Underspecification of Intersective Modifiers
Some arguments from German

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Overview

- Intersective modifiers and scrambling
- Some suboptimal solutions
  - Solution 1: Storage and retrieval
  - Solution 2: Scrambling as movement
- Modifier interaction
- Underspecified Modifier Attachment
- Further application: relative clause extraposition
- Evaluation
  - Grammars
    - Syntactic attachment
    - Underspecified modifier attachment
    - Storage and retrieval
    - Underspecified modifier and relative clause attachment
  - Test parameters
  - Results
- Conclusion
Introduction

- Current treatment of intersective modifiers assumes homomorphism between syntactic and semantic structure
- Assumption works well for highly configurational languages
- Non-configurational languages pose problems for current treatment:
  - Elegance
  - Efficiency
- Some solutions
  - Scrambling as movement
  - Storage and retrieval
  - Underspecification (Egg & Lebeth 1996)
Coherence

- Current treatment of intersective modifiers assumes homomorphism between syntactic and semantic structure
- Assumption works well for highly configurational languages
- Standard treatment of intersective modifiers assumes
  - Unification of the modifier's LBL with that of the head daughter
  - Unification of modifier's ARG1 with the INDEX of head daughter
- Non-configurational languages pose problems for current treatment:
  - Elegance
  - Efficiency
- German exhibits complex predicate formation (coherent construction):
  - Arguments of different verbs can easily be interleaved
  - Modifiers can semantically attach to every verb in the cluster (standard test)
Coherence and modifier attachment

- Syntactic treatment of attachment sometimes possible
- Example (trivial)
  - Weil Peter es im Laboratorium blitzen sah.
  - 2 readings:
    - Peter observes some lightning, while being in the lab.
    - Peter observes some flashes in the lab.
  - Ambiguity resolvable via high/low attachment to elements in verb-cluster
Coherence and modifier attachment

- Syntactic treatment of attachment sometimes possible
- Example (Pütz 1982)
  - Weil Peter es im Laboratorium blitzen sah.
  - 2 readings:
    - Peter observes some lightning, while being in the lab.
    - Peter observes some flashes in the lab.
  - Ambiguity resolvable via high/low attachment to elements in verb-cluster
Attachment of scrambled modifiers

- Scrambling of modifiers does not reduce attachment ambiguity
- Syntactic solution derives upstairs reading only
- Downstairs reading unavailable
- Problem most severe for intersective modifiers
- For scopal modifiers, exploit standard qeq constraints

Source: Berthold Crysmann 2004
Attachment of scrambled modifiers

- Scrambling of modifiers does not reduce attachment ambiguity
- Syntactic solution derives upstairs reading only
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- For scopal modifiers, exploit standard qeq constraints
Some suboptimal solutions 1 – Scrambling as movement

- **Idea:**
  - derive low semantic attachment via low base generation and successive syntactic movement

- **Problems:**
  - Foundational:
    - scrambling is local, extraction non-local
    - Extraction has dedicated landing site, scrambling does not
  - Spurious ambiguity
    - Need to canonicalise base attachment of intersective modifiers
    - Failing this, ambiguity is factorial to number of modifiers
    - Canonicalisation cannot always be given
      - “Er hat in Paris in der rue St. Honoré im Hinterhof gewohnt”
    - Termination problems in bottom-up parsing w/o lazy evaluation
  - Solution: artificially restrict number of modifiers??

- **Undesirable**
Some suboptimal solutions 2 – Storage and retrieval

- **Kiss (1995)-style storage for modification targets?**
  - Collect target indices and labels on a list
  - Have H-Adjunct schemata retrieve alternative target elements from that list

- **Problem**
  - Efficiency depends largely on the maximum complexity of the cluster
  - Number of cluster elements not always known locally (partial VP fronting)
  - Up to 5 verbs (targets) per cluster (Meurers)
    - Müller (p.c.) reports up to 4 verbs in corpora
    - 1 verb possibly deducible as auxiliary
  - Number of head-adjunct rules multiplied by 3 (4)
  - Worst-case scenario:
    Attachment potential of intersective modifiers is independent
  - Best-case scenario:
    Attachment potential of intersective modifiers is less-or-equal to inner modifiers

