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Sentences like (1) *The small square is the only one that is a policeman* are ambiguous depending on what referent is considered for *one*. To illustrate, in Fig 1 we can evaluate (1) against the set of all geometrical figures (the only geometrical figure that...) or alternatively against the set of squares (the only square that...) .

Following Crain et.al., (1994) we call the former “Maximal Commitment” strategy (i.e., select the strongest interpretation) and the latter “Minimal Commitment” strategy (i.e., choose the interpretation that has more chances of being true). Previous studies concluded that in interpreting (1) adults adopt the Minimal commitment strategy to avoid costly and unnecessary commitments.

Our goal was to investigate whether adults ever consider the 'Maximal commitment' strategy. We conducted an eye-tracker experiment with Italian sentences like (1) in situations in which the sentence is true under a “Minimal commitment strategy” and false under a “Maximal commitment strategy”. A Visual World Paradigm on an Eye Link 1000 has been used.. Participants heard sentences and had to evaluate them relative to a scenario on the display screen. For example, the critical sentence (1) *The small square is the only one that is a policeman* was heard relative to a scenario in which among the squares, the small one was the only being a policeman but there were other figures (a circle, a triangle) that were also policemen. Thus, the interpretation *the small square is the only square that is a policeman* (maximal commitment) is true, but *the small square is the only thing that is a policeman* (minimal commitment) is false. Besides, we compared critical trials with unambiguous control trials. Crucially the unambiguous controls varied relatively to the 'exploration strategy' required to evaluate the sentence, some requiring the exploration of the whole scenario in order to be properly evaluated (*4-quadrants exploration*); some requiring only the exploration of one set of objects (*one-quadrant exploration*)
Results. The 30 participants rejected the critical sentences (> 90%). Mixed-effects models were employed using R (Baayen et al., 2008), with crossed random effects for subjects and items. Interestingly, the exploration pattern (e.g. number of fixations, area explored and time of exploration) for the critical trials is halfway between controls and is statistically significant from both controls (4-quadrants pMCMC=.0012; 1-quadrant pMCMC=.0001). The results suggest that adults adopt a Maximal Commitment Strategy and stop their search once a counterexample is found contra Crain et al. (1994). However, another possibility could be that adults maximally exploit whatever information is available in the context. Our experiment does not distinguish between a Maximal Commitment strategy from a Maximal Exploitation of the context since both converge toward the same interpretation: the strongest interpretation is the one that requires to use all contextual information. To disentangle these two strategies we conducted another experiment that differs from our first experiment only in the use of a negative sentence (2) The small square is not the only one that is a policeman. Since in (2) the entailment relations are reversed, the stronger interpretation, as dictated by Maximal Commitment, requires the investigation of only one of the quadrants, i.e. the quadrant with the squares (see Fig 1). This interpretation makes the sentence false because, among the squares, the small one IS the only policeman. A Maximal Exploitation strategy on the other hand makes the sentence true since there are other figures that are policemen. Based on the data from 30 Italian-speaking adults we can conclude that adults do not follow a Maximal Commitment strategy: the high acceptance rate of target sentences (> 92%) suggests that they rather follow a more general strategy that instructs them to use all the available information.

References:

Establishing propositional truth-value in counterfactual and real-world contexts during sentence comprehension: Differential sensitivity of the left and right inferior frontal gyri

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What makes a proposition true or false has traditionally played an essential role in philosophical and linguistic theories of meaning (e.g., Montague, 1973; Tarski, 1944). A comprehensive neurobiological theory of language must ultimately be able to explain the combined contributions of real-world truth-value and discourse context to sentence meaning. Counterfactual comprehension is an interesting test-case for identifying the brain regions that are sensitive to propositional truth-value; whereas establishing truth-value of regular sentences requires straightforward mapping of propositional meaning onto real-world knowledge, establishing counterfactual truth-value requires online construction of a contextually relevant interpretation by temporarily ‘bracketing’ factual knowledge (e.g., Stalnaker, 1968; Searle, 1975). This event-related FMRI study investigated the neural circuits that are sensitive to the propositional truth-value of sentences about counterfactual worlds, aiming to reveal differential hemispheric sensitivity of the inferior prefrontal gyri to counterfactual truth-value and real-world truth-value. A larger effect of counterfactual truth-value was predicted in the right hemisphere, based on its association with comprehension of counterfactual and figurative language (e.g., Menenti et al., 2009).

While inside a 3-T MR scanner, twenty-four participants read true or false negated counterfactual sentences ("If N.A.S.A. had not developed its Apollo Project, the first country to land on the moon would have been Russia/America") and real-world sentences ("Because N.A.S.A. developed its Apollo Project, the first country to land on the moon was America/Russia") that were matched on contextual constraint and truth-value. Participants read 30 sentences from each of the four conditions mixed with 60 non-counterfactual filler sentences, divided over 6 short runs. Given the a priori hypothesis about the role of the IFG, a region-of-interest (ROI) analysis was performed by extracting average parameter estimates per condition and per subject for 2 LIFG ROIs and their right hemisphere counterparts. These ROIs were based on reported activations within different subregions of the left and right IFG (pars orbitalis/triangularis; BA 45/47) for world knowledge violations in healthy adults during sentence processing (Tesink et al., 2011).

The ROI analyses showed that whereas the left BA 47 showed similar activity increases to counterfactual false sentences and to real-world false sentences (compared to true sentences), the right BA 47 showed a larger increase for counterfactual false sentences. This larger RIFG sensitivity to counterfactual truth-value than to real-world truth-value may reflect the increased processing demands (i.e., inhibiting competing concepts during interpretation; e.g., Jung-Beeman, 2005) associated with counterfactual comprehension. Moreover, whole-brain analyses revealed that counterfactual false and real-world false sentences both elicited activation increases in left and right inferior prefrontal gyrus, middle and superior frontal gyrus, left middle temporal gyrus and in the inferior parietal lobule, revealing a distributed neural circuit for dealing with propositional truth-value.
References:


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Figure 1. (a) ROIs in the current study. Two 10-mm sphere centered at MNI coordinates [44 29 12] (BA 45, top) and [36 26 -8] (BA 47, bottom) and their right hemisphere equivalents (based on Tesink et al., 2011). (b) Effect of truth-value in counterfactual sentences (dark grey bars, ‘CF’) and real-world sentences (light gray bars, ‘RW’) in four ROIs (left/right, BA 45/47). Displayed are the false-minus-true difference score (and 95 % confidence intervals) in average beta parameter value per sentence type and per ROI. (*p < .05).

Figure 2. Effect of truth-value in counterfactual sentences (a) and in real-world sentences (b). Pair-wise comparisons for false minus true sentences (thresholded at P ≤ 0.001 uncorrected). Labels are provided only for significant clusters (corrected for multiple comparisons with a cluster-level FDR P ≤ 0.05). LIFG = Left inferior frontal gyrus. RIFG = Right inferior frontal gyrus. SFG = Superior frontal gyrus. MFG = Middle frontal gyrus. MTG = Middle temporal gyrus. IPL = Inferior parietal lobule.
Readers need more than (just) world knowledge to process subset comparatives

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This research explores the use of conceptual/world knowledge and syntax in processing subset comparatives. Subset comparatives have the form More NP<sub>1</sub> than NP<sub>2</sub>..., where NP<sub>2</sub> is a subset of the set described by NP<sub>1</sub>. In (1a), eagles are a subset of birds.

1. a. More birds than eagles flew over the conservation area.
   b. More birds than airplanes flew over the conservation area.

To distinguish subset comparatives from contrastive comparatives like (1b), comprehenders must use their knowledge of the world or the context (e.g., 2). Syntactic information can also signal a subset comparative. For example, bare plural NP complements to than can be either contrastive or subset comparatives, but full-DP complements to than can only be subsets (compare 3a to 3b).

2. Yankee stadium poses more problems than just empty seats.
   (Brenden Monroe, www.bleacherreport.com, 23 April 2009)

3. a. More birds than an eagle flew over the conservation area.
   b. More birds than an airplane flew over the conservation area.

Further, subset comparatives often contain just in the than-complement, while contrastive comparatives cannot (4). We investigated these signals of subset comparatives in two studies of eye movements during reading.

4. #More birds than just airplanes/an airplane flew over the conservation area.

In Experiment 1 (N = 36), subjects read items like (5), which were either subset or contrastive comparatives with bare plural or singular indefinite (full-DP) complements to than. We predicted that bare plural subset comparatives (5a) would initially be processed as contrastive, with readers realizing late in processing that a subset interpretation is necessary. Singular indefinite complements to than cannot be contrastive comparatives; therefore in (5c) the subset relationship could be exploited earlier in processing. On Region 4 (complement to than), we found longer Go-Past Times (pMCMC < .001) and more Regressions Out (p < .001) for full-DPs (see (6) for means). While Region 4 effects could be due to length, this penalty persisted on Region 5. Consistent with our prediction, a penalty for bare plural subset comparatives emerged in Regressions Out of Region 6, where this condition had the most regressions (interaction p = .02).

5. Experiment 1 Materials (| indicates analysis regions)
   a. It seems that<sub>1</sub> more flowers<sub>2</sub> than<sub>3</sub> tulips<sub>4</sub> grew well<sub>5</sub> in the small greenhouse<sub>6</sub>.
   b. It seems that<sub>1</sub> more violets<sub>2</sub> than<sub>3</sub> tulips<sub>4</sub> grew well<sub>5</sub> in the small greenhouse<sub>6</sub>.
   c. It seems that<sub>1</sub> more flowers<sub>2</sub> than<sub>3</sub> a tulip<sub>4</sub> grew well<sub>5</sub> in the small greenhouse<sub>6</sub>.
   d. It seems that<sub>1</sub> more violets<sub>2</sub> than<sub>3</sub> a tulip<sub>4</sub> grew well<sub>5</sub> in the small greenhouse<sub>6</sub>.

6. Mean Go-Past Times and Regression rates for critical regions, Experiment 1.
In Experiment 2 (N = 24), subjects read items like (7), which manipulated subset vs. contrastive comparatives and the presence/absence of just. Go-Past Times on Region 5 showed a penalty for subsets (pMCMC < .01) and a trend toward an interaction wherein subset comparatives without just were longest (see 8). Regressions Out showed a similar pattern, with effects of subset (p < .05), just (p < .05), and an interaction (p < .01). These immediate effects of the subset comparative may be due to the presence of just in the experiment leading readers to become aware of subset interpretations. We included trial order in our statistical models, and found interactions of order and just such that reading times on Regions 5-6 for conditions with just decreased over the course of the experiment. We believe that just focused readers’ attention on the following NP, allowing them to interpret the NP as a subset, or dismiss it as anomalous.

7. Experiment 2 Materials (| indicates analysis regions)
   a. In the book, it says that | more insects | than | butterflies | are commonly | found | near ponds. | 8 |
   b. In the book, it says that | more mosquitoes | than | butterflies | are commonly | found | near ponds. | 8 |
   c. In the book, it says that | more insects | than | just | butterflies | are commonly | found | near ponds. | 8 |
   d. In the book, it says that | more mosquitoes | than | just | butterflies | are commonly | found | near ponds. | 8 |

8. Mean reading times and regression rates for critical regions, Experiment 2.

<table>
<thead>
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<th>Subset</th>
<th>No Subset</th>
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<tr>
<td>Bare Plural</td>
<td>Sg. Indefinite</td>
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<tr>
<td>Region 4</td>
<td>344</td>
</tr>
<tr>
<td>Region 5</td>
<td>366</td>
</tr>
<tr>
<td>Region 6</td>
<td>1495</td>
</tr>
<tr>
<td>Regressions Out (%)</td>
<td>Region 4</td>
</tr>
<tr>
<td>Region 5</td>
<td>3</td>
</tr>
<tr>
<td>Region 6</td>
<td>38</td>
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Together, these experiments show that the timecourse of interpretation of subset comparatives depends on the presence and type of syntactic indicator. Although norming data showed that our NP2 s were good members of the NP1 sets (rating 4.81/5 for subsets vs. 2.3 for contrastives), subset information does not appear to guide processing immediately unless there is an overt indication of its importance.
Order implicatures are faster (but less accurate) than explicit meaning

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Speakers have many options to communicate the order of events in natural language. For example, a speaker could explicitly communicate the order of events with words such as after or before, e.g., “he took off his clothes before showering”. They could also imply a given order using and, e.g., “he took off his clothes and showered”. The difference is that the order meaning is not obligatory in the and case. For example, “John smiled and waved” can mean that John smiled and waved at the same time (see Bott, Frisson & Murphy, 2009). Of interest for psycholinguists is exactly how listeners go about deriving the order implication: does the order of mention of the events in the sentence determine a fast and automatic iconic representation of the events or do listeners use conversational maxims to derive a slower, pragmatic inference (e.g., Grice, 1975). We use a multiple-response speed-accuracy trade-off method (e.g., McElree, 1993) to compare speed of processing for implicit and explicit temporal order sentences.

Participants made sensicality judgments about four types of sentences: 1) John took off his clothes and showered (implicit sense) 2) John took off his clothes before showering (explicit sense) 3) John put on his clothes and showered (implicit nonsense) and 4) John put on his clothes before showering (explicit nonsense). Participants’ responses were cued by a series of 15 beeps at 300ms intervals starting at the onset of the final word (see Diagram 1). There were 181 quadlets of items (4 versions of each of the 181 items) divided across four lists. Participants’ response times were placed into 300ms bins (corresponding to each beep) and $d$-prime values were calculated for implicit (and) and explicit (before) conditions. Accuracy as a function of time was compared across conditions via individual participant and averaged data model fitting. The results are shown in Graph 1.

The results show two important findings. First, the implicit sentences have lower overall accuracy (lower asymptotic accuracy) than explicit sentences. This suggests that in the implicit condition, participants were able to derive more flexible interpretations to the nonsense items than in the explicit condition. Second, implicit sentences are faster to be derived than explicit sentences, i.e. there is an earlier intercept for the implicit condition, consistent with an iconic account of temporal order implicatures. This is the first demonstration of how implications can be faster to interpret than their explicit equivalents. Further experiments are planned to investigate what causes the speed differences across conditions. We discuss the results in relation to scalar implicatures, which are found to be slow to derive with respect to explicit controls (Bott, Bailey, & Grodner, submitted; Huang & Snedeker, 2009).
References

**Diagram 1 – Multiple Response Speed-Accuracy Tradeoff Method**

**Graph 1 – Model fits with average parameter values for Explicit vs. Implicit conditions.**
It has been shown that the syntactic structure of dative sentences can be primed in production, and that this kind of syntactic priming is influenced by lexical factors. Syntactic priming effects are larger when the same dative verb has to be used in prime and target sentences than when a different verb has to be used (the lexical boost to priming, Pickering & Branigan, 1998). Additionally, the strength of priming varies according to the syntactic preference of the prime verb: The less expected a syntactic structure is, given the verb, the stronger its priming effect (the verb bias effect, Bernolet & Hartsuiker, 2010; Jaeger & Snider, 2008). It is, however, not entirely clear what the exact locus of these effects is: Do they occur at the level of the verb lexeme or at the level of the verb sense?

Many dative verbs have different senses, mostly depending on the abstractness of the arguments they take. The Dutch verb ‘bezorgen’ takes a concrete direct object (a hat) in sentences a and c, while it takes a more abstract object (a heart attack) in sentences b and d, making the latter two sentences more figurative. If different verb senses are represented separately in memory, it should be possible to observe sense-contingent modulations of dative priming. In order to investigate this, we selected 15 dative verbs with a concrete and a more abstract sense from the CONDIV corpus of written Dutch. Each of these verbs was presented to at least 36 students in a written sentence production experiment (Experiment 1). This pretest showed that 14 out of 15 verbs were used in both senses. Overall, in 43% of all dative sentences, the verbs’ more abstract sense was used. On the basis of these data, sense-contingent alternation biases were computed for each verb. Interestingly, 4 verbs had reverse syntactic preferences for both verb senses (e.g. ontfutselen [to diddle/worm something out of somebody] is biased towards a DO dative in its literal sense, but prefers a PO dative when it is used figuratively).

The same 15 verbs were then presented in a syntactic priming experiment (Experiment 2). The target pictures always depicted the concrete meaning of the verbs, and the dative primes always used the same verb as the one on the target picture. The primes were either double object (DO, examples a & b) or prepositional object (PO, examples c & d) datives. Crucially, half of the primes used the dative verb in the same sense (i.e. the concrete sense, examples a & c) as in the target picture, while the other half used the alternate sense (examples b & d). Transitive primes (e) were used as a baseline. The results of this experiment showed significant priming for DO (35%) and PO (8%) primes, and a significant ‘sense’ boost of dative priming: Priming effects were stronger (13%) when prime and target use the same verb sense than when they used different senses of the same verb. This effect is due to a large sense boost in the DO-conditions; the PO-conditions do not benefit from sense overlap (Figure 1). The biases corresponding to both verb senses were correlated with the syntactic choices in the baseline condition. The observed sense boost suggests that the different senses of a verb have separate memory representations and that verb bias and lexical boost effects are actually sense-contingent modulations of syntactic priming (cf. Roland and Jurafsky, 2000).
Figure 1: Priming effects (vs. baseline) for DO and PO primes in the same sense and different sense conditions of Experiment 2.

<table>
<thead>
<tr>
<th></th>
<th>De kok bezorgt de matroo een hoed.</th>
<th>De kok bezorgt de matroos een hoed.</th>
<th>De kok bezorgt de matroos een hoed.</th>
<th>De kok bezorgt de matroos een hoed.</th>
<th>De rechter beschuldigt de matroos.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DO SAME</td>
<td>PO SAME</td>
<td>PO DIFF</td>
<td>DO DIFF</td>
<td>BASE</td>
</tr>
<tr>
<td>a.</td>
<td>De kok bezorgt de matroos een hoed. [The cook gives [lit. delivers] the sailor a hat]</td>
<td>De kok bezorgt de matroos een hoed. [The cook gives a hat to the sailor]</td>
<td>De kok bezorgt de matroos een hoed. [The box gives a heart attack to the judge]</td>
<td>De kok bezorgt de matroos een hoed. [The boxer gives the judge a heart attack]</td>
<td>De rechter beschuldigt de matroos. [The judge accuses the sailor]</td>
</tr>
<tr>
<td>b.</td>
<td>De bokser bezorgt de rechter een hartaanval. [The boxer gives the judge a heart attack]</td>
<td>De bokser bezorgt de rechter een hartaanval. [The boxer gives the judge a heart attack]</td>
<td>De rechter beschuldigt de matroos. [The judge accuses the sailor]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>De kok bezorgt een hoed aan de matroos. [The cook gives a hat to the sailor]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>De bokser bezorgt een hartaanval aan de rechter. [The boxer gives a heart attack to the judge]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>De rechter beschuldigt de matroos. [The judge accuses the sailor]</td>
<td></td>
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</tbody>
</table>

Influential linguistic theories assume a perfect mapping between syntactic and semantic structure, such that each noun phrase maps onto one semantic role [1]. However, in light verb constructions (LVCs) like “Jan gave Elsa a kiss”, the indirect object (“kiss”) forms a complex predicate together with the verb (“give”), such that the subject (“Jan”) is the Agent of both the verb and the indirect object (“kiss”). This results in a mismatch between syntactic and semantic argument structure.

To overcome this mismatch, some theories treat LVCs as listed exceptions, whose idiosyncratic syntax-semantic mapping has to be stored in the lexicon [2,3]. An alternative view is that both the verb and the direct object of an LVC project their argument structures onto the subject, leading to the computation of a shared argument structure through semantic combination [4]. While the former two proposals predict that LVCs should be simple to process than non-light constructions for their reduced syntactic complexity [3] or high frequency [2], the latter assumes that LVCs require more complex semantic composition than typical sentence processing. Consistent with this, previous behavioral data has shown that LVCs elicit increased reading times [5,6].

In the present study we used event-related potentials (ERPs) to examine the online neural processing of LVCs. In particular we were interested in whether, compared to non-LVCs, LVCs would evoke a characteristic signature of complex semantic composition, a larger late negativity [7, 8, 9] that is distinct from the N400 component that would be predicted if LVCs were retrieved from the lexicon as a unit [10].

METHODS: Eighteen German native speakers read sentences, presented word-by-word (450ms, 150ms ISI), using Subject-Object-Verb word order. ERPs were measured to verbs in three constructions: normal LVCs (1); non-LVCs using the same verb (2); and anomalous LVCs using the same verb (3). Sentences were fully counterbalanced across three lists, each of which contained 120 critical items and 80 filler scenarios. A context sentence, presented as a whole, preceded each critical sentence, and the main clause followed it. The cloze probability for verbs was 53% in LVCs, 20% in non-LVCs, and zero in anomalous LVCs. Participants’ task was to classify every scenario as natural or unnatural.

RESULTS: Subjects rated LVCs and non-LVCs as equally natural, and the anomalous LVCs as unnatural. Construction type did not modulate N400 amplitude evoked by critical verbs. Instead, within the 500 to 900ms time window, verbs in LVCs elicited a large, widely distributed negativity, compared to verbs in non-LVCs, while anomalous LVCs evoked a posteriorly distributed positivity between 500 and 900ms (a P600). Additionally, LVC evoked a sustained negativity on words following the critical verb.

CONCLUSIONS: These findings indicate that, despite their frequent usage, LVC processing is very different from non-LVC processing. The effect's timing, scalp distribution and prolonged duration indicate that argument sharing processes are distinct from detecting semantic anomalies that evoke a classical N400 [11]. The results are most consistent with theories in which LVCs involve complex semantic composition [4], rather than retrieval from the lexicon as a unit [2, 3].
EXAMPLE SENTENCES:

Context sentence: Das Flugzeug war bereits hoch über den Wolken. 
The airplane was already high over the clouds (i.e., high in the sky)

(1) LVC sentence:
Als die Stewardess eine Ansage machte
When the stewardess an announcement made,

(2) Non-LVC sentence:
Als die Stewardess einen Kaffee machte
When the stewardess a coffee made,

(3) Anomalous LVC sentence (ungrammatical in German due to semantic restrictions):
*Als die Stewardess ein Gespräch machte
*When the stewardess a conversation made,

Continuation of each sentence: ging gerade die Sonne auf.
went just the sun up (i.e., the sun was just rising)

Figure 1. Averaged waveforms on the Central Electrode to verbs in the LVCs (dashed line), non-LVCs (solid line), and anomalous LVCs (dotted line). Starting at 500ms after verb onset, there was a widespread and sustained negativity for verbs in the LVCs, and a P600 to verbs in the anomalous constructions.

References:
Different results have been reported between the offline questionnaire tasks eliciting preferred interpretations and the studies measuring reading speed (e.g., self-paced reading and eye-tracking studies) on the relative-clause (RC) attachments in the complex noun phrases (NPs), i.e., NP1 of NP2 followed by a relative clause, such as “the teacher of the student who was singing a song”. In the offline questionnaire studies, low attachments (LA) were preferred over high attachments (HA) in L1 English (Cueto & Mitchell, 1988) and high attachments were preferred over low attachments in L1 Japanese (Kamide & Mitchell, 1997). The tendencies, however, were reversed in some online studies, for instance, reading times were faster in the LA-biased condition than in the HA-biased condition in L1 Japanese. The involvement of working memory (WM) capacity also made the results differ, i.e., HA preferences rose with the increase of working memory (WM) capacity in L1 English (Traxler, 2007) and in L1 Japanese (Nakano, 2008).

In contrast, in L2 studies the discrepancies found in L1 studies have not been reported. Offline judgment tasks and online self-paced reading tasks in English (Felser et al., 2003) showed that advanced L2 learners (70% or more correct in the Oxford Placement Test) did not show any particular preference when NP1 and NP2 were linked with the preposition of (the GEN condition as in (1)), whereas when the two NPs were linked with the preposition with (the PP condition as in (2)), low attachments were preferred. The results also indicated native speakers’ preferences for low attachments over high attachments in both conditions. The difference between L1 and L2 studies calls for further investigations on L2 RC attachments with different language speakers. Structural differences between English and Japanese and different preferences by native speakers of English and Japanese enable us to contrast RC attachment preferences in L1 and L2.

We investigated RC attachments in the LA-biased (1a & 2a) and HA-biased (1b & 2b) sentences in English by using an offline questionnaire task and an eye-tracking technique with lower- and upper-level Japanese learners of English as well as native speakers of English as participants. An English reading-span test was also conducted for WM capacity.

The results for the questionnaire revealed that the native speakers preferred low attachments both in the GEN and PP conditions, regardless of their WM capacity, and that the high-span upper-level learners indicated HA preferences in the GEN condition and LA preferences in the PP condition. The rest of the participants showed no particular preferences for the GEN condition and LA preferences in the PP condition.

First-pass time, first-pass regressions, regression path time and total reading time were computed for each region. Region 6 was critical because the verb form, e.g., “was”, solved
the ambiguity of the two antecedents. It has been assumed that the four types of data are related to different cognitive processing stages (Pickering et al., 2004). We found the following results in Region 6 and/or 7.

Native speakers of English showed no particular preferences in the first-pass time. They showed no preferences in the GEN condition but the LA preference in the PP condition for the first-pass regressions. For the regression path time they showed the LA preference but they did not indicate any preferences in the PP condition. As for the total reading time, for the GEN condition they indicated the HA preference, and for the PP condition the LA preference. Upper-level learners showed the HA preference in the GEN and the PP conditions for the first-pass time. They showed no preference in either the GEN or the PP condition for the first-pass regressions. For the regression path time as well as for the total reading time, they showed the LA preference in the GEN condition but no preference in the PP condition. Lower-level learners showed no preference in either the GEN or the PP condition for the first-pass time, the regression path time or the total reading time. They indicated no preference in the GEN condition but showed the LA preference in the PP condition for the first-pass regressions.

The upper-level learners made attachment decisions in the early stage of processing, whereas the native speakers did not until they had read the sentences through. In other words, the two groups took different strategies. The attachment decisions at the initial stage (reflected in the first-pass time) lead us to assume the incremental parser for the upper-level learners, and the shift from HA to LA preferences indicated the later occurrence of a reanalysis. When the native speakers encountered structural ambiguities, even if their parser was also incremental, they looked for cues to solve the ambiguities. No preference found in the lower-level learners in the GEN and the PP conditions could be due to the difficulties of the experimental sentences for them to decide antecedents.

