verbs. In Experiment 1, however, effects of word order may not appear because the target SOV sentences do not incur much processing cost (Tamaoka et al., 2004). To investigate whether the processing cost of the target sentences affects the priming effects, OSV sentences were used as targets in Experiment 2. The same ANOVA revealed reliable priming effect only when the word orders were congruent and the verb was repeated. These results indicated that (i) syntactic factors can be attributed to syntactic priming effects, which closely interact with sentence-end verb repetition and (ii) the relative processing costs of target sentences influence these priming effects.

Examples

(1) Takashi-ga ringo-o tabeta. (SOV prime with verb repetition)
Takashi-Nom apple-Acc ate
Takashi ate (an/the) apple(s).

(2) Tomoko-ga mado-o shimeta. (SOV prime without verb repetition)
Tomoko-Nom window-Acc closed
Tomoko closed (a/the) window(s).

(3) mikan-o Ichiro-ga tabeta. (OSV prime with verb repetition)
orange-Acc Ichiro-Nom ate
Ichiro ate (an/the) orange(s).

(4) taiko-o Shinji-ga tataida. (OSV prime without verb repetition)
drum-Acc Shinji-Nom beat
Shinji beat(played) the drum.

(5) Makoto-ga keeki-o tabeta. (SOV target in Experiment 1)
Makoto-Nom cake-Acc ate
Makoto ate (a piece/pieces of) cake.

Notes In Experiment 2, OSV sentences were used for targets.
The format of the design and materials was the same as Experiment 1.

Structural priming during comprehension of datives

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How similar are language comprehension and production? Some researchers have argued that comprehension relies less on abstract syntactic representations than production (Townsend & Bever, 2001). A comparison of structural priming during comprehension and production offers some support for this position. In this paradigm, priming *across* verbs is taken as evidence for the use of abstract syntactic representations. Several studies have found robust across-verb priming during *production*, even when the contrasted structures do not differ semantically (e.g., the dative alternation) (Bock & Griffin, 2000). In contrast, two recent studies failed to find across-verb priming during *comprehension*, despite finding priming for the same verb (Branigan, et al., 2005; Arai, et al., 2005). In the current study, we use the real-world eye-movement paradigm to demonstrate across-verb priming in adults during comprehension of dative sentences.

Participants followed pre-recorded instructions while their eye movements were videotaped. Prime sentences were either double-object (DO: Hand the dog the spoon) or prepositional-object (PO: Hand the spoon to the dog) datives. Within any block, participants heard two prime sentences followed by a test sentence which was either the same or different kind of dative as the primes, resulting in four experimental conditions: DO-DO, DO-PO, PO-DO, PO-PO. Test sentences used the verb "throw" or "show" and were temporarily ambiguous. The *initial* part of the first noun (*hor*…) could refer to either the recipient (DO: Show the *horse* the book) or the theme (PO: Show the *horn* to the dog). Our dependent variable was the proportion of looks to the potential theme (*horn*) after the onset of the first noun and prior to any disambiguating information. Participants primed with PO sentences looked significantly longer at the potential theme than those primed with DO sentences, irrespective of the target sentence that they actually heard ($N = 28$; $F(1,24) = 5.47$, $p<.03$).

In a second experiment, we used fast priming to rule out non-linguistic explanations for priming. Participants heard eight target verbs in DO or PO sentences. There were no prime sentences. Instead, a DO or PO-biased prime verb was mixed into the target sentence such that it was heard simultaneously with the target verb, but at a lower amplitude and in a different voice (Novick, et al., 2003). Preliminary results show a marginal effect of prime for DO sentences ($N = 23$, $F_1(1,21) = 4.34$, $p=.05$; $F_2(1,14) = 4.23$, $p=.059$). Participants who heard PO-biased prime verbs looked significantly longer at the potential theme than those who heard DO-biased prime verbs. Participants were unable to explicitly identify the prime verbs. The effects were consistent regardless of semantic compatibility between prime verbs and objects in the visual scene.

Thus, the two experiments demonstrate across-verb priming in the comprehension of dative sentences. Experiment 2 indicates that these effects cannot be solely attributed to deliberate strategies or priming of action plans. We suggest that the discrepancy with previous studies may be attributed to temporal parameters of the tasks and the nature of the dependent variables (Konopka & Bock, 2005).

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Priming in sentence comprehension: Semantic, strategic, or syntactic?