- **Costly (see below), but viable**
Underspecification

- Provide underspecified representation (cf. Egg & Lebeth 1996)
  - Collect modification targets (label & index)
  - Distribute modifier over list of targets
- Choice between underspecification and retrieval depends on modifier interaction
  - Inner modifiers constrain attachment potential of outer ones: prefer retrieval mechanism
  - Outer modifiers attach independently of inner ones: prefer underspecification (then cheap anyway)
- Caution: Standard claim for scopal modifiers: Left-to-Right rule
  - If true for intersective modifiers, underspecification hard
  - If not true, underspecification both easy and preferred
Modifier Interaction 1: Intersective vs. Scopal

*Bei dem Wetter wird ohne Regenmantel ein besorgter Vater seine Kinder niemals aus dem Haus gehen lassen.*

'In this weather, a caring father will never let his children go out without a macintosh.'
Modifier Interaction 1: Intersective vs. Scopal

Bei dem Wetter wird ohne Regenmantel ein besorgter Vater seine Kinder niemals aus dem Haus gehen lassen.

'In this weather, a caring father will never let his children go out without a macintosh.'

- Accepted by 4/4 native speakers of German
- Intersective modifier ohne Regenmantel semantically attached to downstairs verb in verb cluster
- Wide scope for scopal modifier niemals 'never' over intersective modifier
- Attachment underivable by tree configuration
Modifier Interaction 2: Intersective vs. Intersective

Der diensthabende Beamte gab zu Protokoll, daß in der Dachwohnung zum fraglichen Zeitpunkt ein Rentner von der anderen Straßenseite aus die Angeklagte mehrmals auf das Opfer einstechen sah.

'the policemen who was on duty noted that a retired man witnessed from the opposite side of the road that, in the apartment under the roof, the accused stabbed the victim several times.'
Modifier Interaction 2: Intersective vs. Intersective

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'the policemen who was on duty noted that a retired man witnessed from the opposite side of the road that, in the appartment under the roof, the accused stabbed the victim several times.'

- Accepted by 4/4 native speakers of German
- Modifier *in der Dachwohnung* may attach to lower verb, despite intervention of another intersective modifier *von der anderen Straßenseite aus* being attached to the perception verb *sah*
- Unclear whether order of retrieval categorically reflects linear order or hypothesised c-command relations
Modifier Interaction 3 – External locative

Weil sie ihn vor dem Kapitol die Marseille nicht singen lassen wollten, sagte er das ganze Konzert kurzerhand ab.

"Because they wouldn't let him sing the Marseillaise in front of the Capitol, he just cancelled the entire concert.”
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"Because they wouldn't let him sing the Marseillaise in front of the Capitol, he just cancelled the entire concert."

- Availability of downstairs attachment possible even in canonical position
- Maienborn (2001) claims external locative modifiers base-generated in pre-object position
Modifier Interaction 4 – Manner adverbs

*Stephan ist wohl deshalb krank geworden, weil er äußerst hart wegen der Konferenz in Saarbrücken arbeiten mußte.*

'Stephan probably only became ill, because he had to work extremely hard because of the upcoming conference in Saarbrücken.'
Modifier Interaction 4 – Manner adverbs

Stephan ist wohl deshalb krank geworden, weil er äußerst hart wegen der Konferenz in Saarbrücken arbeiten mußte.

'Stephan probably only became ill, because he had to work extremely hard because of the upcoming conference in Saarbrücken.'