Different attachment preferences for the three participant groups could be attributed to varying proficiency levels and working memory capacity. Consistent with Traxler (2007), the results for the native speakers of English indicated an increase of HA preferences and a possible influence of different WM capacity on the attachment decisions. In contrast, no clear influence of WM capacity on the attachment decisions was found in the non-native speakers, which could result in the above-mentioned different attachment preferences.

References:
Examining the nature of variability in gender and number agreement in native and nonnative Spanish
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We investigate the acquisition of gender and number agreement by English-speaking learners of Spanish in order to examine the nature of variability in learners’ comprehension of agreement morphology. Previous studies in L2 Spanish have observed morphological variability even at high proficiency levels and have reported that the errors follow a systematic pattern (McCarthy, 2008). Specifically, masculine and singular agreement morphemes are incorrectly extended to contexts that require feminine or plural agreement (ex. 1b, 2c). These errors are argued to reflect the suppliance of ‘default’ morphology (McCarthy, 2008; White et al., 2004). McCarthy (2008) proposed that the opposite pattern, which she defined as ‘feature-clash’ errors (ex. 3b, 3c), is less frequent in L2 learners, and presumably easier for learners to detect as ungrammatical.

Some researchers argue that the source of these errors is a deficient L2 grammar (Franceschina, 2002; McCarthy, 2008), while others propose that the deficiency is computational (McDonald, 2006; Hopp, 2010; White et al., 2004). In support of the second account, Hopp (2010) found that native speakers behaved similarly to L2 learners when they performed grammaticality judgments under an increased processing burden, suggesting that variability in learners may be caused by processing being more taxing in the L2.

Following Hopp (2010) we manipulated the conditions under which participants were asked to judge sentences targeting agreement. Three separate groups of Spanish natives took a speeded grammaticality judgement task in which sentences were presented word by word at three different presentation rates (Table 1). L2 leaners took either a speeded grammaticality judgment task (Speed 1) or an untimed GJ task that included the same sentences.

Table 1. Tasks and Participants

<table>
<thead>
<tr>
<th>Tasks &amp; Groups</th>
<th>Speed 1 (155ms/word +17ms/character)</th>
<th>Speed 2 (71ms/word +17ms/character)</th>
<th>Speed 3 (37ms/word +17ms/character)</th>
<th>Untimed GJ Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natives</td>
<td>n=12</td>
<td>n=36</td>
<td>n=36</td>
<td>—</td>
</tr>
<tr>
<td>L2 Low</td>
<td>n=16</td>
<td>—</td>
<td>—</td>
<td>n=7</td>
</tr>
<tr>
<td>L2 Int.</td>
<td>n=16</td>
<td>—</td>
<td>—</td>
<td>n=4</td>
</tr>
<tr>
<td>L2 Adv.</td>
<td>n=15</td>
<td>—</td>
<td>—</td>
<td>n=4</td>
</tr>
</tbody>
</table>

The tasks included 108 experimental sentences manipulating agreement between a noun and a predicative adjective (ex.1-4); 108 fillers were also included.

(1) Julio dijo que vio una tela que era a) fina (gram.) b)*fino (gen. default sg.) c)*finas (num. clash fem.)
Julio said that he saw a fabric that was… *finese *fines

(2) …unas telas que eran a) finas (gram.) b)*finos (gen. default pl.) c)*fina (num. default fem.)

(3) Juan…vio un colegio que era a) antiguo (gram.) b)*antigua (gen. clash sg.) c)*antiguos (num. clash m.)
Juan …he saw a school that was old *oldse *oldsp

(4) unos colegios que eran a) antiguos (gram.) b)*antiguas (gen. clash pl.) c)*antiguo (num. default m.)
This methodology allowed us to investigate the quantitative and qualitative effects of speed on native speakers’ and L2 learners’ sensitivity to default versus feature-clash errors, and examine similarities between the groups. Preliminary results show quantitative effects of speed for both groups. Natives were significantly less sensitive to errors as speed increased (Fig. 1/3). For the learners, all proficiency levels showed increased sensitivity in the untimed task, with individuals in the advanced group showing target-like performance. As for the qualitative nature of the errors, differences between ‘default’ and ‘feature-clash’ errors emerged for the natives in Speed 2 and the intermediate L2 group in Speed 1. For number, in both groups, participants were more sensitive to feature-clash (1c & 3c) than default (2c & 4c) errors. In contrast, for gender, both groups were more sensitive to default (1b & 2b) than feature-clash (3b & 4b) errors. The quantitative and qualitative similarity that emerges in both groups is more consistent with a computational account of variability.

Fig. 1. d’ scores for number for Spanish natives Fig. 2. d’ scores for number for learners on speeded GJ

Fig. 3. d’ scores for gender for Spanish natives Fig. 4. d’ scores for gender for learners on speeded GJ

\[ d' \text{ scores reflect the difference in the average acceptance rates between each ungrammatical condition and its grammatical counterpart. A } d' \text{ score near zero represents performance at chance, while perfect performance results in a } d' \text{ score of approximately 4.0.} \]

REFERENCES


Language order effects in letter fluency in Dutch-English bilinguals

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Research on bilingual language processing has shown that lexical representations from both languages become activated even when the task requires processing in one language (e.g., Van Assche, Duyck, Hartsuiker, & Diependaele, 2009). This dual-language activation could result in a processing disadvantage for bilinguals compared to monolinguals in production studies. For example, bilinguals have slower picture-naming times (e.g., Ivanova & Costa, 2008) and reduced verbal fluency scores (e.g., Gollan, Montoya, & Werner, 2002) than monolinguals. The verbal fluency task is becoming increasingly important as a measure to investigate cross-language interference in bilinguals. In this task, participants are given 1 min to verbally generate as many members of a specified semantic category (e.g., animals) or words beginning with a specific letter (e.g., words that begin with the letters F). Previous studies have typically considered performance of bilinguals compared to monolinguals (e.g., Gollan et al., 2002), but few studies have contrasted L1 and L2 performance within participants (e.g., Sandoval, Gollan, Ferreira, & Salmon, 2010).

In the present study, we tested the hypothesis that between-language interference influences bilingual fluency performance in dominant L1 and non-dominant L2 language production. More specifically, we investigated the effects of language order (L1-L2 versus L2-L1) and of letter repetition (same or different letters in both languages) in the fluency task. Sixty relatively proficient but unbalanced Dutch-English bilinguals performed a verbal letter fluency task. The effect of language order was investigated by testing half of the subjects in L1 (Dutch) first and then in L2 (English), while the other half was tested in L2 first and then in L1. The effect of letter repetition was investigated by testing the same (i.e., F A S) and different letters (i.e., B I L in L1-fluency and M O N in L2-fluency) in L2- and L1-fluency. The letters in L1 and L2 were selected so that the number of words that begin with that letter in L1 and L2 was matched (based on the CELEX lexical database, Baayen, Piepenbrock, & Van Rijn, 1993). The results for L1-fluency showed significantly fewer correct responses for the same letter trials (i.e., the letters F A S tested in both L1 and L2) when L1-fluency was tested after the L2 block than when L1-fluency was tested before the L2 block. There was no significant difference in number of correct responses for the different letter trials (i.e., the letters B I L were tested in L1 and the letters M O N in L2). There were no significant effects of language order or letter repetition for L2-fluency results. The graph below shows the mean number of correct responses in L1 and L2 for the same and different letters in the two presentation orders.
The results of this study show that only the dominant L1 suffers between-language interference. Moreover, this interference is specific because we only observed an effect of language order when the same letters were repeated in the fluency trials. This seems to indicate that the locus of interference is not the activation of the whole language. Instead, the results provide evidence for cross-language interference in the form of direct competition between lexical representations from both languages. The data show that bilinguals are strongly affected by recent production and that this effect is asymmetrical by language. An interpretation of the results is provided within the framework of current models of language production.

References:
L2 Influences on L1: Evidence from Bilingual Sentence Processing
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Abstract:

The study of L1 influences on L2 has a long tradition in bilingualism and second language acquisition research (cf. Odlin, 1989; Jarvis & Pavlenko, 2007). L2 influences on L1, on the other hand, have only started receiving deeper attention over the past years (cf. Cook, 2003; Pavlenko & Jarvis, 2002). However, much of the evidence for L2 influences on the L1 derives from bilingual subjects who are immersed in the L2 environment (cf. Hartsuiker, Pickering & Veltkamp, 2004). This state of things suggests that L2 influences on L1 occur primarily in situations where bilinguals are undergoing first language attrition, or when bilinguals’ L2 become their dominant language.

This poster reports a study that provided an opportunity for the exploration of evidence of knowledge of L2 activation by Brazilian Portuguese-English bilinguals who achieved high proficiency in their L2 (English), but who were immersed in the L1 dominant environment. The poster reports findings from a study focusing on an argument structure pattern – the induced action alternation. According to Levin (1993), the induced action alternation is a subset of the causative construction, and it applies to a set of verbs expressing manner of motion (verbs such as “run”, “walk”, “fly”, and “jump”), licensing sentences such as “The researchers ran the mice through the maze”. The study examined the extent to which bilingual subjects departed from constraints imposed by their L1 grammar as they processed sentences instantiating this alternation. For sentences such as this to be processed, the reader/listener must rely on a grammar that allows for late closure of the VP headed by “run”, with incorporation of the second NP as direct object of the head verb. As demonstrated by Souza (2011), this is not the case of the grammar of Brazilian Portuguese, in which verbs expressing manner of motion are mostly intransitive, therefore not licensing direct object.

The experiment reported in this poster involved a self-paced moving window reading task consisting of two sets of 32 sentences, one for English and the other for Brazilian Portuguese. 8 sentences in the English set were exemplars of the induced action alternation with verbs of manner of motion, and 8 sentences in the Brazilian Portuguese set mimicked this construction with corresponding verbs (e.g.: “The researchers ran the mice through the maze”/ “Os pesquisadores correram cobaias em um labirinto”). All 32 sentences in both sets followed a Sub-V-Obj-PP pattern. The alternating verbs used in the study were “run”, “walk”, “race”, “swim”, “leap”, “jump”, “fly”, and “dance”. All such verbs, along with their Portuguese counterparts, are high frequency lexemes, belonging to the 5,000 more frequent types of the two languages, and their participation in the induced action alternation in English was testified in the Corpus of Contemporary American English (COCA). 44 subjects divided in five groups participated in the study. The subjects were speakers of Brazilian Portuguese with virtually no knowledge on English (n=9), native speakers of English and English dominant bilinguals living in the USA (n=8), low proficiency Brazilian Portuguese L1 users of English L2 living in Brazil (n=9), and high proficiency Brazilian Portuguese L1 users of English L2 living in Brazil (n=18). The speakers of Brazilian Portuguese with little or no knowledge of English, and half of the high proficiency Brazilian Portuguese L1 users of English L2 read the sentences in Portuguese. All other subjects read sentences in English. All sentences were fragmented as NP1/V/NP2/PP. Therefore, participants visualized sequences of frames such as “1: The researchers/2-run 3-the mice/4-through the maze. Reaction times to the third frame, i.e. NP2, were calculated, and inter-group comparisons were made.

The results obtained are as follows:

![Graphs showing reaction times for run, walk, race, and swim actions in L1 and L2 contexts]
The results support Souza’s (2011) findings concerning the gradual development of representation of the induced motion by Brazilian Portuguese users of L2 English. It also demonstrates that lower proficiency bilinguals experience high processing costs when integrating a potential object NP into VPs headed by verbs of manner of motion. Therefore, they parallel monolinguals processing of similar constructions. This result supports the hypothesis that L1-to-L2 influences lead to underrepresentation of the induced action alternation with verbs of manner of motion, in convergence with findings from offline studies with speakers of Spanish and English reports in Montrul (2001). A noteworthy finding, however, is that the reaction time patterns of the high proficiency L2 users not only departed from their L1 when they read in English – indicating a diminished effect of the L1-based constraint – but they also showed behavior that corresponds to native English speaking monolinguals and English dominant bilinguals reading in English. Such behavior of high proficiency Brazilian-English bilinguals was found both when they were reading sentences in their L2 and when they were reading sentences in their L1. These results can be interpreted as activation of L2 knowledge of the induced action construction with verbs of manner of motion during sentence processing irrespective of the language of the stimuli, or even as loosening of the L1 constraint experienced by monolinguals of Brazilian Portuguese and less proficient bilinguals. Although further investigation is needed for a more thorough explanation to be proposed, the present study can be viewed as providing evidence that a high level of L2 proficiency rather than immersion in the L2 environment is the key variable in activation of knowledge of an L2 during L1 processing.

References:


Temporal alignment of prosody and gesture in Catalan-babbling infants

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In recent years, several studies have worked on the relation between gesture and speech in communicative acts, showing that both are tightly related (McNeill, 1992; Kita, 2000; Loehr, 2004). McNeill (1992) proposes a growth point, i.e. a minimal unit of an imagery-language dialectic, a package that has both linguistic categorical and imagistic components. He gives five main reasons for the growth point: (1) gestures occur with speech in 90% of the cases, (2) gesture and speech are semantically and pragmatically co-expressive, (3) gesture and speech are phonologically synchronous, (4) gesture and speech develop together in children, and (5) also they break together in aphasia. Right after birth, children do not gesture in a communicative way. It is not until 0;8-0;10, coinciding with the development of intentionality, that children gesture to influence the mental state of others, producing deictic gestures such as pointing, giving, showing, or requesting. At around 1;0, children start reproducing actions associated with specific objects, called object-actions. From 1;4 to 1;8, children mostly produce pointing gestures and they start producing iconic gestures, which increase a lot between 3;0 and 5;0. And it is it not until children are 5 years of age that they produce metaphoric gestures and beats (Bates, Camaioni & Volterra, 1975; Iverson & Goldin-Meadow 2005; Sansavini, Guarini & Stefanini, 2010; Tomasello, Carpenter & Liszkowsky, 2007). Some research in the field has focused on the temporal synchronization between gesture and intonation in adult communication (Bolinger, 1986; Kendon, 1980; Loehr, 1994). Whereas in adult communication most gestures were found to occur during speech, previous work suggests that it is not until the end of the one-word period that children primarily use gestures in combination with speech for communicative purposes, and that gesture and speech are temporally synchronized, i.e. that gestural strokes occur during or after the stressed syllable of the word they produce (Butcher & Goldin-Meadow, 2000). Yet, no studies have focused on the relation between prosody and gesture at the babbling period or on the precise temporal alignment between intonation peaks and gestural strokes at this period.

This study investigates the communicative acts where gesture and speech occur together at the babbling stage. To do this, two analyses were run: first, a pilot study with adults; second, an analysis of a corpus of four Catalan-learning children. In the adult analysis, 5 Catalan-speaking adults produced 240 occurrences of pointing gestures accompanied by speech. Results show that these speakers synchronized the stroke of the pointing gesture with the pitch accent in 98% of the cases, and that the pitch peak tended to align at the beginning of the stroke. In the children’s analysis, all communicative acts produced when children were 0;11, 1;1, 1;3, 1;5, and 1;7 were classified as ‘gesture-only’, ‘speech-only’, or ‘gesture-speech combinations’. Then, position of the pitch peak, position of the gestural stroke, type of speech act, and gesture type of deictic ‘gesture-speech combinations’ were analyzed. All meaningful words produced by children during the 30-minute recording session were also annotated to determine the lexical developmental points. Results showed that at 0;11, ‘gesture-speech combinations’ represent only 43.26% of the cases of the communicative acts containing gesture, whereas at age 1;1 they are already 54.8%, and this tendency is more evident in the late babbling and one-word stage (see figure 1). Chi-squared tests of independence were carried out in order to investigate whether these proportions differed significantly from each other across ages. Results showed that the proportion of gesture-only acts and gesture-speech combinations were statistically significant at 0;11 (χ²(1, N=594)=10.774, p=.001), 1;3 (χ²(1, N=304)=17.053, p=.001), 1;7 (χ²(1, N=191)=31.642, p<.001), almost significant at 1;1 (χ²(1,
N=310)=2.903, p=.088), and non-significant at 1;5 (χ²(1, N=281)=0.801, p=.371). Across ages, the statistical analyses revealed that the change in tendencies observed between 0;11 and 1;1 was statistically significant: (χ²(1, N=477)=81.361, p<.001) for gesture-only acts and (χ²(1, N=427)=17.726, p<.001) for gesture-speech combinations. The analysis of the alignment showed that in the late babbling stage most children produced pitch peaks while performing the stroke of the gesture (see figure 2), thus aligning adequately. A closer analysis showed that at the beginning of the babbling stage, the pitch peak tends to align at the end of the stroke, moving to the beginning of the stroke at the late babbling stage (see figure 3). In conclusion, gesture-speech combinations are more often produced than gesture-only acts already at the late babbling stage, and adequate alignment was shown to emerge in the late babbling and early one-word period (earlier than predicted in Butcher & Goldin-Meadow, 2000). Specifically, as the child turns into the one-word period, the f0 peak is progressively aligned at the beginning of the stroke (as in the adult data). Thus, we claim that at the end of the babbling stage, temporal alignment between gesture and prosody starts being adult-like.

![Figure 1. Longitudinal evolution of ‘gesture-only’ and ‘gesture-speech combinations’ communicative acts.](image1)

![Figure 2. Evolution of the position of the pitch peak compared to the stroke.](image2)

![Figure 3. Longitudinal evolution of the alignment of the pitch peak and the stroke.](image3)

**REFERENCES**


Electrophysiological evidence for syllabic segmentation in French-learning 12-month-old infants

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Previous behavioral studies have shown that the ability to segment words as cohesive units from fluent speech emerges between 12 and 16 months in French (Nazzi et al., 2006). Given the importance of these results for lexical acquisition, we used high-density ERPs to reassess this issue in French-learning 12-month-olds, and specify the neuronal correlates of entire word (Experiment. 1) versus syllable-based (Experiments. 2 & 3) segmentation.

In Experiment. 1, infants were familiarized with repetitions of various bisyllabic words (‘guitare’), and then tested with sentences, half containing the target words (‘guitare’) and the other half ‘control’ words (‘dorade’). In the test phase, mean ERPs were calculated for target versus control syllables, for both positions: initial versus final syllables. An ANOVA with the factors of familiarity and area (anterior, posterior) revealed for the initial syllables a significant effect of familiarity. Mean amplitude being more negative for target than for control syllable, all over the scalp, p = .01, for the 350-500 ms window. No effects were found for the final syllables.

In Experiment. 2, in order to assess syllabic segmentation, infants were familiarized with the isolated final syllables of the previous target words (‘tar’) and tested as in Experiment. 1. Analyses similar to those conducted in Experiment. 1 revealed for the final syllables a significant interaction between familiarity and area. Mean amplitude being more negative for target than for control syllables on the left anterior area, p = .039 for the 350-500 ms window. No effects were found for the initial syllables.

Theses results suggest that either infant were performing in the Exp.1 whole word segmentation, or that segmentation of the second syllable was masked by the reaction to the first syllable. Overall, these ERP data show evidence of whole word segmentation while also confirming syllabic-based segmentation. When comparing segmentation results for initial syllable (Exp. 1) and final syllable (Exp. 2), it appears that the timing is the same but the localization is different. So, can we expect that the ERP responses will be similar or not when the same syllables are either in the initial or final positions of bisyllabic words?

In Experiment. 3, to evaluate the effect of syllable position in word segmentation, infants were familiarized with various syllables (‘di’) and then tested on target sentences (half containing a bisyllabic word whose initial syllable was the target syllable: ‘diva’; half containing a bisyllabic word whose final syllable was the target syllable: ‘radis’) and control sentences (containing bisyllabic words with the same control syllable in either initial or final position). For the test phase, mean ERPs were calculated for target versus control syllables, for both positions: initial and final syllables, and ANOVAs with the same factors as explored earlier were performed. For initial syllables, an ANOVA with the factors of familiarity and scalp area on mean amplitude for the 450-600 ms window found an interaction between familiarity and area (p = .04). Mean amplitude being more positive for target than control words on the right anterior area (p = .03). For final syllables a marginal interaction between familiarity and area for the 650-800 ms window (p = .051) was found. Mean amplitude being more positive for target than for control words on the posterior median area (p = .03). The present results support the proposal that French-learning 12-month-olds segment syllables. The differences in timing and topographical signatures of the ERP responses for initial and
final syllables suggest that infants are responding differently to syllable positions within words, which could be explained by coarticulation processes. To conclude, the results of the Experiment 1 are the first to establish that French-learning infants segment words as units by 12 months. The data of the Experiments 2 and 3 support the proposal that they segment syllables, while establishing that syllabic segmentation differs according to the position within the word.

References:
His father’s daughter and her mother’s son: 
Gender attraction errors in child English
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Production errors provide a window into the mechanisms of language computations and their development (Dell, 1986; Fromkin, 1971; Garrett, 1990). While a number of studies have investigated the properties of subject-verb agreement errors in the mature and the developing systems, the mechanisms of nominal gender agreement between a nominal possessor and the possessive pronoun it antecedes (as in 1)) have received little attention in the literature.

1) Bob sent a present to his sister
2) *Bob sent a present to her sister

Adult monolingual English speakers occasionally produce gender-agreement errors (as in 2)) (i.e., 5%, see Sleve et al., 2007) while adult L2-English learners produce errors like 2) 10-15% of the time, possibly as a result of L1 transfer (Antón-Méndez, 2010). The present elicited production study investigates whether errors like 2) also occur in the productions of monolingual child learners of English. The existence of such errors in child speech would indicate (a) that gender-agreement errors in learners are not caused solely by L1-transfer, (b) and that child and adult learners compute agreement on the basis of similar principles.

Method and Results

Fourteen monolingual English-speaking children (mean age: 4;5) were prompted to produce 12 experimental items each (see Table 1 for design.) In four items the possessor and the possessee matched in gender (Match Condition: FEM-FEM, as in 3)). In eight items they mismatched (Mismatch Conditions: FEM-MASC, as in (4), and MASC-FEM, as in 5)):

3) Target: Katie is hugging her mom Gender error: his dad
4) Target: Katie is hugging her dad Gender error: his dad
5) Target: John is hugging his mom Gender error: her mom

The dependent variable was percent accuracy. Children produced significantly more errors in the mismatch conditions than in the match condition ($t_{13} = 2.8, p=.013$), but the difference between the two mismatch conditions was not significant ($t_{13} = .86, p = .41$), suggesting that children do not use the masculine pronoun as a default (see Fig. 1). Adult controls (N=7), in contrast to the children, produced no agreement errors.

Discussion

Children learning English surprisingly often (35%-55%, depending on condition) produce a possessive pronoun that erroneously agrees with the gender of the noun it precedes and modifies, rather than with its antecedent. A unitary explanation for possessive gender agreement errors in L1 and L2 English-learners casts doubt on a L1 transfer explanation for such errors in L2 learners; in contrast, we hypothesize that child and adult learners draw on the same set of grammatical hypotheses and language production mechanisms. Additional analysis show that children corrected an erroneous first attempt (as in 6) around 20% of the time, while never changing a correct first attempt:

6) The brother is kissing her grandmother
   His grandmother

This suggests that some of their agreement errors reflect a systematic speech error instead of a grammatical option in child English. The remaining errors may reflect a non-target grammar.
Table 1: Experimental Design

<table>
<thead>
<tr>
<th>Possessor Gender</th>
<th>Possessee Gender</th>
<th>Items (N)</th>
<th>Correct</th>
<th>Gender Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Match Condition</td>
<td>MALE</td>
<td>4</td>
<td>John is hugging his mom</td>
<td>John is hugging her mom</td>
</tr>
<tr>
<td></td>
<td>FEM</td>
<td>4</td>
<td>Katie is hugging her dad</td>
<td>Katie is hugging his dad</td>
</tr>
<tr>
<td></td>
<td>MALE</td>
<td>4</td>
<td>John is hugging his mom</td>
<td>John is hugging her mom</td>
</tr>
</tbody>
</table>

Figure 1: Percent Gender Errors by Condition

References:
Hebrew provides a challenge to theories of language variation and language acquisition. Subjects are required in some person-tense combinations but not others: in the present tense, subjects are required for all three persons, but in the past and future tenses, subjects are only required in 3rd person. The 3rd person also has exceptions, where subjects must be absent (such as in impersonal constructions and expletives) or may be absent (as in embedded clauses where the subject is co-referential with the matrix subject). The Borer-Chomsky Conjecture (Baker, 2008) hypothesizes that features of functional categories determine a range of phenomena, including the types and locations of empty categories. Such functional categories include agreement features, specifically person (e.g., Levy & Vainikka, 1999/2000; see papers in Biberauer, et al., 2010), and tense (Shlonsky, 2009).

What is the role of person and tense in the development of children's knowledge and production of subjects? We use the acquisition of Hebrew as a case study. We suggest that children determine the distribution of subjects by testing the input for the presence of subjects in each cell of a matrix defined by the intersection of tense and person. If children's parses are aided by tense-person information, they should show the adult pattern from the onset of acquisition, but should have difficulty with 3rd person because of apparent exceptions. If children use only person features to parse their input, given the distinct morphological characteristics of each tense in Hebrew, they should provide the same percentage of subjects within each tense. Similarly, if children use only perceptual properties of individual verbs and communicative functions to make grammatical generalizations and lack abstract syntactic knowledge (Abbot-Smith & Tomasello, 2006), given the distinct tense morphology, they should either provide the same percentage of subjects within each tense, or copy the parents, including exceptions.

Method. We taped 19 children (aged 1;10 to 2;7, with MLUWs ranging from 1.40 to 3.01) in approximately 1½ hours of spontaneous conversation with an adult. We tabulated children's main clauses with a verb and the number of subjects for both verb types and tokens, separately by tense (present vs. past) and person (1st vs. 3rd). For verb types, we established whether a verb was always used with a subject or not.