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A reduced relative clause is easier to process when it follows a sentence containing a related syntactic structure and the same verb (Pickering & Traxler, 2004; Traxler & Pickering, 2005; Traxler, Pickering & Tooley, 2005). Because facilitated processing occurs only in the presence of lexical overlap, it is possible that the source of facilitation is semantic or strategic, rather than syntactic. We tested the semantic-source hypothesis (the SSH) in two ways. First, we conducted an eye-tracking experiment manipulating lexical and semantic overlap between prime and target sentences, as in (1a–c):

(1) a. Identity Prime The director *watched* by the cop was in a bad part of town.

b. Synonym Prime The director *observed* by the cop was in a bad part of town.

c Target The child *watched* by the babysitter played with some toys

The eye-tracking data showed greater and earlier facilitation for identity primes as compared to synonym primes. Second, an ERP experiment used prime sentences like (1a) and (1d), with target sentences like (1c):

d. Main Clause Prime The director watched the cop who was in a bad part of town.

The ERP results indicated greater positivity at the noun in relative clause (e.g., *babysitter*) for the main clause condition than for the identity prime condition. The results of these two experiments are contrary to the SSH.

Another possible source of facilitation in our previous experiments is strategic. Because lexical overlap is critical, participants may learn to treat any pair of sentences with lexical overlap as related, and may alter their parsing strategies accordingly (Mauner & Kim, 2005). We tested the strategic-source hypothesis (the Other SSH) by conducting a further experiment. In this experiment, overlapping verbs in the filler items eliminated the strategic value of overlapping verbs in the targets. Despite the lack of good strategic cues, priming was still observed for pairs like (1a) and (1c). These new experimental results are also consistent with new analyses of old experiments, which showed that priming effects occurred in the absence of any effects predicted by the Other SSH (such as increases in the magnitude of priming as an experiment progressed). We conclude that contingent learning and semantics may play a role in syntactic priming, but they do not account for all of the observed effects.

Structural priming magnitudes are affected by frequency of the prime structure

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Chang, Dell, and Bock (in press) have recently proposed a computational model that probably provides the most complete and detailed account of syntax acquisition and structural priming. One important claim of their model is that structural priming and syntax acquisition are the result of prediction errors during sentence comprehension. During sentence comprehension, people predict the syntactic structure of the next word. If this prediction is incorrect, the processor learns by adjusting its connection strengths. An interesting prediction that can be derived from this is that structural priming should be stronger for infrequent than for frequent structures: When the prime structure is relatively infrequent, the predicted structure is more often incorrect than when the predicted structure is frequent.

To test whether infrequent structures result in more priming than frequent structures, we compared transitive and intransitive structures. A corpus study using the British National Corpus showed that transitives are more frequent than intransitives. Participants read either a transitive prime (1a), an intransitive prime (1b), or a baseline sentence (1c), which did not contain either verbs or nouns and was therefore neither transitive nor intransitive. Prime sentences were followed by a target fragment (2), which could be completed as either a transitive or intransitive.

Participants produced more transitive than intransitive completions following the baseline sentences, indicating that in the absence of a prime, the transitive structure was preferred for the verbs that we used. There were more transitive completions after transitive primes than after baseline sentences, and more intransitive completions after intransitive primes than after baselines. Most importantly however, the priming effect was much larger for intransitives than for transitives.

The results suggest that the magnitude of the priming effect depends on the frequency of the prime structure, consistent with Chang et al.'s model. Furthermore, the finding that transitive structures did prime (even though the effect was smaller than with intransitives), has important implications for a recent proposed by Arai, Van Gompel, and Pearson (2005). In their experiments, they observed that intransitives primed more strongly when the verb in prime and target was repeated than when it was not, whereas there was no verb repetition effect for transitives. They argued that because transitive is the default structure (e.g., because it is most frequent), the activation of the transitive structure is not associated with individual verbs, but with the class of verbs as a whole. However, an alternative explanation for their findings is that transitives do not prime at all. Given that our transitive and intransitive primes were the same as in Arai et al., the current results support their conclusion that the activation of the transitive structure is independent of lexical information.

Examples

(1) a. The marksman was shooting the assassin.
b. The marksman and the assassin were shooting.
c. Unbearably dull and so extremely laborious.

(2) When the gamekeeper was shooting …

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Acquiring and processing verb argument structures: A miniature language study

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Adult language combines a complex mix of regular, 'rule like' processes and more conservative, lexically based patterns. For example, verb argument structure constructions may generalize to new verbs (*John gorped →Bill gorped John)* yet resist generalization with certain lexical items *(John sighed → *Bill sighed John).* Pinker (1989) suggests that whether a particular verb can occur with a particular argument structure may depend upon a fine-grained semantic representation. However, more recent work suggests that statistical learning mechanisms play an important role in acquisition (Saffran, Aslin & Newport, 1996). Studies of young children (Theakston, 2004) and on-line comprehension in adults (MacDonald et al., 1994) demonstrate sensitivity to the frequency with which particular verbs have occurred in alternate structures. Here we investigate whether learners track verb-structure co-occurrences, as well as the distribution of argument structures across the language.