- Intersective manner adverbs cannot scope over causal modifiers (Kasper 1994)
- Only available reading is wide scope for wegen der Konferenz...
Implementation

- Anchors = index/label pairs
- Target introduction
  - Lexical verbs (non-aux) insert an index/label pair onto [SS.LOC._TARGET-ANCS]
- Target composition
  - Verb-cluster formation and PVP rules concatenate target anchors
- Target percolation
  - Percolation of _TARGET-ANCS along head projection path
  - Auxiliary verbs inherit _TARGET-ANCS from verbal complement (no own contribution)
- Target binding
  - Intersective H-Adjunct schema inserts modifier's anchor and percolated anchors into HCONS
Relative clause extraposition (Theory)

- Relative clause extraposition as anaphoric binding (Kiss 2002)
  - Extraposition not strictly local
    - No island effects
    - (see also Müller 200? for complement extraposition)
  - Process is upward-bounded (=clause-local)

- Core idea: generalise (intersective) modifier attachment
  - Percolate anchors (pairs of handel and index) via nonlocal feature (ANC)
  - Intersect relative clause's handel and index with an anchor in the ANC set

  Generalized Modification

  The index of a modifying phrase has to be identified with a suitable index contained in the phrase to which the modifier is adjoined (Kiss 2002, p.5)

  Anchor Projection Principle

  The anchors set of a headed phrase consists of the union of the anchors sets of the daughters less those anchors specified as TO-BIND\ANCHORS on the head daughter. (Kiss 2002, p. 29)

  Approach applicable to extraposition in English (Kiss, 2003)
Relative clause extraposition (Implementation; Crysmann, t.a.)

- Anchor percolation implemented by means of LOCAL feature
  - Coordination (ATB vs. extraposition)
  - Extraposition from fronted constituents (including partial VPs)
- Extraposed relative clause attachment sets a value to be bound
- Binding of indices/handles by means of unary retrieval rules
  - Full recursive retrieval currently not possible (termination problems owing to local underspecification of percolated anchors)
  - At present, limited to 5 anchors
  - Anchor percolation simulates recency effect
  - Performance comparable to grammar without extraposition (-10+%)
- Increase in the number of retrieval rules leads to negatively affects performance (locally underspecified anchors)
- Underspecify anchor binding?
  - Match index restriction on semantics construction?
Evaluation - Grammars

- **Baseline: Syntactic attachment (Cellar)**
  - DFKI German HPSG (Müller & Kasper 2000, Crysmann 2003, Crysmann t.a.)
  - Semantic attachment determined by syntactic attachment:
    - LBL and ARG1 of intersective modifier identified with LBL and INDEX of syntactic sister
  - Addresses some attachment ambiguities:
    - high/low attachment for cluster-adjacent modifiers
    - high/low slash introduction
  - Distinction between scopal and intersective modifiers in the lexicon
    - Subject to Kasper's problem
  - Relevant extensions: Kiss-style relative clause extraposition
    - Index and Label of NPs percolate (diff-list)
    - Extraposed relatives bind index (and label) form the list
Evaluation - Grammars

- Underspecified modifier attachment (Ground floor)
  - Modification targets collected on difference list ([SS.LOC._TARGET-ANCS])
  - Most deeply embedded modification target appear first
  - H-Adjunct schemata (incl slash introduction) differentiated according to scopal/intersective distinction
  - Intersective H-Adjunct schema inserts isect-mod constraint into HCONS
    - Equate [C-CONT.HCONS <! [TARGET-ANCS ]!>] with [SS.LOC._TARGET-ANCS]
    - Equate modifier's ARG1/LBL w/ INDEX and LBL in [C-CONT.HCONS <! [MOD-ANCS ]!>]
  - Retrieval mechanism for extraposed relative clause attachment retained
    - Permits syntactic checking for suitable targets (number & gender information)
  - Differentiation of adjunct slash introduction into scopal and intersective variants increases local ambiguity in parsing
    - Possible solution (not implemented): relocate differentiation to filler site
Evaluation - Grammars

- **Variant 1: Underspecified relative clause attachment (1st floor)**
  - Underspecified semantic attachment carried over to relative clause attachment
  - Suitability of percolated indices currently not checked:
    - Overgeneration
  - Wellformedness check for constraints must be performed by MRS resolver
  - “Semantic” wellformedness check should be quite efficient:
    - Data structures are quite small
    - No local ambiguity