Results and discussion. The results for verb types (Fig.1) and tokens (not shown, but similar) confirm that from the onset of combinatorial speech, children show the adult pattern in their provision of subjects, not just for a few verbs but across the board. Children do not overgeneralize based on person features alone; they are sensitive to both person and tense. Their use of subjects also increases as a function of MLUW, suggesting relaxation of performance constraints as acquisition proceeds. Children's performance is weakest in 3rd person present, where the parental input contains omissions in special contexts that are apparently not categorized as such by the children. Children are thus not simply copying their input on a verb by verb basis, but using person and tense features in parsing.
Fig. 1. Percentage of verb types always used with a subject

References:
The acquisition of novel constructional patterns by five-year-olds and adults

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While computational models of language development invariably cite input-related factors as affecting the acquisition of linguistic generalizations, isolating these effects experimentally can be daunting. In particular, it is difficult to separate effects of input from the age of the learners in question. Here, we use a novel construction learning paradigm (Boyd, Gottschalk, & Goldberg, 2009; Wonnacott, Newport, & Tanenhaus, 2008)—which affords significant experimental control over the input—to explore the effects of input structure and learners’ age on the development of clausal syntax.

Our experiment compared the learning of five-year-old and adult participants. The procedure consisted of exposure and test blocks. Exposure was to 64 exemplars of a novel VOS construction across three days. The construction described APPROACH events in which an agent moved towards a goal in a manner denoted by a novel verb (English nouns were used). In exposure trials the experimenter enacted approach scenes using stuffed animals, then described them for participants with an instance of the novel construction—e.g. a bear flew towards a frog with the description “Wugging frog bear.” Input structure (specifically type frequency) was manipulated as a between-participants variable: half of all participants were exposed to exemplars using the same novel verb; half were exposed to equivalent input using four equally frequent verbs.

Testing occurred after exposure on days one and three, and consisted of three tasks. Actout comprehension: the experimenter produced an exemplar of the novel construction and participants enacted its meaning. Production: the experimenter enacted an approach event and started a description by producing a verb; participants’ job was to finish it with the appropriate nominals. Forced-choice comprehension: participants heard an exemplar of the novel construction, then indicated which of two movies matched it. Each test contained items involving both familiar verbs (i.e., from the exposure set) and new verbs (not from the exposure set). This made verb novelty a within-participants variable.

Across conditions and test types, five-year-olds showed learning of the novel construction. However, performance was tentative and was affected by the quantity and structure of the input. First, performance was stronger on day three than day one (with both familiar and new verbs, and in both input conditions). Second, on both days there was an interaction between input structure and verb novelty, with children showing particular reluctance to extend the construction to new verbs when their input had exemplified that construction with a single verb. In contrast, adults showed strong performance across the board, with no effect of day of testing, and no difference in usage of the construction with familiar and new verbs in either input condition.

Although other experiments have found that input structure also affects generalization in adults (Wonnacott, et al., 2008), the current results demonstrate that given matched input, adults generalize to a greater extent than children do. This outcome suggests that conservatism in children’s learning (Tomasello, 2000) may be a function both of the statistical structure of their input, and of their age.
References


Infants learn combinatorial properties of verbs from listening

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On the syntactic bootstrapping hypothesis, knowledge of verbs’ combinatorial behavior guides early sentence comprehension: For example, two-year-olds assign different interpretations to novel transitive versus intransitive verbs [1]. Syntactic bootstrapping requires that children learn about verb syntax independent of other information about verb meaning. Recent experiments yield strong evidence for the independent encoding of verb syntax. 28-month-olds heard dialogues in which two people described unseen events using a novel verb; children remembered the syntactic information encountered in these dialogues, and used it to interpret the verb when later encountering it in a referential context [2]. Children who had heard the verb used transitively looked longer at a two-participant action (relative to a one-participant action) than did children who had heard the new verb used intransitively. 21-month-olds succeeded in a similar task, when the dialogues immediately preceded each novel-verb test phase [3]. The present study built on this evidence to explore infants’ independent encoding of verb syntax: We asked whether 22-month-olds could learn about a verb’s syntactic privileges simply through hearing its use in sentences, and (1) attach their learning from the dialogue phase to a new lexical entry for the unknown verb, (2) retain that information in memory over a delay, and (3) retrieve that information only if the same verb is invoked in later test trials.

Infants watched dialogues in which interlocutors used a made-up verb in transitive (“Jane blicked the baby!”) or intransitive sentences (“Jane blicked!”; Fig-1). Next, infants received two familiar-verb practice trials presented without dialogues; these instituted a brief delay between dialogue and test. Finally, in test trials, infants saw two simultaneously-presented events: one showed a two-participant causal action and the other a one-participant action. The one-participant action was enacted by one person in Experiment 1 and by two people simultaneously in Experiment 2 (to control for the number of people in each video). We tested children’s lexical encoding of what they learned during the dialogues by comparing experimental conditions in which children heard the novel verb from the dialogues in isolation (“Find blicking!”), to control conditions in which infants heard neutral audio at test (“What’s happening?”; Expt-1), or heard a different novel verb (“Find kradding!”; Expt-2).

Infants’ interpretations of the novel verb were guided by the dialogues: Those who had heard the verb used transitively looked reliably longer at the two-participant event when they heard the verb again than did those who had heard the verb used intransitively. No such dialogue effect appeared if infants heard no novel verb (Expt-1) or heard the wrong novel verb (Expt-2).

Thus 22-month-olds encoded information about verb syntax, independent of access to referential information about verb meaning: they learned combinatorial facts about an unknown verb via listening experience alone. Crucially, infants attached this information to a tentative lexical entry for the novel verb they heard in the dialogues, and retained it over a delay. These data suggest that combinatorial information about otherwise unknown words may pervade the infant lexicon, providing useful constraints on later word interpretation.
**Figure 1:** Sample dialogue and test trials for Experiments 1 and 2.

**Dialogue Phase:**

Transitive dialogue
A: Guess what? Jane blicked the baby!
B: Hmm. She blicked the baby?
A: And Bill was blicking the duck.
B: Yeah, he was blicking the duck.

Intransitive dialogue
A: Guess what? Jane blicked!
B: Hmm. She blicked?
A: And Bill was blicking.
B: Yeah, he was blicking.

**Experiment 1 Test Phase:**

Two-participant causal action  One-participant action

Experimental condition:  “Find blicking!”
Control condition:  “What’s happening?”

**Experiment 2 Test Phase:**

Two-participant causal action  One-participant action

Experimental condition:  “Find blicking!”
Control condition:  “Find kradding!”

References:


Cultural evolution renders strong innateness implausible
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Natural languages do not differ arbitrarily, but are constrained so that certain properties recur across languages. These constraints presumably arise, at least in part, from the nature of the human brain, but the nature of the brain-language mapping is unclear. One theory argues that strong language-specific constraints are built into learners (Chomsky, 1965). Evolutionary considerations appear to support this hypothesis, since co-ordinated constraints on learning may facilitate communication and therefore be adaptive (Pinker & Bloom, 1990). An alternative suggestion (Christiansen & Chater, 2008) is that strong constraints on linguistic variation could arise given only weak and/or domain-general biases in learners, as a consequence of cultural transmission in populations. We set out a very general agent-based model of the interactions between the biological evolution of the language faculty and the cultural transmission of languages which shows that such weak or domain-general constraints are more plausible on evolutionary grounds: cultural transmission renders the biological evolution of strong domain-specific innate constraints on language learning unlikely.

We use a Bayesian model of language learning, assuming the minimal case where there are simply two classes of language: this allows us to specify varying degrees of (innate) prior bias for one language type. Language is culturally transmitted: learners select a language based on its posterior probability given some linguistic data, where that data is produced by another individual in the simulated population. We model biological evolution by specifying genes that encode the prior bias of a learner: the prior of a language type is simply the proportion of the learner’s genes that have the allele that promotes that type. Genes are inherited by new learners, subject to mutation, and we assume that reproduction is determined by communicative success. We initialize simulated populations with equal proportions of both language types and genes which specify a perfectly neutral prior, which does not favour either language type.

Previous work has shown that cultural transmission by iterated learning can lead to the amplification of weak biases (Kirby, Dowman & Griffiths, 2007). Our coevolutionary model shows that, as tiny perturbations in initial gene frequencies move the population away from perfectly neutral priors, this amplification associated with cultural transmission unmask these weak biases in individuals, yielding large effects in the population’s language: one language type begins to dominate the population. Natural selection then favours biases encoding the emerging majority language. However, iterated learning also masks relative strength of bias (Smith & Kirby, 2008): because the effects of weak priors are amplified by cultural transmission, both weak and strong priors give rise to strong linguistic universals. Consequently, in a population where weak biases have become established, there is little selection for stronger biases, since these yield equivalent effects to weak biases. This combination of unmasking and masking leads to a balance of evolutionary forces: mutation pressure induces drift towards neutrality, but natural selection keeps biases away from perfect neutrality. The population therefore settles on the weakest possible biases that nevertheless lead to clear linguistic universals (Figure 1). Our co-evolutionary model also shows that strong constraints on learning can evolve, under some parameters. However, this requires an extended period of benign genetic drift: given that such benign drift is unlikely, this renders the evolution of strong domain-specific constraints on language learning problematic.

The model therefore suggests we should expect constraints on language learning to be weak if domain-specific (i.e if selected for their linguistic consequences), and only strong if domain-general (i.e. if selected for their non-linguistic consequences).
Figure 1: A representative run illustrating the evolution of weak biases which lead to a strong language universal, in this case the near-universality of the language type associated with biases below 0.5.

References:
Object identification for naming multiple objects: Semantic access is serial
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Various studies investigating the task of naming multiple objects in succession have suggested that information is obtained from more than one object at the same time (i.e., in parallel; Malpass & Meyer, 2010; Meyer & Dobel, 2003; Meyer, Ouellet & Haacker, 2008; Morgan & Meyer, 2005; Pollatsek, Rayner & Collins, 1984; Schotter, Ferreira & Rayner, 2009). These studies employed a gaze contingent boundary change to present an object to a subject in peripheral vision (i.e., a preview object) that changes to a different object when an eye movement is made toward it (i.e., the target object). Processing of the target is facilitated when the preview is a related object (e.g., semantically, phonologically, visually) compared to when it is unrelated to the target. However, only the Schotter et al. (2009) study tested the relative timing of the processing of the current and next-to-be named objects. Using identical and unrelated previews, they found faster processing of the target when the preview was identical compared to unrelated at three different SOAs (50, 250 and 450ms). They took their results to suggest that information was obtained from both the fixated and next-to-be-named object completely in parallel.

Using this same paradigm, we extended Schotter et al.’s study to determine whether all types of information are obtained in parallel or whether semantic information from the next-to-be-named object is obtained only at a longer SOA (i.e., after semantic information is obtained from the fixated object). Subjects were instructed to name three objects in succession (top left, top right, bottom). While their eyes were on the first object, the second object was a grey box for 50ms or 250ms, then changed to a semantically related (e.g., “corn”) or unrelated (e.g., “chain”) preview object for 200ms and changed back to the grey box until an eye movement to the second object caused it to change from the preview to the target (e.g., a different visual representation of the same object, “corn”; see Figure 1).

Looking times were faster when the preview object was semantically related than when it was unrelated, but only at the late SOA (see Figure 2). These data suggest that, although visual information can be obtained from two objects at the same time (Schotter et al., 2009) there is a certain time at which semantic information is not obtained from the next-to-be-named object. These data are taken to support the idea that object identification for naming happens in stages (visual processing, semantic processing, phonological processing, etc.) and that semantic processing cannot occur on the second object until at least some semantic processing has occurred on the first. Therefore, while visual processing of multiple objects may occur in parallel, semantic processing happens serially.

References:
Can isolated word pairs be lexically processed in parallel?
Combining tachistoscopic presentation with same-different matching
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Whether two or more words can be lexically processed simultaneously during reading remains highly controversial. The dominant technique used to investigate this issue has been eye movement monitoring in conjunction with the boundary paradigm (Rayner, 1975) to identify word n+2 preview benefit (e.g., Murray, Wakeford & Vladeanu, 2008; Rayner, Juhasz & Brown, 2007) and lexical parafoveal-on-foveal effects (e.g., Kliegl, Risse & Laubrock, 2007). However, an answer to the serial/parallel debate remains inconclusive. This study investigated whether parallel processing of two words is - at the least - possible by using a novel experimental paradigm.

Participants received a tachistoscopic presentation of two spatially adjacent words; one word appeared in the middle of the screen, accompanied by one to either its left or its right. The task was to simply decide whether the two words were visually identical or not. When the word pair was different, they differed by only one character. Items were either high or low frequency words, or were legal or illegal nonwords. Each word pair contained words of either four or six characters.

Following Chambers and Forster’s (1975) finding that only ‘same’ pairs show clear lexical effects in a different version of this task, analysis was focussed on just these items. The results showed clear effects of word type, with faster responses and lower error rates on high frequency words. Both word types were faster and generated fewer errors than legal nonwords and these in turn were faster and less error prone than illegal nonwords. Thus, there appears to be clear evidence, consistent with Chambers and Forster, that despite the task merely requiring visual matching, lexical activation was automatic. Additionally, in line with the evidence regarding the asymmetrical distribution of attention during natural reading (McConkie & Rayner, 1976), response times were significantly faster and less error prone for right-sided word-pairs compared to left-sided word-pairs.

Critically for the serial/parallel debate, the nature and significance of these differences did not vary with display time. At 215ms – just long enough for one fixation – the effects were just as clear as when the display duration allowed two or more fixations. Participants were unaware of where the second word would be located and with short presentation times they should not have been able to execute an eye movement to the peripheral word, so this suggests the two words must have been processed in a parallel fashion. Further, the effects were significant for both four and six character words, suggesting that words can be processed in parallel even when they fall into the peripheral regions of the perceptual span as defined by McConkie and Rayner (1976).

While it is acknowledged that participants may have adopted task dependent strategies, these results suggest that - despite inconsistent evidence for parallel processing in natural reading - it is clearly possible for words to be lexically processed in parallel in an ‘automatic’ fashion [since the task only requires visual matching rather than lexical access, but nonetheless shows lexical effects]. If two words presented in isolation can be processed in parallel during a single fixation, then it seems entirely plausible that this may be happening during normal reading.
References:
How can failure sometimes be better than success?

Varying effects of emotion on lexical processing.

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Although emotion has mostly been ignored when it comes to processing word meaning, a growing number of studies show that emotional characteristics of words affect processing (e.g., Estes & Adelman, 2008a,b; Kousta et al., 2009; Larsen et al., 2006; Nasrallah et al., 2009; Tse & Altarriba, 2009). Most importantly this extends beyond words which refer overtly to emotional experience like "love", "hate", "embarrassment" and "depression"; also including words with emotional connotations like "cake", "prison", "promotion" and "failure". Moreover, such emotional connotations seem especially important for words referring to abstract concepts which tend to have far greater emotional connotation than those referring to concrete objects; as a result it has been suggested that emotional channels may offer a means of grounding abstract concepts in experience, akin to sensory-motor experience by which concrete concepts may be grounded. It is very difficult, however, to draw broad conclusions about mechanisms, due to the great variation in studies of emotion in lexical processing. Some studies show advantages for negative words over positive (e.g. Nasrallah et al., 2009), others show disadvantages for negative words (e.g. Estes & Adelman, 2008a,b; Vinson et al., 2011), and others show advantages for all emotional over neutral (e.g. Kousta et al., 2009). Some of these differences could be attributed to uncontrolled lexical factors (see Estes & Adelman, 2008a; Larsen et al., 2006), but results still vary despite ever better controlled stimulus sets. Here we address variation in emotion effects, employing the same well-controlled words across different tasks.

In Experiments 1 and 2 we compare lexical decision to valence judgment (is a word emotionally loaded or not). Despite using exactly the same words in the two tasks, we found a dissociation in emotion effects. Lexical decision replicated Kousta et al. (2009): positive and negative words faster than neutral words, while valence decision replicated Nasrallah et al. (2009): accuracy advantage in detecting negative words over positive words. Experiments 3 and 4 used the same word sets and the same tasks, but also included the presence of face stimuli (happy, neutral, angry) thus permitting us to also examine the interplay between processing of lexical and nonlexical emotion. Main effects of word category replicated the patterns observed in Experiment 1 and 2. However, effects of face emotion differed across the two tasks despite using the same materials: faces had no effect on lexical decision, but an incongruency cost on valence decisions (angry faces reduced accuracy to positive words; happy faces reduced accuracy to negative words). These apparently inconsistent results may be best explained in terms of attentional theories of emotion processing, whereby negative stimuli receive/hold attentional focus only in early processing and thus would facilitate tasks directly related to emotion (e.g. Nasrallah et al., 2009 and our experiments 2 and 4) but interfere with other tasks sensitive to early visual processing (e.g. Vinson et al., 2011). On the other hand, non-emotional tasks using fully visible stimuli benefit from emotional content regardless of polarity and are not affected by incongruent faces, suggesting that negative attentional focus only affects processing in brief time periods or emotion-specific tasks, with a general motivational account explaining performance more broadly.

References:

The processing of word class ambiguous words

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Word class ambiguous words are words which can appear as a verb or a noun, depending on the context they are presented in (e.g., to race or the race). Within the English language there are numerous biased word class ambiguous words where the verb or noun version of the word is more frequent than the other. In most, if not all, experiments, this property is ignored and word frequencies are calculated without distinguishing between different classes (e.g., word form frequency of “race” is used, adding the N and V frequency). In the present eye-tracking experiment the effect of word-class frequency on the processing of biased word class ambiguous words was investigated. Two types were distinguished: N>V (noun form more frequent than verb form) or N<V (verb form more frequent). The word class ambiguous words were presented either as a verb or a noun across counterbalanced lists:

(1) The jockey wanted to ride the race on his favourite horse. (N>V)
(2) The jockey wanted to race at Ascot on his favourite horse. (N>V)
(3) Kim tried to blame her colleague so she wouldn’t get fired. (N<V)
(4) Kim tried to take the blame so her colleague wouldn’t get fired. (N<V)

A significant effect of word-class frequency was found both in early (first fixation duration, first-pass regression) and late (regression-path duration, regressions into region of interest) processing measures for the N<V condition, with faster processing of the word when it appeared as a verb compared to when it was presented as a noun. In contrast, no significant effects were observed for the N>V condition, with words in this condition being processed as fast when they’re used as nouns as when they’re used as verbs. These results suggest a processing advantage associated with the verb form of word class ambiguous words (contra Gentner, 1981). The results are also, to some extent, in line with Farmer et al.’s (2006) study on “nouny and verby nouns”, though their classification was based on phonological properties of the words rather than word class frequency.


ERP evidence for the activation of gender stereotypes: The case of Italian

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Language users have mental representations of words (e.g., occupation nouns and personal characteristics) that include information about the word’s stereotypical gender. This information is difficult to suppress during on-line language processing (e.g., Banaji & Hardin, 1996; Cacciari & Padovani, 2007; Oakhill, Garnham, & Reynolds, 2005). The few electrophysiological studies conducted on this topic showed that different neural processes are engaged in the processing of gender-stereotype information (Irmen, Holt, & Weisbrod, 2010: N400, P600; Osterhout, Bersick, & McLaughlin, 1997: P600; White, et al., 2009: N400).

In this ERP study we investigated the activation of gender stereotypes in Italian using a priming paradigm adapted from Banaji and Hardin (1996). Our aim was, first, to establish how early this information becomes available to the reader, and, second, to uncover the ERP signature of the emergence of gender stereotypes in language. Participants were presented with a prime that could be: a masculine or feminine stereotypical gender noun (conducenteMASC “driver” vs. insegnanteFEM “teacher”); a masculine or feminine grammatically marked noun (pensionatoMASC “pensioner” vs. passeggeraFEM “passenger”). Each prime was followed by either a masculine or a feminine personal pronoun (Lui “he” vs. Lei “she”). Participants decided whether the pronoun was masculine or feminine, while their RTs and ERPs were recorded. Primes and targets were controlled for psycholinguistic variables (length, frequency); in addition, masculine and feminine stereotypes were matched in stereotype strength and valence.

As in previous behavioural studies, participants were faster to judge the gender of the pronoun when preceded by a gender-congruent than gender-incongruent prime in both biological and stereotypical conditions. The ERP results suggest two different effects. First, when the pronouns were preceded by biological grammatically marked incongruent nouns (e.g., pensionato-lei; passeggera-lui), a larger negativity between 200 and 380 ms peaking around 300 ms (most prominent across frontal/central sites) emerged. Interestingly, when the pronouns were preceded by stereotypical primes, a negativity with similar latency and distribution emerged in the incongruent condition only for masculine pronouns. Second, an increased positivity between 380 and 500 ms peaking around 420 ms (most prominent across frontal/central sites) was observed when pronouns followed biological, but not stereotypical, gender-incongruent primes.

The waveforms we obtained for biological gender violations are comparable to the N400 reported by Barber and Carreiras (2003). Our seemingly early and more frontal effect could be due to the use of function words (prouns) rather than content ones as in Barber and Carreiras (2003). The positivity around 420 ms for biological gender violations appears to be in line with the P300 effect observed in Barber and Carreiras (2003) together with the N400. Crucially, our ERP results provide further support for online effects of stereotypical gender in language comprehension. When a role noun is read, the stereotypical gender associated with it, if any, is activated together with other lexical-semantic information and might prime gender-congruent nodes. Remarkably, the ERP confirmed a gender stereotype asymmetry (cfr. Cacciari &
Padovani, 2007), in that male and female gender stereotypes affected the processing of pronouns differently.

The results imply that participants seemed more accepting of female drivers than male teachers, suggesting that gender stereotypes (conveyed by occupation nouns or personal characteristics) might be less restrictive for females than males. According to social psychologists, one social group (e.g., males) can become more normative than another (e.g., females) (Hegarty & Pratto, 2001). Indeed, attitudes and stereotypes have been found to be influenced more by male exemplars than by female ones (Eagly & Kite, 1987).

We can thus hypothesize that female gender stereotypes (e.g., insegnante “teacher”) recruited only female category members, while male gender stereotypes (e.g., conducente “driver”) recruited both male and female category members. This is because in our society, the male social group is more normative than the female one, being the “unmarked normative group” (Hegarty & Pratto, 2001). As a result, masculine pronouns that followed female stereotypes mismatched category norms, eliciting longer reading times and a more pronounced negativity, while feminine pronouns that followed male stereotypes did not.

References:

Acoustic cues for segmentation resist within speaker variation: An EEG study

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In order to recognize spoken words, listeners must map sensory information from the acoustic input onto stored lexical entries. Because the speech signal is continuous, listeners must segment the speech stream in order to recognize words. To accomplish the task of segmentation listeners use their tacit knowledge of a wide range of patterns in their native language including cues from allophonic variation, phonotactic constraints, transitional probabilities, lexical stress etc. Among those cues, there is now a growing body of evidence suggesting that fine-grained acoustic information is available for lexical access and used for segmenting the speech stream. Although it is generally agreed that acoustic cues are used on line to segment the speech signal and to bias lexical access, some important questions remained unanswered. First we ought to know whether these cues are robust enough to be used in the context of multiple productions of the same segmentation as speech is by nature variable and listeners are never exposed to invariant speech. The second important open question is that of the timing of the use of the cues.

In this study, we examined the electrophysiological correlates of the use of such segmentation cues with a modified version of the Oddball paradigm (Brunellière, Dufour, Nguyen & Frauenfelder, 2010). We used spoken utterances in French that are phonemically ambiguous (e.g., l’amie ‘the friend’ vs. la mie ‘the crumb’, both [lamî]) but which show acoustic differences that are used by listeners during word segmentation (Welby, 2007; Spinelli, Welby & Shaegis, 2007; Spinelli, Grimault, Meunier & Welby, 2010). In experiment 1 (syllabic experiment), event related potentials (ERPs) were recorded while French participants were presented with four standard [la#] syllables (coming from four different productions of carrier sentences containing e.g., la mie [la#mi] ‘the crumb’) and a fifth deviant that could be either [la], a syllable that was excised from another production of la mie [la#mi] (same segmentation condition) or [la] from l’amie [l#ami] (‘the friend’ different segmentation condition), or [li] a phonemic deviant. All stimuli were recorded by the same French native female speaker. We examined and compared the mismatch negativity (MMN) elicited for the test syllable in the different segmentation condition (for example, [la#], [la#], [la#], [la#], and test [l#a]), in the same segmentation condition (here, [la#], [la#], [la#], [la#], and test [l#a]), and in a phonemic deviant condition [la#], [la#], [la#], [la#], and test [li]). In experiment 2 (word experiment), the whole determiner-word sequences were presented (for example, [la#mi], [la#mi], [la#mi], [la#mi], and test [l#ami]).

In both experiments, results showed an increased MMN (with an onset on the beginning of stimuli) for both the phonemic deviant condition and the different segmentation condition
suggested that even in a passive listening situation (no task), the acoustic cues that differentiate “l’a” from “la” are relevant to the recognition system (the MMN mean amplitude significantly differed from zero for all deviant types in all paradigms; p < .001). MMN-[la#] was significantly earlier than that observed for MMN-[l#a] (respectively +243 ms and +289 ms, t15=5,024, p < .001).

![Figure](image.png)

*Figure.* Grand average deviant – minus - standard difference signals at Fz as well as the corresponding voltage maps for deviant [la#] (left), [l#a] (right) and the control deviant [li] for the syllabic experiment. The MMNs peaked between 200 and 300 ms from deviation onset (sound onset always at 0 ms). Identity MMN (ERP for the deviant standard) is in blue, [la]-MMN in red and [li]-MMN in green. Results for the word experiment were similar.

Moreover acoustic cues are robust and remain from one production to another since listeners could discriminate between the two segmentations despite within speaker variability. Our results also complement previous behavioral findings by showing that these fine acoustic details are available as early as phonemic information.

