Part-Whole Modifiers and the *-Operator

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The Idea

- German part-whole-modifiers (PWMs) as exemplified by ‘ganz’ (‘whole’) exhibit an interesting pattern of ambiguity
- German PWMs co-occur with singular count nouns (SCN)

(1) \textit{Er aß den ganzen Brotlaib.}  
he ate the \textit{gan}z loaf.of.bread

- but also mass nouns:

(2) \textit{Er aß das ganze Brot.}  
he ate the \textit{gan}z bread

- and plural count nouns (PCN):

(3) \textit{Er aß die ganzen Brote.}  
he ate the \textit{gan}z breads
The Issue

(4)  
   a.  *Er aß den ganzen Brotlaib.*
   he ate the ganz loaf.of.bread
   ‘He ate the whole loaf of bread’
   
   b.  *Er aß das ganze Brot.*
   he ate the ganz bread
   (i)  ‘He ate all the bread.’
   (ii) ‘He ate the loaf of bread which was whole.’
   
   c.  *Er aß die ganzen Brote.*
   he ate the ganz breads
   (i)  ‘He ate all the bread.’
   (ii) ‘He ate the loaves of bread which were whole.’

- mass & plural cases are ambiguous, singular case is not

- Proposal: Ambiguities due to syntactic scope interaction between ‘ganz’ and the plural operator * (cf. Link 1983).
Parallel ambiguities

Mass noun:

(5)  *das ganze Brot*
the whole bread.sg
a) all the bread’
b) ‘the whole loaf of bread’

Figure 1: Context 1
Introduction - Parallel ambiguities

Plural:

(6) \textit{die ganzen Brote}  
the whole bread.pl  
a) ‘all the bread’  
b) ‘the whole loaves of bread’

![Figure 2: Context 2](image)
Parallel ambiguities

refer to the readings where ‘ganz’ is cognate with ‘all’ as **universal readings** and the ones where ‘ganz’ makes references to ‘wholeness’ as **integrity readings**.

(7) *das ganze Brot*
the whole bread
a) ‘all the bread’ (**universal**)
b) ‘the whole (loaf of) bread’ (**integrity**)

(8) *die ganzen Brote*
the whole bread.pl
a) ‘all the bread’ (**universal**)
b) ‘the whole (loaves of) bread’ (**integrity**)

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Framework

- Context: exactly three heroes exist; \([\text{hero}] = \{\text{Allison, Klaus, Vanya}\}\)
- Mereology (Champollion & Krifka 2016)
  - parts, single entities and pluralities are all type \(\langle e \rangle\)
  - \(D_e\) is closed with regards to a ‘join’-operation \(\oplus\):
    \[ \forall x, y \in D_e : x \oplus y \in D_e \]
  - \(D_e\) is partially ordered according to ‘part of’-relation \(<\):
    \[ \text{Vanya’s arm} < \text{Vanya} < \text{Vanya} \oplus \text{Klaus} \]
- Plural Predication:
  - \(-\)-Operator, restricted by a cover (Schwarzschild 1996, Brisson 2003)
    \[ [\text{* Cov}]\langle\langle e, t \rangle, \langle e, t \rangle\rangle. \forall P \in D_{\langle e, t \rangle}, x \in D_e : [\text{* P}] (x) = 1 \text{ iff } [P] (x) = 1 \text{ or } \exists x_1, x_2 \in \text{Cov} \text{ s.t. } x = x_1 \oplus x_2, [\text{* P}] (x_1) = [\text{* P}] (x_2) = 1 \]
  - Assuming \(A, K, V \in [\text{Cov}]\):
    \[ [\text{*hero}] = \{\text{Allison; Klaus; Vanya; } A \oplus K; A \oplus V; K \oplus V; A \oplus K \oplus V\} \]
Definite Determiner has a maximal interpretation (Sharvy 1980, Link 1983, this version modeled on Schwarz 2013):