We exposed adult subjects to miniature languages in which the relationship between verbs and possible argument structures had to be learned from the input statistics: no semantic or phonological features correlated with verb subcategory. Each language had twelve verbs and two synonymous argument structures: *V[S0]* and *V[OS]Particle,* with meaning provided by video scenes depicting simple transitive events. Four languages were explored, with differences among them in the degree to which their verbs exhibited lexically-based versus language-wide patterns. Participants were exposed to a language for 30-minute sessions across five days. After exposure, *Production, Grammaticality Judgment* and *Comprehension* tests were administered. In this last test, eye-movements were monitored as participants listened to a sentence and viewed two pictures: correct or agent-patient reversed. If subjects were biased to expect the verb to occur with a particular argument structure, they should show a looking preference *before* hearing the disambiguating *Particle*.

In general, the tendency to use lexically specific versus language general patterns depended upon the distribution of the particular language learned. Subjects were very consistent across the different tests, and eye-tracking data showed that the statistics of the language influenced online processing. Given an appropriate input distribution (8 verbs occurring in only one of the two structures, 4 occurring in both), learners were able to learn lexical restrictions, while still maintaining the ability to generalize. In addition, we saw an influence of statistical *bias* for one construction, both when this bias held at the lexical level (all verbs occurred in both constructions but were biased towards one construction), and when it did not (each verb only occurred in one construction but there was an overall bias across verbs for one construction). This statistic was particularly reflected in subjects' treatment of 'new' verbs (introduced only during testing and not related phonologically or semantically to 'old' verbs).

In conclusion, *learning* and *processing* of verb argument structures is strongly driven by the distributional properties of the input, and these purely formal phenomena may occur in the absence of semantic cues. In addition, exposing learners to artificial languages may provide a fruitful methodology for exploring learning and on-line syntactic processing — a methodology we are currently exploring in studies with children.

The interaction of lexical, syntactic, and discourse factors in on-line Chinese parsing: Evidence from eye tracking

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Historically, the vast majority of research on parsing has been carried out in a few European languages. Recent years have seen increased interest in East Asian languages, which often have quite different properties than languages like English. One such property is the use of noun classifiers. In classifier languages, each noun is obligatorily accompanied by a particular classifier (or one of a small set of classifiers). Classifiers therefore provide a cue to the identity of an upcoming noun, and could aid in parsing. Prior research on the use of classifiers as a cue to construct a relative clause (RC) has yielded positive results for Japanese (Yoshida, Aoshima & Phillips, 2004), but not Chinese (Hsu, Phillips & Yoshida, 2005). One possible reason for the inconsistent results is that these studies presented their target sentences in isolation, leading participants to not expect an RC. This may have interfered with their ability to utilize the classifier cue. The present study investigates whether classifiers can produce facilitation in Chinese when a more supportive discourse context is provided.

In the first experiment, ten native Chinese speakers viewed pictures and listened to sentences while their eye movements were monitored. The last sentence on each trial was an instruction to point to a target picture (see the examples below). The visual display was designed so that a restrictive relative clause was often necessary to indicate which of two pictures was being referred to. In the critical instructions, a mismatch between a classifier and the following noun provided an early cue to such an RC. Participants showed a small but reliable increase in early looks to the target picture following a mismatch ($p<.01$), relative to a control condition in which the classifier and noun matched.

In the second experiment, an additional ten Chinese speakers heard the same sentences, but with the passive marker 'bei' intervening between the classifier and the embedded noun. 'Bei' also serves as a cue to an upcoming relative clause, making the mismatch cue redundant. In this experiment, the advantage in the mismatch condition disappeared.

A comparison of the current results with those of Hsu et al. (2005) suggests an interaction between lexical, syntactic, and discourse factors in on-line Chinese parsing. Relatively subtle cues to a RC (such as a mismatch between a classifier and a noun) have little observable effect when the context provides little reason to expect an RC to occur. The same cues can have a larger effect when discourse factors favor an RC. The difference between Japanese and Chinese may be in the relative weight of different parsing cues, due to the fact that Japanese is strictly head-final and Chinese is a mixed-order language. If comprehenders do not have a verb available until the end of the sentence, they may be more inclined to utilize other cues to upcoming structure, as the work on Japanese classifiers suggests.

Examples

Match Condition	Mismatch Condition
zhixiang nei zhi (bei) zuqiu dasui de huaping point to that CL football break DE vase	zhixiang nei shan (bei) zuqiu dasui de chuanghu point to that CL football break DE glass window
'Point to the vase that the ball broke/was broken by the ball.'	'Point to the window that the ball broke/was broken by the ball.'