References:


Acoustic versus linguistic interferences during speech-in-speech comprehension

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Most of models on language comprehension, although making different proposals regarding nature of competitors, postulate that identification and comprehension of words are the results of competitions between different linguistic units (see for example NAM, Luce and Pisoni, 1998; the revised Cohort model, Marslen-Wilson et al., 1996, TRACE, McClelland and Elman, 1986, or Shortlist, Norris, 1994). In this context, situation in which speech is masked by others speech signals could be critical. Our goal is to examine psycholinguistic processes implicated in the situation of speech-in-speech comprehension and to identify information levels in which linguistic interferences can occur. To determine this, nature and language of background noise were manipulated. In a series of experiments, we used cocktail-party signals in different world languages: French, Breton, Irish and Italian. These babbles were composed of 4 talkers and were chunked into sequences of 4s. In each sequence, a French target word was inserted 2.5s from the start of the sequence, with signal-to-noise ratio of -5dB or 0dB. Forty native speakers of French had to write down the target words. Interesting results were observed only at -5dB since differences in masking effects were obtained between the different languages manipulated. Native French speaking participants had more difficulties to understand French words in French babble than in unknown languages. This result could reflect the fact that in the case of 4 talkers in the French babble, some words in the background are still activated and therefore compete with the identification of the target word. Then, level of difficulties varied depending on language spoken in background, demonstrating that some languages interfered more with French than some others. This way, it appears that the interference effect is not purely acoustic but also linguistic. To isolate linguistic effects, we ran a second experiment in which we controlled for acoustic effects. In this experiment, cocktail-party signals in the different world languages were used again as babble noises and also served to generate language specific fluctuating speech noises. These two types of background carried the same acoustic information, while cocktail-party signals are the only ones carrying linguistic information. A lower identification of target words was observed with cocktail-party signals than with matched fluctuating noises of about 20%, clearly showing that part of interferences is linguistics. Finally, a bigger difference between the two types of backgrounds (cocktail-party signals - fluctuating noises) was observed in French compared to all the other languages, while no difference between the unknown languages was observed. These results suggested a strong effect of lexical competition in the French-in-French situation. These studies explored situation of speech-in-speech with an “off line” task, i.e. intelligibility task. Therefore answers are given once process of target words is fully completed and not during process of identification. In the discussion we will look at the differences observed between “off line” and “on line” tasks, i.e. intelligibility and lexical decision tasks.
Exploring the role of stress change in compound recognition across modalities

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Greek compounds exhibit two main stress patterns; the compound preserves the stress of the second constituent (the morphological head) (1) and the compound receives stress on the antepenultimate syllable (2):

(1) jiôovoskôs < jiô- + vosk- (cf. voskôs)
‘goat herder’ ‘goat’ ‘herder’
(2) tsiomed líðos < tsiimed- líð- (cf. líðos)
‘concrete block’ ‘cement’ ‘stone’

Previous studies on compounding (cf. Libben & Jarema (2006), Libben, Derwin, De Almeida, 1999)) have argued for a dual representation of compounds. This account of compounding permits stress, among other properties to have a role during processing. However, while other compound properties like headedness and constituency (Kehayia et al., 1999) have been shown to affect compound processing, the role of stress has only recently begun to be explicitly explored.

In an earlier study, Tsiamas & Kehayia (in press) investigated the role of stress change in compound recognition, hypothesising that compounds with stress change (SC) will be processed slower than those without (NSC), due to the extra cost stress change, under the premise that any additional processing operation will yield extra processing cost. Two experimental tasks were employed; a cross modal (audio-visual) lexical decision one and a primed naming (reading) task. For both tasks, the prime (second constituent of a compound) was auditorily presented, followed by the target (compound word) visually presented on a computer screen. In all trials, participants performed faster in experimental stimuli than controls, with a smaller mean difference (MD) for SC compounds as originally predicted. These results confirmed the initial hypothesis, where especially for the naming task, NSC compounds were recognized significantly faster than those with stress change ($p<0.5$):

(3)

![Mean Differences - Naming](attachment:image.png)

To explore further the role of modality, we conducted an ‘auditory-auditory’ primed lexical decision with twenty nine native speakers of Modern Greek. The experimental results...
obtained present an intriguing pattern, as they contrast the ones obtained from the naming task. In particular, speakers performed significantly faster in compounds with stress change than those without:

(4)

To confirm that results were not simply due to an experimental artefact an additional auditory simple lexical decision task was run. Findings parallel those obtained in the priming task, again with compounds undergoing stress change yielding faster RTs than those that do not.

In view of this disparity of results across the different modalities, we are obliged to re-consider the role of stress change in compound processing and its interaction with other processes operating during word recognition, e.g., point of recognition of a word during auditory processing. We argue that the results obtained particularly from the naming (reading) task, where stress has to be realized, show that stress change hinders the production/reading of the word, because of the extra processing cost it incurs. On the other hand, in the auditory recognition tasks (both primed and simple), stress change yielding antepenultimate stress, facilitates the recognition of the compound as speakers seem to rely on stress position for word recognition, as the new position of stress appears to coincide with the point of recognition of the word. This hypothesis is also supported by a preliminary analysis of the fillers (derived words) in the auditory-auditory task where speakers show faster RTs for derivatives with antepenultimate stress than those with ultimate stress.

We believe that our results present a compelling case not only for the role of stress in compound recognition, but also for the importance of considering the interaction of modality in the realisation of specific linguistic properties.

References
Prosodically-facilitated attribution of belief states: an eyetracking study

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It has been claimed that through language, children develop a Theory of Mind (ToM) (J. de Villiers, 2007), i.e. the ability to infer others' mental states. A child's developing ToM is often measured through the use of a the false belief task (FBT), usually some version of the classic "Sally Ann" task (Wimmer & Perner, 1983), which assesses the child's ability to predict an individual's actions based on her having been disconnected from some event. While it is accepted that by age 4, children can pass explicit FBTs, methodologies exploiting the visual behavior (i.e. eyetracking, anticipatory looking) have shown that children make hypotheses about false beliefs much earlier (Onishi & Baillargeon, 2005; Southgate et al 2007, Clements & Perner, 1994).

Although we know that prosody provides information about speaker belief, its relationship with false belief and ToM development remains unexplored. Central Catalan, for example, prosodically distinguishes between confirmation questions unmarked for belief (Fig. 1) and those encoding counter-expectation (Fig. 2). This study's goal is to test whether prosody facilitates knowledge about speaker belief states for children. And if so, at which point in a child's development does this occur? For the first adult control study, we used a Tobii 120 eyetracker to assess whether 10 adult speakers of Central Catalan were able to use prosody only to attribute mental states to others. We used seven short videos with events similar to those from the Sally Ann task. In each video, participants saw a walking actress (WA) enter a room (Fig. 3) with a seated actress (SA). WA left the duck in one of two buckets and left the room, shutting the door (Fig. 4). SA stands up and looks into the bucket with the duck (Fig. 5). Later WA re-enters and looks into the buckets (Fig. 6). The subjects heard the question The duck is here? (in Catalan) with confirmation (Fig.1) or counter-expectation (Fig.2) intonation, hypothesizing that anticipatory looking would occur based on the intonation contour.

Pilot results from 10 Central-Catalan speaking adults show that prosody affects how subjects anticipate where the actor will look. Figure 7 shows percentages of looks to the cued versus the uncued bucket. While there was undoubtedly a memory effect for these subjects (i.e. they tended to simply fixate the bucket where the duck was left), there was a clear effect of intonation contour. If the counter-expectation contour hadn't triggered fixations, we would expect a marginal value for the counter-expectation condition (like the one for the uncued bucket). Instead, participants used the counter-expectation contour to look to the cued bucket 25.95% of the time, indicating that adults are capable of using prosody to attribute a specific belief state to a speaker. We are currently collecting data for children between the ages of 2 and 4 in an effort to understand whether prosody facilitates knowledge about belief states during key ages for ToM development.
References
Prosody conveys discourse-level information [1][2], but the extent to which prosodic cues distinguish different kinds of information remains unclear ([2][3] on new-information/contrastive focus). The prosodic encoding of discourse-information is even more complicated in tone languages, where cues such as duration, intensity and F0 also distinguish lexical items (e.g. Mandarin Chinese [4][5]). Prior work in Mandarin led to divergent findings regarding (i) presence/absence of differences between focus-types (new vs. corrective/contrastive) and (ii) what cues—if any—mark differences between focus-types (lengthening, F0 range expansion, intensity), e.g.[6][7].

We conducted a production study on Mandarin to investigate whether (i) the presence/absence of correction and (ii) the new/given distinction are encoded prosodically (2x2, 36 targets, 36 fillers). Participants (4 women, 4 men) produced instructions to move an object to a location, indicated by pictures and arrows (Fig.1), e.g. ‘Move the bamboo TARGET next to the fridge’ (Ex.1). Target nouns were bisyllabic, with High-High, High-Low, Low-High tonal contours (HH/HL/LH).

Fig. 1: Sample display of stimuli

(1) ba OBJECT fangdao LOCATION pangbian (particle) OBJECT put LOCATION side
‘Move the OBJECT next to the LOCATION’

In Non-corrective conditions, the correct object (e.g. bamboo) moved after the command. In Corrective conditions, an incorrect object moved after the participant first produced the command (e.g. the sunglasses moved next to the fridge)—so participants had to repeat the command to correct the incorrect movement. In New conditions, the target word had not been mentioned on that trial until the participant first used it. In Given conditions, the target word occurred in a correct movement earlier on the same trial (i.e., known to hearer). There were four conditions: Corr|New, Corr|Given, NoCorr|New, NoCorr|Given.

Results—The presence/absence of correction was reflected in all three acoustic parameters: Target words in Corrective conditions had longer durations, and larger F0- and intensity-ranges than Non-corrective words (p’s<.03).

The new/given distinction was reflected in duration and F0, but only in Non-Corrective conditions (significant Correction-by-Givenness interaction). Corrective conditions had no differences between given/new. In Non-corrective conditions, New information had longer duration, larger F0-ranges than Given information (p’s<.04); intensity-ranges did not differ. This suggests new-information focus is encoded differently from correction: Only correction is associated with expanded intensity-ranges.
The absence of given/new effects in Corrective conditions may be due to acoustic marking of givenness/newness being defined from the speaker’s perspective: In all Corrective conditions, the target words had already been uttered by the speaker, although the hearer apparently had not heard them properly the first time.

Fig. 2-4: Duration, F0 ranges, intensity ranges in the four information types (X-axis: tone types of the target words)

Discussion—Even in a language with lexical tones, which differ in F0, duration, and intensity, all of these acoustic dimensions also encode information-structure. We found no evidence for a ‘specialized-function’ situation where some cues mark information-structure and others mark lexical distinctions. Instead, all three dimensions are multi-functional. However, further analyses showed that intensity-range expansion was due to minimum-intensity lowering, while F0-range expansion resulted from maximum-F0 raising, pointing to pressures/constraints on how information-structure is encoded. Combining our work with prior claims, it seems that variations in the ranges of both F0 and intensity can mark information-structure, whereas their shapes/contours carry information about lexical tones [4][5]. This highlights the fine-grained ability of the language production system to utilize different aspects of acoustic dimensions.

This study develops a version of PARSER1, PARSER2 – a psychologically feasible model of the earliest stages of speech segmentation and word discovery (SSWD). Unlike several models of SSWD, PARSER2 makes minimal assumptions about the computational capacities of language learners2. PARSER2 is a first-stage process that can feed into other processes. In this case, it is used to estimate the word boundary probability distribution (WBPD). Because the probability of a word boundary given two adjacent segments is usually either very high or very low, the WBPD is extremely bimodal, and it can be thought of as a representation of phonotactic knowledge. It can be used to segment a corpus of English child-directed speech with 76% precision and 69% recall3.

PARSER2 models two processes: the chunking of continuous, unfamiliar input into discrete units, and the retention in memory of more frequently chunked units. PARSER2 (initially randomly) chunks phonemically transcribed speech, creating a lexicon which rewards or penalizes candidate words based on their frequency, with higher weighted candidates more likely to be actual words. These candidates are used to aid subsequent segmentation, and lower-weighted ones are deleted from the lexicon if they are not encountered with sufficient frequency.

The original PARSER was run on syllabified artificial language data. Some psycholinguistic justification for the use of syllabic input exists: even 4-day-old infants can discriminate utterances with different numbers of syllables, but not different numbers of phonemes4; and, among older children, analysis of utterances into phonemes is more difficult than analysis into syllables5. Nevertheless, the perceptual salience of syllables does not mean their boundaries are a priori clear to the child; a model using syllabified input that is consistent with word boundaries begs the question of how that consistency is achieved.

To avoid presupposing what has to be learned, PARSER2 uses input that can be described as “partially”-syllabic. The chunking process outlined above is constrained so that all chunks must contain at least one vowel, reflecting the perceptual salience of syllables. The model illustrates a process whereby children form words (or syllables) around vowels, and refine their understanding of syllable and word boundaries as they proceed. Regular phonemic input can also be used, however, with minimal degradation of precision.

PARSER2 was run on CHILDES8 transcribed speech with variations in the forgetting rate, which is the primary determinant of its performance. A higher forgetting rate leads to a more accurate lexicon, at the expense of completeness, and the reverse is true for a lower forgetting rate. Additionally, words that attained a sufficient weight (subject to parameterization) were automatically segmented for the rest of the process, enabling better segmentation of adjacent words.

The more accurate PARSER2 lexicons did not produce the best segmentation results, because they were too small to be representative. The best segmentation performance came from a lexicon with 904 word candidates, 64% of which were actual words. The precision increases as lower weighted candidates are excluded, with 77% of the top 200 candidates being actual words. Most of the growth in the lexicon occurs in the first few thousand utterances (Figure 1).

This lexicon was used to segment a second batch of utterances, and a word boundary probability distribution was calculated from the segmented utterances, which was then used to segment a third batch of utterances (a cut was made between two segments $p_1$ and $p_2$ when the probability of $p_1p_2$
occurring within a word was less than .5), achieving 55% precision and 54% recall. The numbers might not be impressive at first glance, but the amount of utterances PARSER was trained on—200,000—probably only represents a few hundred hours of parental interaction, according to our extrapolation from the duration-marked transcripts in the Brown corpus in CHILDES. Additionally, the algorithm for segmenting the second batch of utterances with words from the PARSER2 lexicon was rather naive (the longest matching word candidates were segmented from the beginning of each utterance or utterance remainder); a more sophisticated word recognition algorithm could make greater use of PARSER2’s output. PARSERS2’s performance, and the simplicity of the model itself, suggest that it may be a plausible mechanism for the earliest stages of SSWD and the acquisition of phonotactic knowledge.

References:

Figure 1: Development of PARSER Lexicon
Revisiting word shape effects: The role of ascender letters in visual word recognition

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Most current models of visual word recognition are based on the notion that words are recognised via their constituent letters (e.g., Davis, 2010; Whitney, 2001; Grainger & van Heuven, 2003). Although the weight of current evidence suggests that the identification of a word’s constituent letters is critical to word recognition, many studies also suggest that, at some level at least, the overall shape of a word plays a role in the recognition process (e.g., Allen, Wallace, & Weber, 1995; Healy & Cunningham, 1992; Perea & Rosa, 2002). However, the evidence for a word shape effects is inconsistent and the locus of these effects is still unclear. Furthermore, many of the findings are based on methods that aim to disrupt the shape of the words by presenting them, for example, in alternating case (e.g. AITeRNATInG) or visually degrading the words. This makes it difficult to isolate other factors whether lexical or sublexical in nature, which may be contributing to the word shape effect.

The present study investigated the influence of word shape on lexical decision task performance, in which five-letter words and nonwords, each containing one ascender in one of the five possible positions (e.g., ‘frame’, ‘charm’, ‘eaten’, ‘scale’ or ‘ranch’), or control words and nonwords containing no ascenders or descenders (e.g., ‘manor’) were presented. Results showed no overall advantage for words containing an ascender compared to the control words (with no ascenders), however there was a significant effect of the ascender position, which revealed a facilitatory effect for ascenders in the central position. This effect of ascender position within words was further investigated across a number of different lexical and sublexical measures (e.g. word shape uniqueness, bigram, and letter frequency). The results have important implications for models that assume that sublexical processes modulate visual word recognition.

References:


Interhemispheric transfer costs in word reading as evidence for a split fovea

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The split fovea theory (SFT) states that centrally (i.e., within the 3 central degrees of visual angle) and parafoveally presented information is organized in the same way: Letters at the left/right side of fixation are initially sent to the right/left hemisphere respectively. As a consequence, the beginning of a word is the optimal viewing position (OVP) for readers with typical left hemispheric language dominance. The methodology of previous SFT studies was criticized by supporters of the bilateral projecting theory (BPT), who believe that foveal letters have representations in both brain halves. Until now, the assumptions of SFT and BPT were never directly pitted against each other. We compared the OVP curves of left- and right speech dominant subjects in a word naming task.

Subjects with typical left and atypical right language dominance were identified by calculating their lateralization index for Broca's area during a silent word generation task in fMRI (for more details, see Van der Haegen, Cai, Seurinck & Brysbaert, in press). Seventeen subjects were classified as left hemispheric dominant with a lateralization index of at least 0.60 (i.e., more active voxels in the left than right hemisphere); 18 subjects were right dominant for speech as their indices were below -0.60.

In the present study, participants named three-, four- and six-letter words at different fixation locations. The words were horizontally shifted across the screen so that each word was presented once with each possible letter position between the two vertically aligned fixation lines. One letter subtended 0.27° such that the maximum distance from the central fixation position was 1.5 degrees of visual angle, classically seen as the boundary of the foveal region. An eye-tracking device controlled the fixation position of both eyes; Analyses only included trials on which participants made one central fixation throughout the 150 ms stimulus presentation.

Similar to Hunter, Brysbaert and Knecht (2007), the OVP curves were tested as second-order polynomial functions, in which the linear component regression weights reflect the influence of laterality. The production laterality indices correlated significantly with the
individual mean slopes based on all word lengths \([r = .54; p < .01]\). Results showed higher positive slopes for the left dominants compared to the right dominants for all word lengths (see Table below). In other words, left dominant subjects were fastest to name three-, four-, or six-letter words when fixating at the word beginning (when most letters fall in the right visual field), whereas the RH dominant subjects showed flatter curves or even negative regression weights meaning that they were faster when fixating at the word end (when most letters fall in the left visual field).

<table>
<thead>
<tr>
<th>Laterality</th>
<th>Word length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3-letters</td>
</tr>
<tr>
<td>Left dominant</td>
<td>4.79</td>
</tr>
<tr>
<td>Right dominant</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Different naming latencies for varying production laterality is more in line with the SFT than with BPT: Participants were fastest when most letters were directly sent to their dominant hemisphere and less letters had to be transferred from the non-dominant to the dominant side. Consequently, visual word recognition models should take into account that interhemispheric transfer is needed for both parafoveal and foveal word recognition.

References:
Van der Haegen, L., Cai, Q., Seurinck, R., & Brysbaert, M. (in press). Further fMRI validation of the visual half field technique as an indicator of language laterality: A large-group analysis. doi:10.1016/j.neuropsychologia.2011.06.014
It has long been established that people are able to make rapid use of contextual information to assist in the processing of language (e.g. Tanenhaus et al., 1995). The questions of exactly how this is done and, particularly, how quickly it happens, however, are still being examined (e.g. Sereno et al., 2003).

Duffy et al. (1988) used lexical ambiguity to investigate the interface between context and lexical processing. Importantly, they drew distinction between lexical items which were ambiguous with a dominant meaning (biased), and those where each meaning was considered equal (balanced). They posited the re-ordered access model; an interactive account of lexical access which predicts that, when no supportive context is present, balanced ambiguous words are slower to access than biased ambiguous words due to there being little frequency difference between interpretations. Supportive context constitutes addition information to re-order and boost one of the competing interpretations, and so speeds up lexical access.

In this study, we look not only at fixation durations on the critical word (as Duffy et al. did) but also skipping rates of the critical word. Studies have shown effects of predictability and lexical variables on skipping rates (see Brysbaert et al. (2005) for a review), but there have been fewer studies showing effects of higher level variables (such as context) on skipping. Such effects would show evidence for extremely early contextual integration, and would challenge eye-movement models that limit the amount of lexical processing that can occur in the parafovea.

Using a combination of Wordnet / Semcor and our own norming study we produced balanced ambiguous items with lexical frequency and word-length matched unambiguous controls. Neutral and supportive (for the slightly subordinate meaning of the ambiguous words) contexts were generated to provide us with a 2x2 design crossing context (neutral / supportive) and ambiguity (unambiguous / ambiguous).

<table>
<thead>
<tr>
<th>Context</th>
<th>Unambiguous</th>
<th>Ambiguous</th>
<th>Ambiguity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>1</td>
<td>3</td>
<td>Unambiguous</td>
</tr>
<tr>
<td>Supportive</td>
<td>2</td>
<td>4</td>
<td>Ambiguous</td>
</tr>
</tbody>
</table>

We find that people are more likely to fixate on the critical word if it is ambiguous and unsupported by the context, than if it is contextually supported (and therefore disambiguated).
Additionally, when the context is supportive there is no difference in the probability of fixation of unambiguous and ambiguous words. This interaction is reliable (p < 0.01)

Thus some level of lexical processing is occurring prior to the fixation of the word and contextual information is being brought to bear on ambiguity resolution at a very early stage.

The findings of our study speak to models of lexical access, and more generally to the interactivity / modularity debate. Seemingly they fit best with the interactive re-ordered access model but the time-course is much faster than even Duffy et al might predict.

Our findings also impact the reading model literature, with implications for E-Z Reader, SWIFT and other models of eye-movement control.

References:


Word frequency interacts with contextual predictability during reading: Evidence from eye movements

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Word frequency and contextual predictability effects have been reliably demonstrated across a variety of measures – lexical decision RTs, eye fixation durations, and event-related potentials (ERPs). Previous research has been inconsistent as to whether these factors, when examined simultaneously, are additive or interactive. Behavioural RT studies have typically demonstrated interactive effects (e.g., Stanovich & West, 1983), with a greater predictability difference for low frequency (LF) than for high frequency (HF) words. Sereno, Brewer, and O’Donnell (2003) obtained a similar pattern of effects in their ERP voltage amplitude data. In contrast, eye movement reading studies have shown additive effects of frequency and predictability (e.g., Miellet, Sparrow, & Sereno, 2007; Rayner, Ashby, Pollatsek, & Reichle, 2004). More recently, Hand, Miellet, O’Donnell, and Sereno (2010) also found additive fixation time effects. However, when launch distance to the target (used as a metric of parafoveal preview) was additionally considered as a factor, an interactive frequency-predictability effect emerged. Whether frequency-predictability effects are additive or interactive has implications for models of word recognition (modular (Fodor, 1983) vs. interactive (Morton, 1969) models) as well as for models of eye movement control (serial (E-Z Reader; Rayner et al., 2004) vs. parallel (SWIFT; Engbert, Nuthmann, Richter, & Kliegl, 2005) allocation of attention).

One factor of interest regarding prior eye movement frequency-predictability studies is that of the level of predictability, with predictability operationally defined as Cloze probability (the proportion of subjects who guess the target word when presented with the text up to but not including the target). In such studies, “high” and “low” predictable labels imply Cloze values of around 0.50–0.80 and 0.00–0.30, respectively. It is possible that an additive pattern of results may be the result of under-sampling the extremes, and that an interactive pattern may emerge given a larger discrepancy in Cloze probabilities between conditions. Although Rayner and Well (1996) employed 3 levels of predictability, they did not manipulate word frequency. In their study, the mean Cloze values and ranges for their predictability conditions were as follows: high predictable (HP) = 0.86 (0.73-1.00); medium predictable (MP) = 0.41 (0.13-0.68); and low predictable (LP) = 0.04 (0.03-0.08). They found that fixation times on LP targets were longer than those on HP or MP targets which did not differ from each other.

The present study used a 2 (Frequency: LF, HF) × 3 (Predictability: LP, MP, HP) design. In particular, the Cloze probability values for our “high” and “low” predictability conditions were more extreme than what has typically been used in prior research: HP = 0.96 (0.85-1.00); MP = 0.54 (0.20-0.75); and LP = 0.01 (0.00-0.05). Target words were embedded in the second of two-sentence text passages (see examples below). Our results showed an interactive pattern of effects in fixation time measures. As fixation times were relatively fast compared to those in prior studies using more pixilated displays (e.g., Hand et al., 2010; Rayner et al., 2004), it is possible that our findings are due in part to floor effects masking an underlying additive pattern.
References


Example Materials (targets underlined)

| LF-LP | Justin was an enthusiastic baker and was eager to try new things. He was excited about trying his new recipe for icing at the weekend. |
| LF-MP | The school children were impressed after their trip to the aquarium. They admired the shark as it slipped through the water like a knife. |
| LF-HP | Joey excitedly told his parents he saw a striped horse at the zoo. His parents explained that the animal was a zebra from Africa. |
| HF-LP | Juliet kissed her husband on the cheek as he was leaving for work. She noticed that he had left his phone and ran outside after him. |
| HF-MP | Mood around the office was glum and the boss needed to take action. Organising a party for the staff would hopefully boost morale. |
| HF-HP | Adam’s behaviour at school was getting out of control. He kept disrupting the class and would have to be sent to the Head. |
Stuttering and silent reading: Evidence from eye-tracking studies

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The etiology of stammering is still unclear. Some theories hold that the problem arises at the output stage, reflecting a problem with the motor processes involved in articulation, while others situate the problem at an earlier pre-motor stage, reflecting linguistic failures.

Two experiments investigated the differences in the silent reading processes of people who stutter (PWS) and people who do not stutter (PNS) using eye-tracking. Because PWS tend to stutter on longer words and words early in a sentence, we compared reading times for long and short main verbs in normal sentences across both groups.

(1) The barman quit when he was accused of stealing from the till.
(2) The barman confessed when he was accused of stealing from the till.

Experiment 1 showed no differences between PWS and PNS when reading short words, but disproportionally longer fixation times on long words for PWS, indicating that PWS experienced additional processing difficulties for words thought to cause a stuttering event when spoken aloud. This interaction was already apparent in the gaze duration analyses and also showed up in the number of fixations on the target word. Experiment 2 tested whether this effect could be situated at the subvocalisation stage. PWS and PNS read normal sentences either in silence or during articulatory suppression (saying “bababa” while reading). We replicated the length effect found in Experiment 1, and this effect was not modulated by articulatory suppression.