- maximizing function \( \sigma \) picks out the maximal element of a given set: 
  \[
  \sigma = \lambda P_{\langle e, t \rangle}. \lambda x. P(x) \& \forall y : P(y) = 1 \rightarrow y < x
  \]
- Def.Det. presupposes existence of unique maximum and picks it out
  \[
  [[\text{the}_\text{pl}]] = \lambda P_{\langle e, t \rangle} : \exists ! x[\sigma(P)(x) = 1]. \forall x[\sigma(P)(x) = 1]
  \]
- \([\text{*hero}]] = \{\text{Allison; Klaus; Vanya; A} \oplus K; A \oplus V; K \oplus V; A \oplus K \oplus V\}
- \([\text{the heroes}] = [\text{the}\text{[*hero]}]
  = \forall x[\sigma([\text{[*hero]}])(x)]
  = \forall x[[\text{[*hero]}](x) \& \forall y[\text{[*hero]}](y) \rightarrow y < x]]
  = A \oplus K \oplus V

A Lexical Entry

- Lexical entry for ‘ganz’ requires several ingredients:
  - Contextual restriction C (Moltmann 1997, Brisson 2003): part structures and perception of ‘wholeness’ vary situationally
  - Accessible Parts Requirement ACC (Moltmann 1997) ‘ganz’ (like ‘whole’) with SCN is odd in contexts where ‘wholeness’ is not in question (cf. (9))
    - \( \text{ACC}(x)(C) = 1 \text{ iff } \exists x_1 \ldots x_n \in C : x = x_1 \oplus \ldots x_n \)
    - (9) ?He plucked the whole flower.
  - the actual semantic contribution of what it means for an entity X to be ‘ganz P’ in a context C is encoded as \([\text{whole}](C)(P)(x)\); and left deliberately vague for now

- (10) \( \text{ganz} = \lambda C \in D_{\langle e,t \rangle} . \lambda P \in D_{\langle e,t \rangle} . \lambda x_e : \text{ACC}(x)(C) . [P(x) \& [\text{whole}](C)(P)(x)] \)
Solving the Issue via Scope Ambiguity

(11) a. \[
\llbracket \text{ganz} \rrbracket = \lambda C \in D_{\langle e, t \rangle}. \lambda P \in D_{\langle e, t \rangle}. \lambda x \in D_e: \text{ACC}(x)(C). [P(x) \& \llbracket \text{whole} \rrbracket (C)(P)(x)]
\]

b. \[
\forall P \in D_{\langle e, t \rangle}, x \in D_e: [\star P](x) = 1 \iff [P](x) = 1 \text{ or } \exists x_1, x_2 \in \text{Cov s.t. } x = x_1 \oplus x_2, [\star P](x_1) = [\star P](x_2) = 1
\]

- both \( \llbracket \text{ganz}_C \rrbracket \) and \( [\star_{\text{Cov}}] \) are of type \( \langle \langle e, t \rangle, \langle e, t \rangle \rangle \)
- \( \star \) is a covert operator, its position in the LF is unclear
- e.g. for the singular case ‘das ganze Brot’:

(a) \( \text{ganz} > \star \)

(b) \( \star > \text{ganz} \)
Example Calculation (*universal, singular*)

\[(12) \quad [the][ganz[*bread]] = [the][\lambda x.[*bread](x)\&[whole](C)([*bread])(x)] = \text{the unique individual } x \text{ s.t. } [*bread](x)\&[whole](C)([*bread])(x) \\& \forall y \in C[*bread](y) \to y < x] \]

‘the unique individual \(x\) s.t. \(x\) is a quantity of bread, is whole as a quantity of bread, and contains all other quantities of bread in \(C\)’

\[\triangleq A_1 \oplus A_2 \oplus B \text{ (universal reading)}\]
Example Calculation (integrity, singular)

\[(13) \quad \text{[the][*[ganz[bread]]]} = \text{[the][*[\lambda x.[bread](x)\&[whole](C)([bread])(x)] = the unique individual } x \text{ s.t. [*[bread](x)\&[whole](C)([bread])(x)] \&\forall y \in C[[*[bread](y)\&[whole](C)([bread])(y)]]]} \rightarrow y < x \]

‘the unique individual } x \text{ s.t. } x \text{ is a plurality of whole loaves of bread, and any other such plurality is contained in } x\] \quad \Delta \quad B \text{ (integrity reading)
(2) * das ganze Brot
the whole bread.sg
a) 'all the bread'
b) 'the whole (loaf of) bread’