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Conditionals and long-distance dependency formation in Japanese

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It is commonly assumed that 'active filler' effects in English are driven by the need to identify an appropriate thematic interpretation for a fronted filler [1]. Recent evidence from Japanese has been presented as confirmation of this view: fronted *wh*-phrases in Japanese biclausal sentences are preferentially associated with an *embedded* clause gap [2]. This bias for longer dependencies allows early confirmation of the filler's thematic role, since Japanese embedded verbs appear before main verbs; the bias is unexpected if active dependency formation is simply motivated by a need for short filler-gap dependencies. However, the Japanese bias might instead be motivated by the parser's search for a question particle to license the *wh*-phrase [3]. This suggestion is supported by results from three experiments that show that the bias for longer dependencies disappears in embedded *if*-clauses, which allow long-distance scrambling but cannot host question particles.

Japanese conditional *if*-clauses normally cannot be detected until the clause-final conditional particle *–ra* is reached (1), but the presence of the optional conditional adverbial *mosi* may provide a cue to the beginning of an *if*-clause (2). Experiment 1 (sentence fragment completion, N=180) showed that the presence vs. absence of *mosi* modulates expectations for verbs with conditional particles. Fragments containing *mosi* (3a) yielded *if*-clause completions on 98% of trials, whereas conditional clause completions were almost completely absent (0.6%) when *mosi* was replaced with a standard adverbial (3b). Experiment 2 (self-paced reading, N=26) showed that information from *mosi* facilitates the processing of conditional verbs online. Reading times at an embedded verb with conditional morphology were faster in the *mosi*-condition (4a) than in the adverbial condition (4b) ($F1(1,25)=4.56$, $p<.03$, $F2(1,15)=1.62$, $p=.10$). These studies set the stage for a study of filler-gap dependencies and *if*-clauses.

Experiment 3 (self-paced reading, N=60) investigated whether fronted *wh*-phrases would be associated with a gap inside an *if*-clause. Scrambling out of an *if*-clause is acceptable in Japanese [4], unlike English, and the verb in an *if*-clause would provide the first opportunity to confirm the thematic interpretation of the fronted *wh*-phrase. However, an *if*-clause cannot host a question particle and therefore could not license the *wh*-phrase. The experiment extended the Japanese filled-gap paradigm [2], manipulating the nature of the sentence-initial *wh*-phrase (scrambled dative vs. in-situ nominative) and the information at the embedded clause boundary (*mosi* vs. standard adverbial). The critical region was a second dative NP in the embedded clause. When the fronted dative *wh*-phrase is associated with an embedded clause gap, then the second dative NP is read more slowly than in a condition where the first dative NP is not scrambled. This Japanese counterpart of the filled gap effect was replicated in the conditions with standard adverbials (5), $F_1(1,59)=6.44$, $p<.01$; $F_2(1,19)=3.49$, $p<.06$, but it disappeared in the conditions with *mosi* (6), $Fs < 1$. This indicates that the bias for longer *wh*-dependencies is blocked when the embedded verb cannot host a question particle, which in turn suggests that the preference for long-distance dependencies is motivated by the parser's search for a question particle.

Examples

(1) [Taroo-ga Hanako-ni tegami-o dasita-ra] …
T-nom H-dat letter-acc send-conditional
'If Taroo sends a letter to Hanako …'

(2) [mosi Taroo-ga Hanako-ni tegami-o dasita-ra] ...
Adv T-nom H-dat letter-acc send-conditional
'If Taroo sends a letter to Hanako …'

(3) a. NP-top mosi Adj NP-ga ...
b. NP-top Adv Adj NP-ga...

(4) a. *mosi* NP-top / mosi / Adj / NP-nom / NP-dat / NP-acc / V-cond / NP-acc / V.
b. Standard Adv NP-top / Adv / Adj / NP-nom / NP-dat / NP-acc / V-cond / NP-acc / V.

(5) a. Adv-Scrambled Wh-dat / NP-top / Adv / Adj / NP-nom / NP-dat / NP-acc / V-cond / Adv / NP-acc / V?
b. Adv-Unscrambled Wh-nom / NP-dat / Adv / Adj / NP-nom / NP-dat / NP-acc / V-cond / Adv / NP-acc / V?

(6) a. *mosi*-Scrambled Wh-dat / NP-top / mosi / Adj / NP-nom / NP-dat / NP-acc / V-cond / Adv / NP-acc / V?
b. *mosi*-Unscrambled Wh-nom / NP-dat / mosi / Adj / NP-nom / NP-dat / NP-acc / V-cond / Adv / NP-acc / V?

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