- **Variant 2: Storage and retrieval (Toolshed)**
  - Percolation of target anchors identical to underspecified treatment
  - H-Adjunct schemata distinguished as to scopal/intersective distinction
  - Introduction of attachment constraint replaced by retrieval mechanism
    - different intersective H-Adjunct schemata, binding the 1<sup>st</sup>, 2<sup>nd</sup>, or 3<sup>rd</sup> INDEX/LBL pair on [SS.LOC._TARGET-ANCS ]
    - Limited complexity: maximally 3 anchors retrieved (<Meurers)
Evaluation – Test parameters

- **Test runs on**
  - Babel regression test suite (manually constructed, Stefan Müller)
    - Relatively high number of extraposed relatives: >4%
      compare Negra 1.0: 2.8% (Uszkoreit et al. 1998)
    - Many complex predicates
    - Average sentence length: 6.76
    - Average lexical ambiguity: 2.98
  - VM CD-15 (first 1000 sentences):
    - Spoken dialog corpus (appointment scheduling)
    - Almost no extraposed relatives
    - Average sentence length: 5.13
    - Average lexical ambiguity: 2.95

- **Parser:**
  - Pet (Callmeier 2000)
    - Version of Jul 2003; unfilling; no packing; edge limit 70000; scoring model

- **Parse times recorded and evaluated with** [incr tsdb()]
**Evaluation – Results**

- **Underspecified modifier attachment**
- **Cellar vs. Ground Floor**
- **Identical coverage**
  - Babel: 82.9 %
  - VM: 86.4 %
- **Identical overgeneration**:  
  - Babel: 27.6 %
  - VM: 12.5 %
- **Syntactic ambiguity reduced**:  
  - Babel: 3.48 vs. 3.36
  - VM: 11.13 vs. 8.60
- **Mild performance gains**

<table>
<thead>
<tr>
<th>Aggregate</th>
<th>Underspecified modifier attachment</th>
<th>Cellar vs. Ground Floor</th>
<th>Identical coverage</th>
<th>Identical overgeneration</th>
<th>Syntactic ambiguity reduced</th>
<th>Mild performance gains</th>
</tr>
</thead>
<tbody>
<tr>
<td>i-length in [15 .. 20]</td>
<td>91596</td>
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<td>397</td>
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<td>523</td>
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<td>0.25</td>
<td>6793</td>
<td>3931</td>
<td>0.24</td>
<td>6247</td>
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</tbody>
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<th>VM: 86.4 %</th>
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<tr>
<td>i-length in [25 .. 30]</td>
<td>12046</td>
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<td>i-length in [20 .. 25]</td>
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<td>i-length in [0 .. 5]</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>11264</strong></td>
<td><strong>0.79</strong></td>
</tr>
</tbody>
</table>

**Source:** Berthold Crysmann 2004

Semantics in Grammar Engineering, Leuven
Evaluation – Results

- Underspecified relative clause extraposition
- Ground Floor vs. 1st floor
- Identical coverage
- Overgeneration:
  - Babel: 27.6 vs. 28.2
  - VM: unaffected
- Syntactic ambiguity
  - Babel: 3.36 vs. 3.75
  - VM: 8.60 vs. 8.62
- Mild performance gains
  - Only on Babel
  - Confirms findings in Crysmann (t.a.)
Evaluation – Results

- Storage & retrieval
  - Babel: 82.9 vs. 82.4
  - VM: 86.4 vs. 85.0

- Ground floor vs. Toolshed

- Slight losses in coverage
  - Babel: 82.9 vs. 82.4
  - VM: 86.4 vs. 85.0

- Overgeneration:
  - Babel: unaffected
  - VM: 12.5 vs. 11.2*

- Syntactic ambiguity
  - Babel: 3.36 vs. 3.74
  - VM: 8.60 vs. 16.34

- Drastic performance loss
  - Babel: Factor 1.42
  - VM: Factor 1.66

Source: Berthold Crysmann 2004
Semantics in Grammar Engineering, Leuven
Conclusion

- Underspecification of intersective modifier attachment definitely required for modifier scrambling in coherent construction
- Underspecification far more efficient than storage-and-retrieval mechanism
- Beneficial to treatment of extraposed relatives
  - Improves efficiency
  - Guarantees sound treatment w/o termination problems