(a) universal reading

(b) integrity reading
The Plural Case

(14) *die ganzen Brote*
   the whole bread.pl
   a) ‘all the bread’ (*Universal*)
   b) ‘the whole (loaves of) bread’ (*integrity*)

As long as both NPs are defined, the analysis predicts identical truth conditions for the singular and plural case - the calculations remain the same.
The Plural Case

(15) \[ \text{[the][ganz[\ast bread]] = [the][\lambda x.\ast bread](x) \& \text{[whole]}(C)([\ast bread])(x)] = \text{the unique individual } x \text{ s.t. } \ast \text{bread}(x) \& \text{whole}(C)(\ast \text{bread})(x) \& \forall y \in C[[\ast \text{bread}](y) \rightarrow y < x] \]

‘the unique individual \( x \) s.t. \( x \) is a quantity of bread, is whole as a quantity of bread, and contains all other quantities of bread in \( C \)’

\( \triangleq A \oplus B_1 \oplus B_2 \) (universal reading)

(16) \[ \text{[the][\ast [ganz[bread]]] = [the][\ast [\lambda x.\text{bread}](x) \& \text{whole}(C)(\text{bread})(x)] = \text{the unique individual } x \text{ s.t. } [\ast \text{bread}(x) \& \text{whole}(C)(\text{bread})(x)] \& \forall y \in C[[\ast \text{bread}](y) \& \text{whole}(C)(\text{bread})(y)] \rightarrow y < x] \]

‘the unique individual \( x \) s.t. \( x \) is a plurality of whole loaves of bread, and any other such plurality is contained in \( x \)’

\( \triangleq B_1 \oplus B_2 \) (integrity reading)
### Predictions

- parallel analyses for singular and plural, particularly for universal readings, predict that there should be overlap
- the following pattern can be observed:

<table>
<thead>
<tr>
<th></th>
<th>Universal (a)</th>
<th>Integrity (b)</th>
<th>Universal</th>
<th>Integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td>singular</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>‘das ganze Brot’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>plural</td>
<td>✓</td>
<td>?</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>‘die ganzen Brote’</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- as seen in the calculations above, the analysis correctly predicts the outcomes in the green cells
- the remaining universal cases are also predicted by the analysis, as singular and plural case have identical truth conditions
- it remains to be shown that the cases marked with X and ? are also predicted
Testing Predictions

- tackle the stronger case first:

  (17) ‘das ganze Brot’

- In this context, (17) only allows for the universal reading. Analysis predicts this, as the integrity reading would lead to PSP failure:

  (18) a. \([\text{the}_C][\text{ganz}[^{\text{Cov}}][\text{bread}]]\)  
     
     - Universal
  
  b. \([\text{the}_C][^{\text{Cov}}][\text{ganz}_C[\text{bread}]]\)  
     
     - Integrity

- PSP of [the] in (18-a): a unique maximal quantity of bread exists ✓
- PSP of [the] in (18-b): a unique maximal loaf of bread exists X
(19) ‘die ganzen Brote’

- strongly favors universal reading, but allows for integrity reading (e.g. if the speaker is ignorant regarding the number of whole loaves)
- suggests that knowing use of the plural where the singular would be felicitous is odd due to pragmatic effects
Testing Predictions

(20) ‘die ganzen Brote’

- a closer look at (20)’s PSP (particularly of the definite determiner) shows how this is predicted by the analysis$^1$

- PSP of (20) under the integrity reading:
  $\exists! x \in C[\ast \text{[ganz bread]}(x)] \& \forall y [[\ast \text{[ganz bread]}](y) \to y < x]$

- $\ast \text{[ganz bread]}(x) = 1$ iff $[[\text{ganz bread]}](x) = 1$ or $\exists x_1, x_2 \in C \text{ s.t. } x = x_1 \oplus x_2, [[\ast \text{ganz bread]}](x_1) = [[\ast \text{ganz bread]}](x_2) = 1$