Together, these findings suggest that stuttering is not (only) a problem at the output (overt vocalisation) level, but also that it is not situated at the subvocalisation level. Experiments currently underway test whether the effect is due to problems applying grapheme-phoneme conversion rules or at the level of deficient phonological representations.
Parafoveal information can facilitate word identification in reading

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One important difference between listening and reading is that listeners receive linguistic information one word at a time, while a reader’s perceptual span usually contains the currently fixated (foveal) word as well as one or more upcoming (parafoveal) words. To what extent readers can use this information about parafoveal words has been the subject of considerable debate. At this point, it is well-established that readers can preprocess parafoveal words before fixating them (Rayner, 1975). However, it is not clear to what degree parafoveal information can influence processing of the foveal word. Previous research has shown that foveal processing is slowed down by the presence of unusual parafoveal information (Blanchard, Pollatsek, & Rayner, 1989). However, if a word in the parafovea is similar to the foveal word – for example, if the foveal and parafoveal words contain the same letters – this overlap may facilitate the identification of the foveal word. Inhoff, Radach, Starr, and Greenberg (2000) reported that readers were faster at identifying a word (e.g. “mother”) when it was repeated in the parafovea (e.g. in the phrase “mother’s mother”) than when it was followed by an unrelated word (e.g. “mother’s garden”). However, Inhoff et al.’s use of such unusual phrases limits the generalizability of these results. Also, it is not clear at which level of processing these effects occurred.

In order to further investigate this phenomenon, we performed two eye-tracking experiments using the gaze-contingent boundary paradigm (Rayner, 1975) to manipulate the parafoveal information that subjects received while fixating a target word within a sentence. During each experiment, subjects read sentences containing an invisible boundary located to the right of each target word (e.g. “news”; see Figure 1 for an example of the experimental conditions). While readers fixated on the target word in Experiment 1, their parafoveal preview of the next word was manipulated to be a repetition of the fixated word (“news”), a correct preview of the post-target word (“once”), an unrelated word that did not fit in the sentence frame (“warm”), or a random letter string (“cxmr”). Once subjects crossed the boundary, the preview changed to the actual word in the sentence (“once”). We found that fixation times on the target word were significantly lower in the parafoveal repetition condition than in the other conditions, suggesting that foveal processing can be facilitated if the foveal word is repeated in the parafovea.

These results were replicated in Experiment 2, which contained the parafoveal repetition and the correct post-target word preview condition from Experiment 1. Additionally, the preview of the post-target word could be a nonword neighbor of the target word (“niws”), a semantically related word (“tale”), or a nonword neighbor of that word (“tule”). Again, fixation times on the target word were significantly shorter in the parafoveal repetition condition than in any of the other conditions, suggesting that the parafoveal facilitation effect requires the parafoveal word to be identical to the foveal word. We discuss implications of this effect for our understanding of how words are identified during sentence reading.
Figure 1: Example item and display change procedure

Experiment 1

Before readers fixate to the right of the invisible boundary (denoted by |):

<table>
<thead>
<tr>
<th>Preview Type</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identical preview</td>
<td>Victor read the news</td>
</tr>
<tr>
<td>Repetition preview</td>
<td>Victor read the news</td>
</tr>
<tr>
<td>Unrelated preview</td>
<td>Victor read the news</td>
</tr>
<tr>
<td>Random letter preview</td>
<td>Victor read the news</td>
</tr>
</tbody>
</table>

After readers fixate to the right of the invisible boundary:

Victor read the news | once this morning.

Experiment 2

Before readers fixate to the right of the invisible boundary (denoted by |):

<table>
<thead>
<tr>
<th>Preview Type</th>
<th>Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identical preview</td>
<td>Victor read the news</td>
</tr>
<tr>
<td>Repetition preview</td>
<td>Victor read the news</td>
</tr>
<tr>
<td>Orthographically related preview</td>
<td>Victor read the news</td>
</tr>
<tr>
<td>Semantically related preview</td>
<td>Victor read the news</td>
</tr>
<tr>
<td>Unrelated non-word preview</td>
<td>Victor read the news</td>
</tr>
</tbody>
</table>

After readers fixate to the right of the invisible boundary:

Victor read the news | once this morning.

References:


The Psychologist Said Quickly, “Dialogue Descriptions Modulate Reading Speed!”

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While reading stories, readers often have the phenomenological experience of hearing the characters’ voices in their heads. However, the extent to which readers generate the prosodic characteristics of a text has received relatively little attention outside of the proposal that default prosody influences syntactic parsing (IPH, Fodor, 2002). Alexander and Nygaard (2008) showed that after hearing a speaker read a passage quickly, listeners were faster to read a different passage aloud if told it was “written” by the fast speaker, and likewise for a slow speaker. However, this study primed subjects with a spoken cue to talker speed, so readers did not independently generate the prosody.

We investigate whether the semantic content of a sentence affects reading time of an embedded quote to see if the speed at which a character is described as saying a quote affects how quickly it is read. Subjects were presented with sentences like John walked into the room and said quickly/slowly, “I finally found my car keys!” The adverb preceding the quote indicated the speed of the character’s speech. Every subject saw each quote once, preceded by either a fast or slow adverb, and reading times on identical quotes were compared across conditions.

Analyses of reading times on the quote region revealed that quotes following a fast adverb were read significantly faster than those following a slow adverb. This result was significant for go-past time (time spent reading the region before leaving to the right, including regressions), \(F(1,68)=6.36, p<.05\), and total reading time (excluding regressions), \(F(1,68)=5.61, p<.05\). These effects are interpreted to reflect the generation of the quote’s prosodic structure, for the following reasons. First, the effects do not appear on first-pass measures, as would be expected from semantic priming. Secondly, analyses of individual words show that the effect is distributed across the entire quote region, rather than being driven by the first word following the adverb, as would be expected from semantic priming. Additionally, the fast adverbs were themselves read significantly faster than the slow adverbs on gaze duration, go-past time, and total time (all \(p<.05\), and marginally so on first fixation duration (\(p=.051\)), controlling for adverb length and frequency.

This is the first eye-tracking study to show that the semantic content of a sentence can affect reading speed on an entire region of text, without priming subjects with recordings of particular speakers. These findings have important implications for models of eye movement control during reading and sentence processing. They support the view that eye movements are driven by cognitive control, consistent with the EZ-Reader Model (Pollatsek, Reichle & Rayner, 2006). They also demonstrate that fixation durations are modulated by features of the higher-level representation of the text, beyond simple lexical access. Specifically, readers represent prosodic features of a text, like the speed at which a character is talking, and these representations can in turn affect their eye movements.
References
Discourse events influence verb integration and argument prediction: Evidence from ERPs

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It is an open question, which role the discourse context plays in influencing the predictions of verbal complements during incremental sentence comprehension. One recent study by Metusalem et al. (2010) suggests that verbal expectations for its arguments are largely unaffected by discourse context. However their study did not directly contrast the influence of discourse context to that of verb information on the integration of verbal arguments.

In our study we investigated both the integration of the verb and its argument with the discourse context as a function of semantic fit between the verb and the context. We presented a context sentence followed by a sentence containing either a fitting or non-fitting verb followed by a noun, which either fit well with the context or not, but always fit well with the verb (A-D) independent of context. We thus have a 2x2 design with the factors Verb congruency and Noun congruency.

Analysis of the data revealed a centro-parietal negativity on the critical verb between 400 and 600 ms after word onset (A&B: opened versus C&D: closed, p = .03), showing an integration effect for the incongruent verb (Kutas and Hillyard, 1984). An analysis on the noun revealed a main effect of the factor verb congruency (p = .02) and noun congruency (p = .0001) as well as a significant interaction (p = .02).

Single comparisons between the context-congruent (A: bottle) versus the context-incongruent (B: window) noun after the semantically fitting verb showed a strong increase in the N400 amplitude, even though both nouns were equally plausible direct objects for the verb. The noun comparison after the non-fitting verb (C vs. D) showed a similar yet reduced N400 effect: The context-incongruent (D: window) noun elicited larger N400 amplitudes than the context-congruent (C: bottle) noun.

The N400 amplitude for the context-congruent noun was larger after the non-fitting verb (C) than after the fitting verb (A). For the context-incongruent noun this effect was reversed: The amplitude after the non-fitting verb (D) was smaller than after the fitting verb (B).

Our findings suggest that integration of the verb and noun is fundamentally determined by the context. Further, while integration of the noun is modulated by the verb, this does not override contextual expectations, contra the findings of Metusalem et al (2010). If the verb was playing a predominant role in expectation generation, one would expect a much larger reduction or even extinction of the N400 effect after the incongruent verb, due to override of context information. It rather seems that the verb is treated like any other meaningful element in the context, which leads to more specific expectations in conditions A and B, resulting in a larger effect of expectation violations. These results challenge psycholinguistic accounts in which prediction is controlled by the verb, but are generally in line with recent studies on the influence of distinct cues (verbal information, discourse context) on semantic/pragmatic processing of meaningful elements (vanBerkum 2004, Kuperberg 2007).

Material:
Context: Als Jan am Wasserkasten vorbeikommt, will er etwas trinken.
   As Jan walks past a waterbox, he wants to drink something.
A. Deshalb oeffnet er die Flasche mit aeusserster Sorgfalt.
   Therefore he opens the bottle carefully.
   [fitting verb, context-congruent noun]
B. Deshalb oeffnet er das Fenster mit aeusserster Sorgfalt.
Therefore he opens the window carefully.
[fitting verb, context-incongruent noun]
C. Deshalb schließt er die Flasche mit äußerster Sorgfalt.
Therefore he closes the bottle carefully.
[non-fitting verb, context-congruent noun]
D. Deshalb schließt er das Fenster mit äußerster Sorgfalt.
Therefore he closes the window carefully.
[non-fitting verb, context-incongruent noun]

References:
Metusalem, R., Kutas, M., Hare, M., McRae, K., & Elman, J. L. (2010). Generalized Event Knowledge Activation During Online Language Comprehension. In Proceedings of the 32 nd annual meeting of the cognitive science society (pp. 1058 • 1063).
Speakers and listeners switch their roles with small or even no time lag during conversations. Such accurate timing requires the next speaker of a conversation to anticipate the moment when the current turn is going to end, because the production system is quite slow and the response must be underway before the other speaker has stopped speaking. How people are able to anticipate the end of a turn is topic of current research. In earlier work it was shown that anticipation of a turn-end relies more on the semantic and syntactic information of a turn than on the prosody (De Ruiter et al., 2006). However, it is yet unclear how lexico-syntactic information helps in predicting the moment when a turn ends. We hypothesize that people can predict the time of turn-ends by predicting the upcoming word forms that finish the turn. We have shown that turns which end-point can be more accurately predicted have also more predictable last words (Magyari, De Ruiter, 2008). Evidence for anticipatory processes that pre-activate words during sentence processing has been around for some time (DeLong et al., 2005), but turn-taking provides evidence that language comprehension should help also in estimating the duration of the upcoming linguistic information. Such forward-looking processing is crucial for response preparation.

In order to gain a better understanding of the anticipatory processes involved in turn-taking, we need to have a better view on the temporal evolution of turn-end anticipation. Word production experiments have shown that it takes 600-1200 ms for the production system to get from the thought to the articulation of a word (Indefrey, Levelt, 2004). Therefore, preparation for a turn-end must be active at least 600 ms before a (predictable) turn-end. Similarly, turn-end anticipation must occur also around this time as latest. To test this hypothesis empirically, we recorded EEG in order to identify the neuronal processes accompanying the anticipation of turn ends. We focused on the dynamics of EEG oscillations, as oscillatory dynamics have been clearly associated with both motor and non-motor anticipation in the past (Bastiaansen, Brunia, 2001).

In our experiment, participants were listening to turns taken out of real conversations and they were instructed to try press a button exactly when a turn ended. The experimental task and stimuli were the same as in De Ruiter et al.’s study (2006). In a behavioral pretest, we used a gating paradigm to quantify the predictability of the last few words of each turn. Turns in which the last few words were predictable were assigned to the predictable (PRED) condition, turns with less predictable last few words formed the unpredictable (UNPRED) condition. Next to a 64-channel EEG recording, we also recorded the (timing accuracy of the) button-presses.

The behavioral results showed that participants were more accurate in predicting turn-ends in the PRED condition than in the UNPRED condition. Time-frequency analysis performed on the EEG data from 2 s before until the button-press showed that oscillatory dynamics were significantly different between the two conditions in the 11-18 Hz (lower beta) frequency range. Over frontal electrodes, we observed a significant beta band power decrease starting as early as 1.7 s before the button-press in the PRED condition. In the UNPRED condition, a beta power increase was observed during this time interval. Over motor areas, beta power decreases were observed for both conditions. In order to estimate the source of the frontal beta power decrease we used a source-localization method based on beamformers (Dynamic Imaging of Coherent Sources, Gross et al., 2001). This analysis revealed sources in
midfrontal and left frontal areas, with a maximum in the left inferior frontal gyrus (LIFG, BA 47).

Figure 1. A) Time-frequency representation (TFR) of the oscillatory activity at electrode 59. The x-axis represent the time from 2s before the button-press until the button-press. The y-axis represents the frequency bins. The relative power changes are color-coded (see the color bars). The first column shows the TFRs for each condition. The second column shows the differences of the TFRs between the two conditions. The third column shows only the significant differences. B.) Schematic head with the electrode positions. Electrode 59 is shown in black. C.) The source reconstruction of the significant beta power changes.

The button-press results further support the claim that people rely on their predictions about the upcoming word forms for anticipating turn ends. The EEG results showed that people anticipated the turn-end already 1.7 s before the button-press when the words were predictable in the turn. Further, the EEG data suggest that turn-end anticipation is mediated by midfrontal and left frontal cortical areas, including LIFG. The LIFG has been proposed to play a role in the unification of sentence- and discourse-level linguistic information. The midfrontal areas have been suggested to be part of a functional network that is involved in verbal action planning and attentional control (Hagoort, 2005). The source localization results suggest that brain areas involved in estimating the timing of a turn-end are part of the same functional network that subserves sentence and discourse-level comprehension processes and control.

References:
Choosing referring expressions: Are the grammatical role, linguistic competitor and visual competitor effects influenced by the presence of an addressee?

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Theories of reference claim that language users tend to produce reduced referring expressions such as pronouns when the referent is highly salient, but more explicit expressions such as repeated names and noun phrases when the referent is less salient (e.g., Ariel, 1990; Givón, 1983). Speakers are less likely to produce pronouns (rather than names or noun phrases) when the referent is an object than a subject in the preceding sentence (e.g., Brennan, 1995; Fletcher, 1984), when a competitor is mentioned than when it is not (Arnold & Griffin, 2007; Fukumura, Van Gompel, & Pickering, 2010) and when a competitor is visually present than when it is not (Fukumura et al., 2010).

An important question is whether these saliency effects are driven by the needs of the addressee, that is, whether the speaker takes into account various saliency factors because the expression has to be understood by an addressee, or whether they are unaffected by the presence of an addressee. We therefore manipulated the saliency of the referent while speakers produced referring expressions either for an addressee (Experiment 1) or in the absence of an addressee (Experiment 2). We were interested in three questions: (1) Is the effect of grammatical role (or order of mention) influenced by the presence of an addressee? (2) Is the effect of presence/absence of a linguistic competitor influenced by it? (3) Is the visual competitor effect influenced by it?

Each experiment had four conditions (Figs. 1a-d).

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**a. Object antecedent, competitor linguistically and visually present**
Context sentence: A supporter kicks a footballer.

**b. Subject antecedent, competitor linguistically and visually present**
Context sentence: A footballer kicks a supporter.

**c. Subject antecedent, competitor linguistically absent but visually present**
Context sentence: A footballer fails.

**d. Subject antecedent, competitor linguistically and visually absent**
Context sentence: A footballer fails.

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Figure 1: Context sentence and picture in the four item conditions.
Participants first heard a context sentence while they saw a picture. Next, they saw another picture (Fig. 2), which showed an action of the referent that the participant had to describe. Participants could either refer using a pronoun or a noun phrase (he/the footballer throws a bottle). In Experiment 1, they described the picture to a confederate, while in Experiment 2 there was no addressee.

The results are in Figs. 3.

Participants produced fewer pronouns (and more noun phrases) when the antecedent was an object (1a) than subject (1b), but this was unaffected by whether an addressee was present or not. They also produced fewer pronouns when the competitor was linguistically present (1b) than absent (1c), and again this did not interact with addressee presence. This suggest that the grammatical role and linguistic competitor effects are not driven by cooperativeness to the addressee. It is unlikely that the absence of an interaction was due to a weak addressee manipulation, because the visual competitor effect was significantly modulated by addressee presence: In Experiment 1, participants produced fewer pronouns when the competitor was visually present (1c) than absent (1d), but there was no significant effect in Experiment 2. This suggests that the visual competitor effect is at least partly due to cooperativeness with the addressee. We argue that in the absence of an addressee, speakers only use the linguistic discourse for their choice of referring expression, whereas in the presence of an addressee, they also use the visual context.

Fluency or accuracy: What matters when correcting errors in spoken dialogue?

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When speakers make errors, they must coordinate the tasks of interrupting erroneous speech and of replanning the utterance. While early accounts (Levelt, 1983) have suggested that speakers interrupt themselves immediately upon realising their error and then commence replanning, it has been suggested more recently that these processes may run in parallel (Hartsuiker & Kolk, 2001). With replanning no longer seen as contingent on interruption, speakers may be able to make a strategic decision about when to interrupt themselves (Tydgat et al., 2011). Fluency could be maintained by continuing to produce (possibly erroneous) speech for as long as possible while a repair is planned; on the other hand, accuracy could be improved by interrupting the erroneous signal as quickly as possible, introducing a (possibly disruptive) pause for planning.

Here we present an analysis of 3020 self-corrected errors produced by 64 speakers in conversations from the Map Task Corpus (Anderson et al., 1991). In particular, we investigate the locus of the interruption (whether mid-word or word-final), and the length of any silent pause that precedes a resumption. If speakers attempt to maintain fluency while executing repairs, they should only interrupt themselves mid-word if they have already completed replanning and can resume immediately. This suggests that the pauses which follow mid-word interruptions will tend to be shorter than those following word-final interruptions. The fluency account also predicts an interaction between the locus of the interruption and the severity of the error to be repaired; with major errors being those where the original utterance is abandoned entirely. For word-final interruptions, the difference between pauses following major and minor errors should be greater than those following mid-word interruptions, as replanning is likely to take longer following major errors. Although evidence in support of these predictions has been reported by Seyfeddinipur et al. (2008), the accuracy account—which predicts pauses may be longer following mid-word interruptions—has also been supported by Hartsuiker et al. (2008).

In the Map Task Corpus dialogues, we found a main effect for location of interruption, with the pauses following word-final interruptions consistently longer than those following mid-word interruptions. We also found an interaction with severity of repair, with the effect of severity greater for word-final interruptions. Our findings also provide the first known evidence of a linear relationship between the length of a pause and the length of the utterance repaired, suggesting that speakers may retrace their way back through the utterance as part of planning their repair. Importantly for the fluency account, this was found to interact with the location of completion, with the effect of utterance length having a greater effect following word-final interruptions. Taken together, our findings strongly support the view that when they produce errorful speech, speakers strive to maintain fluency, continuing to produce words in the existing speech plan until a repair has been planned (or there are no further words to utter).

References

In the past decade, research on spoken language comprehension has been informed by the so-called visual world paradigm, in which comprehenders’ eye gaze is recorded while they hear utterances relating to visual context. The assumption is that participants’ fixations to objects reflect their incremental utterance comprehension and rapid integration of linguistic and visual information. A further (generally unstated) assumption is that hearing a sentence while viewing a scene generates a strong impulse to map the one onto the other, irrespective of any other goals. The possibility that different tasks (e.g., passive listening versus acting out) might affect this mapping has largely been ignored (Salverda et al., 2011), despite clear evidence that tasks and viewers’ moment-to-moment goals can both affect fixation behaviour (Hayhoe & Ballard, 2005). Existing research has further disregarded the possibility that even subtly different comprehension sub-goals (e.g., assigning reference versus thematic roles) might modulate (visual) attention. If this is the case, accounts that aim to model comprehension at the level of these sub-goals need to accommodate their effects (e.g., Knoeferle & Crocker, 2006).

Three eye-tracking experiments presented identical materials but varied a subsequent verification task (each N = 32). A videotaped speaker referred to depicted characters, using either a German subject-verb-object (SVO) or a non-canonical object-verb-subject (OVS) sentence. At the verb, the speaker shifted her gaze from the pre-verbal to the post-verbal referent (‘gaze’ is used in a wide sense here, including head movement). In conditions where the speaker was visible (Fig. 1a, vs. Fig. 1b), this allowed anticipation of the upcoming NP2 referent (cf. Hanna & Brennan, 2007). We compared participants’ anticipatory eye movements to this character depending on speaker gaze availability, sentence structure, and verification task: Following the video, participants had to verify whether a schematic depiction correctly highlighted either the two referents (Exp. 1, Fig. 1c), the sentential patient (Exp. 2, Fig. 1d), or the thematic role relations (Exp. 3, Fig. 1e) of the sentence.

Verification response times (RTs) were not affected by speaker gaze but differed between tasks: RTs were faster for reference (Exp. 1) than for patient or role-relations verification (Exps. 2 and 3), and faster to SVO than OVS sentences in role-relations verification only (ps < .05).

Eye movements: Speaker gaze rapidly influenced the allocation of attention during comprehension, with earlier fixation of the NP2 referent in all tasks when the speaker was visible than when she was not (ps < .001). When verifying the patient (Exp. 2), this anticipation was more pronounced for SVO than OVS sentences (ps < .01). This was not the case for referent or role relations verification (Exps. 1 and 3, ps < .05), which actually showed somewhat more anticipatory fixations of the referent in OVS than SVO sentences. However, the overall facilitatory effect of speaker gaze was greater in these tasks for subject-than for object-initial sentences (ps < .05).

Thus, different post-sentence verification tasks affected not only post-sentence RTs, but also listeners’ progressive allocation of visual attention during sentence comprehension. Task affected which character participants inspected, and modulated the effects of both sentence structure and speaker gaze on NP2 anticipation. In sum, visual attention during
comprehension is exquisitely sensitive to response preparation processes, even for subtly differing comprehension subtasks.

![Figure 1: Stills from a comprehension video with (a) speaker visible vs. (b) speaker obscured, and verification templates for the three tasks of verifying (c) the referents (Exp.1), (d) the patient of the action (Exp. 2), and (e) the thematic roles of the sentence (Exp. 3).](image)

References:
Speaker emotion affects lexical and syntactic ambiguity avoidance in speech production.

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There is growing evidence that positive emotions can diminish communicative effectiveness: Happy speakers are less polite and indirect in their request formulation (Forgas, 1999), make more egocentric inferences when interpreting ambiguous statements (Converse, Lin, Keysar & Epley, 2008) and produce more prosodic cues that are misaligned with syntactic structure (Kempe, Schaeffler & Thoresen, 2010). Using mood induction, the present study is the first to investigate directly whether emotional valence has an effect on informativeness in speech production by comparing happy and sad speakers in their lexical (Experiment 1) or syntactic (Experiment 2) ambiguity avoidance. In both experiments, participants were randomly assigned to either a happy condition (watching the ‘Bambi on ice’- cartoon scene from Walt Disney’s movie Bambi accompanied by Mozart’s Rondo in G), or a sad condition (watching the ‘Death of Simba’s father’ – cartoon scene from Walt Disney’s movie The Lion King accompanied by Barber’s Adagio for Strings).

Experiment 1 modified a methodology introduced by Ferreira, Slevc & Rogers (2005) to examine lexical ambiguity avoidance: After mood induction, 48 participants (36 women) were asked to describe a series of four objects to a hypothetical addressee in a pre-specified order. In the critical trials, one homonym, e.g. a flying mammal, bat, appeared in third position followed by a second homonym, e.g. a baseball bat. Manipulation checks, administered after completion of the speech task, showed that the intended mood reliably persisted throughout the task in women but not in men who were therefore excluded from further analyses. The failure of the mood induction in the men may have been due to a combination of a demanding task with lesser susceptibility to mood induction of men in general. For the women, the results showed that while happy and sad speakers were equally likely to produce bare homonyms, e.g. bat, in the first instance (t(34)=0.3, n.s.), sad speakers were more likely to repair the temporary ambiguity by modifying the subsequent homonym (t(34)=2.5, p<.05), e.g. to say baseball bat (figure 1).

In Experiment 2, 48 participants (24 women) underwent mood induction, which this time reliably induced happy vs. sad mood in men and women. Participants were then shown arrays of objects and asked to formulate instructions for moving these objects around in space. In the critical trials, the arrays contained two exemplars of the same object so that identifying one of these objects to a potential listener required a relative clause modification as in Put the ball that’s under the boot under the barn for an array with two balls or Put the ball under the boot that’s under the barn for an array with two boots. Happy speakers omitted the modifying relative clause altogether 44% of times compared to only 22% omissions in sad speakers (t(46) = 2.3, p < .05. Thus, happy speakers were more likely to produce Put the ball under the boot when two balls were present in the array thereby rendering the whole expression ambiguous.
Figure 1: Percent of bare homophones produced by happy and sad speakers when naming a series of pictures in the control trials (one homophone in the array of pictures) and in the critical trials (two homophones in the array of pictures).

These results provide converging evidence that sad speakers are more likely to avoid lexical and syntactic ambiguity. One possible explanation for this finding, to be investigated in future research, is that because negative mood is associated with more systematic and deliberate information processing sad speakers are perhaps more likely to allocate more cognitive resources to effective monitoring of how well their speech is aligned with the perspective of the interlocutor. In general, the preliminary findings presented here fit well with a body of research suggesting that negative emotional valence can to some extent benefit communication.

References:
Pure perceptual cues and learned object knowledge influence selection of fit terms in Korean

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Korean speakers distinguish tight-fitting spatial relations from loose-fitting ones, encoding them in verbs, unlike other languages. While this issue has received much attention, it is unknown precisely how Korean speakers recognize these relations. In the present study, we explored whether Korean speakers utilize pure perceptual cues (e.g., relative motion between two objects or static visual one such as fit) or gradually learn that objects can have particular types of fit (e.g., connected lego blocks are tight fit) and rely on such acquired knowledge, by examining the effect of objects (familiar vs. abstract) and perceptual dimension (motion vs. fit) on Korean children’s as well as adults’ selection of fit terms.