- recall PSP in the singular case: a unique whole loaf of bread exists

- the plural case allows for either a unique loaf or a unique quantity of loaves

- the plural PSP is strictly entailed by the singular’s, if the latter is felicitous, the former is a violation of max-PSP (Heim 1991)

$^1$ACC is trivially met in plural and mass noun constructions and can safely be ignored
What it means to be ‘whole’

- vague notion of ‘wholeness’ in the analysis is doing a lot of work, while at the same time being hard to pinpoint
- what is considered ‘whole’ varies from situation to situation - as such, any definitive definition has to leave room for vagueness
- Assumption: an entity x is perceived as a ‘whole P’ if it is not recognized as part of some larger P-entity

\[(21) \quad [\text{whole})(C)(P)(x)] = 1 \iff \not\exists y \in C'[x < y & P(y)]\]

- C’ is a superset of the restrictor C, derived by ‘completing’ all things with missing pieces and closing the set with regards to \(\oplus\). E.g., If C contains a table leg x, C’ contains the other legs and the table top, as well as the entire table and x itself.
Semantic Contribution of ‘ganz’

- the actual semantic contribution of ‘ganz’ has not been discussed so far
- completeness markers such as ‘whole’ and ‘all’ are generally analyzed in terms of (non-)maximality. Classic example from Lasersohn (1999):

  (22) a. The townspeople are asleep.
       b. All the townspeople are asleep.

- (21-a) can still be judged true if a few townspeople are still awake (non-maximality), (21-b) allows no exceptions
- Previous approaches to non-maximality include influencing the cover variable (Brisson 2003, Morzycki 2002), or intensional approaches (Moltmann 1997, Križ 2016)
Semantic Contribution of ‘ganz’

(23) \([[[\text{whole}] (C)(P)](x))] = 1 \text{ iff } \forall y \in C'[x < y \& P(y)]

- Analysis correctly predicts blocking of non-maximal interpretation:
  - Definition of C’: contains ‘missing parts’; closed w.r.t \(\oplus\)
    - A set \(S\) is closed w.r.t \(\oplus\) \(\iff\) \(\forall a, b \in S : A \oplus B \in S\)

\[\text{(24)} \quad \text{Die ganzen Bürger schlafen.}\]
\[\text{the whole citizens sleep}\]
\[\text{‘All the citizens are asleep.’}\]

- Assume non-sleeping citizen \(x\), let \(S = s_1 \oplus \ldots s_n\) all the sleepers.
- \(S \oplus x \in C'\) (\(C'\) is closed w.r.t \(\oplus\))
- Non-maximal interpretation (applying the predicate only to \(S\)) is not available:
  - \(S < S \oplus x\)
  - \(S \oplus x \in C'\)
  - \([\ast \text{citizen}](S \oplus x) = 1\)
- Calculation only returns true if every last citizen is asleep
Concession: satisfactory definition of ‘ganz’ requires the assumption of a naturally understood/understandable concept of ‘wholeness’ - however this is encoded

Structural analysis correctly predicts pattern of availability of the two readings across the two contexts, for both singular and plural forms

Evidence that the plural operator * appears in the syntax and can interact scopally with other operators

Tentatively: wholeness and ‘missing parts’ as an alternative approach to non-maximality phenomena
assuming a typeshifted $[ganz_R]$, the pattern repeats itself in relational constructions including the $**$-Operator (Beck 2000)

$[ganz_R]$

$= \lambda C_{\langle e,t \rangle} . \lambda R_{\langle e, \langle e,t \rangle \rangle} . \lambda x_e . \lambda y_e : ACC(y)(C) . R(x)(y) & [\text{whole}](C)(P)(y)$

(25)  

\textit{die ganzen Modelle von den Flugzeugen}  
the \textit{ganz} models of the airplanes

a. ‘all the models of the airplanes’
b. ‘the complete(d) models of the airplanes’
c. LF for (a): $[\text{the}_C[ \text{ganz}_C[**_Cov \text{ models}]
\text{[of.the.airplanes]]}]$
d. LF for (b): $[\text{the}_C[**_Cov \text{ [ganz}_C \text{ models}]
\text{[of.the.airplanes]]}]$
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Bibliography II


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