Korean-speaking adults (n=32) and children (ages 3 to 6 years, n=64) were asked to describe scenes of containment and support relations, portrayed with familiar (Figure 1) or abstract objects (in a robot world, Figure 2). Each scene had a tight and loose version which differed in one perceptual dimension: type of relative motion or visual fit. For example, a scene of a flower being put into a vase had the flower stand up straight due to some material in the vase in the tight version, while the loose version had the flower fall to the side of the vase. In the corresponding abstract scene, the robot placed a rod into an open can and at the end of the event, the rod either stayed straight up or fell to the side. Each participant described both familiar-object (7 trials) and abstract-object scenes (4 trials), with the fit relation of each event alternating between trials. We expected that if acquired object-knowledge is influential, then selection of tight verbs would be greater in familiar than abstract-object condition and would also increase with age.

Logistic mixed models were used to predict tight descriptions with age, type (familiar, abstract), and visual fit (tight, loose) as factors. Participants produced more tight descriptions when the visual features suggested a tight relation ($z=5.83, p<0.001$). There was an interaction of type and age ($z=2.01, p<0.04$), where as participants got older, familiar objects elicited more tight descriptions than scenes with abstract objects. This suggests that learned real world object knowledge is indeed influential on selection of spatial terms. Interestingly, we also found an interaction of visual fit and cue-type (relative motion or visual cues) ($z=2.5, p<0.02$) in another logistic mixed model that was applied to the robot data only with cue-type, age, and fit as factors. While relative motion was sufficient to distinguish tight from loose (main effect of fit, $z=4.07, p<0.001$), static visual cues were stronger signals for the difference between tight and loose, and this pattern did not interact with age.

Together, these results provide the first demonstration that tight Korean language can be triggered by simple perceptual cues and the use of this knowledge does not change over language development. Children also learn that particular objects have particular spatial relations and future experimental work needs to consider the role of object associations in the processing of these relations.
Figure 1: Familiar Scenes: Tight self-standing flower (left), Loose resting flower (right)

Figure 2: Abstract Scenes: Robot putting rod into pot (self-standing rod shows tight relationship)

Figure 3: Proportion of tight descriptions by scene type, fit, and age.

Figure 4: Proportion of tight descriptions by cue type and fit for abstract scenes.
Common perceptual parameters underlying demonstrative usage across languages

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Spatial demonstratives (e.g. *this/that*) are among the most frequent terms in all languages and philologically emerge as the earliest traceable words in languages [1, 2]. They also appear early in child language acquisition [3], often co-occurring with deictic pointing. Given the importance of these lexical items, it is perhaps surprising that demonstrative systems exhibit considerable cross-linguistic variation. Whilst just over 50% of the world’s languages make a binary proximal/distal contrast [4] many languages make additional distinctions, including whether or not the object referred to is owned by the speaker (Supyire) and whether or not the object is visible (Tiriyó).

Given the diversity in the world’s demonstrative systems, one can ask if there is nevertheless a set of common perceptual parameters underlying demonstrative usage in all languages. If there is, then the distinctions lexicalised in other languages, such as ownership, should affect the use of demonstratives in English, where such parameters are not lexicalised. In the two experiments we report here, we tested directly whether ownership and visibility affect demonstrative use in English.

The experiments used a memory game paradigm [see 5 for full details] designed to elicit the use of the demonstratives ‘this’ and ‘that’ without participants realising the purpose of the experiment. Participants placed objects at various distances along the midline of a table, returned to their seat and then pointed and identified the object (e.g. ‘This blue diamond.’, ‘That red square.’)

**Experiment 1: Visibility (n=17)**

In addition to placing objects, participants were required to sometimes place a metal or glass container over the object (Figure 1, Panel B). The object was therefore only visible in the glass and no-cover condition. Visibility significantly affected participants’ use of ‘this’ and ‘that’ (F(2,32)=8.24, *p*=.001). There was no significant difference in performance between the glass and no cover condition, and both of these conditions produced significantly more usage of ‘this’ than the non-visible, metal container condition. There was also a significant effect of distance (F(2,32)=22.24, *p*=<.001), with participants using ‘this’ more often for closer locations. There were no interactions.

**Experiment 2: Ownership (n=25)**

Participants were given the British £2, £1, and 50p coins in participant payment, which also served as the ‘owned’ objects to be placed (Figure 1, Panel A). The experimenter also had a coin set. Both the participant and the experimenter placed objects at varying distances using both sets of coins.
As with the previous experiment, use of demonstratives was affected by where the object was placed (F(1.45,34.5)=30.40, p<.001). Participants also used ‘this’ more often for objects they had placed (F(1,24)= 5.79, p=.024). In addition, participants used ‘this’ significantly more often when identifying their own coins (F(1,24) = 7.44, p=.012). There were no interactions.

Conclusions

These experiments demonstrate that lexicalisation is not the only predictor of use of demonstratives, and that distinctions lexicalised in some languages also influence the use of demonstratives in other languages. These results suggest that there may be a common set of parameters that underpin demonstratives across languages.

Figure 1. This figure shows two examples of the experimental arrangement.

References

Priming word order at the conceptual level
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Structural priming data from languages with variable word order such as Dutch or Japanese suggest that speakers do not only tend to repeat the phrase structural realization of their utterances (Bock, 1986), but that they also tend to preserve the linearization of the resulting phrases. In some of the studies (Hartsuiker, Kolk, & Huiskamp, 1999; Yamashita & Chang, 2006), thematic roles and their phrase structural realizations are confounded such that one does not know whether priming in these studies occurs at the conceptual or the positional level of sentence production.

The present study, in German, aims at disentangling these factors by pairing primes and targets that differ in phrase structure but are potentially parallel in the order of thematic roles. Prepositional object (NP PP) structures served as primes. The object NP was marked for accusative and referred to a theme whereas the PP referred to a recipient. The relative order of the critical constituents was manipulated (ACC PP vs. PP ACC).

(ACC PP, Theme Recipient) Der Händler verkauft den Traktor an den Bauern.
the.NOM salesman sells the.ACC tractor to the.ACC farmer

(PP ACC, Recipient Theme) Der Händler verkauft an den Bauern einen Traktor.
the.NOM salesman sells to the.ACC farmer a.ACC tractor

Targets presented for sentence generation consisted of non-alternating double object (NP NP) verbs and three vertically aligned nouns (e.g., zeigen Vater Kind Haus 'show father child house'). The position of the critical nouns was varied. Either the potential recipient (e.g., Kind, 'child') was presented above the potential theme (e.g., Haus, 'house') or the order was reversed. Responses were coded as to whether they displayed dative before accusative (DAT ACC) or accusative before dative (ACC DAT) word order.

(DAT ACC, Recipient Theme) Der Vater zeigt dem Kind das Haus.
the.NOM father shows the.DAT child the.ACC house

(ACC DAT, Theme Recipient) Der Vater zeigt das Haus dem Kind.
the.NOM father shows the.ACC house the.DAT child
'The father shows the child the house.'

Participants mostly produced structures that displayed DAT ACC order (91 %). Responses were submitted to a Generalized Linear Mixed Model (Baayen, 2008) with prime structure and noun position as fixed variables and participants and items as random variables. There was a significant effect of prime structure ($p < .05$) showing that there were more responses with ACC DAT order after ACC PP primes than after PP ACC primes. Moreover, there was a significant effect of noun position ($p < .01$) indicating that in their responses the participants tended to preserve the order in which the nouns were presented. Including the interaction terms did not improve the model.

There are several conclusions to be drawn from the data. First, they add to the evidence that the production of word order variants can be primed even when they only differ in case marking but not in phrase structure. Second, as primes and responses did indeed differ in phrase structure, an account in terms of structural priming at the positional level (Hartsuiker, Kolk, & Huiskamp, 1999) can be ruled out for our data. Third, primes and responses tended
to share the order of thematic roles and therefore add to the evidence for structural priming at the conceptual level (Bernolet, Hartsuiker, & Pickering, 2009). Finally, as there were relatively more marked ACC DAT responses after canonical ACC PP primes than after marked PP ACC primes (cf. Lenerz, 1977), our data indicate that an information structural account cannot be reduced to the notion of relative markedness of the resulting structures.

References:
Lexically incremental message planning
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Models of speech production typically assume speaking begins when message-level information is passed to linguistic encoding processes. An open question is the time-course of this coordination. Recently, Allum & Wheeldon (2007; 2009) proposed the functional phrase—FP—(e.g., a simple or conjoined NP) as the unit defining the scope of advanced planning. They found that when a sentence-initial FP (underlined) contained two nouns (the dog and the flower...), speech onsets were delayed compared to sentence-initial FPs that contained one noun (the dog above the flower...). However, speech onset delays are not necessarily the result of message-planning per se. An alternative proposal (Brown-Schmidt & Konopka, 2008) argues that message-planning scope can be as small as a single word. Examining gaze at unmentioned, but message-relevant entities, they exploited the timing of speakers’ first fixation to the “size-contrast” (e.g., a large butterfly when describing a smaller butterfly) to estimate when speakers first incorporated size-information into their message. They found that bilingual speakers fixated the size-contrast earlier when speaking English (e.g., the small butterfly), vs. Spanish (e.g., la mariposa pequeña), and interpreted this as evidence for lexically-incremental message-planning because a 1-word delay in adjective position afforded delayed planning of size-information in Spanish. However, these findings are consistent with Allum & Wheeldon’s proposal because the postnominal modifier is outside the first FP, on Allum & Wheeldon’s account.

The present research tests for incrementality within a FP. Eye-tracked participants (n=36) played an unscripted interactive task in which they described pairs of objects, one of which was presented with a size-contrastting item in the display, resulting in a size-adjective on the first or second noun (e.g., 1-2). Data were analyzed using mixed-models. Speakers produced significantly more scalar modifiers when they fixated the size-contrast, 88%, vs. when they did not, 25%, (ps<.0001), validating the first-contrast fixation as a reasonable estimate of when speakers first incorporated size-information into their message. For fluent expressions, the timing of the first-contrast fixation, relative to utterance onset revealed that prenominal size-adjectives in the first NP (NP1) were planned well before speech onset (1st fixation m=293ms before speech onset), whereas prenominal size-adjectives in NP2 were planned after (1st fixation m=533ms after speech onset), p<.0001. Further, both phrase-initial disfluencies (e.g., 3-4) and size-repairs (e.g., 5-6) were associated with delayed first-contrast fixations for both NPs (ps<.001), indicating disfluency was used throughout the utterance to incorporate late-planned message elements. Speech onsets revealed a consistent pattern: For fluent expressions, utterance onset was delayed when NP1 contained a size-modifier vs. when it was unmodified (p<.001); there was no delay when NP2 was modified (p=.56), further suggesting that only NP1 was planned before speaking.

Delayed planning of size-modifiers in NP2 suggests speakers planned less than a FP before speaking. Thus, the FP is unlikely to be the unit of advanced planning. Instead, speakers can plan minimal message elements before speaking, possibly as limited as what is needed to express a single lexical item. Disfluency facilitates this lexically-incremental message-level planning, suggesting a tight link between message-planning and linguistic encoding.
Examples

1. The small duck and the lamp are flashing.
2. The duck and the small lamp are flashing.
3. Thee uh small duck and the lamp are flashing.
4. The duck and thee uh small lamp are flashing.
5. The duck uh small one and the lamp are flashing.
6. The duck and the lamp uh small lamp are flashing.

References


Are working memory (WM) resources that support linguistic processing specialized for language or are they more general in nature? Based on their behavioral and patient work, Caplan & Waters (1999) proposed that linguistic WM resources are specific to language. However, this conclusion is based on null results: no correlations between language comprehension and verbal WM tasks. Recent behavioral and fMRI evidence challenged Caplan & Waters’ position (Gordon et al., 2002; Fedorenko et al., 2007; Novick et al., 2005, 2010; January et al., 2009). However, if resources are indeed shared between language processing and other cognitive tasks, it remains a puzzle why these effects have been elusive in individual-difference paradigms (Caplan & Waters, 1999). One possible reason is that the language comprehension measures – typically a difference between object- and subject-extracted relative clauses (ORCs-SRCs) in RTs/accuracies – are noisy. Indeed, in previous work we observed low split-half correlations for the language measure (ORC-SRC effect).

We here present a novel robust paradigm for assessing linguistic WM within individual participants based on people’s ability to complete simple and complex sentences grammatically and show that it strongly correlates with a measure of non-verbal IQ.

In Experiment 1, 60 participants completed 42 fragments across 7 conditions, (1). The materials included (i) complex structures (1a-d), which are notoriously difficult to comprehend (Yngve, 1960; Chomsky & Miller, 1963); (ii) simpler structures (1e), which, although complex, have been shown to be easier than doubly-nested ORCs (Cowper, 1976; Gibson & Thomas, 1996); and (iii) simple (control) structures (1f-g). Participants were expected to be able to complete the control conditions grammatically, with two verb phrases (VPs; (2)). For analyses of the critical conditions (1a-e), we only included participants (n=53) who grammatically completed at least 5/6 of each of the control conditions. Participants had difficulty grammatically completing ORC/ORC structures (1a-b): they produced three VPs only 23% of the time (Fig.1). (Furthermore, most of their incorrect completions involved omitting the middle VP (2), consistent with previous comprehension work which showed that ORC/ORC structures with the middle VP omitted are easier than those with all three VPs (Gibson & Thomas, 1999; Vasishth et al., 2010).) Critically, we related participants’ ability to complete the critical conditions with their IQ scores, assessed using Ravens Advanced Progressive Matrices (RAPM; Raven et al., 1988). A large and highly reliable correlation was observed (r=.478, p<.001; Fig.3a). A logit model demonstrated the same strong relationship, even controlling for the time taken to complete the study or the length of participants’ completions on the filler materials.

In Experiment 2, we focused on materials that elicited completion performance in the dynamic range: SC/ORC structures (2c-d) and simpler versions of doubly-nested RC structures (2a-b; Fig. 2). 60 new participants completed the task (5 removed using the method above). We successfully replicated the correlation between completion accuracy and performance on the RAPM (r =.504, p<.001; Fig.3b).

In conclusion, we have presented a novel measure of linguistic WM – complex-sentence completions – and showed that this measure correlates strongly with a measure of general (non-verbal) intelligence. These results suggest that linguistic processing is supported, at least in part, by domain-general cognitive/neural resources, contra Caplan&Waters(1999). Given the robustness of the linguistic WM measure, this work has important implications for diagnosis and treatment (e.g.,Jaeggi et al., 2008) of Broca’s aphasia.
(1) Experiment 1 materials (ORC = object-extracted relative clause; SRC = subject-extracted relative clause; SC = sentence complement)

a. ORC-anim/ORC: The reporter who the professor who the diplomat…
b. ORC-inan/ORC: The manuscript which the student who the dog…
c. ORC/SC: The reporter who the fact that the diplomat…
d. SC/SC: The prediction that the story that the preacher…
e. SC/ORC: The fact that the professor who the diplomat…
f. ORC: The veterinarian who the…
g. SRC: The fencer who…

(2) Sample grammatical and ungrammatical completions

SRC: The fencer who… fenced poorly won anyway.
ORC-inan/ORC: The manuscript which the student who the dog… chased was turned in late.
SC/ORC: The fact that the professor who the diplomat… insulted was later proven false.

(3) Experiment 2 materials

a. ORC-anim/SRC: The reporter who the professor who…
b. ORC-inan/SRC: The manuscript which the writer who…
c. SC/ORC: The fact that the senator who the diplomat…
d. SC-verb/ORC: The rumor stating that the suspected mobster who the media…
e. ORC: The veterinarian who the…
f. SRC: The fencer who…

Figure 3a (left): Correlation between Ravens accuracy and completion accuracy in Experiment 1 (r = .478; n=53; p < .001).
Figure 3b (right): Correlation between Ravens accuracy and completion accuracy in Experiment 2 (r = .505; n=55; p < .001). (Note that there are fewer participants in the low range of completion accuracy as compared with Experiment 1, because of the lower complexity of the language materials in Experiment 2, by design.)
Eliciting the production of doubly center-embedded object relative clauses in French:
The influence of lexical type and working memory capacity.

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According to the Syntactic Prediction Locality Theory (SPLT, Gibson, 1998), the processing difficulty of doubly center-embedded object relatives (DCEOR) like (1) reflects the maximal memory cost during parsing the sentence. This maximal cost is at the most embedded subject (the clinic) because at this point, the two syntactic predictions with a high cost concerning the second verb (VP2) (admitted) must be maintained. This high cost should result in the omission of predictions relative to the occurrence of the VP2. Consistent with this analysis, Gimenes et al. (2009) showed that eliminating VP2 reduced the complexity rating of (1). The SPLT also predicts that the memory cost of a prediction is reduced when it must be maintained across an indexical pronoun (e.g., "I") relative to full NP (e.g., "the clinic") (Warren and Gibson, 2002). An aspect of DCEOR processing that is not clear is whether DSEOR can be produced by adults (De Vries et al., 2008). Corpus studies showed very few sentences with such structure (Karls\(\text{son}, 2007\)). SPLT suggests that adults could more often produce DCEOR if the most embedded subject is a pronoun than if it is a full NP. It also predicts that participants with a working memory (WM) capacity should be correlated with the number of verbs successfully processed in DCEOR structures.

(1) The patient who the nurse who the clinic had hired admitted met Jack
(2) The patient who the nurse who (the clinic) / (I) …
(3) Le malade que l’infirmière que (la clinique) / (je) …

Method:

We used continuation task to assess syntactic performance on DCEOR. The 48 French participants were presented a fragment to continue in a paper and pencil task. Each fragment contained 3 NPs starting a complex sentence, like in (3) which is the French translation of (2). We counted the number of verbs in the continuation. The occurrence of three verbs would indicate a complete syntactic parse, whereas only 2 verbs are consistent with a parsing failure. Two WM tests were used: the Reading Span (RS) test and a visuo-spatial WM test. Twenty-four sentences with three NPs, like (2) were used. They were mixed with 24 fillers. Each participant had to continue a group a 12 experimental fragments with a final "I" and 12 experimental fragments with a final NP.

Results:

There were 11.5\% of 3 VPs continuations in the NP condition, and 20.5\% in the pronoun condition (Khi\(^2 = 17.5, p<.001\)), confirming the first prediction. A regression analysis using participants as a random variable showed that the Reading Span score was significantly correlated with the number of produced verbs (r(46)=0.528, p<.0001). A regression analysis showed that the RS test was a better predictor than the Visuo-Spatial test. The Table 1 reports other specific results, contrasting participants according to median RS.
Table 1: Mean number of continuations (/12) with 3 verbs and 2 verbs produced by participants with low WM span (N=24) and high WM span (N=24) according to the lexical type of the last NP in the fragment (Full NP vs. Pronoun)

<table>
<thead>
<tr>
<th></th>
<th>Indexical Pronoun</th>
<th>Full NP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3 verbs</td>
<td>2 verbs</td>
</tr>
<tr>
<td>Low WM</td>
<td>1.1</td>
<td>9.1</td>
</tr>
<tr>
<td>High WM</td>
<td>3.8</td>
<td>7.7</td>
</tr>
</tbody>
</table>

Discussion:
This experiment confirmed that adults can produce the 3 VPs sequence required by a DCEOR sentence. Consistent with SPLT, the results showed that two conditions facilitate such production: a high verbal WM capacity, and a pronoun in the most embedded OR clause. Christiansen and Chater (1999) showed that a simple recurrent network has difficulties to process DCEOR, although it has no specific WM device to support computation. We currently examine whether a specific training of such network could simulate our results.

References:
Hypothesis: We propose that a major part of the parsing difficulty of doubly center-embedded relative clause constructions (2CE-RC) stems from a mis-match between their syntactic structure and the prosodic phrasing typically assigned to them, which is influenced by phrase lengths as well as syntactic alignment.

Rationale: A prosodic division between matrix subject and predicate (NP1 NP2 NP3 VP1 VP2 || VP3) is syntactically well-aligned but severely length-unbalanced for typical examples like (1). However, a balanced example like (2) is better, even though longer.

(1) The boy the cat the dog chased bit || died.
(2) The girl the man I love met || died of cholera in 1962.

An additional cut yields a 3-phrase analysis (NP1 || NP2 NP3 VP1 VP2 || VP3), which is prosodically acceptable if the inner items are short/light enough to be combined; see (3). Intuitively, this is easier and more natural than typical experimental items like (4), even allowing for the difference in overall sentence length.

(3) The kind old French lady || that the man I love met || now lives in upstate New York.
(4) The ancient manuscript that the grad student who the new card catalog had confused a great deal was studying in the library was missing a page. (Gibson & Thomas, 1999)

The benefit of shrinking the middle phrase offers a prosodic explanation for the well-known ameliorating effect of an unstressed pronoun as NP3.

An over-long middle phrase could be divided as NP1 || NP2 NP3 VP1 VP2 || VP3. But intuitively this 4-phrase analysis is less helpful to the syntactic parser; see (5).

(5) The beautiful young woman || the man the girl loved || met on a cruise ship in Maine || died of cholera in 1962. (Frazier & Fodor 1978)

To explain this, we assume that the parser attempts to relate successive prosodic phrases as syntactic sisters, but cannot do so when VP2 is phrased separately. Wagner (2009) argues that an RC can string-vacuously raise to become sister to its head in a list-like construction; this yields the 3-phrase analysis. But VP2 cannot raise out of an RC (an extraction island) to become sister to the RC-residue, yielding the 4-phrase analysis. VP2 can be a sister only if (mis-)attached as matrix VP, but then would be ousted by the real matrix VP3. This explains why VP2 is often suppressed by the parser, creating the ‘missing VP effect’ (mVPe) in which a 2CE-RC sentence with VP2 missing is falsely perceived as grammatical.

Indications in prior research:

(a) Since self-paced reading inhibits natural prosody assignment, robust mVPe is expected in
SPR experiments regardless of phrase lengths. This is so for Christiansen & MacDonald (2009); Gimenes et al. (2009); Vasishth et al. (2010, English).

(b) With full-sentence presentation, greater mVPe is expected where phrase-lengths preclude the 3-phrase pronunciation. This comports with the divergent results of recent non-SPR studies, with mean word-counts for \( NP_1 + [NP_2 NP_3 VP_1 VP_2] + VP_3 \) as follows.

<table>
<thead>
<tr>
<th>Source</th>
<th>Language</th>
<th>NP1 + NP2 + NP3 + VP1 + VP2 + VP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gibson &amp; Thomas (1999)</td>
<td>English</td>
<td>2+15+4</td>
</tr>
<tr>
<td>Bader &amp; Häussler (2011)</td>
<td>German</td>
<td>2+13+2</td>
</tr>
<tr>
<td>Vasishth et al. (2010)</td>
<td>German</td>
<td>2+8+1</td>
</tr>
</tbody>
</table>

### Prosody elicitation experiment:

**Aim:** To test the benefit of balanced 3-phrase prosody, with overall sentence length controlled.

**Materials:** 12 English 2CE-RC sentences (full sentence presentation), with distributions of phrase-lengths expected to ENCourage versus DISCourage 3-phrase prosody; see (6) versus (7).

(6) *The rusty old ceiling pipes that the plumber my dad trained fixed continue to leak occasionally.*  
  ENC: 5+7+4=16

(7) *The pipes that the unlicensed plumber the new janitor reluctantly assisted tried to repair burst.*  
  DISC: 2+12+1=15

**Procedure:** Since 3-phrase pronunciation is unlikely by naïve subjects reading without preview, a familiarization protocol was employed to facilitate it. All target sentences (and fillers) were built up in five steps, as illustrated in (8). (Note: only the ENC version is shown here.)

(8) *My dad trained a plumber.*  
  *Here is the plumber my dad trained.*  
  *The plumber my dad trained fixed the rusty old ceiling pipes.*  
  *Here are the rusty old ceiling pipes that the plumber my dad trained fixed.*  
  *The rusty old ceiling pipes that the plumber my dad trained fixed continue to leak occasionally.*

At each step, participants read silently for comprehension, then aloud for recording. They judged the pronounceability and comprehensibility of the fifth sentence. Two expert judges tallied prosodic boundary locations and appropriateness of contours.

**Results:** For N=24, results (all \( p<.05 \)) indicate that, as predicted:

(i) 2CE-RC sentences more often received 3-phrase prosody when NP2 NP3 VP1 VP2 were short/light, than when NP1 and VP3 were matched for overall sentence length.

(ii) Even with familiarization, 2CE-RC sentences were judged harder to pronounce and understand when 3-phrase prosody was not assigned.

**Next step:** Direct test of the missing VP illusion for these length-manipulated materials.
The Processing of PP-Attachment Ambiguity in German – The Influence of Explicit Prosody and Verb Placement

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Three experiments were conducted to investigate whether and when the explicit prosodic structure of an utterance influences the processing of prepositional phrase (PP) attachment ambiguity in German. Moreover, it was examined which constraints drive attachment preferences, e.g. availability of lexical heads (e.g. Konieczny et al., 1995), minimality principles (e.g. Frazier, 1987), or prosodic boundary information (Prosodic Structuring, Zschernitz, 2011, following Speer, Kjelgaard, and Dobroth, 1996; and as previous research, e.g. by Speer et al., 1996, Snedeker & Trueswell, 2003, indicates). A variety of empirical online and off-line methods was used to answer these questions.

In all three studies, two factors, prosody and verb placement, were varied. The manipulation of prosody featured two patterns of boundary marking each of which was associated with either attachment of the ambiguous PP¹. For the manipulation of verb placement, sentences with the finite verb either in second or in sentence-final position were created. Materials are illustrated under (1) – (4), hash marks (#) indicate prosodic boundaries². In Experiment 3, a sentence completion study, items as those under (1) – (4) were employed, which had been cut after the direct object noun (Igel).

The results of Experiment 1, an off-line forced choice categorisation study, showed clear evidence that prosodic boundary marking was used by the listeners to resolve ambiguity. Additionally, an underlying preference for VP-attachment was observed. These two effects showed up independently of the verb placement manipulation.

On-line visual-world data (Experiment 2) yielded a reliable prosodic effect on fixations to picture referents time-locked with the occurrence of prosodic cues in the signal for verb-second conditions. This indicates that prosodic cues are employed to guide parsing decisions³. Conversely, results of verb-final structures, showed no reliable prosody effect. As descriptive tendencies indicate, nonetheless, prosody cannot be completely neglected as a factor of influence in the processing of verb-final sentences. Fixation data for both verb-final conditions yielded a late NP-attachment preference predicted by the availability of lexical attachment sites.

Sentence completion data (Experiment 3) replicated the prosodic effects for verb-second conditions. Smaller and less complex phrases were preferentially added in NP-modifying prosody conditions (when sentence fragments do not end in a major prosodic boundary), whereas VP-modifying prosody conditions (sentence fragments end with a major boundary) exhibited a reliable increase in completions with larger and more complex phrases. Therefore, the categories of completed phrases mirror listeners’ sensitivity for the prosodic manipulation. No effect of prosody was found for verb-final structures. As in Experiment 1,

¹ Materials were constructed avoiding biasing any of the possible attachment types. This was controlled for in a number of pre-tests. Additionally, materials were controlled for typicality of direct object noun and PP-noun co-occurrences.
² For illustration purpose, structure is given in a simplified way.
³ It should be noted that none of the participants reported having been aware of the ambiguity and the prosody manipulation.
an overall VP-attachment preference of the completed phrases was discovered. No evidence for a general NP-attachment preference of completions was found in verb-final sentences.

Although results on the processing of verb-final structures are mixed (and we are intrigued to know why), our data provide further evidence that explicit prosodic cues are used during incremental processing to build a prosodic representation that can guide parsing decisions, speaking in support of Prosodic Structuring.

Examples:

(1) Verb-second structure, NP-modifying prosody
\[
[S[NP \text{ Der Junge}] [VP[\text{berührt gleich}] # [NP[NP \text{ den Igel}] [PP mit der Birne]]]]
\]
‘The boy touches soon the hedgehog with the pear.’

(2) Verb-second structure, VP-modifying prosody
\[
[S[NP \text{ Der Junge}] [[VP[V \text{berührt gleich}] [NP \text{ den Igel}] # [PP mit der Birne]]]]
\]
‘The boy touches soon the hedgehog with the pear.’

(3) Verb-final structure, NP-modifying prosody
\[
[S[NP \text{ Der Junge}] [VP[V \text{überlegt}] [S ob er gleich # [NP[NP \text{ den Igel}] [PP mit der Birne]] # [V \text{berühren soll}]]]]
\]
‘The boy considers whether he soon the hedgehog with the pear touch should.’

(4) Verb-final structure, VP-modifying prosody
\[
[S[NP \text{ Der Junge}] [VP[V \text{überlegt}] [S ob er gleich [NP \text{den Igel}] # [VP[PP mit der Birne] [V \text{berühren soll}]]]]]
\]
‘The boy considers whether he soon the hedgehog with the pear touch should.’

References:


Two (potential) differences between VP ellipsis and pseudogapping

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Verb phrase ellipsis and pseudogapping are often treated as variants of the same process [1-6]. In both something verbal is elided. In VP ellipsis the verb and all of its arguments are elided, while in pseudogapping, the verb is elided stranding one of its arguments (see (1), from [6]). We present two novel experiments examining potential differences between VP ellipsis and pseudogapping.

1. VPE: Some have served mussels to Sue but others wouldn’t <serve mussels to Sue>.
   PG: Some have served mussels to Sue while others have <served> swordfish.

Merchant [7] discusses one potential difference between the two constructions: VPE can seemingly tolerate syntactic mismatches between the antecedent and ellipsis clauses, while pseudogapping cannot (see (2)). He argues that the asymmetry follows from a difference in the height of ellipsis: the elided constituent includes the voice feature on \( v \) in pseudogapping, but not in VPE, so [voice] is subject to syntactic identity for pseudogapping but not VPE. We note, however, that the Merchant’s VPE examples enjoy an unfair advantage. VPE mismatch examples can be improved in sentences involving auxiliary, rather than argument, focus [8]. Pseudogapping, unlike VPE, requires argument focus, and not aux focus. To level the playing field, argument focus VPE and pseudogapping must be compared directly.

2. VPE: This problem was to have been looked into, but obviously nobody did <look into this problem>.
   PG: *Roses were brought by some, and others did <bring> lilies.

Experiment 1 did just that by testing the acceptability of sentences like (3-4) (and no-ellipsis controls), using magnitude estimation [9]. Results: Main effects of Ellipsis (\( \rho < 0.001 \)) and Mismatch (\( \rho < 0.001 \)): Ellipsis judged less acceptable than No Ellipsis, Mismatch less acceptable than Match. Mismatch-Ellipsis interaction (\( \rho < 0.001 \)): Mismatch less acceptable than Match only with Ellipsis; Mismatch-EllipsisType (\( \rho < 0.05 \)): Mismatch penalty greater for VPE than Pseudogapping, Ellipsis-Mismatch-EllipsisType (\( \rho < 0.05 \)): Mismatch-Ellipsis interaction stronger for VPE than Pseudogapping (see Figure 1). Discussion: mismatch affects both VPE and pseudogapping, but is more severe in VPE (contra Merchant’s predictions).

3. Match
   VPE: Andy accused Jill, and Matt did <accuse Jill>, too.
   PG: Andy accused Jill, and Matt did <accuse> Beth.

4. Mismatch
   VPE: Jill was accused by Andy, and Matt did <accuse Jill>, too.
   PG: Jill was accused by Andy, and Matt did <accuse> Beth.

Another dimension in which VPE and Pseudogapping might differ is anaphoricity. Kehler [10] argued that VPE—as opposed to gapping—is anaphoric because it can take place across a discourse and allows cataphoric reference. By those criteria, pseudogapping, like gapping, is not anaphoric, thus providing an additional difference between VPE and PG (5-6).

Experiment 2 tested this by embedding sentences like (3-4) in either “resemblance” or “cause-effect” discourse relations, which should affect only anaphoric processes (VPE but not PG). Results: Both PG (\( \rho < 0.001 \)) and VPE (\( \rho < 0.05 \)) judged less acceptable than...
NoEllipsis. Mismatch less acceptable than Match (p<.05), Cause-Effect Relation less acceptable than Resemblance (p<.05). Mismatch-Ellipsis for VPE (p<.0001) but not PG: Mismatch penalty greater with VPE than without, Ellipsis-Mismatch-DiscRelation marginal for VPE (p<.08) but not PG (p>.6): Mismatch-Ellipsis interaction stronger for Resemblance than Cause-Effect, for VPE but not PG (see Figure 2). Discussion: discourse manipulation affected VPE and not PG, consistent with the claim that VPE is anaphoric while PG is not.

(5) Across discourse
VPE: A. Bill will make a statement blasting the media. B. Hillary will make a newspaper reporters.
PG: A. Bill will make a statement blasting the media. B. *Hillary will the newspaper reporters.

(6) Cataphoric reference
VPE: If Hillary will, Bill will make a statement blasting the media.
PG: *If Hillary will the newspaper reporters, Bill will make a statement blasting the media.

Though VP ellipsis and pseudogapping may differ syntactically, Experiment 1’s results contradict the “height of ellipsis” distinction proposed by Merchant [7]: VP ellipsis was more sensitive to voice mismatch than pseudogapping when compared in similar examples. VP ellipsis and pseudogapping do appear to differ on the dimension of anaphoricity as suggested by the effect of discourse relation on VP ellipsis and not pseudogapping observed in Experiment 2.

References:
Simulating Speed in Language
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The embodied approach to language processing describes understanding sentences as the mental simulation of events being referred to, recruiting the same resources as those used in perception and action (e.g. Barsalou, 2008, Zwaan, 2004). It is now quite accepted that very concrete aspects of meaning, such as orientation (Stanfield & Zwaan, 2001) and direction of movement (Glenberg & Kaschak, 2002), are included in simulations, however there are other aspects of meaning not directly linked with perception and action that are less well understood. Recently, eye-tracking methodology has been utilized to investigate perceptual simulation in language processing (e.g. Spivey & Geng, 2000, Richardson & Matlock, 2007, Coventry, Lynott, Cangelosi, Monrouxe, Joyce & Richardson, 2010) with results suggesting that eye-movements behave in similar ways when both understanding language and perceiving events in the world.

The present research looks specifically at the representation of speed in language (e.g. walking vs. running). Speed should affect the nature of a simulation in one important aspect: its duration. Presenting results from an eye-tracking study, we provide evidence for the mental simulation of speed in language. Participants had to listen to spoken sentences describing fast or slow events (e.g. The lion ambled/dashed to the balloon) whilst being presented with corresponding visual scenes. Speed was either encoded in the verb of the sentence (e.g. amble, dash) or with an adverb (e.g. slowly or quickly). Each scene contained the subject of the sentence, the target and a distractor. Additionally, sentences had either a fast or slow speaking rate. This was introduced firstly to provide a manipulation check (as effects of this manipulation should be found) and secondly, to investigate the possibility of an interaction between speaking rate and event speed. Participants were instructed to click on the object referred to last in the sentence with the computer mouse and answer comprehension questions on filler trials (25% of all trials).

For sentences in which the speed of the verb was manipulated, we found a differential pattern of eye movements between fast and slow events but only in the slow speaking rate condition. For sentences describing slow events, participants’ dwell time (total looking time) on the subject (e.g. lion) of the sentence was longer than that of fast events. Thus eye movements reflect the understanding of speed events being described in language in a similar way to viewing the same event in the real world. There were however, no differences between fast and slow events when speed was described using an adverb. This suggests that speed information contained in a verb may modify the described event via a different process to that of an adverb.

This research provides new evidence for simulation in language for speed. Speed is interestingly different from other investigated sensory-motor domains because of its temporal and therefore more abstract connotations.
Figure 1. Example visual scene

Figure 2. Verb sentences: Average dwell time on subject

Figure 3. Adverb sentences: Average dwell time on subject

References:
How referential expressions are processed online is a long-standing question in psycholinguistic research. The correlation between referring-expression type and cognitive accessibility status for the speaker/listener was proposed in the Givenness Hierarchy (e.g., Gundel, Hedberg & Zacharski, 1993), in which pronouns in focus are most accessible and indefinite full NPs are least accessible. Recent studies demonstrated, following the Hierarchy, the graded processing costs imposed by NPs differing in accessibility.

Givenness Hierarchy (Warren & Gibson, 2002)

<table>
<thead>
<tr>
<th>Central</th>
<th>Peripheral</th>
</tr>
</thead>
<tbody>
<tr>
<td>in focus</td>
<td>referential</td>
</tr>
<tr>
<td>I, we, you</td>
<td>the chairman</td>
</tr>
<tr>
<td>he, she, they</td>
<td>a chairman</td>
</tr>
<tr>
<td>Donald Trump</td>
<td>a chairman</td>
</tr>
</tbody>
</table>

In self-paced reading experiments, Warren & Gibson found shorter reading times for relative clauses (RCs) with a first/second person subject than for RCs with an indefinite subject in sentences such as The consultant who {we, Donald Trump, the chairman, a chairman} called advised wealthy companies about tax laws. The present study seeks to add to existing research by asking whether referential accessibility of an intervening NP additionally influences processing of subject-verb (dis)agreement when the subject is modified by an RC (Table1).

Table 1: Experimental sentences

<table>
<thead>
<tr>
<th>(1) Singular main-clause subject</th>
<th>(2) Plural main-clause subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. The cookie that I baked last night was very delicious.</td>
<td>a. The cookies that I baked last night were very delicious.</td>
</tr>
<tr>
<td>b. The cookie that he the student baked last night *were very delicious.</td>
<td></td>
</tr>
<tr>
<td>c. The cookie that the student baked last night *were very delicious.</td>
<td></td>
</tr>
<tr>
<td>d. The cookie that he the student baked last night *was very delicious.</td>
<td></td>
</tr>
<tr>
<td>e. The cookie that the student baked last night *was very delicious.</td>
<td></td>
</tr>
<tr>
<td>f. The cookie that the student baked last night *was very delicious.</td>
<td></td>
</tr>
</tbody>
</table>

English-speaking natives have less difficulty with subject-verb agreement when subjects are modified by an RC than by a PP (Bock & Cutting, 1992). Nevertheless, it could still be the case that referential accessibility of the intervening subject of (object) RCs affects ease of processing (matrix) subject-verb agreement, more specifically, that a less accessible intervening embedded subject (e.g., the student), hence requiring more resource demands, induces greater difficulty processing (matrix) subject-verb agreement than does a more accessible intervening embedded subject (e.g., I).

Our online self-paced reading experiment manipulates 3 factors: intervening embedded-subject NP-type (I, he, the student), (dis)agreement (grammatical, ungrammatical), and main-clause subject-number (singular, plural)—see Table 1. Five tokens per condition yielded 60 target sentences, distributed across 6 lists in a Latin Square design; there were also 60 fillers. As the intervening embedded subject becomes less accessible (I < he < the student), effects of NP-type should appear as slower reading at or immediately after the embedded verb.
(baked in Table 1), where it integrates its object (the cookie(s) in Table 1). As (projected) processing cost increases, sensitivity to a number-agreement violation in subsequent regions should decline, reflected as faster reading time at the disagreeing main-clause verb (*was/*were) in the order of (1f) < (1e) < (1d) and (2f) < (2e) < (2d) for the ungrammatical conditions.

Results from 46 English-speaking natives revealed clear effects of NP-type at the embedded-verb region for both singular [$F(2, 44)=13.30, p<.001$] and plural [$F(2, 44)=16.87, p<.001$] subject-number (Figures 1&3). At the main-clause verb, sensitivity to (dis)agreement was significant for the singular [$F(1,45)=7.01, p=.01$] and marginally significant for the plural [$F(1,45)=3.04, p=.088$] (Figures 2&4). There was also a marginal interaction effect between NP-type and (dis)agreement only for singular subject-number [$F(2,44)=2.91, p=.065$].

Figures 1 and 2: Reading times for grammatical/ungrammatical singular sentences

Figures 3 and 4: Reading times for grammatical/ungrammatical plural sentences

These findings clearly suggest that online processing demands are modulated by the referential status of NPs, and, specifically, that processing a less referentially accessible intervening NP in subject-modifying RCs disrupts maintaining (matrix) subject-verb agreement.

References:
Morphological and working memory effects on Subject – Verb agreement in Greek

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Aim
The aim of this paper is to examine (a) whether the case features of an intervening NP between the head noun of the subject and the verb affect Greek adults’ and children’s grammaticality judgments and (b) whether the participants’ working memory span correlates with their performance on the grammaticality judgment (GJ).

Background
Crosslinguistic findings argue for morphophonological and/or semantic effects on verbal and nominal agreement (Hartsuiker & Barckhuysen, 2006; Hartsuiker et al., 2003; Vigliocco et. al., 1995; 1996; Deutsch, 1998). Intervening constituents between two agreeing elements have been found to impede agreement in adults and children (Blackwell & Bates, 1995; Hartsuiker & Barkhuysen, 2006; Hayiou-Thomas et al., 2004). Franck et al. (2006) suggested that attraction rates are higher when the intervening constituent c-commands the verb than when it just precedes it. Furthermore, working memory capacity has been shown to correlate with accuracy on S-V agreement in English children (McDonald, 2008) as well as in English and Dutch adults (Bock & Cutting, 1992; Hartsuiker & Barkhuysen, 2006). However, it has not yet been extensively tested whether the morphological features of the intervening constituent affect attraction rates.

The present study
The novelty of this study is that it explores whether the case features of the intervening nouns affect attraction rates and how they interplay with working memory. Attraction effects on S-V agreement were tested by means of an on-line GJ task and correlations between verbal working memory capacity and the GJs through a word and a non-word list recall task (Masoura et al., 2004).

In the on-line GJ task, the case features of the intervening nouns were manipulated so that (a) the determiner and the noun were unambiguously case marked for accusative and, thus, could not be taken as subjects (1), (b) only the determiner was unambiguously marked for accusative (2) and (c) neither the determiner nor the noun were unambiguously marked for accusative (3). The GJ task consisted of 42 experimental sentences, half grammatical and half ungrammatical, seven per each experimental condition. The sentences were presented in a word-by-word fashion, while at the end of each sentence the participants had to judge its grammaticality. Thirty-five Greek adults (age range: 20-41 years; 8 males) and thirty-two Greek children (age range: 10-11 years; 13 males) participated in all tasks.

The children were overall less accurate and slower than the adults, though this effect was larger in the case of ambiguously case marked nouns. Moreover, verbal working memory capacity was positively correlated with accuracy scores only in conditions with ambiguously case marked nouns ((2) & (3) for children and (3) for adults) and negatively correlated with RTs in the same conditions. These results indicate that attraction rates depend on the case features of the intervening noun; namely, intervening nouns unspecified for case features render the processing of S-V agreement more prone to errors.
More interestingly, it is in these cases only that working memory correlates with accuracy and RTs, showing that cognitive resources matter when unambiguous morphological information is not available.

References:
Implicit Learning and Syntactic Priming in Comprehension: Evidence from ERPs and Eye-Tracking

Kristen M. Tooley, Matthew J. Traxler, Tamara Y. Swaab, Megan Zirnstein, and Megan A. Boudewyn
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Syntactic priming effects during on-line comprehension have now been firmly established (Traxler & Pickering, 2005; Arai et al., 2007; Ledoux et al., 2007; Tooley et al., 2009; Traxler, 2008; see also Branigan et al., 2005). However, the precise nature of the mechanisms and processes that produce syntactic priming have not been fully identified. The residual activation account appeals to persistent activation among combinatorial nodes as the driving force behind priming (Pickering & Branigan, 1998). By contrast, the implicit learning account appeals to changes in the strength of structural representations (Bock et al., 2007; Chang et al., 2006). The dual mechanism account proposes that residual activation and implicit learning both contribute to different aspects of syntactic priming effects (Tooley, 2009; Tooley & Traxler, 2010; Tooley et al., 2009). The implicit learning account is more consistent with long-lasting priming effects, including those that occur when several unrelated sentences appear between a prime and a target (Bock & Griffin, 2000). The residual activation account provides a more compelling explanation for the lexical boost -- i.e., priming effects are larger when the same lexical item appears in the prime and the target.

We conducted one ERP and two eye-tracking experiments. In these experiments, a prime sentence containing a reduced relative clause was presented prior to a target sentence that also contained a reduced relative clause. In prior studies, participants responded more quickly when a syntactically related prime sentence preceded a target (Arai et al., 2007; Ledoux et al., 2007). However, in these previous studies, the prime and target sentences were immediately adjacent.

In the current study, one or more unrelated filler sentences intervened between the prime and the target. All of the experiments tested sentences with reduced relative clauses, such as (1):

(1) The client wanted by the advertiser was worth a lot of money.

Experiment 1, an ERP experiment, tested responses when zero or one unrelated filler sentences appeared between the prime and the target. Reductions in the P600 indicated that processing the prime sentence facilitated processing of the syntactic form of the target sentence (see Figure 1). Further, the P600 was reduced to a similar degree whether zero or one filler sentences intervened between the prime and the target. Experiment 2, an eye-tracking experiment, produced evidence for syntactic priming when one or three filler sentences intervened between the prime and the target. As in Experiment 1, the magnitude of the priming effects did not differ when one or three sentences separated prime from target. Experiment 3 replicated the priming effect observed in Experiment 2 when three unrelated sentences appeared between the prime and the target.

The fact that syntactic priming persists when unrelated filler sentences appear between the prime and the target suggests that implicit learning contributes to the effects. However, in the eye-tracking experiments, the absolute magnitude of the priming effects at lags of one and three may have been smaller than those obtained in comparable lag zero experiments. Hence, residual activation may decay as the amount of intervening material increases.
Example stimulus:

Prime: The outlaw wanted by the police had committed a terrible crime.
(Filler 1): The tour guide led the people around the museum slowly.
(Filler 2): The pastry chef invented a new kind of cookie dough.
(Filler 3) The dogs played together all day at the dog park.
Target: The client wanted by the advertiser was worth a lot of money.

Note: Lag one trials had only one filler sentence. Lag 3 trials used all three fillers.

**Priming Effects at the Determiner: Lag Zero Condition**

**Priming Effects at the Determiner: Lag 1 Condition**
Multi-word bottom-up effects in the visual world paradigm  

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Listeners show simultaneous anticipatory and lexically-based bottom-up effects in predictive contexts in the visual world. Kamide et al. (2003) found that listeners hearing sentences like “The girl will ride…,” with scenes that included a verb-predicted carousel and motorbike, anticipated the carousel predicted by the context (“girl” + “ride”). However, listeners also fixated the motorbike more with “(The girl will) ride…” vs. “taste…” Relatedly, Kukona et al. (2011) found that listeners hearing sentences like “Toby arrests the…,” with displays that included Toby, and a patient (crook) and agent (policeman) of the verb, anticipated the patient predicted by the context (active sentence + “arrest”). However, listeners also fixated the agent more than unrelated distractors (gardener). In both cases, listeners activated items (motorbike/policeman) predicted by the bottom-up verb constraints (“ride”/“arrest”), although these bottom-up constraints conflicted with the context (“girl”/active sentence). These results suggest that in addition to anticipating predictable items that fully satisfy the context, language users also simultaneously interpret the language signal based on context-independent, bottom-up (verb) input.

One interpretation of these results is that they support bottom-up, emergent theories of language processing that do not strictly enforce the coherence of language representations \([1,2,6,7]\). However, an alternative interpretation is that these results reflect independent lexical (bottom-up) vs. syntactic (anticipatory) processes \([3]\). To distinguish between these hypotheses, we tested for multi-word bottom-up effects in anticipatory contexts: such effects are unexpected given lexical-syntactic independence because syntactic/multi-word processes are hypothesized to have full access to contextual information.

**Methods.** Listeners (N = 33) heard 16 sentences like “The boy will eat the spotted, white cake” while viewing displays with items like: spotted, white cake; spotted, brown cake; striped, white cake; striped, brown cake; spotted, white car; spotted, brown car; striped, white car; and striped, brown car.

**Predictions.** We focus on verb-inconsistent items (cars, which are not predicted by “eat”), which allow us to distinguish the hypotheses. Bottom-up theories claim that the emergent, multi-word entity “spotted, white” is reinforced via feedback at the expense of entities like “spotted, brown,” “striped, white,” and “striped, brown,” predicting a preponderance of fixations to the spotted, white car relative to the other cars. Lexical-syntactic independence predicts no such interaction.

**Results.** Proportions of fixations to the verb-inconsistent items are plotted in Fig. 1. During “spotted,” there were reliably more fixations to the spotted, white/brown cars than the striped white/brown cars; during “white,” there were no reliable effects; and during “cake,” there was a reliable interaction, revealing more fixations to the spotted, white car than the remaining cars.

**Conclusions.** We found evidence for multi-word bottom-up effects in anticipatory contexts. These results are consistent with emergent theories, which assume that large-scale linguistic representations form via the ganging of local word structures. Non-feedback models, which form tree-structures on a strictly information-driven basis, have trouble simultaneously
predicting time-locked anticipatory effects [4,5], and the delay we observe in the appearance of the significant interaction. The emergent model predicts a delay because ganging depends on feedback, which in the case of input-inconsistent structure (cars), takes longer to develop than input-consistent anticipation effects.

Fig 1. Average proportions of fixations over time to verb-inconsistent items (e.g., cars; A), and average proportions of trials with fixations during “spotted,” “white,” and “cake” (windows begin at the offset of the relative word, and extend for 200 ms; B) for the example sentence “The boy will eat the spotted, white cake.”

References:
Automatic extraction of property norm-like features from large text corpora with gold standard, human and semantic-similarity evaluations.

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Property norms (e.g., banana is yellow, aeroplane has wings) play a key role in cognitive science, forming the basis for many recent theoretical accounts of conceptual representations (e.g., Cree et al., 2006; Grondin et al., 2009; Randall et al., 2004). Such norms are typically derived from norming studies where a large number of human participants elicit properties for a set of concepts (e.g., McRae et al., 2005).

We propose a novel system for the automated extraction of property norm-like triples from large text corpora which uses syntactic, encyclopedic, semantic and statistical information to guide extraction. Prior work has mostly focused on the simpler task of relation extraction (e.g., Davidov et al., 2007; Pantel and Pennacchiotti, 2008), and only Devereux et al. (2009) and Baroni et al. (2009) have attempted the more ambitious task of full property extraction.

The first stage of our system employs part of speech and grammatical relation (GR) rules to extract candidate property triples in a concept relation feature format from our C&C-parsed corpora (Wikipedia and the British National Corpus). These rules are derived from typical patterns of instantiation of property norm-like information, manually generated from a subset of Wikipedia. The system makes two passes over the corpus. The first pass extracts candidate features from short GR paths. The second pass uses these candidate features and longer GR paths to generate concept-relation-feature triples. These triples are grouped and lemmatized to remove inflectional variation, giving a set of triples with their corpus production frequency.

The second stage of our system scores each triple on four statistical metrics: log-likelihood, pointwise mutual information, entropy and a semantic reweighting factor. A linear combination of scores from these metrics and normalised frequency information yields an ordered list of triples – we select the top twenty highest-scoring triples as our system output.

We evaluate our system by directly comparing our output with a synonym-expanded subset of the McRae norms (Baroni et al., 2008). Our best F-scores are 0.147 (matching on both the relation and feature portions of our triples) and 0.285 (matching on features alone) when using a combination of triples output from the BNC and Wikipedia. We also calculate F-scores using Baroni et al.’s evaluation criteria (i.e., evaluating the top ten features), outperforming their best F-score of 0.239 with an F-score of 0.321.

In a second evaluation, two human judges evaluated our top twenty output (excluding triples marked as correct by our gold standard) over 15 concepts. For our combined BNC/Wikipedia system, our judges marked 50.2% of this subset of the output triples as correct/plausible (and the remainder as wrong/wrong-but-related) indicating that the majority of our output (i.e., the top twenty, including correct, gold standard triples) tends to be correct/plausible.

Finally, we compare concept-concept similarity, calculating cosine similarity from our triples, with a WordNet semantic-similarity measure (Leacock and Chodorow, 1998) shown
to correlate highly with human judgements (Budanitsky and Hirst, 2006). Our best system achieves a Pearson correlation of 0.522 with the WordNet measure when considering both features and relations, exceeding the correlation with the McRae norms themselves (0.470).

Our system offers an original and effective method for property norm-like triple extraction: our gold standard comparison shows improvement on the current state-of-the-art and subsequent evaluations demonstrate the humanlike nature of our output.

References:
Prominence on coreference processing: weight of syntactic and order of mention information

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The choice of an antecedent for a pronoun is based on the prominence of the available entities in the discourse, but what makes an entity more prominent over another has been a matter of passionate debate. It is assumed by most that the linguistic form of an anaphoric expression signals the accessibility of its antecedent. Therefore, the more salient an antecedent is in the discourse the less marked and informative will be the anaphoric expression referring to it (Ariel, 1996). Many studies have already shown that anaphoric expressions like null pronouns are preferred to retrieve a sentential Subject as antecedent while overt pronouns are preferred to retrieve non-Subject constituents assuming that syntactic information in its own is responsible for prominence ascription (for instance, Costa et al., 1998, and Costa et al., 2004, for European Portuguese; Corrêa, 1998, and Melo & Maia, 2005, for Brazilian Portuguese; Carminatti, 2002, for Italian, Alonso-Ovalle et al., 2002, for Spanish). However, in all these studies, the Subject was also the first referred entity, and, as Gernsbacher and Hargreaves (1988) propose, first mentioned entities are very prominent, regardless of their syntactic status.

In the present study we attempt to disentangle the weight of Syntactic and Order of Mention information on prominence ascription. To do so, we developed a Visual World Paradigm experiment where 24 Portuguese native-speakers listened to sentences like (1) and (2) and viewed, simultaneously, a picture where the locative and the two referred entities were represented (for instance, with the sentence (1), participants viewed a picture with a garage, an engineer and a technician). We used complex sentences whose subordinate clause is a temporal adverbial with a pronominal Subject (a covert or an overt pronoun) that must be identified by an antecedent in the previous clause. Antecedents in main clauses may be in their canonical position, preserving the basic European Portuguese order (SVO), or not, having the Object at first place and the Subject in post verbal position (OVS). In addition to the listening/viewing task, participants had to choose, on a multiple choice questionnaire, the antecedent for the pronoun.

Our results show that: (i) when antecedents are in their canonical position, the expected tendency is confirmed both in the off-line and in the on-line data: the null pronoun retrieves the Subject and the overt one retrieves the Object1; (ii) when the Subject is post-verbal and the Object occupies the first position, there are changes in the antecedent retrieving preference. In the answers to interpretation questions, the off-line task, the Subject is preferred both for null and overt pronouns, although the difference between Subject and Object is very narrow. In the on-line task, the Object is preferred for null pronoun while the Subject is the preferred antecedent for the overt pronoun. These results suggest that during on-line processing Order of Mention information may overcome Syntactic one, contributing more to prominence ascription.

(1) O mecânico trabalhou com o engenheiro na oficina quando Ø/ele remodelou o carro de competição.
The technician worked with the engineer in the garage when Ø/he remodeled the competition car.

(2) Com o engenheiro trabalhou o mecânico na oficina quando Ø/ele remodelou o carro de competição.
With the engineer worked the technician in the garage when Ø/he remodeled the competition car.

1 In this study we use generically the term Object to refer to constituents that are Obliques, i.e., prepositional verb adjuncts.
References:
Effects of processing depth on pronoun interpretation: Use of inferencing and gender cues
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Language processing—including pronoun interpretation—is argued to be susceptible to shallow processing (Ferreira et al., 2000; Sanford & Sturt, 2002; Steward et al., 2007, and others). Although pronouns can be interpreted rapidly (e.g. Arnold et al., 2000), other findings suggest that demands of the task at hand determine whether comprehenders fully resolve pronouns. On the basis of whole-sentence reading-times, Steward et al. (2007) concluded that presence of deep questions (probed pronoun’s antecedent) vs. shallow ones (pronoun antecedent irrelevant) influenced whether readers resolved pronouns. In the deep condition—but not the shallow—gender-ambiguous pronouns (Paul…Rick…he) resulted in a slowdown relative to gender-unambiguous pronouns (Paul…Kate…(s)he). This suggests gender cues are used during deep processing.

With two different-gender referents, gender-marked pronouns offer an unambiguous cue to the antecedent. We investigated (i) how processing of gender cues compares to more complex, probabilistic cues to the antecedent, namely verb-based inferencing, and (ii) how comprehenders’ use of verb-based inferencing is modulated by processing depth. In “Elaine protected Jen. Stephen awarded her…” (ex.1), we can infer that ‘her’ refers to Elaine; the one who protects is awarded something (cf. Kehler et al., 2008). We investigated how rapidly people make probabilistic cross-clausal inferences, and compared them to gender cues.

These issues relate to fundamental questions about the architecture of the reference-resolution system, including the real-time availability/influentiality of information encoded on different levels (morphological gender-marking vs. cross-sentential inferences) and with different levels of determinacy (categorical vs. probabilistic).

In a self-paced reading study, participants read two-sentence mini-stories (ex.1). We manipulated processing depth, pronoun ambiguity and verb informativity:
- Processing depth was manipulated between-subjects (24 participants/group) with Shallow vs. Deep questions after each mini-story (defined as shown in ex.2 below).
- The critical pronoun was gender-ambiguous (1b,d) or clearly subject-referring (1a,c).
- The verb in Sentence1 was a nonword (1c,d), or a real verb (1a,b) that could be used to infer the antecedent.

(1) Sample item [Coherence relation in all targets is ‘result’ (normed, partially adapted from Wolf et al. 2006). Verb-based inferencing pushes pronoun towards preceding subject]

(a) [Realverb|Unamb]: Elaine protected Joel. Stephen awarded her a special prize for bravery and everyone cheered happily.
- Unambiguous pronoun (=> Elaine/subject)
- Real verb in first sentence (biases pronoun towards Elaine/subject)

(b) [Realverb|Amb]: Elaine protected Jen. Stephen awarded her a special prize for bravery and everyone cheered happily.
- Ambiguous pronoun (Elaine or Jen?)
- Real verb in first sentence (biases pronoun towards Elaine/subject)
(c) [Nonverb][Unamb]: Elaine brondled Joel. Stephen awarded her a special prize for bravery and everyone cheered happily.

- Unambiguous pronoun (⇒ Elaine/subject)
- Nonsense verb in first sentence

(d) [Nonverb][Unamb]: Elaine brondled Jen. Stephen awarded her a special prize for bravery and everyone cheered happily.

- Ambiguous pronoun (Elaine or Jen?)
- Nonsense verb in first sentence

(2) Sample comprehension question
(2a) Shallow Question: Was the prize for bravery? [yes/no question, simple recall]
(2a) Deep Question: Who did Stephen award a prize to? [wh-question, interpret pronoun]

Predictions for Shallow processing: We expect no sensitivity to pronoun/verb manipulations.
Deep processing: We expect (i) slowdowns with ambiguous pronouns, and, if verb-driven inferences are generated, (ii) alleviation of these slowdowns in conditions where the verb can be used to infer the antecedent.

Results: In general, question-type influenced processing-depth. Deep readers’ RTs were longer at the Pronoun and Spill1 (ex.(3) shows regions) than Shallow readers’ (p’s<.05). Overall, Shallow readers had fast RTs and no clear effects of pronoun/verb manipulations. However, Deep readers showed finer-grained patterns: In Spill2 and Spill3, Deep readers showed significant slowdowns in [Nonverb][Ambig] relative to [Nonverb][Unambig] and [Realverb][Unambig]. [Nonverb][Ambig] was also slower than [Realverb][Ambig] at Spill3 (p’s~.06, n.s. at Spill2): The condition lacking both verb- and gender-cues was slower than unambiguous-pronoun conditions, and marginally slower than the condition requiring verb-based inferencing. This suggests Deep readers use both gender-cues and verb-based inferences, with verb-based inferencing being slightly weaker/delayed. (These analyses focus on the second half of the study, where question-driven processing effects are clearest.)

(3) Analysis regions during the second sentence

<table>
<thead>
<tr>
<th>subject</th>
<th>verb</th>
<th>pro</th>
<th>Spill1</th>
<th>Spill2</th>
<th>Spill3</th>
<th>Spill4</th>
<th>Spill5</th>
<th>Spill6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stephen</td>
<td>awarded</td>
<td>her</td>
<td>a</td>
<td>prize</td>
<td>for</td>
<td>bravery</td>
<td>and</td>
<td>everyone..</td>
</tr>
</tbody>
</table>

Conclusions: Our results support claims that, under shallow processing, pronoun interpretation is not automatic—even with gender-unambiguous pronouns. Under deep processing, comprehenders used both gender-marking and probabilistic higher-level inferences online—though gender-marking effects seem more robust, possibly due to their local, non-probabilistic nature and lack of higher-level inferencing. Our findings suggest processing-depth modulations are far-reaching, impacting both simple, categorical cues and probabilistic, non-local cues.

References:
Ferreira, Bailey, Ferraro (2002). Good-enough representations….Current Directions in Psych Science
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Coargumenthood and the Processing of Reflexives
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The sensitivity of the parser to structural constraints on pronoun resolution during sentence comprehension has been widely debated [1, 4, 6, 7]. Principle A of binding theory [2] predicts that anaphors must be bound within their local domain, such that the reflexive in (i) must refer to ‘the soldier’ and not any other referent in the discourse. One proposal [6] has been that binding theory accessible antecedents (e.g. the soldier) are considered as antecedents of a reflexive at a point in time before inaccessible ones (e.g. Jonathan/Jennifer). However, while this defeasible filter hypothesis was proposed to account for the processing of reflexives in contexts such as (i), where the reflexive and antecedent are coarguments of the same predicate, it is unclear whether it also applies to reflexive-antecedent relations in non-coargument contexts. Such contexts include picture noun phrases (PNPs) and possessed picture noun phrases (PPPNPs), as in (ii/iii), and it has recently been claimed that inaccessible antecedents can have early effects on processing in such contexts [3, 5].

We examined the processing of reflexives in these different syntactic contexts in three experiments in each of which 28 different native English speakers read 32 critical and 64 filler texts while their eye-movements were monitored. Critical texts contained one accessible and one inaccessible antecedent, and gender congruence (match vs. mismatch) between the reflexive and both antecedents was manipulated in a 2x2 design. Congruence between the reflexive and inaccessible antecedent used proper names (Jonathan/Jennifer) and pre-tested gender stereotypes for the accessible antecedent (the soldier… himself/herself). Experiment 1 tested coargument reflexives (i), while Experiments 2 and 3 tested PNP and PPPNP environments (ii and iii).

Results from each experiment indicated the same relative time-course of antecedent effects, in that comparatively earlier reading time measures were longer when the accessible antecedent mismatched the stereotypical gender of the reflexive compared to when they matched, while inaccessible antecedent effects were in comparison delayed. However, whereas stereotypical gender mismatches incurred reliably longer regression path times at the reflexive in (i) and (iii), this accessible antecedent effect was delayed until the spillover region, and during rereading of the reflexive, in (ii). Between-experiment analyses indicated that these interactions between the accessible antecedent and syntactic context were reliable.

These data extend previous findings that binding theory accessible antecedents only are initially considered as antecedents of a reflexive during early processing stages [6]. The between-experiment analyses indicate rapid binding between a reflexive and local subject in coargument contexts. The antecedent search in PPPNP but not PNP contexts appears to be similarly constrained (cf. [3, 5]).

Jonathan/Jennifer was walking through the military barracks...
(i) He/She heard that the soldier had positioned himself/herself in the middle of the mess hall.
(ii) He/She heard that the soldier had a picture of himself/herself in the middle of the mess hall.
(iii) He/She heard about the soldier’s picture of himself/herself in the middle of the mess hall.
References:
Thematic information and pronominal resolution of inter-sentential subject

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Following work on co-reference in European Portuguese (Costa et al 1998, Costa 2003 and 2010), we report a task of sentence processing to test pronominal co-reference between sentence Subjects. European Portuguese being a null subject language, we tested the preference for covert vs. overt pronoun as a syntactic-semantic strategy, productive in anaphoric chains, now in untested conditions.

Referring to the Theory of Accessibility, (Ariel, 1990, 1994) and the Theory of the Antecedent Position, (Carminati, 2002), we created the conditions in (1) and (2). We used pairs of simple sentences in juxtaposition, where the pronominal Subject in the second sentence is ambiguous: it can either retrieve the Subject or the Direct Object of the previous sentence. Against results obtained in European Portuguese in complex sentences, we wanted to verify if Subject prominence holds out of intra-sentential domain. Moreover, choosing agentive and perceptive verbs and active and passive sentences, we tested semantic properties of the Subject with divergent thematic roles, given the Theory of Thematic Hierarchy (Grimshaw, 1991): in (1a) the Subject of the first sentence is Agent and in (1b) it is Theme; in (2a) it is a perceptive Experiencer, while in (2b) it is Theme.

We intended to verify:

(i) If covert pronouns are preferred to retrieve the Subject of the first sentence;
(ii) If thematic roles influence semantic prominence of the Subject of the first sentence.

Twenty-four informants read a sequential task (PsyScope programme) and chose the antecedent of the subject in the second sentence (the two antecedents, Subject and Direct Object appeared on the screen). We registered the time (in milliseconds) in choosing the antecedent and the choice (Subject/Direct Object).

The results show a significant preference for retrieving the Subject (71%), regardless of type of pronoun, and thematic role of the antecedent, and lower decision times for retrieving the Subject (1755ms) than the Direct Object (2055ms.). Moreover, the condition null pronoun for Subject/Agent antecedent had slower decision times than the one with overt pronoun, both in active (1817ms vs 1470ms) and passive sentences (2107ms vs 1918ms), thus contradicting the Avoid Pronoun Principle (Chomsky, 1981; Brito, 1991), as well as results for intra-sentential pronoun resolution, in European Portuguese, Italian and Spanish. It seems that the overt pronoun, and not the covert one, is the preferred option for retrieving a high salient antecedent in a discursive context.

Also, although we didn’t find significant differences between retrieving an Agent Subject (1693ms) and a Theme Subject (1909ms), we did find them between retrieving a Theme Object (1856ms) and a Passive Complement (2375ms.). More importantly, an Agent Passive Complement induces higher decision times (2247ms.) than an Experiencer one (2205ms.), which cannot be attributed to syntactic information but rather to semantic information.

We conclude that semantic information is important in pronoun resolution: a salient semantic constituent, the Agent, induces lower decision times in a prominent syntactic position and higher decision times in a non-prominent syntactic position.
Examples:

(1a) O Samuel agrediu o Bruno no pavilhão. Horas mais tarde, Ø/ele discutiu o assunto com preocupação.

Samuel hit Bruno in the pavilion. Hours later, Ø/ he discussed the matter with concern.

(1b) O Samuel foi agredido pelo Bruno no pavilhão. Horas mais tarde, Ø/ele discutiu o assunto com preocupação.

Samuel was hit by Bruno in the pavilion. Hours later, Ø/ he discussed the matter with concern.

(2a) O Júlio ouviu o Tobias na loja. No dia seguinte, Ø/ele arrumou as estantes.

Júlio heard Tobias at the store. The following day, Ø/ he tidied the shelves.

(2b) O Júlio foi ouvido pelo Tobias na loja. No dia seguinte, Ø/ele arrumou as estantes.

Júlio was heard by Tobias at the store. The following day, Ø/ he tidied the shelves.

Results:

<table>
<thead>
<tr>
<th>condition</th>
<th>SN1</th>
<th>condition</th>
<th>SN2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>decision times in ms.</td>
<td>% answers</td>
<td>decision times in ms.</td>
</tr>
<tr>
<td>SU/AG Cov P</td>
<td>1817</td>
<td>72,5</td>
<td>DO/TE Cov P</td>
</tr>
<tr>
<td>SU/AG Ov P</td>
<td>1470</td>
<td>73,3</td>
<td>DO/TE Ov P</td>
</tr>
<tr>
<td>SU/EX Cov P</td>
<td>1518</td>
<td>74,2</td>
<td>DO/TP Cov P</td>
</tr>
<tr>
<td>SU/EX Ov P</td>
<td>1655</td>
<td>65,8</td>
<td>DO/TP Ov P</td>
</tr>
<tr>
<td>SU/TE Cov P</td>
<td>2107</td>
<td>65,8</td>
<td>CP/AG Cov P</td>
</tr>
<tr>
<td>SU/TE Ov P</td>
<td>1918</td>
<td>75,8</td>
<td>CP/AG Ov P</td>
</tr>
<tr>
<td>SU/TP Cov P</td>
<td>1778</td>
<td>74,2</td>
<td>CP/EX Cov P</td>
</tr>
<tr>
<td>SU/TP Ov P</td>
<td>1780</td>
<td>65,0</td>
<td>CP/EX Ov P</td>
</tr>
<tr>
<td>Means</td>
<td>1755</td>
<td>70,8</td>
<td>Means</td>
</tr>
</tbody>
</table>

References:


Carminati, Maria Nella (2002), The processing of Italian subject pronouns. PhD.


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1 Cov P – retrieval by covert pronoun
SU/TE – Theme subject
DO/TE – Theme direct object
CP/AG – Agent passive complement

Ov P – retrieval by overt pronoun
SU/TP – Theme subject of perceptive verb
DO/TP – Theme direct object of perceptive verb
CP/EX – Experiencer passive complement
'Looking at nothing' is neither automatic nor an inevitable consequence of human cognitive architecture

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In studies using the blank screen paradigm (Altmann, 2004; Spivey & Geng, 2001) a visual display containing some objects is shown first for a few seconds, then a spoken sentence follows while a blank screen is shown. Such studies have shown that, as the spoken sentences unfold, people tend to re-fixate the regions on the blank screen that were previously occupied by relevant objects suggesting that language-mediated eye movements are not contingent upon a visual item being co-present during that expression. Altmann (2004, cf. Richardson & Spivey, 2000) has proposed that "the spatial pointers are a component of the episodic trace associated with each item - activating that trace necessarily activates the (experiential) component encoding the location of that item, and it is this component that automatically drives the eyes towards that location" (p. B86). Similarly, Ferreira, Apel, and Henderson (2008) claimed that "whether the looks are intentional or are unconsciously triggered, the conclusion is the same: looking at nothing is an entirely expected consequence of human cognitive architecture" (p.409). In the present study we tested these strong claims. We studied Indian low literates (2 mean years of formal schooling) and high literates (15 mean years of formal schooling) on the same 'look and listen' task as used by Altmann (2004). If 'looking at nothing' is automatic and reflects human cognitive architecture in non-trivial ways then it should be present in all proficient speakers/listeners regardless of their level of formal schooling. Even low literates integrate language with objects in their visual surroundings every day, and this experience should result in similar language-vision mapping as for high literates.

In Experiment 1, high and low literates were presented with a visual display of four objects (a semantic competitor, e.g., 'kachuwa', turtle, and three distractors) for five seconds. Then the visual display was replaced with a blank screen and participants listened to simple spoken sentences containing a target word (e.g., 'margar', crocodile, a semantic competitor of 'kachuwa', turtle). High (but not low) literates looked at the empty region previously occupied by the semantic competitor as the spoken target word was heard. Interestingly, the blank screen effect was also absent for low literates in the filler trials. Filler trials consisted of line drawings of the referent of the spoken critical word (e.g., a plate if the spoken target word was 'plate'). In Experiment 2, the same participants were presented with the identical materials except that the visual display (containing the semantic competitor and the distractors) was present as participants heard the spoken sentences. With such a set-up both low literates and high literates did shift their eye gaze towards the semantic competitors (and the targets in the filler trials) immediately as the target word was heard (cf. Huettig & Altmann, 2005; Yee & Sedivy, 2006).

These data strongly suggest that the 'looking at nothing' phenomenon is modulated by formal literacy. Accounts which assume that this language-mediated eye
movement behavior is automatic or a (non-trivial) consequence of human cognitive architecture must be revised.
Recent evidence suggests that language comprehenders routinely activate visual representations of objects that are referred to. However, evidence for such activation (priming between objects with similar shapes: e.g., pizza – coin) has only been obtained under certain circumstances: 1) during metalinguistic tasks (e.g., lexical decision), 2) during the processing of single words, or 3) when pictures of the objects were (co-)present in the task (e.g., visual world eye-tracking or sentence-picture verification). It is still unclear whether and when visual representations are activated when listeners hear sentences without looking at pictures or performing additional tasks.

In the present ERP study, 21 adult native speakers of Dutch were presented with spoken sentences (32 per condition) in a passive listening task. The lead-in sentences (e.g., the translation equivalent of “In 1969 Neil Armstrong was the first man to set foot on the…”) were highly predictive of specific words. The critical word following the lead-in sentence was 1) correct and expected (correct condition, e.g., “moon”), or 2) a semantic violation with the referent having a visual shape similar to the expected referent (shape condition, e.g., “orange”), or 3) a semantic violation with a shape-unrelated referent (unrelated condition, e.g., “banana”). The ERP component of interest was the N400, a sensitive index of semantic processing. If listeners activate shape information, the amplitude of the N400 for the shape condition should differ from that of the unrelated condition.

The objects mentioned in the shape and unrelated condition belonged to the same semantic category. Norming studies had established that the critical words in the correct condition had a high cloze probability and that the plausibility ratings for the critical words in the shape and unrelated condition were equally low. The referents of the critical words in the correct and the shape conditions (e.g., “moon” and “orange”) were judged to be highly related in shape. The critical words were rotated across sentence contexts to form the different conditions, with every sentence context and critical word occurring once on each of three lists.

We observed a significant N400 effect between 300 and 500 ms after word onset for both the shape and the unrelated condition relative to the correct condition (Fig. 1). More importantly, the unrelated condition also elicited a significantly more negative mean voltage than the shape condition, however this shape effect emerged somewhat later, from approximately 500 to 700 ms.

These results demonstrate that on-line evidence for the activation of visual shape representations can be found during listening to sentences in the absence of any metalinguistic judgments or pictures of the referent objects. The timing of the shape effect is important with regard to the information flow between cognitive representations and suggests that shape information is activated relatively late during the processing of linguistic information. Shape information may therefore not receive the same degree of priority as semantic category information, which usually elicits N400 effects at 300-500 ms after word onset.
Figure 1: ERP results. A) Grand average ERPs from a central electrode (Cz). Word onset is at 0 ms. Negative is plotted up. B) Scalp topographies of the mean difference between each of the conditions in two time intervals. Blue color indicates negative voltage.
Individual differences in the immediate sensitivity of temporal order cues

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Research on the comprehension of temporal order statements such as Before/After sentences is sparse and sometimes conflicting. Solidifying its base is important for examining event structure and event ordering both in cognition generally (e.g., with non-linguistic stimuli, Zacks, et al., 2007; Raisig et al. 2010) and in language comprehension. Zacks’ event segmentation theory predicts that people develop expectations about sub-events based on event perception. This event perception is grounded in a person’s experience of a linear flow of events, viz ‘temporal iconicity’ (cf. Zwaan & Yaxley, 2003 on spatial iconicity). Analogously, comprehenders could derive expectations about event order based on linguistic cues. For example, the word Before at the beginning of the sentence is a cue to the reader that the expectation of temporal iconicity will be violated; potentially signaling the error-monitoring mechanism in event segmentation theory. An interesting question is to what extent such prediction is sensitive to comprehenders’ reading skill. Indeed, analyses of event-related brain potentials (ERPs) suggest that event order cues (e.g., Before vs. After) are processed immediately, and further, that Before sentences cue greater working memory (WM) demands to which high-WM relative to low-WM readers are sensitive (Münte et al., 1998). These greater WM demands are indexed to more negative amplitudes of the left anterior negativity (LAN) component, a slow negative-leading waveform that typically appears between 300 – 500 ms post-stimulus onset. We revisited Münte et al.’s findings using eye tracking with full sentence presentation, because this methodology – unlike the rapid serial visual presentation used in EEG recording - allows sentence re-reading. Longer reading time is interpreted as indexing greater WM demands, analogous to the LAN component in ERP research. Based on findings by Münte et al., we don’t know the extent to which high- and low-WM readers differ in processing event order cues in language. High-WM readers could process event order cues in language entirely differently from low-WM readers. If so, we should see no similarities in gaze pattern for either initial processing or re-reading between these two groups. Alternatively, high-WM could merely have a slight temporal advantage in how they process these cues. If so, then we should see differences in initial gaze measures but ensuing similarities between these two groups.

Methods
Across four lists, each sentence appeared with Bevor or Nachdem, and subclause order was also counterbalanced. Participants were randomly assigned to list. Participants’ eye movements were recorded as they read 96 sentences (32 critical trials, see (1)). Following each sentence was a comprehension question. After the eye-tracking part of the experiment, participants’ WM was tested using a German version of the Automated Reading Span Test (Auto-RST; Unsworth et al., 2009). Participants were split into two groups based on the top and bottom third of the ranked scores from the Auto-RST.

(1) Bevor/Nachdem (TC) die Postbeamtin (NP1) die Karte (NP2) frankierte, reparierte die Elektrikerin (NP3) die Ampel. (NP4)
‘Before/After the postal clerk put a stamp on the card, the electrician repaired the traffic light.’
Results
We conducted a 2 X 2 mixed-design ANOVA, where WM was the between-subjects factor and temporal conjunction was the within-subjects factor on all measures of reading times. First-pass reading time analyses revealed longer reading times (analogous to the differential LAN waveforms found by Münte et al.) for Before than After sentences shortly after the temporal conjunction (NP2). However, this effect was reliable for high-WM, but not low-WM participants. Second-pass reading times at NP1 were longer for Before versus After sentences for both high-WM and low-WM readers. Regression path duration analyses revealed that both high-WM and low-WM participants’ times were reliably longer at NP3 for After relative to Before sentences. Total reading times for the very first word After were significantly longer than Before, but significantly longer at NP3 for Before compared to After sentences with no clear differences as a function of working memory.

Conclusions
Only high-WM readers exhibited an influence of temporal order cues immediately, but both high-WM and low-WM readers showed an influence in second pass. This suggests that these two groups differ only in their initial preparations toward the goal of understanding event order. However, both regression path and total times revealed two regions of elevated processing times for After versus Before, suggesting a potential trade-off between early processing ease and later integration cost. Methodologically, these findings complement insights from EEG and highlight the importance of cross-methodological research. The theoretical implications of these findings are that linguistic cues drive the expectations as to whether temporal iconicity will or will not be violated in the upcoming reference to the events in the sentence, and whether the comprehender has the skill to use them, an idea related to, but as yet not born out in event segmentation theory.

References: